CRVENA KNJIGA FAUNE SRBIJE V

RIBE

RED BOOK OF FAUNA OF SERBIA V

FISHES

BEOGRAD 2024

BELGRADE 2024

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Aleksandar Hegediš
Jasmina Krpo-Ćetković

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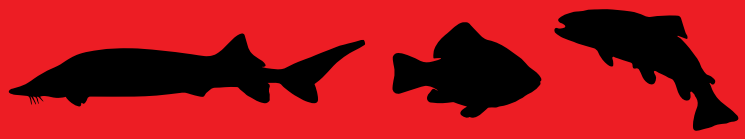

UNIVERZITET U BEOGRADU - BIOLOŠKI FAKULTET
UNIVERSITY OF BELGRADE - FACULTY OF BIOLOGY

ЗАВОД ЗА ЗАШТИТУ ПРИРОДЕ СРБИЈЕ
INSTITUTE FOR NATURE CONSERVATION OF SERBIA

ИНСТИТУТ ЗА МУЛТИДИСЦИПЛИНАРНА ИСТРАЖИВАЊА
INSTITUTE FOR MULTIDISCIPLINARY RESEARCH

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Zavod za zaštitu prirode Srbije/Institute for Nature Conservation of Serbia
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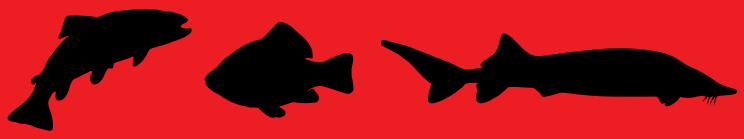
ŠTAMPA/PRINT
BIROGRAF doo, Beograd

TIRAŽ/CIRCULATION
500

ISBN 978-86-80877-86-0

Beograd, 2024
Belgrade, 2024

Решењем Републичког геодетског завода бр. 034-01-1-250/2024 картографска публикација је одобрена за стављање у промет и дистрибуцију.
By the Decision of the Republic Geodetic Authority no. 034-01-1-250/2024 the cartographic publication has been approved for sale and distribution.



PREDGOVOR

U radu na „Crvenoj knjizi faune Srbije V – ribe" učestvovalo je 15 autora iz nekoliko institucija: Univerzitet u Beogradu – Institut za multidisciplinarna istraživanja, Univerzitet u Beogradu – Biološki fakultet, Univerzitet u Novom Sadu – Prirodno matematički fakultet, Zavod za zaštitu prirode Srbije i Pokrajinski zavod za zaštitu prirode. Rukopis knjige predstavlja jedan od rezultata projekta *Pribavljanje podataka i druge usluge u cilju nastavka izrade crvenih lista pojedinačnih grupa organizama flore, faune i gljiva u Republici Srbiji* (JNOP 01-2019), koga je, za potrebe Zavoda za zaštitu prirode Srbije, realizovao Biološki fakultet Univerziteta u Beogradu.

Knjiga sadrži dve celine: uvodni deo i posebni deo. Uvodni deo se odnosi na osnovne informacije o diverzitetu faune riba u Srbiji, proceni statusa ugroženosti vrsta, staništima riba u Srbiji, faktorima ugrožavanja i merama zaštite, dok posebni deo obuhvata pregled ugroženih vrsta riba u fauni Srbije. Uključene su sve ugrožene autohtone vrste riba za koje je postojao makar i jedan publikovan ili drugi pouzdani nalaz u vodama sva tri sliva na teritoriji Srbije. Dat je i spisak svih ostalih autohtonih vrsta čiji stepen ugroženosti prema IUCN kriterijumima nije zahtevao njihovo uključivanje u Crvenu knjigu, kao i vrsta koje bi se na osnovu geografskih i ekoloških kriterijuma mogle naći u vodama Srbije, ali do sada nisu fizički registrovane.

„Crvena knjiga faune Srbije V – ribe" ima, pre svega, informativno-edukativni karakter. Za svaku vrstu dato je važeće naučno ime i taksonomski status, kao i kratki pregled osnovnih odlika (globalno i lokalno rasprostranjenje, opis vrste, populacione karakteristike vrste, ekologija vrste, stanište, ribolovni značaj). Sa aspekta aktuelne ugroženosti i zaštite, dat je pregled faktora ugrožavanja za svaku pojedinačnu vrstu, pregled postojećih mera zaštite prema domaćoj i međunarodnoj legislativi, kao i pregled predloženih mera zaštite i naučnih istraživanja potrebnih za bolje poznavanje vrste i efikasnije planiranje budućih mera.

U aktuelnoj situaciji vezanoj za ugroženost, zaštitu i održivo korišćenje faune riba u Srbiji, „Crvena knjiga faune Srbije V – ribe" postaje neophodan dokument vremena, jer daje vredan presek stanja baziran na veoma velikoj količini raspoloživih podataka o ribama naših voda. Ova knjiga nije namenjena samo stručnjacima ihtiolozima, već svima koji se bave zaštitom prirodnih resursa, unapređenjem stanja životne sredine, kao i donosiocima odluka i kreatorima legislative u ovim oblastima. Takođe je namenjena i ribolovcima kao direktnim korisnicima ribljeg fonda.

Prema *Zakonu o zaštiti prirode, Zakonu o vodama, Zakonu o zaštiti i održivom korišćenju ribljeg fonda* i brojnim međunarodnim konvencijama koje je Srbija usvojila, nameće se obaveza zaštite ugroženih vrsta riba i njihovih staništa, ali i određivanje adekvatnih mera koje bi trebalo da obezbede održivo korišće-

PREFACE

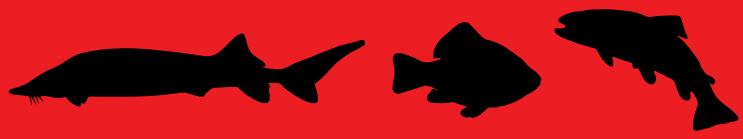
Fifteen authors from different institutions were involved in the work on the "Red Book of Fauna of Serbia V – Fishes": University of Belgrade – Institute for Multidisciplinary Research, University of Belgrade – Faculty of Biology, University of Novi Sad – Faculty of Sciences, Institute for Nature Conservation of Serbia and the Institute for Nature Conservation of Vojvodina Province. The book is one of the results of the project *Procurement of data and other services for further development of Red Lists of individual groups of organisms of flora, fauna and fungi in the Republic of Serbia* (JNOP 01-2019), carried out by the Faculty of Biology of the University of Belgrade for the Institute for Nature Conservation of Serbia.

The book consists of two parts: an introductory part and a special part. The introductory part contains basic information on the diversity of fish fauna in Serbia, assessment of the threat status of fish species, fish habitats in Serbia, threat factors and protection measures, while the special part gives an overview of the threatened fish species in the fauna of Serbia. All threatened native fish species for which there is at least one published or other reliable record in the waters of all three basins in the territory of Serbia are included. There is also a list of all other native species whose threat level according to IUCN criteria did not require listing in the Red Book, as well as species that could occur in the waters of Serbia according to geographical and ecological criteria, but have not been physically recorded so far.

The "Red Book of Fauna of Serbia V – Fishes" has primarily informative and educational character. For each species, a valid scientific name and taxonomic status are given, as well as a brief overview of the most important characteristics (global and local distribution, description of the species, population characteristics of the species, ecology of the species, habitat, importance for fisheries). From the point of view of current threats and protection, an overview is provided of the threat factors for each species, of the existing protection measures under national and international legislation, and of the proposed protection measures and scientific research needed for better knowledge of the species and more effective planning of future measures.

In the current situation regarding the threat, protection and sustainable use of fish fauna in Serbia, the "Red Book of Fauna of Serbia V – Fishes" becomes a necessary document of the times, because it provides a valuable cross-section of the situation based on a very large amount of available data on the fishes of our waters. This book is aimed not only at ichthyologists, but also at all those concerned with the protection of natural resources and the improvement of the environment, as well as decision-makers and legislators in these fields. It is also aimed at fishers as direct users of fish resources.

According to the *Law on Nature Protection*, the *Law on Water*, the *Law on Protection and Sustainable Use of Fish Stocks* and numer-



nje ribolovnih i ekonomski značajnih vrsta. Za ispunjenje ovih obaveza, Crvena knjiga riba trebalo bi da bude relevantan izvor podataka za nadležne institucije, koji će usmeriti aktivnosti i prioritete ka izradi akcionih planova upravljanja populacijama pojedinih vrsta. Takođe, ova knjiga bi trebalo da inicira naučna istraživanja o manje poznatim vrstama riba, ali i o vrstama koje se koriste za ribolov. Pored toga, zainteresovana javnost i nevladine organizacije bi u „Crvenoj knjizi faune Srbije V – ribe" trebalo da nađu polaznu osnovu za svoje aktivnosti na zaštiti prirode i ugroženih vrsta riba.

I na kraju, ova publikacija nije konačna, podložna je revizijama i dopunama koje bi trebalo da dođu sa godinama koje su pred nama. Tek će rezultati tih revizija i dopuna pokazati koliko se ovom knjigom doprinelo poboljšanju aktuelnog stanja ihtiofaune u vodama Srbije.

U Beogradu, 2024. godine

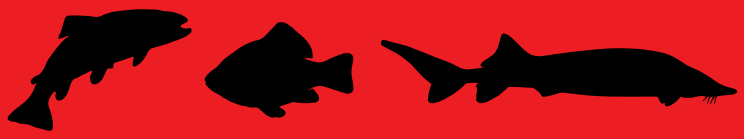
Urednici

ous international conventions adopted by Serbia, there is an obligation to protect threatened fish species and their habitats, as well as to take appropriate measures to ensure sustainable use of species important for fisheries and commercially important species. In order to fulfil these obligations, the Red Book of Fishes should be an important source of data for the relevant institutions to direct their activities and priorities towards the development of action plans for the management of populations of individual species. In addition, this book should promote scientific research on lesser known fish species, as well as species used in fisheries. Furthermore, the interested public and non-governmental organisations should find in the "Red Book of Fauna of Serbia V - Fishes" a starting point for their activities to protect nature and threatened fish species.

Finally, this publication is not final, but is subject to revisions and additions to be made in the years to come. Only the results of these revisions and additions will show how much this book has contributed to improving the current state of fish fauna in the waters of Serbia.

Belgrade, 2024

Editors



ZAHVALNICA

Urednici i autori „Crvene knjige faune Srbije V – ribe" izražavaju veliku zahvalnost svima koji su na bilo koji način doprineli izradi ove knjige. Posebnu zahvalnost dugujemo dr Gordani Tomović, redovnom profesoru Biološkog fakulteta Univerziteta u Beogradu, koja je nesebično pomagala autorima u obuci, kao i u samoj obradi podataka za IUCN procene ugroženosti vrsta, i dr Dmitru Lakušiću, redovnom profesoru Biološkog fakulteta Univerziteta u Beogradu, koji je učestvovao u obimnom poslu na pripremi baze podataka na osnovu koje je izrađena ova publikacija.

Posebno se zahvaljujemo kolegama koji su nam ustupili fotografije pojedinih vrsta, Goranu Đurđeviću, Đorđu Gajiću, Dušanu Jeliću, Yannisu Kapakosu, Aleni Kohoutová Šedivá, Davidu Koutsogiannopoulosu, Yordanu Kutsarovu, Andreju Makari, Lubomíru Piáleku, Johannesu Schöffmannu, Radeku Šandi, Katarini Tošić, Deniku Ulqiniju i Stamatisu Zogarisu. Ilustracije riba na naslovnoj strani ustupio je Paul Vecsei, na čemu se takođe zahvaljujemo.

Veliku zahvalnost dugujemo i recenzentima, dr Vladimiru Stevanoviću, redovnom profesoru Biološkog fakulteta Univerziteta u Beogradu u penziji i redovnom članu Srpske akademije nauka i umetnosti, dr Ljiljani Tomović, redovnom profesoru Biološkog fakulteta Univerziteta u Beogradu, dr Radeku Šandi, kustosu zbirke riba i rukovodiocu Zoološkog odeljenja Narodnog muzeja u Pragu, Češka Republika, i dr Mirjani Lenhardt, naučnom savetniku Instituta za biološka istraživanja „Siniša Stanković" Univerziteta u Beogradu – Instituta od nacionalnog značaja za Republiku Srbiju, koji su svojim sugestijama, komentarima, korekcijama i dopunama u izuzetno značajnoj meri doprineli izgledu konačne verzije i kvalitetu publikacije. Dr Ljiljani Tomović posebno se zahvaljujemo i na pomoći pri izradi UTM mreže centara diverziteta riba u Srbiji.

U Beogradu, 2024. godine

Urednici i autori

ACKNOWLEDGEMENTS

The editors and authors of the "Red Book of Fauna of Serbia V - Fishes" would like to thank everyone who contributed in any way to the creation of this book. We owe special thanks to Dr Gordana Tomović, Full Professor at the Faculty of Biology, University of Belgrade, who selflessly provided guidance to authors and helped with the processing of the data for the IUCN species threat assessments, as well as Dr Dmitar Lakušić, Full Professor at the Faculty of Biology, University of Belgrade, who was involved in the extensive work of preparing the database on which this publication is based.

Special thanks go to the colleagues who provided us with photos of specific species, Goran Đurđević, Đorđe Gajić, Dušan Jelić, Yiannis Kapakos, Alena Kohoutová Šedivá, David Koutsogiannopoulos, Yordan Kutsarov, Andrej Makara, Lubomír Piálek, Johannes Schöffmann, Radek Šanda, Katarina Tošić, Denik Ulqini and Stamatis Zogaris. The illustrations of the fish on the cover were provided by Paul Vecsei, for which we are also grateful.

Great thanks are also due to the reviewers, Dr Vladimir Stevanović, retired Full Professor at the Faculty of Biology, University of Belgrade, and Full Member of the Serbian Academy of Sciences and Arts, Dr Ljiljana Tomović, Full Professor at the Faculty of Biology, University of Belgrade, Dr Radek Šanda, Curator of the Fish Collection and Head of the Zoological Department of the National Museum in Prague, Czech Republic, and Dr Mirjana Lenhardt, Scientific Advisor of the Institute for Biological Research "Siniša Stanković" – National Institute of the Republic of Serbia, University of Belgrade, who made an extremely important contribution to the appearance of the final version and the quality of the publication with their suggestions, comments, corrections and additions. We especially thank Dr Ljiljana Tomović for her help in creating the UTM network of fish diversity centres in Serbia.

Belgrade, 2024

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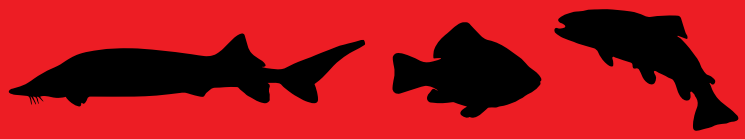

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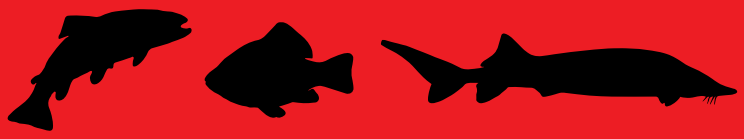

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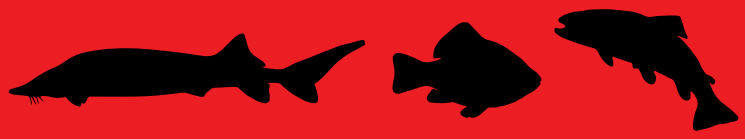

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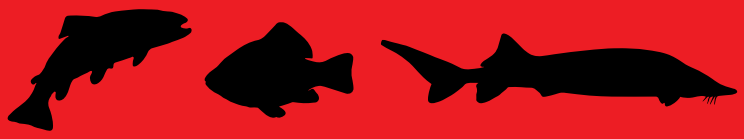

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1

UVOD

Aleksandar Hegediš

INTRODUCTION

Aleksandar Hegediš

1. UVOD

Aleksandar Hegediš

Slatkovodni ekosistemi imaju ključnu ulogu u opstanku čoveka, prevashodno zbog vodosnabdevanja pijaćom vodom, ali i zbog drugih funkcija koje su značajne za život ljudskih zajednica. Pored vodosnabdevanja za piće, voda se koristi za navodnjavanje u poljoprivredi, za dobijanje električne energije, vodni saobraćaj, snabdevanje industrijskih objekata, rekreaciju, privredni i rekreativni ribolov i drugo. Zato i ne treba da čudi činjenica da je tokom razvoja civilizacije najveći broj ljudskih naseobina nastajao i razvijao se uz neki slatkovodni ekosistem (reku, jezero ili drugo vlažno stanište) (Slika 1). Tu su se mogle ispuniti dve osnovne potrebe za opstanak: voda za piće i hrana, pre svega ribe. Međutim, i pored ovih esencijalnih vrednosti i značaja, mnoge reke, jezera i drugi slatkovodni ekosistemi širom sveta izloženi su razarajućim efektima različitih ljudskih aktivnosti, što dovodi do njihovog narušavanja i uništavanja mnogo brže nego u slučaju kopnenih ekosistema. Ovo ukazuje na veliku osetljivost slatkovodnih ekosistema, a populacije riba u njima svakako su među najosetljivijim komponentama.

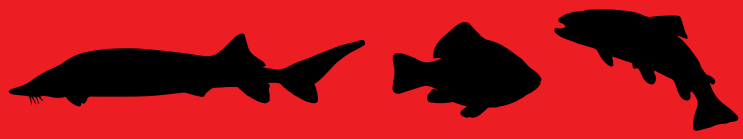
1. INTRODUCTION

Aleksandar Hegediš

Freshwater ecosystems play a key role in human survival, primarily through the provision of drinking water, but also through other functions that are important for the life of human communities. In addition to providing drinking water, water is used for agricultural irrigation, power generation, water traffic, industrial supply, recreation, commercial and recreational fishing, and other purposes. It should therefore come as no surprise that most human settlements in the course of civilisation developed along some freshwater ecosystem (river, lake or other wet habitat) (Figure 1). There, two basic needs for survival could be met: drinking water and food, particularly fish. Despite these essential values and significance, many rivers, lakes and other freshwater ecosystems around the world are subject to the devastating effects of various human activities that lead to their disturbance and destruction, much faster than in the case of terrestrial ecosystems. This shows how fragile freshwater ecosystems are, and the fish populations in them are certainly among the most vulnerable components.

Slika 1. Lepenski vir: kultura Lepenskog Vira stara je oko 8.500 godina, a lokalitet koji se nalazi na desnoj obali Dunava u blizini Donjeg Milanovca predstavlja jedno od najvećih arheoloških nalazišta kamenog doba. Lepenski Vir je naseljavala ljudska zajednica koju su odlikovali složeni društveni odnosi. Smatra se da je ova zajednica prva u Evropi planski organizovala svoje stanište na urbanim principima. Naselja u Lepenskom Viru podizana su na lesnim terasama okrenutim ka Dunavu. Reka je tadašnjim žiteljima darivala život, pre svega hranu i vodu, i istovremeno bila izvor božanskog poštovanja i kulturnih inspiracija.
Lepenski vir (foto: Mickey Mystique, https://commons.wikimedia.org/w/index.php?curid=67886026); Lepenski vir – figura (foto: Mazbln, https://commons.wikimedia.org/w/index.php?curid=1346259).

Figure 1. Lepenski Vir: The culture of Lepenski Vir is about 8,500 years old, and the site, located on the right bank of the Danube near Donji Milanovac, is one of the largest archaeological sites of the Stone Age. Lepenski Vir was inhabited by a human community characterised by complex social relations. This community is believed to have been the first in Europe to plan and organise its habitat according to urban principles. The settlements in Lepenski Vir were built on loess terraces facing the Danube. The river gave life to the inhabitants of that time, especially food and water, and was at the same time a source of divine worship and cultural inspiration.
Lepenski vir (photo: Mickey Mystique, https://commons.wikimedia.org/w/index.php?curid=67886026); Lepenski vir – figurine (photo: Mazbln, https://commons.wikimedia.org/w/index.php?curid=1346259).



Podaci o ukupnom broju vrsta riba koje žive u morima i slatkim vodama vrlo se razlikuju u zavisnosti od izvora, a prema FishBase (Froese & Pauly, 2022) vode na Zemlji naseljava oko 34.700 vrsta riba, od čega 18.000 čine slatkovodne vrste. Takođe, slatkovodne vrste riba čine 25% svih kičmenjaka i stoga su veoma važan deo globalnog biodiverziteta (Reid *et al*., 2013). Iako marinski ekosistemi sadrže više vrsta, slatkovodni su znatno bogatiji vrstama u odnosu na jedinicu prostora. Podatak da se u kopnenim vodama jedna vrsta ribe javlja na svakih 15 km³ vode, dok se u morima jedna vrsta javlja na svakih 100.000 km³ vode, odslikava produktivnost, fiziogeografsku raznovrsnost i geografsku izolovanost slatkovodnih staništa (Ormerod, 2003). Oko 8.000 svih vrsta riba (30%) nalazi se u samo 6 od ukupno 515 porodica, a od toga oko 6.100 vrsta (77%) koje pripadaju ovim reprezentativnim porodicama živi u slatkovodnim ekosistemima (IUCN Freshwater Fish Specialist Group, 2020a). Veliki broj taksona i dalje je nedovoljno proučen. Imajući u vidu da pojedine procene ukazuju na to da se svake godine prosečno otkrije i opiše oko 300 novih vrsta riba (Reid *et al*., 2013), ovi podaci se brzo menjaju. S druge strane, impozantan je podatak da, sa tako velikim brojem vrsta riba, površinski slatkovodni ekosistemi (jezera, reke i vlažna područja) čine samo oko 0,4% od 2,5% ukupne količine slatke vode na Zemlji, tj. 0,01% celokupne vode na Zemlji, za razliku od morskih ekosistema koji čine oko 97,5% (De Villiers, 2001). Zbog izolovanosti ekosistema u kojima žive, u slučaju naglih nepovoljnih promena, slatkovodne ribe ne mogu pobeći u neko drugo, susedno okruženje, kao što to mogu mnoge kopnene životinje, i dovoljan je samo jedan akcidentalni izliv neke toksične otpadne vode pa da se u određenom slatkovodnom ekosistemu izgubi čitavo naselje riba.

U Evropi, ribe naseljavaju gotovo sve slatkovodne ekosisteme i smatraju se važnim delom evropskog prirodnog nasleđa, pružajući ekosistemske usluge desetinama miliona ljudi, što se posebno odnosi na privredni i rekreativni ribolov. Najvažniji ugrožavajući faktori za ribe u evropskim kopnenim vodama jesu prevelika eksploatacija vode, negativni efekti invazivnih vrsta, pregrađivanje i izgradnja brana, prekomerno korišćenje ribljeg fonda, kao i različiti oblici zagađivanja voda.

Naselje riba, koje predstavlja skup populacija riba u nekom vodenom ekosistemu, odlikuje se specifičnostima uslovljenim kompleksom abiotičkih i biotičkih uslova koji vladaju u svakom vodenom ekosistemu. Funkcionalna uloga mnogih vrsta riba od ključnog je značaja za ekosistem, kao i za povezivanje trofičkih komponenti kroz lance ishrane, kako u samom vodenom ekosistemu, tako i između vodenih i kopnenih ekosistema jer, s jedne strane, ribe predstavljaju hranu mnogim kopnenim organizmima, a s druge strane, neke ribe se takođe hrane kopnenim organizmima. Ribe obavljaju i niz regulatornih funkcija: modifikuju recikliranje nutrijenata, uključene su u procese sedimentacije i restrukturiranja supstrata, kontrolišu druge organizme kroz predatorstvo, doprinose diverzitetu na nivou gena, vrsta, zajednica i ekosistema. Na osnovu strukture naselja riba moguće je proceniti nivo stresa i statusa ekosistema, dok se na osnovu parametara o ekologiji riba i ribarstvu dobija čitav niz naučnih i edukativnih, kao i naučno-istorijskih informacija.

Data on the total number of fish species living in marine and freshwaters today vary greatly depending on the source of information. According to FishBase (Froese & Pauly, 2022), there are approximately 34,700 species of fish living in the Earth's waters, of which 18,000 are freshwater species. In addition, freshwater fish species account for 25% of all vertebrates and are consequently a very important part of global biodiversity (Reid *et al*., 2013). Although marine ecosystems have more species, freshwater ecosystems are much more diverse relative to a spatial unit. The fact that there is one fish species per 15 km³ of water in terrestrial waters compared to one species per 100,000 km³ of water in marine waters reflects the productivity, physiogeographic diversity and geographic isolation of freshwater habitats (Ormerod, 2003). About 8,000 of all fish species (30%) belong to only 6 families out of a total of 515 families, and of these, about 6,100 species (77%) belonging to these representative families live in freshwater ecosystems (IUCN Freshwater Fish Specialist Group, 2020a). A large number of taxa remain poorly known. Considering that, according to some estimates, an average of 300 new fish species are discovered and described every year (Reid *et al*., 2013), these data are changing rapidly. On the other hand, it is an impressive fact that with such a large number of fish species, surface freshwater ecosystems (lakes, rivers and wetlands) account for only about 0.4% of the total freshwater of 2.5% on Earth, i.e. about 0.01% of the total water on Earth, in contrast to marine ecosystems, which account for about 97.5% (De Villiers, 2001). Because of the isolation of the ecosystems in which they live, freshwater fish cannot escape to another adjacent environment in the event of sudden unfavourable changes, as is the case with many terrestrial animals, and it only takes one accidental spill of toxic effluent to cause the entire fish population in a given freshwater ecosystem to become extinct.

In Europe, fish live in almost all freshwater ecosystems and are considered an important part of Europe's natural heritage, providing ecosystem services to several million people, which refers in particular to commercial and recreational fisheries. The main threat factors for fish in European inland waters are overexploitation of waters, negative impacts of invasive species, dam construction, overfishing of stocks and various forms of water pollution.

An assemblage of fishes, which includes all fish populations in an aquatic ecosystem, is characterised by specific features caused by the complex of abiotic and biotic conditions in each aquatic ecosystem. The functional role of many fish species is central to the ecosystem as well as to connection of trophic levels in food chains, both within the aquatic ecosystem itself and between aquatic and terrestrial ecosystems, as fish provide food for many terrestrial organisms and some fish also feed on terrestrial organisms. In addition, fish have a number of regulatory functions: they modify nutrient cycling, they are involved in sedimentation and substrate restructuring processes, they control other organisms through predation, and contribute to diversity at the gene, species, community and ecosystems levels. The structure of fish assemblages can be used to assess ecosystem stress levels and condition, while data on fish ecology provide a whole range of scientific and educational as well as scientific and historical information.

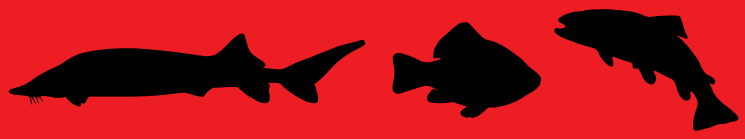
Tabela 1. Broj autohtonih slatkovodnih vrsta po porodicama riba u Evropi (prema Kottelat & Freyhof, 2007, klasifikacija modifikovana prema Van der Laan *et al.*, 2021).

Table 1. Number of native freshwater species by fish family in Europe (after Kottelat & Freyhof, 2007, classification modified after Van der Laan *et al.*, 2021).

KLASA / CLASS	RED / ORDER	PORODICA / FAMILY	NARODNO IME / VERNACULAR NAME	BROJ VRSTA / NUMBER OF SPECIES
Actinopteri	Acipenseriformes	Acipenseridae	jesetrovke / sturgeons	10
	Anguilliformes	Anguillidae	jegulje / freshwater eels	1
	Atheriniformes	Atherinidae	gavuni / Old World silverside	1
	Blenniiformes	Blenniidae	slingure / combtooth blennies	2
	Clupeiformes	Clupeidae	haringe / herrings, shads, sardines, menhadens	18
	Cypriniformes*	Cobitidae	vijuni / true loaches	34
		Nemacheilidae	brkice / stone loaches	8
		Acheilognathidae	gavčice / bitterlings	2
		Gobionidae	krkuše / gudgeons	29
		Cyprinidae	šaranke / minnows and carps	38
		Leuciscidae	klenovi / true minnows	160
		Tincidae	linjak / tenches	1
	Cyprinodontiformes	Cyprinodontidae	zubati šarani / pupfish and toothcarps	4
		Valenciidae		2
	Esociformes	Esocidae	štuke / pikes	1
		Umbridae	crnke / mudminnows	1
	Gadiformes	Lotidae	manići / hakes and burbots	1
	Gobiiformes	Gobiidae	glavoči / gobies	42
	Mugiliformes	Mugilidae	cipoli / mullets	5
	Osmeriformes	Osmeridae	smrdljivke / smelts	3
	Perciformes	Cottidae	peševi / sculpins	16
		Gasterosteidae	gregorci / sticklebacks and tubesnouts	8
		Moronidae	brancini / temperate basses	1
		Percidae	grgeči / perches	14
	Pleuronectiformes	Pleuronectidae	iverci / righteye flounders	3
	Salmoniformes	Salmonidae*	pastrmke / salmonids	125
	Siluriformes	Siluridae	somovi / sheatfishes	2
	Syngnathiformes	Syngnathidae	šila / pipefishes and seahorses	1
Petromyzonti	Petromyzontiformes	Petromyzontidae	kolouste (paklare) / northern lampreys	13
UKUPNO / TOTAL				**546**

*prema Van der Laan *et al.* (2021), red Cypriniformes u Evropi obuhvata i četiri porodice koje su prema starijoj klasifikaciji imale status potporodica (Acheilognathidae, Gobionidae, Leuciscidae, Tincidae), dok porodica Salmonidae uključuje i dve potporodice koje su prema starijoj klasifikaciji imale status porodica (Coregoninae i Thymallinae) /

*according to Van der Laan *et al.* (2021), the order Cypriniformes in Europe also includes four families that had the status of subfamilies following the older classification (Acheilognathidae, Gobionidae, Leuciscidae, Tincidae), while the family Salmonidae also includes two subfamilies that had the status of families following the older classification (Coregoninae and Thymallinae)



Biodiverzitet faune riba u Evropi obuhvata 546 autohtonih slatkovodnih vrsta riba iz 29 porodica, od čega je oko 80% vrsta endemično (Kottelat & Freyhof, 2007; Freyhof & Brooks, 2011) (Tabela 1). Takođe, procenjeno je da je, od 524 vrste riba koje se nalaze na IUCN Crvenoj listi ugroženih vrsta (IUCN, 2022), oko 37% ugroženo u većoj ili manjoj meri. Među njima je vrlo značajan broj endemičnih taksona (177 ili >90%) (Tabela 2). Populacioni trendovi su opadajući kod 17% evropskih slatkovodnih riba, stabilni kod oko 6%, a rastući samo kod 1%. Kod preostalih 76% populacioni trendovi nisu poznati.

The biodiversity of the fish fauna in Europe includes 546 native freshwater fish species from 29 families, of which about 80% species are endemic (Kottelat & Freyhof, 2007; Freyhof & Brooks, 2011) (Table 1). It is also estimated that of the 524 fish species on the IUCN Red List of Threatened Species (IUCN, 2022), about 37% are threatened to a greater or lesser degree. This includes a very large number of endemic taxa (177 or >90%) (Table 2). Population trends are declining for 17% of European freshwater fish species, stable for about 6% and increasing for only 1%. For the remaining 76%, population trends are unknown.

Tabela 2. Ugroženost faune slatkovodnih riba u Evropi (prema Freyhof & Brooks, 2011).

Table 2. Threat status of freshwater fishes in Europe (after Freyhof & Brooks, 2011).

IUCN status ugroženosti IUCN Threat Status	Broj ugroženih vrsta Number of threatened species	Broj endemičnih ugroženih vrsta Number of endemic threatened species	% endemičnih ugroženih vrsta % of endemic threatened species
CR	63	53	84
EN	52	49	94
VU	79	75	95
Ukupno / Total (CR+EN+VU)	194	177	91

Površinske vode u Srbiji odlikuju se gustom hidrografskom mrežom tekućih voda (ne previše bogatih količinom vode), značajnim brojem veštačkih vodnih tela i relativno malim brojem prirodnih stajaćih voda. Tekuće vode u Srbiji otiču u tri sliva: crnomorski koji pokriva 92% državne teritorije, jadranski (5% teritorije) i egejski (3% teritorije) (Gavrilović & Dukić, 2002) (Slika 2). Veće reke crnomorskog sliva jesu Dunav, Sava, Tisa, Drina, Kolubara, Tamiš, Velika Morava, Zapadna Morava i Južna Morava, Mlava, Pek i Timok. Jadranskom slivu pripada Beli Drim na Kosovu i Metohiji, a glavne pritoke jesu Pećka Bistrica, Dečanska Bistrica, Prizrenska Bistrica, Klina, Miruša i Erenik. Egejskom slivu pripadaju Dragovištica, Pčinja, Lepenac i Nerodimka. Sa aspekta vodnog bogatstva, Vojvodina i severni deo centralne Srbije mnogo su bogatiji vodom od ostatka Srbije.

Reke egejskog i jadranskog sliva u Srbiji pripadaju manjim i srednjim vodotocima brdsko-planinskih područja (Slika 3), dok vodotoci crnomorskog sliva obuhvataju sve tipove tekućica, od velikih nizijskih sporotekućih reka do brzih i bujičavih visokoplaninskih potoka, sa jasnom smenom potamonskih i ritronskih sekcija toka na gradijentu nadmorske visine.

Prirodnih stajaćih voda, posebno jezera, u Srbiji nema mnogo. Pri tome, površina ovih voda je mala, plitka su, a najveće jezero je Palićko jezero sa površinom od 4,2 km² vodenog ogledala i prosečnom dubinom od oko 2 m. Prirodna jezera u Srbiji po načinu nastanka spadaju u eolska, rečna, lednička i urvinska.

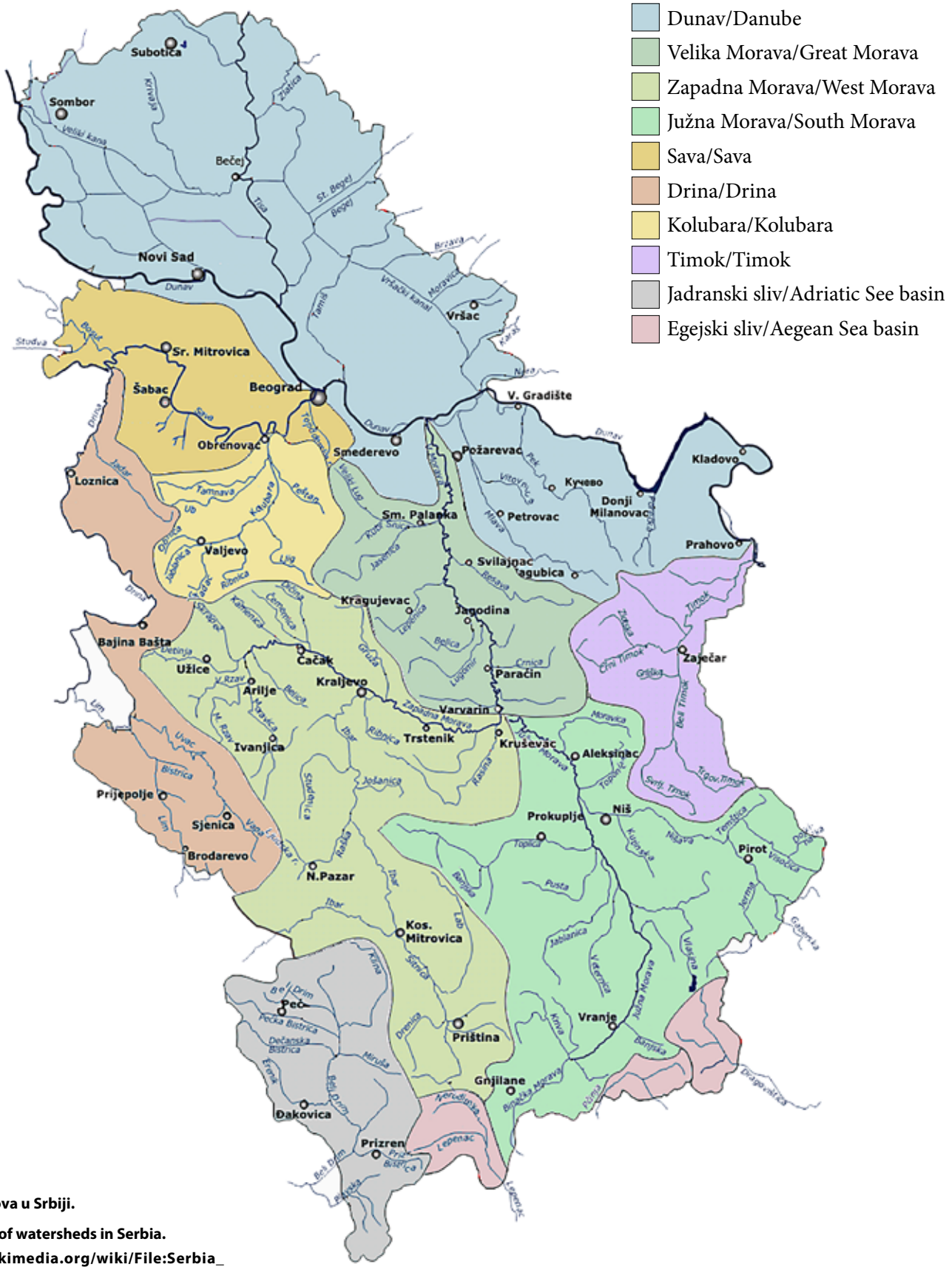
Eolska i rečna jezera karakteristična su za Vojvodinu, dok su lednička i urvinska karakteristična za planinska područja. U eolska jezera, nastala erozijom vetra, spadaju Palićko, Ludaško, Kelebijsko i Krvavo jezero.

Surface waters in Serbia are characterized by a dense hydrographic network of running waters (not too rich in water), a considerable number of artificial waterbodies and a relatively small number of natural standing waters. The running waters in Serbia flow into three basins: the Black Sea, which covers 92% of the country's area, the Adriatic Sea (5% of the area) and the Aegean Sea (3% of the area) (Gavrilović & Dukić, 2002) (Figure 2). The major rivers of the Black Sea basin are the Danube, the Sava, the Tisza, the Drina, the Kolubara, the Tamiš, the Great Morava, the West Morava, the South Morava, the Mlava, the Pek and the Timok. The White Drim in Kosovo and Metohija belongs to the Adriatic Sea basin, and its main tributaries are the Pećka Bistrica, the Dečanska Bistrica, the Prizrenska Bistrica, the Klina, the Miruša and the Erenik. The Dragovištica, the Pčinja, the Lepenac and the Nerodimka belong to the Aegean Sea basin. From the aspect of water richness, Vojvodina and the northern part of central Serbia are much more water-rich than the rest of Serbia.

The rivers of the Aegean Sea and Adriatic Sea basins in Serbia are small and medium sized streams of the hilly-mountainous regions (Figure 3), while the watercourses of the Black Sea basin include all types of rivers, from large, slow-flowing lowland rivers, to fast torrential high mountain streams, with a distinct alternation of potamon and rhithron zones along the elevation gradient.

There are not many natural standing waters in Serbia, especially lakes. The largest lake is Lake Palić with an area of 4.2 km² and an average depth of about 2 metres. The natural lakes in Serbia can be classified into the following types, according to their origin: aeolian lakes, fluvial lakes, glacial lakes and landslide lakes.

Aeolian lakes and fluvial lakes are characteristic of Vojvodina, while glacial lakes and landslide lakes are characteristic of moun-



Slika 2. **Raspored slivova u Srbiji.**

Figure 2. **Distribution of watersheds in Serbia.**

https://commons.wikimedia.org/wiki/File:Serbia_drainage_basins_detailed.png

Presecanjem ili napuštanjem meandara nastaju rečna ili fluvijalna jezera, obično male dubine, koja karakterišu rečne doline većih nizijskih reka. Rečnom erozijom nastala su jezera Rusanda (slano jezero, meandar Tise), Provala (nastalo izlivanjem Dunava 1925. godine, najdublje jezero u Vojvodini, duboko 5–19 m) i Obedska bara (meandar Save).

Lednička ili glacijalna jezera nastaju ledničkom erozijom i nalaze se na Šar-planini i Prokletijama. Po površini su mala, ali često vrlo duboka. Nazivaju se „gorskim očima" zbog čiste vode i posebnih estetskih vrednosti.

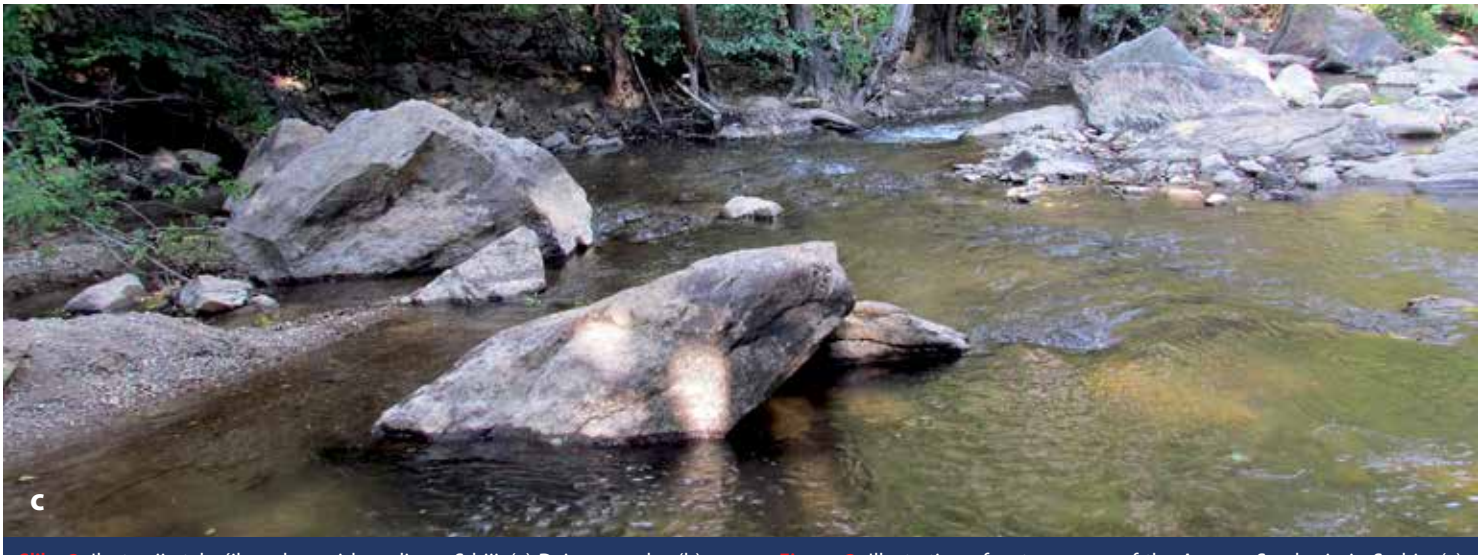
Urvinska jezera nastaju za vreme jačih zemljotresa kada dolazi do pokretanja klizišta. Velike količine skliznute zemlje i kamenja tada pregrađuju rečne doline prirodnim zemljanim branama, formirajući jezera. Ovakva jezera jesu Zavojsko jezero na reci Visočici na Staroj planini kod Pirota, Semeteško jezero na Kopaoniku i Jovačka jezera kod Vladičinog Hana.

tainous regions. Aeolian lakes formed by wind erosion include Palićko, Ludaško, Kelebijsko and Krvavo lakes.

Cutoff and abandoned meanders form fluvial lakes, which are usually shallow and characteristic of the river valleys of larger lowland rivers. River erosion created the lakes Rusanda (a salt lake, meander of the Tisza), Provala (formed by the flood of the Danube in 1925, the deepest lake in Vojvodina, 5–19 m deep) and Obedska bara (meander of the Sava).

Glacial lakes are formed by glacial erosion and are located on the Šar Mt. and the Prokletije Mts. They have a small surface area, but are often very deep. They are called "mountain eyes" because of their clear water and special aesthetic value.

Landslide lakes form during stronger earthquakes when landslides are triggered. Large amounts of landslides and rocks then block the river valleys with natural earth dams and form a lake. Such lakes are Lake Zavojsko on the Visočica River on the Stara



Slika 3. Ilustracija tekućih voda egejskog sliva u Srbiji: (a) Dejanova reka; (b) Dragovištica uzvodno od ušća Brankovačke reke; (c) Pčinja kod Manastira Prohor Pčinjski (foto: A. Hegediš).

Figure 3. Illustration of watercourses of the Aegean Sea basin in Serbia: (a) Dejanova River; (b) Dragovištica upstream from the mouth of the Brankovačka River; (c) Pčinja near the Prohor Pčinjski Monastery (photo: A. Hegediš).

Slika 4. Obedska bara (foto: A. Hegediš).

Figure 4. Obedska bara (photo: A. Hegediš).

Veliki broj vodnih celina u Srbiji nosi u svom imenu izraz „bara", a najčešće je reč o rečnim (fluvijalnim) jezerima, kao što su Carska bara (Stari Begej), Obedska bara (Sava) (Slika 4), Sefkerinska bara (Tamiš), Okanj bara (Tisa), Selska bara (Dobrava) i druge. Kako su u pitanju vodene celine sa malom dubinom vode, bez profundalne zone, koje brzo obrasta vodena vegetacija, odrednica „bara" mnogo više odgovara ekološkim odlikama takvih ekosistema od odrednice „jezero".

S druge strane, Srbija obiluje veštačkim stajaćim vodama. Jedna od takvih je i 960 km duga kanalska mreža hidro-sistema „Dunav-Tisa-Dunav" (DTD sistem), koja se prostire na velikom delu teritorije Vojvodine. DTD je hidrotehnički sistem veštačkih kanala koji povezuje tokove Dunava i Tise sa sledećim osnovnim namenama: odvodnjavanje, navodnjavanje, vodosnabdevanje, prihvatanje iskorišćenih voda, plovidba, prihvatanje vode sa teritorije susednih zemalja, šumarstvo, ribolov, turizam i rekreacija. Hidroakumulacije nastale pregrađivanjem rečnih tokova predstavljaju drugi veoma rasprostranjen tip veštačkih stajaćih voda u Srbiji, posebno prisutan u delu južno od Save i Dunava. Hidroakumulacije se razlikuju po veličini i dubini vode, kao i nameni. Površine se kreću od nekoliko hektara (jezero u Topoli, jezero Zaova) (Slika 5) do više stotina kvadratnih kilometara (jezero Đerdap I), a dubine od oko 1 m (jezero Bubanj u Kragujevcu) do preko 100 m (Zaovine 110 m, Sjeničko 108 m, Gazivode 105 m). U odnosu na namenu, veštačka jezera se koriste za proizvodnju električne energije, za vodosnabdevanje naselja, za navodnjavanje obradivih površina, za vodosnabdevanje industrije, za turizam i rekreaciju, a ribnjačka jezera (ribnjaci) za privredni i rekreativni ribolov. Poseban tip jezera nastaje potapanjem podzemnim vodama iskopa nastalog nakon eksploatacije treseta (tresetna jezera kod Velikog Gradišta) ili šljunka (Šalinačka jezera, jezera u Beloj Crkvi, tzv. bageri kod Požarevca).

planina Mt. near Pirot, Lake Semeteško near Kopaonik and Jovačka Lakes near Vladičin Han.

A large number of waterbodies in Serbia are termed "pond" (*Serbian*: bara) and most of them are river lakes, such as Carska bara (Stari Begej), Obedska bara (Sava) (Figure 4), Sefkerinska bara (Tamiš), Okanj bara (Tisza), Selska bara (Dobrava) and others. Since these are waterbodies with shallow depths and without a profundal zone, which are quickly overgrown with aquatic plants, the term "pond" corresponds better to the ecological characteristics of such ecosystems than the term "lake".

On the other hand, Serbia is rich in man-made standing waters. One of them is the 960 km long network of canals of the "Danube-Tisza-Danube" hydrosystem (DTD), which covers a large part of the territory of Vojvodina. DTD is a hydrotechnical system of artificial canals connecting the rivers Danube and Tisza and serving mainly the following purposes: drainage, irrigation, water supply, withdrawal of used water, navigation, withdrawal of water from the neighbouring countries, forestry, fishery, tourism and recreation. Another type of artificial reservoirs, widespread in Serbia, are those created by damming rivers, which are mainly found south of the Sava and Danube rivers. These reservoirs differ in size and water depth, as well as in their purpose. The areas range from a few hectares (a lake in Topola, Lake Zaova) (Figure 5) to hundreds of square kilometres (Lake Đerdap I) and the water depths from about 1 m (Lake Bubanj in Kragujevac) to over 100 m (Zaovine 110 m, Sjenica 108 m, Gazivode 105 m). Depending on their purpose, artificial lakes are used for power generation, water supply to settlements, irrigation of arable land, water supply to industry, tourism and recreation, and as fish ponds for commercial and recreational fishing. A special type of lakes is created by groundwater flooding of excavation pits formed after the extraction of peat (peat lakes near Veliko Gradište) or gravel (Lakes Šalinačka, lakes in Bela Crkva, so-called dredging lakes, *Serbian*: bageri, near Požarevac).

Slika 5. Primeri veštačkih vodenih ekosistema: (a) drenažni kanali u okolini Velikog Gradišta i Srebrnog jezera; (b) jezera u okolini Velikog Gradišta formirana na kopovima treseta; (c) akumulacija Zaova kod Požarevca (primer male akumulacije); (d) akumulacija Zvorničko jezero (primer velike akumulacije) (foto: A. Hegediš).

Figure 5. Examples of artificial water ecosystems: (a) drainage canals in the vicinity of Veliko Gradište and Lake Srebrno; (b) lakes in the vicinity of Veliko Gradište formed on peat mines; (c) reservoir Zaova near Požarevac (example of a small reservoir); (d) Lake Zvorničko (example of a large reservoir) (photo: A. Hegediš).

U pogledu faktora koji ugrožavaju površinske slatkovodne ekosisteme i naselja riba u njima, ti ekosistemi u Srbiji dele sudbinu sa regionalnim, evropskim, pa i svetskim kopnenim vodama – glavni ugrožavajući faktori se u manjoj ili većoj meri poklapaju, a jedino lokalne specifičnosti određuju značaj pojedinih faktora. Najvažniji su svakako sveprisutno zagađivanje, zatim pregrađivanje tokova i izgradnja brana i hidroakumulacija, regulacija tokova i degradacija staništa, negativni efekti unosa alohtonih vrsta, prelov i krivolov, a slede ih negativni efekti klimatskih promena, eksploatacija peska i šljunka, negativni uticaj toplovodne i hladnovodne akvakulture, nagli i stihijski razvoj turizma, promenljiva zakonska regulativa i drugo.

As far as the factors threatening surface freshwater ecosystems and fish habitats in them are concerned, these ecosystems in Serbia share a fate with regional, European and even global inland waters – the main threat factors more or less coincide, and only local features determine the importance of individual factors. The most important ones are certainly the ubiquitous pollution, followed by the damming of rivers and the construction of dams and reservoirs, the regulation of rivers and the destruction of habitats, the negative effects of introduction of non-native species, overfishing and poaching, as well as the negative effects of climate change, exploitation of sand and gravel, negative effects of warm and cold water aquaculture, rapid and unplanned development of tourism, changing legislation and others.

U najužem smislu, zaštita flore i faune u Srbiji obuhvaćena je *Pravilnikom o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* (Službeni glasnik RS, br. 5/2010, 47/2011, 32/2016 i 98/2016). *Pravilnik* obuhvata 67 autohtonih vrsta riba. *Pravilnikom* se proglašavaju „divlje vrste biljaka, životinja i gljiva radi očuvanja biološke raznovrsnosti, prirodnog genofonda, odnosno vrste koje imaju poseban značaj sa ekološkog, ekosistemskog, biogeografskog, naučnog, zdravstvenog, ekonomskog i drugog aspekta za Republiku Srbiju, kao strogo zaštićene divlje vrste ili zaštićene divlje vrste i utvrđuju se mere zaštite zaštićenih vrsta i njihovih staništa" (član 1. *Pravilnika*). *Pravilnik* u Prilogu I sadrži listu strogo zaštićenih divljih vrsta koja obuvata 38 vrsta riba, dok je u Prilogu II data lista zaštićenih divljih vrsta sa 29 autohtonih vrsta riba.

Strogo zaštićene divlje vrste biljaka, životinja i gljiva definišu se kao „divlje vrste koje su iščezle sa teritorije Republike Srbije ili njenih delova, vraćene programima reintrodukcije, krajnje ugrožene, ugrožene, reliktne, lokalno endemične, stenoendemične, međunarodno značajne i zaštićene divlje vrste, od posebnog značaja za očuvanje biološke raznovrsnosti Republike Srbije" (član 3. *Pravilnika*).

Zaštićene divlje vrste biljaka, životinja i gljiva jesu „divlje vrste koje u prirodi trenutno nisu ugrožene u meri da im preti opasnost da nestanu ili postanu kritično ugrožene a to su ranjive, endemične, indikatorske, ključne i kišobran vrste, reliktne, međunarodno značajne i zaštićene divlje vrste, kao i vrste koje nisu ugrožene ali se zbog svog izgleda mogu lako zameniti sa strogo zaštićenim vrstama" (član 5. *Pravilnika*).

Članom 7. *Pravilnika* precizno se definišu zaštita i očuvanje strogo zaštićenih i zaštićenih divljih vrsta koje se sprovode preduzimanjem mera i aktivnosti na upravljanju populacijama, kao što su:

1) zaštita staništa,
2) praćenje stanja populacija vrsta i činilaca njihovog ugrožavanja, naročito praćenje i smanjivanje uticaja promene klime na visoko ranjive vrste i njihova staništa,
3) biotehničke mere,
4) reintrodukcija vrsta na teritoriju Republike Srbije ili njene pojedine delove, odnosno gajenje vrsta u uslovima van prirodnog staništa (*ex situ*) i na prirodnom staništu (*in situ*) radi njihovog vraćanja u prirodu,
5) sanacija i revitalizacija oštećenih staništa,
6) sprovođenje kompenzacijskih mera uspostavljanjem novog lokaliteta koji ima iste ili slične osobine kao oštećeni lokalitet i unošenje vrsta na druge lokalitete u cilju povećanja brojnosti;
7) podrška naučnim istraživanjima, obrazovnim aktivnostima i popularizaciji očuvanja i zaštite vrsta,
8) sakupljanje matičnih jedinki u cilju razmnožavanja, gajenja njihovih potomaka i prometa u komercijalne svrhe u za to registrovanim plantažama i farmama,
9) premeštanje jedinki strogo zaštićenih vrsta u slučaju akcidentnih situacija (zagađenja vazduha, vode i zemljišta, masovna pojava gmizavaca, vodozemaca i sl.),
10) povećanje brojnosti strogo zaštićene vrste iznad optimalne brojnosti, predviđene posebnim programom, odnosno programom razvoja lovnog područja koji donosi ministarstvo nadležno za poslove poljoprivrede, šumarstva i vodoprivrede,

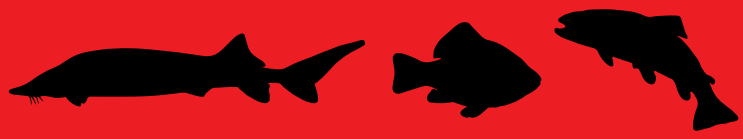
In the narrowest sense, the protection of flora and fauna in Serbia is covered by the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* (Official Gazette of RS, No. 5/2010, 47/2011, 32/2016 and 98/2016). The *Rulebook* covers 67 native fish species. The *Rulebook* proclaims "wild species of plants, animals and fungi in order to preserve biological diversity, the natural gene pool, i.e. species that are extremely important for the Republic of Serbia, from an environmental, ecosystem, biogeographical, scientific, health, economic and other aspects, as strictly protected wild species or protected wild species and shall establish measures for protection of protected species and their habitats" (Article 1 of the *Rulebook*). Annex I of the *Rulebook* contains a list of strictly protected wild species, including 38 fish species, while Annex II contains a list of protected wild species with 29 native fish species.

Strictly protected wild species of plants, animals and fungi are defined as "wild species that have disappeared from the territory of the Republic of Serbia or its parts, which are reintroduced through a reintroduction programme, or extremely endangered, endangered, relict, local endemite, stenoendemite, internationally significant and protected wild species, and of particular importance for the preservation of the biological diversity of the Republic of Serbia" (Article 3 of the *Rulebook*).

Protected wild species of plants, animals and fungi are "those wild species which are not currently threatened in nature to the extent to be in danger to disappear or to become critically endangered, and these are vulnerable, endemic, indicator, key and umbrella species, relict, internationally important and protected wild species, species that are not threatened, but because of their appearance can be easily mistaken for strictly protected species" (Article 5 of the *Rulebook*).

Article 7 of the *Rulebook* precisely defines the protection and conservation of strictly protected and protected wild species through population management measures and activities such as:

1) protection of habitats;
2) monitoring the condition of populations and the factors of their endangerment, in particular monitoring and reducing the impact of climate change on highly vulnerable species and their habitats;
3) biotechnical measures;
4) reintroduction of species into the territory of the Republic of Serbia or into certain parts of the country, i.e. breeding of species outside their natural habitat (*ex situ*) and in the natural habitat (*in situ*) for their reintroduction into nature;
5) rehabilitation and revitalization of damaged habitats;
6) implementation of compensatory measures by establishing a new site with the same or similar characteristics as the damaged site and introduction of species at other sites in order to increase their numbers;
7) support scientific research, educational activities and popularisation of species conservation and protection;
8) collection of parent specimens for reproduction, breeding of their offspring and trade for commercial purposes on registered plantations and farms;
9) relocation of specimens of strictly protected species in case of accidents (air, water and soil pollution, mass emergence of reptiles, amphibians, etc.);



11) pronalaženje odgovarajućeg mesta za reintrodukciju migratornih vrsta, kao područje značajno za razvojni ciklus vrste, ili stanište migratornih vrsta (hranilišta, zimovališta, odmarališta, legla za nosilje, migratorni koridori, menjanje dlake).

Pored *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva*, zaštita riba u Srbiji realizuje se i kroz *Naredbu o merama za očuvanje i zaštitu ribljeg fonda* (Službeni glasnik RS, br. 56/2015 i 94/2018). Ovom Naredbom trajnim lovostajem zaštićena je 31 vrsta riba, za 17 vrsta određen je vremenski ograničen lovostaj u periodu mresta, 26 vrsta zaštićeno je minimalnom lovnom merom, dok je 18 vrsta u režimu dnevnog ograničenja ulova u pogledu broja komada. Sve autohtone vrste riba dodatno se štite merom ograničenja dnevnog ulova na najviše 5 kg, osim trofejnih riba. Alohtone vrste nemaju nikakvih lovnih ograničenja.

Međutim, u praksi se zaštita populacija riba teško ostvaruje. Mere zaštite riba koje su predviđene *Pravilnikom* i *Naredbom* ugrađuju se u programe upravljanja ribarskim područjima, ali njihova implementacija u najvećoj meri zavisi od rada ribočuvarskih službi. Nažalost, ribočuvarske službe raspolažu skromnim sredstvima i isto tako skromnom opremom, kao i nedovoljnim brojem ribočuvara, pa su i rezultati u zaštiti riba nedovoljni.

S druge strane, znatno pre donošenja *Pravilnika* i *Naredbe*, 2005. godine urađena su dva akciona plana upravljanja populacijama riba u ribolovnim vodama Srbije. Prvi se odnosio na svih šest jesetarskih vrsta riba, *Akcioni plan upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al*., 2005), a drugi na mladicu (*Hucho hucho*) (Hegedиš *et al*., 2005). Ovi akcioni planovi izrađeni su na nivou nacrta i nikad nisu usvojeni, te nisu ni postali deo obaveznog zakonodavnog okvira, a koriste se samo na nivou stručnog dokumenta (Galamboš, 2018). U godinama nakon što su napisani, implementirani su tek u malim, beznačajnim fragmentima. Danas su ovi dokumenti izgubili na aktuelnosti i za njihovu primenu bila bi potrebna ozbiljna revizija. Iz ova dva primera jasno je da donošenje dokumenata bez njihove implementacije u praksi malo znači u zaštiti populacija riba.

10) increasing the abundance of strictly protected species above optimal numbers through a special programme, i.e. a hunting area development programme, carried out by the Ministry competent for agriculture, forestry and water management;
11) identify a suitable site for the reintroduction of migratory species, as a site suitable for the species' development cycle or a site that serves as habitat for migratory species (feeding, wintering, refuges, litter for laying hens, migration corridors, moulting).

In addition to the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi*, the protection of fish in Serbia is implemented by the *Regulation on Measures for the Conservation and Protection of Fish Stocks* (Official Gazette of RS, No. 56/2015 and 94/2018). According to this Regulation, 31 fish species are protected by a permanent ban on fishing, for 17 species a time-limited fishing during the spawning season was introduced, 26 species are protected by a minimum catch size, and for 18 species a daily catch limit in terms of number of individuals applies. All native fish species are additionally protected by a daily catch limit of no more than 5 kg, with the exception of trophy fish. There are no hunting restrictions for non-native species.

In practice, however, protection of fish populations is difficult to achieve. While the fish protection measures provided for in the *Rulebook* and *Regulation* are integrated into fisheries management programmes, their implementation depends largely on the work of fisheries inspection services. Unfortunately, fisheries inspection services have only modest resources and equally modest equipment, as well as an insufficient number of fish wardens, so the results in fish protection are also inadequate.

On the other hand, two action plans for the management of fish populations in Serbian fishing waters were prepared in 2005, long before the adoption of the *Rulebook* and *Regulation*. The first one referred to all six sturgeon fish species, the *Action plan for sturgeon species management in fishery waters of the Republic of Serbia* (Lenhardt *et al*., 2005), and the second one referred to the huchen (*Hucho hucho*) (Hegedиš *et al*., 2005). These action plans were drawn up at draft level and never adopted, so they have not even become part of the binding legal framework and are only used at the level of an expert document (Galamboš, 2018). In the years following their drafting, they were implemented only in small, insignificant fragments. Today these documents have lost their importance and their application would require serious revision. Based on these two examples, it is clear that the adoption of documents without their implementation in practice means little for the protection of fish populations.

2

KARAKTERISTIKE FAUNE RIBA SRBIJE

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CHARACTERISTICS OF THE FISH FAUNA OF SERBIA

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2. KARAKTERISTIKE FAUNE RIBA SRBIJE

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2.1. Diverzitet faune riba Balkanskog poluostrva i Srbije

Balkansko poluostrvo predstavlja najznačajniji centar diverziteta riba u Evropi i jedan od 25 tzv. vrućih tačaka biodiverziteta (*engl.* biodiversity hotspots) sveta (Meyers *et al.*, 2000; Freyhof, 2012). Obuhvata 35.000 km rečnih tokova, od kojih je 80% ili u kategoriji čistih voda (oko 30%) ili voda dobrog kvaliteta (oko 50%) (Shwarz, 2012). Raznovrsnost faune riba ogleda se kako u velikom broju autohtonih vrsta (najmanje 193 vrste), tako i u visokom stepenu endemizma (87 vrsta), a oko trećine (28%) ugroženih vrsta riba Evrope živi na Balkanskom poluostrvu (Oikonomou *et al.*, 2014; Weiss *et al.*, 2018; Fricke *et al.*, 2022). Cyprinidae (uključujući porodicu Leuciscidae, ranije potporodicu Leuciscinae) predstavljaju najbrojniju porodicu (59% vrsta), a zatim slede Cobitidae (10%), Salmonidae (10%) i Gobiidae (6%) (Oikonomou *et al.*, 2014). Slično je i sa endemičnim vrstama – najveći broj vrsta takođe pripada porodicama Cyprinidae (uključujući i Leuciscidae) (64%), Cobitidae i Salmonidae (po 9%) i Gobiidae (8%).

U poređenju sa ostalim zemljama Balkanskog poluostrva, diverzitet riba u Srbiji nije visok. Najveći broj slatkovodnih vrsta riba imaju Grčka i Bugarska, dok najveći broj endemičnih vrsta imaju Grčka i Hrvatska (Tabela 3).

Tabela 3. Pregled broja slatkovodnih vrsta riba u zemljama Balkanskog poluostrva (procenat u odnosu na broj autohtonih vrsta u Evropi dat je prema Freyhof & Brooks, 2011).

Zemlja / Country	Autohtone vrste / Native species	% ukupnog broja evropskih vrsta / % of total European species	Alohtone vrste / Non-native species	Ukupno / Total	Endemične vrste / Endemic species	Referenca / Reference
Grčka / Greece	137	25%	23	160	47	Barbieri *et al.* (2015)
Bugarska / Bulgaria	133	24%	21	154	3	Vassilev & Pehlivanov (2005); Fricke *et al.* (2022)
Hrvatska / Croatia	118	22%	19	137	18	Ćaleta *et al.* (2019); Fricke *et al.* (2022)
Rumunija / Romania	109	20%	23	132	7	Fricke *et al.* (2022); Froese & Pauly (2022)
Bosna i Hercegovina / Bosnia and Herzegovina	104	19%	14	118	4	Glamuzina *et al.* (2010); Fricke *et al.* (2022)
Srbija / Serbia	90	16%	23	113	0	
Severna Makedonija / North Macedonia	73	13%	5	78	1	Petkovski (2010)
Slovenija / Slovenia	71	13%	14	85	1	Hlad & Skoberne (2001); Fricke *et al.* (2022)
Crna Gora / Montenegro	62	11%	13	75	4	Marić (2019)
Albanija / Albania	50	9%	18	68	2	Rakaj & Flloko (1995); Fricke *et al.* (2022)

2. CHARACTERISTICS OF THE FISH FAUNA OF SERBIA

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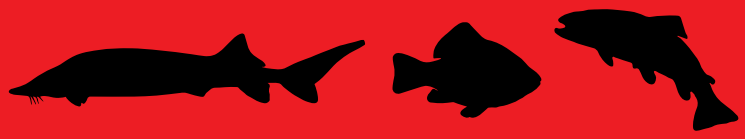
2.1. Diversity of the fish fauna of the Balkan Peninsula and Serbia

The Balkan Peninsula is the most important centre of fish diversity in Europe and one of the 25 designated biodiversity hotspots in the world (Meyers *et al.*, 2000; Freyhof, 2012). It contains 35,000 km of rivers, 80% of which of are categorised to be either in pristine (ca. 30%) or good (ca. 50%) hydromorphological condition (Shwarz, 2012). The diversity of the fish fauna is reflected both in the large number of native species (at least 193 species) and the high degree of endemism (87 species), and about one-third (28%) of Europe's threatened fish species live in the Balkan Peninsula (Oikonomou *et al.*, 2014; Weiss *et al.*, 2018; Fricke *et al.*, 2022). The family Cyprinidae (including the family Leuciscidae, formerly the subfamily Leuciscinae) represent the most numerous family (59% of species), followed by Cobitidae (10%), Salmonidae (10%) and Gobiidae (6%) (Oikonomou *et al.*, 2014). It is similar with the endemic species – the largest number of species also belongs to the families Cyprinidae (including Leuciscidae) (64%), Cobitidae and Salmonidae (9% each) and Gobiidae (8%).

Compared to other countries in the Balkan Peninsula, fish diversity in Serbia is not high. Greece and Bulgaria have the largest number of freshwater fish species, while Greece and Croatia have the most endemic species (Table 3).

Table 3. Overview of the number of freshwater fish species in the countries of the Balkan Peninsula (the percentage in relation to the number of native species in Europe is given according to Freyhof & Brooks, 2011).



Prema procenama urađenim za potrebe ove knjige, akvatične ekosisteme u Srbiji naseljava ukupno 113 vrsta riba iz 26 porodica (Tabela 4), od čega je 90 vrsta iz 21 porodice autohtono, što predstavlja 16% ukupnog broja autohtonih slatkovodnih vrsta riba Evrope (546 vrsta iz 29 porodica, prema Kottelat & Freyhof, 2007). Sliv Crnog mora (tj. sliv Dunava) u Srbiji naseljavaju 92 vrste, od čega je 67 autohtonih i 25 alohtonih, sliv Jadranskog mora naseljava 26 vrsta, od čega 20 autohtonih i 6 alohtonih, a sliv Egejskog mora naseljava 16 vrsta, od čega 14 autohtonih i 2 alohtone vrste.

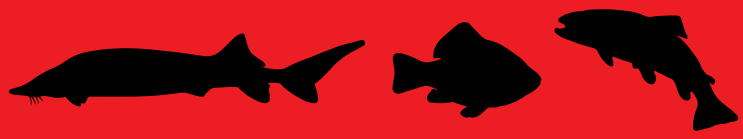
According to the estimates made for this book, the aquatic ecosystems in Serbia are inhabited by a total of 113 fish species from 26 families (Table 4), of which 90 species from 21 families are native, which represents 16% of the total number of native freshwater fish species in Europe (546 species from 29 families, according to Kottelat & Freyhof, 2007). The Black Sea basin (i.e. the Danube basin) in Serbia is inhabited by 92 species, of which 67 are native and 25 are non-native, the Adriatic Sea basin by 26 species, of which 20 are native and 6 are non-native, and the Aegean Sea basin by 16 species, of which 14 are native and 2 are non-native.

Tabela 4. Spisak vrsta riba u Srbiji (END – endemična za sliv; + prisutna; * prisutna u slivu, ali ne u Srbiji; I – introdukovana).

Table 4. List of fish species in Serbia (END – endemic to the basin; + present; * present in the basin but not in Serbia; I – introduced).

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	SLIV / BASIN		
			crnomorski (sliv Dunava) / Black Sea (Danube)	jadranski / Adriatic	egejski / Aegean
Petromyzontiformes	Petromyzontidae	*Eudontomyzon danfordi*	END		
		Eudontomyzon mariae	+		*
		Eudontomyzon stankokaramani		END	
		Eudontomyzon vladykovi	END		
Acipenseriformes	Acipenseridae	*Acipenser gueldenstaedtii*	+		
		Acipenser nudiventris	+		
		Acipenser ruthenus	+		
		Acipenser stellatus	+		
		Acipenser sturio	+	*	*
		Huso huso	+		
		Polyodon spathula	I		
Anguilliformes	Anguillidae	*Anguilla anguilla*	+	+	*
Clupeiformes	Clupeidae	*Alosa immaculata*	+		
		Alosa tanaica	+		
Cypriniformes	Cobitidae	*Cobitis elongata*	END		
		Cobitis elongatoides	+		
		Cobitis ohridana		END	
		Misgurnus fossilis	+		
		Sabanejewia balcanica	+		+
		Sabanejewia bulgarica	END		
		Sabanejewia romanica	END		
	Nemacheilidae	*Barbatula barbatula*	+	+	+
		Barbatula sturanyi		END	
		Oxynoemacheilus bureschi			END
	Cyprinidae	*Barbus balcanicus*	+	+	+

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	SLIV / BASIN		
			crnomorski (sliv Dunava) / Black Sea (Danube)	jadranski / Adriatic	egejski / Aegean
Cypriniformes	Cyprinidae	*Barbus barbus*	+		
		Barbus rebeli		END	
		Barbus strumicae			END
		Carassius carassius	+		*
		Carassius gibelio	I	I	
		Cyprinus carpio	+	+	
	Xenocyprididae	*Ctenopharyngodon idella*	I		
		Hypophthalmichthys molitrix	I		
		Hypophthalmichthys nobilis	I		
	Tincidae	*Tinca tinca*	+	I	
	Acheilognathidae	*Rhodeus amarus*	+	+	+
	Gobionidae	*Gobio bulgaricus*			END
		Gobio obtusirostris	+		+
		Gobio skadarensis		END	
		Pseudorasbora parva	I	I	I
		Romanogobio kesslerii	+		
		Romanogobio uranoscopus	END		
		Romanogobio vladykovi	END		
	Leuciscidae	*Abramis brama*	+		
		Alburnoides bipunctatus	+		
		Alburnoides ohridanus		END	
		Alburnoides strymonicus			END
		Alburnoides thessalicus			END
		Alburnus alburnus	+		
		Alburnus sava	END		
		Alburnus scoranza		END	
		Ballerus ballerus	+		
		Ballerus sapa	+		
		Blicca bjoerkna	+		
		Chondrostoma nasus	+		
		Chondrostoma ohridanum		END	
		Chondrostoma vardarense		*	+
		Leucaspius delineatus	+		*
		Leuciscus aspius	+		



RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	SLIV / BASIN		
			crnomorski (sliv Dunava) / Black Sea (Danube)	jadranski / Adriatic	egejski / Aegean
Cypriniformes	Leuciscidae	*Leuciscus idus*	+		
		Leuciscus leuciscus	+		
		Leucos basak	I	END	
		Pachychilon macedonicum	I		*
		Pachychilon pictum		END	
		Pelecus cultratus	+		
		Phoxinus phoxinus	+	+	
		Phoxinus strymonicus			END
		Rutilus rutilus	+		*
		Rutilus virgo	END		
		Scardinius erythrophthalmus	+		*
		Squalius cephalus	+		
		Squalius platyceps		END	
		Squalius vardarensis			END
		Telestes souffia	+	*	
		Vimba vimba	+		
Siluriformes	Siluridae	*Silurus glanis*	+		*
	Ictaluridae	*Ameiurus melas*	I		
		Ameiurus nebulosus	I		
Esociformes	Esocidae	*Esox lucius*	+		*
	Umbridae	*Umbra krameri*	+		
Salmoniformes	Salmonidae	*Hucho hucho*	END		
		Coregonus peled	I		
		Oncorhynchus mykiss	I	I	
		Salmo farioides		END	I
		Salmo macedonicus	I		END
		Salmo marmoratus		END	
		Salmo trutta	+		
		Salvelinus fontinalis	I		
		Salvelinus umbla	I		
		Thymallus thymallus	+		
Gadiformes	Lotidae	*Lota lota*	+		
Syngnathiformes	Syngnathidae	*Syngnathus abaster*	I		
Gobiiformes	Odontobutidae	*Perccottus glenii*	I		

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	SLIV / BASIN		
			crnomorski (sliv Dunava) / Black Sea (Danube)	jadranski / Adriatic	egejski / Aegean
Gobiiformes	Gobiidae	*Babka gymnotrachelus*	I		
		Knipowitschia caucasica	I		
		Neogobius fluviatilis	I		
		Neogobius melanostomus	I		
		Ponticola kessleri	I		
		Proterorhinus semilunaris	+		*
Centrarchiformes	Centrarchidae	*Lepomis gibbosus*	I		
		Micropterus salmoides	I		
Blenniiformes	Blenniidae	*Salariopsis fluviatilis*		+	*
Perciformes	Percidae	*Gymnocephalus baloni*	+		
		Gymnocephalus cernua	+		
		Gymnocephalus schraetser	END		
		Perca fluviatilis	+	I	*
		Sander lucioperca	+	I	*
		Sander volgensis	+		
		Zingel streber	+		
		Zingel zingel	+		
	Gasterosteidae	*Gasterosteus aculeatus*	I		
		Pungitius platygaster	+		
	Cottidae	*Cottus gobio*	+		

Osnovne odlike faune riba u našim vodama jesu dominacija riba iz porodice Leuciscidae (prema starijoj klasifikaciji potporodica Leuciscinae porodice Cyprinidae), zatim prisustvo četiri migratorne vrste jesetrovki (Acipenseridae), koje su nažalost kritično ugrožene, kao i nizak nivo endemizma, i to kako u odnosu na čitavo Balkansko poluostrvo tako i u odnosu na jugoistočni deo sliva Jadranskog mora. U Srbiji žive 32 endemične vrste za pojedine slivove, od čega je 11 vrsta endemično za sliv Dunava, 13 za sliv Jadranskog mora i 8 za sliv Egejskog mora. Nijedna od njih nije endemična samo za područje Srbije.

Od pomenutih 113 vrsta riba u vodama Srbije, 23 vrste jesu alohtone. U ovaj broj nisu uključene vrste koje su registrovane u našim vodama samo jednom: *Tilapia* sp. (Maletin *et al*., 2008), *Pterygoplichthys pardalis* (Simonović *et al*., 2010), *Morone saxatilis* x *Morone chrysops* (Skorić *et al.,* 2012), *Poecilia reticulata* (Milenković *et al*., 2013). Više alohtonih vrsta ima izrazito invazivni karakter (babuška *Carassius gibelio*, patuljasti somovi *Ameiurus nebulosus* i *A. melas*, sunčica *Lepomis gibbosus*, amurski čebačok *Pseudorasbora parva*, amurski spavač *Perccottus glenii*).

The most important features of the fish fauna in our waters are the dominance of fishes from the family Leuciscidae (according to the older classification, the subfamily Leuciscinae of the family Cyprinidae), followed by the presence of four migratory sturgeon species (Acipenseridae), which are unfortunately critically threatened, and a low level of endemism, both in relation to the entire Balkan Peninsula and the southeastern part of the Adriatic Sea basin. In Serbia there are 32 endemic species for specific basins, of which 11 species are endemic to the Danube basin, 13 to the Adriatic Sea basin and 8 to the Aegean Sea basin. None of them is endemic only to the territory of Serbia.

Of the mentioned 113 fish species in Serbian waters, 23 species are non-native. This number does not include species that have been recorded only once in our waters: *Tilapia* sp. (Maletin *et al*., 2008), *Pterygoplichthys pardalis* (Simonović *et al*., 2010), *Morone saxatilis* x *Morone chrysops* (Skorić *et al.* 2012), *Poecilia reticulata* (Milenković *et al*., 2013). Some non-native species have a strong invasive character (Prussian carp *Carassius gibelio*, bullheads *Ameiurus nebulosus* and *A. melas*, pumpkinseed *Lepomis gibbosus*, topmouth gudgeon *Pseudorasbora parva*, Amur sleeper *Perccottus glenii*).

Postoji još nekoliko vrsta riba čije prisustvo u Srbiji nije egzaktno utvrđeno. U crnomorskom slivu, to je *Gobio carpathicus* koja naseljava sliv Tise u Rumuniji, Mađarskoj, Ukrajini, Poljskoj i Slovačkoj, a u Srbiji bi mogla da se nađe u severoistočnom delu, u nekim manjim nizijskim ciprinidnim vodama koje su sada uključene u kanalsku mrežu Dunav-Tisa-Dunav (reka Zlatica, na primer) (Freyhof & Kottelat, 2008l). U egejskom slivu, prema kartama rasprostranjenja prikazanim na IUCN Crvenoj listi ugroženih vrsta (IUCN, 2022), mogle bi se naći *Cobitis strumicae*, *Romanogobio elimeius*, *Rutilus heckelii* i *Zingel balcanicus*, a prema Simić & Šorić (2006), i *Vimba melanops*. Kod vrste *Alburnus thessalicus* severna granica rasprostranjenja ima polumesečast oblik, pa prema karti prikazanoj na IUCN Crvenoj listi ugroženih vrsta zahvata i slivove Dragovištice i Lepenca. Za reku Erenik u jadranskom slivu vezuje se jedan nalaz koji je naveden kao *Rhodeus meridionalis* (Ibrahimi *et al*., 2019). Prema kartama rasprostranjenja na IUCN Crvenoj listi ugroženih vrsta, ova gavčica naseljava vode egejskog sliva, pa bi se u Srbiji mogla očekivati u slivu Lepenca i eventualno Pčinje, dok bi nalaz iz Erenika zahtevao sveobuhvatniju potvrdu koja uključuje i molekularno-genetičke analize.

Kvalitativni sastav naselja riba u vodenim ekosistemima u Srbiji veoma je varijabilan. U pojedinim planinskim potocima naselje riba čini samo jedna vrsta – potočna pastrmka *Salmo trutta* (u Rakovcu i drugim pritokama Gvozdačke reke na Goču, rekama Rači i Derventi koje sa Tare teku do Drine, odnosno do akumulacije Perućac) ili pijor *Phoxinus phoxinus* (u nekim potocima koji seku put Nova Varoš – Sjenica). Nasuprot tome, naselje riba u velikim nizijskim rekama može činiti i preko 60 vrsta.

Na Slici 6 prikazani su brojevi podataka o rasprostranjenju svih autohtonih vrsta u Srbiji. Na osnovu relativne učestalosti nalaza, može se uočiti da je za 56 vrsta (62%) zabeleženo manje od 100 nalaza, dok je za 34 vrste (38%) zabeleženo manje od 20 nalaza, a za 18 vrsta (20%) manje od 10 nalaza. U skladu sa ovim podacima, 1/5 vrsta može se smatrati retkim vrstama, dok je za svega 8 vrsta (9%) zabeleženo više od 500 nalaza i te vrste se mogu smatrati čestim vrstama.

Analiza centara diverziteta faune autohtonih vrsta riba Srbije na UTM mreži 10×10 km pokazala je da se centri diverziteta ove grupe (sa po 29–35 vrsta) nalaze u 18 UTM kvadrata (Slika 7), i to najviše u okviru kvadrata DQ, DR i EQ, u Dunavu i Savi, u okolini Beograda, Novog Sada i Šapca. Najmanji diverzitet riba (sa 1–8 vrsta po kvadratu) utvrđen je u čak 348 UTM kvadrata, koji obuhvataju male, slabije ispitane vodotoke.

Analiza centara diverziteta ugroženih vrsta riba na UTM mreži 10×10 km pokazala je da u Srbiji postoji 9 UTM kvadrata u kojima je zabeleženo prisustvo 9–11 ugroženih vrsta riba (Slika 8). Najveći diverzitet, sa 11 vrsta, zabeležen je u 3 kvadrata, jedan u Dunavu, na području Nacionalnog parka „Đerdap", i dva u slivu Belog Drima, na području Metohije. U dva kvadrata zabeleženo je po 10 vrsta, jedan u Savi u blizini Šapca i jedan takođe u slivu Belog Drima na području Metohije. Ostala 4 kvadrata velikog diverziteta, sa po 9 vrsta, takođe obuhvataju Dunav (na ulazu u Srbiju kod Apatina, zatim na području Beograda, kao i na izlazu iz Srbije kod Prahova) i sliv Belog Drima.

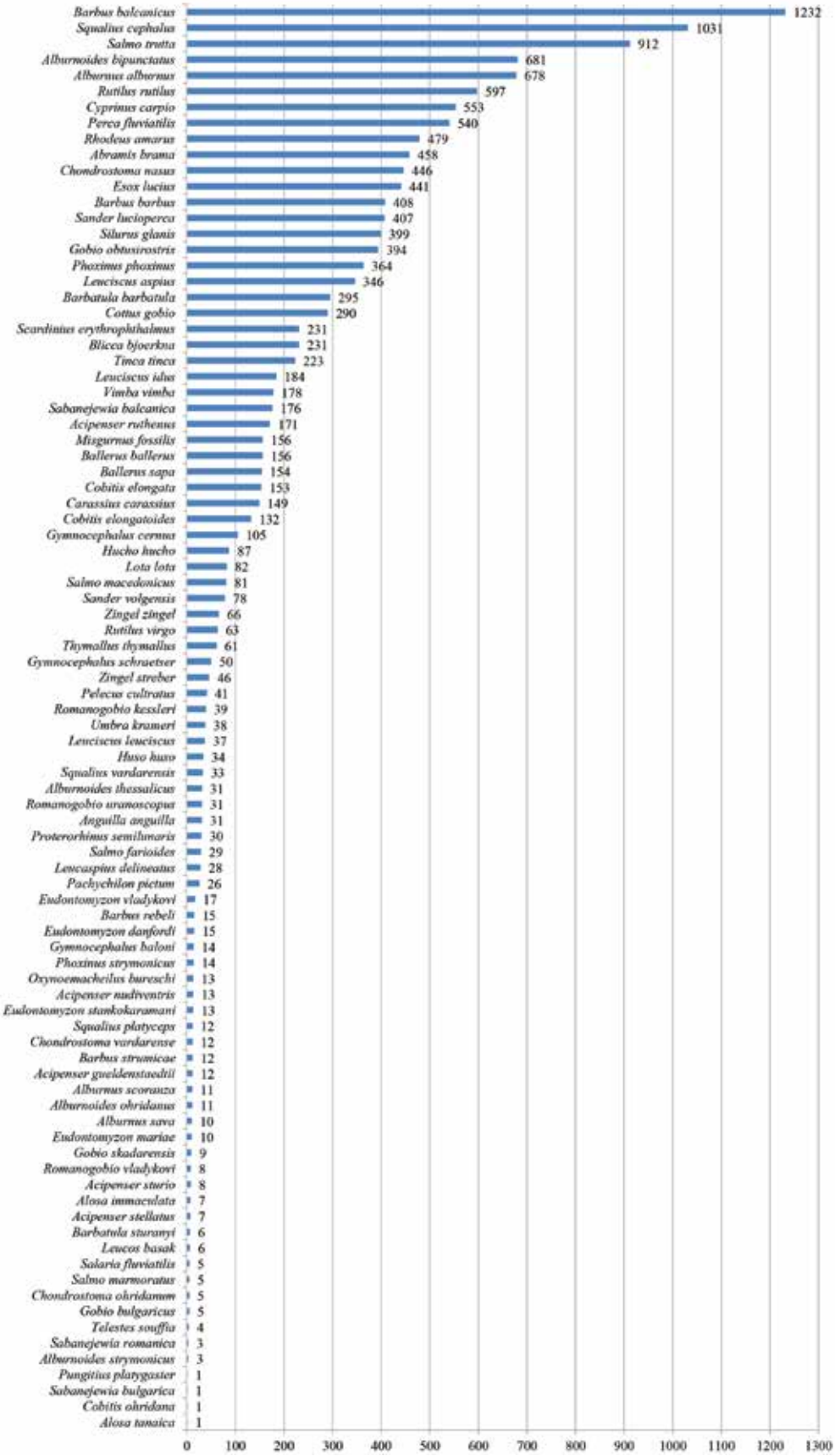
There are several other fish species the occurrence of which in Serbia has not been exactly determined. In the Black Sea basin it is *Gobio carpathicus*, which inhabits the Tisza watershed in Romania, Hungary, Ukraine, Poland and Slovakia, and in Serbia it might occur in the northeastern part, in some smaller lowland cyprinid waters, which are now part of the Danube-Tisza-Danube canal network (e.g. river Zlatica) (Freyhof & Kottelat, 2008l). In the Aegean Sea Basin, according to the distribution maps of the IUCN Red List of Threatened Species (IUCN, 2022), *Cobitis strumicae*, *Romanogobio elimeius*, *Rutilus heckelii* and *Zingel balcanicus* could be found, and according to Simić & Šorić (2006) also *Vimba melanops*. In the case of *Alburnus thessalicus*, the northern distribution limit has the shape of a crescent, so according to the map on the IUCN Red List of Threatened Species, it also includes the watersheds of Dragovištica and Lepenac. One record, listed as *Rhodeus meridionalis*, is associated with the Erenik/Ribnik River in the Adriatic Sea Basin (Ibrahimi *et al*., 2019). According to the distribution maps of the IUCN Red List of Threatened Species, this bitterling is native to the waters of the Aegean Sea Basin, so it would be expected to occur in Serbia in the Lepenac watershed and possibly in the Pčinja, while the record from the Erenik/Ribnik would require more comprehensive confirmation, including molecular genetic analyses.

The qualitative composition of fish assemblages in aquatic ecosystems in Serbia is highly variable. In certain mountain streams, the fish assemblage consists of only one species – the brown trout *Salmo trutta* (in the Rakovac and other tributaries of the Gvozdačka River on the Goč Mt., the Rača and Derventa rivers flowing from the Tara Mt. into the Drina, i.e. into the Perućac reservoir) or the Eurasian minnow *Phoxinus phoxinus* (in some streams crossing the Nova Varoš–Sjenica road). In contrast, the fish assemblage in large lowland rivers may consist of more than 60 species.

Figure 6 shows the number of data on the distribution of all native species in Serbia. Based on the relative frequency of records, it can be seen that there are less than 100 records for 56 species (62%), while there are less than 20 records for 34 species (38%), and less than 10 records for 18 species (20%). According to these data, 1/5 of the species can be considered rare species, while only for 8 species (9%) more than 500 records were observed and these species can be considered common species.

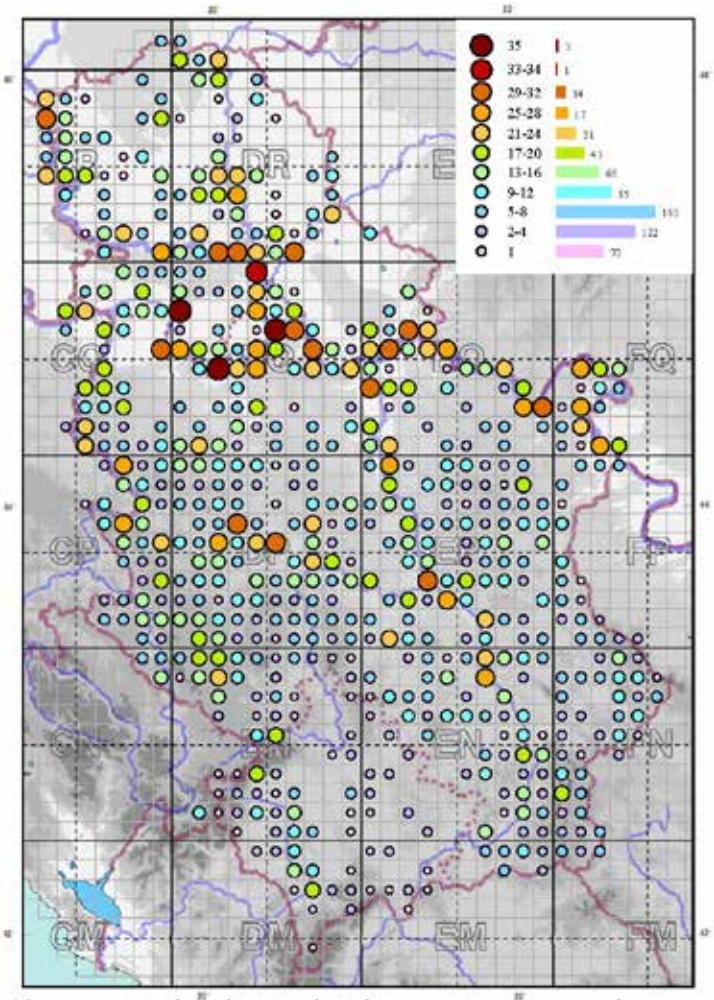
The analysis of diversity centres of the native fish species fauna of Serbia on the 10×10 km UTM grid showed that the diversity centres of this group (with 29–35 species each) are located in 18 UTM squares (Figure 7), mainly in the squares DQ, DR and EQ, in the Danube and Sava rivers, near Belgrade, Novi Sad and Šabac. The lowest fish diversity (with 1–8 species per square) was found in 348 UTM squares, which include small, less studied watercourses.

The analysis of the centres of diversity of threatened fish species on the 10×10 km UTM grid showed that there are 9 UTM squares in Serbia in which the presence of 9–11 threatened fish species was detected (Figure 8). The greatest diversity, with 11 species, was detected in three squares, one on the Danube, in the area of the National Park "Đerdap", and two in the watershed of the White Drim, in the region of Metohija. In two squares, 10 species were detected, one in the Sava River near Šabac and another also in the White Drim watershed, in the region of Metohija. The other 4 squares with high diversity and 9 species each also include the Danube (one at its entrance into Serbia near Apatin, one in the area of Belgrade and one at its exit from Serbia near Prahovo) and the White Drim watershed.



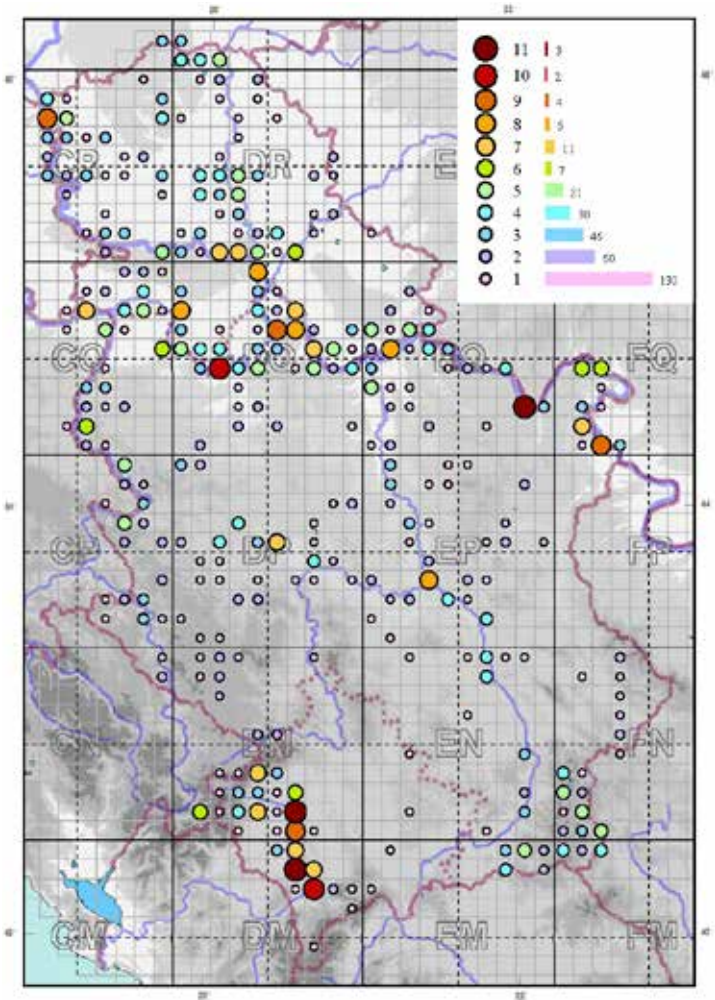
Slika 6. **Pregled autohtonih vrsta riba u Srbiji prema broju podataka o rasprostranjenju.**

Figure 6. **Overview of native fish species in Serbia according to the number of distributional data.**



Slika 7. **Broj autohtonih vrsta riba Srbije na UTM mreži 10×10 km. Boja i veličina kruga pokazuju broj vrsta riba po UTM polju (legenda – levo), a boja i dužina pravougaonika broj UTM polja sa odgovarajućim brojem vrsta (legenda – desno).**

Figure 7. **The number of native fish species in Serbia on the 10×10 km UTM grid. The colour and size of the circle show the number of fish species per UTM field (legend – left), and colour and length of the rectangle show the number of UTM fields with the corresponding number of species (legend – right).**



Slika 8. **Broj ugroženih vrsta riba Srbije na UTM mreži 10×10 km. Boja i veličina kruga pokazuju broj vrsta riba po UTM polju (legenda – levo), a boja i dužina pravougaonika broj UTM polja sa odgovarajućim brojem vrsta (legenda – desno).**

Figure 8. **The number of threatened fish species in Serbia on the 10×10 km UTM grid. The colour and size of the circle show the number of fish species per UTM field (legend – left), and colour and length of the rectangle show the number of UTM fields with the corresponding number of species (legend – right).**

2.2. Crnomorski sliv

Od tri sliva koja postoje u Srbiji (crnomorski, jadranski i egejski), najveću površinu zauzima crnomorski sliv, tj. sliv Dunava (oko 92% teritorije). Osim značaja po raznovrsnosti ihtiofaune, Dunav je i važan prirodni resurs Evrope sa aspekta vodosnabdevanja, transporta, turizma, ribarstva, industrije, poljoprivrede itd. Usled ljudskog delovanja, današnje stanje reka dunavskog sliva značajno se razlikuje od nekadašnjeg, pre svega u smislu izmena hidroloških i hidrografskih karakteristika. Krupni zahvati na rekama, kao što su izgradnja brana, isušivanje ritskih i močvarnih područja, regulacije tokova i izgradnja veštačkih vodenih ekosistema, uticali su na odlike naselja riba (Hegediš, 2013; Simonović, 2019).

2.2. Black sea basin

Of the three basins that exist in Serbia (Black Sea, Adriatic Sea and Aegean Sea), the Black Sea basin, i.e. the Danube basin, occupies the largest area (about 92% of the territory). Besides its importance for the diversity of fish fauna, the Danube is also an important natural resource of Europe for water supply, transport, tourism, fishery, industry, agriculture, etc. Due to human activities, the present condition of the rivers in the Danube catchment differs considerably from that of the past, especially with regard to changes in hydrological and hydrographical characteristics. Large-scale interventions on rivers, such as the construction of dams, draining of wetlands and floodplains, flow regulation and construction of artificial aquatic ecosystems, have influenced the characteristics of fish habitats (Hegediš, 2013; Simonović, 2019).

Osnovne karakteristike ihtiofaune u ribolovnim vodama crnomorskog sliva jesu: dominacija ciprinidnih vrsta riba, nizak nivo endemizma (odnosno originalnosti ihtiofaune), relativno visok nivo alohtonosti faune riba i značajan broj jesetarskih vrsta (koje su nažalost kritično ugrožene, a jedina od šest vrsta koja se još uvek može naći u našim vodama uzvodno od đerdapskih brana jeste kečiga).

Ponto-kaspijski biogeografski region, kome pripada i crnomorski, odnosno dunavski sliv, predstavlja drugi najbogatiji region u pogledu raznovrsnosti riba u Evropi (~100 vrsta), posle centralno-perimediteranskog regiona (~110 vrsta riba) (Reyjol *et al.*, 2007). Odlikuje se dominacijom vrsta iz porodice šaranki (Cyprinidae/Leuciscidae). U poslednjih četrdeset godina (naročito nakon izgradnje HE „Đerdap" I i II), stanje ihtiofaune dunavskog sliva značajno se menja (Janković & Krpo-Ćetković, 1995; Simonović, 2001).

2.2.1. Dunav

Dunav u Srbiju ulazi kod mesta Bezdan (sa protokom od 2.413 m^3/s), a izlazi kod ušća reke Timok (sa protokom od 5.840 m^3/s). Ukupna dužina toka kroz Srbiju, uključujući i pogranični tok sa Hrvatskom (gornji deo) i Rumunijom (donji deo), iznosi 588 km (od 1.433 rkm do 845 rkm). Najveće desne pritoke Dunava jesu Sava (sa Drinom, Bosutom i Kolubarom), zatim Velika Morava, Mlava, Pek i Timok. Velike leve pritoke jesu Tisa, Tamiš, Karaš i Nera. Ne računajući Kazan u Đerdapskoj klisuri, gde je izmerena najveća rečna dubina u Evropi od 87 m, Dunav ima najveću dubinu od 27 m kod Dalja i Bogojeva. Izgradnjom brane HE „Đerdap I" 1972. godine, stvoreno je veštačko jezero dugo oko 140 km, čime su potopljena mnoga naselja u Đerdapskoj klisuri. Uspor Dunava usled pregrađivanja u Đerdapu oseća se uzvodno sve do Rama (po nekima, čak do Beograda, pa i ušća Tise), što se prenosi i na donje tokove njegovih velikih pritoka (Simonović, 2001).

U Srbiji, Dunav je tipična nizijska reka sa aluvijalnim zonama i velikim plavnim područjima (Slika 9). Međutim, s obzirom da je u velikoj meri pod antropogenim uticajem, smatra se značajno izmenjenim vodnim telom. Regulacija vodotoka izgradnjom hidroelektrana prekinula je migratorne puteve riba, narušena je celovitost ekosistema, česte su oscilacije vodostaja, a nestala su i brojna staništa zbog sedimentacije veće količine vučenog nanosa i promenjenih fizičko-hemijskih svojstava reke. Očigledno je da su hidromorfološke promene činilac koji najviše utiče na promene u strukturi naselja riba (Schiemer *et al.*, 2004; Simonović *et al.*, 2019).

Izvori zagađenja su brojni i uključuju gradske i industrijske otpadne vode, koje posebno štete tokom letnjih meseci kada svako veće izlivanje uzrokuje povećanje mikrobiološke razgradnje i time dodatno smanjuje količinu kiseonika, što uzrokuje pomor riba. Poljoprivredna proizvodnja i spiranje pesticida sa okolnog zemljišta izazivaju negativne efekte. Veoma izražen problem jeste i eksploatacija peska i šljunka jer uzrokuje gubitak staništa za mnoge vrste riba. Prelov i krivolov, kao i neadekvatno upravljanje vodama i nedostatak finansijskih sredstava za organizovanje odgovarajućih ribočuvarskih službi, doveli su do pada brojnosti populacija ribolovno značajnih vrsta slatkovodnih riba.

The basic characteristics of the fish fauna in the fishing waters of the Black Sea basin are: the dominance of cyprinid species, a low degree of endemism (i.e. the originality of the fish fauna), a relatively high degree of allochthonism of the fish fauna and a considerable number of sturgeon species (which are unfortunately critically endangered, and the only one of the six species still present in our waters upstream of the Đerdap dams is the sterlet).

The Ponto-Caspian biogeographical region, which includes the Black Sea and the Danube basin, is the second richest region in Europe in terms of fish diversity (~100 species) after the Central peri-Mediterranean region (~110 fish species) (Reyjol *et al.*, 2007). It is characterised by the dominance of species from the carp family (Cyprinidae/Leuciscidae). In the last forty years (especially after the construction of the hydroelectric power plants "Đerdap" I and II), the state of the fish fauna of the Danube catchment has changed considerably (Janković & Krpo-Ćetković, 1995; Simonović, 2001).

2.2.1. Danube

The Danube enters Serbia at Bezdan (with a flow rate of 2,413 m^3/s) and exits at the mouth of the River Timok (with a flow rate of 5,840 m^3/s). The total length of the Danube in Serbia, including the border flow with Croatia (upper part) and Romania (lower part), is 588 km (from rkm 1,433 to rkm 845). The largest right tributaries of the Danube are the Sava (with Drina, Bosut and Kolubara), Great Morava, Mlava, Pek and Timok. The major left tributaries are the Tisza, Tamiš, Karaš and Nera. Apart from Kazan in the Đerdap Gorge, where the greatest river depth in Europe was measured at 87 m, the Danube has the greatest depth of 27 m at Dalj and Bogojevo. The construction of the dam "Đerdap I" in 1972 created an artificial lake about 140 km long, which flooded many settlements in the Đerdap Gorge. The slowing down of the Danube due to the dam in Đerdap is noticeable upstream to Ram (according to some, even as far as Belgrade and even the mouth of the Tisza) and is also transferred to the lower reaches of the major tributaries (Simonović, 2001).

In Serbia, the Danube is a typical lowland river with alluvial zones and large floodplains (Figure 9). However, as it is largely under anthropogenic influence, it is considered a heavily modified waterbody. Regulation of streamflow through the construction of hydroelectric dams has disrupted fish migration routes, the integrity of the ecosystem has been compromised, there are frequent water level fluctuations, and many habitats have disappeared due to the deposition of large amounts of bed load and the altered physical and chemical characteristics of the river. It is obvious that hydromorphological changes have the greatest influence on the changes in fish habitat structure (Schiemer *et al.*, 2004; Simonović *et al.*, 2019).

Sources of pollution are numerous and include municipal and industrial effluents, which are especially harmful during the summer months when any major pollution leads to an increase in microbiological decomposition, further reducing oxygen levels and causing fish kills. Agricultural production and leaching of pesticides from surrounding soils also have negative impacts. A very pronounced problem is the exploitation of sand and gravel because it results in the loss of habitat for many fish species. Overfishing and poaching, as well as inadequate water management and the lack of financial resources to organise proper fisheries services, have led to a decline in the populations of freshwater fish species important for fisheries.

Dunav naseljavaju uglavnom ribe nizijskih voda, a preovladavaju šaranke. Na području Dunava u Srbiji mogu se naći i endemične vrste dunavskog sliva: *Alburnus sava*, *Cobitis elongata*, *Eudontomyzon danfordi*, *E. vladykovi*, *Gymnocephalus schraetser*, *Hucho hucho*, *Romanogobio uranoscopus*, *R. vladykovi*, *Rutilus virgo*, *Sabanejewia bulgarica* i *S. romanica*. Subendemiti ovog basena, koji se još mogu naći i u slivu Dnjestra, jesu: *Umbra krameri*, *Zingel streber* i *Z. zingel*.

Jesetarske vrste (sim, pastruga, moruna, ruska jesetra) i crnomorske haringe, kao migratorne vrste, zbog nepostojanja prolaza za ribe, prestale su da redovno posećuju delove Dunava i njegovih većih pritoka uzvodno od druge đerdapske brane. Njihova pojava u uzvodnom delu Dunava jeste samo slučajnost koja se desi kada sa brodovima u prevodnicama prođu uzvodno (Schiemer *et al*., 2004).

The Danube is mainly populated by fish from lowland waters, with cyprinids predominating. In the course of the Danube in Serbia, endemic species of the Danube basin are also found: *Alburnus sava*, *Cobitis elongata*, *Eudontomyzon danfordi*, *E. vladykovi*, *Gymnocephalus schraetser*, *Hucho hucho*, *Romanogobio uranoscopus*, *R. vladykovi*, *Rutilus virgo*, *Sabanejewia bulgarica* and *S. romanica*. The subendemic species of this basin, which also occur in the Dniester basin, are: *Umbra krameri*, *Zingel streber* and *Z. zingel*.

Sturgeon species (ship sturgeon, starry sturgeon, beluga, Russian sturgeon) and Black Sea shads, which are migratory species, have stopped regularly visiting parts of the Danube and its larger tributaries upstream of the second Đerdap dam due to the lack of fish passage. Their occurrence in the upstream part of the Danube is only incidental when they follow the ships upstream through the locks (Schiemer *et al*., 2004).

Slika 9. Dunav u Srbiji: (a) Dunav kod Novog Sada i Petrovaradina; (b) Dunav kod Beograda; (c) Dunav, jezero Đerdap II; (d) Dunav nizvodno od brane „Đerdap II" (foto: A. Hegediš).

Figure 9. Danube in Serbia: (a) Danube near Novi Sad and Petrovaradin; (b) Danube near Belgrade; (c) Danube, Lake Đerdap II; (d) Danube downstream from the "Đerdap II" dam (photo: A. Hegediš).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u samom toku Dunava:

- regionalno iščezle vrste (RE): *Acipenser sturio*
- kritično ugrožene vrste (CR): *Acipenser gueldenstaedtii*, *Acipenser stellatus*, *Acipenser nudiventris*, *Alosa immaculata*, *Anguilla anguilla*, *Huso huso*
- ugrožene vrste (EN): *Acipenser ruthenus*
- ranjive vrste (VU): *Alburnus sava*, *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- gotovo ugrožene vrste (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Eudontomyzon mariae*, *Gymnocephalus baloni*, *Romanogobio uranoscopus*
- vrste sa nedovoljno podataka o ugroženosti (DD): *Alosa tanaica*

Species classified according to the category of threat present in the Danube itself:

- regionally extinct species (RE): *Acipenser sturio*
- critically endangered species (CR): *Acipenser gueldenstaedtii*, *Acipenser stellatus*, *Acipenser nudiventris*, *Alosa immaculata*, *Anguilla anguilla*, *Huso huso*
- endangered species (EN): *Acipenser ruthenus*
- vulnerable species (VU): *Alburnus sava*, *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- near threatened species (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Eudontomyzon mariae*, *Gymnocephalus baloni*, *Romanogobio uranoscopus*
- data deficient species (DD): *Alosa tanaica*

2.2.2. Sava

Najveća desna pritoka Dunava jeste Sava, sa 206 km toka kroz Srbiju i prosečnim protokom na ušću od 1.700 m^3/s. Sava u Srbiji ima karakteristike nizijske reke: tok je relativno usporen u poređenju sa uzvodnim delovima, meandrira i stvara poplavna područja, korito je široko, formira mrtvaje, rukavce i kanale. Sava, kao i Dunav, predstavlja u značajnoj meri izmenjeno vodno telo. Naselje riba Save u ovom delu toka ima karakter potamona (zajednica mirnih sporotekućih voda) (Slika 10), ali sa značajnom interakcijom sa uzvodnim elementima koji pripadaju ritronu (zajednica brzotekućih voda). Najveća biomasa i produkcija u Savi upravo se javljaju u donjem delu toka gde ima poplavnih zona i rukavaca pogodnih za mrest.

Voda reke Save deli sudbinu većine velikih reka, te su najistaknutiji faktori ugrožavanja za riblji fond: modifikacija korita, izgradnja brana, separacija i vađenje šljunka i peska (što uzrokuje promene i nestanak staništa), zagađenje komunalnim i industrijskim otpadnim vodama (neki industrijski objekti uz Savu koriste vodu za hlađenje postrojenja a vraćaju zagrejanu vodu u reku), zagađenja slivanjem sa poljoprivrednih površina, prelov (Mrakovčić *et al*., 2006; Hegediš *et al*., 2013; Simonović *et al*., 2019).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Savi:

- kritično ugrožene vrste (CR): *Anguilla anguilla*
- ugrožene vrste (EN): *Acipenser ruthenus*, *Hucho hucho*
- ranjive vrste (VU): *Alburnus sava*, *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- gotovo ugrožene vrste (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Eudontomyzon mariae*, *Eudontomyzon vladykovi*, *Gymnocephalus baloni*

2.2.2. Sava

The largest right tributary of the Danube is the Sava, which flows through Serbia for 206 km and has an average flow rate of 1,700 m^3/s at its mouth. The Sava in Serbia has the characteristics of a lowland river: the flow is relatively slow compared to the upstream parts, it meanders and creates floodplains, the bed is wide and it forms oxbows, backwaters and channels. Like the Danube, the Sava is a highly modified waterbody. The fish assemblage of the Sava in this part of the river belongs to the potamon zone (a community of slow-flowing waters) (Figure 10), but with significant interaction with upstream elements belonging to the rhithron zone (a community of fast-flowing waters). The highest biomass and production in the Sava occur in the lower part of the river, where there are flood zones and backwater areas suitable for spawning.

The Sava shares the fate of most large rivers and the main factors threatening the fish assemblage are: alteration of the riverbed, construction of dams, separation and extraction of gravel and sand (which leads to habitat alterations and loss), pollution from municipal and industrial wastewater (some industrial plants along the Sava use water to cool equipment and return the heated water into the river), pollution from agricultural runoff, overfishing (Mrakovčić *et al*., 2006; Hegedis *et al*., 2013; Simonović *et al*., 2019).

Species classified according to the category of threat present in the Sava:

- critically endangered species (CR): *Anguilla anguilla*
- endangered species (EN): *Acipenser ruthenus*, *Hucho hucho*
- vulnerable species (VU): *Alburnus sava*, *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- near threatened species (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Eudontomyzon mariae*, *Eudontomyzon vladykovi*, *Gymnocephalus baloni*

Slika 10. Sava u Srbiji: (a) Sava kod Jamene; (b) Sava kod Šapca; (c) Sava kod Umke; (d) Sava kod Beograda (foto: A. Hegediš).

Figure 10. Sava in Serbia: (a) Sava near Jamena; (b) Sava near Šabac; (c) Sava near Umka; (d) Sava near Belgrade (photo: A. Hegediš).

2.2.3. Drina

Reka Drina, najveća pritoka Save, dužine 346 km, pokriva slivno područje od 20.000 km² koje obuhvata severni deo Crne Gore, istočni deo Bosne i Hercegovine, kao i jugozapadnu i zapadnu Srbiju (deo toka kroz Srbiju dug je 220 km). Granična je reka, tako da samo desna obala toka pripada Srbiji. Spada u reke sa kišno-snežnim režimom. Gornji tok je karakterističan po karstnom terenu i dubokom i uskom krečnjačkom kanjonu. Gornji i srednji tok pripadaju ritronskoj zajednici (dominacija salmonidnih vrsta). U delu toka kod Bajine Bašte, Drina predstavlja brdsko-planinsku reku sa šljunkovito-kamenitim dnom i ima hiporitronski karakter, dok donji tok ima karakteristike potamona (ravničarskih reka sa meandrima, mrtvajama, promenama korita i dominacijom ciprinidnih vrsta) (Slika 11). Prosečni protok na ušću Drine u Savu iznosi 400 m³/s. Drina je značajno izmenjeno vodno telo. Izgradnjom hidroelektrane „Bajina Bašta" – Perućac značajno su promenjene karakteristike reke. Akumulacija HE „Bajina Bašta" – Perućac duga je 52 km, a na teritoriji Nacionalnog parka „Tara" nalazi se u dužini od 24,5 km. Od šestog kilometra akumulacije uzvodno od brane počinje kanjon u kome se širina akumulacije sužava na 80–100 m, sa veoma strmim, kamenitim obalama i izrazitom dubinom vode. U svom donjem delu neposredno u pribranskom sektoru, širina akumulacije iznosi i do

2.2.3. Drina

The Drina, the largest tributary of the Sava with a length of 346 km, has a catchment area of 20,000 km², which includes the northern part of Montenegro, the eastern part of Bosnia and Herzegovina, and the southwest and west of Serbia (the part of the river that flows through Serbia is 220 km long). Being a border river, only the right bank of the river belongs to Serbia. It is a rain-snow regime type river. The upper course is characterised by karst terrain and a deep and narrow limestone gorge. The upper and middle reaches belong to the rhithron zone (dominance of salmonid species). In the section near Bajina Bašta, the Drina is a hilly-mountain river with a gravelly-rocky bed and belongs to the hyporhithron zone, while the lower course has the characteristics of the potamon zone (lowland rivers with meanders, oxbows, bed fluctuations and the dominance of cyprinid species) (Figure 11). The average flow rate at the confluence of the Drina and Sava is 400 m³/s. The Drina is a significantly modified waterbody. The construction of the hydroelectric power plant "Bajina Bašta" – Perućac has significantly changed the characteristics of the river. The reservoir of the hydroelectric power plant "Bajina Bašta" – Perućac is 52 km long and for a length of 24.5 km it is located in the territory of the National Park "Tara". From the sixth kilometre of the reservoir upstream of the dam, a gorge begins where the width of the reservoir narrows to 80-100 m, with very steep, rocky banks and a considerable depth of water. In its lower part, in the immediate vicinity of the dam,

1,8 km. Tu su obale blagog nagiba sa dosta drveća i predstavljaju mesto za odlaganje ikre nekih vrsta riba. Temperatura vode značajno varira i kreće se od 0,5 °C do 26 °C (Hegediš, 2013).

Najizraženiji ugrožavajući faktor na Drini predstavlja brana, odnosno hidroelektrana, koja osim što je hidrološki izmenila izgled reke i staništa i sprečila migracije riba, utiče i na velike i nagle oscilacije vodostaja. Različiti vidovi zagađenja na Drini utiču na ribljи fond: komunalne otpadne vode, deponije uz reku, industrijske otpadne vode, kavezni ribnjaci, vikend kućice, seoska domaćinstva (Hegediš *et al*., 2008; Hegediš, 2013).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Drini:

- kritično ugrožene vrste (CR): *Anguilla anguilla*
- ugrožene vrste (EN): *Acipenser ruthenus*, *Hucho hucho*, *Thymallus thymallus*
- ranjive vrste (VU): *Alburnus sava*, *Carassius carassius*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- gotovo ugrožene vrste (NT): *Esox lucius*

the reservoir is up to 1.8 km wide. Here, the banks are gently sloping and covered with many trees, where some fish species deposit their eggs. The water temperature varies greatly and ranges from 0.5 °C to 26 °C (Hegediš, 2013).

The biggest threat factor on the Drina is the dam, i.e. the hydroelectric power plant, which not only hydrologically alters the appearance of the river and its habitats and prevents fish migration, but also causes large and sudden fluctuations of the water level. Various types of pollution in the Drina affect the fish stock: municipal sewage, landfills along the river, industrial wastewater, cage ponds, weekend homes, rural households (Hegediš *et al*., 2008; Hegediš, 2013).

Species classified according to the category of threat present in the Drina:

- critically endangered species (CR): *Anguilla anguilla*
- endangered species (EN): *Acipenser ruthenus*, *Hucho hucho*, *Thymallus thymallus*
- vulnerable species (VU): *Alburnus sava*, *Carassius carassius*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- near threatened species (NT): *Esox lucius*

Slika 11. Drina u Srbiji: (a) Drina, nizvodno od brane u Perućcu; (b) Drina kod Ljubovije; (c) Drina, nizvodno od Malog Zvornika; (d) Drina kod Loznice (foto: A. Hegediš).

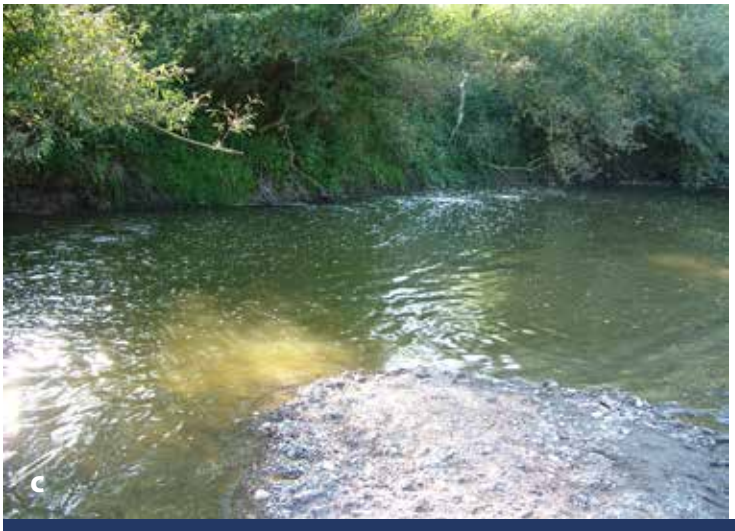
Figure 11. Drina in Serbia: (a) Drina, downstream of the dam in Perućac; (b) Drina near Ljubovija; (c) Drina, downstream from Mali Zvornik; (d) Drina near Loznica (photo: A. Hegediš).

2.2.4. Kolubara

Reka Kolubara (dužine 123 km) je desna pritoka Save koja se nalazi u severozapadnom delu centralne Srbije. Sliv Kolubare pokriva površinu od 3.641 km². U slivu preovlađuje nizija, dok se niske (do 1.000 m) i srednje visoke planine (do 1.500 m) nalaze samo u izvorišnom delu sliva. Bitnu odliku njenog vodnog režima predstavljaju nagla i velika kolebanja vodostaja i proticaja, a pripada rekama sa kišno-snežnim režimom. Glavni vodoprivredni problemi u slivu Kolubare jesu vodosnadbevanje naselja i industrije, zaštita od poplava, zaštita od erozije i bujica. Da bi se smanjile posledice poplava u dolini Kolubare, obavljeni su veliki hidromelioracioni radovi nizvodno od ušća reke Ljig, zbog čega Kolubara predstavlja značajno izmenjeno vodno telo. Gornji tok Kolubare ima elemente ritronske zajednice, dok veći deo toka pripada velikim rekama sa dominacijom srednjeg nanosa, sa karakterističnom zajednicom potamona (Simonović *et al.*, 2019) (Slika 12).

2.2.4. Kolubara

The Kolubara (123 km long) is a right tributary of the Sava in the northwestern part of central Serbia. The Kolubara catchment covers an area of 3,641 km². The basin is dominated by lowlands, while low (up to 1,000 m) and medium-high mountains (up to 1,500 m) are found only in the headwaters of the basin. Sudden and sharp fluctuations in water level and discharge are an important feature of its hydrology, and it is one of the rivers with a rain-snow regime. The most important water management problems in the Kolubara catchment area are water supply to settlements and industry, protection against floods, protection against erosion and flash floods. In order to reduce the consequences of flooding in the Kolubara valley, major hydromelioration works have been carried out downstream of the mouth of the Ljig, which is why the Kolubara is a significantly modified watercourse. The upper course of the Kolubara has elements of the rhithron zone, while the rest of the river course belongs to the large river type, with a dominance of medium riverbed deposits, and has the characteristics of the potamon zone (Simonović *et al.*, 2019) (Figure 12).



Slika 12. Kolubara u Srbiji: (a) Kolubara nizvodno od Valjeva; (b) Kolubara kod Velikih Crljena; (c) Kolubara uzvodno od Lajkovca; (d) Kolubara uzvodno od Obrenovca (foto: A. Hegediš).

Figure 12. Kolubara in Serbia: (a) Kolubara downstream from Valjevo; (b) Kolubara near Veliki Crljeni; (c) Kolubara upstream from Lajkovac; (d) Kolubara upstream from Obrenovac (photo: A. Hegediš).

Slika 13. Jezero u koritu Kolubare: (a) satelitski snimak jezera iz aprila 2020. godine (Google Earth); (b) fotografija jezera iz oktobra 2008. godine (foto: A. Hegediš).

Figure 13. Lake in the Kolubara Basin: (a) satellite image of the lake from April 2020 (Google Earth); (b) photo of the lake from October 2008 (photo: A. Hegediš).

Najveći problem na reci Kolubari koji utiče na riblji fond jeste pre svega izuzetno zagađenje (komunalno i industrijsko). Modifikacije rečnog korita i hidrotehnički radovi takođe nepovoljno utiču na stanište riba (Slika 13).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Kolubari:

- ranjive vrste (VU): *Misgurnus fossilis*, *Zingel streber*, *Zingel zingel*
- gotovo ugrožene vrste (NT): *Esox lucius*

Krajem 2008. godine završeno je formiranje „jezera" površine oko 15 ha, u koritu Kolubare kod Velikih Crljena. Jezero je formirano kao rezerva vode za potrebe rudnika uglja. Lokalni ribolovci prihvatili su ideju, kako se tada govorilo, „industrijskog turizma", sa planovima za lokalno izletište sa kupalištem. Međutim, 12 godina kasnije, neodržavano „jezero" je zasuto u velikoj meri, obraslo makrofitskom vegetacijom i nepristupačno (ribolovaca praktično nema), a na satelitskom snimku se vidi da je postalo i recipijent otpadnih voda. Primarno rečno stanište u dužini od oko 500 m je nestalo, a za samo desetak godina formirano je nešto što je teško svrstati u bilo koju kategoriju veštačkih vodenih staništa. Dalja sudbina ovog projekta je neizvesna.

2.2.5. Velika Morava

Velika Morava je desna pritoka Dunava i najveća reka koja čitavim tokom teče kroz Srbiju. Nastaje spajanjem Južne i Zapadne Morave kod Stalaća. Sliv Velike Morave pokriva površinu od 37.561 km² i objedinjuje brdsko-planinsku regiju srednje, zapadne, južne i jugoistočne Srbije i nadmorske visine koje se kreću između 67 m i 2.400 m. Dužina Velike Morave je 185 km, Zapadne Morave 308 km i Južne

Extreme pollution (municipal and industrial) is the biggest problem on the Kolubara River affecting the fish stock. Changes in the riverbed and hydrotechnical works also affect the fish habitat (Figure 13).

Species classified according to the category of threat present in the Kolubara:

- vulnerable species (VU): *Misgurnus fossilis*, *Zingel streber*, *Zingel zingel*
- near threatened species (NT): *Esox lucius*

At the end of 2008, the creation of a "lake" with an area of about 15 ha in the riverbed of the Kolubara near Veliki Crljeni was completed. The lake was created as a water reserve for the needs of a coal mine. Local fishers welcomed the idea of so-called "industrial tourism" with plans for a local resort with a swimming pool. Twelve years later, however, the neglected "lake" is largely filled in, overgrown with macrophytes and inaccessible (there are practically no fishers), and the satellite image shows that it has also become a sewage collector. The river's original habitat has disappeared over a length of about 500 m, and in just ten years an object has been created that is difficult to place in any category of artificial aquatic habitats. The future fate of this project is uncertain.

2.2.5. Great Morava

The Great Morava is the right tributary of the Danube and the largest river flowing through Serbia in its entire course. It is formed by the confluence of the South and West Morava rivers at Stalać. The catchment area of the Great Morava covers an area of 37,561 km² and includes the hilly-mountainous regions of central, western, southern and southeastern Serbia with altitudes ranging from 67 to 2,400 metres. The length of the Great Morava is 185 km, the West Morava 308 km and the

Morave 295 km. Južna Morava je nekada bila duža od Zapadne, međutim, usled melioracije i regulacije, danas je znatno kraća. Velika Morava je značajno izmenjeno vodno telo. Tipična je nizijska reka koja protiče kroz dolinu centralne Srbije i okružena je poljoprivrednim zemljištem. Prosečni protok je 255 m^3/s. U gornjem delu toka dominira krupan supstrat (krupan šljunak, kamenje), dok nizvodno dominira sitan šljunak, pesak, mulj, glina (Slika 14).

Veći deo Velike Morave protiče kroz poljoprivredne površine a na samoj reci nalaze se i neki od većih gradova u Srbiji. Zbog toga, najizraženije negativne faktore za ihtiofaunu reke upravo predstavljaju: zagađenje (komunalno, industrijsko, poljoprivredno), regulacija toka i rečnog korita, kao i ribnjaci (kako zbog zagađenja, tako i zbog imigranata koji su najčešće alohtone vrste) (Hegediš *et al.*, 2019a).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Velikoj Moravi:

South Morava 295 km. The South Morava used to be longer than the West Morava, but is now much shorter due to land reclamation and regulation. The Great Morava is a highly modified waterbody. It is a typical lowland river flowing through a valley in central Serbia surrounded by agricultural land. The average flow rate is 255 m^3/s. The upper part of the river is dominated by coarse substrate (coarse gravel, stones), while downstream fine gravel, sand, silt and clay predominate (Figure 14).

Most of the Great Morava flows through agricultural areas, and some of the largest cities in Serbia are located on its river banks. The most obvious negative factors for the river's fish fauna are therefore: pollution (municipal, industrial, agricultural), regulation of the flow and riverbed, and fish ponds (both due to pollution and the presence of immigrant species, most of which are non-native) (Hegediš *et al.*, 2019a).

Species classified according to the category of threat present in the Great Morava:

Slika 14. Velika Morava u Srbiji: (a) Velika Morava kod Bagrdana; (b) Velika Morava kod Žabarskog mosta; (c) Velika Morava kod Ljubičevskog mosta; (d) Velika Morava kod Brežana (foto: A. Hegediš).

Figure 14. Great Morava in Serbia: (a) Great Morava near Bagrdan; (b) Great Morava near the Žabar bridge; (c) Great Morava near the Ljubičevo bridge; (d) Great Morava near Brežan (photo: A. Hegediš).

- ranjive vrste (VU): *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- gotovo ugrožene vrste (NT): *Esox lucius*

2.2.6. Tisa

Reka Tisa je najveća leva pritoka Dunava, duga 966 km, sa protokom na ušću od 820 m³/s. U Srbiju ulazi iz Mađarske, a dužina toka kroz Srbiju iznosi 168 km. Tisa je bila poznata po izuzetnom bogatstvu ribom. Na svom delu toka kroz Srbiju tipična je nizijska reka (Slika 15). Smatra se značajno izmenjenim vodnim telom. Protiče kroz poljoprivredne i urbane zone, a između rečnog korita i odbrambenog nasipa, na mnogim delovima prostiru se plavne šume ili plantažne šume. Tisa je poznata po poplavnim talasima. Osim što je tok regulisan izgradnjom kanalske mreže Dunav-Tisa-Dunav, pre svega zbog zaštite od poplava, na Tisi su izgrađene i brane. Tisa u

- vulnerable species (VU): *Carassius carassius*, *Misgurnus fossilis*, *Tinca tinca*, *Zingel streber*, *Zingel zingel*
- near threatened species (NT): *Esox lucius*

2.2.6. Tisza

The Tisza is the largest left tributary of the Danube, 966 km long and has a discharge of 820 m³/s at its mouth. It flows from Hungary to Serbia and its course through Serbia is 168 km long. The Tisza was once known for its exceptional abundance of fish. In its course through Serbia, it is a typical lowland river (Figure 15). It is considered a heavily modified waterbody. It flows through agricultural and urban areas, and in many places there are floodplain or plantation forests between the riverbed and the protective levee. The Tisza is known for its flood waves. In addition to the regulation of the river through the construction of the Danube-Tisza-Danube canal network, which primarily serves flood

Slika 15. Tisa u Srbiji: (a) Tisa kod Adorjana (foto: A. Bajić); (b) Tisa kod Novog Bečeja (foto: A. Bajić); (c) Tisa kod Titela (ušće Begeja) (foto: A. Hegediš); (d) Tisa, oko 1 km uzvodno od ušća u Dunav (foto: A. Hegediš).

Figure 15. Tisza in Serbia: (a) Tisza near Adorjan (photo: A. Bajić); (b) Tisza near Novi Bečej (photo: A. Bajić); (c) Tisza near Titel (mouth of the Begej) (photo: A. Hegediš); (d) Tisza, about 1 km upstream from the mouth of the Danube (photo: A. Hegediš).

Srbiju već ulazi lošijeg kvaliteta, zatim se duž toka kvalitet popravlja, a onda do samog ušća u Dunav kvalitet ponovo opada, što se može videti i na osnovu naselja riba. Faktori koji utiču negativno na naselje riba u Tisi jesu: regulacija reke, kanalska mreža, izgradnja brana i akumulacija, unos i pojava alohtonih vrsta, zagađenje reke, porast temperature vode (Telcean & Bănărescu, 2002; Harka, 2006; Telcean & Cupşa, 2009b). Tisa je poznata i po akcidentnim izlivanjima različitih zagađivača koji povremeno utiču na pomor riba. U delu toka kroz Srbiju dominira sitan šljunak, pesak, mulj i glina, a naselje riba odgovara potamonu (Miljanović *et al*., 2016a).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Tisi:

- ugrožene vrste (EN): *Acipenser ruthenus*
- ranjive vrste (VU): *Carassius carassius*, *Misgurnus fossilis*, *Romanogobio vladykovi*, *Tinca tinca*
- gotovo ugrožene vrste (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Gymnocephalus baloni*

2.2.7. Tamiš

Tamiš izvire u severnim delovima rumunskih Karpata. Svojim tokom prolazi kroz ceo Banat i kod Pančeva se uliva u Dunav. Od ukupno 359 km toka, 118 km je u Srbiji. U Vojvodini sliv Tamiša pokriva 5.000 km². Tamiš je kod nas spora, ravničarska reka koja je tek u poslednjih 60 km plovna (Slika 16). Prosečan protok Tamiša iznosi oko 150 m³/s. Staro ušće Tamiša nalazilo se 40 km dalje od današnjeg. Kanal Karaš je jedino što je preostalo od starog tamiškog korita. Deo između Dunava, starog ušća Tamiša i današnjeg Tamiša poznat je kao Pančevački rit, i zahvata površinu od 400 km². Antropogene aktivnosti značajno su uticale i utiču na hidrološki režim i kvalitet vode i sedimenta Tamiša. Tamiš se smatra značajno izmenjenim vodnim telom. Postoje mnogi ribnjaci, a najveća ugroženost preti ribama od zagađenja sredstvima za zaštitu bilja i đubrivom, koji se spiraju sa površina zasađenih kulturama, kao i od zagađenja produktima prehrambene industrije. Osnovni izvori zagađenja Tamiša jesu: kanali za irigaciju koji se ne održavaju ispravno, kanalizacione otpadne vode, otpadne vode iz industrije minerala, stočne farme i ribnjaci (Teodorović, 2010). Podizanjem brana hidrolektrane „Đerdap" na Dunavu i uključenjem reke Tamiš u sistem kanala DTD 1978. godine, uništeno je njegovo prirodno bogatstvo. Usporen je tok, zagađenje je drastično povećano, a živi svet nepovratno osiromašen (Simonović *et al*., 2019). Tip naselja riba odgovara potamonu (ribe nizijskih ravničarskih voda) (Miljanović *et al*., 2016a).

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Tamišu:

- ugrožene vrste (EN): *Acipenser ruthenus*
- ranjive vrste (VU): *Carassius carassius*, *Misgurnus fossilis*, *Romanogobio vladykovi*, *Tinca tinca*
- gotovo ugrožene vrste (NT): *Esox lucius*, *Eudontomyzon danfordi*

control, dams have also been built on the Tisza. The Tisza reaches Serbia already in poorer quality, then the quality improves along the course of the river, only to decline again until the confluence with the Danube, which is also reflected in the fish assemblage. Factors that have a negative impact on the fish assemblage in the Tisza River are: river regulation, canal network, construction of dams and reservoirs, introduction and occurrence of alien species, river pollution, rise in water temperature (Telcean & Bănărescu, 2002; Harka, 2006; Telcean & Cupşa, 2009b). The Tisza is also known for accidental spills of various pollutants, which occasionally cause fish kills. In the part of the river flowing through Serbia, fine gravel, sand, silt and clay dominate, and the fish assemblage corresponds to the potamon zone (Miljanović *et al*., 2016a).

Species classified according to the category of threat present in the Tisza:

- endangered species (EN): *Acipenser ruthenus*
- vulnerable species (VU): *Carassius carassius*, *Misgurnus fossilis*, *Romanogobio vladykovi*, *Tinca tinca*
- near threatened species (NT): *Esox lucius*, *Eudontomyzon danfordi*, *Gymnocephalus baloni*

2.2.7. Tamiš

The Tamiš rises in the northern parts of the Romanian Carpathians. In its course it crosses the entire Banat region and flows into the Danube at Pančevo. Of the total 359 km of its course, 118 km are in Serbia. In Vojvodina, the catchment area of the Tamiš extends over 5,000 km². In our country, the Tamiš is a slow lowland river, navigable only on the last 60 km (Figure 16). The average discharge of the Tamiš is about 150 m³/s. The old mouth of the Tamiš was 40 km from the present one. All that is left of the old bed of the Tamiš is the Karaš channel. The part between the Danube, the old Tamiš mouth and today's Tamiš is known as Pančevački Rit, which covers an area of 400 km². Anthropogenic activities have significantly affected and continue to affect the hydrological regime and the quality of the water and sediments of the Tamiš. The Tamiš is considered a significantly modified waterbody. There are many fish ponds in the vicinity, and the main threat to fish comes from pollution from pesticides and fertilisers washed from the cultivated areas, as well as from pollution from food industry products. The main sources of pollution in Tamiš are: irrigation canals that are not properly maintained, sewage, wastewater from the mineral industry, livestock farms and fish ponds (Teodorović, 2010). With the construction of the dams of the hydroelectric power plant "Đerdap" on the Danube and the inclusion of the river Tamiš in the canal system DTD in 1978, its natural wealth was destroyed. The flow has slowed down, pollution has increased drastically, and the habitat has become irreversibly impoverished (Simonović *et al*., 2019). The type of fish habitat corresponds to the potamon zone (fishes of the lowland plain) (Miljanović *et al*., 2016a).

Species classified according to the category of threat present in the Tamiš:

- endangered species (EN): *Acipenser ruthenus*
- vulnerable species (VU): *Carassius carassius*, *Misgurnus fossilis*, *Romanogobio vladykovi*, *Tinca tinca*
- near threatened species (NT): *Esox lucius*, *Eudontomyzon danfordi*

Slika 16. Tamiš u Srbiji: (a) Tamiš kod Tomaševca (foto: Ž. Višnjić-Jeftić); (b) Tamiš kod Farkaždina (foto: A. Bajić); (c) Tamiš uzvodno od Sakula (foto: L. Galamboš); (d) Tamiš kod Pančeva (foto: A. Hegediš).

Figure 16. Tamiš in Serbia: (a) Tamiš near Tomaševac (photo: Ž. Višnjić-Jeftić); (b) Tamiš near Farkaždin (photo: A. Bajić); (c) Tamiš upstream from Sakule (photo: L. Galamboš); (d) Tamiš near Pančevo (photo: A. Hegediš).

2.2.8. Timok

Timok se nalazi u istočnoj Srbiji. Sastavljen je od više manjih reka sa istim imenom i različitim pridevom ispred imena (Crni Timok, Beli Timok, Svrljiški Timok, Trgoviški Timok). Od izvora (Svrljiškog Timoka) do ušća (Velikog Timoka) u Dunav dug je 202 km, a poslednjih 15 km predstavlja granicu Srbije i Bugarske (Slika 17). Ušće Timoka u Dunav nalazi se na nadmorskoj visini od 28 m, što predstavlja i najnižu tačku u Srbiji. Timok je reka koja ima bujičasti karakter sa protokom od 24 m^3/s, a može da dosegne i 40 m^3/s. Ima snežno-kišni vodni režim, što diktira nivo vodostaja i protok. Sliv Timoka izložen je delovanju erozije, a na površini sliva postoji 812 bujičnih tokova i veliki broj vododerina. Uzvodni delovi reke imaju karakteristike planinskih reka sa usecima i klisurama. Duž toka Crnog Timoka u jednom od njenih meandara nalazi se i Gamzi-

2.2.8. Timok

The Timok is located in eastern Serbia. It consists of several smaller rivers with the same name and different adjectives before the name (Crni Timok, Beli Timok, Svrljiški Timok, Trgoviški Timok). From its source (Svrljiški Timok) to its confluence with the Danube (Veliki Timok), it is 202 km long (Figure 17). The last 15 km form the border between Serbia and Bulgaria. The confluence of the Timok with the Danube is at an altitude of 28 m and is also the lowest point in Serbia. The Timok is a torrential river with a discharge of 24 m^3/s, which can even reach 40 m^3/s. It has a snow-rain water regime that determines the water level and flow. The Timok catchment is prone to erosion and there are 812 torrential streams and a large number of gullies in the catchment area. The upstream parts of the river have the characteristics of a mountain river with canyons and gorges. Along

gradska banja sa lekovitim izvorima čije su temperature između 26 °C i 42 °C i koji izbijaju u samom koritu Crnog Timoka. Vode sliva Timoka koriste se za navodnjavanje i snabdevanje industrije vodom. Na Velikom Timoku izgrađena je prva hidroelektrana u Jugoslaviji posle Drugog svetskog rata. Poslednjih decenija reka se znatno zagađuje otpadnim vodama poreklom iz industrijskih

the course of the Crni Timok, in one of its meanders, there is also the Gamzigradska Banja spa with curative springs whose temperature ranges from 26 °C to 42 °C, which rise directly from the Crni Timok riverbed. The water from the Timok catchment area is used for irrigation and industrial water supply. After the World War II, the first hydroelectric power plant in Yugoslavia was built on the Veliki

Slika 17. Timok u Srbiji: (a) Timok kod Rajca (https://www.rajackepivnice.com/reka-timok/); (b) Timok u blizini ušća u Dunav (http://1.bp.blogspot.com/-mzSriTcjdGM/To8O6Ej7TqI/AAAAAAAAAgw/BI1qJK9s920/s1600/usce%2Btimoka.JPG).

Figure 17. Timok in Serbia: (a) Timok near Rajac (https://www.rajackepivnice.com/reka-timok/); (b) Timok near its confluence with the Danube (http://1.bp.blogspot.com/-mzSriTcjdGM/To8O6Ej7TqI/AAAAAAAAAgw/BI1qJK9s920/s1600/usce%2Btimoka.JPG).

postrojenja duž sliva Timoka (Simić *et al.*, 2017a, 2017b). Najizraženiji negativni faktori koji se odražavaju na naselje riba sliva Timoka jesu komunalno i industrijsko zagađenje, regulacija vodotoka i ribolov.

Ihtiofauna Timoka ima elemente ritrona, a u donjim, najnizvodnijim delovima elemente hiporitrona sa elementima potamona (Marić *et al.*, 2003). Podlogu čine pesak i šljunak u nizvodnom delu toka, dok je u uzvodnim delovima krupniji supstrat.

Vrste klasifikovane prema kategoriji ugroženosti prisutne u Timoku:

- ranjive vrste (VU): *Misgurnus fossilis*
- gotovo ugrožene vrste (NT): *Eudontomyzon mariae*

2.3. Egejski sliv

Sliv Egejskog mora se na teritoriji Srbije prostire na oko 2.650 km², odnosno zahvata samo 3% površine. Obuhvata reke Pčinju, Dragovištica i Lepenac, ali samo gornje i/ili srednje delove tokova. Lepenac i Pčinja prelaze na teritoriju Severne Makedonije i ulivaju se u Vardar, a Dragovištica otiče ka Strumi u Bugarskoj. Vodni režimi ovih reka nisu uravnoteženi i oko 60% godišnjeg proticaja otekne u periodu od februara do maja, kao posledica otapanja snega. Najmanji proticaji beleže se u avgustu, što je karakteristično za oblasti u kojima preovlađuje mediteranski pluviometrijski režim (Gavrilović & Dukić, 2002).

Reka Pčinja nastaje spajanjem nekoliko potoka koji se spuštaju niz jugozapadne padine planine Dukat, u krajnjem jugoistočnom delu Srbije. U izvorišnom delu nosi naziv Crna reka, između naselja Radovnica i Trgovište naziv Tripušnica, a nizvodno od Trgovišta, posle spajanja sa Kozjedolskom rekom, počinje Pčinja. Ukupna dužina Pčinje je 135 km, od čega kroz Srbiju teče u dužini od 52 km (Gavrilović & Dukić, 2002). Čitavim tokom, rečno korito prekriveno je šljunkom i kamenjem. Vodotoci u slivu Pčinje nalaze se na nadmorskim visinama iznad 400 m, imaju širinu toka između 2 m i 15 m i dubinu vode od 30 cm do 100 cm (Slika 18). Sa aspekta naselja riba, tokovi u slivu Pčinje imaju ciprinidni karakter, a dominantna vrsta jeste potočna mrena (*Barbus balcanicus*).

Vrste riba koje naseljavaju reku Pčinju, prema stepenu ugroženosti mogu se svrstati u sledeće kategorije:

- ugrožene vrste (EN): *Alburnoides thessalicus*, *Chondrostoma vardarense*, *Oxynoemacheilus bureschi*
- ranjive vrste (VU): *Squalius vardarensis*

Dragovištica je desna pritoka Strume, koja se u Egejsko more uliva u Orfanskom zalivu. Nastaje od Božičke i Ljubatske reke, koje se sastaju kod Bosilegrada na 787 mnv. Duga je 63 km, od čega kroz Srbiju protiče oko 11 km. Hidrografsku mrežu sliva Dragovištice u Srbiji čini 166 stalnih i periodičnih vodotoka. Najveća pritoka je Brankovačka reka, koja je duga oko 25 km i u Dragovišticu se uliva s desne strane, neposredno pred granicu s Bugarskom. Prosečan godišnji proticaj na izlasku iz Srbije iznosi 5,6 m³/s i najveći je u aprilu, a najmanji u avgustu. Do izgradnje kanala Božica i pumpno-akumulacionog postrojenja Lisina, kojim se deo vode iz Božičke reke upumpava u Vlasinsko jezero (crnomorski sliv), Dragovištica je bila značajno bogatija vodom nego što je to danas slučaj (Gavrilović &

Timok. In recent decades, the river has been significantly polluted by wastewater from industrial plants in the Timok catchment (Simić *et al.*, 2017a, 2017b). The most pronounced negative factors affecting the fish fauna of the Timok catchment are municipal and industrial pollution, regulation of the river and fishing.

The fish fauna of the Timok has elements of the rhithron zone and in the lower, downstream parts, elements of the hyporhythron zone with some potamon elements (Marić *et al.*, 2003). The substrate consists of sand and gravel in the downstream part of the stream and a coarser substrate in the upstream parts.

Species classified according to the category of threat present in the Timok:

- vulnerable species (VU): *Misgurnus fossilis*
- near threatened species (NT): *Eudontomyzon mariae*

2.3. Aegean sea basin

The basin of the Aegean Sea in the territory of Serbia covers about 2,650 km², which is only 3% of the area. It includes the rivers Pčinja, Dragovištica and Lepenac, but only their upper and/or middle reaches. The Lepenac and the Pčinja flow into the territory of Northern Macedonia and empty into the Vardar, and the Dragovištica empties into the Struma in Bulgaria. The water regime of these rivers is not balanced and about 60% of the annual discharge is concentrated in the period from February to May as a result of snowmelt. The lowest discharges are recorded in August, which is characteristic for areas where the Mediterranean pluviometric regime prevails (Gavrilović & Dukić, 2002).

The Pčinja River is formed by the confluence of several streams that rise on the southwestern slopes of the Dukat Mt. in the far southeast Serbia. In its headwaters it is called Crna reka, between the settlements of Radovnica and Trgovište it is called Tripušnica, and downstream from Trgovište, after joining with the Kozjedolska River, the Pčinja begins. The total length of the Pčinja is 135 km, of which 52 km flow through Serbia (Gavrilović & Dukić, 2002). Throughout its course, the riverbed is covered with gravel and stones. The streams of the Pčinja catchment are located at altitudes above 400 m, with bed widths between 2 and 15 m, and water depths of 30 to 100 cm (Figure 18). As regards the fish assemblage, the streams in the Pčinja catchment have a cyprinid character, with the Danube barbel (*Barbus balcanicus*) being the dominant species.

Species classified according to the category of threat present in the Pčinja:

- endangered species (EN): *Alburnoides thessalicus*, *Chondrostoma vardarense*, *Oxynoemacheilus bureschi*
- vulnerable species (VU): *Squalius vardarensis*

The Dragovištica is the right tributary of the Struma, which flows into the Aegean Sea in the Strymonian Gulf. It rises from the Božička and Ljubatska rivers, which join near Bosilegrad at 787 m above sea level. It is 63 km long, of which about 11 km flow through Serbia. The hydrographic network of the Dragovištica catchment in Serbia consists of 166 permanent and periodic watercourses. The largest tributary is the Brankovačka River with a length of about 25 km long, which flows into the Dragovištica from the right, just before the border with Bulgaria. The average annual discharge at the exit from Serbia is 5.6 m³/s and is highest in April and lowest in August. Until the construction of the Božica Canal and the Lisina pumped-storage plant, which pumps part of the water from the Božica into Lake Vlasina (the Black Sea basin), the Dragovi-

Dukić, 2002). U slivu Dragovištice svi vodotoci se nalaze na nadmorskim visinama većim od 700 m, sa širinom toka između 1 m i 15 m, i dubinom vode od 30 cm do 100 cm. Dno ovih reka uglavnom je šljunkovito i kamenito. Ihtiofauna reka u slivu Dragovištice ima izrazito salmonidni karakter. Makedonska pastrmka je ili jedina vrsta riba u vodotoku ili jasno dominira u naselju riba.

Vrste riba koje naseljavaju reke sliva Dragovištice prema stepenu ugroženosti mogu se svrstati u sledeće kategorije:

- kritično ugrožene vrste (CR): *Alburnoides strymonicus*
- ugrožene vrste (EN): *Barbus strumicae*, *Gobio bulgaricus*, *Phoxinus strymonicus*, *Salmo macedonicus*

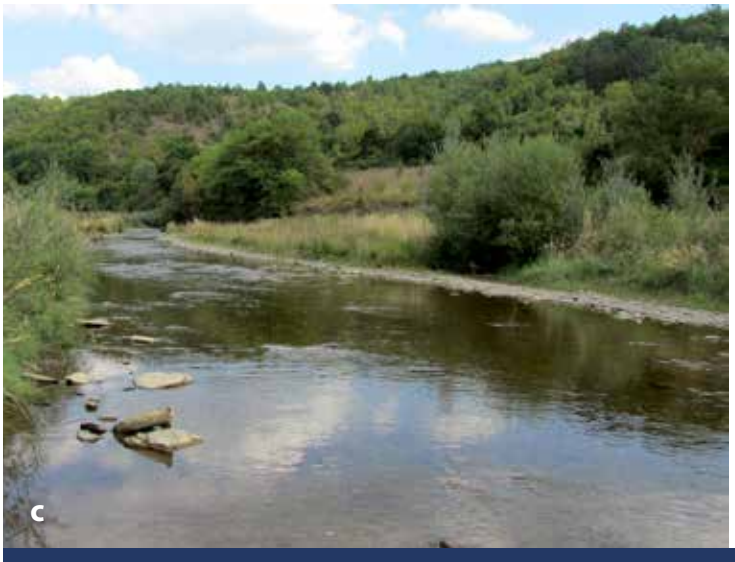
Vodotoci u slivovima Pčinje i Dragovištice značajno su izmenjeni pregrađivanjem i izgradnjom mini-hidroelektrana (MHE), što je jedan od osnovnih faktora ugrožavanja faune riba u njima.

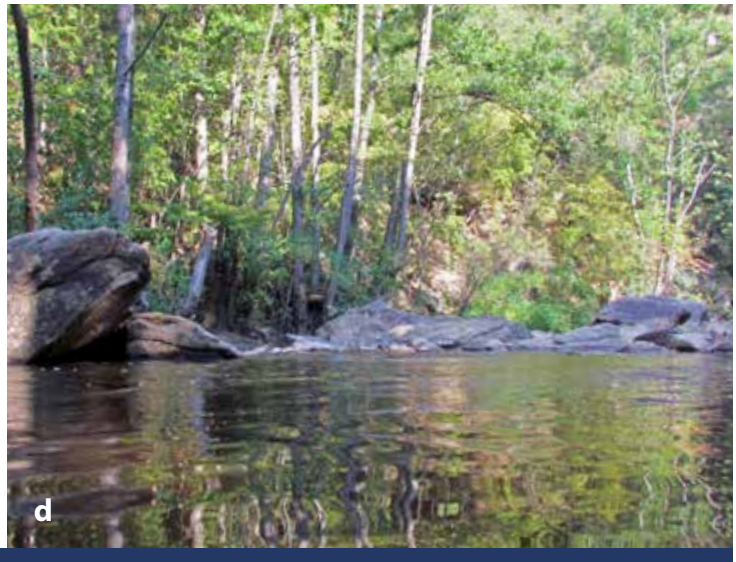
štica was much more water-rich than it is today (Gavrilović & Dukić, 2002). In the Dragovištica catchment area, all streams are located at altitudes above 700 m, with bed widths between 1 and 15 m and water depths between 30 and 100 cm. The bottom of these streams consists mostly of gravel and stones. The fish fauna in the Dragovištica catchment has a distinct salmonid character. The Macedonian trout is either the only fish species in the waterbody or it clearly dominates the fish assemblage.

Species classified according to the category of threat present in the Dragovištica:

- critically endangered species (CR): *Alburnoides strymonicus*
- endangered species (EN): *Barbus strumicae*, *Gobio bulgaricus*, *Phoxinus strymonicus*, *Salmo macedonicus*

Watercourses in the Pčinja and the Dragovištica catchments have been significantly modified by damming and construction of mi-





Slika 18. Vodotoci egejskog sliva u Srbiji: (a) Lisinska reka; (b) Dragovištica uzvodno od ušća Brankovačke reke; (c) Pčinja kod Novog Sela; (d) Pčinja kod Manastira Prohor Pčinjski (foto: A. Hegediš).

Figure 18. Watercourses of the Aegean Sea basin in Serbia: (a) Lisinska River; (b) Dragovištica upstream from the mouth of the Brankovačka River; (c) Pčinja near Novo Selo; (d) Pčinja near the Prohor Pčinjski Monastery (photo: A. Hegediš).

Lepenac izvire na severnoj strani Šar-planine, na 1.860 mnv. Spuštajući se niz padine Šar-planine, probija se kroz nekoliko klisura (Brodska i Kačanička) i teče kroz nekoliko kotlina (Sirinićka župa, Sopotnička kotlina). Kod mesta Đeneral Janković, Lepenac ulazi u Severnu Makedoniju i teče ka Skopskoj kotlini. U Vardar se uliva kod mesta Đorče Petrov na 253 mnv. Zbog velikog pada, Lepenac nosi znatne količine nanosa. Ukupna dužina toka Lepenca iznosi 75 km, od čega se na teritoriji Srbije nalazi 65 km. Najduža i vodom najbogatija pritoka jeste Nerodimka. Lepenac pripada rekama nivalno-pluvijalnog režima, što znači da najviše vode ima u maju i da ona potiče od topljenja snega, a najmanje u avgustu. Prosečan godišnji proticaj na izlazu iz naše zemlje iznosi 8,6 m^3/s (Gavrilović & Dukić, 2002). Ihtiofauna reke Lepenac ima izrazito salmonidni karakter i u delu koji protiče kroz Srbiju naseljava je samo jedna vrsta, makedonska pastrmka.

Vrste riba koje naseljavaju reke sliva Lepenca prema stepenu ugroženosti mogu se svrstati u sledeće kategorije:

- ugrožene vrste (EN): *Salmo macedonicus*

2.4. Jadranski sliv

Jadranski sliv se na teritoriji Srbije prostire na 4.500 km^2, odnosno zahvata 5% površine. Obuhvata Metohijsku kotlinu i njen planinski obod. Najviša kota sliva jeste vrh Đeravica (2.656 m) na Prokletijama, dok se najniža nalazi na izlazu Belog Drima u Albaniju (270 m). Prosečna nadmorska visina jadranskog sliva iznosi 820 m. Predstavljen je rekom Beli Drim sa pritokama – Pećka Bistrica, Dečanska Bistrica, Erenik (desne pritoke), Topluga, Prizrenska Bistrica, Istočka reka, Klina, Miruša i Plavska reka (leve pritoke) (Gavrilović & Dukić, 2002) (Slika 19). Protok Belog Drima na izlazu iz Srbije iznosi prosečno 61 m^3/s (Simonović, 2001). Dužina ove reke iznosi 175 km, od čega je u Srbiji 156 km (Grapci-Kotori *et al*., 2010).

Basen Belog Drima deo je Ohrid-Drim-Skadar sistema. Kako su ekološki uslovi slični ili isti, ihtiofauna basena Belog Drima ima jedinstvenu karakteristiku koja se ogleda u tome da se sve vrste koje naseljavaju ovaj basen mogu sresti u svim njegovim delovima. Jedini izuzetak predstavlja gornji tok reke Miruše, u kome se beleži manji broj vrsta: glavatica, primorska (drimska) pastrmka, ohridska plašica, ohridska (crna) mrena, skadarska krkuša, slatkovodna slingura, drimsko-skadarski klen, šaradan i gavčica (*Rhodeus amarus*). Ovaj deo faune riba izolovan je od ostatka basena zbog odsustva komunikacije sa drugim vodotocima, kao i činjenicom da se na Miruši nalazi 13 jezera na relativno maloj udaljenosti koja su odvojena vodopadima (neki visine i do 22 m). Time je onemogućeno kretanje riba iz Belog Drima i donjeg toka Miruše u gornji tok ove reke. Postoji mogućnost da je ihtiofauna gornjeg toka Miruše primarna i najstarija u oblasti koju zahvata basen Belog Drima (Šorić, 1992).

Vrste riba koje naseljavaju Mirušu prema stepenu ugroženosti mogu se svrstati u sledeće kategorije:

- kritično ugrožene vrste (CR): *Salmo marmoratus*
- ugrožene vrste (EN): *Salmo farioides*

ni-hydropower plants (MHPs), which is one of the main factors endangering fish fauna in these areas.

The Lepenac rises on the northern side of the Šar Mt. at an altitude of 1,860 m. It flows down the slopes of the Šar Mt., breaks through several gorges (Brodska and Kačanička) and flows through several valleys (Sirinićka Župa, Sopotnička valley). Near the town of Đeneral Janković, the Lepenac enters Northern Macedonia and flows towards the Skopje valley. It flows into the Vardar at Đorče Petrov at an altitude of 253 meters. Due to its steep gradient, the Lepenac carries considerable amounts of sediment. The total length of the Lepenac is 75 km, of which 65 km are on Serbian territory. The longest and most water-rich tributary is the Nerodimka. The Lepenac belongs to the rivers of the nival-pluvial regime and carries the greatest amount of water in May, which comes from snowmelt, and the least in August. The average annual discharge at the exit from our country is 8.6 m^3/s (Gavrilović & Dukić, 2002). The fish fauna of the Lepenac has a distinct salmonid character and the part flowing through Serbia is inhabited by only one species, the Macedonian trout.

Species classified according to the category of threat present in the Lepenac:

- endangered species (EN): *Salmo macedonicus*

2.4. Adriatic sea basin

The Adriatic Sea basin in the territory of Serbia covers 4,500 km^2, which is 5% of the area. It includes the Metohija basin and its mountainous rim. The highest elevation of the basin is the peak of Đeravica (2,656 m) on Prokletije Mts., while the lowest elevation is at the outflow of the White Drim to Albania (270 m). The average altitude of the Adriatic Sea basin is 820 m. It is formed by the White Drim with its tributaries – Pećka Bistrica, Dečanska Bistrica, Erenik/Ribnik (right tributaries), Topluga, Prizrenska Bistrica, Istočka reka, Klina, Miruša and Plavska reka (left tributaries) (Gavrilović & Dukić, 2002) (Figure 19). The discharge of the White Dream at the exit from Serbia averages 61 m^3/s (Simonović, 2001). The length of this river is 175 km, of which 156 km are in Serbia (Grapci-Kotori *et al*., 2010).

The White Drim watershed is part of the Ohrid-Drim-Skadar system. As the ecological conditions are similar or the same, the fish fauna of the White Drim watershed has a unique characteristic, which is reflected in the fact that all species inhabiting this watershed are found in all its parts. The only exception is the upper reach of the Miruša, where a smaller number of species can be found: marble trout, Balkan brook trout, Ohrid bleak, Western Balkan barbel, Skadar gudgeon, freshwater blenny, River Drin chub, Albanian roach and European bitterling (*Rhodeus amarus*). This part of the fish fauna is isolated from the rest of the watershed, as there is no connection to other watercourses and the 13 lakes on the Miruša are separated by waterfalls (some up to 22 m high) at a relatively short distance. This has prevented the migration of fish from the White Drim and the lower reaches of the Miruša into the upper reaches of this river. There is a possibility that the fish fauna of the upper reaches of the Miruša is primary and the oldest in the White Drim watershed (Šorić, 1992).

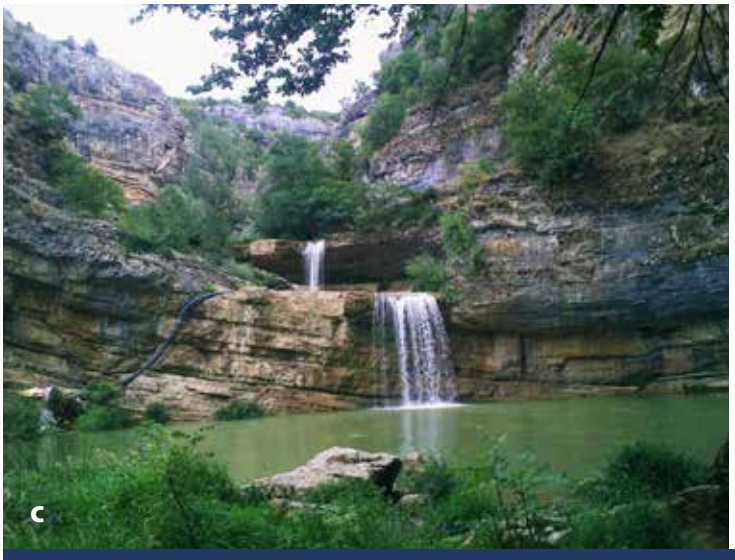
Species classified according to the category of threat present in the Miruša:

- ranjive vrste (VU): *Alburnus scoranza*, *Barbus rebeli*, *Gobio skadarensis*, *Salariopsis fluviatilis*, *Squalius platyceps*
- gotovo ugrožene vrste (NT): *Pachychilon pictum*

Ihtiofaunu Belog Drima i ostatka Ohrid-Drim-Skadar sistema čini veći broj endemičnih vrsta: ohridski vijun, ohridska ukljevica, ohridska plašica, ohridska brkica, ohridska (crna) mrena, ohridski skobalj, drimska paklara, skadarska krkuša, drimsko-skadarski klen i šaradan, s tim što se vijun, plašica, mrena, skobalj i šaradan mogu naći i u reci Vojuši. Novija istraživanja su pokazala da još uvek nisu rešeni svi taksonomski problemi vezani za vrste prisutne na ovom području. Za sada se pretpostavlja da u jadranskom slivu na terito-

- critically endangered species (CR): *Salmo marmoratus*
- endangered species (EN): *Salmo farioides*
- vulnerable species (VU): *Alburnus scoranza*, *Barbus rebeli*, *Gobio skadarensis*, *Salariopsis fluviatilis*, *Squalius platyceps*
- near threatened species (NT): *Pachychilon pictum*

The fish fauna of the White Drim and the rest of the Ohrid-Drim-Skadar system consists of a large number of endemic species: Ohrid spined loach, Ohrid spirlin, Ohrid bleak, Ohrid stone loach, Western Balkan barbel, Ohrid nase, Drin brook lamprey, Skadar gudgeon, River Drin chub and Albanian roach, whereas Ohrid spined loach, Ohrid bleak, Western Balkan barbel, River Drin chub and Albanian



Slika 19. Vode u jadranskom slivu: (a) Pećka Bistrica (https://ozoutback.com.au/Kosovo/peja/slides/58_20090629028.jpg); (b) Prizrenska Bistrica (https://web.archive.org/web/20161013133705if_/http://static.panoramio.com/photos/large/28370353.jpg); (c) Miruša (foto: Flutur Gërbeshi, https://upload.wikimedia.org/wikipedia/commons/d/d5/KosovoMirusha.jpg); (d) Beli Drim (foto: Martin Furtschegger, https://upload.wikimedia.org/wikipedia/commons/4/4d/Drini_i_Bardh%C3%AB_%28Wei%C3%9Fer_Drin%29%2C_Kosovo_-_panoramio_%281%29.jpg).

Figure 19. Watercourses of the Adriatic Sea basin: (a) Pećka Bistrica (https://ozoutback.com.au/Kosovo/peja/slides/58_20090629028.jpg); (b) Prizrenska Bistrica (https://web.archive.org/web/20161013133705if_/http://static.panoramio.com/photos/large/28370353.jpg); (c) Miruša (photo: Flutur Gërbeshi, https://upload.wikimedia.org/wikipedia/commons/d/d5/KosovoMirusha.jpg); (d) White Drim (photo: Martin Furtschegger, https://upload.wikimedia.org/wikipedia/commons/4/4d/Drini_i_Bardh%C3%AB_%28Wei%C3%9Fer_Drin%29%2C_Kosovo_-_panoramio_%281%29.jpg).

riji Srbije živi dvadesetak autohtonih i desetak alohtonih vrsta riba (Grapci-Kotori *et al*., 2020).

Godine 2019. objavljena je Crvena knjiga faune za područje Kosova i Metohije (Ibrahimi *et al*., 2019) kojom je obuhvaćeno 15 vrsta riba, od čega se za deset vrsta riba navodi prisustvo u slivu Jadranskog mora. U kategoriji kritično ugroženih vrsta (CR) nalazi se jedna vrsta – *Anguilla anguilla*, u kategoriji ugroženih vrsta (EN) jedna vrsta – *Salmo marmoratus*, u kategoriji ranjivih vrsta (VU) takođe jedna vrsta – *Cyprinus carpio*, u kategoriji gotovo ugroženih vrsta (NT) četiri vrste – *Barbus rebeli*, *Eudontomyzon stankokaramani*, *Pachychilon pictum* i *Rhodeus amarus*, u kategoriji najmanje zabrinjavajućih vrsta (LC) jedna vrsta – *Scardinius erythrophthalmus*, i u kategoriji vrsta sa nedovoljno podataka o ugroženosti (DD) dve vrste – *Rhodeus meridionalis* i *Sabanejewia balcanica*.

I vodotoci jadranskog sliva izloženi su negativnom antropogenom pritisku (Gashi *et al*., 2016; Ibrahimi *et al*., 2019; Grapci-Kotori *et al*., 2020). Naime, s obzirom na odsustvo sistema za preradu otpadnih voda, netretirani otpad se ispušta u vodotoke dovodeći do njihovog zagađenja. Ne manji problem predstavlja i ekploatacija peska i šljunka koja dovodi do potpune ili delimične devastacije staništa riba, kao i drugi oblici izmene staništa (npr. izgradnja brana). Znatan negativni uticaj na ihtiofaunu jadranskog sliva mogu imati i alohtone vrste riba putem kompeticije, hibridizacije, prenošenja bolesti, predatorstva, kao i suše.

Vrste koje naseljavaju jadranski sliv u Srbiji, prema stepenu ugroženosti mogu se svrstati u sledeće kategorije:

- kritično ugrožene vrste (CR): *Anguilla anguilla*, *Cobitis ohridana*, *Salmo marmoratus*
- ugrožene vrste (EN): *Leucos basak*, *Salmo farioides*
- ranjive vrste (VU): *Alburnoides ohridanus*, *Alburnus scoranza*, *Barbatula sturanyi*, *Barbus rebeli*, *Chondrostoma ohridanum*, *Eudontomyzon stankokaramani*, *Gobio skadarensis*, *Salariopsis fluviatilis*, *Squalius platyceps*
- gotovo ugrožene vrste (NT): *Pachychilon pictum*

2.5. Ekonomski značaj i održivo korišćenje riba u Srbiji

Direktna vrednost riba, sa antropogenog aspekta, jeste ekonomska, jer ribe predstavljaju namirnicu namenjenu tržištu, dok je druga, ništa manje značajna vrednost to što ribe predstavljaju važnu komponentu biodiverziteta (Wilson & Carpenter, 1999; Sipponen & Grėboval, 2001).

Tragovi bavljenja ribolovom na području Srbije mogu se naći još od neolitskog doba, zahvaljujući diverzitetu faune riba koja ga naseljava (Martinović, 1978). Nekadašnje stanje akvatičnih ekosistema hidrografski i hidrološki značajno se razlikovalo od ovog koje danas poznajemo, pre svega zbog isušivanja ritskih područja, regulacije tokova i izgradnje i formiranja veštačkih vodenih sistema. Međutim, to nije umanjilo njihov ribolovni značaj, ali je uticalo na karakteristike ribolovnog resursa i ribljeg fonda. Iako zvanične statistike o potrošnji ribljeg mesa u Srbiji ne pokazuju tako, riba ipak predstavlja značajnu namirnicu u ishrani lokalnog stanovništva (Smederevac-Lalić, 2013).

roach also occurring in the Aoös-Vjosa River. Recent studies have shown that not all taxonomic problems related to the species found in this area have been solved yet. Currently, about 20 native and ten non-native fish species are supposed to live in the Adriatic Sea basin in the territory of Serbia (Grapci-Kotori *et al*., 2020).

In 2019, the Red Book of Fauna for the territory of Kosovo and Metohija was published (Ibrahimi *et al*., 2019), listing 15 fish species, ten of which are believed to occur in the Adriatic Sea basin. In the category of endangered species (CR) there is one species – *Anguilla anguilla*, in the category of endangered species (EN) one species – *Salmo marmoratus*, in the category of vulnerable species (VU) one species – *Cyprinus carpio*, in the category of near threatened species (NT) there are four species – *Barbus rebeli*, *Eudontomyzon stankokaramani*, *Pachychilon pictum* and *Rhodeus amarus*, in the category of least concern species (LC) one species – *Scardinius erythrophthalmus*, and in the category of data deficient species (DD) there are two species – *Rhodeus meridionalis* and *Sabanejewia balcanica*.

The streams of the Adriatic Sea basin are also exposed to negative anthropogenic impacts (Gashi *et al*., 2016; Ibrahimi *et al*., 2019; Grapci-Kotori *et al*., 2020). Namely, in the absence of a wastewater treatment system, untreated wastewater is discharged into waterbodies, leading to their pollution. The exploitation of sand and gravel, which leads to the complete or partial destruction of fish habitats, and other forms of habitat modification (e.g. the construction of dams) are no less of a problem. Non-native fish species can also have a significant negative impact on the fish fauna of the Adriatic Sea basin through competition, hybridisation, disease transmission, predation and drought.

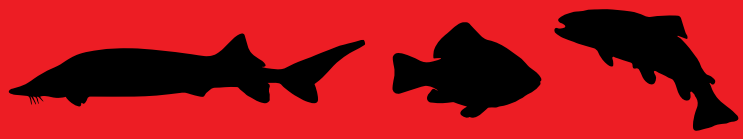
Species classified according to the category of threat present in the Adriatic Sea basin in Serbia:

- critically endangered species (CR): *Anguilla anguilla*, *Cobitis ohridana*, *Salmo marmoratus*
- endangered species (EN): *Leucos basak*, *Salmo farioides*
- vulnerable species (VU): *Alburnoides ohridanus*, *Alburnus scoranza*, *Barbatula sturanyi*, *Barbus rebeli*, *Chondrostoma ohridanum*, *Eudontomyzon stankokaramani*, *Gobio skadarensis*, *Salariopsis fluviatilis*, *Squalius platyceps*
- near threatened species (NT): *Pachychilon pictum*

2.5. Economic importance and sustainable use of fishes in Serbia

The direct value of fish from an anthropogenic point of view is the commercial one, as food for the market, while another, no less significant value is that fish are an important component of biodiversity (Wilson & Carpenter, 1999; Sipponen & Grėboval, 2001).

Traces of fishing in Serbia can be found since the Neolithic period, which is due to the diversity of fish fauna living there (Martinović, 1978). The former state of aquatic ecosystems was hydrographically and hydrologically quite different from the one we know today, which is mainly due to the drying up of marshes, regulation of water flow and the construction and creation of artificial water systems. However, this has not diminished their importance for fisheries, but has influenced the characteristics of fish resources and fish stocks. Although official statistics on the consumption of fish meat in Serbia do not show it, fish is still an important food in the diet of the local population (Smederevac-Lalić, 2013).



U Srbiji je ribarenje tradicionalna delatnost već vekovima, o čemu svedoče brojni istorijski zapisi. Još je grčki istoričar Herodot, putujući Dunavom, uočio bogat ulov i divio se izobilju dunavske ribe (Petrović, 1998). Arheološki nalazi pokazuju da je na području Save i Dunava ribolov predstavljao jednu od osnovnih delatnosti. Riba je bila simbol života i jedan od uslova egzistencije u vreme početaka ljudske civilizacije (Jovanović, 2009; Dinu, 2010; Rakezić, 2010; Živaljević, 2017).

Nekada nepregledne bare i ritovi uz Savu i Dunav predstavljali su idealne uslove za ishranu i razmnožavanje riba. Prema navodima pisaca XVI i XVII veka, na ovim područjima lovili su se krupni šarani, velike morune i ruske jesetre, kao i kečiga, atlantska jesetra, sim, pastruga, štuka, manić i som. Često su beležene veličine jedinki koje su danas nezamislive. Ulovljeni primerci šarana bili su dugi i do 1 m, štuka i više od 2 m, a pojedini somovi težili su i preko 135 kg. Zbog veoma razvijenog ribarstva još u tursko vreme postojao je Ribarski esnaf (Petrović, 1998). Ribari su u okolini Beograda nosili naziv „alas", po mađarskom „halász" (ribar), ili „balugdžija", od turskog „balık" (riba). Prostrana ribolovna područja Save i Dunava sa ritovima smatrani su kao opšte dobro i opšti izvor hrane za stanovništvo. Prva *Uredba o ribarstvu* u Srbiji doneta je 1859. godine, a prvi *Zakon o ribolovu* u Kraljevini Srbiji 1898. godine. Ribarski esnaf opstao je sve do početka XX veka, kada prerasta u Beogradsko ribarsko udruženje. U okviru *Zakona o slatkovodnom ribarstvu* u Srbiji iz 1938. godine, postojao je i poseban član koji se odnosio na zaštitu i unapređenje ribarstva. Postojale su ribarske zadruge čiji je zadatak bio „racionalno vršenje, unapređenje i usavršavanje ribolova, gajenje, prerada, organizacija prodaje i transporta ribe i uopšte unapređenje ekonomskih interesa članova". Država i banovine pomagale su takva udruženja. Banske uprave bile su dužne da za svoje područje prikupljaju sve ribarske statističke podatke, da ih sređuju i šalju nadležnom ministarstvu. Zakonom je bio propisan ribarski fond predviđen da se koristi za poslove unapređenja, organizacije, uređenja i proučavanja ribarstva. Postojao je i poseban pravilnik o rukovanju i trošenju sredstava ovog fonda. Posle Drugog svetskog rata, ribolov na velikim rekama u Srbiji (Dunav, Sava i Tisa) postaje sve značajnija privredna grana. Bogatstvo ribom umanjila je prvi put regulacija Đerdapa, a kasnije i sve veći razvoj industrije duž obala Save i Dunava. Međutim, ribolov je ostao do danas profesionalno zanimanje jednog dela stanovništva, osnova njihove ishrane i predmet trgovine (Smederevac-Lalić, 2013).

Ribolov u Srbiji obuhvata privredni (komercijalni) i rekreativni ribolov, koji uključuje i sportski (takmičarski) ribolov i sanacioni ribolov (obavlja se radi sprečavanja razvoja alohtonih ili prenamnožavanja pojedinih vrsta). Nažalost, u značajnom obimu prisutni su i različiti oblici ilegalnog ribolova (krivolova).

Najčešći pokazatelji koji ilustruju društveno-ekonomski značaj ribolova jesu ulov i njegova vrednost, kao i broj rekreativnih ribolovaca i privrednih ribara, odnosno broj osoba koje su zaposlene kao ribari. Prema podacima Republičkog zavoda za statistiku (RZS, 2023), u periodu od 2013. do 2022. godine broj privrednih ribara u Srbiji varira između 289 i 388, a rekreativnih ribolovaca između 77.109 i 109.606 (Tabela 5). Tokom tog perioda, prodato je ukupno 3.387 dozvola za privredni ribolov (godišnji prosek 339) i 871.329

In Serbia, fishing has been a traditional activity for centuries, as evidenced by numerous historical records. Even the Greek historian Herodotus, who travelled the Danube, observed a rich catch and marvelled at the abundance of Danube fish (Petrović, 1998). Archaeological findings show that fishing was one of the most important activities in the Sava and Danube area. Fish was a symbol of life and one of the existential prerequisites for at the beginning of human civilisation (Jovanović, 2009; Dinu, 2010; Rakezić, 2010; Živaljević, 2017).

In the past, endless ponds and marshes along the Sava and Danube provided ideal conditions for consuming and breeding fish. According to the writers of the 16th and 17th centuries, large individuals of common carp, beluga and Russian sturgeon were caught in these areas, as well as sterlet, Atlantic sturgeon, ship sturgeon, starry sturgeon, northern pike, burbot and wels catfish. Often specimens were caught in sizes that can no longer be imagined today. The carp caught were up to 1 m long, pike over 2 m, and some wels catfish weighed over 135 kg. Due to the highly developed fishery, there was already the Fishermen's Guild in Turkish times (Petrović, 1998). The fishermen around Belgrade were called "alas", after the Hungarian "halász" (fisherman), or "balugdžija", from the Turkish "balık" (fish). The vast fishing areas on the Sava and Danube rivers with their marshes were considered common property and a general source of food for the population. The first *Regulation on Fishing* in Serbia was issued in 1859 and the first *Law on Fishing* in the Kingdom of Serbia was passed in 1898. The Fishermen's Guild survived until the beginning of the 20th century, when it evolved into the Belgrade Fishermen's Association. The *Law on Freshwater Fishing* in Serbia from 1938 also included a special article on the protection and improvement of fishing. There were fishermen's cooperatives whose task was "to rationally carry out, improve and perfect fishing, farming, processing, organization of sale and transport of fish and, in general, improvement of economic interests of members". The state and its banovine (banates, provinces) supported such associations. Banate administrations were required to collect, organize and forward all fishery statistical data for their area to the relevant ministry. The Law prescribed a fisheries fund to be used for the improvement, organization, regulation and study of fisheries. There was also a special set of rules for handling and using the resources of this fund. After the World War II, fishing on the major rivers in Serbia (Danube, Sava and Tisza) became an increasingly important industry. The abundance of fish declined first due to the regulation of Đerdap and later due to the increasing development of industry on the banks of the Sava and the Danube. Nevertheless, fishing has remained the occupational activity of part of the population, the basis of their diet and the object of trade to this day (Smederevac-Lalić, 2013).

Fishing in Serbia includes commercial and recreational fishing, which also includes sport (competitive) fishing and sanitary fishing (to prevent the development of non-native species or overpopulation of certain species). Unfortunately, there are also various forms of illegal fishing (poaching) on a significant scale.

The most common indicators of the socioeconomic importance of fishing are the catch size and value, and the number of recreational fishers and professional fishers (people employed as fishers). According to the data of the Statistical Office of the Republic of Serbia (RZS, 2023), in the period from 2013 to 2022, the number of professional fishers in Ser-

dozvola za rekreativni ribolov (godišnji prosek 87.133); privredni ribari su ulovili ukupno 9.382 tone ribe (godišnji prosek 938 t), a rekreativni ribolovci 17.968 tona (godišnji prosek 1.797 t), što ukupno iznosi 27.350 t (ukupni godišnji prosek 2.735 t). Brojevi se odnose na one korisnike ribolovnog resursa koji kupuju dozvole za ribolov i time spadaju u legalne korisnike ribljeg fonda. Kod obe grupe može se uočiti trend pada broja izdatih dozvola do 2015. godine, a zatim porast od 2016. do 2019. godine. Ovakva dinamika broja izdatih dozvola može se povezati sa donošenjem novog *Zakona o zaštiti i održivom korišćenju ribljeg fonda* krajem 2014. godine i obavezama koje su proistekle iz njega i odgovarajućih podzakonskih akata. Takođe, potrebno je napomenuti da su od 2013. do 2015. godine ribarska područja u Srbiji bila bez korisnika jer nije bilo konkursa za dodelu područja na upravljanje. Situacija sa dozvolama i ulovom (koji je u skladu sa brojem alasa i ribolovaca) stabilizovala se tek nakon konkursa iz 2016. godine, kada su riblji fond i ribarska područja dodeljena novim korisnicima na zaštitu i održivo desetogodišnje korišćenje.

Ribarstvo ima veliki društveno-ekonomski značaj tamo gde druga zanimanja (poljoprivreda i industrija) nisu u dovoljnoj meri zastupljena. Privredni ribolov se može posmatrati kroz više društvenih aspekata, kao tradicionalna delatnost, kao uobičajena i očekivana aktivnost, ali najviše kao osnovna ekonomska delatnost (od koje najčešće zavisi čitava porodica), tj. aktivnost za svakodnevnu prehranu lokalnog stanovništva, dok je kod neznatnog broja ribara to samo dodatni izvor prihoda. Tesna sprega između lokalnih zajednica i reke kao prirodnog resursa ukazuje na potrebu uređivanja ovog odnosa, kako bi se postigla održivost korišćenja prirodnih resursa, a istovremeno i razvoj lokalnih zajedinica (Smederevac-Lalić *et al.*, 2011b; Smederevac-Lalić, 2013).

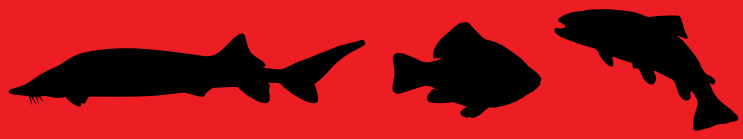
bia varies between 289 and 388, and the number of recreational fishers varies between 77,109 and 109,606 (Table 5). During this period, a total of 3,387 commercial fishing licences (annual average 339) and 871,329 recreational fishing licences (annual average 87,133) were sold; professional fishers caught a total of 9,382 tonnes of fish (annual average 938 tonnes) and recreational fishers caught 17,968 tonnes (annual average 1,797 tonnes), for a total of 27,350 tonnes (total annual average 2,735 tonnes). The figures refer to the users of the fishery resources who buy fishing licences and are thus legal users of the fish stock. In both groups, a downward trend in the number of licences issued can be observed until 2015, followed by an increase from 2016 to 2019. These changing aspects in the number of licences issued can be linked to the adoption of the new *Law on Protection and Sustainable Use of Fish Stocks* at the end of 2014 and the resulting obligations and regulations. It should also be noted that from 2013 to 2015, fishing areas in Serbia were without users because there was no competition for the allocation of areas for management. The situation with licences and catches (which corresponds to the number of fishers) stabilised only after the 2016 competition, when fish stocks and fishing areas were allocated to new users for protection and sustainable ten-year use.

Fishing has great socioeconomic importance where other occupations (agriculture and industry) are not sufficiently represented. Commercial fishing can be considered from different social aspects: as a traditional activity, as a usual and expected activity, but above all as a basic economic activity (on which the whole family usually depends), that is, as an activity for the daily subsistence of the local population, while for a small number of fishers it is only an additional source of income. The close link between local communities and the river as a natural resource shows the need to regulate this relationship in order to achieve sustainable use of natural resources and at the same time the development of local communities (Smederevac-Lalić *et al.*, 2011b; Smederevac-Lalić, 2013).

Tabela 5. Broj privrednih i rekreativnih ribolovaca i veličina ulova u otvorenim vodama u Srbiji za period 2013–2022. godina (RZS, 2023).

Table 5. Number of professional and recreational fishers and catch sizes in open waters in Serbia for the period 2013–2022 (RZS, 2023).

Godina / Year									
2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Broj privrednih ribara / Number of professional fishers									
388	351	289	313	335	295	349	350	369	348
Broj izdatih dozvola za rekreativni ribolov / Number of recreational fishing licences issued									
77.589	82.750	77.109	77.345	81.944	85.426	88.991	96.001	109.606	94.568
Ulov ribe u privrednom ribolovu (tone) / Fish catch in commercial fisheries (tonnes)									
2.235	908	851	581	590	686	884	761	927	959
Ulov ribe u rekreativnom ribolovu (tone) / Fish catch in recreational fisheries (tonnes)									
2.805	2.683	2.299	1.488	1.618	1.397	1.662	1.170	1.426	1.420
Ukupan ulov ribe (tone) / Total fish catch (tonnes)									
5.040	3.591	3.150	2.069	2.208	2.083	2.546	1.931	2.353	2.380



U današnje vreme ribolov na otvorenim vodama u Srbiji ne smatra se ekonomski značajnom oblašću sa aspekta države. Tržište ribom je neuređeno i neorganizovano već par decenija. Otkako ne postoji organizovan otkup ribe od ribara, prodaju slatkovodne ribe najčešće vrše ribnjačke prodavnice (ribe iz uzgoja), nešto malo privatnih ribarnica, restorani i preprodavci koji otkupljuju ribu od ribara. Srbija sve više uvozi ribu i riblje proizvode i niskim cenama uvozne ribe konkuriše plasmanu domaće slatkovodne ribe. Ekonomska funkcija rečnog ribarstva umanjena je činjenicom da rečna riba nije prisutna na tržištu u velikoj meri, niti je preterano tražena namirnica u supermarketima. Tržište je, dakle, malo, a retka su preduzeća koja se bave preradom ribe i njenih proizvoda.

Sa aspekta privrednog ribolova, posebno značajnima smatra se deset kvalitetnih vrsta riba: smuđ, smuđ kamenjar, som, štuka, šaran, manić, amur, sivi tolstolobik i beli tolstolobik, dok je kečiga od 2019. godine stavljena pod trajni lovostaj. Još oko 15 vrsta, pre svega iz porodica Cyprinidae i Leuciscidae, takođe se lovi, ali se svrstavaju u „belu ribu" I i II kategorije. Ostale vrste riba, zbog malih dimenzija ili retkosti, ne predstavljaju predmet ribolova. Sa aspekta rekreativnog ribolova, dijapazon aktuelnih vrsta nešto je širi. Može se zaključiti da je za privredno i rekreativno ribolovno korišćenje značajno oko 40% od ukupnog broja vrsta koje naseljavaju vode Srbije. Ribolovne statistike o godišnjim ulovima postoje za smuđa (obuhvata i ulov smuđa kamenjara), soma, deveriku, šarana, tolstolobika (obuhvata obe vrste, sivog i belog) i srebrnog karaša (babušku), dok su ostale vrste grupisane u kategoriju „ostala slatkovodna riba" (Tabela 6).

Zvaničnih podataka o ribolovnim resursima Srbije, njihovom bogatstvu, stanju i potencijalima praktično nema, iako zakonska regulativa koja se bavi uslovima korišćenja ovog resursa predviđa poznavanje i redovno praćenje stanja (monitoring). Nažalost, isto se može reći i za postojanje korektnih procena aktuelnog nivoa korišćenja ribljeg fonda u okviru privrednog i rekreativnog ribolova. Republički zavod za statistiku vodi evidenciju o ulovu ribe u rekama, jezerima i kanalima, tako da se mogu naći višegodišnji podaci o nivou korišćenja slatkovodnih ribolovnih resursa u Srbiji. Međutim, analiza navedenih podataka ukazuje na njihovu nepotpunost i nepouzdanost.

Poseban problem predstavlja procena uticaja rekreativnog ribolova. Međutim, treba naglasiti da se udeo ovog oblika ribolova u ukupnom pritisku na riblji resurs vrlo neopravdano zanemaruje. Na osnovu podataka Republičkog zavoda za statistiku, u Srbiji broj rekreativnih ribolovaca raste godinama. Takođe, ovaj vid ribolova, sa tolikim brojem ribolovaca, izuzetno je teško kontrolisati, te se procenjuje da je obim ilegalnog ribolova alatima koji se koriste u rekreativnom ribolovu približan obimu legalnog rekreativnog ribolova. Rekreativni ribolov u Srbiji mogao bi stoga imati čak vrlo značajan uticaj na ribolovne resurse.

Način života u starim civilizacijama podržavao je ono što danas zovemo održivim korišćenjem prirodnih resursa. Međutim, sa razvojem industrije i tehnologije omogućena je brža eksploatacija prirodnih resursa, tako da su decenije intenzivnog crpljenja dovele do nedostatka prirodnih resursa koji predstavljaju sirovine za dalji opstanak. To je naročito izraženo u slučaju obnovljivih resursa, kao što su čista voda, riblji fond i predeli koji se eksploatišu iznad moguć-

Nowadays, fishing in open waters in Serbia is not considered an economically significant sector from the state's point of view. The fish market has been unregulated and unorganised for several decades. Since there is no organised procurement of fish from fishers, the sale of freshwater fish usually takes place at fish markets (which sell farmed fish), a few private fish shops, restaurants and resellers who buy fish from fishers. Serbia is importing more and more fish and fish products, and the low prices of imported fish compete with the domestic trade in freshwater fish. The economic function of river fisheries is diminished by the fact that river fish is neither widely available on the market, nor is it an overly sought-after food item in supermarkets. Therefore, the market is small and there are only a few companies that process fish and its products.

From a perspective of commercial fishing, approximately ten high-value fish species are considered most important: pikeperch, Volga pikeperch, wels catfish, pike, carp, burbot, grass carp, bighead carp and silver carp, whereas sterlet has been under permanent ban on fishing since 2019. A further 15 species, mainly from the Cyprinidae and Leuciscidae families, are also caught but are classified as category I and II "white fish". Other fish species are not fished because of their small size or rarity. From a perspective of recreational fishing, the spectrum of common species is somewhat broader. It can be concluded that about 40% of all species found in Serbian waters are important for commercial and recreational fishing. Fishery statistics on annual catches exist for the pikeperch (including the Volga pikeperch), wels catfish, common bream, carp, bighead carp, silver carp and Prussian carp, while the other species are grouped in the category "other freshwater fish" (Table 6).

There is practically no official data on fishery resources in Serbia, their richness, condition and potential, although the legal provisions governing the specifications for the use of these resources provide for knowledge and regular monitoring of their condition. The same is unfortunately true for the existence of correct assessments of the current exploitation rate of fish stocks in commercial and recreational fisheries. The Statistical Office of the Republic of Serbia keeps records of fish catches in rivers, lakes and canals, so there is multi-year data on the level of exploitation of freshwater fish stocks in Serbia. However, analysis of the above data shows that they are incomplete and unreliable.

Estimating the impact of recreational fishing is a particular problem. However, it must be emphasized that the contribution of this form of fishing to the overall impact on fish stocks is unjustly neglected. According to data from the Statistical Office of the Republic of Serbia, the number of recreational fishers in Serbia has been increasing for years. Moreover, with such a large number of anglers, this type of fishing is extremely difficult to control and it is estimated that the volume of illegal fishing with tools used in recreational fishing is almost as large as the volume of legal recreational fishing. Therefore, recreational fishing in Serbia could even have a significant impact on fishery resources.

The way of life of ancient civilizations supported what we now call sustainable use of natural resources. However, with the development of industry and technology, more rapid exploitation of natural resources became possible, so that decades of intensive exploitation led to

Tabela 6. **Ulov pojedinih vrsta riba (u tonama) u otvorenim vodama u Srbiji prema podacima RZS (2023) (PR – privredni ribolov; RR – rekreativni ribolov).**

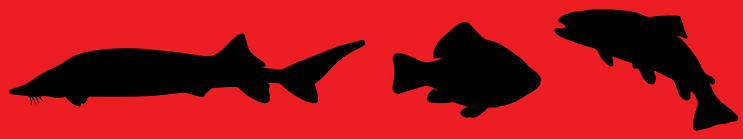
Table 6. **Catch of certain fish species (in tonnes) in open waters in Serbia according to RZS data (2023) (PR – commercial fishing; RR – recreational fishing).**

Vrsta / Species	Tip ribolova / Type of fishing	Godina / Year									
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Smuđ[1] / Pikeperch[1]	PR	128	84	72	54	51	67	99	88	81	87
	RR	130	106	105	100	144	113	134	74	95	106
	Ukupno / Total	258	190	177	154	191	180	233	162	176	193
Som / Wels catfish	PR	171	116	113	77	100	135	192	138	179	182
	RR	175	139	137	108	145	120	149	72	135	118
	Ukupno / Total	346	255	250	185	245	255	341	210	314	299
Deverika / Common bream	PR	180	95	72	59	40	47	74	61	95	97
	RR	209	186	175	68	69	67	54	93	141	126
	Ukupno / Total	389	281	247	127	109	114	128	154	237	222
Šaran / Carp	PR	200	71	58	28	23	35	48	52	64	61
	RR	281	264	254	113	125	105	149	117	120	122
	Ukupno / Total	481	335	312	141	148	140	197	169	184	183
Tolstolobik[2] / Silver carp and bighead carp[2]	PR	227	94	143	119	173	169	200	154	184	221
	RR	10	11	9	40	24	53	34	21	24	22
	Ukupno / Total	237	105	152	159	197	222	234	177	207	244
Srebrni karaš[3] / Prussian carp[3]	PR	347	130	82	63	58	81	94	94	118	91
	RR	437	470	434	259	342	339	452	226	242	273
	Ukupno / Total	784	600	516	322	400	420	546	321	360	365
Ostala slatkovodna riba / Other fresh-water fish	PR	982	318	311	181	144	152	184	173	206	320
	RR	1.563	1.507	1.185	800	770	601	693	565	669	654
	Ukupno / Total	2.545	1.825	1.496	981	914	753	877	738	875	873

[1]podaci o ulovu obuhvataju zajedno smuđa (*Sander lucioperca*) i smuđa kamenjara (*S. volgensis*) / catch data include the pikeperch (*Sander lucioperca*) and the Volga pikeperch (*S. volgensis*) combined
[2]podaci o ulovu obuhvataju zajedno belog (*Hypophthalmichthys molitrix*) i sivog tolstolobika (*H. nobilis*) / catch data include silver cap (*Hypophthalmichthys molitrix*) and bighead carp (*H. nobilis*) combined
[3]srebrni karaš ili babuška (*Carassius gibelio*) / Prussian carp or gibel carp (*Carassius gibelio*)

nosti regeneracije, kao i kroz gubitak biodiverziteta i staništa. Riba kao resurs spada u kategoriju iscrpljivih, ali obnovljivih prirodnih bioloških resursa. Nedovoljne količine i iscrpljivanje ovog resursa podrivaju perspektive budućeg održivog opstanka. Cilj kome treba težiti jeste smanjenje intenziteta korišćenja ribolovnog resursa da bi se takav opstanak omogućio.

a shortage of natural resources that are raw materials for continued survival. This is particularly evident for renewable resources such as clean water, fish stocks and landscapes that are exploited beyond the possibility of regeneration, as well as through the loss of biodiversity and habitats. Fish as a resource belongs to the category of depletable but renewable natural biological resources. Insufficient quantities and depletion of this resource undermine the prospects for future sustai-



Opšti zaključak bi stoga bio da za ribolovne resurse Srbije ne postoje dobre procene veličine ribljeg fonda, kao ni efekata aktuelnog ribolovnog pritiska na riblji fond i biodiverzitet ihtiofaune, te je praktično nemoguće korektno valorizovati realno stanje i potencijal ovog resursa. Međutim, ovakav zaključak ne isključuje postojanje čak i značajnog nivoa privredne i rekreativne eksploatacije ribolovnih resursa i svih pratećih efekata, uz sve probleme koji su prisutni (Smederevac-Lalić, 2013). S druge strane, iz istih razloga nemoguće je proceniti valjanost i prave efekte mera koje se, kroz programe upravljanja ribolovnim područjima, preduzimaju za poboljšanje stanja ribolovnih resursa.

Korišćenje i zaštita ribolovnih resursa u vodama Srbije regulisana je odgovarajućim zakonima (*Zakon o zaštiti i održivom korišćenju ribljeg fonda*, *Zakon o zaštiti prirode*, *Zakon o zaštiti životne sredine*) i podzakonskim aktima (*Naredba o merama za očuvanje i zaštitu ribljeg fonda*, *Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva*, *Pravilnik o načinu, alatima i sredstvima kojima se obavlja privredni ribolov*, *kao i o načinu, alatima, opremi i sredstvima kojima se obavlja rekreativni ribolov*) koji predviđaju redovno praćenje i poznavanje stanja resursa na pojedinim područjima. I pored toga, u praksi i dalje izostaje adekvatna primena i kontrola racionalnog korišćenja ribljeg fonda. S druge strane, ribarstvene statistike kojima se trenutno raspolaže neprecizne su i nepouzdane, te ne daju mogućnost korektnog i preciznog, već samo grubog zaključivanja o trendovima koji su prisutni u populacijama riba.

Međutim, poslednjih godina, uvođenjem operativnog monitoring programa površinskih voda Republike Srbije, po prvi put se na osnovu zajednica riba u odabranim vodnim telima u Srbiji dobijaju elementi za ocenu ekološkog statusa ili potencijala, zavisno od tipa vodnog tela o kome se radi, a ti podaci ujedno mogu pružiti i neku preliminarnu sliku sastava i procenu stanja ribolovnih resursa.

nable survival. The objective to be pursued is to reduce the intensity of exploitation of fishery resources to enable such survival.

The general conclusion is therefore that there are no good estimates of the size of the fish stock and the impact of current fishing pressure on the fish stock and fish fauna biodiversity in Serbia, and that it is practically impossible to properly assess the actual status and potential of this resource. However, this conclusion does not exclude the fact that fishery resources are also exploited to a significant extent for commercial and recreational purposes, with all the associated impacts and problems (Smederevac-Lalić, 2013). On the other hand, for the same reasons, it is impossible to assess the validity and actual impact of the measures taken under fisheries management programmes to improve the status of fisheries resources.

The use and protection of fishery resources in waters of Serbia are regulated by relevant laws (*Law on Protection and Sustainable Use of Fish Stocks*, *Law on Nature Protection*, *Law on Environmental Protection*) and by-laws (*Regulation on Measures for the Conservation and Protection of Fish Stocks*, *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi*, *Rulebook on Methods, Tools and Means for Commercial Fishing, and Methods*, *Tools*, *Equipment and Means for Recreational Fishing*), which provide for regular monitoring and knowledge of the state of resources in certain areas. In practice, nevertheless, there is still a lack of adequate implementation and control of the rational use of fishery resources. On the other hand, the fisheries statistics currently available are inaccurate and unreliable, and do not allow correct and accurate but only rough conclusions on the fish population trends.

However, in recent years, with the introduction of the programme for operational monitoring of surface water status in the Republic of Serbia, elements for the assessment of ecological status or potential, depending on the type of waterbody concerned, have been obtained for the first time on the basis of fish assemblages in selected waterbodies in Serbia, and these data can at the same time provide a preliminary depiction of the composition and assessment of the status of fishery resources.

3

PROCENA STATUSA UGROŽENOSTI VRSTA
(KATEGORIJE I KRITERIJUMI)

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Laslo Galamboš
Aleksandar Hegediš
Jasmina Krpo-Ćetković

ASSESSMENT OF THE SPECIES THREAT STATUA
(CATEGORIES AND CRITERIA)

Saša Branković
Nenad Sekulić
Laslo Galamboš
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Jasmina Krpo-Ćetković

3. PROCENA STATUSA UGROŽENOSTI VRSTA (KATEGORIJE I KRITERIJUMI)

Saša Branković, Nenad Sekulić, Laslo Galamboš, Aleksandar Hegediš i Jasmina Krpo-Ćetković

3.1. Procena ugroženosti

Osnovni element svake crvene knjige jeste procena ugroženosti vrsta i određivanje kriterijuma i kategorija ugroženosti. Procena ugroženosti radi se na osnovu *IUCN Red List Criteria* (IUCN Species Survival Commission, 2012a, 2012b) – sistema za procenu rizika od izumiranja koji je prihvaćen u celom svetu. Prvobitno je ovaj sistem bio razvijen za procene na globalnom nivou, ali se to pokazalo kao nepraktično za primenu na regionalnom ili nacionalnom nivou. Osnovno ograničenje primene procene ugroženosti vrsta na globalnom nivou jesu ogromne razlike u potencijalnoj ugroženosti regionalnih (nacionalnih) populacija u odnosu na ukupnu svetsku populaciju. Da bi se prevazišle ove razlike, sistem je prilagođen primeni na regionalnom i nacionalnom nivou.

Slatkovodne ribe predstavljaju jednu od najugroženijih grupa životinja u Evropi i po stepenu ugroženosti, nalaze se na drugom mestu, posle slatkovodnih mekušaca (IUCN European Red List of Threatened Species, 2022). Najmanje 37% evropskih slatkovodnih vrsta riba ugroženo je na kontinentalnom nivou, najmanje 13 vrsta je izumrlo, a još 5 vrsta spadaju u grupu verovatno nestalih, ali ne postoje pouzdani podaci koji bi to potvrdli (Freyhof & Brooks, 2011). Nekoliko jesetarskih vrsta nalazi se pod pretnjom trenutnog izumiranja, kao i nekoliko drugih vrsta koje žive u slivovima mediteranskog basena.

Velika ugroženost značajnog broja vrsta riba predstavlja indikator izuzetne osetljivosti evropskih slatkovodnih staništa, ali i lošeg stanja njihove zaštite. Glavni razlozi ovakvog stanja jesu zagađenje voda, gubitak staništa zbog prekomernog zahvatanja vode za različite potrebe, kao i unos alohtonih vrsta. Povećana učestalost i intenzitet suša već imaju veliki uticaj na slatkovodne ekosisteme i vrste koje zavise od njih.

Procena ugroženosti vrsta ima sledeće glavne ciljeve:

- planiranje zaštite na nacionalnom nivou prikazivanjem osnovnih podataka koji pokazuju razloge za stavljanje pod zaštitu;
- određivanje područja i staništa kojima su potrebne mere zaštite da bi se izbegao kako njihov nestanak, tako i nestanak vrsta koje u njima žive;
- određivanje glavnih uzroka ugroženosti i predlog mera njihovog ublažavanja i mera zaštite.

Procena obezbeđuje sledeće podatke:

- prikaz stanja i rasprostranjenost vrsta, glavnih faktora ugroženosti i preporuka za mere zaštite;
- svima dostupnu bazu podataka i mogućnost monitoringa stanja i rasprostranjenosti slatkovodnih vrsta riba.

3. ASSESSMENT OF THE SPECIES THREAT STATUS (CATEGORIES AND CRITERIA)

Saša Branković, Nenad Sekulić, Laslo Galamboš, Aleksandar Hegediš and Jasmina Krpo-Ćetković

3.1. Threat assessment

The basic element of each Red Book is the assessment of threats to species and the establishment of criteria and categories of threats. Threat assessment is based on the *IUCN Red List criteria* (IUCN Species Survival Commission, 2012a, 2012b) – a globally recognised extinction risk assessment system. Originally, this system was developed for global-scale assessments, but it proved impractical for use at regional or national scales. The fundamental limitation in applying species threat assessments at the global level is the enormous differences in the potential threat to regional (national) populations relative to the total world population. To overcome these differences, the system has been adapted for use at regional and national scales.

Freshwater fishes represent one of the most threatened groups of animals in Europe, second only to freshwater molluscs in terms of threat level (IUCN European Red List of Threatened Species, 2022). At least 37% of European freshwater fish species are threatened on a continental scale, at least 13 species are extinct, and another 5 species belong to the group of probably extinct species, but there are no reliable data to confirm this (Freyhof & Brooks, 2011). Several sturgeon species are in imminent danger of extinction, as are several other species living in the watershed of the Mediterranean Sea basin.

The severe threat to a large number of fish species is an indicator of the extreme vulnerability of European freshwater habitats, but also of the poor state of their protection. The main reasons for this are water pollution, habitat loss due to excessive abstraction of water for various needs and the introduction of non-native species. The increasing frequency and intensity of droughts is already having a significant impact on freshwater ecosystems and the species that depend on them.

The threat assessment of species has the following main objectives:

- conservation planning at national level by presenting baseline data showing the rationale for protection;
- identification of areas and habitats requiring conservation measures to prevent both their disappearance and the disappearance of the species living in them;
- identification of the main causes of threats and proposal of remedial actions and protection measures.

The assessment provides the following information:

- a review of the status and distribution of the species, the main threats and recommendations for conservation measures;
- a database accessible to everyone and the possibility of monitoring the status and distribution of freshwater fish species.

Analiza populacionih trendova ključna je za procenu stanja vrsta. Kao deo ove procene, neophodno je odrediti za koje vrste postoji trend rasta, stabilnosti ili pada populacija. Smatra se da oko 17% evropskih vrsta riba ima konstantan pad brojnosti populacija, oko 6% ima stabilnu brojnost, a samo 1% pokazuje rast brojnosti (Freyhof & Brooks, 2011). Nažalost, zbog nedostatka podataka, populacioni trendovi za 76% evropskih vrsta riba i dalje su nepoznati. To otvara mogućnost za opravdanu pretpostavku da je procenat vrsta čije populacije opadaju daleko veći.

3.2. Kategorije ugroženosti prema IUCN

Međunarodna unija za očuvanje prirode (IUCN) precizno je definisala standarde za izradu crvenih lista i crvenih knjiga, kao i pravila i kriterijume za procenu ugroženosti taksona (IUCN Species Survival Commission, 2012b; IUCN Standards and Petitions Committee, 2019). Crvene liste prikazuju samo spisak taksona i odgovarajuće kategorije i kriterijume za procenu rizika od izumiranja prirodnih populacija. Crvene knjige se izrađuju prema istim standardima, ali pored kategorija i kriterijuma daju širi prikaz taksona, uključujući i rasprostranjenje, opis, tip staništa, ekološke karakteristike, faktore ugrožavanja, kao i postojeće i predložene mere zaštite. Značaj ovog sistema ogleda se u jedinstvenosti kriterijuma, objektivnosti i širokoj primeni. Međutim, za primenu ovih kriterijuma na manjem prostoru, tj. na nacionalnom nivou, neophodna su odgovarajuća prilagođavanja.

Prvi korak u postupku jeste procena statusa populacije određene vrste na nacionalnom nivou uz primenu standardnih kriterijuma. Nakon što se definiše procena (povećanje ili smanjenje brojnosti populacije), neophodno je odrediti stepen povezanosti populacije sa populacijama u državama u okruženju. Procena rizika od izumiranja smanjuje se u slučaju da postoji mogućnost imigracije iz populacija u okruženju, jer u tom slučaju postoji realna mogućnost opstanka populacije na nacionalnom nivou. Smanjenje je u tom slučaju najčešće za jednu kategoriju naniže (npr. iz ugrožene u ranjivu vrstu). U slučaju da je prisutan samo mali deo inače velike populacije koja se nalazi u državama u okruženju, smanjenje je često i veće od jednog stepena kategorije (npr. iz ugrožene u gotovo ugroženu vrstu). S druge strane, u slučaju da postoje relevantni dokazi da je populacija u demografskom kolapsu, da ne može da opstane zahvaljujući migracijama iz populacija u okruženju, ili je brojnost populacija u okruženju u padu, kategorija ugroženosti ide naviše (npr. iz ugrožene u kritično ugroženu vrstu). Navedeno se može primeniti u većini slučajeva kada dati takson ima malu brojnost, fragmentisanu distribuciju i kada postoji velika izolovanost u odnosu na populacije iste vrste u okruženju. Procena ugroženosti vrste raste u slučaju značajnog uništavanja staništa.

Prema IUCN, definisane su sledeće kategorije ugroženosti taksona (Slika 20):

- **Izumrla (Extinct – EX) vrsta** – vrsta je izumrla kada je nepobitno dokazano da je uginuo i poslednji primerak. Može se smatrati izumrlom ukoliko su sprovedena opsežna istraživanja u poznatim i potencijalnim staništima vrste, u odgovarajućem vremenu (deo dana, sezone ili godine) na području poznatog istorijskog rasprostranjenja, prilikom kojih vrsta nije zabeležena. Trajanje istraživanja treba da bude

Analysis of population trends is key to assessing species status. As part of this assessment, it is necessary to identify which species are showing a trend of population increase, stability or decline. It is estimated that about 17% of European fish species show a constant decline in population numbers, about 6% have stable numbers, and only 1% show an increase in numbers (Freyhof & Brooks, 2011). Unfortunately, due to lack of data, population trends for 76% of European fish species are still unknown. This gives rise to the justified assumption that the proportion of species whose populations are declining is much higher.

3.2. IUCN threat categories

The International Union for Conservation of Nature (IUCN) has detailed the standards for the preparation of Red Lists and Red Books, as well as the rules and criteria for assessing the threat risks (IUCN Species Survival Commission, 2012b; IUCN Standards and Petitions Committee, 2019). Red Lists contain only a list of taxa and the corresponding categories and criteria for assessing the risk of extinction of natural populations. Red Books are created using the same standards, but in addition to the categories and criteria, they provide a more comprehensive view of taxa, including distribution, description, habitat type, ecological trends, threats and existing and proposed conservation measures. The importance of this system is reflected in the uniqueness of the criteria, objectivity and broad application. However, for the applications of these criteria on a smaller scale, i.e. at national level, appropriate adjustments are required.

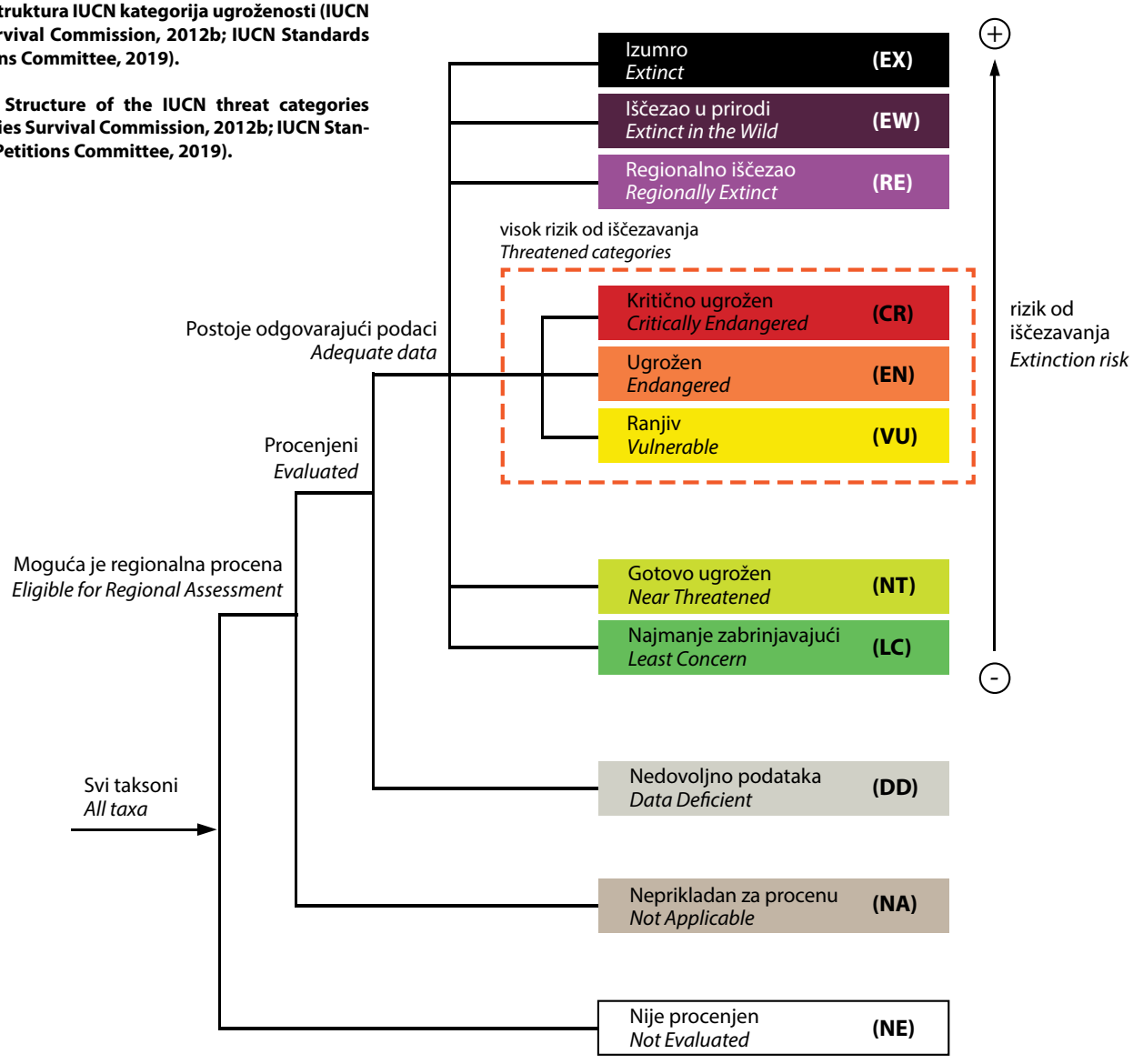
The first step of the process is to assess the population status of a particular species at the national level using standard criteria. Once the assessment has been made (population increase or decrease), it is necessary to determine the extent to which the population is connected to populations in surrounding countries. The assessment of extinction risk is lower if there is a possibility of immigration from populations in the surrounding area, because in this case there is a real possibility of the population surviving at the national level. In this case, downlisting usually occurs by one category (e.g. from endangered to vulnerable species). If only a small portion of the otherwise large population occurs in neighbouring countries, the downlisting is often by more than one category (e.g. from an endangered to a near threatened species). If, on the other hand, there is strong evidence that the population is demographically collapsing, that it cannot survive independently of the migration of populations in the vicinity or that the number of populations in the vicinity is declining, the threat category is uplisted (e.g. from an endangered to a critically endangered species). The above can be applied in most cases where a particular taxon has low abundance, fragmented distribution and high isolation compared to populations of the same species in the vicinity. The threat category of a species is uplisted if the habitat is significantly destroyed.

The International Union for the Conservation of Nature (IUCN) categories are as follows (Figure 20):

- **Extinct (EX)** – A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal,

Slika 20. **Struktura IUCN kategorija ugroženosti (IUCN Species Survival Commission, 2012b; IUCN Standards and Petitions Committee, 2019).**

Figure 20. **Structure of the IUCN threat categories (IUCN Species Survival Commission, 2012b; IUCN Standards and Petitions Committee, 2019).**

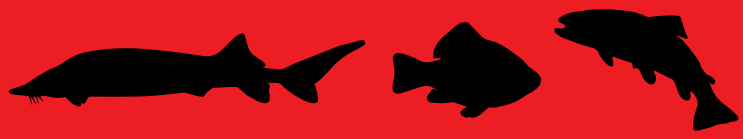


primereno odlikama životnog ciklusa i životne forme vrste.

- **Vrsta iščezla u prirodi (Extinct in the Wild – EW)** – vrsta spada u ovu kategoriju kada je iščezla iz svog prirodnog staništa, ali još uvek postoje jedinke/populacije u uzgoju, zatočeništvu i/ili naturalizovane jedinke/populacije. Može se smatrati iščezlom u prirodi ukoliko su sprovedena opsežna istraživanja u poznatim i potencijalnim staništima vrste, u odgovarajućem vremenu (deo dana, sezone ili godine) na području poznatog istorijskog rasprostranjenja, prilikom kojih vrsta nije zabeležena. Trajanje istraživanja treba da bude primereno odlikama životnog ciklusa i životne forme vrste.
- **Kritično ugrožena vrsta (Critically Endangered – CR)** – vrsta je kritično ugrožena ukoliko najbolji dostupni dokazi ukazuju na to da zadovoljava bilo koji od kriterijuma A, B, C, D ili E za kategoriju kritično ugroženog taksona (videti u delu *Kriterijumi ugroženosti*) i smatra se da se suočava sa

annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

- **Extinct in the Wild (EW)** – A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
- **Critically Endangered (CR)** – A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered and it is therefore considered to be facing an extremely high risk of extinction in the wild.



ekstremno velikim rizikom od iščezavanja u prirodi.

- **Ugrožena vrsta (Endangered – EN)** – vrsta je ugrožena ukoliko najbolji dostupni dokazi ukazuju na to da zadovoljava bilo koji od kriterijuma A, B, C, D ili E za kategoriju ugroženog taksona (videti u delu *Kriterijumi ugroženosti*) i smatra se da se suočava sa veoma visokim rizikom od izumiranja u prirodi.
- **Ranjiva vrsta (Vulnerable – VU)** – vrsta je ranjiva ukoliko najbolji dostupni dokazi ukazuju na to da zadovoljava bilo koji od kriterijuma A, B, C, D ili E za kategoriju ranjivog taksona (videti u delu *Kriterijumi ugroženosti*) i smatra se da se suočava sa visokim rizikom od izumiranja u prirodi.

Vrste koje spadaju u gorenavedene kategorije svrstane su zajedno u grupu **ugroženih vrsta**. Ostale vrste svrstane su u sledeće kategorije:

- **Gotovo ugrožena vrsta (Near Threatened – NT)** – vrsta spada u ovu kategoriju ukoliko trenutno ne ispunjava kriterijume ugroženosti, ali je blizu ispunjavanja kriterijuma ili bi mogla biti klasifikovana kao ugrožena vrsta u bliskoj budućnosti.
- **Najmanje zabrinjavajuća vrsta (Least Concern – LC)** – vrsta spada u ovu kategoriju ukoliko trenutno ne ispunjava kriterijume ugroženosti. Ovde spadaju široko rasprostranjene vrste sa velikom brojnošću, što nikako ne znači da nisu značajne za zaštitu.
- **Vrsta sa nedovoljno podataka o ugroženosti (Data Defficient – DD)** – vrsta spada u ovu kategoriju ukoliko trenutno ne postoje neophodni podaci za direktnu ili indirektnu procenu ugroženosti bazirani na rasprostranjenju ili stanju populacija. Vrsta može biti dobro proučena u smislu biologije i životnog ciklusa, ali ne postoje podaci o njenoj rasprostranjenosti i brojnosti. Prema tome, vrsta sa nedovoljno podataka ne spada u neku od kategorija ugroženosti.
- **Vrsta nije procenjena (Not Evaluated – NE)** – vrsta spada u ovu kategoriju kada procena ugroženosti nije urađena.

U Crvene knjige uključuju se sve kategorije osim NE. Treba dodati da se na regionalnom nivou koriste još dve kategorije: **regionalno iščezla vrsta (Regionally Extinct – RE) i vrsta neprikladna za procenu (Not Applicable – NA)**.

3.3. Kriterijumi ugroženosti prema IUCN

Postoji pet kvantitativnih kriterijuma za procenu ugroženosti i određivanje kategorije ugroženosti (Tabela 7):

- **kriterijum A** koji se odnosi na smanjenje veličine populacije (u prošlosti, sadašnjosti i/ili u budućnosti);
- **kriterijum B** koji se odnosi na veličinu areala i njegovu fragmentisanost i pad ili fluktuaciju brojnosti populacije;
- **kriterijum C** koji se odnosi na male populacije, fragmentisanost i pad ili fluktuaciju brojnosti populacije;
- **kriterijum D** koji se odnosi na veoma male ili prostorno ograničene populacije;
- **kriterijum E** koji se odnosi na kvantitativne analize rizika od izumiranja, a na osnovu analiza vijabilnosti populacija.

Termini korišćeni u kriterijumima definisani su na sledeći način: **Populacija i veličina populacije (kriterijumi A, C i D)** – termin

- **Endangered (EN)** – A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered and it is therefore considered to be facing a very high risk of extinction in the wild.
- **Vulnerable (VU)** – a taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.

Species belonging to these categories are collectively classified as threatened. Other species are classified into the following categories:

- **Near Threatened (NT)** – A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- **Least Concern (LC)** – A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.
- **Data Deficient (DD)** – A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat.
- **Not Evaluated (NE)** – A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

All categories except NE are included in the Red Books. It should be added that two other categories are used at the regional level: **Regionally Extinct (RE)** and **Not Applicable NA**.

3.3. IUCN threat criteria

There are five quantitative criteria used to evaluate if a taxon belongs in a threatened category (Table 7):

- **Criterion A** – Population size reduction (past, present and/or projected);
- **Criterion B** – Geographic range size and fragmentation, few locations, decline or fluctuations;
- **Criterion C** – Small and declining population size and fragmentation, fluctuations, or few subpopulations;
- **Criterion D** – Very small population or very restricted distribution;
- **Criterion E** – Quantitative analysis of extinction risk (e.g., Population Viability Analysis).

The terms used in the criteria are defined as follows:

Population and population size (criteria A, C and D) – The term "population" is used in a specific sense in the Red List Criteria that is different to its common biological usage. Population is here defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life forms, population size is measured as numbers of mature individuals only.

populacija koristi se u vrlo specifičnom značenju prema IUCN kriterijumima i razlikuje se od klasičnog biološkog termina. Ovde populacija označava ukupan broj jedinki date vrste. Zbog funkcionalnih razloga, uglavnom zbog razlika u životnim formama, veličina populacije se meri samo kao broj adultnih jedinki. U slučajevima kad određena vrsta obligatno zavisi od druge vrste, u celom životnom ciklusu ili nekom njegovom delu, neophodno je koristiti brojnost populacija domaćina.

Subpopulacije (kriterijumi B i C) – definišu se kao geografski (ili na neki drugi način) odvojene grupe u okviru populacije između kojih postoji samo mala genetička razmena.

Adultne jedinke (kriterijumi A, B, C i D) – broj odraslih jedinki predstavlja broj jedinki za koje je utvrđeno ili pretpostavljeno da mogu da se razmnožavaju. Kada se procenjuje ovaj kvantitativni indikator, neophodno je uzeti u obzir sledeće:

1. adultne jedinke koje se neće razmnožavati ne smeju biti brojane (npr. kada je gustina populacije tako niska da ne postoji mogućnost fertilizacije);
2. kod populacija kod kojih postoji disbalans u odnosu polova, potrebno je koristiti najnižu ekspertsku procenu broja adultnih jedinki koja ovo uzima u obzir;
3. kada veličina populacije fluktuira, moraju se koristiti niže vrednosti; u većini slučajeva, te vrednosti će biti manje od srednje vrednosti;
4. reproduktivne jedinice klona treba brojati kao posebne jedinke, osim u slučaju kada ne mogu preživeti same (npr. korali);
5. kod vrsta kod kojih postoji gubitak svih ili nekih adultnih jedinki u određenom trenutku životnog ciklusa kao prirodni proces, procena se mora vršiti u odgovarajućem vremenskom periodu kada su adultne jedinke prisutne i mogu se razmnožavati;
6. reintrodukovane jedinke mogu se računati kao adulti samo ako je dokazano da su već dali vitalne potomke.

Generacija (kriterijumi A, C i E) – vreme generacije jeste prosečna starost roditeljskih jedinki trenutno prisutnih novorođenih jedinki u populaciji i, prema tome, odražava trajanje reproduktivnog ciklusa zrelih jedinki u populaciji. Vreme generacije je veće od uzrasta u kojoj se dešava prvo razmnožavanje i manje od uzrasta najstarije jedinke koja se još uvek ramnožava (izuzetak predstavljaju vrste koje se razmnožavaju samo jednom).

Pad veličine populacije (kriterijum A) – predstavlja smanjenje broja adultnih jedinki najmanje onog reda veličine (u %) koji je utvrđen kriterijumom A za određeni vremenski period (u godinama), čak i kada pad ne pokazuje kontinuirani trend. Padom se ne sme smatrati fluktuacija populacije, osim ako za to nema definitivnih dokaza. Smanjenje broja jedinki kao rezultat prirodne fluktuacije veličine populacije se, u principu, ne smatra smanjenjem.

Kontinuirani pad veličine populacije (kriterijumi B i C) – predstavlja skorašnje, trenutno ili predviđeno buduće smanjenje veličine populacije (koje može biti postepeno, neredovno ili sporadično). Traje dok se ne preduzmu odgovarajuće mere zaštite. U principu, fluktuacije se ne smatraju stalnim padom, ali se takođe i kontinuirani pad ne sme smatrati fluktuacijom, osim ako za to nema dokaza.

Ekstremne fluktuacije (kriterijumi B i C) – primećene su kod mnogih vrsta kod kojih se veličina populacije ili područje rasprostranjenja menja u vrlo širokom rasponu, brzo i često, tipično sa varijacijom većom od jednog reda veličine (tj. desetostruko povećanje ili smanjenje).

Ozbiljno fragmentirana (kriterijum B) – ova fraza se odnosi na situaciju u kojoj povećan rizik od izumiranja za takson rezultira

In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

Subpopulations (Criteria B and C) – Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange (typically one successful migrant individual or gamete per year or less).

Mature individuals (Criteria A, B, C and D) – The number of mature individuals is the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity, the following points should be borne in mind:

1. Mature individuals that will never produce new recruits should not be counted (e.g. densities are too low for fertilization);
2. In the case of populations with biased adult or breeding sex ratios, it is appropriate to use lower estimates for the number of mature individuals, which take this into account;
3. Where the population size fluctuates, use a lower estimate. In most cases this will be much less than the mean;
4. Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals);
5. In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding;
6. Re-introduced individuals must have produced viable offspring before they are counted as mature individuals.

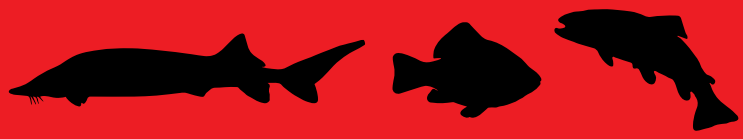
Generation (Criteria A, C and E) – Generation length is the average age of parents of the current cohort (i.e. newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once.

Reduction (Criterion A) – A reduction is a decline in the number of mature individuals of at least the amount (%) stated under the criterion over the time period (years) specified, although the decline need not be continuing. A reduction should not be interpreted as part of a fluctuation unless there is good evidence for this. The downward phase of a fluctuation will not normally count as a reduction.

Continuing decline (Criteria B and C) – A continuing decline is a recent, current or projected future decline (which may be smooth, irregular or sporadic) which is liable to continue unless remedial measures are taken. Fluctuations will not normally count as continuing declines, but an observed decline should not be considered as a fluctuation unless there is evidence for this.

Extreme fluctuations (Criteria B and C) – Extreme fluctuations can be said to occur in a number of taxa when population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e. a tenfold increase or decrease.

Severely fragmented (Criterion B) – This phrase refers to the situation in which increased extinction risk to the taxon results



stranjenja menjaju u velikoj meri, brzo i često, obično za više od jednog reda veličine (tj. deseterostruko povećanje ili smanjenje).

Jako fragmentisana rasprostranjenost (kriterijum B) – odnosi se na situacije u kojima je povećan rizik od izumiranja posledica činjenice da se većina jedinki nalazi u malim i relativno izolovanim subpopulacijama (u nekim slučajevima to se može utvrditi iz podataka o staništu). Ove male subpopulacije mogu nestati, uz smanjenu verovatnoću za ponovnu kolonizaciju.

Obim rasprostranjenja (*engl.* extent of occurrence – EOO) (kriterijumi A i B) – obim rasprostranjenja definisan je kao područje omeđeno najkraćom kontinuiranom imaginarnom granicom koja se može povući tako da obuhvata sve poznate, podrazumevane ili prognozirane aktuelne lokalitete vrste, isključujući slučajne susrete. Ova procena mora da isključi diskontinuitete ili velika razdvajanja ukupnog areala (na primer, velika područja sa staništima koja nisu odgovarajuća za vrstu). Obim rasprostranjenja se često može proceniti pomoću "minimalnog konveksnog poligona" (najmanji poligon kod kojeg nijedan od unutrašnjih uglova ne prelazi 180° i koji sadrži sve lokalitete koja vrsta naseljava).

Površina naseljavanja (*engl.* area of occupancy – AOO) (kriterijumi A, B i D) – definisana je kao područje unutar obima rasprostranjenja koje naseljava vrsta, isključujući slučajne susrete. Odslikava činjenicu da data vrsta najčešće ne naseljava ceo prostor svog obima rasprostranjenja u kome se mogu nalaziti i neodgovarajuća ili nenaseljena staništa. U nekim slučajevima, površina naseljavanja predstavlja najmanje područje neophodno za opstanak populacije u bilo kojoj fazi životnog ciklusa. Površina naseljavanja zavisi od merne skale. Stoga se mora predstaviti u najprikladnijoj skali, u skladu sa biološkim karakteristikama vrste, faktorima ugrožavanja i drugim dostupnim podacima. Da bi se izbegle nedoslednosti i pristrasnosti u proceni merenja površine naseljavanja na različitim skalama, korisno je da se stručne procene takvih merenja standardizuju primenom faktora korekcije skaliranja. Međutim, teško je obezbediti stroge smernice za standardizaciju takvih podataka, pošto različite taksonomske grupe imaju različite odnose razmere i površine.

Lokalitet (kriterijumi B i D) – odnosi se na geografski ili ekološki jasno definisan prostor u kome i samo jedan faktor ugrožavanja može brzo da utiče na sve jedinke date vrste. Veličina lokaliteta zavisi od površine na kojoj se faktor ugrožavanja manifestuje i može da obuhvati deo jedne ili više subpopulacija. Kada ugroženost vrste zavisi od više faktora, lokalitet se definiše faktorom ugrožavanja koji predstavlja najveću pretnju.

Kvantitativne analize (kriterijum E) – predstavljaju bilo koji oblik analize kojom se procenjuje verovatnoća izumiranja vrste, a bazira se na životnom ciklusu, faktorima ugrožavanja staništa i mogućnostima za upravljanje. Jedna od metoda jeste analiza vijabilnosti populacije (*engl.* Population Viability Analysis – PVA). Kvantitativna analiza mora biti zasnovana na svim dostupnim podacima. U slučajevima kada su informacije ograničene, svi dostupni podaci mogu se koristiti za procenu rizika od izumiranja (npr. procena uticaja slučajnih događaja na stanište). Pri prezentaciji rezultata kvantitativnih analiza, pretpostavke (koje moraju biti relevantne i opravdane), korišćeni podaci i netačnosti u podacima ili u samom kvantitativnom modelu moraju biti dokumentovani.

from the fact that most of its individuals are found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonisation.

Extent of occurrence (EOO) (Criteria A and B) – Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180° and which contains all the sites of occurrence).

Area of occupancy (AOO) (criteria A, B and D) – Area of occupancy is defined as the area inhabited by the species within the range, excluding chance encounters. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured and should be at a scale appropriate to relevant biological aspects of the taxon, the nature of threats and the available data. To avoid inconsistencies and bias in assessments caused by estimating area of occupancy at different scales, it may be necessary to standardize estimates by applying a scale-correction factor. It is difficult to give strict guidance on how standardization should be done because different types of taxa have different scale-area relationships.

Location (Criteria B and D) – The term "location" defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many subpopulations. Where a taxon is affected by more than one threatening event, location should be defined by considering the most serious plausible threat.

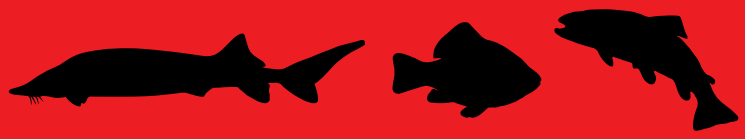
Quantitative analyses (Criterion E) – A quantitative analysis is defined here as any form of analysis which estimates the extinction probability of a taxon based on known life history, habitat requirements, threats and any specified management options. Population viability analysis (PVA) is one such technique. Quantitative analyses should make full use of all relevant available data. In a situation in which there is limited information, such data as are available can be used to provide an estimate of extinction risk (for instance, estimating the impact of stochastic events on habitat). In presenting the results of quantitative analyses, the assumptions (which must be appropriate and defensible), the data used and the uncertainty in the data or quantitative model must be documented.

Tabela 7. **Sažetak pet IUCN kriterijuma (A–E) za klasifikovanje kritično ugroženih, ugroženih i ranjivih taksona (IUCN Species Survival Commission, 2012b; IUCN Standards and Petitions Committee, 2019).**

Table 7. **Summary of the five criteria (A-E) used to evaluate if a taxon belongs in a threatened category (Critically Endangered, Endangered or Vulnerable) (IUCN Species Survival Commission, 2012b; IUCN Committee on Standards and Petitions, 2019).**

A. Smanjenje populacije koje se desilo u toku 10 godina ili tri generacije, u zavisnosti od toga šta je duže Population reduction measured over the longer of 10 years or 3 generations			
	Kritično ugrožen takson (CR) Critically Endangered taxon (CR)	**Ugrožen takson (EN) Endangered taxon (EN)**	**Ranjiv takson (VU) Vulnerable taxon (VU)**
A1	≥90%	≥70%	≥50%
A2, A3 & A4	≥80%	≥50%	≥30%
Definicija / Definition:			Bazirano na / Based on:
A1.	Smanjenje populacije koja je uočena, procenjena, pretpostavljena ili na koju se sumnja u prošlosti. Uzroci smanjenja su jasni i otklonjeni, a njihov efekat je reverzibilan. / Population reduction observed, estimated, inferred, or suspected in the past where the causes of the reduction are clearly reversible and understood and have ceased.		a) Direktnom posmatranju (neprimenjivo za kriterijum A3) /Direct observation (not applicable for A3) b) Odgovarajućem indeksu brojnosti za takson / An index of abundance appropriate to the taxon c) Smanjivanju površine naseljavanja (AOO), obima rasprostranjenja (EOO), i/ili kvaliteta staništa / A decline in area of occupancy (AOO), extent of occurrence (EOO) and/or habitat quality d) Utvrđenom ili potencijalnom nivou eksploatacije/ Actual or potential levels of exploitation e) Efektu introdukovanih taksona, hibridizaciji, patogenima, polutantima, kompetitorima i parazitima / Effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites
A2.	Smanjenje populacije koja je uočena, procenjena, pretpostavljena ili na koju se sumnja u prošlosti. Uzroci redukcije nisu jasni ili nisu otklonjeni ili nisu reverzibilni. / Population reduction observed, estimated, inferred, or suspected in the past where the causes of reduction may not have ceased or may not be understood or may not be reversible.		
A3.	Smanjenje populacije koja je uočena, procenjena, pretpostavljena ili za koju se veruje da će se dogoditi u budućnosti (najdalje za 100 godina). / Population reduction projected, inferred or suspected to be met in the future (up to a maximum of 100 years).		
A4.	Smanjenje populacije koja je uočena, procenjena, pretpostavljena, prognozirana ili na koju se sumnja i koja obuhvata i prošlost i budućnost. Uzroci redukcije nisu jasni ili nisu otklonjeni ili nisu reverzibilni. / An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future, and where the causes of reduction may not have ceased or may not be understood or may not be reversible.		

B. Geografska rasprostranjenost u smislu obima rasprostranjenja (B1) i/ili površine naseljavanja (B2) Geographic range in the form of either B1 (extent of occurrence) and/or B2 (area of occupancy)			
	Kritično ugrožen takson (CR) Critically Endangered taxon (CR)	**Ugrožen takson (EN) Endangered taxon (EN)**	**Ranjiv takson (VU) Vulnerable taxon (VU)**
B1: Obim rasprostranjenja (EOO)/ Extent of occurrence (EOO)	<100 km²	<5.000 km²	<20.000 km²
B2: Površina naseljavanja (AOO) / Area of occupancy (AOO)	<10 km²	<500 km²	<2.000 km²
I najmanje dva od tri dole navedena uslova / And at least 2 of the following 3 conditions:			
a) Veoma fragmentisan obim rasprostranjenja (EOO) i površina naseljavanja (AOO) ili broj naseljenih lokaliteta koji je: Severely fragmented EOO and AOO or Number of locations that is:	=1	≤5	≤10
b) Uočeno, procenjeno, pretpostavljeno ili prognozirano kontinuirano opadanje obima rasprostranjenja (i), površine naseljavanja (ii), površine, obima i/ili kvaliteta staništa (iii), broja naseljenih lokaliteta ili subpopulacija (iv) ili broja odraslih jedinki (v) / Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals **c)** Ekstremne fluktuacije u obimu rasprostranjenja (i), površini naseljavanja (ii), broju naseljenih lokaliteta ili subpopulacija (iii); ili broju odraslih jedinki (iv) / Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			



C. Mala populacija i opadanje / Small population size and decline			
	Kritično ugrožen takson (CR) Critically Endangered taxon (CR)	**Ugrožen takson (EN) Endangered taxon (EN)**	**Ranjiv takson (VU) Vulnerable taxon (VU)**
Broj adultnih jedinki Number of mature individuals	<250	<2.500	<10.000
I najmanje jedan od uslova C1 ili C2 / and at least one of C1 or C2			
C1: Uočeno, procenjeno ili prognozirano kontinuirano opadanje za najmanje: / An observed, estimated or projected continuing decline of at least:	25% u toku tri godine ili jedne generacije (šta god da je duže) / 25% in 3 years or 1 generation (whichever is longer)	20% u toku pet godina ili dve generacije (šta god da je duže) / 20% in 5 years or 2 generations (whichever is longer)	10% u toku deset godina ili tri generacije (šta god da je duže) / 10% in 10 years or 3 generations (whichever is longer)
C2: Uočeno, procenjeno, prognozirano ili pretpostavljeno kontinuirano opadanje, uz najmanje jedan od sledeća tri uslova: / An observed, estimated, projected or inferred continuing decline and at least 1 of the following 3 conditions:			
a) (i) Broj odraslih jedinki u svakoj od subpopulacija / Number of mature individuals in each subpopulation	≤50	≤250	≤1.000
(ii) % odraslih jedinki u jednoj subpopulaciji / % of mature individuals in one subpopulation	90-100%	95-100%	100%
b) Ekstremne fluktuacije u broju odraslih jedinki / Extreme fluctuations in the number of mature individuals			

D. Veoma mala ili ograničena populacija / Very small or restricted population			
	Kritično ugrožen takson (CR) Critically Endangered taxon (CR)	**Ugrožen takson (EN) Endangered taxon (EN)**	**Ranjiv takson (VU) Vulnerable taxon (VU)**
D1. Broj adultnih jedinki Number of mature individuals	<50	<250	**D1**. 1.000
D2. *Primenjiv jedino za kategoriju ranjivog taksona VU*: Ograničena površina naseljavanja (AOO) ili mali broj lokaliteta uz postojanje realne pretnje koja bi mogla brzo da dovede takson do kategorije CR ili EX / (Only applies to the VU category): Restricted area of occupancy or number of locations with a plausible future threat that could drive the taxon to CR or EX in a very short time:			**D2**. tipično: AOO <20 km² ili broj lokaliteta ≤5 / typically: AOO <20 km² or number of locations ≤5

E. Kvantitativna analiza / Quantitative Analysis			
	Kritično ugrožen takson (CR) Critically Endangered taxon (CR)	**Ugrožen takson (EN) Endangered taxon (EN)**	**Ranjiv takson (VU) Vulnerable taxon (VU)**
Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodi / Quantitative Analysis indicates the probability of extinction in the wild to be:	≥50% u narednih 10 godina ili tri generacije (šta god da je duže) / ≥50% in 10 years or 3 generations (whichever is longer)	≥20% u narednih 20 godina ili pet generacija (šta god da je duže) / ≥20% in 20 years or 5 generations (whichever is longer)	≥10% u narednih 100 godina / ≥10% in 100 years

3.4. Klasifikacione šeme standardnih kriterijuma za IUCN crvene liste

U postupku uključivanja taksona u IUCN crvene liste, kao i za analizu osnovnih podataka, neophodno je osigurati ujednačeno opisivanje staništa na kome se takson javlja, prikaz negativnih faktora i pretnji koji ugrožavaju takson, mere zaštite koje se sprovode ili ih je potrebno sprovesti, kao i prikupljanje informacija o korišćenju taksona. To se obezbeđuje korišćenjem izrađenih IUCN setova standardnih kriterijuma potrebnih za klasifikaciju vrsta, tzv. klasifikacionih šema.

Klasifikacione šeme (https://www.iucnredlist.org/resources/classification-schemes) sadrže setove standardnih kriterijuma za:

- utvrđivanje faktora ugrožavanja,
- beleženje mera koje se sprovode,
- utvrđivanje mera koje je potrebno da se sprovedu i
- definisanje potrebnih istraživanja.

Klasifikaciona šema faktora ugrožavanja prema IUCN (*engl.* Threats Classification Scheme, Version 3.3) uključuje direktne pretnje koje predstavljaju ljudske aktivnosti ili procesi koji su uticali, utiču ili mogu uticati na status taksona koji se procenjuje (npr. neodrživ ribolov ili seča, poljoprivreda, izgradnja stambenih naselja itd.). Direktne pretnje jesu sinonim za izvore stresa i neposrednih pritisaka.

Pri korišćenju hijerarhijske klasifikacije uzroka opadanja brojnosti vrsta, od procenjivača se traži da ukažu na pretnje sa najnižeg mogućeg hijerarhijskog nivoa. Ove pretnje su se možda dešavale u prošlosti ("istorijske, malo je verovatno da će se vratiti" ili "istorijske, verovatno će se vratiti"), ili mogu biti "u toku", ili će se verovatno dogoditi u "budućnosti", koristeći vremenski okvir od tri generacije ili deset godina (ono što je duže, do maksimalno 100 godina u budućnosti), kako to zahtevaju kriterijumi IUCN Crvene liste ugroženih vrsta. "Glavne pretnje" koje se pominju u "Potrebnim i preporučenim pratećim informacijama za procene IUCN Crvene liste" jesu pretnje kodirane kao pretnje sa visokim ili srednjim uticajima.

U Prilogu 1 prikazana je klasifikaciona šema faktora ugrožavanja navedenih za vrste riba koje su uključene u ovu knjigu (ostali faktori koji se ne odnose na te vrste nisu navedeni) prema trenutno važećoj verziji (https://www.iucnredlist.org/resources/threat-classification-scheme).

Klasifikaciona šema mera zaštite koje se sprovode (*engl.* Conservation Actions in Place Classification Scheme, Version 2.0) obuhvata set kriterijuma za beleženje mera zaštite koje se već sprovode. Cilj je prikupljanje osnovnih informacija o tome koje se mere zaštite trenutno primenjuju, da bi se obezbedile smernice potrebnih mera zaštite koje treba da se sprovedu u budućnosti. Trenutno važeća verzija šeme (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_conservation_actions_in_place_classification_scheme.pdf) prikazana je u Prilogu 2.

Klasifikaciona šema predloženih mera zaštite prema IUCN (*engl.* Conservation Actions Classification Scheme, Version 2.0) obuhvata set kriterijuma za utvrđivanje potrebnih mera i aktivnosti koje je realno moguće ostvariti u narednom periodu od pet godina. Pri korišćenju ove šeme, od procenjivača se traži da naznače akcije ili mere očuvanja koje su potrebne za određenu biljnu ili životinj-

3.4. IUCN red list classification schemes

To allow the underlying data to be analysed and to ensure uniformity when describing the habitat in which a taxon occurs, the threats to a taxon, what conservation actions are in place or are needed and whether or not the taxon is utilized, a set of standard terms (Classification Schemes) have been developed for documenting taxa on the IUCN Red List.

Classification schemes (https://www.iucnredlist.org/resources/classification-schemes) contain a set of standard criteria for:

- Threats,
- Conservation actions in place,
- Conservation actions needed,
- Research needed.

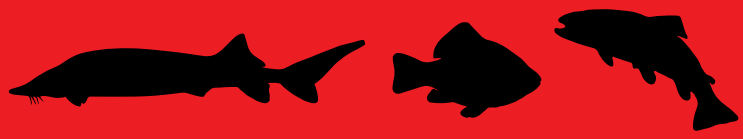
The **IUCN Threats Classification Scheme** (Version 3.3) includes direct threats from proximate human activities or processes that have impacted, are impacting or may impact the status of the taxon being assessed (e.g. unsustainable fishing or logging, agriculture, housing developments, etc.). Direct threats are synonymous with sources of stress and proximate pressures.

In using this hierarchical classification of the drivers of species decline, Assessors are asked to indicate the threats that triggered the listing of the taxon concerned at the lowest level possible. These threats may have occurred in the past ("historical, unlikely to return" or "historical, likely to return"); or may be "ongoing"; or may be likely to occur in the "future", using a time frame of three generations or ten years (whichever is the longer, up to a maximum of 100 years in the future), as required by the IUCN Red List Criteria. The 'Major Threats' referred to in the 'Required and Recommended Supporting Information for IUCN Red List Assessments', are threats coded as having High or Medium impacts.

Appendix 1 shows the classification scheme for the threat factors listed for the fish species covered in this book (other factors not related to these species are not listed), according to the version currently in force (https://www.iucnredlist.org/resources/threat-classification-scheme).

The **IUCN Conservation Actions in Place Classification Scheme** (Version 2.0) provides a set of criteria for recording conservation actions that are already being implemented. The intention of this scheme is to gather basic information about what conservation actions are currently in place to provide some guidance on what conservation actions are needed to be implemented in the future. The current version of the scheme (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_conservation_actions_in_place_classification_scheme.pdf) is shown in the Appendix 2.

The **IUCN Conservation Actions Classification Scheme** (Version 2.0), provides a set of interventions that need to be undertaken to help improve the conservation status of the taxon being assessed, as a set of realistic key actions that can be achieved in the next five years. Assessors are asked to use this Classification Scheme to indicate the conservation actions or measures that are needed for the plant or animal concerned. In suggesting what actions are needed, assessors are asked to be realistic and not simply select everything.



sku vrstu. U predlaganju potrebnih radnji, od procenjivača se traži da budu realni i da ne odaberu sve predložene mere zaštite. Treba odabrati one akcije koje su najhitnije, najznačajnije i najvažnije, a koje se realno mogu ostvariti u narednih pet godina. Potrebne akcije takođe treba da budu zasnovane na aktivnostima očuvanja koje se već sprovode. Klasifikaciona šema predloženih mera zaštite prema trenutno važećoj verziji (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_conservation_actions_needed_classification_scheme.pdf) prikazana je u Prilogu 3.

Klasifikaciona šema predloženih naučnih istraživanja prema IUCN (*engl.* Research Needed Classification Scheme, Version 2.0) obuhvata set kriterijuma za utvrđivanje istraživanja koje je potrebno sprovesti za dati takson. Treba odabrati teme istraživanja za procenu stanja taksona koje je realno moguće ostvariti u narednom periodu od pet godina. Pri korišćenju ove šeme, od procenjivača se traži da ukažu na istraživanja koja su neophodna za određeni takson. U predlaganju potrebnih istraživanja, od procenjivača se traži da budu realni i da ne odaberu sve predložene kategorije istraživanja. Izbor treba da bude usmeren ka onim kategorijama istraživanja koje su najpotrebnije za poboljšanje statusa taksona koji se procenjuje i koja bi realno mogla da se ostvare u narednih pet godina. Hijerarhijska struktura klasifikacione šeme predloženih naučnih istraživanja prema trenutno važećoj verziji (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_research_needed_classification_scheme.pdf) prikazana je u Prilogu 4.

3.5. Izvori i struktura podataka za procene konzervacionih statusa vrsta riba u Srbiji

Nove procene statusa ugroženosti urađene su na osnovu analize objedinjenog seta od 14.920 georeferenciranih podataka o rasprostranjenju riba u Srbiji koji su integrisani u *Bazu podataka o distribuciji potencijalno ugroženih vrsta Srbije* (Lakušić, 2020). Baza je formirana u okviru projekata *Pribavljanje podataka i druge usluge u cilju nastavka uspostavljanja ekološke mreže u Republici Srbiji* i *Pribavljanje podataka i druge usluge u cilju nastavka izrade crvenih lista pojedinačnih grupa organizama flore, faune i gljiva u Republici Srbiji*, koje je u periodu od 2015. do 2019. godine realizovao Biološki fakultet Univerziteta u Beogradu, za potrebe Zavoda za zaštitu prirode Srbije, kao i na osnovu ličnog iskustva saradnika koji su vršili analize. Procene su urađene u *Aplikaciji za procenu ugroženosti vrsta u Srbiji prema IUCN kriterijumima* (Niketić, 2021), koja je formirana u sklopu aktivnosti na nastavku izrade crvenih knjiga i crvenih lista pojedinačnih grupa organizama u Srbiji.

Karte su generisane na osnovu dostupnih literaturnih podataka i rezultata višegodišnjih terenskih istraživanja autora. Obim rasprostranjenja (EOO), odnosno veličina prostora na kome se vrsta pojavljuje, definisan je konturnim arealom koji obuhvata sve poznate lokalitete na kojima je vrsta zabeležena, a izračunat je pomoću minimalnog konveksnog poligona, tj. najmanjeg poligona kod koga su svi unutrašnji uglovi manji od 180° i unutar koga se nalaze svi utvrđeni lokaliteti. Površina naseljavanja (AOO), odnosno veličina zauzete površine u okviru obima rasprostranjenja, izračunata je preko mreže UTM kvadrata 2×2 km², kao zbir površina onih kvadrata

The selection should be for those actions that are most urgent, significant and important; and that they could realistically be achieved within the next five years. The actions needed should also be informed by the conservation actions already in place. The current version of the scheme (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_conservation_actions_needed_classification_scheme.pdf) is shown in the Appendix 3.

The **IUCN Research Needed Classification Scheme** (Version 2.0) contains a list of the research needs with definitions, examples and guidance notes on using the system. The purpose of this scheme is to record what additional research is required for the taxon being assessed. Assessors are asked to use this Classification Scheme to indicate the research that is needed on the taxon concerned. In suggesting what research is needed, assessors are asked to be realistic and not simply select every proposed research category. The selection should be for those research subjects that are most needed to improve the status of the taxon being assessed and that could realistically be achieved within the next five years. The current version of the scheme (https://nc.iucnredlist.org/redlist/content/attachment_files/dec_2012_guidance_research_needed_classification_scheme.pdf) is shown in the Appendix 4.

3.5. Data sources and data structure for conservation status assessment of fish species in Serbia

New threat status assessments were made based on the analysis of a unified set of 14,920 georeferenced fish distribution data in Serbia, which were integrated into the *Database on the distribution of potentially threatened species in Serbia* (Lakušić, 2020). The database was created within the framework of the projects *Procurement of data and other services for further development of an ecological network in the Republic of Serbia* and *Procurement of data and other services for further development of the Red Lists of individual groups of organisms of the of flora, fauna and fungi in the Republic of Serbia*, carried out in the period from 2015 to 2019 by the Faculty of Biology of the University of Belgrade for the Institute for Nature Conservation of Serbia, as well as based on the personal experience of the collaborators who carried out the analyses. The assessments were made within the *Application for species threat assessment in Serbia according to IUCN criteria* (Niketić, 2021), which was prepared as part of the activities for the further development of Red Books and Red Lists of individual groups of organisms in Serbia.

The maps were generated on the basis of the available literature data and the results of several years of field research by the authors. The extent of occurrence (EOO), i.e. the measure of geographic range size in which the species occurs, is defined by the contour area encompassing all known localities where the species has been recorded and is calculated using the minimum convex polygon (the smallest polygon with no internal angles >180°), containing all the sites of occurrence. The area of occupancy (AOO), i.e. the size of the range within the extent of occurrence, was calculated using a UTM square grid of 2×2 km² as the sum of the grid cells comprising one or more localities (or their parts) (Lazarević *et al.*, 2016).

For a large number of species in Serbia, there are no data to esti-

koji obuhvataju jedno ili nekoliko nalazišta (ili njihovih delova) (Lazarević *et al*., 2016).

Za veliki broj vrsta u Srbiji ne postoje podaci o proceni veličine populacije i populacionih trendova. Pri izradi programa upravljanja ribarskim područjima vrše se procene populacija ekonomski značajnih vrsta, ali i to najčešće na osnovu samo jednog uzorkovanja. Zbog toga su podaci o populacionim trendovima u okviru Crvene knjige dati na osnovu IUCN procena, kao i terenskih iskustava samih autora.

3.6. Procena ugroženosti riba u Srbiji

Procene statusa ugroženosti svih 90 autohtonih vrsta riba koje su registrovane u Srbiji tokom prikupljanja podataka za potrebe ove knjige prikazane su u Tabeli 8. Najveći broj vrsta zadržao je istu kategoriju koju ima i na globalnom nivou (46 vrsta). Za 32 vrste dodeljena je viša kategorija zaštite u Srbiji nego na globalnom nivou, dok je za dve vrste dodeljena niža kategorija zaštite (šaran *Cyprinus carpio* i skadarska krkuša *Gobio skadarensis*). Jedina vrsta neprikladna za procenu (NA) bila je *Pungitius platygaster* (ukrajinska koljuška) za koju postoji samo jedan istorijski nalaz u Dunavu kod Beograda iz 1953. godine (Taler, 1953), tako da se kriterijumi za procenu ugroženosti nisu mogli primeniti. Na Slici 21 prikazana je procentualna zastupljenost vrsta po kategorijama ugroženosti u Srbiji.

Prethodnu procenu statusa ugroženosti vrsta riba u Srbiji prema IUCN kategorijama uradio je Simonović (2001). Od današnjeg,

mate population size and population trends. When developing fisheries management programmes, populations of commercially important species are assessed, but this is usually based on one sample only. Therefore, the data on population trends in this Red Book are based on IUCN estimates and the authors' own experience in the field.

3.6. Threat status assessment of fish species in Serbia

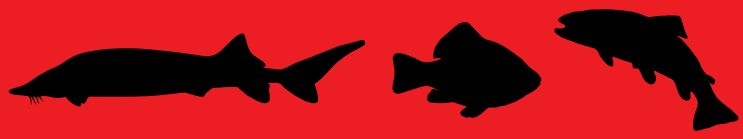
Estimates of the threat status of all 90 native fish species recorded in Serbia during the data collection for this book are presented in Table 8. Most species remained in the same category as at the global level (46 species). For 32 species, a higher threat category was assigned in Serbia than at the global level, while two species were downlisted (common carp *Cyprinus carpio* and Skadar gudgeon *Gobio skadarensis*). The only species unsuitable for assessment (NA) was *Pungitius platygaster* (Ukrainian stickleback), for which there is only one historical record in the Danube near Belgrade from 1953 (Thaler, 1953), so that the threat assessment criteria could not be applied. Figure 21 shows the percentage distribution of species by threat category in Serbia.

The previous assessment of the threat status of fish species in Serbia according to the IUCN categories was made by Simonović (2001). Of the number of native species recorded today, twenty years later (90 species), the estimate at that time included 78 native fish species (many of them described as subspecies).

Tabela 8. Procene statusa ugroženosti autohtonih vrsta u Srbiji i na globalnom nivou prema IUCN kriterijumima.

Table 8. Threat status assessments of native species in Serbia and at global level according to IUCN criteria.

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	IUCN STATUS	
			SRBIJA / SERBIA	GLOBALNI / GLOBAL
Petromyzontiformes	Petromyzontidae	*Eudontomyzon danfordi*	NT	LC
		Eudontomyzon mariae	NT	LC
		Eudontomyzon stankokaramani	VU	LC
		Eudontomyzon vladykovi	NT	LC
Acipenseriformes	Acipenseridae	*Acipenser gueldenstaedtii*	CR	CR
		Acipenser nudiventris	CR	CR
		Acipenser ruthenus	EN	VU
		Acipenser stellatus	CR	CR
		Acipenser sturio	RE	CR
		Huso huso	CR	CR
Anguilliformes	Anguillidae	*Anguilla anguilla*	CR	CR
Clupeiformes	Clupeidae	*Alosa immaculata*	CR	VU
		Alosa tanaica	DD	LC



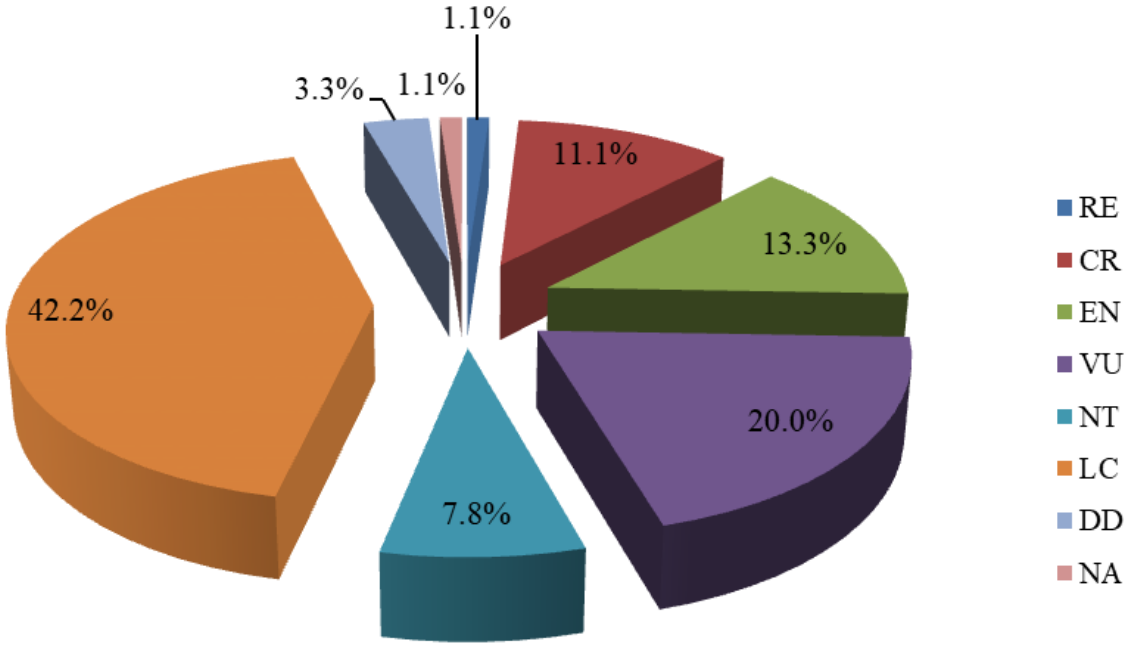
RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	IUCN STATUS	
			SRBIJA / SERBIA	GLOBALNI / GLOBAL
Cypriniformes	Cobitidae	*Cobitis elongata*	LC	LC
		Cobitis elongatoides	LC	LC
		Cobitis ohridana	CR	LC
		Misgurnus fossilis	VU	LC
		Sabanejewia balcanica	LC	LC
		Sabanejewia bulgarica	DD	LC
		Sabanejewia romanica	CR	NT
	Nemacheilidae	*Barbatula barbatula*	LC	LC
		Barbatula sturanyi	VU	LC
		Oxynoemacheilus bureschi	EN	LC
	Cyprinidae	*Barbus balcanicus*	LC	LC
		Barbus barbus	LC	LC
		Barbus rebeli	VU	LC
		Barbus strumicae	EN	LC
		Carassius carassius	VU	LC
		Cyprinus carpio	LC	VU
	Tincidae	*Tinca tinca*	VU	LC
	Acheilognathidae	*Rhodeus amarus*	LC	LC
	Gobionidae	*Gobio bulgaricus*	EN	LC
		Gobio obtusirostris	LC	LC
		Gobio skadarensis	VU	EN
		Romanogobio kesslerii	LC	LC
		Romanogobio uranoscopus	NT	LC
		Romanogobio vladykovi	VU	LC
	Leuciscidae	*Abramis brama*	LC	LC
		Alburnoides bipunctatus	LC	LC
		Alburnoides ohridanus	VU	VU
		Alburnoides strymonicus	CR	NE
		Alburnoides thessalicus	EN	NE
		Alburnus alburnus	LC	LC
		Alburnus sava	VU	NE
		Alburnus scoranza	VU	LC
		Ballerus ballerus	LC	LC
		Ballerus sapa	LC	LC

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	IUCN STATUS	
			SRBIJA / SERBIA	GLOBALNI / GLOBAL
Cypriniformes	Leuciscidae	*Blicca bjoerkna*	LC	LC
		Chondrostoma nasus	LC	LC
		Chondrostoma ohridanum	VU	-
		Chondrostoma vardarense	EN	NT
		Leucaspius delineatus	LC	LC
		Leuciscus aspius	LC	LC
		Leuciscus idus	LC	LC
		Leuciscus leuciscus	LC	LC
		Leucos basak	EN	LC
		Pachychilon pictum	NT	LC
		Pelecus cultratus	LC	LC
		Phoxinus phoxinus	LC	LC
		Phoxinus strymonicus	EN	EN
		Rutilus rutilus	LC	LC
		Rutilus virgo	LC	LC
		Scardinius erythrophthalmus	LC	LC
		Squalius cephalus	LC	LC
		Squalius platyceps	VU	LC
		Squalius vardarensis	VU	LC
		Telestes souffia	DD	LC
		Vimba vimba	LC	LC
Silurifromes	Siluridae	*Silurus glanis*	LC	LC
Esociformes	Esocidae	*Esox lucius*	NT	LC
	Umbridae	*Umbra krameri*	VU	VU
Salmoniformes	Salmonidae	*Hucho hucho*	EN	EN
		Salmo farioides	EN	NE
		Salmo macedonicus	EN	DD
		Salmo marmoratus	CR	LC
		Salmo trutta	LC	LC
		Thymallus thymallus	EN	LC
Gadiformes	Lotidae	*Lota lota*	LC	LC
Gobiiformes	Gobiidae	*Proterorhinus semilunaris*	LC	LC
Blenniiformes	Blenniidae	*Salariopsis fluviatilis*	VU	LC

RED / ORDER	PORODICA / FAMILY	VRSTA / SPECIES	IUCN STATUS	
			SRBIJA / SERBIA	GLOBALNI / GLOBAL
Perciformes	Gasterosteidae	*Pungitius platygaster*	NA	LC
	Cottidae	*Cottus gobio*	LC	LC
	Percidae	*Gymnocephalus baloni*	NT	LC
		Gymnocephalus cernua	LC	LC
		Gymnocephalus schraetser	LC	LC
		Perca fluviatilis	LC	LC
		Sander lucioperca	LC	LC
		Sander volgensis	LC	LC
		Zingel streber	VU	LC
		Zingel zingel	VU	LC

Slika 21. Procentualna zastupljenost autohtonih vrsta riba po kategorijama ugroženosti u Srbiji.

Figure 21. Percentage distribution of native species by threat category in Serbia.



dvadeset godina kasnije zabeleženog broja autohtonih vrsta (90 vrsta), tadašnja procena obuhvatila je 78 autohtonih vrsta riba (više njih opisanih kao podvrste). Oko 80% vrsta bilo je svrstano u kategorije LC i DD, a tek nešto oko 14% u kategorije EN i VU (Tabela 9). U fauni riba i danas je najbrojnija kategorija LC, koja čini 42% ukupnog broja vrsta. Međutim, savremenim procenama čak 10 vrsta (11%) prepoznato je kao CR, dok vrste u ovoj visokoj kategoriji ugroženosti nisu postojale u prethodnoj proceni. Broj ugroženih i ranjivih vrsta (EN i VU) porastao je sa 14% na 33%. Razlozi povećanja broja ugroženih vrsta mogu se pripisati pre svega egzaktnijoj primeni IUCN kriterijuma ugroženosti u odnosu na prethodnu procenu, kao i većem broju sistematski prikupljanih podataka tokom rada na projektima *Pribavljanje podataka i druge usluge u cilju nastavka uspostavljanja ekološke mreže u Republici Srbiji* i *Pribavljanje podataka i druge usluge u cilju nastavka izrade crvenih lista pojedinačnih grupa organizama flore, faune i gljiva u Republici Srbiji*, a sigurno da je i uočeni pad kvaliteta većeg broja akvatičnih staništa u Srbiji doprineo pogoršanju statusa populacija mnogih vrsta.

About 80% of the species were categorised as LC and DD, and only about 14% as EN and VU (Table 9). The category LC is still the most common in the fish fauna, accounting for 42% of the total number of species. However, according to the current assessments, no less than 10 species (11%) are recognised as CR, whereas in the last assessment there were no species in this highly threatened category. The number of endangered and vulnerable species (EN and VU) increased from 14% to 33%. The reasons for the increase in the number of threatened species are mainly due to the more accurate application of the IUCN threat criteria compared to the previous assessment, as well as a greater amount of systematically collected data during the work on projects *Procurement of data and other services for further development of an ecological network in the Republic of Serbia* and *Procurement of data and other services for further development of the Red Lists of individual groups of organisms of the of flora, fauna and fungi in the Republic of Serbia*, while the observed decline in the quality of a number of aquatic habitats in Serbia has certainly contributed to the deterioration of the population status of many species.

Tabela 9. Statusi vrsta riba u Srbiji prema IUCN kriterijumima 2001. godine (Simonović, 2001) i danas.

Table 9. Status of fish species in Serbia according to IUCN criteria in 2001 (Simonović, 2001) and today.

IUCN status	2001		2022	
	Broj vrsta / Number of species	(%)	Broj vrsta / Number of species	(%)
RE	0	0	1	1,1
CR	0	0	10	11,1
EN	7	9,0	12	13,3
VU	4	5,1	18	20,0
NT	4	5,1	7	7,8
LC	47	60,3	38	42,2
DD	16	20,5	3	3,3
NA	0	0	1	1,1
Ukupno / Total	78	100	90	100

4

STANIŠTA RIBA U SRBIJI

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FISH HABITATS IN SERBIA

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4. STANIŠTA RIBA U SRBIJI

Nenad Sekulić, Laslo Galamboš i Saša Branković

4.1. Osnovni tipovi staništa

Prema *Generalizovanoj klasifikaciji staništa Srbije* (Lakušić & Lazarević, 2019), koja predstavlja klasifikacioni sistem namenjen potrebama kartiranja staništa u cilju uspostavljanja nacionalne ekološke mreže, uključujući i evropsku Natura 2000 mrežu u Srbiji, ugrožene vrste riba u Srbiji naseljavaju četiri od osam osnovnih tipova staništa, a to su *močvare i tresave* (E), *kopnene površinske vode* (F), *urbana, industrijska i druga veštačka staništa* (H) i *komplekse staništa* (I). U okviru ova četiri osnovna tipa staništa, ribe u Srbiji naseljavaju devet glavnih podtipova staništa, koji predstavljaju drugi nivo klasifikacije po nacionalnim kriterijumima, a to su: *slatke močvare* (E4), *kopnene površinske stajaće vode* (F1), *kopnene površinske tekuće vode* (F2), *obale kopnenih voda* (F3), *veoma veštačke vode* (H9), *tresavski kompleksi* (I1), *močvarni kompleksi* (I2), *obalni kompleksi* (I3) *i kompleksi staništa slobodne vode i dna* (I4).

4.2. Staništa od prioriteta za zaštitu faune riba

U skladu sa *Pravilnikom o kriterijumima za izdvajanje tipova staništa, o tipovima staništa, osetljivim, ugroženim, retkim i za zaštitu prioritetnim tipovima staništa i o merama zaštite za njihovo očuvanje* (Službeni glasnik RS, br. 35/2010) određeni tipovi staništa, prvenstveno u okviru *kopnenih površinskih voda* (F), ali u izvesnoj meri i *močvara i tresava* (E), *urbanih, industrijskih i drugih veštačkih staništa* (H) i *kompleksa staništa* (I), direktno su ili indirektno od značaja i za očuvanje određenih autohtonih vrsta riba i drugih akvatičnih organizama i njihovih zajednica. Neki od ovih tipova staništa prepoznati su kao Natura 2000 i Emerald staništa na međunarodnom nivou, dok su većina retki na području Srbije ili su primarno fragilni usled funkcionalne nepostojanosti i osetljivosti na degradaciju.

Među kopnenim površinskim vodama (F), od značaja su sledeći tipovi staništa:

- površinske stajaće vode (F1), i to stalne oligotrofne (F1.1), mezotrofne (F1.2), eutrofne (F1.3) i distrofne (F1.4) stajaće vode sa određenim zajednicama planktona, bentosa i biljaka (F1.11, F1.12, F1.13, F1.14, F1.15, F1.16, F1.23, F1.25, F1.26, F1.31, F1.32, F1.33, F1.34, F1.35, F1.41, F1.42, F1.43, F1.44, F1.45, F1.46, F1.47, F1.48) i određene privremene stajaće vode (F1.6);
- od kopnenih površinskih tekućih voda (F2), izdvajaju se izvori, vrulje i gejziri (F2.1) sa izvorima slatke tvrde vode (F2.12), kao i stalni, brzi i turbulentni tokovi bez variranja nivoa vode (F2.2) sa epiritralnim i metaritralnim potocima (F2.21) i acidofilnim (F2.25) i bazofilnim oligotrofnim zajednicama brzih potoka (F2.26) i mezotrofnim zajednicama brzih potoka (F2.27);
- u okviru obala kopnenih voda (F3) i srednje visokih i visokih helofita (F3.1), ugrožene su obalne zajednice helofita (F3.11) i tršćaka (F3.12) i srednje visoke ne-travolike

4. FISH HABITATS IN SERBIA

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4.1. Basic habitat types

According to the *Generalized classification of habitats of Serbia* (Lakušić & Lazarević, 2019), a classification system for mapping habitat for the purpose of creating a national ecological network, including the European Natura 2000 network in Serbia, threatened fish species in Serbia inhabit four of the eight basic habitat types, namely: *mires, bogs and fens* (E), *inland surface waters* (F), *constructed, industrial and other artificial habitats* (H) and *habitat complexes* (I). Within these four basic habitat types, fish in Serbia inhabit nine main habitat subtypes, which represent the second level of classification according to national criteria, namely: *base-rich fens and calcareous spring mires* (E4), *inland surface standing waters* (F1), *inland surface running waters* (F2), *littoral zone of inland surface waters* (F3), *highly artificial man-made waters* (H9), *bog complexes* (I1), *wetland complexes* (I2), *littoral zone complexes* (I3), and *bentho-pelagic habitat complexes* (I4).

4.2. Priority habitats for protection of the fish fauna

According to the *Regulation on Criteria for Selection of Habitat Types, on Habitat Types, Sensitive, Endangered, Rare and on Protection of Priority Habitat Types and on Protection Measures for their Preservation* (Official Gazette of RS, no. 35/2010), certain habitat types, mainly in *inland surface waters* (F), but also to some extent in *mires, bogs and fens* (E), in *constructed, industrial and other artificial habitats* (H), and in *habitat complexes* (I), are directly or indirectly important for the conservation of certain native fish species and other aquatic organisms and their communities. Some of these habitat types are internationally recognised as Natura 2000 and Emerald habitats, while most of them are rare in Serbia or are considered particularly vulnerable due to their functional instability and vulnerability to degradation.

Within inland surface waters (F), the following habitat types are important:

- surface standing waters (F1), namely permanent oligotrophic (F1.1), permanent mesotrophic (F1.2), permanent eutrophic (F1.3) and permanent dystrophic standing waters (F1.4) with specific plankton, benthic and plant communities (F1.11, F1.12, F1.13, F1.14, F1.15, F1.16, F1.23, F1.25, F1.26, F1.31, F1.32, F1.33, F1.34 , F1.35, F1.41, F1.42, F1.43, F1.44, F1.45, F1.46, F1.47, F1.48), as well as certain temporary standing waters (F1.6);
- within surface running waters (F2), springs, hot springs and geysers (F2.1) and hard freshwater springs (F2.12) are distinguished as are permanent, non-tidal, fast, turbulent watercourses (F2.2) with epirhithral and metarhithral streams (F2.21) and acid (F2.25) and lime-rich oligotrophic vegetation of fast-flowing streams (F2.26), and mesotrophic vegetation of fast-flowing streams (F2.27);
- within littoral zone of inland surface waters (F3) and water-fringing beds and tall helophytes other than canes (F3.1), species-rich helophyte beds (F3.11) and water-fringing reedbeds and tall

(F3.13) i travolike zajednice (F3.14), višegodišnje (F3.21) i jednogodišnje amfibijske obalne zajednice (F3.22) u okviru amfibijskih obalnih zajednica niskih šaševa i sita (F3.2), kao i muljevite obale slatkih bara i jezera bez vegetacije (F3.35) u okviru obala bez ili sa raštrkanom vegetacijom (F3.3);

- u okviru tipa staništa močvare i tresave (E) i podtipa slatke močvare (E4), izdvajaju se kopneni tršćaci (E4.11) i kopnena rogozišta rogoza (*Typha* spp.) (E4.12), koji su, uz močvarne (I2) i obalne komplekse (I3) iz kompleksa staništa (I), značajni na nacionalnom nivou kao fragilna staništa usled funkcionalne nepostojanosti i osetljivosti na degradaciju.

Mere zaštite za očuvanje određenih tipova staništa obuhvataju niz aktivnosti koje su neophodne za održavanje ili vraćanje prirodnih i poluprirodnih staništa u povoljno stanje. Mere i aktivnosti se planiraju u cilju očuvanja staništa koja su od značaja za zaštitu, kao i u cilju očuvanja odgovarajuće strukture i funkcionalne povezanosti svih podtipova staništa u okviru određenog tipa staništa. Osim toga, mere su od značaja i za očuvanje povoljnog stanja populacija ugroženih vrsta.

4.3. Zaštićena područja i staništa riba

Pojedini planinski, brdsko-planinski i nizijski vodotoci, jezera, akumulacije, kanali, bare, močvare i određena plavna područja predstavljaju akvatične ekosisteme od značaja za očuvanje populacija različitih vrsta riba, te se nalaze pod određenim režimom zaštite unutar zaštićenih područja. U skladu sa *Zakonom o zaštiti prirode* (Službeni glasnik RS, br. 36/2009, 88/2010, 91/2010 – ispr., 14/2016, 95/2018 – dr. zakon, i 71/2021), *Uredbom o režimima zaštite* (Službeni glasnik RS, br. 31/2012) i pojedinačnim aktima o proglašenju zaštićenih područja za nacionalne parkove, predele izuzetnih odlika, parkove prirode, specijalne rezervate prirode, spomenike prirode i zaštićena staništa, staništa riba i njihove zajednice mogu se naći u režimima zaštite prvog, drugog i trećeg stepena zaštite ili u okviru zaštitne zone oko pojedinih zaštićenih područja. U odnosu na ukupan broj od 765 zaštićenih područja koja se trenutno nalaze pod određenim vidom zaštite i koja zauzimaju površinu od 7,81% teritorije Srbije, 65 zaštićenih područja, osim geološke, ekosistemske ili predeone raznovrsnosti, imaju i izraženu biološku komponentu, u okviru koje su i značajna staništa riba.

Akvatični ekosistemi i vlažna područja u kojima su evidentirane određene vrste riba i njihova naselja, među kojima su neka i stavljena pod zaštitu upravo zbog očuvanja pojedinačnih vrsta riba i staništa na kojima se te vrste prirodno mreste, nalaze se u sledećim zaštićenim područjima (Slika 22):

- nacionalni parkovi *Đerdap*, *Fruška gora*, *Šar-planina*, *Tara* i *Kopaonik*;
- predeli izuzetnih odlika Klisura reke *Gradac*, *Miruša*, *Lepterija-Sokograd*, *Veliko ratno ostrvo*, *Ovčarsko-Kablarska klisura*, *Karaš – Nera*, *Vlasina*, *Dolina Pčinje*, *Maljen*, *Željin i Stolovi*;
- predeli naročite prirodne lepote *Deo područja u slivu reka Resave*, *Suvaje*, *Čemernice*, *Jelovog potoka i Beljaničke reke*;
- parkovi prirode *Golija*, *Begečka jama*, *Grmija*, *Sićevačka klisura*, *Radan*, *Zlatibor*, *Beljanska bara*, *Stara planina*, *Palić*, *Stara Tisa kod Bisernog ostrva*, *Tikvara*, *Jegrička*, *Ponjavica*, *Šargan – Mokra Gora* i *Bačkotopolske doline*;

helophytes other than canes (F3.12) are threatened, as well as water-fringing beds of medium-tall non-graminoid helophytes (F3.13), water-fringing beds of medium tall canes (F3.14), perennial (F3.21) and annual amphibious communities (F3.22) within species-poor beds of low-growing water-fringing or amphibious vegetation (F3.2), and unvegetated mud banks of lakes and ponds (F3.35) within unvegetated or sparsely vegetated shores (F3.3);

- within mires, bogs and fens (E) habitat type and base-rich fens and calcareous spring mires (E4) subtype, reedbeds normally without free-standing water (E4.11) and land bulrush (*Typha* spp.) (E4.12) are important at the national level as fragile habitats together with wetland complexes (I2) and littoral zone complexes (I3) within habitat complexes (I), because of their functional instability and susceptibility to degradation.

Conservation measures for the preservation of specific habitat types comprise a range of activities necessary to maintain or restore natural and semi-natural habitats to a favourable condition. The measures and activities are planned with the aim of preserving habitats worthy of protection and maintaining the appropriate structure and functional connectivity of all habitat subtypes within a given habitat type. In addition, the measures are also important to maintain the favourable status of populations of threatened species.

4.3. Protected areas and protected habitats of fishes

Certain mountain, upland and lowland waters, lakes, reservoirs, canals, ponds, wetlands and certain floodplains constitute aquatic ecosystems that are important for maintaining populations of various fish species and are subject to special protection regulation within protected areas. According to the *Law on Nature Protection* (Official Gazette of RS, No. 36/2009, 88/2010, 91/2010 – Corrigendum, 14/2016, 95/2018 – other law, and 71/2021), the *Decree on Protection Regimes* (Official Gazette of RS, No. 31/2012) and individual acts on the designation of protected areas for national parks, landscapes of exceptional quality, nature parks, special nature reserves, natural monuments and protected habitats, fish habitats and their assemblages are located in first, second and third degree protection regimes or within the protection zones around certain protected areas. Of the total 765 protected areas currently under some form of protection, covering an area of 7.81% of Serbia, 65 protected areas have, in addition to geological, ecosystem or landscape diversity, a distinct biological component, which includes important fish habitats.

Aquatic ecosystems and wetlands where specific fish species and their habitats have been identified, some of which have been placed under protection precisely because of the conservation of individual fish species and the habitats where these species naturally spawn, are located in the following protected areas (Figure 22):

- National parks (NP): *Đerdap*, *Fruška gora*, *Šar-planina*, *Tara* and *Kopaonik*;
- Landscapes of exceptional quality (PIO): *Gradac River Gorge*, *Miruša*, *Lepterija-Sokograd*, *Great War Island*, *Ovčar-Kablar Gorge*, *Karaš – Nera*, *Vlasina*, *Pčinja Valley*, *Maljen*, *Željin* and *Stolovi*;
- Landscapes of exceptional natural beauty: *Part of River Watershed of the Resava*, *Suvaja*, *Čemernica*, *Jelov potok* and *Beljanička reka*;

- specijalni rezervati prirode *Obedska bara*, *Jelašnička klisura*, *Gornje Podunavlje*, *Klisura reke Trešnjice*, *Deliblatska peščara*, *Ludaško jezero*, *Goč-Gvozdac*, *Uvac*, *Suva planina*, *Kraljevac*, *Peštersko polje*, *Brzansko Moravište*, *Klisura reke Mileševke*, *Osredak*, *Jerma*, *Rtanj*, *Koviljsko-petrovaradinski rit*, *Carska bara*, *Karađorđevo*, *Ritovi Donjeg Potisja* i *Zasavica*;
- spomenici prirode *Vrelo Mlave*, *Krupajsko vrelo*, *Vodopad Lisine*, *Lazarev kanjon*, *Krupačko vrelo*, *Klisura Osaničke reke*, *Vrelo Grze* i *Jovačka jezera*;
- opšti rezervat prirode *Vinatovača*;
- zaštićena staništa *Pančevačke ade*, *Bara Trskovača* i *Veliko blato*.

- Nature parks (PP): *Golija*, *Begečka jama*, *Grmija*, *Sićevo Gorge*, *Radan*, *Zlatibor*, *Beljanska bara*, *Stara planina*, *Palić*, *Stara Tisa near the Pearl Island*, *Tikvara*, *Jegrička*, *Ponjavica*, *Šargan – Mokra Gora* and *Bačkotopolske Valleys*;
- Special nature reserves (SRP): *Obedska bara*, *Jelašnička Gorge*, *Gornje Podunavlje*, *Trešnjica River Gorge*, *Deliblatska peščara*, *Ludaško Lake*, *Goč-Gvozdac*, *Uvac*, *Suva Planina*, *Kraljevac*, *Peštersko polje*, *Brzansko Moravište*, *Mileševka River Gorge*, *Osredak*, *Jerma*, *Rtanj*, *Kovilj-Petrovaradin Marsh*, *Carska bara*, *Karađorđevo*, *Donje Potisje Marshes* and *Zasavica*;
- Natural monuments: *Mlava Spring*, *Krupaj Spring*, *Lisine Waterfall*, *Lazar's Canyon*, *Krupačko Spring*, *Osanička River Gorge*, *Grza Spring* and *Jovačka Lakes*;

Slika 22. Primeri ribarskih područja u zaštićenim prirodnim dobrima: (a) akumulacija „Bajina Bašta" („Perućac"), Ribarsko područje u Nacionalnom parku „Tara" (foto: A. Hegediš); (b) Gradac na lokalitetu Šareno platno, Ribarsko područje u Predelu izuzetnih odlika „Klisura reke Gradac" (foto: A. Hegediš); (c) Ponjavica, Ribarsko područje u Parku prirode „Ponjavica" (foto: M. Jaćimović); (d) Akumulacija „Zlatarsko jezero", Ribarsko područje u Specijalnom rezervatu prirode „Uvac" (foto: A. Hegediš).

Figure 22. Examples of fishing areas in protected natural assets: (a) Reservoir "Bajina Bašta" ("Perućac"), Fishing area in the National Park "Tara" (photo: A. Hegediš); (b) Gradac at the site Šareno platno, Fishing area in the Landscape of Exceptional Quality "Gradac River Gorge" (photo: A. Hegediš); (c) Ponjavica, Fishing area in the Nature Park "Ponjavica" (photo: M. Jaćimović); (d) Reservoir "Zlatarsko jezero", Fishing area in the Special Nature Reserve "Uvac" (photo: A. Hegediš).

Osim navedenih zaštićenih područja, unutar granica područja koja su predložena za zaštitu, kao što su NP *Kučaj – Beljanica*, PP *Mojstirsko-Draške planine*, PP *Mrtvaje gornjeg Potisja*, PP *Donja Mostonga*, PIO *Kanjiški jaraši*, PIO *Potamišje*, PIO *Vardenik – Strešer*, PIO *Ada Ciganlija*, PIO *Forland leve obale Dunava kod Beograda*, SRP *Krupačko blato* i SRP *Veliki Rzav*, takođe se nalaze vodene površine od značaja za očuvanje autohtone ihtiofaune i njenih staništa.

4.4. Ribarska područja i posebna staništa riba

U skladu sa važećim *Zakonom o zaštiti i održivom korišćenju ribljeg fonda*, u Srbiji je ustanovljeno 17 ribarskih područja utvrđenih *Rešenjem o ustanovljavanju ribarskih područja* (Službeni glasnik RS, br. 90/2015): *Južna Morava 1*, *Južna Morava 2*, *Rasina*, *Ibar*, *Zapadna Morava*, *Sava*, *Kolubara*, *Beograd*, *Velika Morava 2*, *Velika Morava 1*, *Mlava*, *Timok*, *Dunav*, *Banat*, *Srem*, *Bačka* i *Kosovo* (Slika 23).

Osim njih, ustanovljeno je i 38 ribarskih područja unutar zaštićenih područja, a to su: Nacionalni park (NP) *Đerdap*, NP *Kopaonik*, NP *Tara*; Predeo izuzetnih odlika (PIO) *Ovčarsko-Kablarska klisura*, PIO *Veliko ratno ostrvo*, PIO *Vlasina*, PIO *Gradac*, PIO *Dolina Pčinje*, PIO *Karaš-Nera*; Park prirode (PP) *Golija*, *PP Zlatibor*, PP *Lepterija – Sokograd*, PP *Sićevačka klisura*, PP *Radan*, PP *Tikvara,* PP *Begečka jama*, PP *Palić*, PP *Bačkotopolske doline*, PP *Beljanska bara*, PP *Stara Tisa kod Bisernog ostrva*, PP *Jegrička*, PP *Ponjavica*; Specijalni rezervat prirode (SRP) *Uvac*, PP *Stara planina*, SRP *Jerma*, SRP *Jelašnička klisura*, SRP *Gornje Podunavlje*, SRP *Ludaško jezero*, SRP *Karađorđevo*, SRP *Koviljsko-petrovaradinski rit*, SRP *Ritovi donjeg Potisja*, SRP *Carska bara*, SRP *Obedska bara*, SRP *Zasavica*, SRP *Kraljevac*, SRP *Deliblatska peščara* i Zaštićeno stanište *Bara Trskovača*.

Sva navedena područja čine prirodne ili veštačke tekuće i stajaće ribolovne vode ili njihove delove, i predstavljaju hidrološke, biološke i ekonomske celine za zaštitu i održivo korišćenje ribljeg fonda. U odnosu na svako pojedinačno ribarsko područje, njihovi korisnici u obavezi su da, u skladu sa pomenutim *Zakonom*, programima upravljanja ribarskim područjima odrede pojedine ribolovne vode ili njihove delove za posebna staništa koja su značajna za biološke potrebe riba, kao što su: mrest, zimovanje, rast, ishrana i kretanje/migracija riba. Na osnovu preliminarnih analiza ovih planskih dokumenata za ribarska područja u centralnoj Srbiji, ustanovljeno je da je na 28 ribarskih područja ukupno izdvojeno preko 150 lokaliteta za posebna staništa ribljeg fonda. Na 23 ribarska područja u Vojvodini (Banat, Bačka, Srem i 20 ribarskih područja na zaštićenim područjima) izdvojeno je preko 75 posebnih staništa riba.

Očuvanje ovih staništa, za koje su utvrđeni prostorni raspored, granice i mere, od posebnog je značaja, jer je u njima trajno zabranjen svaki vid ribolova (izuzev u naučno-istraživačke svrhe), kao i sve aktivnosti koje ometaju mrest, razvoj i kretanje riba. Među zabranjenim aktivnostima jesu i vađenje peska, šljunka, kamenja i panjeva, kao i preduzimanje radnji kojima se, narušavanjem ekoloških odlika ribolovnih voda, ugrožava riblji fond.

- General nature reserve: *Vinatovača*;
- Protected habitats: *Pančevačka ada*, *Bara Trskovača* and *Veliko blato*.

In addition to the above-mentioned protected areas, there are also waterbodies within the boundaries of the areas proposed for protection, such as NP *Kučaj – Beljanica*, PP *Mojstirsko-Draške Mts.*, PP *Mrtvaje Gornjeg Potisja*, PP *Donja Mostonga*, PIO *Kanjiški jaraši*, PIO *Potamišje*, PIO *Vardenik – Strešer*, PIO *Ada Ciganlija*, PIO *Forland of the left bank of the Danube near Belgrade*, SRP *Krupačko blato* and SRP *Veliki Rzav*, which are also important for the conservation of native fish fauna and their habitats.

4.4. Fishing areas and special fish habitats

In accordance with the current *Law on Protection and Sustainable Use of Fish Stocks*, 17 fishing areas have been established in Serbia, determined by the *Decision on Fishery Areas Allotment* (Official Gazette of RS, No. 90/2015): *South Morava 1*, *South Morava 2*, *Rasina*, *Ibar*, *West Morava*, *Sava*, *Kolubara*, *Belgrade*, *Great Morava 2*, *Great Morava 1*, *Mlava*, *Timok*, *Danube*, *Banat*, *Srem*, *Bačka* and *Kosovo* (Figure 23).

In addition, 38 fishing areas were established within the protected areas, namely: National Park (NP) *Đerdap*, NP *Kopaonik*, NP *Tara*; Landscape of exceptional quality (PIO) *Ovčar-Kablar Gorge*, PIO *Great War Island*, PIO *Vlasina*, PIO *Gradac*, PIO *Pčinja Valley*, PIO *Karaš-Nera*; Nature Park (PP) *Golija*, PP *Zlatibor*, PP *Lepterija – Sokograd*, PP *Sićevo Gorge*, PP *Radan*, PP *Tikvara*, PP *Begečka jama*, PP *Palić*, PP *Bačkotopolske Valleys*, PP *Beljanska bara*, PP *Stara Tisa near the Pearl Island*, PP *Jegrička*, PP *Ponjavica*; Special Nature Reserve (SRP) *Uvac*, PP *Stara planina*, SRP *Jerma*, SRP *Jelašnička Gorge*, SRP *Gornje Podunavlje*, SRP *Ludaško Lake*, SRP *Karađorđevo*, SRP *Kovilj-Petrovaradin Marsh*, SRP *Donje Potisje Marshes*, SRP *Carska bara*, SRP *Obedska bara*, SRP *Zasavica*, SRP *Kraljevac*, SRP *Deliblatska peščara* and Protected habitat *Bara Trskovača*.

All of the above-mentioned areas are natural or artificial running and standing fishing waters or parts thereof, which are hydrological, biological and commercial units for the protection and sustainable use of fish stocks. In relation to each individual fishing area, the aforementioned *Law* requires users to designate in the fisheries management programmes certain fishing waters or parts thereof as special habitats important for the biological requirements of fish, such as: spawning, overwintering, growth, feeding and movement/migration. The preliminary analysis of these planning documents for fisheries areas in central Serbia showed that in 28 fisheries areas a total of more than 150 sites were designated as special fish habitats. In 23 fishing areas in Vojvodina (Banat, Bačka, Srem and 20 fishing areas in protected natural assets), more than 75 special fish habitats were designated.

The conservation of these habitats, for which the spatial layout, boundaries and measures have been established, is of particular importance, as all types of fishing (except for scientific and research purposes) and all activities affecting fish spawning, development and movement are permanently prohibited in these areas. Prohibited activities include the extraction of sand, gravel, stones and tree stumps, as well as all actions that threaten the fish stock by disturbing the ecological characteristics of the fishing waters.

Slika 23. Primeri ribolovnih voda na ribarskim područjima: (a) Sava kod Umke, Ribarsko područje "Beograd"; (b) Savsko jezero, Ribarsko područje "Kolubara"; (c) Zapadna Morava kod Guglja, Ribarsko područje "Zapadna Morava"; (d) Mlava nizvodno od Žagubice, Ribarsko područje "Mlava" (foto: A. Hegediš).

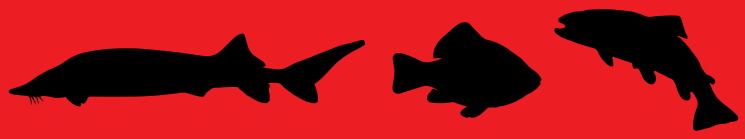
Figure 23. Examples of fishing areas: (a) Sava near Umka, Fishing area "Belgrade"; (b) Lake Sava, Fishing area "Kolubara"; (c) West Morava near Gugalj, Fishing area "West Morava"; (d) Mlava downstream from Žagubica, Fishing area "Mlava" (photo: A. Hegediš).

4.5. Ekološki značajna područja i ekološki koridori ekološke mreže Srbije u funkciji zaštite faune riba

Za potrebe uspostavljanja ekološke mreže Republike Srbije, a u cilju očuvanja biološke i predeone raznovrsnosti, održivog korišćenja i obnavljanja prirodnih resursa i dobara i očuvanja određenih tipova staništa i staništa divljih vrsta u povoljnom stanju, *Uredbom o ekološkoj mreži* (Službeni glasnik RS, br. 102/2010) određeno je 101 ekološki značajno područje i 15 vodotoka sa svojim obalskim pojasevima koji predstavljaju ekološke koridore od međunarodnog značaja (Dunav, Tisa, Sava, Drina, Južna Morava, Velika Morava, Tamiš, Kereš, Zlatica, Karaš, Nera, Brzava, Moravica, Bosut i Studva). Ova ekološki značajna područja obuhvataju sledeće prostorne celine na kojima se nalaze staništa različitih vrsta riba:

4.5. Role of ecologically important areas and ecological corridors of the ecological network of Serbia in protection of the fish fauna

In order to establish the ecological network of the Republic of Serbia and with the aim of preserving biological and landscape diversity, sustainable use and restoration of natural resources and assets, as well as maintaining certain types of habitats and habitats of wild species in a favourable condition, 101 ecologically significant areas and 15 watercourses with their coastal belts, which are ecological corridors of international importance (Danube, Tisza, Sava, Drina, South Morava, Great Morava, Tamiš, Kereš, Zlatica, Karaš, Nera, Brzava, Moravica, Bosut and Studva), have been designated in the *Regulation on the Ecological Network* (Official Gazette of RS, No.



- određena gorepomenuta zaštićena područja, ali i neka druga područja koja nemaju formalni status zaštite na nacionalnom nivou. Među njima su: Donje Podrinje, ušće Save u Dunav, Mala Vrbica, Kladovo – Radujevac, akumulacija Gruža, Brđanska klisura, Kučajske planine, Gornje Pomoravlje, Mojsinjske planine i Stalaćka klisura, Klisura Ibra, Dolina Malog Rzava, Pešter, Ćelije i Prokletije – Sitnica;
- područja od posebnog interesa za očuvanje, odnosno područja u okviru Emerald ekološke mreže, izdvojena na osnovu Bernske konvencije Saveta Evrope (*Zakon o potvrđivanju Konvencije o očuvanju evropske divlje flore i faune i prirodnih staništa*, Službeni glasnik RS – Međunarodni ugovori, broj 102/2007). U odnosu na vrste riba koje su navedene u Rezoluciji 6. Bernske konvencije (Council of Europe, 1998), a prisutne su u Srbiji: *Alburnus sava* (navedena kao *Chalcalburnus chalcoides*), *Alosa* spp., *Barbus balcanicus* (navedena kao *B. meridionalis*), *Cobitis elongatoides* (navedena kao *C. taenia*), *Cottus gobio*, *Eudontomyzon* spp., *Gymnocephalus schraetser* (navedena kao *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (navedena kao *Aspius aspius*), *Misgurnus fossilis*, *Rhodeus amarus* (navedena kao *R. sericeus amarus*), *Romanogobio uranoscopus* (navedena kao *Gobio uranoscopus*), *Romanogobio vladykovi* (navedena kao *Gobio albipinnatus*), *Rutilus virgo* (navedena kao *R. pigus*), *Sabanejewia balcanica* i *S. bulgarica* (navedene kao *S. aurata*), *Salmo marmoratus*, *Telestes souffia* (navedena kao *Leuciscus souffia*) i *Zingel* spp., do sada je u okviru Emerald mreže identifikovano 37 potencijalnih Emerald područja: Gornje Podunavlje, Obedska bara, Deliblatska peščara, Vlasina, Tara, Stara planina, Đerdap, Ludaško jezero, Zasavica, dolina Pčinje, Šargan – Mokra gora, Suva planina, Jelašnička klisura, Koviljsko-petrovaradinski rit, Stari begej – Carska bara, klisura reke Uvac, klisura reke Mileševke, Rtanj, Palić, Golija, Sićevačka klisura, Ovčarsko-Kablarska klisura, Zlatibor, Jerma, Suvobor, Pešter, Karađorđevo, klisura reke Trešnjice, Lazarev kanjon, Vinatovača, klisura Osaničke reke, Tikvara, klisura reke Gradac, Kučajske planine, Pančevačke ade, Zaovine i Radan. Ovde treba napomenuti da je revizijom Dodatka I Rezolucije 6. (Council of Europe, 2011) obuhvaćeno još pet vrsta riba koje su prisutne u Srbiji i za koje je takođe potrebno izdvojiti područja sa ciljem očuvanja samih vrsta i njihovih staništa: *Cobitis elongata*, *Gymnocephalus baloni*, *Pelecus cultratus*, *Romanogobio kesslerii* (navedena kao *Gobio kessleri*) i *Umbra krameri*;
- deset od ukupno 11 Ramsarskih područja u Srbiji (Peštersko polje, Gornje Podunavlje, Koviljsko – petrovaradinski rit, Labudovo okno, Ludaško jezero, Obedska bara, Stari Begej – Carska bara, Vlasina, Zasavica i Đerdap) koja se nalaze na listi Ramsarske konvencije (*Uredba o ratifikaciji Konvencije o močvarama koje su od međunarodnog značaja, naročito kao staništa ptica močvarica*, Službeni list SFRJ – Međunarodni ugovori, br. 9/1977) (Slika 24);
- dva Rezervata biosfere (*Golija – Studenica* i *Bačko Podunavlje*) proglašena pod UNESCO MaB Programom

102/ 2010) These ecologically significant areas include the following spatial units, which contain habitats for various fish species:

- some of the aforementioned protected areas, but also some other areas that do not have a formal protection status at the national level. These include: Donje Podrinje, confluence of the Sava and Danube, Mala Vrbica, Kladovo – Radujevac, Reservoir Gruža, Brđani Gorge, Kučaj Mts., Gornje Pomoravlje, Mojsinje Mts. and Stalać Gorge, Ibar Gorge, Mali Rzav Valley, Pešter, Ćelije and Prokletije – Sitnica;
- areas of special conservation interest, i.e. areas within the Emerald Ecological Network designated on the basis of the Bern Convention of the Council of Europe (*Law on Ratification of the Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats*, Official Gazette of RS – International Treaties, No. 102/2007). With regard to the fish species listed in Resolution 6 of the Bern Convention (Council of Europe, 1998), which occur in Serbia: *Alburnus sava* (listed as *Chalcalburnus chalcoides*), *Alosa* spp., *Barbus balcanicus* (listed as *B. meridionalis*), *Cobitis elongatoides* (listed as *C. taenia*), *Cottus gobio*, *Eudontomyzon* spp., *Gymnocephalus schraetser* (listed as *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (listed as *Aspius aspius*), *Misgurnus fossilis*, *Rhodeus amarus* (listed as *R. sericeus amarus*), *Romanogobio uranoscopus* (listed as *Gobio uranoscopus*), *Romanogobio vladykovi* (listed as *Gobio albipinnatus*), *Rutilus virgo* (listed as *R. pigus*), *Sabanejewia balcanica* and *S. bulgarica* (listed as *S. aurata*), *Salmo marmoratus*, *Telestes souffia* (listed as *Leuciscus souffia*) and *Zingel* spp., to date, 37 potential Emerald sites have been identified within the Emerald Network: Gornje Podunavlje, Obedska bara, Deliblatska peščara, Vlasina, Tara, Stara planina, Đerdap, Ludaško Lake, Zasavica, Pčinja Valley, Šargan – Mokra gora, Suva planina, Jelašnička gorge, Kovilj-Petrovaradin Marsh, Stari Begej – Carska bara, Uvac River Gorge, Mileševka River Gorge, Rtanj, Palić, Golija, Sićevačka gorge, Ovčar-Kablar Gorge, Zlatibor, Jerma, Suvobor, Pešter, Karađorđevo, Trešnjica River Gorge, Lazar's Canyon, Vinatovača, Osanička River Gorge, Tikvara, Gradac River Gorge, Kučaj Mts., Pančevačke ade, Zaovine and Radan. It should be noted here that the revision of Annex I of Resolution 6 (Council of Europe, 2011) included five additional fish species that occur in Serbia and for which areas must also be designated in order to conserve these species and their habitats: *Cobitis elongata*, *Gymnocephalus baloni*, *Pelecus cultratus*, *Romanogobio kesslerii* (listed as *Gobio kessleri*) and *Umbra krameri*;
- ten of a total of 11 Ramsar sites in Serbia (Peštersko polje, Gornje Podunavlje, Kovilj-Petrovaradin Marshes, Labudovo okno, Ludaško Lake, Obedska bara, Stari Begej – Carska bara, Vlasina, Zasavica and Đerdap), which are on the list of the Ramsar Convention (*Decree on the Ratification of the Convention on Wetlands of International Importance, Especially as Waterfowl Habitats*, Official Gazette of SFRY – International Treaties, No. 9/1977) (Figure 24);
- two biosphere reserves (*Golija – Studenica* and *Bačko Podunavlje*) declared under the UNESCO MaB Programme

lje) proglašenih u okviru UNESCO MaB programa (Man and the Biosphere/MaB Programme) *Čovek i biosfera* (Biosphere Reserves), pri čemu se Rezervat biosfere *Bačko Podunavlje*, proglašen 2017. godine, od 2021. godine nalazi u okviru Prekograničnog rezervata biosfere Mura–Drava–Dunav.

Uredbom o ekološkoj mreži, osim mera zaštite divljih vrsta, propisane su i mere zabrane uništavanja i narušavanja njihovih staništa, promene namene površina pod prirodnom i poluprirodnom vegetacijom, promene morfoloških i hidroloških osobina područja od kojih zavisi funkcionalnost koridora, kao i mere sprečavanja, odnosno smanjenja, kontrole i sanacije svih oblika zagađivanja.

Osim navedenih područja, *Uredbom* je definisano da ekološki koridori mogu biti i vodotoci u prirodnom i poluprirodnom stanju, kao i kanali sa poluprirodnom vegetacijom, čije se očuvanje i unapređenje, kroz uslove zaštite prirode, propisuje pri izradi prostornih i urbanističkih planova i planske i projektne dokumentacije.

Man and the Biosphere (Biosphere Reserves), with the *Bačko Podunavlje* Biosphere Reserve declared in 2017 being located in the Mura–Drava–Danube Transboundary Biosphere Reserve as of 2021.

Along with the measures to protect wild species, the *Regulation on the Ecological Network* also provides for measures to prohibit the destruction and disturbance of their habitats, the altered use of areas with natural and semi-natural vegetation, the alteration of the morphological and hydrological characteristics of areas on which the functionality of the corridor depends, and measures to prevent or reduce, control and remediate all forms of pollution.

In addition to the above-mentioned areas, the *Regulation* defines that ecological corridors can also be watercourses in natural and semi-natural state, as well as channels with semi-natural vegetation, the preservation and improvement of which is prescribed by nature conservation requirements in the preparation of spatial and urban plans, as well as planning and project documents.

Slika 24. Primeri Ramsarskih područja u Srbiji: (a) Carska bara (foto: A. Bajić); (b) Zasavica (foto: A. Hegediš); (c) Ludaško jezero (foto: A. Bajić); (d) Obedska bara (foto: A. Hegediš).

Figure 24. Examples of Ramsar sites in Serbia: (a) Carska bara (photo: A. Bajić); (b) Zasavica (photo: A. Hegediš); (c) Ludaško lake (photo: A. Bajić); (d) Obedska bara (photo: A. Hegediš).

4.6. Zaštita staništa strogo zaštićenih i zaštićenih vrsta riba

U svim navedenim zaštićenim područjima, područjima predloženim za zaštitu, ekološki značajnim područjima i ekološkim koridorima nalaze se određene vodene površine koje nastanjuju populacije različitih vrsta riba. Osim toga, u njima se nalaze i staništa nekih od 67 vrsta riba koje se nalaze u prilozima *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* (Službeni glasnik RS, br. 5/2010, 47/2011, 32/2016 i 98/2016), među kojima 38 ima status strogo zaštićenih, a 29 status zaštićenih vrsta (Slika 25). Samo neka od zaštićenih područja u okviru kojih se nalaze staništa određenih strogo zaštićenih vrsta riba jesu Zasavica i Kraljevac zbog crnke (*Umbra krameri*), reka Pčinja koja je stanište strumičke brkice (*Oxynoemacheilus bureschi*), područje Golije, reke Gradac, Kladnica i Tisnica na Uvcu zbog peša (*Cottus gobio*), Veliki Galijaš na Velikom ratnom ostrvu gde je evidentirana karpatska paklara (*Eudontomyzon danfordi*), većina zaštićenih područja na teritoriji Vojvodine gde se nalaze staništa zlatnog karaša (*Carassius carassius*), čikova (*Misgurnus fossilis*), gavčice (*Rhodeus amarus*) i linjaka (*Tinca tinca*), i Gornje Podunavlje gde su zabeležene velika pliska (*Alburnus sava*, u *Pravilniku* navedena kao *A. chalcoides*), belica (*Leucaspius delineatus*), sabljarka (*Pelecus cultratus*) itd.

Međutim, za većinu strogo zaštićenih vrsta, među kojima su i crnomorska haringa (*Alosa immaculata*), azovska haringa (*Alosa tanaica*), veliki vijun (*Cobitis elongata*), vijun (*Cobitis elongatoides*, u *Pravilniku* navedena kao *C. taenia*), Balonov balavac (*Gymnocephalus baloni*), Keslerova krkuša (*Romanogobio kesslerii*, u *Pravilniku* navedena kao *R. banaticus*/*R. kessleri kessleri*), tankorepa krkuša (*Romanogobio uranoscopus*), govedarka (*Romanogobio vladykovi*, u *Pravilniku* navedena kao *R. albipinnatus*), balkanski vijun (*Sabanejewia balcanica*), mali vretenar (*Zingel streber*) i veliki vretenar (*Zingel zingel*), nije izdvojen dovoljan broj lokaliteta na kojima bi se štitila njihova staništa, što bi doprinelo i smanjenju stepena ugroženosti pojedinačnih vrsta. S tim u vezi, u okviru uspostavljanja nacionalne ekološke mreže i zaštite područja, akcenat treba staviti na očuvanje staništa sa ciljem poboljšanja njihovog statusa. U prilog tome ide i činjenica da u Srbiji, za sada, izuzev ekoloških koridora od međunarodnog značaja, nisu izdvojena i

4.6. Habitat protection for strictly protected and protected fish species

All listed protected areas, areas proposed for protection, ecologically significant areas and ecological corridors contain certain waters inhabited by populations of various fish species. In addition, they also contain the habitats of some of the 67 fish species listed in the Annexes of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* (Official Gazette of RS, No. 5/2010, 47/2011, 32/2016 and 98/2016), of which 38 have the status of "strictly protected" and 29 have the status of "protected species" (Figure 25). Some of the protected areas where the habitats of certain strictly protected fish species are located are Zasavica and Kraljevac because of the European mudminnow (*Umbra krameri*), the river Pčinja which is the habitat of the Struma stone loach (*Oxynoemacheilus bureschi*), the area of Golija, the rivers Gradac, Kladnica and Tisnica on the Uvac because of the European bullhead (*Cottus gobio*), Veliki Galijaš on the Great War Island where the Carpathian brook lamprey (*Eudontomyzon danfordi*) was registered, most of the protected areas in the territory of Vojvodina where the habitats of the crucian carp (*Carassius carassius*), the weatherfish (*Misgurnus fossilis*), the European bitterling (*Rhodeus amarus*) and the tench (*Tinca tinca*) are found, and Gornje Podunavlje, where the Balkan shemaya (*Alburnus sava*, listed in the Rulebook as *A. chalcoides*), the sunbleak (*Leucaspius delineatus*), the sichel (*Pelecus cultratus*), etc. are registered.

However, for most strictly protected species, including the Pontic shad (*Alosa immaculata*), Azov shad (*Alosa tanaica*), Balkan loach (*Cobitis elongata*), Danubian spined loach (*Cobitis elongatoides*, listed in the Rulebook as *C. taenia*), Balon's ruffe (*Gymnocephalus baloni*), Kessler's gudgeon (*Romanogobio kesslerii*, listed in the Rulebook as *R. banaticus*/*R. kessleri kessleri*), Danubian longbarbel gudgeon (*Romanogobio uranoscopus*), Danube white-finned gudgeon (*Romanogobio vladykovi*, listed in the Rulebook as *R. albipinnatus*), Balkan golden loach (*Sabanejewia balcanica*), streber (*Zingel streber*) and zingel (*Zingel zingel*), not enough areas have been designated to protect their habitats, which would also help to reduce the threat level of individual species. In this respect, the establishment of the national ecological network and site protection should focus on habitat conservation in

Velika nizijska reka umereno brzog toka – stanište svih migratornih jesetri i haringi. / Large lowland river with a moderately swift current – habitat of all migrating sturgeon and shad.

Rečna ada sa močvarnim terenom – stanište karpatske paklare. / River island with marshy terrain – habitat of the Carpathian brook lamprey.

Brdska reka mirnijeg toka, šljunkovito dno – stanište strumičke brkice i istočne mrenke. / Upland river with calmer current and gravelly bottom – habitat of the Struma stone loach and Strymon barbel.

Bara, obrasla vegetacijom, mulj na dnu – stanište zlatnog karaša, linjaka, čikova, gavčice i crnke. / Pond, overgrown with vegetation, mud at the bottom – habitat of the crucian carp, tench, weatherfish, European bitterling, European mudminnow.

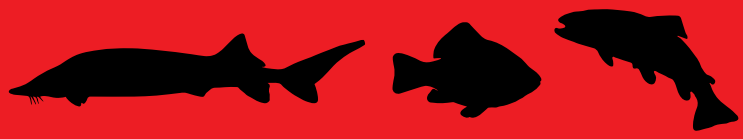
Salmonidni planinski tok sa brzim strujanjem vode i kamenitim dnom – stanište peša. / Salmonid mountain stream with fast flowing water and rocky bottom – habitat of the European bullhead.

Velika nizijska reka sporog toka – stanište velikog vretenara, Balonovog balavca, sabljarke. / Large, slow-flowing lowland river – habitat of the the zingel, Balon's ruffe, sichel.

Brdsko-planinska rečica, smena virova i brzaka – stanište Keslerove krkuše, tankorepe krkuše, govedarke, balkanskog vijuna. / Mountain stream, alternation of whirlpools and rapids – habitat of the Kessler's gudgeon, Danubian longbarbel gudgeon, Danube white-finned gudgeon, Balkan golden loach.

Slika 25. Ilustracija tipova staništa strogo zaštićenih vrsta riba. Kao primer prikazane su sledeće vode: (a) Dunav nizvodno od brane "Đerdap II"; (b) Veliko ratno ostrvo (Google Earth); (c) Pčinja kod Trgovišta; (d) Tresetna bara kod Velikog Gradišta; (e) Tisovica, utoka Zlatarskog jezera; (f) Dunav kod Batajnice; (g) reka Rača na Tari (foto: A. Hegediš).

Figure 25. Illustration of habitat types of strictly protected fish species. The following waterbodies are shown as examples: (a) Danube downstream of the dam "Đerdap II"; (b) Great War Island (Google Earth); (c) Pčinja near Trgovište; (d) A peat pond near Veliko Gradište; (e) Tisovica, inlet of Lake Zlatar; (f) Danube near Batajnica; (g) Rača (photo. A. Hegediš) .



ekološki značajna područja ekološke mreže koja naseljavaju ugrožene migratorne jesetarske vrste riba – *Acipenser gueldenstaedtii*, *A. nudiventris*, *A. stellatus*, *A. sturio* i *Huso huso*, kao i semimigratorna vrsta *A. ruthenus* (dunavska populacija). Reč je o vrstama koje se nalaze u Dodatku II *Konvencije o očuvanju migratornih vrsta divljih životinja* (*Zakon o potvrđivanju Konvencije o očuvanju migratornih vrsta divljih životinja*, Službeni glasnik RS – Međunarodni ugovori, br.102/2007) koje imaju nepovoljan status očuvanja i za koje su gazdovanje i očuvanje predmet međunarodnih sporazuma.

4.7. Međunarodna dokumenta kao osnov za zaštitu staništa riba u Srbiji

Evropska **Direktiva o očuvanju prirodnih staništa i divlje faune i flore – Direktiva o staništima** (Council Directive 92/43/EEC) obavezuje zemlje članice Evropske unije da obezbede adekvatnu zaštitu i očuvanje divlje faune i flore, kao i njihovih prirodnih staništa. S obzirom na to da Srbija još uvek nije članica EU, nije u obavezi da primenjuje odredbe ove direktive, ali su neke odredbe ipak već implementirane u domaće zakonodavstvo. Takođe, ova direktiva propisuje i određivanje mreže posebnih zaštićenih područja (NATURA 2000) koja su neophodna za očuvanje i zaštitu nekih vrsta flore i faune. *Direktiva* sadrži pet dodataka, od kojih se tri (II, IV i V) odnose na zaštićene vrste. U Dodatku II nalaze se vrste životinja i biljaka od zajedničkog interesa čije očuvanje zahteva određivanje posebnih područja zaštite, u Dodatku IV nalaze se vrste životinja i biljaka koje zahtevaju striktnu zaštitu, a u Dodatku V nalaze se vrste životinja i biljaka koje se mogu kontrolisano sakupljati iz prirode i za njih se propisuju posebne mere.

U procesu pridruživanja Evropskoj uniji, Srbija ima obavezu da predloži područja od značaja za zajednicu (*engl.* proposed Sites of Community Importance, skraćeno pSCIs) za ekološku mrežu Natura 2000, u odnosu na prisutnih 29 vrsta riba koje se nalaze u Prilogu II *Direktive o staništima*, a evidentirane su u Srbiji: *Acipenser sturio*, *Alburnus sava* (navedena kao *Chalcalburnus chalcoides*), *Alosa immaculata* i *A. tanaica* (navedene kao *Alosa* spp.), *Cobitis elongata*, *Cobitis elongatoides* (navedena kao *C. taenia*), *Cobitis ohridana* (navedena kao *C. taenia*), *Cottus gobio*, *Eudontomyzon* spp. (*E. danfordi*, *E. mariae*, *E. stakokaramani* i *E. vladykovi*), *Gymnocephalus baloni*, *G. schraetser* (navedena kao *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (navedena kao *Aspius aspius*), *Misgurnus fossilis*, *Pelecus cultratus*, *Rhodeus amarus* (navedena kao *R. sericeus amarus*), *Romanogobio kesslerii* (navedena kao *Gobio kessleri*), *R. uranoscopus* (navedena kao *Gobio uranoscopus*), *R. vladykovi* (navedena kao *Gobio albipinnatus*), *Rutilus virgo* (navedena kao *R. pigus*), *Sabanejewia balcanica* i *S. bulgarica* (navedene kao *S. aurata*), *Salmo marmoratus*, *Telestes souffia* (navedena kao *Leuciscus souffia*), *Umbra krameri* i *Zingel streber*.

Od vrsta koje se nalaze u Prilogu IV *Direktive o staništima*, za koje je, osim izdvajanja područja zaštite, obaveza da se obezbedi i stroga zaštita na njihovom celokupnom arealu unutar države, u Srbiji je prisutna samo jedna vrsta riba, *Gymnocephalus baloni*.

order to improve their status. This is supported by the fact that so far, apart from the ecological corridors of international importance, no ecologically significant areas of the ecological network, inhabited by endangered migratory sturgeon species – *Acipenser gueldenstaedtii*, *A. nudiventris*, *A. stellatus*, *A. sturio* and *Huso huso*, as well as the semi-migratory species *A. ruthenus* (Danube population), have been designated. These are the species listed in Appendix II of the *Convention on the Conservation of Migratory Species of Wild Animals* (*Law on the Ratification of the Convention on the Conservation of Migratory Species of Wild Animals*, Official Gazette of RS – International Treaties, No. 102/2007), which have an unfavourable conservation status and whose management and conservation is the subject of international agreements.

4.7. International documents as a basis for protection of fish habitats in Serbia

The **EU Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora – Habitats Directive** (Council Directive 92/43/EEC) obliges the member states of the European Union to ensure adequate protection and conservation of wild fauna and flora and their natural habitats. Considering the fact that Serbia is not yet a member of the EU, it is not obliged to apply the provisions of this *Directive*, but some provisions have already been transposed into national law. In addition, this *Directive* requires the designation of a network of special protection areas (NATURA 2000) necessary for the conservation and protection of some animal and plant species. The *Directive* contains five annexes, three of which (II, IV and V) refer to protected species. Annex II lists animal and plant species of general interest whose conservation requires the designation of special areas of conservation, Annex IV lists animal and plant species that require strict protection, and Annex V lists animal and plant species that can be taken from the wild in a controlled manner and for which special measures are required.

In the process of joining the European Union, Serbia has the responsibility for proposing Sites of Community Importance (pSCIs) for the ecological network Natura 2000, in relation to the present 29 species of fish listed in Annex II of the *Habitats Directive* and recorded in Serbia: *Acipenser sturio*, *Alburnus sava* (listed as *Chalcalburnus chalcoides*), *Alosa immaculata* and *A. tanaica* (listed as *Alosa* spp.), *Cobitis elongata*, *Cobitis elongatoides* (listed as *C. taenia*), *Cobitis ohridana* (listed as *C. taenia*), *Cottus gobio*, *Eudontomyzon* spp. (*E. danfordi*, *E. mariae*, *E. stakokaramani* and *E. vladykovi*), *Gymnocephalus baloni*, *G. schraetser* (listed as *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (listed as *Aspius aspius*), *Misgurnus fossilis*, *Pelecus cultratus*, *Rhodeus amarus* (listed as *R. sericeus amarus*), *Romanogobio kesslerii* (listed as *Gobio kessleri*), *R. uranoscopus* (listed as *Gobio uranoscopus*), *R. vladykovi* (listed as *Gobio albipinnatus*), *Rutilus virgo* (listed as *R. pigus*), *Sabanejewia balcanica* and *S. bulgarica* (listed as *S. aurata*), *Salmo marmoratus*, *Telestes souffia* (listed as *Leuciscus souffia*), *Umbra krameri* and *Zingel streber*.

Of the species listed in Annex IV of the *Habitats Directive*, for which, in addition to the designation of protected areas, a strict protection regime must be applied across their entire natural range within the country, only one fish species, *Gymnocephalus baloni*, occurs in Serbia.

S druge strane, za vrste koje se nalaze u Prilogu V *Direktive o staništima*, odnosno one koje mogu da se uzimaju iz prirode i eksploatišu, treba primeniti mere upravljanja, što u odnosu na IUCN status ugroženosti pojedinih vrsta može povoljno uticati na njihovo dalje očuvanje u prirodi. Među tim vrstama, a koje naseljavaju i vode u Srbiji, nalaze se vrste iz porodice Acipenseridae (*Acipenser gueldenstaedtii*, *A. nudiventris*, *A. ruthenus*, *A. stellatus* i *Huso huso*), zatim sve vrste iz roda *Alosa* (*A. immaculata* i *A. tanaica*), sve vrste iz roda *Barbus* (*Barbus balcanicus*, *B. barbus*, *B. rebeli* i *B. strumicae*), kao i *Gymnocephalus schraetser* (navedena kao *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (navedena kao *Aspius aspius*), *Pelecus cultratus*, *Rutilus virgo* (navedena kao *R. pigus*), *Thymallus thymallus* i *Zingel zingel*.

Od ostalih međunarodnih dokumenata koji se odnose na zaštitu faune riba i njihovih staništa, izdvaja se **Bernska konvencija** (*Zakon o potvrđivanju Konvencije o očuvanju evropske divlje flore i faune i prirodnih staništa*, Službeni glasnik RS – Međunarodni ugovori, br. 102/2007), a za zaštitu migratornih vrsta riba, očuvanje i održavanje pogodnih i obnavljanje narušenih ili uništenih staništa i **Bonska konvencija** (*Zakon o potvrđivanju Konvencije o očuvanju migratornih vrsta divljih životinja*, Službeni glasnik RS – Međunarodni ugovori, br. 102/2007). U Dodatku II Bernske konvencije, koji obuhvata strogo zaštićene vrste koje podležu posebnim zakonskim i upravljačkim merama zaštite, a koje podrazumevaju zabranu hvatanja, držanja, uznemiravanja, namernog ubijanja, posedovanja i prometa, nalaze se tri vrste riba koje žive (ili su živele) u Srbiji: *Acipenser sturio*, *Huso huso* i *Umbra krameri*. U Dodatku III, koji uključuje vrste koje podležu posebnim merama zaštite, kao što je lovostaj i druge mere kojima se kontroliše eksploatacija, nalazi se 37 vrsta koje žive u Srbiji, dok se u Rezoluciji 6, koja uključuje vrste koje zahtevaju posebne mere zaštite staništa, nalazi i 29 vrsta koje žive u Srbiji.

Za postizanje dobrog ekološkog statusa površinskih (slatkih) voda i za zaštitu staništa slatkovodnih vrsta riba u Evropi od važnosti je i **Okvirna Direktiva EU o vodama** (Directive 2000/60/EC), koja je delom transponovana u *Zakon o vodama* (Službeni glasnik RS, br. 30/2010, 93/2012, 101/2016, 95/2018 i 95/2018 – dr. zakon).

4.8. Diverzitet staništa riba u Srbiji

Raznovrsni slatkovodni ekosistemi, koji se u osnovi dele na tekuće (izvori, potoci, rečice, reke, kanali za navodnjavanje i odvodnjavanje) i stajaće vode (stalne bare, močvare, ritovi, mrtvaje, stari rukavci i napušteni tokovi reke, prirodna i veštačka jezera, akumulacije za navodnjavanje, akumulaciona jezera hidroelektrana, rekreaciona jezera, ribnjaci, bare, šljunkare, kamenolomi, pozajmišta mineralnih sirovina itd.), predstavljaju staništa, odnosno životni prostor riba u Srbiji. Uz sve navedene ekosisteme, staništa od posebnog značaja za faunu riba jesu i privremene i povremene vode u plavnoj zoni nizijskih reka.

Uz velike reke sa dužim tokom, kao što su Dunav (588 km), Zapadna Morava (308 km), Južna Morava (295 km), Ibar (272 km), Drina (220 km), Sava (206 km), Timok (202 km), Velika Morava (185 km), Tisa (168 km), Nišava (151 km), Toplica (130 km), Pek (129 km), Tamiš (118), Beli Drim (156 km), Golijska Moravica (98 km),

On the other hand, management measures should be applied to species listed in Annex V of the *Habitats Directive*, i.e. species that can be taken from nature and exploited, which may have a positive impact on their further conservation in nature in view of the IUCN threat status. Species occurring in Serbia include species from the family Acipenseridae (*Acipenser gueldenstaedtii*, *A. nudiventris*, *A. ruthenus*, *A. stellatus* and *Huso huso*), all species from the genus *Alosa* (*A. immaculata* and *A. tanaica*), all species from the genus *Barbus* (*Barbus balcanicus*, *B. barbus*, *B. rebeli* and *B. strumicae*), *Gymnocephalus schraetser* (listed as *G. schraetzer*), *Hucho hucho*, *Leuciscus aspius* (listed as *Aspius aspius*), *Pelecus cultratus*, *Rutilus virgo* (listed as *R. pigus*), *Thymallus thymallus* and *Zingel zingel*.

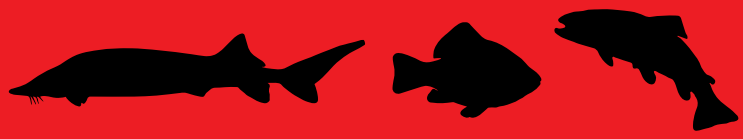
Among the other international documents related to the protection of fish fauna and their habitats, it is worth highlighting the **Bern Convention** (*Law on Ratification of the Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats*, Official Gazette of RS – International Treaties, No. 102/2007) as well as the **Bonn Convention** (*Law on the Ratification of the Convention on the Conservation of Migratory Species of Wild Animals*, Official Gazette of RS – International Treaties, No. 102/2007) for protection of migratory fish species, the conservation and maintenance of suitable habitats and the restoration of damaged or destroyed habitats. In Appendix II of the Bern Convention, which contains strictly protected species subject to special legal and administrative protection measures, which include prohibition of capture, keeping, disturbance, intentional killing, possession and trade, there are three fish species that live (or lived) in Serbia: *Acipenser sturio*, *Huso huso* and *Umbra krameri*. In Annex III, which contains species subject to special protection measures, such as designations of non-hunting season and other exploitation control measures, there are 37 species living in Serbia, while in Resolution 6, which contains species requiring special habitat protection measures, there are 29 species living in Serbia.

In order to achieve good ecological status of surface freshwaters and to protect the habitats of freshwater fish species in Europe, the **EU Water Framework Directive** (Directive 2000/60/ EC), which was partially transposed into the *Law on Water* (Official Gazette of RS, No. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018 – other law), is also important.

4.8. Diversity of fish habitats in Serbia

Diverse freshwater ecosystems, basically divided into running (springs, streams, rivulets, rivers, irrigation and drainage canals) and standing waters (permanent ponds, swamps, marshes, oxbows, backwaters and abandoned river beds, natural and artificial lakes, reservoirs for irrigation, reservoirs of hydroelectric power plants, recreational lakes, fish ponds, ponds, gravel pits, quarries, borrow pits for mineral resources, etc.), are fish habitats in Serbia. Besides the mentioned ecosystems, the temporary and occasional waterbodies in the floodplains of the lowland rivers are of special importance for the fish fauna.

Along with large and longer rivers, such as the Danube (588 km), West Morava (308 km), South Morava (295 km), Ibar (272 km), Drina (220 km), Sava (206 km), Timok (202 km), Great Morava (185 km), Tisza (168 km), Nišava (151 km), Toplica (130 km), Pek (129 km), Tamiš (118), White Drim (156 km), Golijska Moravica (98 km), the fish habitats in Serbia are represented by thousands of other watercourses, among which small and medium-sized rivers under 100 km



staništa riba u Srbiji predstavlja i više hiljada vodotoka, među kojima preovlađuju male i srednje reke ispod 100 km, a čija ukupna dužina iznosi oko 66.000 km ili prosečno 747 m/km² (Gavrilović & Dukić, 2002). Najveći deo hidrografske mreže pripada slivu Dunava, tj. basenu Crnog mora – 92%, dok vode sliva Jadranskog mora čine samo 5% svih vodotoka Srbije, a vode sliva Egejskog mora 3% teritorije.

U odnosu na tip staništa i abiotičke faktore, podela riba na reofilne i limnofilne vrste takođe je uslovna i odnosi se na njihovu prilagođenost na brzinu vodenog toka, količinu i kvalitet same vode, temperaturu i koncentraciju rastvorenog kiseonika u vodi itd. Za razliku od reofilnih vrsta, koje preferiraju tekuće vode sa bržim proticajem, a posebno brze brdsko-planinske, hladne i čiste vodotoke sa čvrstom podlogom i dnom bez mulja, za koje su karakteristične niže temperature sa visokom koncentracijom rastvorenog kiseonika u vodi, limnofilne vrste naseljavaju sporotekuće i stajaće vode, sa većom količinom nutrijenata i velikim oscilacijama temperature i koncentracije rastvorenog kiseonika.

U vodotocima razlikujemo tri zone: izvorišnu zonu (krenal ili krenon), zonu planinskih potoka (ritral ili ritron) i zonu reka (potamal ili potamon) (Huet, 1959; Ilies, 1961). Ritral predstavlja salmonidni region, u kome preovladavaju vrste iz porodice Salmonidae, koji obuhvata tri podregiona (Slika 26):

- gornji salmonidni region (gornji region pastrmke ili epiritral) obuhvata planinske potoke, rečice i gornje tokove manjih reka koje karakteriše stenovito i kamenito dno sa brzim tokom vode, u kojima je prisutna potočna pastrmka (*Salmo trutta*), kao i prateće vrste riba, kao što su peš (*Cottus gobio*), pijor (*Phoxinus phoxinus*) i brkica (*Barbatula barbatula*);
- srednji salmonidni region (donji region pastrmke ili metaritral) obuhvata brdsko-planinske vodotoke, u kojima je takođe dominantna potočna pastrmka, ali u koje zalazi i lipljen (*Thymallus thymallus*), kao i neke vrste riba iz porodice Cyprinidae;
- donji salmonidni region (region lipljena ili hiporitral) obuhvata vodotoke brdskih područja, u kojima su karakteristične vrste mladica (*Hucho hucho*) i lipljen, a česte su i neke vrste iz porodice Cyprinidae, kao što su klen (*Squalius cephalus*), skobalj (*Chondrostoma nasus*) i mrena (*Barbus* spp.); nizvodno reka postaje šira i dublja, brzina toka se znatno smanjuje, a dno je prekriveno šljunkom i peskom.

Potamal predstavlja šaranski, ciprinidni region u kome se takođe razlikuju tri podregiona (Slika 27):

- gornji ciprinidni region (region mrene ili epipotamal) obuhvata nizijske vode u kojima su najčešće ribe iz porodice Cyprinidae sa mrenom kao dominantnom vrstom, a od ostalih vrsta iz ove porodice prisutne su krkuša (rodovi *Gobio* i *Romanogobio*), skobalj, kesega (*Ballerus ballerus*), nosara (*Vimba vimba*), a u izvesnoj meri i deverika (*Abramis brama*), kao i neke vrste iz porodica Cobitidae, Gobiidae i Cottidae, a česte su i grabljivice kao što su som (*Silurus glanis*), smuđ (*Sander* spp.) i manić (*Lota lota*);
- srednji ciprinidni region (region deverike ili metapotamal) obuhvata vode sa tipičnim vrstama kao što su šaran (*Cyprinus*

predominate, with the total length of about 66.000 km or an average of 747 m/km² (Gavrilović & Dukić, 2002). The largest part of the hydrographic network belongs to the Danube basin, i.e. the Black Sea basin – 92%, while the waters of the Adriatic Sea basin represent only 5% of all watercourses in Serbia, and the waters of the Aegean Sea basin 3%.

In relation to habitat type and abiotic factors, the classification of fishes into rheophilic and limnophilic species is conditional and refers to their adaptation to the water flow speed, the quantity and quality of the water itself, the water temperature, the concentration of dissolved oxygen, etc. In contrast to rheophilic species, which prefer running waters with faster currents, especially fast, mountainous, cold and clean running waters with solid substrate and silt-free bottom, characterised by lower temperatures and high concentration of dissolved oxygen, limnophilic species inhabit slow-flowing and standing waters with a greater amount of nutrients and large variations in temperature and concentration of dissolved oxygen.

Three zones are distinguished in streams: the headwater zone (crenon), the upland stream zone (rhithron) and the river zone (potamon) (Huet, 1959; Ilies, 1961). The rhithron is the salmonid zone dominated by species from the Salmonidae family and includes three subzones (Figure 26):

- upper salmonid zone (upper-trout zone or epirhithron) includes mountain streams, rivulets and upper reaches of smaller rivers, characterised by rocky and stony bottoms with rapid water flow and inhabited by the brown trout (*Salmo trutta*) and accompanying fish species such as the European bullhead (*Cottus gobio*), Eurasian minnow (*Phoxinus phoxinus*) and stone loach (*Barbatula barbatula*);
- middle salmonid zone (lower-trout zone or metarhithron) includes upland streams, where the brown trout also predominate, but the grayling (*Thymallus thymallus*) and some fish species from the Cyprinidae family also occur;
- lower salmonid zone (grayling zone or hyporhithron) includes watercourses of the hilly areas, where the characteristic species are the huchen (*Hucho hucho*) and grayling and some species of the carp family (Cyprinidae) are also common, such as the chub (*Squalius cephalus*), common nase (*Chondrostoma nasus*) and barbel (*Barbus* spp.); downstreams, the river becomes wider and deeper, the flow velocity decreases significantly and the bottom is covered with gravel and sand.

Potamon represents the carp or cyprinid zone and includes three subzones also (Figure 27):

- upper cyprinid zone (barbel zone or epipotamon) includes lowland waters where fishes of the Cyprinidae family are most abundant, with the barbel as the predominant species, and among other species from this family there are the gudgeon (genera *Gobio* and *Romanogobio*), common nase, zope (Ballerus ballerus), vimba bream (*Vimba vimba*) and, to some extent, the common bream (*Abramis brama*), as well as some species from the families Cobitidae, Gobiidae and Cottidae, and predatory fish such as wels catfish (*Silurus glanis*), pikeperch (*Sander* spp.) and burbot (*Lota lota*);
- middle cyprinid zone (bream zone or metapotamon) with typical species such as carp (*Cyprinus carpio*), barbel, common

carpio), mrena, skobalj, klen, som, štuka (*Esox lucius*), smuđ, deverika, kesega, bucov (*Leuciscus aspius*) i sabljarka (*Pelecus cultratus*), a može se sresti i kečiga (*Acipenser ruthenus*);

- donji ciprinidni region (region šarana ili hipopotamal) obuhvata donje tokove velikih reka, kao i jezera koje leže na nadmorskim visinama ispod 100 m. Ovo su tipične nizijske, eutrofne vode (sa visokom organskom produkcijom). Za ovaj region karakteristične su ukljeva (*Alburnus alburnus*), linjak (*Tinca tinca*), zlatni karaš (*Carassius carassius*) i crvenperka (*Scardinius erythrophthalmus*), kao i druge vrste iz porodice Cyprinidae koje se sreću i u gornjem i srednjem ciprinidnom regionu, ali i čikov (*Misgurnus fossilis*). Prisutne su i brojne alohtone vrste, među kojima su i beli amur (*Ctenopharyngodon idella*), beli (*Hypophthalmichthys molitrix*) i sivi tolstolobik (*H. nobilis*), babuška (*Carassius gibelio*), američki somić (*Ameiurus* spp.) itd.

nase, chub, wels catfish, northern pike (*Esox lucius*), pikeperch, common bream, zope, asp (*Leuciscus aspius*), sichel (*Pelecus cultratus*) and sometimes the sterlet (*Acipenser ruthenus*);

- lower cyprinid zone (carp zone or hipopotamon) includes the lower reaches of large rivers as well as lakes at elevations below 100 meters. These are typical lowland eutrophic waters (with high organic production). Characteristic fish of this region are the common bleak (*Alburnus alburnus*), tench (*Tinca tinca*), crucian carp (*Carassius carassius*) and common rudd (*Scardinius erythrophthalmus*), as well as other species of the Cyprinidae family from the upper and middle cyprinid zones and weatherfish (*Misgurnus fossilis*). There are also numerous non-native species, including the grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*H. nobilis*), Prussian carp (*Carassius gibelio*), bullhead (*Ameiurus* spp.), etc.

Slika 26. Salmonidni region u tekućim vodama (ritral): (a) Beli Rzav, Barakovac, epiritral; (b) Drina, Bajina Bašta, metaritral; (c) Drina, Loznica, hiporitral (foto: A. Hegediš).

Figure 26. Salmonid zone in running waters (rhithron): (a) Beli Rzav, Barakovac, epirhithron; (b) Drina, Bajina Bašta, metarhithron; (c) Drina, Loznica, hyporhithron (photo: A. Hegediš).

Slika 27. Ciprinidni region u tekućim vodama (potamal): (a) Velika Morava, Predor, epipotamal; (b) Velika Morava, Brežana, metapotamal; (c) Dunav, Veliko Gradište, hipopotamal (foto: A. Hegediš).

Figure 27. Cyprinid zone in running waters (potamon): (a) Great Morava, Predor, epipotamon; (b) Great Morava, Brežana, metapotamon; (c) Danube, Veliko Gradište, hipopotamon (photo: A. Hegediš).

5

FAKTORI UGROŽAVANJA RIBA U SRBIJI

Milica Jaćimović
Željka Višnjić-Jeftić

FACTORS THREATENING FISH SPECIES IN SERBIA

Milica Jaćimović
Željka Višnjić-Jeftić

5. FAKTORI UGROŽAVANJA RIBA U SRBIJI

Milica Jaćimović i Željka Višnjić-Jeftić

Iako slatkovodni ekosistemi zauzimaju svega 0,8% Zemljine površine (odnosno 0,01% celokupne vode na Zemlji), njihova uloga u svim prirodnim procesima i ciklusima veoma je važna (Dudgeon *et al.*, 2006). Pružaju brojne ekosistemske usluge i predstavljaju dom za oko 12% (preko 140.000) svih do sada poznatih i opisanih životinjskih vrsta, odnosno 47–53% (~18.000) vrsta riba (Nelson, 2006; Reid *et al.*, 2019). Kopnene vode i slatkovodni biodiverzitet predstavljaju važan prirodni resurs u ekonomskom, kulturnom, estetskom, naučnom i edukativnom smislu. Očuvanje i upravljanje ovim resursom od ključne je važnosti za čitavo čovečanstvo (Reid *et al.*, 2013). Nažalost, ovo dragoceno nasleđe danas je u velikoj krizi. Slatkovodne vrste životinja izumiru znatno brže od terestričnih i marinskih. Više od trećine nalazi se pred izumiranjem, a smatra se da će problem postati još veći kako raste brojnost ljudske populacije (Dudgeon *et al.*, 2006; IUCN Freshwater Fish Specialist Group, 2020b).

Slatkovodne ribe, osim što predstavljaju veoma važan izvor hrane, koriste se u različitim vidovima sportskog ribolova i u akvaristici, učestvuju u ključnim ekološkim procesima, kao što su kruženje nutrijenata u prirodi, trofička dinamika i produkcija, mogu da menjaju i održavaju staništa, ali i da povezuju ekosisteme kroz migracije (Mota *et al.*, 2014). Nažalost, one su danas globalno ugrožene kombinacijom različitih faktora, kao što su prekomerni izlov i krivolov, zagađenje, gubitak, promena i fragmentacija staništa, unos invazivnih alotonih vrsta, uništavanje šuma (deforestacija), plantažno gajenje nepogodnih vrsta, kao i klimatske promene. Sinergistički uticaj ovih promena, koje su nastale kao posledica ljudskih aktivnosti, čini slatkovodne ribe drugom najugroženijom grupom kičmenjaka, nakon vodozemaca (Jenkins, 2003; Dudgeon *et al.*, 2006; Dudgeon, 2014; Reid *et al.*, 2019).

Sa aspekta ugrožavanja populacija riba, ali i čitavih vodenih ekosistema, vode u Srbiji dele sudbinu sa vodama u regionu i čitavoj Evropi. Intenzivan antropogeni uticaj koji se vrši u poslednjim decenijama predstavlja osnovu ugrožavanja vodenih ekosistema. Sve su veće potrebe za čistom vodom, ali i potrebe da se vodeni ekosistemi koriste na druge načine, kao recipijenti otpadnih voda, za dobijanje električne energije (što zahteva pregrađivanje i regulaciju tokova i dovodi do degradacije i gubitka staništa), kao izvor građevinskog materijala u obliku šljunka i peska, kao izvor vode za akvakulturu itd. Kada se svemu tome doda loša i neusklađena, a često i anahrona zakonska regulativa, stanje vodenih ekosistema i populacija riba u njima mora se oceniti kao zabrinjavajuće.

Pored navedenih faktora ugrožavanja, u Srbiji je prisutno i višenamensko korišćenje vodnih resursa sa međusobno neusklađenim planovima, loše upravljanje ribljim fondom i nepoznavanje bioloških karakteristika i distribucije vrsta. Slatkovodni ekosistemi na ovaj način trpe pritisak sa više strana. Otpadna voda iz domaćinstava i industrije u velikoj meri opterećuje vodne resurse organskim mate-

5. FACTORS THREATENING FISH SPECIES IN SERBIA

Milica Jaćimović and Željka Višnjić-Jeftić

Although freshwater ecosystems occupy only 0.8% of the Earth's surface (or 0.01% of all water on Earth), their role in all natural processes and cycles is very important (Dudgeon *et al.*, 2006). They provide numerous ecosystem services and host approximately 12% (over 140,000) of all animal species known and described to date and 47–53% (~18,000) of fish species (Nelson, 2006; Reid *et al.*, 2019). Inland waters and freshwater biodiversity represent an important natural resource in commercial, cultural, aesthetic, scientific and educational terms. The conservation and management of this resource is crucial for all humanity (Reid *et al.*, 2013). Unfortunately, this precious heritage is currently in severe crisis. Freshwater animals are becoming extinct much faster than terrestrial and marine ones. More than a third are threatened with extinction and the problem is expected to worsen as the human population grows (Dudgeon *et al.*, 2006; IUCN Freshwater Fish Specialist Group, 2020b).

Freshwater fishes are not only a very important source of food, but are also used for various types of sport fishing and in aquaristics. They are involved in key ecological processes, such as nutrient cycling, trophic dynamics and production, they can modify and maintain habitats, and they also connect ecosystems through species migrations (Mota *et al.*, 2014). Unfortunately, they are now globally threatened by a combination of factors, including overfishing and poaching, pollution, habitat loss, modification and fragmentation, introduction of invasive non-native species, forest destruction (deforestation), plantation cultivation of unfavourable species and climate change. The synergistic effects of these changes, which are a consequence of human activities, make freshwater fish the second most threatened group of vertebrates, after amphibians (Jenkins, 2003; Dudgeon *et al.*, 2006; Dudgeon, 2014; Reid *et al.*, 2019).

As far as threats to fish populations and entire aquatic ecosystems are concerned, the waters in Serbia share the fate of the waters in the region and throughout Europe. The intensive anthropogenic influence of the last decades is the basis for the threat to aquatic ecosystems. The need for clean water is increasing, but so is the need to use aquatic ecosystems in other ways: as recipients of wastewater, for electricity generation (which requires damming and regulation of waterbodies and leads to habitat degradation and loss), as a source of construction material in the form of gravel and sand, as a source of water for aquaculture, etc. Combined with inadequate, inconsistent and often anachronistic legislation, the state of aquatic ecosystems and the fish populations living in them should be considered a matter of concern.

In addition to the above risk factors, Serbia also has multi-purpose use of water resources with conflicting plans, poor management of fish stocks and ignorance of biological characteristics and species distribution. In this way, freshwater ecosystems are under pressure from several sides. Wastewater from households and industry heavily pollutes water resources with organic matter and nutrients, as well as

rijama i nutrijentima, kao i opasnim i toksičnim supstancama. Prerađuje se samo 5–10% otpadnih voda, a više od 65% industrijskih postrojenja u Srbiji ne prečišćava otpadne vode, jer nema sisteme za prečišćavanje (Jakovljević *et al*., 2019). Veliki broj stanovnika otpadne vode ispušta u neadekvatne septičke jame koje predstavljaju veliki izvor kontaminacije zemljišta i podzemnih voda. Ni Beograd nema postrojenja za prečišćavanje otpadnih voda koje se ulivaju u Dunav, a 30% teritorije glavnog grada nije pokriveno kanalizacionom mrežom (Slika 28). U Srbiji samo 20% opština ima postrojenja za prečišćavanje komunalnih otpadnih voda, dok ih nemaju

hazardous and toxic substances. Only 5–10% of wastewater is treated and more than 65% of industrial enterprises in Serbia do not treat their wastewater because they do not have treatment systems (Jakovljević *et al*., 2019). Many residents discharge their wastewater into inadequate septic tanks, which are a major source of soil and groundwater contamination. Belgrade also lacks facilities to treat wastewater that flows into the Danube and 30% of the capital's territory is not connected to a sewerage network (Figure 28). In Serbia, only 20% of municipalities have municipal wastewater treatment plants and other major urban centres – Novi Sad and Niš – also lack such facilities

Slika 28. Neprečišćavanje otpadnih voda i pomori riba: (a) satelitski snimak kolektora u Beogradu na desnoj obali Dunava nizvodno od Pančevačkog mosta (Google Earth); (b) pomor riba u Kolubari kao posledica ispuštanja neprečišćenih otpadnih voda (foto: A. Hegediš); (c) satelitski snimak kolektora u Beogradu u rukavcu Dunava u Višnjici (Google Earth).

Figure 28. Untreated sewage and fish kills: (a) satellite image of a collector in Belgrade on the Danube right bank downstream of the Pančevo bridge (Google Earth); (b) fish kills in Kolubara due to discharge of untreated sewage (photo: A. Hegediš); (c) satellite image of a collector in Belgrade in the Danube arm in Višnjica (Google Earth).

ni drugi veliki urbani centri – Novi Sad i Niš (Bovan *et al*., 2015). Trenutno stanje ukazuje na to da su osnovni problemi sa kojima se Srbija suočava u domenu upravljanja i tretmana komunalnim i industrijskim otpadnim vodama nedovoljna izgrađenost kanalizacione infrastrukture u gradovima i industriji, a posebno nedovoljna izgrađenost uređaja za tretman otpadnih voda (Bovan *et al*., 2015; Veljković *et al*., 2018).

Vodni resursi u Srbiji izloženi su i drugim problemima, poput izgradnje na vodnom zemljištu i intenzivne izgradnje mini-hidroelektrana na planinskim vodotocima i u zaštićenim područjima. Ilegalna izgradnja objekata na vodnom zemljištu predstavlja veliki faktor ugrožavanja vodnih resursa. Jedan od najpoznatijih primera jeste desna obala Save kod Beograda, odnosno Savski nasip na kome je u poslednjih desetak godina izgrađeno oko 300 kuća, iako se *Zakonom o vodama* (Službeni glasnik RS, br. 30/2010, 93/2012, 101/2016, 95/2018 i 95/2018 – dr. zakon) i *Prostornim planom Republike Srbije* (Službeni glasnik RS, br. 88/2010) izričito zabranjuje izgradnja objekata na vodnom zemljištu (Slika 29). Veliki broj ovih kuća se priključuje na električnu mrežu postojećih reni-bunara, ili se čak snabdeva vodom iz reni-bunara. U neposrednoj blizini izgrađenih objekata nalazi se 16 od 99 beogradskih reni-bunara kojima se ostvaruje vodosnabdevanje celog grada, tako da ilegalno izgrađeni objekti predstavljaju i rizik za snabdevanje vodom za piće. Dodatno, stanovnici ilegalno izgrađenih objekata uništavaju priobalnu vegetaciju, prirodna staništa i brojne zaštićene vrste, zaposedaju obalu i doprinose njenoj eroziji (Koalicija 27, 2019).

(Bovan *et al*., 2015). The current situation indicates that the main problems Serbia faces in the field of municipal and industrial wastewater management and treatment are the insufficient construction of wastewater infrastructure in cities and industry and, in particular, the insufficient construction of wastewater treatment plants (Bovan *et al*., 2015; Veljković *et al*., 2018).

Water resources in Serbia are also exposed to other problems, such as building on aquifers and intensive construction of mini-hydropower plants on mountain watercourses and in protected areas. Illegal construction of buildings on aquifers is an important factor of threat to water resources. One of the most prominent examples is the right bank of the Sava near Belgrade, namely the Savski Nasip neighbourhood, where about 300 houses have been built in the last decade, despite the fact that the *Law on Water* (Official Gazette of RS, No. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018 – other law) and the *Spatial Plan of the Republic of Serbia* (Official Gazette of RS, No. 88/2010) explicitly prohibit the construction of buildings on aquifers (Figure 29). A large proportion of these houses are connected to the electricity grid of the existing Ranney collectors or are even supplied with water from these collectors. In the immediate vicinity of the built-up properties are 16 of Belgrade's 99 Ranney collectors, which supply the entire city with water, so the illegally erected structures also pose a threat to the drinking water supply. In addition, the occupants of the illegally constructed buildings destroy coastal vegetation, natural habitats and numerous protected species, occupy the coastline and contribute to its erosion (Koalicija 27, 2019).

Slika 29. Potpuno zaposednuta obala Save kod Beograda (a) i uzurpacija obale na Srebrnom jezeru (b) (foto: A. Hegediš).

Figure 29. The completely occupied bank of the Sava near Belgrade (a) and the usurpation of the bank at Silver Lake (b) (photo: A. Hegediš).

Kada je reč o problemu izgradnje malih hidroelektrana na rekama u Srbiji (Slika 30), jedini aktuelni proces jeste izrada katastra malih hidroelektrana koji se realizuje kroz istoimeni IPA projekat. Implementacija ovog projekta poverena je Ministarstvu rudarstva i energetike, uz uključivanje većeg broja državnih institucija, među kojima je i sektor zaštite životne sredine. Međutim, u ovaj proces nisu uključene organizacije civilnog društva, niti javnost (Koalicija 27, 2019).

As for the problem of construction of small hydropower plants on rivers in Serbia (Figure 30), the only current process is the creation of a cadastre of small hydropower plants, which is implemented by the IPA project of the same name. The Ministry of Mining and Energy has been entrusted with the implementation of this project, with the participation of a number of state institutions, including the environmental protection sector. However, civil society organizations and the public are not involved in this process (Koalicija 27, 2019).

Slika 30. Male hidroelektrane (MHE) kao ugrožavajući faktor za ribe (I deo): (a) vodozahvatna građevina za MHE na Božičkoj reci, koja skoro da ne propušta vodu. Mašinska zgrada je oko 5 km nizvodno od vodozahvata i na tom potezu jedva da ima vode u koritu reke, a riblja staza nije funkcionalna (videti Sliku 35); (b) MHE na reci Tripušnici kod Donjeg Stajevca. Brana i riblja staza su suve, a vegetacija u koritu ispod brane nije akvatična jer tu vode najčešće i nema; (c) ista MHE iznad brane – sve je već zasuto muljem i gumama, ali je skakanje u vodu, koje leti i nema, zabranjeno (foto: A. Hegediš).

Figure 30. Small hydropower plants (SHPs) as a threat factor for fish (part I): (a) water intake structure for SHP on the Božička River, which releases almost no water. The powerhouse is located about 5 km downstream from the water intake structure; in this section there is hardly any water in the riverbed and the fish pass is not functional (see Figure 35); (b) SHP on the Tripušnica River near Donji Stajevac. The dam and the fish pass are dry and the vegetation in the bed below the dam is not aquatic because there is usually no water there; (c) the same SHP above the dam – everything is already covered with mud and tyres, but jumping into the water, which is lacking in summer, is prohibited (photo: A. Hegediš)

Svi gorepomenuti problemi uglavnom su se ticali kvaliteta vode. Međutim, drugi veliki problem tiče se količine vode. Nepotpuno istraživanje dostupnosti vodnih resursa kao i njihova neadekvatna eksploatacija najveći su problemi vezani za količinu vode (Jury & Vaux, 2005). Ostali problemi, prema *Strategiji upravljanja vodama na teritoriji Republike Srbije do 2034. godine* (Službeni glasnik RS, br. 3/2017), uključuju neodgovarajući kvalitet vode za piće, koji je prisutan u velikom delu Vojvodine (posebno u Bačkoj i Banatu), Pomoravlju, delovima Šumadije i brojnim manjim opštinama, neodgovarajuću eksploataciju podzemnih voda (prisutno prvenstveno u Vojvodini), nedovoljnu zaštićenost izvorišta, neadekvatnu cenu vode, nelegalno bušene bunare (pretežno u ruralnim i suburbanim sredinama), nedovoljnu efikasnost komunalnih službi, kao i nedostatak odgovarajućeg kadra. Takođe, veliki problemi u upravljanju vodnim resursima ogledaju se i kroz nedostatak harmonizovanog zakonodavstva, nedovoljna ulaganja u upravljanje vodnim resursima, nizak nivo usluga, nedostatak efikasnog integrisanog sistema upravljanja vodama, nelegalnu gradnju u potencijalno poplavnim područjima, kao i neadekvatan monitoring. Da bi se rešili ovi problemi i prevazišle ili ublažile njihove posledice, neophodno je sprovođenje niza mera u okviru interdisciplinarnih i transdisciplinarnih nacionalnih i međunarodnih projekata (Jakovljević *et al*., 2019).

5.1. Fragmentacija, modifikacija i uništavanje staništa

Močvarna područja, kao sezonski plavna staništa, prepoznata su kao dragocena sa aspekta prirodnih plodišta riba, staništa ptica, mesta samoprečišćavanja reka itd. (Slika 31). Močvare su staništa koja su u jednom periodu godine prekrivena vodom, a u drugom periodu potpuno suva i predstavljaju prelaz između vodenih i kopnenih ekosistema (Krpić *et al*., 2018). Najveće površine pod močvarama nalaze se na severu Evroazije i Severne Amerike. Poslednjih 100 godina uništeno je oko dve trećine svetskih vlažnih staništa (močvara), uglavnom zbog nekontrolisane urbanizacije,

All the problems mentioned above were mainly related to water quality. However, another major problem concerns the quantity of water. Incomplete studies on the availability of water resources as well as their inadequate use are the major problems related to water quantity (Jury & Vaux, 2005). Other problems, according to the *Strategy for Water Management of the Territory of the Republic of Serbia until 2034* (Official Gazette of RS, No. 3/2017) are the insufficient quality of drinking water in a large part of Vojvodina (especially in Bačka and Banat), in Pomoravlje, in parts of Šumadija and in numerous smaller municipalities, improper use of groundwater (primarily occurring in Vojvodina), inadequate protection of headwaters, unreasonable price of water, illegally drilled wells (especially in rural and suburban areas), insufficient efficiency of municipal services and lack of adequate personnel. Other major problems in water resource management include the lack of harmonized legislation, insufficient investment in water management, low level of services, lack of an efficient integrated water management system, illegal construction in potential floodplains and inadequate monitoring. In order to solve these problems and overcome or mitigate their consequences, it is necessary to implement a number of measures within the framework of inter- and transdisciplinary national and international projects (Jakovljević *et al*., 2019).

5.1. Habitat fragmentation, modification and destruction

As seasonally flooded habitats, wetlands are valuable natural fish spawning grounds for fish, habitat for birds, place of river self-purification, etc. (Figure 31). Wetlands are habitats that are covered with water in one season and completely dry in another, forming a transition between aquatic and terrestrial ecosystems (Krpić *et al*., 2018). The largest wetlands are located in northern Eurasia and North America. In the last 100 years, about two-thirds of the world's wetlands have been destroyed, mainly due to uncontrolled urban-

Slika 31. Plavna područja Dunava: (a) plavna zona kod sela Ivanova; (b) efemerna vodena staništa (kubici) kod Beograda (foto: A. Hegediš).

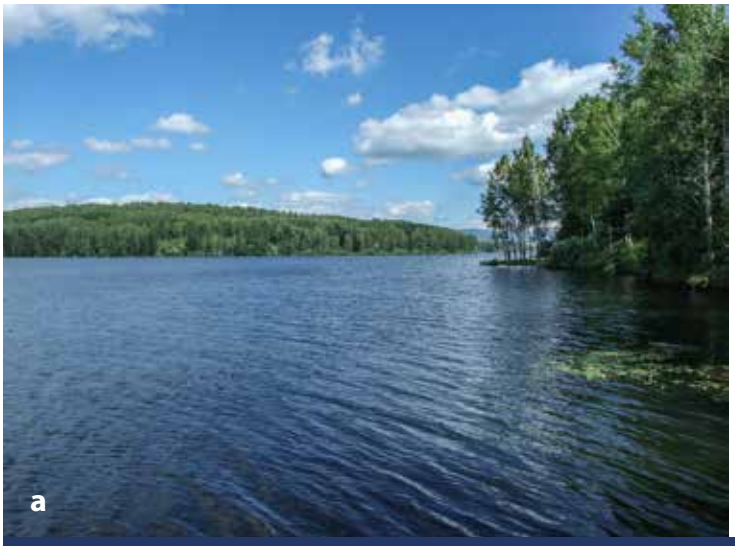
Figure 31. Floodplains of the Danube: (a) floodplain near the village of Ivanovo; (b) ephemeral aquatic habitats (so-called "kubici") near Belgrade (photo: A. Hegediš).

hidromelioracionih radova i postavljanja brana na rekama (Bram *et al*., 2003; Ranđelović & Jenačković-Gocić, 2021).

Zaštitom močvarnih područja od međunarodnog značaja bavi se Ramsarska konvencija (The Convention on Wetlands). U Srbiji je do sada proglašeno ukupno 11 područja od međunarodnog značaja koja se prostiru na ukupnoj površini od 130.411 ha: Peštersko polje, Gornje Podunavlje, Koviljsko-petrovaradinski rit, Labudovo okno, Ludaško jezero, Obedska bara, Slano Kopovo, Stari Begej – Carska bara, Vlasina, Zasavica i Đerdap (https://www.ramsar.org/wetland/serbia) (Slika 32). Intenzivne antropogene aktivnosti, poput poljoprivrede, navigacije, hidromeliorativnih mera, pravljenja nasipa i brana, regulacije rečnih tokova, u poslednjih 150 godina uništile su plavna područja oko velikih reka. Izgubljeno je više od 80% močvara oko Dunava, a sa njima i raznovrsnost riba i drugih vrsta koje su od njih zavisile (https://www.wwfadria.org). Osim značaja za biodiverzitet, ovi ekosistemi doprinose i odbrani od poplava, turizmu i rekreaciji (Scharbert & Borcherding, 2013). Poslednjih godina javlja se svest o prednostima koje močvare pružaju, kao i o tome da je harmonija sa prirodom ne samo dobra za okolinu, već da ima i ekonomsku opravdanost.

ization, hydromelioration works and the construction of dams on rivers (Bram *et al*., 2003; Ranđelović & Jenačković-Gocić, 2021).

The protection of wetlands of international importance is regulated by the Ramsar Convention on Wetlands. To date, 11 sites of international importance have been designated in Serbia, covering a total area of 130,411 ha: Peštersko polje, Gornje Podunavlje, Kovilj-Petrovaradin Marsh, Labudovo okno, Ludaško Lake, Obedska bara, Slano Kopovo, Stari Begej – Carska bara, Vlasina, Zasavica and Đerdap (https://www.ramsar.org/wetland/serbia) (Figure 32). Intensive anthropogenic activities such as agriculture, navigation, hydromeliorative measures, construction of levees and dams and regulation of river courses have destroyed floodplains on major rivers in the last 150 years. More than 80% of the Danube wetlands were lost and with them the rich diversity of fish and other species on which they depend (https://www.wwfadria.org). In addition to their importance for biodiversity, these ecosystems also contribute to flood control, tourism and recreation (Scharbert & Borcherding, 2013). In recent years, people have become more aware of the benefits that wetlands provide and that being in harmony with nature is not only good for the environment but also makes commercial sense.



Slika 32. Zaštićena močvarna područja: (a) Vlasinsko jezero (foto: A. Bajić); (b) Zasavica (foto: A. Hegediš).

Figure 32. Protected wetlands: (a) Lake Vlasina (photo: A. Bajić); (b) Zasavica (photo: A. Hegediš).

Postavljanje brana takođe negativno utiče na biodiverzitet, pa samim tim i na ribe. Postavljanje pregrada na rekama ne samo što utiče na isušivanje plavnih područja, već izaziva i diskontinuitet staništa tj. njegovu fragmentaciju, te onemogućava migraciju riba. Brane i kanali menjaju tokove reka u celom svetu. Samo jedna trećina svetskih reka dužih od 1.000 km ima slobodan tok. U više od 60% najvećih svetskih reka, brane i kanali doprineli su smanjenju biodiverziteta slatkovodnih ekosistema, a najveći uticaj na biodiverzitet imaju brane na područjima koja se nalaze na spisku Ramsarske konvencije. Kako bi se umanjio negativan uticaj brana na biodiverzitet riba, neophodno je predvideti ekološki prihvatljiv protok vode, obnavljanje i zaštitu staništa, pre svega plavnih i močvarnih područja, kao i riblje staze i liftove (Babić-Mladenović & Ninković, 2009; Grujić & Ivanović, 2013) (Slika 33).

The construction of dams also has a negative impact on biodiversity and thus also on fish. Dam construction on rivers not only leads to the drying out of floodplains, but also to the discontinuity of habitats, i.e. their fragmentation, and prevents the migration of fish. Dams and canals are changing the course of rivers around the world. Only one-third of the world's rivers longer than 1,000 km have a free-flowing course. In more than 60% of the world's largest rivers, dams and canals have contributed to the reduction of freshwater ecosystem biodiversity, and dams have the greatest impact on biodiversity in Ramsar sites. To reduce the negative impacts of dams on fish biodiversity, it is necessary to provide for environmentally sustainable water flow, habitat restoration and protection, especially of floodplains and wetlands, as well as fish ladders (Babić-Mladenović & Ninković, 2009; Grujić & Ivanović, 2013) (Figure 33).

Slika 33. Riblja staza na brani u Malom Zvorniku: (a) izlazni deo riblje staze; (b) riblja staza u brani; (c) skobalj u momentu prolaska iz kasete u kasetu; (d) ulazni deo riblje staze (foto: A. Hegediš).

U Srbiji postoji veliki broj brana na rekama, od manjih brana koje su u sklopu MHE (malih hidroelektrana) do velikih brana na Dunavu (Đerdap I i Đerdap II). Brane su intenzivno građene posle Drugog svetskog rata, a posebnim kuriozitetom može se smatrati postojanje ribljih staza na najstarijima od njih – Sokolovnica na Timoku iz 1948. godine i brana u Malom Zvorniku iz 1955. godine. Ove staze i danas vrše svoju funkciju – omogućavaju prolećne mresne migracije potamodromnih migranata kao što je skobalj, (na Drini i Timoku nema anadromnih migratornih vrsta kao što su, na primer, jesetre). Na većim branama, koje su nastale šezdesetih godina prošlog veka i kasnije, riblje staze više nisu građene. U novije vreme MHE imaju obavezu izgradnje riblje staze u vodozahvatnu građevinu i one formalno postoje, ali najveći broj njih nije u funkciji zbog toga što se praktično sva voda koristi za proizvodnju struje.

Figure 33. Fish ladder at the reservoir in Mali Zvornik: (a) exit part of the fish ladder; (b) fish ladder in the reservoir; (c) the common nase at the transition from compartment to compartment; (d) entry part of the fish ladder (photo: A. Hegediš).

In Serbia, there are a large number of dams on rivers, from smaller dams that are part of SHPs (small hydropower plants) to large dams on the Danube (Đerdap I and Đerdap II). The dams were built intensively after the World War II, and the existence of fish ladders on the oldest of them – Sokolovnica on Timok from 1948 and the dam in Mali Zvornik from 1955 – can be considered a special curiosity. These passageways still fulfil their function today – they enable the spring spawning migration of potamodromous migrants such as the common nase (anadromous migratory fish species such as sturgeon do not live in the Drina and Timok). No fish ladders were installed at the larger dams built in the 1960s and later. More recently, MHPs are required to install a fish ladder in the water intake building and formally they do exist, but most of them are not in operation as practically all the water is used for power generation.

Na rekama u Srbiji postavljeno je oko 170 brana i pregrada različitog tipa. Najveća brana, HE „Đerdap I" na reci Dunav, postavljena je 1971. godine, a nakon nje i HE „Đerdap II" 1984. godine (Slika 34). Nakon izgradnje prve brane zabeležen je drastičan pad ulova jegulje i pastruge, a nakon izgradnje druge brane, obe vrste su gotovo nestale. Izgradnjom ovih brana prekinuta je mresna migracija svih anadromnih vrsta (morune, ruske jesetre, pastruge, sima, crnomorske i azovske haringe). Njihova uzvodna migracija iz Crnog mora ograničena je trajno na 863 km toka Dunava, tj. na svega 17,6 km toka kroz Srbiju (od 863 rkm do 845,6 rkm) (Višnjić-Jeftić, 2012). Većina tih vrsta sada se smatra ugroženim i nalaze se na različitim listama zaštićenih vrsta.

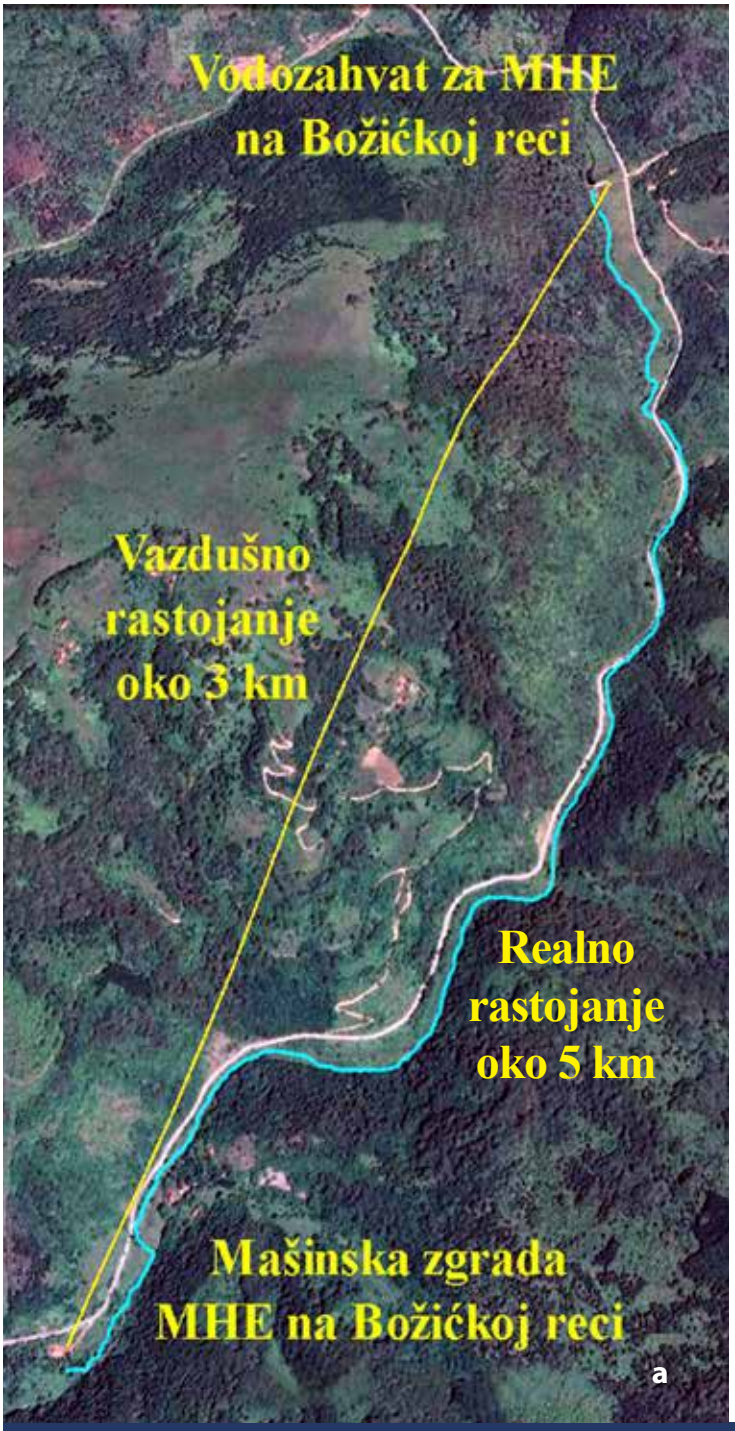
There are about 170 dams and barriers of various types installed on rivers in Serbia. The largest dam, HPP "Đerdap I" on the Danube, was built in 1971, followed by HPP "Đerdap II" in 1984 (Figure 34). After the construction of the first dam, there was a drastic decrease in eel and starry sturgeon catches, and after the construction of the second dam, both species had almost disappeared. The construction of these dams interrupted the spawning migration of all anadromous species (beluga, Russian sturgeon, starry sturgeon, ship sturgeon, Pontic and Azov shad). Their migration upstream from the Black Sea is permanently restricted to 863 km of the Danube, i.e. only 17.6 km of flow through Serbia (from rkm 863 to rkm 845.6) (Višnjić-Jeftić, 2012). Most of these species are now considered threatened and are on various lists of protected species.

Slika 34. Velike brane u Srbiji – brana HE Đerdap II na Dunavu kod Prahova (foto: A. Hegediš).

Figure 34. Large dams in Serbia – HPP Đerdap II dam on the Danube near Prahovo (photo: A. Hegediš).

Poslednjih godina svedoci smo sve veće pojave malih hidroelektrana (MHE) za koje se zna da imaju devastirajući efekat na životnu sredinu, bez jasne ekonomske i socijalne isplativosti za lokalnu zajednicu (Slika 35). Glavni negativni efekti MHE na životnu sredinu jesu: prekid kontinuiteta toka reke, promena morfologije vodotoka, promena dna i priobalja, uništavanje vegetacije, uništavanje akvatičnog biodiverziteta, tj. presecanje migratornih pravaca za ribe i druge životinje, zagađenje uzvodno i nizvodno u periodu niskih voda, kao i potpuno presušivanje vodotoka (Ristić *et al.*, 2018). Nakon dobijanja dozvole za izgradnju MHE, inspekcijski nadzor izostaje u praksi, te nema adekvatnog praćenja i kontrole sprovođenja mera koje smanjuju negativni uticaj na životnu sredinu, kao ni njihovog daljeg sistematskog praćenja.

In recent years, more and more small hydropower plants (SHPs) have been built, which are known to have a devastating impact on the environment without being commercially or socially profitable for the local population (Figure 35). The main negative impacts of SHPs on the environment are: disruption of the river course continuity, alteration of the rive morphology, alteration of the substrate and of the riparian zone, destruction of vegetation, destruction of aquatic biodiversity, namely disruption of migration routes of fish and other animals, pollution upstream and downstream during low water periods and complete drying up of watercourses (Ristić *et al.*, 2018). Once permission is granted for the construction of a SHP, in practice there is a lack of inspection supervision, and there is neither adequate monitoring and control of the implementation of measures to reduce negative impacts on the environment nor their further systematic monitoring.



Slika 35. Mini-hidroelektrana (MHE) na Božičkoj reci: (a) satelitski snimak MHE (Google Earth). Vodozahvat za ovu MHE prikazan je na Slici 30a. Nalazi se na oko 3 km vazdušne linije i 5 km vodene linije od mašinske zgrade. S obzirom da je Božička reka duga oko 50 km, to bi značilo da je, sa aspekta faune riba, zbog ove MHE potpuno devastirana desetina njenog toka. U vreme niskog vodostaja ovaj deo toka ostaje gotovo bez vode, čime su uslovi za opstanak riba značajno pogoršani; (b) veoma mala količina vode koja se nakupila u koritu nakon vodozahvata (foto: A. Hegediš); (c) tok nizvodno od mašinske zgrade MHE, gde se u korito vraća uzeta voda. Količina vode svrstava Božičku reku u bogatu planinsku rečicu (foto: A. Hegediš).

Figure 35. A mini-hydropower plant (MHP) on the Božička River: (a) satellite image of the MHP (Google Earth). The water intake structure for this power plant is shown in Figure 30a. It is located about 3 km by air route and 5 km by water route from the powerhouse. Considering that the Božička River is about 50 km long, this would mean that one tenth of the river course was completely destroyed by the MHP for the fish fauna. When the water level is low, this part of the river remains almost without water, which significantly worsens the survival conditions for fish; (b) a very small amount of water accumulated in the riverbed after water extraction (photo: A. Hegediš); (c) the river downstream of the powerhouse, where the extracted water is returned to the riverbed. Due to its amount of water the Božička River represents a rich mountain stream (photo: A. Hegediš).

5.2. Zagađenje kopnenih voda

Porast svetskog stanovništva, kao i razvoj industrije i poljoprivrede doveli su do povećanja količine otpadnih voda koje ugrožavaju kvalitet kopnenih voda na globalnom nivou. Osnovni izvori zagađenja voda jesu poljoprivreda, industrija i rudarstvo (Kovačević *et al.*, 2017) (Slika 36). Polutante vodenih ekosistema odlikuje toksičnost, postojanost i disperzivnost. Mogu se podeliti na organske i neorganske. Organski polutanti uključuju policiklične aromatične ugljovodonike, polihlorovane bifenile, pesticide, deterdžente, trihloretilen, perhlorate, a neorganski metale, elemente u tragovima, amonijak, fosfate, nitrate, nitrite (Dalmacija & Tričković, 2010). Zagađenje akvatičnih ekosistema predstavlja pretnju za akvatične organizme, uključujući i ribe. Ribe su često izložene visokom stepenu zagađenja u vodi, što može dovesti do čitavog niza različitih promena, od biohemijskih na nivou ćelije, do promena na nivou celih populaci-

5.2. Pollution of inland waters

The increase in the world's population and the development of industry and agriculture have led to an increase in the amount of wastewater that threatens the quality of inland waters on a global scale. The main sources of water pollution are agriculture, industry and mining (Kovačević *et al.*, 2017) (Figure 36). Pollutants to aquatic ecosystems are characterized by toxicity, persistence and dispersal ability. They can be classified into organic and inorganic. Organic pollutants include polycyclic aromatic hydrocarbons, polychlorinated biphenyls, pesticides, detergents, trichloroethylene and perchlorates; inorganic pollutants include metals, trace elements, ammonia, phosphates, nitrates and nitrites (Dalmacija & Tričković, 2010). Pollution of aquatic ecosystems poses a threat to aquatic organisms, including fish. Fish are often exposed to severe water pollution, which can lead to a whole range of different changes, from biochemical alterations at the cellular level up to

Slika 36. Zagađenje vode: (a) reka Belica protiče kroz industrijsku zonu Jagodine i sa sobom nosi svu otpadnu vodu, zbog čega je boja vode sivkasto-ljubičasta (foto: A. Hegediš); (b) reka Lepenica koja dolazi iz Kragujevca, sa nakupinama otpadne pene (foto: A. Hegediš); (c) satelitski snimak zagađenja Velike Morave rekom Belicom (Google Earth).

Figure 36. Water pollution: (a) the Belica River flows through the industrial area of Jagodina and carries all the sewage with it, which is why the water has a grey-purple colour (photo: A. Hegediš); (b) the Lepenica River, coming from Kragujevac, with accumulation of waste foam (photo: A. Hegediš); (c) satellite image of the pollution of the Great Morava by the Belica River (Google Earth).

ja (Bernet *et al*., 1999); smatraju se jednom od najosetljivijih grupa organizama na prisustvo toksičnih materija u vodi. Ribe se nalaze na samom vrhu lanaca ishrane u vodenim ekosistemima, usled čega se u njihovim telima često akumuliraju značajne količine pojedinih toksičnih metala i ostalih zagađivača (Mingelgrin & Nasser, 2006; Naigaga *et al*., 2011; Višnjić-Jeftić, 2012; Antonijević *et al*., 2014).

Izloženost ljudi zagađenim kopnenim vodama prvenstveno se odvija preko ishrane, pa je zato praćenje kontaminacije polutantima komercijalno značajnih vrsta riba od izuzetnog značaja. Meso riba predstavlja jednu od osnovnih komponenti ljudske ishrane, usled čega je prisutno veliko interesovanje naučne javnosti za prisustvo zagađujućih materija u vodi i njihovo akumuliranje u tkivu riba (posebno mesa, tj. mišića) (Erdoğrul & Erbilir, 2007; Yilmaz *et al*., 2007).

Od 2011. godine Agencija za zaštitu životne sredine sprovodi praćenje kvaliteta površinskih i podzemnih voda u Srbiji (Krstović *et al*., 2020). U okviru svojih nadležnosti, na odabranim rečnim profilima Agencija vrši i praćenje kvaliteta voda u akumulacijama, kao i kvaliteta sedimenta. Položaj mernih stanica i učestalost merenja nisu na svim vodotocima zadovoljavajući. Prema *Strategiji upravljanja vodama na teritoriji Republike Srbije do 2034. godine* (Službeni glasnik RS, br. 3/2017), osmatranja na malim i srednjim vodotocima neravnomerno su i nedovoljno zastupljena, što se negativno odražava na kompletnost i pouzdanost ocena stanja kvaliteta površinskih i podzemnih voda i status vodnih tela.

Zaštita voda od zagađenja jeste najlošije uređena oblast u sektoru voda u Republici Srbiji. Postojeće nadležnosti u sektoru voda koje se tiču kontrole zaštite od zagađivanja nisu jasno podeljene, što aktuelizuje sukob nadležnosti u inspekcijskom nadzoru koji se javlja u pojedinim slučajevima u praksi. Osim toga, blaga kaznena politika ne doprinosi rešavanju postojećih problema zagađenja vodotoka koji su decenijama prisutni (Grujić, 2018).

U Srbiji, najveći izvori zagađenja voda jesu neprečišćene industrijske i komunalne otpadne vode, koje se direktno ispuštaju u vodotoke, bez prethodnog tretmana (Slika 37). U periodu od 2010. do 2019. godine, prosečna količina zagađenih neprečišćenih otpadnih voda na teritoriji Republike Srbije iznosila je 370,2 miliona m^3 godišnje (88,7% od ukupnih otpadnih voda), dok je prosečna količina prečišćenih otpadnih voda iznosila svega 11,3% (Perunović Ćulić *et al*., 2021). Najveći procenat neprečišćenih otpadnih voda (95–100%) zabeležen je u Nišavskoj, Beogradskoj, Zlatiborskoj, Borskoj, Rasinskoj, Pirotskoj, Topličkoj, Braničevskoj, Južnobačkoj, Srednjobanatskoj i Sremskoj oblasti, a najmanje u Severnobačkoj, Kolubarskoj, Severnobanatskoj i Šumadijskoj oblasti. Ovakvo stanje posledica je malog broja postrojenja koja su u funkciji i koja obezbeđuju odgovarajući stepen prečišćavanja, a time i zadovoljavajući kvalitet otpadnih voda koje se ispuštaju u recipijent. Takođe, u većini postojećih postrojenja za tretman otpadnih voda primenjuje se zastarela tehnologija, imajući u vidu da su građena pre 30 i više godina (Krstović *et al*., 2020).

Kapacitet samoprečišćivanja reka u najvećoj meri zavisi od veličine vodotoka. Velike reke imaju veliku sposobnost samorevitalizacije, dok su mali vodotoci veoma ugroženi. U najzagađenije reke u Srbiji spadaju Stari Begej, Toplica, Veliki Lug, Lugomir, Crni Timok, Borska reka i kanal Vrbas (Josimović *et al*., 2018).

changes in whole populations (Bernet *et al*., 1999); they are considered one of the most sensitive groups of organisms to the presence of toxic substances in water. Fish are at the top of food chains in aquatic ecosystems and therefore their bodies often accumulate significant amounts of certain toxic metals and other pollutants (Mingelgrin & Nasser, 2006; Naigaga *et al*., 2011; Višnjić-Jeftić, 2012; Antonijević *et al*., 2014).

Human exposure to polluted inland waters is primarily through food, making monitoring of contaminant levels in commercially valuable fish species extremely important. Since fish meat is one of the main components of the human diet, there is great interest among the scientific public in the presence of pollutants in water and their accumulation in fish tissues (especially in the meat, i.e. muscle) (Erdoğrul & Erbilir, 2007; Yilmaz *et al*., 2007).

Since 2011, the Serbian Environmental Protection Agency has been monitoring the quality of surface and groundwater in Serbia (Krstović *et al*., 2020). As part of its responsibilities, the agency monitors water quality in reservoirs and sediment quality on selected river profiles. The location of monitoring stations and the frequency of measurements are not satisfactory on all watercourses. According to the *Water Management Strategy of the Territory of the Republic of Serbia until 2034* (Official Gazette of RS, No. 3/2017), observations on small and medium-sized watercourses are irregular and insufficiently represented, which has a negative impact on the completeness and reliability of surface and groundwater quality assessments and the status of waterbodies.

Protection of water from pollution is the most poorly regulated area in the water sector of the Republic of Serbia. The existing responsibilities in the water sector for controlling protection against pollution are not clearly distributed, which in practice in some cases leads to conflicts of competence in inspection supervision. Moreover, lenient sanction policies do not help to solve the problems of water pollution that have existed for decades (Grujić, 2018).

In Serbia, the biggest sources of water pollution are untreated industrial and municipal wastewater discharged directly into waterways without prior treatment (Figure 37). In the period from 2010 to 2019, the average amount of polluted untreated wastewater in the Republic of Serbia was 370.2 million m^3 per year (88.7% of the total wastewater), while the average amount of treated wastewater was only 11.3% (Perunović Ćulić *et al*., 2021). The highest percentage of untreated wastewater (95–100 %) was recorded in the districts of Niš, Beograd, Zlatibor, Bor, Rasina, Pirot, Toplica, Braničevo, South Bačka, Central Banat and Srem, and the lowest in the districts of North Bačka, Kolubara, North Banat and Šumadija. This situation is due to the fact that only a few wastewater treatment plants are in operation that would ensure an adequate degree of purification and thus a satisfactory quality of the wastewater discharged into the recipient body of water. Moreover, most of the existing wastewater treatment plants are equipped with outdated technology, having been built 30 or more years ago (Krstović *et al*., 2020).

The self-purifying capacity of rivers depends largely on the size of the waterbody. Large rivers have a great capacity for self-revitalization, while small watercourses are very vulnerable. The most polluted rivers in Serbia are Stari Begej, Toplica, Veliki Lug, Lugomir, Crni Timok, Borska River and the Vrbas Canal (Josimović *et al*., 2018).

Slika 37. Kolektori zagađenih otpadnih voda: (a) Lugomir nakon prijema otpadnih voda iz klanice (foto: G. Đurđević); (b) Lugomir na mestu prijema otpadnih voda nepoznatog porekla i sastava (foto: G. Đurđević); (c) ušće Topčiderske reke u Čukarički rukavac (Google Earth).

Figure 37. Sewage collectors: (a) Lugomir after receiving sewage from a slaughterhouse (photo: G. Đurđević); (b) Lugomir at the point where sewage of unknown origin and composition is discharged (photo: G. Đurđević); (c) the confluence of the Topčiderska River with the Čukarica Channel (Google Earth).

5.3. Unošenje invazivnih alohtonih vrsta

Raseljavanje vrsta van njihovog prirodnog areala i njihovo unošenje u nove ekosisteme globalno predstavlja jednu od glavnih pretnji prirodnim ekosistemima i celokupnom biodiverzitetu, odmah iza uništavanja staništa (Clavero & García-Berthou, 2005; Vilà *et al.*, 2010). Prema takozvanom „pravilu desetine" (*engl.* „tens rule") samo 10% introdukovanih vrsta uspe da se uspostavi na nekom novom staništu i samo 10% uspešno unetih vrsta može biti tretirano kao „štetočine" ili „korovi" (Williamson, 1996; Gozlan *et al.*, 2010). I pored toga, postoji rastuća zabrinutost za potencijalni uticaj, bilo direktni ili indirektni, ovakvih vrsta na autohtone vrste, ekosisteme, lokalnu i nacionalnu ekonomiju i društvo u celini. Smatra se da je 20% od oko 680 vrsta kičmenjaka koji su izumrli od XVI veka do danas nestalo samo zbog uticaja invazivnih alohtonih vrsta na njihove

5.3. Introduction of invasive alien species

Displacement of species from their natural range and introduction into new ecosystems is one of the greatest threats to natural ecosystems and overall biodiversity worldwide, right after habitat destruction (Clavero & García-Berthou, 2005; Vilà *et al.*, 2010). According to the so-called "tens rule" only 10% of introduced species succeed in establishing themselves in a new habitat, and only 10% of successfully introduced species can be treated as "pests" or "weeds" (Williamson, 1996; Gozlan *et al.*, 2010). Nevertheless, there is growing concern about the potential direct or indirect impact of such species on native species, ecosystems, local and national economies, and society in general. It is estimated that 20% of the approximately 680 vertebrate species that have become extinct since the 16th century have disappeared solely due to the impact of invasive alien species on their populations

populacije (Clavero & García-Berthou, 2005). Na globalnom nivou, broj introdukovanih vrsta se eksponencijalno povećao kao posledica globalizacije, jer su se putevi njihovih unošenja povećali. U Evropi se broj invazivnih alohtonih vrsta povećao za 76% od 1970. do 2007. godine (Sundseth, 2014).

Slatkovodni ekosistemi znatno su podložniji invazijama od kopnenih. Ova ranjivost je nastala kao posledica intenzivne eksploatacije od strane ljudi, prirodne povezanosti i velike sposobnosti širenja i kretanja akvatičnih organizama. Glavni putevi introdukcije slatkovodnih invazivnih vrsta u Evropi povezani su sa širokim spektrom ljudskih aktivnosti i intenzitetom sa kojim ljudi menjaju slatkovodne ekosisteme u cilju rekreacije, proizvodnje hrane i drugih komercijalnih razloga (Welcomme, 2001; Dudgeon *et al*., 2006). Akvakultura predstavlja jedan od najbrže rastućih sektora u proizvodnji hrane na globalnom nivou. U Evropi postoji trend gajenja alohtonih vrsta riba, što je dovelo do njihovih brojnih introdukcija u prirodne ekosisteme (Copp *et al*., 2010; Gozlan *et al*., 2010). Takođe, brodski saobraćaj je doprineo introdukciji slatkovodnih vrsta u Evropu, tako što su se vrste prenosile balastnim vodama ili su bile zakačene za trupove brodova (Copp *et al*., 2005).

U poslednjih 30 godina udvostručila se stopa indrodukcije slatkovodnih vrsta riba (Gozlan *et al*., 2010). Najvažniji motiv unošenja novih vrsta jeste akvakultura, obogaćivanje autohtone ihtiofaune zbog razvoja privrednog i rekreativnog ribolova, akvaristika i biomanipulacija. Pojedine introdukcije su nenamerne i mnoge vrste su migrirale iz akvakulture i akvarijuma u prirodne ekosisteme. Drugim rečima, ekonomske aktivnosti jesu glavni pokretač introdukcija koje su izazvane ljudskom aktivnošću, uključujući i globalizaciju uzgoja vrsta riba koje se koriste u ishrani i kao ukras (Copp *et al*., 2010; Savini *et al*., 2010; Maceda-Veiga *et al*., 2013; Nunes *et al*., 2015). Shodno tome, neophodno je izbalansirati ekonomsku korist i negativne efekte koje alohotne invazivne vrste riba imaju na životnu sredinu. Ova situacija je stvorila sukob između dva sasvim različita stanovišta – povećane ekonomske aktivnosti i progresa s jedne strane, i zašitite životne sredine s druge strane. Zbog toga je donosiocima odluka izuzetno teško da uspostave zakonodavne okvire i politike kojima bi sprečili širenje alohtonih invazivnih vrsta i ublažili ekološke rizike koje one stvaraju (Gherardi *et al*., 2009; Gozlan *et al*., 2010).

Alohtone vrste riba mogu da utiču na akvatične ekosisteme na više nivoa organizacije živog sveta. Na individualnom nivou menjaju ponašanje autohtonih vrsta kroz predatorstvo i kompeticiju za hranu i druge resurse, uništavaju staništa, dovode do hibridizacije i gubitka genetičke celovitosti i prenose bolesti i parazite; na populacionom nivou menjaju zastupljenost, biomasu i distribuciju autohtonih vrsta; na nivou zajednice utiču na interakcije između populacija i modifikuju trofičke kaskade; na ekosistemskom nivou utiču na protok energije i kruženje nutrijenata (Dudgeon *et al*., 2006; Gozlan *et al*., 2010; Savini *et al*., 2010; Boon *et al*., 2020).

U Srbiju su do sada unete 23 alohtone vrste, bilo namerno ili slučajno. Vrste su introdukovane prvenstveno zbog povećanja produkcije naselja riba, ali i zbog biomanipulacije i poboljšanja rekreativnog ribolova (Zorić *et al*., 2014) (Slika 38). Takođe, izvestan broj vrsta unet je slučajno. Većina alohtonih vrsta u Srbiji poreklom je iz Severne Amerike – predstavnici porodica Ictaluridae (smeđi američki

(Clavero & García-Berthou, 2005). On a global scale, the number of introduced species has increased exponentially with globalization, as the pathways of their introduction have expanded. In Europe, the number of invasive alien species increased by 76% between 1970 and 2007 (Sundseth, 2014).

Freshwater ecosystems are much more vulnerable to invasion than terrestrial ecosystems. This vulnerability is due to intensive human exploitation, natural connectivity and the great dispersal and movement capacity of aquatic organisms. The main pathways of introduction of invasive freshwater species in Europe are related to a wide range of human activities and the intensity with which humans modify freshwater ecosystems for recreational, food production and other commercial purposes (Welcomme, 2001; Dudgeon *et al*., 2006). Aquaculture is one of the fastest growing sectors of food production worldwide. In Europe, there is a trend toward farming of non-native fish species, which has led to their numerous introductions into natural ecosystems (Copp *et al*., 2010; Gozlan *et al*., 2010). Shipping has also contributed to the introduction of freshwater species into Europe, as they can be found in ballast water or attached to ship hulls (Copp *et al*., 2005).

In the last 30 years, the rate of introduction of freshwater fish species has doubled (Gozlan *et al*., 2010). The primary motive for the introduction of new species is aquaculture, enhancement of native fish fauna for the purpose of commercial and recreational fisheries, aquaristics and biomanipulation. Some introductions are unintentional and many species have migrated from aquaculture and aquaria into natural ecosystems. In other words, commercial activities are the main cause of human-induced introductions, including the globalisation of farming of fish species used as food or ornamental fish (Copp *et al*., 2010; Savini *et al*., 2010; Maceda-Veiga *et al*. , 2013; Nunes *et al*., 2015). Consequently, the commercial benefits and negative impacts that alien invasive fish species have on the environment must be weighed against each other. This situation creates a conflict between two completely different viewpoints – increasing commercial activity and progress on the one hand and environmental protection on the other. Therefore, it is extremely difficult for decision makers to establish legal frameworks and policies to prevent the spread of alien invasive species and mitigate the ecological risks they pose (Gherardi *et al*., 2009; Gozlan *et al*., 2010).

Non-native fish species can affect aquatic ecosystems at multiple hierarchical levels of biological organization. At the organism level they alter the behaviour of native species through predation and competition for food and other resources, destroy habitats, cause hybridization and loss of genetic integrity and transmit diseases and parasites; at the population level they alter the abundance, biomass and distribution of native species; at the community level they affect interactions among populations and alter trophic cascades; and at the ecosystem level they affect energy flow and nutrient cycling (Dudgeon *et al*., 2006; Gozlan *et al*., 2010; Savini *et al*., 2010; Boon *et al*., 2020).

To date, 23 alien species have been introduced to Serbia either intentionally or accidentally. The species were introduced primarily to increase fish production, but also for biomanipulation and recreational fisheries enhancement (Zorić *et al*., 2014) (Figure 38). However, a num-

patuljasti som *Ameiurus nebulosus*, crni američki patuljasti som ili cverglan *A. melas*), Centrarchidae (sunčica *Lepomis gibbosus*, velikousti bas ili pastrmski grgeč *Micropterus salmoides*), Polyodontidae (američki veslonos *Polyodon spathula*) i Salmonidae (kalifornijska ili dužičasta pastrmka *Oncorhynchus mykiss*, potočna zlatovčica *Salvelinus fontinalis*), a zatim iz Azije, pre svega iz basena reke Amur – porodice Cyprinidae (babuška *Carassius gibelio*), porodice Xenocyprididae (beli amur *Ctenopharyngodon idella*, sivi tolstolobik *Hypophthalmichthys nobilis*, beli tolstolobik *H. molitrix*), porodice Gobionidae (amurski čebačok ili bezribica *Pseudorasbora parva*) i

ber of species were introduced accidentally. Most non-native species in Serbia originate from North America – species of the families Ictaluridae (brown bullhead *Ameiurus nebulosus*, black bullhead *A. melas*), Centrarchidae (pumpkinseed *Lepomis gibbosus*, largemouth bass *Micropterus salmoides*), Polyodontidae (American paddlefish *Polyodon spathula*) and Salmonidae (rainbow trout *Oncorhynchus mykiss*, brook trout *Salvelinus fontinalis*), and then from Asia, mainly from the Amur River basin – families Cyprinidae (Prussian carp *Carassius gibelio*), Xenocyprididae (grass carp *Ctenopharyngodon idella*, bighead carp *Hypophthalmichthys nobilis*, silver carp *H. molitrix*), Gobionidae (topmouth gudg-

Slika 38. Invazivne alohtone vrsta riba u Savskom jezeru.

Od 2003. do 2009. godine, izdvajanjem značajnih sredstava, obnovljeno je naselje riba u jezeru, tako da su autohtone vrste postale dominantne, i u tom periodu održano je veoma uspešno VII svetsko prvenstvo u šaranskom ribolovu (2007. godine). Zapostavljanje i neodržavanje stanja počelo je 2013. godine, po isticanju programa upravljanja ribarskim područjima dodeljenim za period 2008–2012. godina. Veoma brzo, u naselju riba ponovo su postale dominantne alohtone invazivne vrste riba, kao što su (a) cverglan (*Ameiurus melas*) (foto: R. Stefanek, https://www.dreamstime.com/black-bullhead-catfish-ameiurus-melas-underwater-black-bullhead-catfish-ameiurus-melas-underwater-photography-freshwater-fish-image130986952) i (b) sunčica (*Lepomis gibbosus*) (foto: G. Farkas, https://www.dreamstime.com/stock-photo-sunfish-pumpkinseed-lepomis-gibbosus-invasive-species-swimming-aquarium-image64902331). Kvalitetne autohtone vrste su prelovljene, tako da se u današnje vreme ulov sportskih ribolovaca takmičara uglavnom sastoji od ove dve nepoželjne vrste riba (c) (foto: A. Hegediš).

Figure 38. Invasive non-native fish species in Lake Sava.

From 2003 to 2009, significant funding restored the fish population in the lake so that native species dominated and the very successful VII Carp Fishing World Championship was held during this period (in 2007). The neglect and non-maintenance of the lake started in 2013, after the fisheries management programme for the period 2008–2012 expired. Very quickly, non-native invasive fish species such as (a) black bullhead (*Ameiurus melas*) (photo: R. Stefanek, https://www.dreamstime.com/black-bullhead-catfish-ameiurus-melas-underwater-black-bullhead-catfish-ameiurus-melas-underwater-photography-freshwater-fish-image130986952) and (b) pumpkinseed (*Lepomis gibbosus*) (photo: G. Farkas, https://www.dreamstime.com/stock-photo-sunfish-pumpkinseed-lepomis-gibbosus-invasive-species-swimming-aquarium-image64902331) became dominant in the fish assemblage. High-value native species have been overfished, so that the catches of sport fishers now consist mainly of these two undesirable fish species (c) (photo: A. Hegediš).

Odontobutidae (amurski spavač *Perccottus glenii*), i Ponto-kaspijskog regiona (porodica Gobiidae – glavoča). Distribucija četiri alohtone vrste (sunčice, smeđeg i crnog američkog patuljastog soma i babuške) pokriva preko 51% površine Srbije. Beli amur nastanjuje 37,5%, sivi tolstolobik 24,6% i beli tolstolobik 35,1% površine Srbije. Predstavnici porodice glavoča nastanjuju između 11,3% i 14,2% površine Srbije, dok ostale alohtone vrste nastanjuju svega par procenata teritorije naše zemlje (Simonović & Nikolić, 1997; Lenhardt *et al*., 2011; Zorić *et al*., 2014).

Od ukupnog broja alohtonih vrsta, samo se beli amur, sivi i beli tolstolobik i kalifornijska pastrmka uzgajaju u akvakulturi, uglavnom u ribnjacima. Beli amur, sivi i beli tolstolobik, babuška, amurski čebačok i američki patuljasti somovi u Srbiju su došli iz Rumunije i Mađarske, preko Dunava i Tise. Američki veslonos je stigao iz rumunskog dela Dunava i najverovatnije je pobegao iz ribnjaka tokom poplava 2006. godine. Invazije od istoka ka zapadu omogućile su disperziju glavoča Dunavom, šilca kratkokljunog (*Syngnathus abaster*) iz Crnog mora i amurskog spavača iz gornjeg toka reke Tise. Kalifornijska pastrmka dospeva u prirodne ekosistemime bežanjem iz ribnjaka. Velikousti bas uglavnom naseljava kanalsku mrežu u severnim delovima Srbije. Kada je reč o gregorcu (*Gasterosteus aculeatus*), u pitanju su samo pojedinačni nalazi i zbog nedostatka raspoloživih podataka nije moguće utvrditi načine širenja ove vrste (Lenhardt *et al*., 2011).

eon *Pseudorasbora parva*) and Odontobutidae (Amur sleeper *Perccottus glenii*), and the Ponto-Caspian region (family Gobiidae – gobies). The distribution of four non-native species (pumpkinseed, brown and black bullhead and Prussian carp) covers over 51% of the surface area of Serbia. Grass carp inhabits 37.5%, bighead carp 24.6% and silver carp 35.1% of the surface area of Serbia. Species of the family Gobiidae inhabit between 11.3% and 14.2% of the territory of Serbia, while other non-native species inhabit only a few percent of our country's territory (Simonović & Nikolić, 1997; Lenhardt *et al*., 2011; Zorić *et al*., 2014).

Of the total number of non-native species, only the grass carp, bighead carp, silver carp and rainbow trout are farmed in aquaculture, mostly in fish ponds. Grass, bighead, silver and Prussian carp, Amur sleeper and American bullheads came to Serbia from Romania and Hungary via the Danube and Tisza. The American paddlefish came from the Romanian part of the Danube and probably escaped from a fish pond during the 2006 flood. Invasions from east to west allowed the spread of gobies along the Danube, the black-striped pipefish (*Syngnathus abaster*) from the Black Sea and the Amur sleeper from the upper reaches of the Tisza. The rainbow trout enters natural ecosystems by escaping from fish ponds. The largemouth bass inhabits mainly the canal network in the northern parts of Serbia. There are only isolated records of the three-spined stickleback (*Gasterosteus aculeatus*) and due to the lack of available data it is not possible to determine the distribution routes of this species (Lenhardt *et al*., 2011).

Slika 39. Sivi tolstolobik (*Hypophthalmichthys nobilis*) od 40,5 kg iz Markovačkog jezera (a) i koi šaran iz Savskog jezera (b) (foto: A. Hegediš). Obe vrste nepoželjne su u našim ekosistemima – sivi tolstolobik zbog svog načina ishrane i ekskrecije doprinosi pogoršanju kvaliteta vode, posebno kada je brojan, dok su koi šarani prenosioci značajnog broja bolesti riba na koje su sami otporni.

Figure 39. Bighead carp (*Hypophthalmichthys nobilis*) weighing 40.5 kg from Lake Markovac (a) and koi carp from Lake Sava (b) (photo: A. Hegediš). Both species are undesirable in our ecosystems – the bighead carp contributes to the degradation of water quality through its food and excreta, especially if it is numerous, while the koi carp is a carrier of numerous fish diseases, to which it is itself resistant.

Beli amur i sivi i beli tolstolobik uneti su namerno u Srbiju 1963. godine kako bi se obogatila ihtiofauna u šaranskim ribnjacima i kako bi se popunila nezauzeta trofička niša (herbivorne ribe). Danas njihov udeo u šaranskim ribnjacima iznosi 20%. Beli i sivi tolstolobik zbog svoje veličine predstavljaju atraktivne ribolovne vrste (Slika 39). Smatralo se da je beli amur korisna vrsta u kontroli makrofitske vegetacije, međutim, njegova stopa konverzije hrane je niska i veliki deo unetog biljnog materijala (preko 70%) biva izbačen, čime se vodeni ekosistemi dodatno opterećuju organskom materijom. Rezultat ovih procesa jeste povećanje sedimenta i smanjena koncentracija kiseonika. Pojedina istraživanja su pokazala da biljna ishrana belog amura smanjuje mesta za mrest šaranu, koji je fitofilna vrsta (Janko-

The grass carp, bighead carp and silver carp were intentionally introduced to Serbia in 1963 to enhance the fish fauna in carp ponds and fill an unoccupied trophic niche (herbivorous fish). Today their share in carp ponds is 20%. The bighead and silver carp are attractive fish species because of their size (Figure 39). The grass carp was considered a useful species for controlling macrophytic vegetation; however, its feed conversion ratio is low and much of the ingested plant material (over 70%) is excreted, further polluting aquatic ecosystems with organic material. The result of these processes is an increase in sediments and a lower oxygen concentration. Some studies have shown that the plant-based diet of the grass carp reduces the spawning grounds of the common carp, which is a phytophilic species (Janković, 1998; Len-

vić, 1998; Lenhardt *et al*., 2011; Zorić *et al*., 2014). Negativan efekat introdukcije sivog tolstolobika ogleda se u činjenici da ova vrsta prenosi bolest koju izaziva jedna vrsta parazitskog račića – *Sinergasilus polycolpus* (Cakić *et al*., 2004; Đikanović *et al*., 2018).

Babuška je u vode Srbije uneta 60-ih godina XX veka i njena aklimatizacija je bila veoma brza, što je dovelo do potpune adaptacije na nove ekosisteme (Slika 40). Može se čak naći i u planinskim rečicama, iznad 1.000 mnv. Ova vrsta ima određeni ekonomski značaj, pre svega zbog svoje niske cene. Negativan uticaj ogleda se u kompeticiji za hranu i mesto za mrest sa autohtonim vrstama poput zlatnog karaša, linjaka i šarana (Ćirković *et al*., 2009; Demeny *et al*., 2009; Lenhardt *et al*., 2011).

hardt *et al*., 2011; Zorić *et al*., 2014). The negative effects of the introduction of the bighead carp are reflected in the fact that this species transmits a disease caused by a parasitic copepod species – *Sinergasilus polycolpus* (Cakić *et al*., 2004; Đikanović *et al*., 2018).

The Prussian carp was introduced to the waters of Serbia in the 1960s and acclimatised very quickly, resulting in a complete adaptation to the new ecosystems (Figure 40). It can be found even in mountain streams at altitudes above 1,000 m. This species has some commercial importance, mainly because of its low price. The negative effects are reflected in competition for food and spawning sites with native species such as golden crucian carp, tench and common carp (Ćirković *et al*., 2009; Demeny *et al*., 2009; Lenhardt *et al*., 2011).

Slika 40. Srebrni karaš ili babuška (*Carassius gibelio*) jedna je od omiljenih vrsta među značajnim brojem ribolovaca koji je koriste u ishrani. Kada se pojavi u nekom vodenom ekosistemu, kao snažan kompetitor, brzo ga osvaja i postaje veoma brojna, pa često čini glavni deo ulova rekreativnih ribolovaca. Zadovoljni time, ribolovci zanemaruju negativne efekte koje babuška ima na autohtone vrste. Partenogenetski način razmnožavanja doprinosi populacionom uspehu ove vrste (foto: E. Podolnaya, https://www.dreamstime.com/prussian-carp-carassius-gibelio-prussian-carp-carassius-gibelio-aquarium-image169924919).

Figure 40. Prussian carp (*Carassius gibelio*) is one of the most popular species for a large number of fishers who use it in their diet. When it emerges as a strong competitor in an aquatic ecosystem, it quickly takes hold of it and becomes very numerous, so that it often accounts for most of the catches of recreational fishers. Anglers are content with this, ignoring the negative impact that the Prussian carp has on native species. The parthenogenetic reproduction contributes to the population success of this species (photo: E. Podolnaya, https://www.dreamstime.com/prussian-carp-carassius-gibelio-prussian-carp-carassius-gibelio-aquarium-image169924919).

Prvi nalaz amurskog čebačoka u vodama Srbije datira iz 1978. godine. Smatra se da je ova vrsta slučajno uneta u Dunav, odakle se dalje proširila. Nema nikakvu ekonomsku vrednost i jedino može da posluži kao mamac prilikom lova na grabljive vrste riba. Upravo je bacanje živih jedinki amurskog čebačoka, kao neiskorišćenih mamaca, jedan od glavnih načina širenja ove vrste u nove ekosisteme. Takođe, nekontrolisano poribljavanje dovelo je do unošenja mnogih alohtonih vrsta riba u prirodne ekosisteme u Srbiji. To je slučaj ne samo sa ovom, već i sa drugim alohtonim vrstama, poput američkih patuljastih somova i sunčice.

The first record of the topmouth gudgeon in Serbian waters dates back to 1978. It is believed that this species was accidentally introduced into the Danube, from where it spread further. It has no commercial value and can only be used as bait when fishing for predatory fish. Releasing live specimens of the topmouth gudgeon as unused bait is one of the most important methods of spreading this species in new ecosystems. Moreover, uncontrolled fish stocking led to the introduction of many non-native fish species into natural ecosystems in Serbia. This is true not only for this one, but also for other non-native species such as American bullheads and pumpkinseed.

Kalifornijska pastrmka (Slika 41a) introdukovana je u Srbiju tokom Prvog i Drugog svetskog rata. Danas ova vrsta ima najveći ekonomski značaj, sa udelom u ukupnoj produkciji riba od oko 15%. U otvorenim vodama ne postoje vijabilne populacije i prirodni mrest nije zabeležen. Postoje pretpostavke da ova vrsta može dovesti do iščezavanja ili smanjenja brojnosti populacija potočne pastrmke. Jezerska zlatovčica (*Salvelinus umbla*) (Slika 41b) uneta je u dva navrata, 1928. i 1943. godine, iz alpskih jezera u vode Jugoslavije (Welcomme, 1981). Danas se nalazi samo u akumulacijama Kokin Brod i Radoinja, kao i u Vlasinskom jezeru. Ovo je atraktivna ribolovna vrsta i do sada nisu zabeleženi negativni uticaji na autohtone populacije riba. Druga vrsta zlatovčice, potočna zlatovčica (*S. fontinalis*), u Srbiju je introdukovana između Prvog i Drugog svetskog rata u pojedina veštačka jezera (Vlasinsko i Lisinsko). Iako je osnovni motiv za introdukciju bio rekreativni ribolov, njen areal u Srbiji vrlo je mali i iznosi oko 0,6% površine (Lenhardt *et al*., 2011). U Vlasinsko jezero introdukovan je i mergur (*Pachychilon macedonicum*), vrsta iz porodice Leuciscidae, koji inače živi u stajaćim i tekućim vodama sliva Egejskog mora u Severnoj Makedoniji i Grčkoj.

The rainbow trout (Figure 41a) was introduced to Serbia during World War I and World War II. Today, this species has the greatest commercial importance, accounting for about 15% of total fish production. There are no viable populations in open waters and natural spawning has not been detected. It is suspected that this species may lead to the loss or reduction of the brown trout populations. Lake char (*Salvelinus umbla*) (Figure 41b) was introduced twice, in 1928 and 1943, from Alpine lakes into the waters of Yugoslavia (Welcomme, 1981). Today it is found only in the Kokin Brod and Radoinja reservoirs and in Lake Vlasina. It is an attractive fishing species and so far no negative impacts on native fish populations have been observed. Another char species, the brook trout (*S. fontinalis*), was introduced in Serbia between World War I and World War II in some artificial lakes (Vlasina and Lisina). Although the main motive for its introduction was recreational fishing, its range in Serbia is very small, amounting to about 0.6% of the surface area (Lenhardt *et al*., 2011). The Macedonian roach (*Pachychilon macedonicum*), a species of the Leuciscidae family that normally lives in standing and running waters of the Aegean Sea basin in Northern Macedonia and Greece, was also introduced into Lake Vlasina.

Slika 41. (a) Kalifornijska pastrmka (*Oncorhynchus mykiss*) često beži iz veoma brojnih, ali nedovoljno dobro obezbeđenih salmonidnih ribnjaka širom Srbije. Srećom, za sada nema podataka o formiranju vijabilnih populacija u nekoj od naših reka (foto: Liquid Art, https://commons.wikimedia.org/wiki/File:Rainbow_Trout_%28Oncorhynchus_mykiss%29.jpg).

(b) Učinjeno je mnogo pokušaja da se jezerska zlatovčica (*Salvelinus umbla*) naseli u naše brdsko-planinske akumulacije. Vijabilne populacije formirane su samo u nekoliko slučajeva: u Zlatarskom jezeru (Kokin brod) i Radoinji na Uvcu, kao i u Vlasinskom jezeru (nepotvrđeno) (foto: H. Chaumeton, http://www.ittiofauna.org/webmuseum/pesciossei/salmoniformes/salmonidae/salmoninae/salvelinus/salvelinus_umbla/index_big.htm)..

Figure 41. (a) Rainbow trout (*Oncorhynchus mykiss*) frequently escapes from the very numerous but inadequately secured salmonid fish ponds throughout Serbia. Fortunately, to date there is no data on the establishment of viable populations in our rivers (photo: Liquid Art, https://commons.wikimedia.org/wiki/File:Rainbow_Trout_%28Oncorhynchus_mykiss%29.jpg).

(b) Many attempts have been made to introduce the lake char (*Salvelinus umbla*) into our mountain reservoirs. Only in a few cases have viable populations formed: in Lake Zlatar (Kokin brod) and in reservoir Radoinja of the Uvac, as well as in Lake Vlasina (unconfirmed) (photo: H. Chaumeton, http://www.ittiofauna.org/webmuseum/pesciossei/salmoniformes/salmonidae/salmoninae/salvelinus/salvelinus_umbla/index_big.htm).

Peled (*Coregonus peled*) je po prvi put introdukovan 1977. godine u akumulaciju Perućac (Welcomme, 1981) kako bi se povećala produkcija ihtiofaune i popunila nezauzeta trofička niša (zooplanktivorna riba). Danas ova vrsta ima vrlo ograničeno rasprostranjenje i nikakvu ekonomsku vrednost (Lenhardt *et al*., 2011).

Smeđi američki patuljasti som došao je u deo dunavskog basena u Srbiji putem introdukcije u ribnjake i slobodnom migracijom duž Dunava i njegovih pritoka u susednim zemljama. Negativan efekat ove vrste ispoljava se kroz kompeticiju za hranu i predatorstvo sa autohtonim vrstama riba. Treba napomenuti da je dugi niz godina crni američki patuljasti som bio pogrešno identifikovan kao smeđi američki patuljasti som zbog njihove velike međusobne morfološke sličnosti (Nowak *et al*., 2010). Osobine, poput boje i nazubljenosti tvrde

The peled (*Coregonus peled*) was first introduced into the Perućac reservoir in 1977 (Welcomme, 1981) to enhance the fish fauna and fill an unoccupied trophic niche (zooplanktivorous fish). Today, this species has a very limited distribution and no commercial value (Lenhardt *et al*., 2011).

The brown bullhead entered the Serbian stretch of the Danube through introduction into fish ponds and free migration along the Danube and its tributaries in neighbouring countries. The negative impacts of this species can be seen in the competition for food and predation on native fish species. It should be noted that for many years the black bullhead was misidentified as the brown bullhead due to the great morphological similarity of these two species (Nowak *et al*., 2010). Characteristics such as colour and serration of

žbice grudnih peraja, koje su korišćene kao kriterijumi za određivanje ovih vrsta, nisu se pokazale pouzdanim. Zbog toga je došlo do velikih zabuna i pogrešnih identifikcija ove dve vrste u Evropi. Crni američki patuljasti som prvi put je identifikovan u Srbiji 2005. godine (Cvijanović *et al*., 2005). Veruje se da je većina prethodnih nalaza, koji su navodili da se radi o vrsti *A. nebulosus*, bila pogrešna. Crni američki patuljasti som predstavlja veoma štetnu korovsku vrstu koja ima tendenciju formiranja populacija velike gustine, sa izraženim negativnim uticajem na autohtonu ihtiofaunu kroz predatorstvo i/ili kompeticiju za hranu, stanište i mesta za mrest sa autohtonim vrstama (Cucherousset *et al*., 2006; Kreutzenberger *et al*., 2008; Leunda *et al*., 2008). Takođe, može prouzrokovati kvantitativne promene u strukturi zajednice ukoliko se uspostavi kao dominantna vrsta (Cucherousset *et al*., 2006; Popa *et al*., 2006). Na prostore bivše Jugoslavije crni američki patuljasti som došao je na dva načina – donošenjem u ribnjake u Hrvatskoj pre Prvog svetskog rata i slobodnim prodiranjem iz susednih zemalja duž tokova Drave, Dunava, Tise, Begeja i Tamiša. Istraživanja sprovedena u proteklih nekoliko godina otkrivaju dominantno prisustvo ove vrste u mnogim kopnenim vodama u Srbiji (Cvijanović, 2009; Jaćimović *et al*., 2019).

Jedinke američkog veslonosa uhvaćene su u Dunavu kod Prahova 2006. godine, od strane lokalnih ribara (Simonović *et al*., 2006) (Slika 42). Ovaj nalaz ukazuje na činjenicu da su one najverovatnije pobegle iz ribnjaka u Rumuniji ili Bugarskoj. Kako bi se sačuvale domaće jesetarske vrste od potencijalne hibridizacije, veoma je važno da se spreče introdukcije alohtonih jesetarskih vrsta. Iako do sada nije potvrđen nijedan slučaj hibridizacije, treba biti veoma obazriv jer ove vrste imaju vrlo slične reproduktivne osobine, poput vremena mrešćenja i staništa koje koriste za mrest

the pectoral fin spines, which have been used as criteria for the identification of these species, have not proven to be reliable. Because of this, there has been much confusion and wrong identification of these two species in Europe. The black bullhead was first recorded in Serbia in 2005 (Cvijanović *et al*., 2005). It is assumed that most of the earlier records mentioning *A. nebulosus* were incorrect. The black bullhead is a very harmful pest species that tends to form dense populations and has a negative impact on native fish fauna through predation and/or competition for food, habitat and spawning sites with native species (Cucherousset *et al*., 2006; Kreutzenberger *et al*., 2008; Leunda *et al*., 2008). It may also cause quantitative changes in community structure if it becomes established as a dominant species (Cucherousset *et al*., 2006; Popa *et al*., 2006). The black bullhead entered the territory of the former Yugoslavia in two ways – by introduction into fish ponds in Croatia before World War I and by free invasion from neighbouring countries along the rivers Drava, Danube, Tisza, Begej and Tamiš. Surveys carried out in recent years show that this species is prevalent in many inland waters of Serbia (Cvijanović, 2009; Jaćimović *et al*., 2019).

Individuals of American paddlefish were caught in the Danube near Prahovo by local fishers in 2006 (Simonović *et al*., 2006) (Figure 42). This record indicates that they most likely escaped from fish ponds in Romania or Bulgaria. To protect native sturgeon species from possible hybridisation, it is very important to prevent the introduction of non-native sturgeon species. Although no cases of hybridisation have been confirmed so far, great care should be taken as these species have very similar reproductive characteristics, such as spawning time and habitat.

Slika 42. Američki veslonos (*Polyodon spathula*) je najverovatnije bio samo privremeni stanovnik Dunava nizvodno od brane Đerdap II. Lovljen je najviše 2006. godine, a poslednji primerci registrovani su 2008. godine. Nema novijih podataka o ulovima ove vrste (foto: Lapandr, https://www.dreamstime.com/stock-photo-paddlefish-natural-habitat-river-polyodon-spathula-image88125697).

Figure 42. American paddlefish (*Polyodon spathula*) was probably only a temporary resident of the Danube downstream from the Đerdap II dam. Most individuals were caught in 2006 and the last individual was recorded in 2008. No recent data on catches of this species are available (photo: Lapandr, https://www.dreamstime.com/stock-photo-paddlefish-natural-habitat-river-polyodon-spathula-image88125697).

Sunčica je severnoamerička vrsta introdukovana u Evropu u XIX veku kao akvarijumska, ukrasna riba. Prvi nalaz u Srbiji datira iz 1930. godine u reci Tisi. Danas je ona široko raspostranjena,

The pumpkinseed is a North American species introduced to Europe in the 19th century as an ornamental fish for aquaria. The first record in Serbia dates back to 1930 from the river Tisza. Today it is

ali nema nikakvu ekonomsku vrednost. Negativan efekat ispoljava kroz predatorstvo i kompeticiju za hranu, stanište i mesta za mrest sa autohtonim vrstama riba (Marković & Simović, 1997; Lenhardt *et al*., 2011).

Velikousti bas je introdukovan u Evropu iz Severne Amerike zajedno sa sunčicom. Ova vrsta uočena je prvi put u reci Jegrički 1984. godine, u dunavskom basenu. Danas se smatra da je velikousti bas sasvim adaptiran na lokalne uslove životne sredine i uglavnom se može naći u kanalu DTD. Kao predatorska vrsta ulazi u kompeticiju za hranu sa domaćom grabljivim vrstom, štukom (Maletin *et al*., 1997; Lenhardt *et al*., 2011).

Šilce kratkokljuno je autohtona vrsta u Sredozemnom i Crnom moru. U Dunav je najverovatnije došla balastnim vodama iz Crnog mora. Prvi zvanični nalaz u Srbiji potiče iz 1998. godine (Sekulić *et al*., 1998b). Ova vrsta nema nikakav privredni značaj, a njen uticaj na autohtone vrste nije poznat (Cakić *et al*., 2002; Lenhardt *et al*., 2011).

Alohtone vrste koje pripadaju porodici glavoča jesu glavoč peskar (*Neogobius fluviatilis*), glavoč kruglak (*N. melanostomus*), glavoč trkač (*Babka gymnotrachelus*) i glavoč glavaš (*Ponticola kessleri*) (Slika 43). Rasprostranjenje ovih vrsta prošireno je daleko od nativnog areala (baseni Crnog i Kaspijskog mora) i danas se one u Srbiji mogu naći u Dunavu, Savi, Tisi i Velikoj Moravi. Iako nemaju privredni značaj, mogu da budu plen ekonomski važnim vrstama poput soma i smuđa. Kompeticija postoji uglavnom između samih glavoča i vezana je za hranu i stanište.

widely distributed, but has no commercial value. Negative impacts are manifested in the form of predation and competition for food, habitat and spawning sites with native fish species (Marković & Simović, 1997; Lenhardt *et al*., 2011).

The largemouth bass was introduced to Europe from North America along with the pumpkinseed. This species was first observed in 1984 in the Jegrička River in the Danube watershed. Today, the largemouth bass is considered well adapted to local environmental conditions and is found mainly in the canal DTD. As a predatory species, it competes for food with a local predator, the northern pike (Maletin *et al*., 1997; Lenhardt *et al*., 2011).

The black-striped pipefish is a species native to the Mediterranean and Black Seas. Most likely, it entered the Danube with ballast water from the Black Sea. The first official record in Serbia dates back to 1998 (Sekulić *et al*., 1998b). This species has no commercial value and its impact on native species is unknown (Cakić *et al*., 2002; Lenhardt *et al*., 2011).

Non-native species belonging to the goby family are the monkey goby (*Neogobius fluviatilis*), the round goby (*N. melanostomus*), the racer goby (*Babka gymnotrachelus*) and the bighead goby (*Ponticola kessleri*) (Figure 43). The range of these species has spread far from their area of origin (the basins of the Black and Caspian Seas) and today they are found in Serbia in the Danube, Sava, Tisza and Great Morava. Although they have no commercial value, they can be prey for commercially important species such as catfish and pikeperch. Competition is mainly between the gobies themselves and is related to food and habitat.

Slika 43. Devedesetih godina prošlog veka glavoči (vrste iz porodice Gobiidae) su proširili svoj areal u crnomorskom slivu i nastavili invazioni put dalje po Evropi. Tada su naselili sve naše veće reke u pomenutom slivu – Dunav, Savu, Tisu, Veliku Moravu, kao i još neke manje tokove. Na slici je glavoč glavaš (*Ponticola kessleri*) (foto: L. Hlasek, https://www.hlasek.com/neogobius_kessleri_hf4809.html).

Figure 43. In the 1990s, gobies (species of the family Gobiidae) expanded their range in the Black Sea basin and continued their invasion path in Europe. At that time they populated all our larger rivers in this basin – Danube, Sava, Tisza, Great Morava - as well as some other smaller rivers. The picture shows the bighead goby (*Ponticola kessleri*) (photo: L. Hlasek, https://www.hlasek.com/neogobius_kessleri_hf4809.html).

Gregorac je u vodama Srbije prvi put zabeležen 1995. godine. Ovo je akvarijumska vrsta i smatra se da je slučajno introdukovana u prirodne ekosisteme. Danas zauzima oko 3,4% površine Srbije, nema nikakvu ekonomsku vrednost i nije poznat njen uticaj na autohtonu ihtiofaunu (Lenhardt *et al*., 2011).

The three-spined stickleback was first detected in Serbian waters in 1995. It is an aquarium species believed to have been accidentally introduced into natural ecosystems. Today it occupies about 3.4% of the surface area of Serbia, has no commercial value and its impact on the native fish fauna is unknown (Lenhardt *et al*., 2011).

Amurski spavač prvi put je zabeležen u Srbiji 2004. godine (Gergely & Tucakov, 2003) (Slika 44). U Srbiju je došao iz Mađarske, preko reke Tise. Ova vrsta je primer neopreznog oslobađanja živih jedinki iz akvarijuma. Negativan uticaj amurskog spavača ogleda se kroz prenošenje jedne vrste parazita iz grupe Nematoda (*Eustrongylides* sp.) (Sokolov *et al*., 2014; Đikanović *et al*., 2018). Brojne karakteristike, poput oportunističkog ponašanja, vrlo fleksibilnih osobina životne istorije, agresivnog ponašanja i sposobnosti preživljavanja u nepovoljnim uslovima životne sredine, širokog spektra ishrane i produženog reproduktivnog perioda, omogućavaju jedinkama ove vrste da budu veoma dobro adaptirane (Koščo *et al*., 2008; Kati *et al*., 2015; Rakauskas *et al*., 2019). Zbog toga se populacije najčešće sastoje od svih uzrasnih klasa. Kompeticiju i predatorstvo izbegavaju tako što mogu da nasele ekosisteme koji su za većinu severnoevropskih vrsta nepogodni (Reshetnikov, 2003; Reshetnikov *et al*., 2011, 2017). Optimalno stanište ove vrste čine izolovana vodna tela, obrasla gustom makrofitskom vegetacijom, sa debelim muljevitim dnom i nižom koncentracijom kiseonika. Prisustvo amurskog spavača značajno utiče na autohtone zajednice makroinvertebrata, vodozemaca i riba, a samim tim i na funkcionisanje čitavog ekosistema (Reshetnikov *et al*., 2009). Veliki problemi se javljaju i zbog prenošenja bolesti i fakultativnog parazitizma (Kvach *et al*., 2016; Đikanović *et al*., 2018).

The Amur sleeper was first recorded in Serbia in 2004 (Gergely & Tucakov, 2003) (Figure 44). It arrived in Serbia from Hungary via the Tisza. This species is an example of careless release of live individuals from aquaria. The negative impact of the Amur sleeper is reflected in the transmission of a parasite species from the phylum Nematoda (*Eustrongylides* sp.) (Sokolov *et al*., 2014; Đikanović *et al*., 2018). Numerous characteristics such as opportunistic behaviour, very flexible life history traits, aggressive behaviour, the ability to survive under unfavourable environmental conditions, a wide food spectrum and a long reproductive period enable individuals of this species to be very well adapted (Koščo *et al*., 2008; Kati *et al*., 2015; Rakauskas *et al*., 2019). For this reason, populations usually consist of all age classes. They escape competition and predation because they are able to inhabit ecosystems that are unsuitable for most northern European species (Reshetnikov, 2003; Reshetnikov *et al*., 2011, 2017). Isolated waters overgrown with dense macrophyte vegetation with a thick muddy bottom and low oxygen concentration are the optimal habitat for this species. The presence of the Amur sleeper has a significant impact on native communities of macroinvertebrates, amphibians and fish, and thus on the functioning of the entire ecosystem (Reshetnikov *et al*., 2009). Major problems also arise from disease transmission and facultative parasitism (Kvach *et al*., 2016; Đikanović *et al*., 2018).

Slika 44. Amurski spavač (*Percottus glenii*) – agresivno oportunističko ponašanje, fleksibilan životni ciklus, sposobnost preživljavanja u nepovoljnim uslovima, širok spektar ishrane, produženi reproduktivni period i još neke druge osobine čine ovu vrstu izuzetno uspešnim kolonizatorom. Prenosi neke specifične bolesti i parazite. Često toliko negativno utiče na lokalne beskičmenjake bentosa, vodozemce i ribe, da ugrožava funkcionisanje čitavog ekosistema (foto: N. Sekulić).

Figure 44. Amur sleeper (*Percottus glenii*) – aggressive opportunistic behavior, flexible life cycle, ability to survive in unfavourable conditions, wide food spectrum, long reproductive period and some other features make this species a highly successful coloniser. It transmits some specific diseases and parasites. It often has such a negative impact on local benthic invertebrates, amphibians and fish that it threatens the functioning of the entire ecosystem (Photo: N. Sekulić).

Prema *Zakonu o zaštiti i održivom korišćenju ribljeg fonda* Republike Srbije (Službeni glasnik RS, br. 128/2014 i 95/2018) nije dozvoljeno unositi alohtone vrste riba u ribolovne vode. Međutim, pojedine kompanije koje se bave uzgojem riba pokušavaju da introdukuju još neke nove vrste radi akvakulture. Takođe, treba imati na umu da su pojedine alohtone vrste došle u otvorene vode Srbije putem međunarodnih reka iz zemalja u kojima introdukcije novih vrsta riba nisu zabranjene.

According to the *Law on Protection and Sustainable Use of Fish Stocks* of the Republic of Serbia (Official Gazette of RS, No. 128/2014 and 95/2018), it is not allowed to import non-native fish species into fishing waters. However, some fish farming companies are trying to introduce some new species for aquaculture. It should also be noted that certain non-native species have entered the open waters of Serbia through international rivers from countries where the introduction of new fish species is not prohibited.

5.4. Nekontrolisan i preveliki izlov komercijalno značajnih vrsta

Tokom srednjeg veka, Evropljani su koristili velike količine ribe za ishranu (već tokom XIII veka primećen je negativni uticaj prekomernog ulova na ribe). Danas se smatra da je riba namirnica namenjena tržištu koja ima direktni ekonomski značaj. Ovaj resurs ima i indirektni ekonomski značaj jer se tretira kao komponenta biodiverziteta. Razvoj tehnologije omogućava savremenom društvu da ovaj resurs iscrpljuje sve intenzivnije. Intenzitet eksploatacije ribljeg resursa niži je u nerazvijenim zemljama, a samim tim i bliži održivom korišćenju (Smederevac-Lalić, 2013). Održivi razvoj jeste ciljani, dugoročni i uređeni politički proces koji utiče na sve aspekte života današnje civilizacije, u koji moraju biti uključene institucije jedne države, sa ciljem obezbeđivanja dostupnosti resursa budućim generacijama (Arlinghaus *et al*., 2002; Nadić, 2012). Na osnovu FAO podataka, ukupan ulov ribe u svetu tokom 2008. godine iznosio je 10,2 miliona tona. Međutim, poznato je da je stvarni ulov višestruko veći (Wilson & Carpenter, 1999). Ukupan ulov ribe početkom XXI veka dostigao je svoj maksimum od 95,61 miliona tona (2000. godina) i od tada se nije povećavao. Prosečan ulov ribe od 2002. do 2012. godine bio je 92,9 miliona tona (Ivanović *et al*., 2015).

Ribolov se deli na privredni, rekreativni, sportski, selektivni i ribolov u naučno-istraživačke svrhe. Najveći pritisak na riblji resurs i vodene ekosisteme u Srbiji predstavlja ilegalni ribolov, a određene probleme mogu prouzrokovati i rekreativni i sportski ribolov. Teško je sa sigurnošću reći koliki pritisak na resurs vrše različiti vidovi ribarenja, jer statistički podaci, zbog neadekvatnog monitoringa ovog resursa i izostanka odgovarajuće kontrole ulova, nisu u potpunosti pouzdani. Poznavanje ribolovnog pritiska osnovni je preduslov za uspešno upravljanje ribljim fondom kao prirodnim resursom, što se zasniva na redovnom vođenju statistike. Evidencija ulova, tj. statistika ulova komercijalno značajnih vrsta riba u Srbiji vodi se od 1948. godine. Sektor ribarstva formalno deluje kao dobro uređen, uz primenu zakonskih i podzakonskih akata (Smederevac-Lalić, 2013). Međutim, praktična primena legislative ukazuje na to da je sektor ribarstva u Srbiji organizovan bez adekvatne usklađenosti regulative i socio-ekonomskih karakteristika ove oblasti (Lenhardt *et al*., 2005). Osnovni zakon koji se bavi ribarstvenim resursom jeste *Zakon o zaštiti i održivom korišćenju ribljeg fonda* (Službeni glasnik RS, br. 128/2014 i 95/2018). Ovaj zakon se bavi regulisanjem obaveza korisnika ribarskog područja, ribočuvarskim službama, očuvanjem i zaštitom ribljeg fonda, definisanjem lovostaja, vođenjem statistike, zaštitom poplavnih područja, privrednim, rekreativnim, sportskim ribolovom i ribolovom u naučno-istraživačke svrhe, prometom i finansiranjem zaštite, nadzorom i kaznenim odredbama.

Ilegalni ribolov (krivolov ili ribokrađa) smatra se krivičnim delom u Srbiji, kažnjava se novčanom kaznom ili kaznom zatvora do šest meseci. Bez obzira na strogu zakonsku regulativu, postoje jasni pokazatelji da je riblji fond pod velikim pritiskom i da postoji značajan stepen ilegalnog i prekomernog ulova ribe (Uljanov, 2020) (Slika 45). Krivolov, osim što ugrožava riblji fond, može ugroziti i zdravlje ljudi, s obzirom da ilegalno uhvaćena riba, čije se poreklo teško može utvrditi, završava u restoranima, ribarnicama i pijacama bez prethodne inspekcijske kontrole i kontrole njene ispravnosti (Smederevac-Lalić, 2013).

5.4. Uncontrolled fishing and overfishing of commercially important species

In the Middle Ages, Europeans used large quantities of fish as food (the negative effects of overfishing were noted as early as the 13th century). Today, food fish is considered to be destined for the market, which has a direct commercial significance. This resource also has an indirect commercial significance, as it is treated as a component of biodiversity. The development of technology allows modern society to exploit this resource more and more intensively. The intensity of exploitation of fish resources is lower in underdeveloped countries and is therefore closer to sustainable use (Smederevac-Lalić, 2013). Sustainable development is a purposeful, long-term and organized political process that affects all aspects of life in today's civilisation and must involve the institutions of a state to ensure the availability of resources for future generations (Arlinghaus *et al*., 2002; Nadić, 2012). According to FAO, the global fish catch in 2008 amounted to 10.2 million tonnes. However, it is known that the actual catch is many times higher (Wilson & Carpenter, 1999). The total fish catch peaked at the beginning of the 21st century at 95.61 million tonnes (year 2000) and has not increased since. The average fish catch from 2002 to 2012 was 92.9 million tonnes (Ivanović *et al*., 2015).

Fisheries are classified into following categories: commercial, recreational, sport, selective and scientific. The greatest pressure on fish stocks and aquatic ecosystems in Serbia comes from illegal fishing, and certain problems can also be caused by recreational and sport fishing. It is difficult to say with certainty how much pressure is exerted on the resource by the different types of fisheries, as statistical data are not fully reliable due to the insufficient monitoring of this resource and the lack of adequate catch control. Knowledge of fishing pressure, based on regular statistics, is a basic requirement for successful management of the fish stock as a natural resource. Catch records, i.e. catch statistics on commercially important fish species in Serbia have been kept since 1948. The fisheries sector appears to be formally well regulated through the application of laws and regulations (Smederevac-Lalić, 2013). However, the practical application of the legislation shows that the fisheries sector in Serbia is organised without adequate coordination of the regulations and the socio-economic characteristics of this subject (Lenhardt *et al*., 2005). The basic law dealing with fishery resources is the *Law on Protection and Sustainable Use of Fish Stocks* (Official Gazette of RS, No. 128/2014 and 95/2018). This law regulates the obligations of users of fishery resources, fish warden services, conservation and protection of fish stocks, designation of fishing areas, keeping of statistics, protection of floodplains, commercial, recreational and sport fishing, as well as fishing for scientific purposes, trade, financing of protection, monitoring and penal provisions.

Illegal fishing (poaching or fish theft) is considered a criminal offence in Serbia, punishable by a fine or imprisonment of up to six months. Notwithstanding the strict legal regulations, there is clear evidence that the fish stock is under great pressure, with significant levels of illegal and excessive fishing (Ulyanov, 2020) (Figure 45). Poaching endangers not only fish stocks, but also the health of people, considering that illegally caught fish, whose origin is difficult to determine, ends up in restaurants, fishmongers and markets without prior inspection control and verification of its correctness (Smederevac-Lalić, 2013).

Slika 45. Ribokrađa se u Srbiji odvija na velikom broju područja u neprihvatljivom obimu, zbog slabo razvijene i loše organizovane ribočuvarske službe. Krivolov se obavlja cele godine, posebno u vreme mresta, bez obzira na minimalne mere, lovostaj, ograničenje ulova itd. Takođe, masovno se koriste alati i tehnike koji nisu dozvoljeni za upotrebu (struja, eksploziv, plin). Blage kazne i sporo procesuiranje slučajeva ne doprinose poboljšanju aktuelnog stanja (foto: A. Hegediš).

Figure 45. Fish theft takes place in Serbia in a large number of areas at an unacceptable level, due to the poorly developed and poorly organised fish warden service. Poaching takes place throughout the year, especially during the spawning season, regardless of the minimum catch size, designation of the non-hunting season, catch restrictions, etc. Tools and techniques the use of which is not allowed (electrofishing, explosives, gas) are also widespread. Light penalties and slow processing of cases do not contribute to improving the current situation (Photo: A. Hegediš).

5.5. Vađenje peska i šljunka

Eksploatacija peska i šljunka relativno je česta pojava u mnogim potocima i rekama širom sveta, ali postoji sve veća zabrinutost na koji način ovi procesi utiču na ekosisteme. Pesak i šljunak jesu ključni materijali u građevinarstvu i njihova primena je veoma široka. Međutim, njihovo vađenje menja morfološke uslove vodotoka, tako da se ova intervencija odražava na režim vode i nanosa na posmatranom sektoru vodotoka (Slika 46). Takođe, vađenje peska i šljunka dovodi do gubitka staništa mnogih vrsta riba. Ove promene stvaraju uslove smanjene brzine vodotoka koji ne odgovaraju vrstama koje preferiraju brže vodene struje, a povećavaju i deponovanje sedimenta, što može nepovoljno da utiče na mnoge beskičmenjake i ribe koje se mreste u tim delovima rečnog korita. Mnoge vrste riba polažu jaja na dnu rečnog korita, upravo na pesku i šljunku, štiteći na taj način larve od potencijalnih predatora (Paukert *et al.*, 2008). Kopanje rečnog dna direktno utiče na stanište bentosnih vrsta. Takođe, uočavaju se i drugi negativni efekti na ekosisteme, poput povećavanja zamućenosti vode, koja negativno utiče na fito- i zooplankton. Transport šljunka od reke do mesta gde se kamenje dalje usitnjava uništava puteve, rečnu obalu i riparijalnu vegetaciju (Slika 47). Ovakvi postupci uzrokuju zagađenje i snižavanje nivoa podzemnih voda, što dovodi do isušivanja plavnih i močvarnih staništa koji su u neposrednoj blizini rečnog korita (Kamboj *et al.*, 2017).

5.5. Mining of sand and gravel

Mining of sand and gravel is relatively widespread in many streams and rivers around the world, but there is a growing concern about how these processes affect ecosystems. Sand and gravel are important construction materials and their uses are extensive. However, their extraction alters the morphological conditions of the stream, so that this intervention is reflected in the water and sediment regime of the observed stream section (Figure 46). In addition, the removal of sand and gravel results in the loss of habitat for many fish species. These changes result in lower water velocities, unsuitable for species that prefer faster water flows, and increase sediment deposition, which can adversely affect many invertebrates and fish that spawn in these sections of the streambed. Many fish species lay their eggs on the bottom of the riverbed, on sand and gravel, which protects the larvae from potential predators (Paukert *et al.*, 2008). Dredging the river bottom directly affects the habitat of benthic species. In addition, other negative effects on the ecosystem are also observed, such as increased water turbidity, which has a negative impact on phyto- and zooplankton. The transport of gravel from the river to the place where the stones are further crushed destroys roads, riverbanks and riparian vegetation (Figure 47). Such processes lead to pollution and lowering of the water table, resulting in the drying out of floodplains and wetlands in the immediate vicinity of the riverbed (Kamboj *et al.*, 2017).

Slika 46. Zona eksploatacije šljunka na Drini. Eksploatacija peska i šljunka direktno utiče na staništa bentosnih organizama, posebno krupnijih beskičmenjaka. Stalno kopanje i prevrtanje materijala na dnu dovodi do izmene morfologije i potpune devastacije staništa i povlačenja živog sveta iz sekcija u kojima se ekploatacija vrši. Delovi toka ostaju bez hranidbene osnove za ribe, što izaziva njihovo povlačenje van područja eksploatacije. Ribe koje kao mresni supstrat preferiraju pesak i šljunak (npr. skobalj) gube mesta za polaganje ikre, čime se ugrožava reprodukcija. Takođe, dolazi do povećanja zamućenosti vode i zasipanja staništa u nizvodnim sekcijama reke, a često se lokalno uništava rečna obala i riparijalna vegetacija. Primećeni su i značajni negativni efekti na podzemne vode na područjima eksploatacije rečnog peska i šljunka (foto: A. Hegediš).

Figure 46. Gravel extraction area on the Drina River. The exploitation of sand and gravel directly affects the habitats of benthic organisms, especially larger invertebrates. The constant dredging and overturning of the material at the bottom leads to a change in the morphology and to the complete destruction of the habitat and the withdrawal of life from the sections where mining takes place. Fish lack food sources in parts of the stream, so they retreat from the mining area. Fish that prefer sand and gravel as spawning substrate (e.g. common nase) lose their spawning sites, endangering reproduction. In addition, water turbidity increases and downstream habitats are filled in, and riparian vegetation is often locally destroyed. In areas where river sand and gravel are mined, significant negative impacts on groundwater have also been observed (photo: A. Hegediš).

Slika 47. Značajniji transport peska i šljunka obavlja se rekama jer su uslovi rečnog saobraćaja lakši i jeftiniji u slučaju teškog i rasutog tereta. U rečnom prevozu, za istu razdaljinu troši se tek 17% goriva u odnosu na drumski i 50% u odnosu na železnički prevoz. Zato ne čudi podatak da je celokupni transport Dunavom u 2015. godini iznosio 5,715 miliona tona robe. Najviše se transportuju metalne rude i kamen, proizvodi poljoprivrede i šumarstva, kao i ugalj i derivati nafte. Transport putnika Dunavom u Srbiji veoma je slabo razvijen. Glavne rečne luke jesu Novi Sad, Beograd, Pančevo, Smederevo i Prahovo (foto: A. Hegediš).

Figure 47. A large part of the sand and gravel transport is carried out via rivers, as the conditions for river transport are easier and cheaper for heavy and bulk cargo. Compared to road transport, river transport consumes only 17% of fuel for the same distance and 50% compared to rail transport. Therefore, it is not surprising that the total transport on the Danube in 2015 amounted to 5.715 million tonnes of goods. The most transported goods are metal ores and stones, agricultural and forestry products, as well as coal and petroleum derivatives. Passenger transport on the Danube is only very weakly developed in Serbia. The most important river ports are Novi Sad, Belgrade, Pančevo, Smederevo and Prahovo (photo: A. Hegediš).

U Srbiji je 2017. godine izrađen *Pravilnik o utvrđivanju Plana vađenja rečnih nanosa za period od avgusta 2017. godine do avgusta 2019. godine* (Službeni glasnik RS, br. 30/2010, 93/2012 i 101/2016), od strane Ministarstva poljoprivrede, šumarstva i vodoprivrede. Donošenjem ovog Plana stvorena je osnova za unapređenje planiranja eksploatacije sedimenata. Plan obuhvata aluvijalne reke na teritoriji Republike Srbije na kojima postoji potreba da se vrši vađenje rečnog nanosa (Dunav, Sava, Tisa, Drina, Velika Morava, Zapadna Morava, Južna Morava, reke u slivu Timoka, Kolubara i Lim). Plan predviđa i vađenje rečnih nanosa sa vodnog zemljišta iz neobnovljivih rezervi za potrebe izvođenja radova na objektima od značaja za Republiku Srbiju. Nažalost, kapaciteti za sprovođenje kontrole na terenu i dalje su veoma skromni, tako da je još uvek prisutan veliki broj neregularnosti u pogledu eksploatisanih količina, kao i u pogledu prostornog i vremenskog obima eksploatacije. Pre i posle svake eksploatacije rečnog nanosa trebalo bi izraditi ozbiljne i nezavisne naučne studije o uticaju ovakvih aktivnosti na ekosisteme i biodiverzitet (Koalicija 27, 2019).

5.6. Nestanak i seča šuma i plantažno gajenje nepogodnih vrsta drveća

Srbija je nekada bila pod šumskim prostranstvima koja su pokrivala kako severne delove naše zemlje (uz velike reke Vojvodine), tako i južne. Šumadija je dobila ime po gustim i neprohodnim šumama u XVI i XVII veku. Visoka pokrivenost Srbije šumama trajala je sve do XIX veka. Već sredinom tog veka, pojavljuju se izveštaji koji ukazuju na to da šume u Srbiji polako propadaju. Pre dva veka, oko 80% teritorije Srbije bilo je pod šumom, da bi nakon Drugog svetskog rata procenat pao na svega 17%, zbog čega su se po Jugoslaviji posle rata organizovale radne akcije pošumljavanja (Orlović, 2008). Prema podacima FAO iz 2015. godine, šume pokrivaju 30% teritorije Srbije, ali od tih 30%, 10% su plantažne, najčešće šume kanadske topole (Slika 48). Održiv sistem gazdovanja šumama ne podrazumeva samo brigu o drvetu, nego i o celokupnom ekosistemu (Dragović *et al*., 2017).

Poseban značaj za vodene ekosisteme imaju plavna područja obično obrasla prirodnom šumskom vegetacijom (vrbaci uz nizijske reke). Prirodnom regulacijom toka i poplavne zone, formirale su se tokom istorije i poplavne šume vrbe i bele i crne topole oko nizijskih reka (tzv. zona nizijskih poplavnih šuma). Ova područja sa svojom autohtonom vegetacijom predstavljaju snažan faktor stabilizacije rečnih obala, ublažavajući uticaje visokih poplavnih talasa. Degradacija ovih područja jedan je od ključnih ekoloških problema u XXI veku, nastao usled različitih načina korišćenja zemljišta. Poplavne zone smatraju se ključnim staništima za mrest riba u nizijskim rekama, bilo kao prikladna mrestilišta ili kao staništa za mlađ. U Evropi, danas je izgubljeno oko 90% poplavnih područja, jer su gotovo sve reke pod uticajem zagađenja, izgradnje brana i drugih aktivnosti koje utiču na preoblikovanje režima protoka (Jurišić, 2015). U velikim evropskim rekama, hemijski kvalitet vode ipak se značajno poboljšao poslednjih decenija, ali oporavak faune riba ne nastavlja se u skladu s tim. Važni uzroci jesu gubitak staništa u glavnim rečnim koritima i njihovim poplavnim vodama, kao i smanjena hidrološ-

The *Regulation on Establishing the Plan for the Extraction of River Deposits between August 2017 and August 2019* (Official Gazette of RS, No. 30/2010, 93/2012 and 101/2016) was prepared by the Ministry of Agriculture, Forestry and Water Management in 2017. The adoption of this plan laid the foundation for improved sediment exploitation planning. The plan covers alluvial rivers in the territory of the Republic of Serbia where there is a need for river sediment extraction (Danube, Sava, Tisza, Drina, Great Morava, West Morava, South Morava, rivers in the Timok, Kolubara and Lim watersheds). The plan envisages the extraction of river sediments from water areas from non-renewable reserves for the implementation of works on facilities important for the Republic of Serbia. Unfortunately, the capacity to carry out on-site inspections is still very modest, so that even now there are many irregularities in the quantities exploited and the spatial and temporal scope of exploitation. Serious and independent scientific studies on the impacts of such activities on ecosystems and biodiversity should be carried out before and after the exploitation of river sediments (Coalition 27, 2019).

5.6. Deforestation, forest logging and plantations of undesirable tree species

In Serbia, there used to be extensive forests covering both the northern parts of our country (along the large rivers of Vojvodina) and the southern parts. Šumadija got its name from the dense and impassable forests in the 16th and 17th centuries. The high forest cover of Serbia continued until the 19th century. Already in the middle of the century, reports appeared indicating that the forests in Serbia were slowly deteriorating. Two centuries ago, about 80% of Serbian territory was forested, but after the World War II the percentage dropped to only 17%, which is why reforestation measures were organised in Yugoslavia after the war (Orlović, 2008). According to FAO data from 2015, 30% of Serbian territory is forested, but of this 30%, 10% are plantations, mainly Canadian poplar forests (Figure 48). A sustainable system of forest management means taking care not only of the tree, but also of the whole ecosystem (Dragović *et al*., 2017).

Of particular importance to aquatic ecosystems are floodplains, which are usually covered with natural woody vegetation (willow groves along lowland rivers). Due to natural regulation of the watercourse and the floodplain, floodplain forests of willows, white poplars and black poplars formed along lowland rivers in the course of history (the so-called zone of lowland floodplain forests). These areas, with their native vegetation, are an important factor in stabilising riverbanks and mitigating the effects of flood waves. The degradation of these areas is one of the most important environmental problems of the 21st century, caused by the various forms of land use. Floodplains are considered important fish spawning habitats in lowland rivers, either as suitable spawning grounds or as juvenile fish habitats. In Europe today, about 90% of floodplains have been lost, as almost all rivers are under the influence of pollution, dam construction and other activities that affect the remodelling of the flow regime (Jurišić, 2015). Nevertheless, in the major European rivers, chemical quality of water has improved significantly in recent decades, but the recovery of fish fauna has not continued accordingly. Important causes are the loss of habitats in the main riverbeds

ka povezanost između njih. U Srbiji, ritovi i poplavne zone takođe predstavljaju glavno prirodno mrestilište duž toka Dunava za preko 20 vrsta riba. Iako je poznata višestruka korist poplavnog područja, tokom prošlog veka izgubljeno je oko 80% prirodnog plodišta reke Dunav (Babić-Mladenović & Ninković, 2009). Osim u očuvanju ribljeg fonda i biološke raznovrsnosti, ova područja imaju veliku ulogu i u održavanju kapaciteta reke u procesu samoprečišćivanja.

and their floodplains, as well as the reduced hydrological connectivity between them. In Serbia, the marshes and floodplains are also the most important natural spawning grounds along the Danube for over 20 fish species. Although the multiple benefits of floodplains are well known, about 80% of the Danube's natural spawning areas have been lost in the last century (Babić-Mladenović & Ninković, 2009). In addition to maintaining the fish stock and biodiversity, these areas also play an important role in maintaining the river's self-purification capacity.

Slika 48. Plantaže kanadske topole u plavnoj zoni Dunava kod Ivanova. Značajne površine uz Dunav, Savu i Tisu, koriste se za plantažno gajenje drveća za potrebe drvne industrije. Ovakve plantaže locirane su u plavnom pojasu koji se nalazi između odbrambenih nasipa i glavnog rečnog korita. Najčešća vrsta drveta koje se gaji jeste kanadska topola. Postoje podaci o negativnom uticaju plantaža na lokalni kvalitet vode i zemljišta (acidifikacija i povećane koncentracije aluminijuma u podlozi) (foto: A. Hegediš).

Figure 48. Canadian poplar plantations in the floodplain of the Danube near Ivanovo. Large areas along the Danube, Sava and Tisza are used to grow trees for the needs of the timber industry. These plantations are located in the flood zone between the protective levees and the main riverbed. The most commonly cultivated tree species is the Canadian poplar. There are data on the negative impacts of the plantations on local water and soil quality (acidification and increased aluminium concentration in the substrate) (photo: A. Hegediš).

5.7. Klimatske promene

Klimatske promene predstavljaju jedan od najvažnijih problema sa kojima se suočava čitava planeta (Feulner, 2017). One dovode do povećanja temperature vode, menjaju obrasce kruženja vode u prirodi, nivoe i hemiju vode i rečne tokove (Heino *et al.*, 2009). Smatra se da će promene klime intenzivirati kompeticiju za vodu između ljudi, što će neminovno dovesti do daljeg smanjenja slatkovodnog biodiverziteta (Flörke *et al.*, 2018). Očekuje se da će ove promene u velikoj meri uticati i na naselja riba. Ribe su ektotermni organizmi i njihova telesna temperatura zavisi od temperature spoljašnje sredine. Promena temperature vode direktno utiče na rast, reprodukciju i metaboličke procese riba i može uticati na usporavanje rasta i smanjenje ili čak potpuno sprečavanje reprodukcije. Pojedine vrste, poput lososa, soma i jesetri, ne mogu da se izmreste ukoliko zimske temperature ne opadnu do određenog nivoa (Olusanya &

5.7. Climate changes

Climate change is one of the most important problems of the whole planet (Feulner, 2017). It leads to an increase in water temperature, changes water circulation patterns in nature, water levels and water chemistry as well as river flows (Heino *et al.*, 2009). Climate change is expected to increase competition for water between people, which will inevitably lead to a further decline in freshwater biodiversity (Floerke *et al.*, 2018). It is expected that these changes will also strongly affect fish habitats. Fish are ectothermic organisms and their body temperature depends on the temperature of the external environment. A change in water temperature directly affects the growth, reproduction and metabolic processes of fish and can lead to growth retardation and a reduction or even complete prevention of reproduction. Some species, such as salmon, catfish and sturgeon, are unable to spawn if winter temperatures do not drop

van Zyll de Jong, 2018). Visoke temperature smanjuju koncentraciju kiseonika u vodi čime se sprečava opstanak mnogih vrsta riba. Za razliku od marinskih vrsta, koje imaju mogućnost migracije u hladnije vode, slatkovodne ribe su ograničene na rečni sliv ili jezero koje naseljavaju. U mnogim regionima predviđa se veliko smanjenje količine vode u donjim tokovima reka, čime će opstanak, uglavnom ekonomski značajnih vrsta riba, biti doveden u pitanje. Mnoge vrste riba koje žive u geografski izolovanim regionima suočavaju se sa potencijalnim izumiranjem, upravo zbog povećanja temperature vode. U kombinaciji sa drugim antropogenim pritiscima, promene će uticati na prostorno-vremensku distribuciju vrsta i doprineti smanjenju brojnosti populacija i lokalnom izmiranju mnogih vrsta (Jarić *et al*., 2019). Prema IUCN, oko 33% evropskih slatkovodnih vrsta riba ugroženo je klimatskim promenama (IUCN, 2017). U istraživanju u kome su analizirane osobine životne istorije i klimatske niše 443 vrste evropskih slatkovodnih riba, upoređene su one vrste koje su identifikovane kao podložnije klimatskim promenama sa vrstama koje se smatraju otpornim. Zaključak je da vrste koje su podložnije negativnom uticaju klimatskih promena naseljavaju topliji mediteranski region i njih karakteriše veći nivo ugroženosti, manja komercijalna vrednost, manja ugroženost ribolovom, manja veličina tela i distribucija i optimalni temperaturni opseg koji je bliži višim temperaturama (*engl*. warmer termal envelope). Povećanje temperature imaće veliki uticaj i na populacije riba koje naseljavaju obode prirodnih areala (Jarić *et al*., 2019). Predviđa se da će u budućnosti biti znatno više elementarnih nepogoda, poput suša (Slika 49) i poplava, koje će takođe uticati na naselja riba (Anderson & Bausch, 2006). S obzirom da su slatkovodni ekosistemi u poslednjih par decenija pretrpeli oštećenja kao nikada ranije u čitavoj istoriji čovečanstva, potrebno je uložiti velike napore kako bi se obezbedila njihova obnova, koja je neophodna kako bi se diverzitet vrsta riba održao ili poboljšao. Međutim, implementacija mera upravljanja i

to a certain level (Olusanya & van Zyll de Jong, 2018). High temperatures reduce oxygen concentration in the water, which prevents many fish species from surviving. Unlike marine species that can migrate to colder waters, freshwater fish are restricted to the river watershed or lake in which they live. In many regions, a sharp decline in the volume of water in the lower reaches of rivers is predicted, which will threaten the survival of commercially important fish species in particular. Many fish species living in geographically isolated regions are threatened with extinction, precisely because of the rise in water temperature. In combination with other anthropogenic pressures, the changes will affect the spatial and temporal distribution of species and contribute to the reduction of populations and local extinction of many species (Jarić *et al*., 2019). According to the IUCN, about 33% of European freshwater fish species are threatened by climate change (IUCN, 2017). In a study analysing the life history traits and climatic niches of 443 European freshwater fish species, species considered more vulnerable to climate change were compared with those considered resistant. The conclusion is that the species more vulnerable to the adverse effects of climate change live in the warmer Mediterranean and are characterised by higher levels of vulnerability, lower commercial value, lower threat from fisheries, smaller body size and distribution, and a warmer thermal envelope. Temperature rise will also have a significant impact on fish populations living at the edges of natural habitats (Jarić *et al*., 2019). It is predicted that there will be significantly more natural disasters in the future, such as droughts (Figure 49) and floods, which will also affect fish habitats (Anderson & Bausch, 2006). As freshwater ecosystems have been more degraded in recent decades than ever before in human history, major efforts are needed to restore them in order to maintain or improve the diversity of fish species. However, the implementation of management and protection measures is very difficult, firstly because of the multitude of threatening factors

Slika 49. Porečka reka u doba suše. Topla i sušna leta već se navode kao jedna od glavnih posledica klimatskih promena; manji tokovi tada praktično ostaju bez vode, a posledice po populacije riba jesu dramatične (foto: A. Hegediš).

Figure 49. Porečka River in the dry season. Hot and dry summers are already mentioned as one of the main consequences of climate change; smaller streams then remain practically without water and the consequences for fish populations are dramatic (photo: A. Hegediš).

zaštite veoma je teška, kako zbog velikog broja ugrožavajućih faktora i njihove međusobne interakcije, tako i zbog specifičnog položaja slatkovodnih ekosistema, u koje dospevaju sve zagađujuće materije sa okolnih terestričnih staništa (Heino *et al*., 2009).

Važno je napomenuti još jedan vrlo značajan problem. Naime, klimatskim promenama danas su ugrožena i mnoga tresetišta, koja predstavljaju jedne od najvrednijih ekosistema na Zemlji. Ona su dom mnogih biljnih i životinjskih vrsta, obezbeđuju vodu za piće, smanjuju rizik od poplava, pomažu u ublažavanju klimatskih promena i predstavljaju najveća kopnena prirodna skladišta ugljenika i organske materije. Njihovo uništavanje (eksploatacija, isušivanje i spaljivanje zbog povećanja poljoprivrednih površina) predstavlja jedan od najvećih izvora emisije ugljen-dioksida. Istraživanja pokazuju da se na ovaj način u atmosferu otpusti oko 6% ukupnog ugljen-dioksida koji nastaje ljudskom aktivnošću. Takođe, ovi ekosistemi predstavljaju stanište mnogih retkih i usko specijalizovanih vrsta riba. Zbog toga je veoma važno njihovo očuvanje i obnavljanje, kako bi se smanjila emisija ugljen-dioksida i obezbedio opstanak mnogim vrstama riba (IUCN Commission on Ecosystem Management Peatland Specialist Group, 2021).

Ceo region jugoistočne Evrope, uključujući i Srbiju, očekuju značajne promene klime u skorijoj budućnosti. Istraživanja pokazuju da je u periodu od 1996. do 2015. godine prosečna temperatura porasla za 1,2 °C, sa najvećim povećanjem maksimalnih dnevnih temperatura tokom leta od 2,2 °C. Projekcije koje nastaju prema regionalnim klimatskim modelima predviđaju da će porast prosečne temperature na godišnjem nivou do kraja ovog veka iznositi od 1,9 °C do 4,4 °C u svim delovima Srbije. Prema nekim predviđanjima, očekuje se smanjene količine padavina na celoj teritoriji Srbije (u proseku 5–10%), uz nešto slabije izraženo smanjene u Vojvodini i nekim delovima istočne Srbije (Krpić *et al*., 2018). Druga predviđanja najavljuju povećanje količine padavina u Vojvodini, dok će u ostalim delovima Srbije ostati ista ili će se smanjiti (Cvetković *et al*., 2015). Najverovatnije će doći do povećanja broja izuzetno toplih dana (>30 °C), dok će se broj hladnih dana (<0 °C) smanjiti. Treba očekivati kraće periode sa mrazom i duže sušne periode. Vrlo je verovatno da će se Srbija u skorijoj budućnosti suočiti i sa povećanim brojem elementarnih nepogoda, kao što su toplotni udari, poplave, suše i šumski požari. Direktne posledice ovih pojava jesu poremećaji u proizvodnji hrane i uticaj na zdravlje svih ekosistema. Istraživanja ukazuju na činjenicu da će u Srbiji doći do prodora subtropske klime, povećanja temperature i rizika od velikih količina padavina (Božanić & Gasperič, 2010; Unkašević & Tošić, 2013, 2015; Ruml *et al*., 2017; Vuković *et al*., 2018).

Republika Srbija je postala član *Okvirne konvencije Ujedinjenih nacija o klimatskim promenama* 2001. godine, dok je *Kjoto protokol* ratifikovala 2008. godine. S obzirom da pripada grupi zemalja u razvoju (ne-Aneks I države), za Republiku Srbiju ne postoje kvantitativne obaveze smanjenja emisije gasova sa efektom staklene bašte u prvom obavezujućem periodu. Međutim, Republika Srbija ima sve obaveze u pogledu uspostavljanja i sprovođenja mera i aktivnosti za postizanje ciljeva *Konvencije* (Božanić & Gasperič, 2010; Ministry of Environmental Protection, 2017).

Uticaj klimatskih promena na biodiverzitet i prirodne ekosisteme u Republici Srbiji razmatran je u dva važna strateška doku-

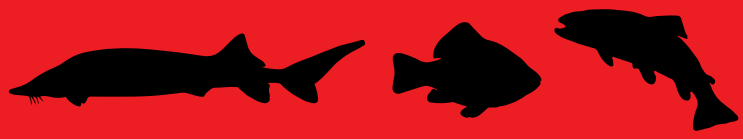
and their mutual interaction, and secondly because of the special situation of freshwater ecosystems, into which all pollutants from the surrounding terrestrial habitats penetrate (Heino *et al*., 2009).

It is important to mention another significant problem. Many peatlands, which are among the most valuable ecosystems on Earth, are now also threatened by climate change. They are home to numerous plant and animal species, provide drinking water, reduce flood risk, contribute to climate change mitigation and are the largest natural terrestrial stores of carbon and organic matter. Their destruction (exploitation, desiccation and slash-and-burn agriculture) is one of the largest sources of carbon dioxide emissions. Studies show that about 6% of all carbon dioxide produced by human activities enters the atmosphere in this way. Furthermore, these ecosystems are the habitat for many rare and specialist fish species. Their conservation and restoration is therefore very important to reduce carbon dioxide emissions and ensure the survival of many fish species (IUCN Commission on Ecosystem Management Peatland Specialist Group, 2021).

The entire region of Southeastern Europe, including Serbia, is expecting significant climate changes in the near future. Studies show that average temperatures increased by 1.2 °C between 1996 and 2015, with the largest increase in daily maximum temperatures being 2.2 °C in summer. Projections based on regional climate models predict that the average annual temperature will increase from 1.9 °C to 4.4 °C in all parts of Serbia by the end of this century. According to some forecasts, lower precipitation is expected for the whole Serbian territory (5–10% on average), with a slightly less pronounced decrease in Vojvodina and some parts of eastern Serbia (Krpić *et al*., 2018). Other forecasts predict an increase in precipitation in Vojvodina, while it will remain the same or decrease in other parts of Serbia (Cvetković *et al*., 2015). Most likely, the number of extremely hot days (>30 °C) will increase, while the number of cold days (<0 °C) will decrease. Shorter frost periods and longer dry periods are to be expected. It is very likely that Serbia will face increased natural disasters such as heat waves, floods, droughts and forest fires in the near future. The immediate consequences of these phenomena are disruptions in food production and impacts on the health of all ecosystems. Studies indicate that Serbia will experience a subtropical climate, an increase in temperature and the risk of large amounts of rainfall (Božanić & Gasperič, 2010; Unkašević & Tošić, 2013, 2015; Ruml *et al*., 2017; Vuković *et al*., 2018).

The Republic of Serbia has been a member of the *United Nations Framework Convention on Climate Change* since 2001 and ratified the *Kyoto Protocol* in 2008. As it belongs to the group of developing countries (non-Annex I countries), there are no quantitative commitments for the Republic of Serbia to reduce greenhouse gas emissions in the first binding period. However, the Republic of Serbia has all obligations related to the definition and implementation of measures and activities to achieve the objectives of the *Convention* (Božanić & Gasperič, 2010; Ministry of Environmental Protection, 2017).

The impact of climate change on biodiversity and natural ecosystems in the Republic of Serbia is addressed in two important strategic documents from the field of nature conservation: *Biodiversity Strategy for the period 2011–2018* (Official Gazette of RS, No. 13/2011) and the *National Environmental Protection Programme*



menta iz sektora zaštite prirode: *Strategiji biološke raznovrsnosti za period od 2011-2018. godine* (Službeni glasnik RS, br. 13/2011) i *Nacionalnom programu zaštite životne sredine* (Službeni glasnik RS, br. 12/2010). U *Strategiji biološke raznovrsnosti* dat je opšti pregled mogućih uticaja klimatskih promena na biodiverzitet i ekosisteme. Primećeno je da ove promene dovode do sledećih efekata na prirodne ekosisteme: fenoloških promena (promena životnih ciklusa biljnih i životinjskih vrsta, migracija i reprodukcije, perioda razmnožavanja i prezimljavanja, odnosno hibernacije određenih vrsta), promena morfologije, fiziologije i ponašanja vrsta, gubitka postojećih staništa i pojave nekih novih na koje vrste nisu adaptirane, promena brojnosti i distribucije vrsta, povećanja brojnosti štetočina i bolesti, genetičkih promena praćenih izumiranjem vrsta koje nisu u stanju da se prilagode na klimatske promene, kao i promena u prirodnim populacijama riba i zajednicima, koje se ogledaju kroz negativan uticaj na mrest i migracije. Takođe, ekosistemi su već u velikoj meri narušeni fragmentacijom i drugim antropogenim pritiscima, što ih čini još ranjivijim na klimatske promene. Među najosetljivijim ekosistemima jesu visokoplaninski predeli, pašnjaci, šume, rečne obale, vlažna i stepska staništa. Osetljivije vrste pretrpeće promene brojnosti i rasprostranjenja, a doći će i do povećanja broja i najezde predatora, parazita i izazivača bolesti. Alohtone invazivne, korovske vrste raširiće se nesmetano kao posledica klimatskih promena. Vrste koje nisu sposobne da se prilagode promenama klime i njihovim posledicama u velikoj su opasnosti od iščezavanja (Cvetković *et al*., 2015).

U Srbiji ne postoji sistem redovnog praćenja efekata klimatskih promena na biodiverzitet i ekosisteme. Dosadašnje aktivnosti Srbije u procesima adaptacije na klimatske promene nisu dovoljne. Na nacionalnom nivou ne postoji jedinstveni strateški dokument za adaptacije na klimatske promene, iako je njegova izrada predviđena u *Nacionalnoj strategiji održivog razvoja* iz 2008. godine (Službeni glasnik RS, br. 3/2008). Ove činjenice ukazuju na prioritetnu potrebu izrade *Nacionalnog akcionog plana za biodiverzitet i klimatske promene*. Ovaj plan bi trebalo da sadrži osnovne korake za dalje aktivnosti u procesu adaptacija, organizaciju samog procesa i odgovorne institucije za sprovođenje programa. *Nacionalnim akcionim planom za biodiverzitet i klimatske promene* predviđene su posebne mere adaptacije biodiverziteta na klimatske promene, poput sprovođenja analize ranjivosti ekosistema, razvoja strategije za adaptacije na klimatske promene, procene ugroženosti zaštićenih područja i osetljivih, retkih i ugroženih ekosistema na klimatske promene, određivanja potrebe za indikatorima, informacijama, kao i prioritetima za dugoročno praćenje uticaja klimatskih promena na biodiverzitet, uključivanja indikatora za praćenje uticaja klimatskih promena u nacionalni program za praćenje biodiverziteta, jačanja naučno-istraživačkih kapaciteta javnog i privatnog sektora i zaposlenih u zaštićenim područjima i dr. (Sekulić *et al*., 2012; Đorđević *et al*., 2013). Međutim, *Programom zaštite prirode za period od 2021. do 2023. godine* (Službeni glasnik RS, br. 53/2021), u okviru posebnog cilja "Smanjeni negativni uticaji na biodiverzitet", definisana je mera uspostavljanja praćenja uticaja klimatskih promena na biodiverzitet i uticaj biodiverziteta na ublažavanje efekata klimatskih promena, sa sledećim aktivnostima za sprovođenje ove mere: 1) de-

(Official Gazette of RS, No. 12/2010). The *Biodiversity Strategy* provides a general overview of the potential impacts of climate change on biodiversity and ecosystems. These changes have been shown to have the following effects on natural ecosystems: phenological changes (changes in the life cycle of plant and animal species, migration and reproduction, breeding and hibernation periods of certain species), changes in the species morphology, physiology and behavior, loss of existing habitats and appearance of some new species to which they are not adapted, changes in the number and distribution of species, increases in pests and diseases, genetic changes associated with the extinction of species unable to adapt to climate change, and changes in natural fish populations and communities reflected in the negative impacts on spawning and migration. In addition, ecosystems are already severely degraded by fragmentation and other anthropogenic impacts, making them even more vulnerable to climate change. The most vulnerable ecosystems include uplands, grasslands, forests, riverbanks, wetlands and steppe habitats. For the more vulnerable species, abundance and distribution will change, and numbers and infestations by predators, parasites and pathogens will increase. Non-native, invasive weed species will spread unhindered as a result of climate change. Species that cannot adapt to climate change and its consequences are at high risk of extinction (Cvetković *et al*., 2015).

In Serbia, there is no system for regular monitoring of climate change impacts on biodiversity and ecosystems. Serbia's activities to date in the field of climate change adaptation are insufficient. At the national level, there is no single strategic document on adaptation to climate change, although its elaboration is foreseen in the *National Sustainable Development Strategy of the Republic of Serbia* from 2008 (Official Gazette of RS, No. 3/2008). These facts indicate that the development of a *National Biodiversity and Climate Change Action Plan* is a priority. This plan should contain the basic steps for further activities in the adaptation process, the organisation of the process itself and the responsible institutions for its implementation. The *National Biodiversity and Climate Change Action Plan* provides for specific measures for the adaptation of biodiversity to climate change, such as conducting an ecosystem vulnerability analysis, developing a climate change adaptation strategy, assessing the vulnerability of protected areas and fragile, rare and threatened ecosystems to climate change, identifying needs for indicators, information and priorities for long-term monitoring of climate change impacts on biodiversity, incorporating indicators for monitoring climate change impacts into the national biodiversity monitoring programme, strengthening the scientific and research capacity of the public and private sectors and protected area staff, etc. (Sekulić *et al*., 2012; Đorđević *et al*., 2013). Under the specific objective "Reduce of negative impacts on biodiversity", the *Nature Protection Programme of the Republic of Serbia for the period from 2021 until 2023* (Official Gazette of RS, No. 53/2021) has identified the action of establishing monitoring of the impacts of climate change on biodiversity and the impacts of biodiversity on mitigation of climate change, with the following activities to implementation this action: 1) establish methods and indicators as well as the number of species, habitats and ecosystems for which the impacts of climate change

finisanje metodologija i indikatora, broja vrsta, staništa i ekosistema na kojima se vrši praćenje uticaja klimatskih promena na biodiverzitet; 2) razvijanje specifičnih mera zaštita vrsta i staništa osetljivih na klimatske promene u relevantnim planskim dokumentima i sprovođenje mera prilagođavanja i ublažavanja efekata klimatskih promena na prirodne ekosisteme i divlje vrste flore i faune na nacionalnom, regionalnom i lokalnom nivou; i 3) priprema i objavljivanje medijskih objava i naučnih radova i priprema i sprovođenje kampanja za povećanje javne svesti o uticaju klimatskih promena na biodiverzitet.

5.8. Višenamensko korišćenje vodnih resursa sa međusobno neusklađenim planovima

Upravljanje vodama postaje sve značajnije pitanje u savremenom svetu. Upravljanje i uređenje voda prvenstveno pružaju bolju prostornu i vremensku ujednačenost korišćenja vodnih resursa. Programi uređenja i korišćenja voda tiču se snabdevanja vodom stanovništva i industrije, navodnjavanja, hidroenergetike, plovidbe, uzgoja ribe, sporta, rekreacije i turizma (Nijland & Cals, 2000; Josimović, 2020).

Integralnim i multidisciplinarnim upravljanjem vodama na teritoriji EU bavi se *Okvirna direktiva o vodama Evropske unije*. Ona predstavlja operativnu alatku za ostvarenje ključnih ciljeva za sveobuhvatnu zaštitu svih voda, uzimajući u obzir prirodnu interakciju među njima u kvantitativnom i kvalitativnom smislu, uz primenu principa integralnog upravljanja vodnim resursima. Koncept integracije svih relevantnih segmenata (vodni resursi na nivou sliva, zaštita životne sredine, korišćenje voda, legislativa, nivoi donošenja odluka, upravljanje vodama prekograničnih slivova kroz međunarodnu saradnju) jeste ključ za dostizanje proklamovanih ciljeva koji se tiču *Okvirne direktive o vodama Evropske unije* (Republička direkcija za vode, 2000).

Hidromorfologija je novi termin koji je nastao u okviru primene *Okvirne direktive o vodama Evropske unije*. Hidromorfološki parametri kvaliteta (hidrološki režim, kontinuitet rečnog toka i morfološki uslovi) koriste se za ocenu ekološkog statusa/potencijala površinskih voda. Naime, uvođenje hidromorfološkog kvaliteta kao mere stanja voda zahteva nov pristup u kom se pravi kompromis između „inženjerskog" i „ekološkog" pristupa upravljanju vodama. Uvođenje hidromorfološkog kvaliteta kao mere stanja voda zahteva neposrednu saradnju i koordinaciju između sektora. U dosadašnjoj praksi, ocena kvaliteta vode u vodotocima vršila se samo na osnovu fizičko-hemijskih i bioloških parametara (Lekić, 2018; Veljković, 2018). U *Okvirnoj direktivi o vodama*, kvalitet površinskih voda određuje se na osnovu ocene njihovog hemijskog i ekološkog statusa. Ekološki status pokazuje kvalitet strukture i funkcionisanja vodenih ekosistema u površinskim vodama. U slučaju reka, klasifikacija ekološkog statusa zasniva se na tri grupe pokazatelja: biološki elementi (sastav i bogatstvo akvatične flore i faune), hidromorfološki elementi (hidrološki režim, kontinuiranost rečnog toka i morfološki uslovi) i hemijski i fizičko-hemijski elementi (Babić-Mladenović & Ninković, 2009) (Slika 50).

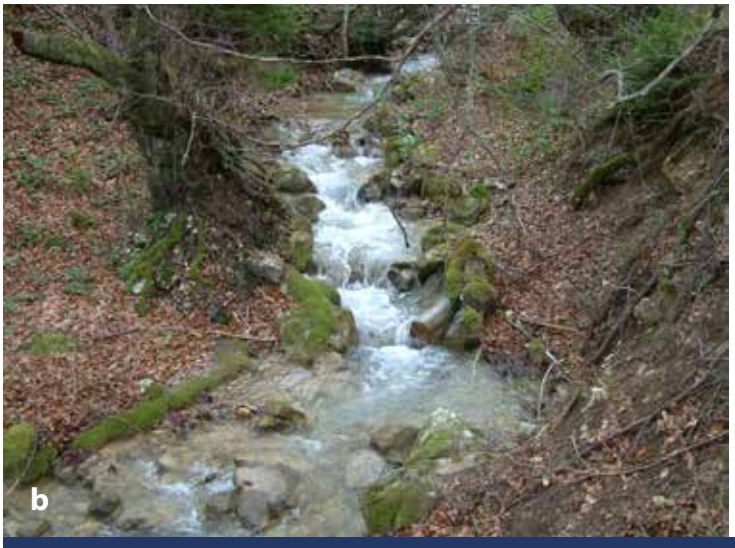
on biodiversity will be monitored; 2) developing specific measures to protect species and habitats sensitive to climate change in relevant planning documents and implementing measures to adapt and mitigate the impacts of climate change on natural ecosystems and wildlife at national, regional and local levels; and 3) preparing and publishing media releases and scientific papers, and preparing and conducting public awareness campaigns on the impacts of climate change on biodiversity.

5.8. Conflicting plans for multipurpose use of water resources

Water management is becoming an increasingly important issue in the modern world. Water management and regulation primarily ensure better spatial and temporal coherence in the use of water resources. Water management and exploitation programmes address water supply of the population and industry, irrigation, hydropower, navigation, fish farming, sports, recreation and tourism (Nijland & Cals, 2000; Josimović, 2020).

Integrated and multidisciplinary water management in the territory of the EU is regulated by the *European Union Water Framework Directive*. It is an operational tool to achieve the main objectives for the comprehensive protection of all waters, taking into account the natural interactions between them in quantitative and qualitative terms and applying the principle of integrated water resources management. The concept of integrating of all relevant areas (water resources at the river watershed level, environmental protection, water use, legislation, decision-making levels, water management of transboundary basins through international cooperation) is key to achieving the proclaimed objectives of the *EU Water Framework Directive* (Republic Water Directorate, 2000).

Hydromorphology is a new term that has emerged in the context of the implementation of the *EU Water Framework Directive*. Hydromorphological quality parameters (hydrological regime, river continuity and morphological conditions) are used to assess the ecological status/potential of surface waters. The introduction of hydromorphological quality as a measure of the status of a waterbody requires a new approach that represents a compromise between "engineering" and "ecological" approaches to water management. The introduction of hydromorphological quality as a measure of the status of a waterbody requires immediate cooperation and coordination between sectors. In previous practice, the assessment of water quality in running waters was based only on physico-chemical and biological parameters (Lekić, 2018; Veljković, 2018). In the *EU Water Framework Directive*, the quality of surface waters is determined on the basis of on an assessment of their chemical and ecological status. Ecological status shows the quality of the structure and functioning of aquatic ecosystems in surface waters. In the case of rivers, the classification of ecological status is based on three groups of indicators: biological elements (composition and abundance of aquatic flora and fauna), hydromorphological elements (hydrological regime, river continuity and morphological conditions) and chemical and physico-chemical elements (Babić-Mladenović & Ninković, 2009) (Figure 50).



Slika 50. Tri manja vodotoka na planini Tari sa poželjnim ekološkim statusom (kategorija "odličan"). To su vodotoci iz kojih se još uvek može piti voda bez bojazni od posledica po zdravlje. Primeri čistih voda: (a) reka Rača; (b) Jokića potok; (c) Omarsko vrelo, detalj (foto: A. Hegediš).

Figure 50. Three smaller watercourses on the Tara Mt. with desirable ecological status (category "excellent"). These are watercourses from which one can still drink water without fearing health consequences. Examples of clean watercourses: (a) Rača river; (b) Jokića stream; (c) Omarsko vrelo, detail (photo: A. Hegediš).

Republika Srbija je usvojila *Strategiju upravljanja vodama do 2034. godine* koja se oslanja na *Okvirnu direktivu o vodama Evropske unije* (Službeni glasnik RS, br. 3/2017). Na osnovu *Strategije*, očekuje se značajno unapređenje stanja u sektoru voda u odnosu na postojeće. Ovo unapređenje odvijaće se u skladu sa društvenim i ekonomskim mogućnostima države, a uz uvažavanje standarda Evropske unije u oblasti voda. Polazeći od ocene postojećeg stanja, izveden je zaključak da period do 2034. godine nije dovoljan za dostizanje svih standarda koji važe za zemlje članice EU. Najveći stepen usklađenosti očekuje se u delu vodne delatnosti koji se odnosi na korišćenje vode za ljudsku potrošnju, dok će za dostizanje propisanih standarda u delu koji se odnosi na zaštitu vodenih ekosistema i održivo korišćenje biti potreban period duži od posmatranog ovim dokumentom.

The Republic of Serbia has adopted the *Water Management Strategy until 2034*, which is based on the *EU Water Framework Directive* (Official Gazette of RS, No. 3/2017). Based on the *Strategy*, the situation in the water sector is expected to improve significantly compared to existing conditions. This improvement will be in line with the social and economic possibilities of the country, while respecting the European Union standards in the field of water management. Based on the assessment of the current situation, it was determined that the period until 2034 is not sufficient to achieve all the standards applicable to EU member states. The highest level of compliance is expected for the part of the water activity related to the use of water for human consumption, while the achievement of the prescribed standards in the part related to the protection of water ecosystems and sustainable use will require a longer period than the one considered in this document.

Upravljanje ribolovnim resursima u okviru sektora voda trebalo bi da se zasniva na principu održivog korišćenja, koji doprinosi očuvanju diverziteta ihtiofaune i ekološkog integriteta vodenih ekosistema. Međutim, u poslednjih 100 godina funkcionisanje ekosistema kopnenih voda znatno je degradirano. Stanje ribljeg fonda suočava se sa mnogim razvojnim aktivnostima koje su u suprotnosti sa održivim razvojem. Tri su glavna razloga koja ugrožavaju riblji fond: (1) neznanje o međusobnoj povezanosti riba i staništa, (2) ribolov se ne smatra visokim prioritetom i (3) njime se ne upravlja na integralan i multidisciplinaran način, iako se u poslednjem periodu tome ipak pridaje sve veća važnost (Smederevac-Lalić, 2013). U zapadnoevropskim zemljama, ribolov se uglavnom koristi za rekreaciju i sport, i malo se ribe konzumira. U regionu severne Evrope, ribolov se sprovodi na održiv način, iako rekreativni ribolov postaje sve popularniji i predstavlja važnu aktivnost u ekspanziji. U istočnoj Evropi, rekreativni ribolov je mnogo više od obične zabave, više se posmatra kao izvor hrane. Rekreativni ribolov u južnoj Evropi uglavnom je manje razvijen i u padu je. S obzirom na sve veći pritisak na vodene (i riblje) resurse, upravljanje ribolovom ne sme se više tretirati izolovano, tako da je neophodan intregativni pristup (Evropska komisija, 2011). Tradicionalni način upravljanja zasniva se na procenama zaliha ribljeg fonda i nije *a priori* loš. Ovaj način upravljanja mora biti sastavni deo integrativnog upravljanja, jer u pojedinim regijama, kao što je to slučaj sa Srbijom, nema dobrih i kontinuiranih statističkih praćenja.

5.9. Neadekvatno upravljanje ribljim fondom

Kao i u marinskim ekosistemima, eksploatacija slatkovodnih vrsta riba takođe može dovesti do pada brojnosti populacija i uticati na ekosistemske usluge koje ove vrste pružaju. Zbog raznovrsnih antoropogenih pritisaka, ribe su na globalnom nivou postale druga najugroženija grupa kičmenjaka, nakon vodozemaca. Ova činjenica zahteva intervencije koje su usmerene na upravljanje i obnovu populacija riba, kako bi se zaustavio negativni trend. Većina mera upravljanja slatkovodnim ekosistemima direktno utiče i na populacije riba, jer mere obuhvataju sve aspekte zaštite životne sredine, uključujući i legislativu (kao što je npr. *Okvirna direktiva o vodama Evropske unije*) (Fenichel *et al*., 2013; Arlinghaus *et al*., 2015).

Upravljanje ribljim fondom jeste proces u kome se pouzdane informacije koriste kako bi se postigli određeni ciljevi u upravljanju ribljim resursom. Opšti principi upravljanja slatkovodnim ribama podrazumevaju: održivo korišćenje ribljeg fonda, očuvanje slatkovodnog biodiverziteta, kao i ravnomernu podelu koristi između svih korisnika. Nažalost, mnoga mala ribarska područja nemaju veći ekonomski značaj i ne mogu da opravdaju neophodna ulaganja u sisteme monitoringa i upravljanja. U svetlu svih faktora koji narušavaju slatkovodni riblji fond, čini se da tradicionalne metode koje se primenjuju u zaštiti (regulacija eksploatacije, uspostavljanje prirodnih rezervata, programi veštačkog uzgoja i poribljavanja) nisu dovoljno efikasne (Cowx, 1994b, 1994c; Collares-Pereira & Cowx, 2004; Naiman & Latterell, 2005; Arlinghaus *et al*., 2015).

Gazdovanje ribljim fondom u Srbiji odvija se na 17 ribarskih područja (Slika 51) i 38 ribarskih područja u zaštićenim prirodnim

Fisheries resource management in the water sector should be based on the principle of sustainable use, which contributes to the maintenance of the diversity of fish fauna and the ecological integrity of aquatic ecosystems. However, over the past 100 years, the functioning of inland aquatic ecosystems has deteriorated significantly. The state of fish stocks faces numerous development problems that are at odds with sustainable development. There are three main reasons that threaten fish stocks: (1) ignorance of the interrelationship between fish and habitat, (2) fisheries are not given high priority, and (3) they are not managed in an inclusive and multidisciplinary manner, although this has become increasingly important recently (Smederevac-Lalić, 2013). In Western European countries, fishing is mainly for recreation and sport, and little fish is consumed. In the Northern European region, fishing is done in a sustainable way, although recreational fishing is becoming more popular and is an important expanding activity. In Eastern Europe, recreational fishing is much more than entertainment; it is seen more as a source of food. Recreational fishing in Southern Europe is generally less developed and in decline. With increasing pressure on water (and fish) resources, fisheries management can no longer be considered in isolation, so an integrative approach is needed (European Commission, 2011). The traditional way of managing is based on estimates of fish stocks and is not *a priori* bad. This type of management must be an integral part of integrative management, as in some regions, such as Serbia, there is no good and continuous statistical monitoring.

5.9. Inadequate management of fish stocks

As in marine ecosystems, exploitation of freshwater fishes can lead to population declines and affect the ecosystem services provided by these species. Due to various anthropogenic influences, fish have become the second most threatened vertebrate group in the world after amphibians. This fact calls for measures to manage and restore fish populations in order to stop the negative trend. Most measures for the management of freshwater ecosystems have a direct impact on fish populations, as the measures cover all aspects of environmental protection, including legislation (such as the *European Union Water Framework Directive*) (Fenichel *et al*., 2013; Arlinghaus *et al*., 2015).

Fish stock management is a process that uses reliable information to achieve specific management objectives for fishery resources. General principles of freshwater fish management include: sustainable use of fish stocks, conservation of freshwater biodiversity and equal distribution of benefits among all users. Unfortunately, many small fishing areas are not of great economic importance and cannot justify the necessary investment in monitoring and management systems. Considering all the factors harming freshwater fish stocks, traditional conservation methods (regulation of exploitation, establishment of nature reserves, artificial breeding and stocking programmes) do not seem to be sufficiently effective (Cowx, 1994b, 1994c; Collares-Pereira & Cowx, 2004; Naiman & Latterell, 2005; Arlinghaus *et al*., 2015).

Management of fish stocks in Serbia is carried out in 17 fishing areas (Figure 51) and 38 fishing areas within protected natural areas regulated by the *Law on Protection and Sustainable Use of Fish Stocks*. The users of the 17 basic fishing areas are companies, public

Slika 51. **Ribarska područja u Srbiji (Kaličanin & Sekulić, 2024); zeleno označene površine predstavljaju ribarska područja u zaštićenim prirodnim dobrima.**

Figure 51. **Fishing areas in Serbia (Kaličanin & Sekulić, 2024); zones coloured green represent fishing areas within protected natural areas.**

Ribarska područja / Fishing areas

1. Južna Morava 1 / South Morava 1
2. Južna Morava 2 / South Morava 2
3. Rasina / Rasina
4. Ibar / Ibar
5. Zapadna Morava / West Morava
6. Sava / Sava
7. Kolubara / Kolubara
8. Beograd / Belgrade
9. Velika Morava 2 / Great Morava 2
10. Velika Morava 1 / Great Morava 1
11. Mlava / Mlava
12. Timok / Timok
13. Dunav / Danube
14. Banat / Banat
15. Srem / Srem
16. Bačka / Bačka
17. Kosovo / Kosovo

dobrima, što je regulisano *Zakonom o zaštiti i održivom korišćenju ribljeg fonda*. Korisnici 17 osnovnih ribarskih područja jesu privredna društva, javna preduzeća ili druga pravna lica. U zaštićenim područjima, korišćenje ribljeg fonda u nadležnosti je upravljača tog područja. *Zakon o zaštiti i održivom korišćenju ribljeg fonda* donet je 2009. godine i menjan 2014. i 2018. godine, dok su se podzakonska akta takođe više puta menjala. Nažalost, ove promene nisu proistekle iz naučnih podataka, znanja, saveta i zaključaka. Zbog toga je u Srbiji došlo do pada broja rekreativnih ribolovaca, a broj profesionalnih ribara stagnira i jedino broj ribočuvara raste. Ulov ima tendenciju opadanja za sve vrste koje se statistički prate (šaran, som, smuđ i deverika od autohtonih vrsta, babuška i tolstolobik od alohtonih vrsta). Odnos ulova u rekreativnom i privrednom ribolovu promenjen je u korist rekreativnog ribolova, koji preuzima dominaciju u poslednjih par godina. Trendovi svih analiziranih parametara drastično su se promenili 2012. godine, jer privremeni korisnici ribarskih područja nisu imali odgovarajuća dokumenta za operativno upravljanje, koje je zatim produženo na narednih pet godina. Smanjenje broja ribara i ulova ukazuje na to da postoje veliki problemi u upravljanju ribarskim područjima. Takođe, u Srbiji postoji velika opasnost od samovoljnog unosa invazivnih alohtonih vrsta riba u ribolovne vode od strane rekreativnih ribolovaca, retke primene pricipa „uhvati i pusti", neadekvatnog i nekontrolisanog poribljavanja, promena u trofičkoj strukturi, uništavanja staništa i unapređivanja tehnika ulova, čime se povećava ribolovni pritisak. Nedostatak pouzdanih i naučno zasnovanih operativnih programa upravljanja, koji imaju za cilj da pruže održivo upravljanje ribljim fondom i da pomognu korisnicima ribarskih područja, tokom tog petogodišnjeg perioda (nakon 2012. godine), doveo je do privremenog upravljanja ribarskim područjima, čije efekte nije moguće proceniti. Takođe, većina programa upravljanja ribarskim područjima nema jasno definisane ciljeve (kratkoročne, srednjoročne, dugoročne) i ne postoji vrednovanje efekata mera koje se predlažu u programima. Zbog loših programa upravljanja, svedoci smo velikih grešaka koje su iz njih proistekle. Primenom neodgovarajućih i nekontrolisanih mera poribljivanja, u mnoge pastrmske vode u Srbiji unesene su alohtone, invazivne varijante ribnjački odgojenih potočnih pastrmki. Istraživanja su pokazala da su u najvrednije populacije potočnih pastrmki unesene nove, strane varijante. Takođe, dešavala su se nekontrolisana poribljavanja šaranom, nakon čega su mrtve jedinke plutale vodom koja služi pre svega za vodosnabdevanje i rekreaciju. I pored upozorenja, nastavljaju se obimna i skupa, a neodgovarajuća poribljavanja bez krajnje opravdanih razloga. Time se obavlja nekontrolisani promet ribljom mlađi, bez obzira što je to suprotno FAO principima upravljanja i konzervacionim načelima. Nažalost, reakcija državne administracije ne postoji, niti ima izgleda da će se ova loša praksa prekinuti u budućnosti (Hegediš *et al*., 2018).

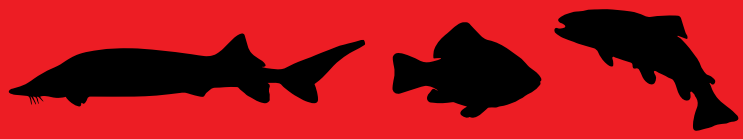
5.10. Naučna politika

Crvena lista ugroženih vrsta prema IUCN kriterijumima često se koristi pri donošenju odluka o finansijskom ulaganju u zaštitu određenih vrsta, kao i o neophodnim naučnim istraživanjima, pri čemu se ističe da istraživanja treba da budu usmerena na vrste koje

enterprises or other legal entities. In the case of protected natural areas, the use of the fish stock is the responsibility of the managers of the area. The *Law on Protection and Sustainable Use of Fish Stocks* was passed in 2009 and amended in 2014 and 2018, and the regulations have also been amended several times. Unfortunately, these changes were not based on scientific data, findings, recommendations and conclusions. For this reason, the number of recreational fishers in Serbia has decreased, while the number of professional fishers has stagnated and only the number of fish wardens is increasing. Catches are tending to decline for all statistically recorded species (common carp, wels catfish, pikeperch and common bream as native species, Prussian carp as well as silver and bighead carp as non-native species). The relationship between the catches of recreational and commercial fisheries has changed in favour of the recreational fishery, which has become dominant in recent years. The trends of all analysed parameters changed drastically in 2012 because the temporary users of the fishing areas did not have appropriate documents for the operational management, which was then extended for the next five years. The decrease in the number of fishers and catches indicates that there are major problems in the management of fishing areas. Furthermore, in Serbia there is a great risk of indiscriminate introduction of invasive non-native fish species into fishing waters by recreational fishers, rare application of the catch-and-release principle, inadequate and uncontrolled fish stocking, alteration of trophic structure, habitat destruction and improvement of fishing techniques, which increases fishing pressure. The lack of reliable and science-based operational management programmes aimed at sustainable management of fish stocks and support for fisheries users resulted in temporary management of fisheries during this five-year period (after 2012), the impact of which cannot be assessed. In addition, most fisheries management programmes do not have clearly defined objectives (short-term, medium-term, long-term) and there is no evaluation of the impact of the measures proposed in the programmes. Due to inadequate management programmes, we have witnessed significant failures that have resulted. Inadequate and uncontrolled stocking programmes have introduced non-native invasive variants of the pond-raised brown trout into many trout waters in Serbia. Studies have shown that new alien variants have been introduced into the most valuable brown trout populations. In addition, the carp was stocked uncontrollably, resulting in dead individuals floating in waterbodies used primarily for water supply and recreation. Despite this warning, large-scale, expensive and improper stocking continues for no good reason. In this way, an uncontrolled trade in juvenile fish is taking place that runs counter to FAO management and conservation principles. Unfortunately, there is neither a response from the state administration nor any prospect that this bad practice will stop in the future (Hegediš *et al*., 2018).

5.10. Science policy

The IUCN Red List of Threatened Species is often consulted when making decisions about financial investment in the conservation of particular species and the need for scientific research, emphasising that research should focus on threatened species and data deficient species. Analysis of scientific papers has shown that there



su ugrožene i na one o kojima ne postoji dovoljno podataka (*engl.* Data Deficient). Analiza naučnih radova pokazala je da postoje izvesni pozitivni pomaci u istraživanju nedovoljno istraženih taksona, dok je ovaj trend primećen i kod malog broja taksona koji se smatraju kritično ugroženim. Čini se da su nedovoljno istražene vrste prepoznate kao važne za istraživanje, dok su istraživački napori usmereni na ugrožene vrste pokrenuti nekim drugim faktorima (blizina staništa proučavane vrste od naučne institucije, bogatstvo države koja sprovodi istraživanje, troškovi i logistika istraživanja, harizmatičnost/atraktivnost proučavane vrste, politika finansiranja, istraživačka inercija naučne zajednice koja ima tendenciju da se fokusira na iste, dobro proučene modele istraživanja, za koje već postoji stručna ekspertiza ili za koje je dokazano da mogu da obezbede finasiranje), a ne samom IUCN listom (Jarić *et al*., 2017). Međutim, i pored svih napora, mali broj publikovanih naučnih radova obrađuje nedovoljno istražene vrste. Istraživanja su i dalje uglavnom usmerena na mali broj ugroženih vrsta, dok je većina vrsta ili nedovoljno ili nimalo istražena. Ovakva neravnomerna raspodela naučnih rezultata dovodi do nedostatka informacija koje su neophodne donosiocima odluka i upravljačima da razviju ispravne mere zaštite i obnove populacija. Stoga bi napori morali da budu uloženi u konzervaciona istraživanja i monitoring veoma ugroženih i nedovoljno proučenih vrsta, kako bi se popunile praznine u dosadašnjim saznanjima.

Nažalost, monitoring programi nisu prepoznati i vrednovani u naučnim okvirima, iako predstavljaju važnu komponentu nauke o životnoj sredini i pomažu u formiranju legislative koja tretira ovu oblast. Važan deo nauke o životnoj sredini jesu upravo ovakve dugoročne studije, jer se ekosistemi menjaju sporo. One pružaju kontekst i okvir za kratkoročna praćenja i neophodne su kako bi se utvrdilo da li su neki događaji neobični/ekstremni ili su sastavni deo prirodnih ciklusa. Ovakve studije obezbeđuju osnovu za naučno-zasnovanu politiku zaštite životne sredine i neophodne su naučnicima jer predstavljaju deo programa koji se bave istraživanjem životne sredine. Na kraju, građanima su potrebni ovakvi monitoring programi kako bi mogli da imaju uvid u nacionalne prirodne resurse i u stanje životne sredine. Zbog toga, izrada monitoring programa nije drugorazredna nauka, već predstavlja ključnu komponentu nauke o životnoj sredini i stoga bi odnos prema ovakvim istraživanjima trebalo da se promeni u budućnosti (Lovett *et al*., 2007).

Prema IUCN Crvenoj listi ugroženih vrsta (IUCN, 2022), od ukupnog broja od oko 18.000 slatkovodnih vrsta riba, procena statusa ugroženosti urađena je za 10.035 vrsta. To znači da je preostalo 44% vrsta koje su nedovoljno proučene, kako po pitanju biologije, tako i po pitanju distribucije, brojnosti populacija, populacionih trendova, faktora ugrožavanja, a samim tim i zaštite. Sve ove činjenice ukazuju na to da je potrebno uložiti mnogo više napora ne samo u završetak popisa svih slatkovodnih vrsta riba, već i u proučavanje njihovih karakteristika.

Takođe, za većinu vrsta ne postoje modeli distribucije u odnosu na klimu, koji su vrlo važni kako bi mogle da se predvide reakcije slatkovodnih vrsta riba na buduće klimatske promene. Ti modeli treba da pruže informacije o tome da li zaštićena područja imaju kapacitet da na odgovarajući način ublaže efekte ovih promena na

are certain positive trends in research of insufficiently studied taxa, with this trend also being observed in a small number of taxa that are considered to be critically endangered. It seems that insufficiently studied species are recognised as important for research, while research efforts for threatened species are driven by some other factors (proximity of the habitat of the studied species to the scientific institution, wealth of the country conducting the research, cost and logistics of the research, charisma/attractiveness of the studied species, funding policies, research inertia of the scientific community, which tends to focus on the same, well-studied research models for which professional expertise already exists or for which it has been demonstrated that they can secure funding) rather than by the IUCN list itself (Jarić *et al*., 2017). Despite all efforts, however, only a small number of published scientific papers address insufficiently studied species. Research still focuses mainly on a few threatened species, while most species are either insufficiently studied or not studied at all. This uneven distribution of scientific results leads to a lack of information that decision-makers and managers need to develop the right measures to protect and restore populations. Efforts should therefore be invested in conservation research and monitoring of highly threatened and poorly studied species to fill the gaps in current knowledge.

Unfortunately, monitoring programmes are not recognised and evaluated in the scientific framework, although they are an important part of environmental science and help in the development of legislation in this area. Long-term studies like these are an important part of environmental science because ecosystems change slowly. They provide a context and framework for short-term monitoring and are necessary to determine whether certain events are unusual/extreme or an integral part of natural cycles. Such studies form the basis for science-based environmental protection policy and are necessary for scientists as they are part of environmental research programmes. Finally, citizens also need such monitoring programmes to get an idea of the country's natural resources and the state of the environment., The establishment of monitoring programmes is therefore not a second-class science, but an essential part of environmental science, and therefore attitudes towards this research should change in the future (Lovett *et al*., 2007).

According to the IUCN Red List of Threatened Species (IUCN, 2022), the threat status of 10,035 of the total of about 18,000 freshwater fish species has been assessed. This means that the remaining 44% of species are poorly known, both in terms of biology and distribution, population numbers, population trends, threats and thus conservation. All these facts indicate that not only the inventory of all freshwater fish species, but also the study of their characteristics requires much more effort.

Furthermore, there are no climate-related distribution models for most species, which are very important for predicting the responses of freshwater fish species to future climate change. These models should inform whether protected areas are able to adequately mitigate the impacts of these changes on the distribution of freshwater fish species (Brownlie *et al*., 2017). This will be a major challenge as the boundaries of most current protected areas are not defined according to the needs of freshwater organisms; these needs

distribuciju slatkovodnih vrsta riba (Brownlie *et al*., 2017). Ovo će predstavljati veliki izazov, jer granice većine sadašnjih zaštićenih područja nisu određene prema potrebama slatkovodnih organizama, zbog čega bi te potrebe trebalo da se uzmu u obzir u određivanju budućih zaštićenih područja.

Proučavanje publikovanih ihtioloških naučnih radova na svetskom nivou, koji su objavljeni u periodu od 2000. do 2009. godine, pokazalo je da je najčešće proučavana porodica Salmonidae, iako se čini da interesovanje za ovu grupu riba opada (Jarić *et al*., 2012). Genetička istraživanja predstavljaju oblast koja se najbrže razvija. Razvoj ribarstvenih modela najčešće je korišćeni metod u ihtiologiji, ali su takve publikacije vrlo malo citirane. Potpuno suprotan trend zabeležen je kod eksperimetalnih studija, kojih je bilo malo, ali koje su imale izuzetnu citiranost. Istraživanja iz SAD bila su najbrojnija, ali vremenom su ih istraživanja iz EU nadmašila u ukupnom zbiru. Uočena je razlika između istraživanja koja su sprovedena u razvijenim zemljama i u zemljama u razvoju. Nalazi ove studije ipak ukazuju na pozitivnu tendenciju u istraživanjima. Zabeležena je sve veća stopa publikacija zasnovanih na međunarodnoj saradnji, a takve publikacije takođe imaju veći broj citata od onih koje sprovodi samo jedna zemlja.

Da bi se dobili relevantni, pouzdani i tačni podaci o populacionim karakteristikama i trendovima određene vrste riba, njenoj ekologiji i distribuciji, potrebno je uložiti izuzetno mnogo vremena (kako na terenu, tako i u laboratoriji) i finansijskih sredstava. Takođe, neophodno je da se time bavi čitav tim ljudi. Ovi napori dodatno se povećavaju kada o proučavanoj vrsti nema dovoljno literaturnih podataka. Zbog globalne hiperprodukije naučnih radova, zahteva da se publikuje što veći broj rezultata istraživanja u vrlo ograničenom vremenskom periodu, broja citata, pisanja projekata kako bi se obezbedila sredstva za istraživanja, naučnici se sve manje bave dugotrajnim i skupim terenskim i laboratorijskim ekološkim istraživanjima. Takođe, istraživanja koje se sprovode u okvirima jedne zemlje nisu visoko vrednovana na međunarodnom nivou i tretiraju se kao podaci od lokalnog značaja. Bolja naučna politika omogućila bi naučnicima koji se bave analizama distribucije, populacione dinamike, ekoloških karakteristika, faktora ugrožavanja i mera zaštite određenih vrsta riba da se upuste u dugotrajnija istraživanja, koja jedino mogu da daju validne i verodostojne podatke.

should therefore be taken into account when defining future protected areas.

A review of ichthyological scientific papers published worldwide from 2000 to 2009 found that the Salmonidae family has been the most researched, although interest in this group of fishes seems to be waning (Jarić *et al*., 2012). Genetic research is the fastest growing area. The development of fishery models is the most commonly used method in ichthyology, but such publications are cited very little. A completely opposite trend was observed in the experimental studies, which, although not numerous, are particularly often cited. Research from the USA was cited most frequently, but over time it was overtaken by research from the EU. A difference was found between research in developed and developing countries. However, the results of this study indicate a positive trend in research. It was found that the number of publications based on international collaboration is increasing and that these publications are also more frequently cited than those conducted by a single country.

Obtaining relevant, reliable and accurate data on the population characteristics, population trends, ecology and distribution of a particular fish species, requires an extremely large investment of time (both in the field and in the laboratory) and financial resources. It also requires an entire team of people to be involved. These efforts are compounded when there is not enough literature data on the species under study. Due to the hyper-production of scientific papers worldwide, the requirement to publish as many research results as possible in a very limited time period, the number of citations and the creation of projects to secure research funding, fewer and fewer scientists are conducting long-term and expensive ecological field and laboratory research. In addition, research conducted within a country is not highly valued at the international level and is treated as data of local importance. A better science policy would allow scientists working on the analysis of distribution, population dynamics, ecological characteristics, threats and conservation measures for specific fish species to conduct longer-term research that can only provide valid and reliable data.

6

MERE ZAŠTITE RIBA U SRBIJI

Laslo Galamboš
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FISH PROTECTION MEASURES IN SERBIA

Laslo Galamboš
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6. MERE ZAŠTITE RIBA U SRBIJI

Laslo Galamboš, Nenad Sekulić i Saša Branković

Slatkovodne ribe predstavljaju značajan prirodni resurs (Rowland, 2013) i širom sveta imaju veliki ekonomski, naučni i kulturno-istorijski značaj (The World Fish Center, 2002; Welcomme *et al*., 2010). Veza između čovečanstva i riba nastala je još u doba praistorije, kada je predak modernog čoveka savladao tehnike iskorišćavanja resursa vodenih staništa. U početku, uticaj ribolova na vodene ekosisteme bio je najverovatnije minimalan, pošto je riba hvatana primitivnim alatima, prvenstveno za ishranu. Međutim, industrijalizacija, porast ljudske populacije, veća potražnja za hranom i nastanak trgovinskih mreža uslovili su i razvoj ribolovnih tehnika i tehnologija koje su obezbeđivale sve veće ulove, što je dovelo do efikasnijeg i intenzivnijeg iskorišćavanja resursa, izazivajući time i sve veći pritisak na riblji fond (Forteath, 2011; Pitcher & Lam, 2015). Ljudsko društvo zavisno je od resursa koje obezbeđuju slatkovodni ekosistemi. Korišćenje tih resursa, često prekomerno i nekontrolisano, dovelo je do nemogućnosti njihovog obnavljanja, a time i do trajnog smanjenja. Imajući u vidu dugoročni značaj slatkovodnog ribarstva za društvo, u procesima izrade politika upravljanja i donošenja odluka vezanih za slatkovodne resurse, ne posvećuje se dovoljno pažnje očuvanju održivosti ribarstva, što može dovesti i do nestanka populacija mnogih vrsta riba (Beard *et al*., 2016).

Slatkovodna staništa održavaju ogromnu raznovrsnost vrsta (Mota *et al*., 2014), a imaju značajnu ulogu i u fundamentalnim ekosistemskim uslugama i funkcijama. Slatkovodni ekosistemi su pod jakim negativnim uticajem antropogeno uslovljenih promena koje su uzrokovane izgradnjom brana, nasipa i hidroelektrana, degradacijom i gubitkom staništa usled potreba za unapređenjem plovidbe, poljoprivrednim aktivnostima, kao i odvodnjavanjem i crpljenjem vode, zagađivanjem i unošenjem alohtonih vrsta (Arlinghaus *et al*., 2015).

Ribe su vrlo osetljive na degradaciju staništa (npr. na promene brzine toka vode, pregrađivanje vodotoka, promene u kvalitetu vode, intenzivno iskorišćavanje vode), zbog čega su jedan od boljih pokazatelja (indikatora) stanja vodenih ekosistema. Konstantna i često nekontrolisana i neadekvatna eksploatacija slatkovodnog ribljeg fonda uzrokovala je smanjenje populacija slatkovodnih riba i izmenu njihovih strukturnih i funkcionalnih svojstava, kao i izmene ekosistemskih usluga koje pružaju ribe. Slatkovodne ribe su stoga postale jedna od najugroženijih grupa kičmenjaka na svetu (Freyhof & Brooks, 2011), što ukazuje na potrebu planiranja i sprovođenja mera zaštite vrsta, odnosno upravljanja njihovim populacijama, u cilju smanjenja daljeg pada brojnosti.

Tri glavna razloga permanentnog smanjenja ribljih resursa u evropskim kopnenim vodama i ugrožavanja ihtiofaunističkog biodiverziteta objavljena su još tokom poslednje decenije prošlog veka (Cowx, 1994a), a i danas su više nego aktuelna:

1. nedovoljno poznavanje odnosa između vrsta riba i njihovih staništa,
2. ribarstvo u kopnenim vodama nije adekvatno valorizovano u odnosu na druge oblike eksploatacije vodenih resursa i
3. privrednim i rekreativnim (sportskim) ribolovom tradicionalno se upravlja izolovano od ostalih korisnika vodnih resursa.

6. FISH PROTECTION MEASURES IN SERBIA

Laslo Galamboš, Nenad Sekulić and Saša Branković

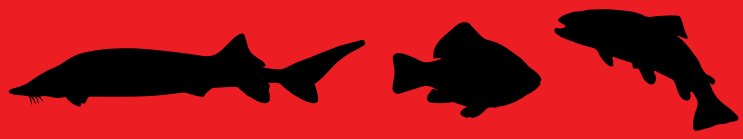
Freshwater fish represent a significant natural resource (Rowland, 2013) and are of great economic, scientific and cultural historical importance worldwide (The World Fish Center, 2002; Welcomme *et al*., 2010). The link between humans and fish emerged in prehistoric times, when the ancestor of modern humans mastered techniques to exploit the resources of aquatic habitats. Initially, the impact of fishing on aquatic ecosystems was likely minimal because fish were caught with primitive tools, primarily for food. However, industrialization, human population growth, greater demand for food and the emergence of trade networks led to the development of fishing techniques and technologies that allowed for increasingly larger catches, resulting in more efficient and intensive use of resources, increasing pressure on fish stocks (Forteath, 2011; Pitcher & Lam, 2015). Human society depends on the resources that freshwater ecosystems provide. The often excessive and uncontrolled use of these resources has resulted in their inability to replenish themselves and thus in their permanent decline. Given the long-term importance of freshwater fisheries to society, insufficient attention is paid to maintaining the sustainability of fisheries when developing management strategies and making decisions related to freshwater resources, which may lead to the disappearance of populations of many fish species (Beard *et al*., 2016).

Freshwater habitats harbour a great diversity of species (Mota *et al*., 2014) and play an important role in basic ecosystem services and functions. Freshwater ecosystems are under the strong negative influence of anthropogenic changes due to the construction of dams, levees and hydropower plants, habitat degradation and loss due to the need to improve navigation, agricultural activities as well as drainage and water pumping, pollution and the introduction of non-native species (Arlinghaus *et al*., 2015).

Fish are very sensitive to habitat degradation (e.g. changes in water flow velocity, impoundment of watercourses, changes in water quality, intensive water use), making them one of the best indicators of aquatic ecosystem health. The constant, often uncontrolled and inappropriate use of freshwater fish stocks has led to declines in freshwater fish populations and changes in their structural and functional characteristics, as well as changes in the ecosystem services provided by fish. Freshwater fishes have therefore become one of the most threatened vertebrate groups in the world (Freyhof & Brooks, 2011), indicating the need to plan and implement species conservation measures, i.e. management of their populations, to prevent further declines.

The three main reasons for the continuing decline of fish stocks in European inland waters and the threat to the biodiversity of fish fauna were published in the last decade of the last century (Cowx, 1994a) and are still more than relevant today:

1. insufficient knowledge of the relationships between fish species and their habitats,
2. inland fisheries are not adequately valued in comparison to other forms of water resource use; and
3. commercial and recreational (sport) fishing has traditionally been conducted in isolation from other users of water resources.



6.1. Zakonodavni okvir kojim se reguliše status zaštite vrsta riba i primena mera zaštite na teritoriji republike Srbije

6.1.1. Nacionalna legislativa

Jedan od načina upravljanja populacijama riba jeste i regulisanje korišćenja ekonomski značajnih vrsta, čime se obezbeđuju očuvanje i opstanak stabilnih populacija. Ukoliko ne bi postojala ograničenja koja regulišu lov ribe, a koja se definišu nacionalnom legislativom, mnoge vrste bi već davno iščezle iz naših voda. Osim očuvanja vrsta koje su značajne i sa aspekta privrednog i rekreativnog ribolova, za potrebe ljudske ishrane ili materijalne dobiti, određenim zakonima štite se i vrste koje spadaju u retke ili ugrožene i koje, kao prirodne vrednosti, imaju veliki značaj za očuvanje biodiverziteta.

Upravljanje ribljim fondom (odnosno svim vrstama riba, mekušaca, rakova i ostalih akvatičnih organizama koje se štite i održivo koriste) u svim vodama u kojima žive ribe na području Republike Srbije, a koje obuhvata zaštitu i korišćenje riba kao prirodnog bogatstva i dobra od opšteg interesa, sa ciljem da se obezbedi ista struktura i stopa korišćenja u dužem vremenskom periodu, regulisano je *Zakonom o zaštiti i održivom korišćenju ribljeg fonda* (Službeni glasnik RS, br. 128/2014 i 95/2018 – dr. zakon) i setom podzakonskih akata, od kojih je najznačajnija *Naredba o merama za očuvanje i zaštitu ribljeg fonda* (Službeni glasnik RS, br. 56/2015 i 94/2018). *Zakonom o zaštiti i održivom korišćenju ribljeg fonda* propisane su mere zaštite riba i mlađi, odnosno njihovih staništa, kao i određivanje područja koja su značajna za biološke potrebe riba (npr. mrest, zimovanje, rast, ishrana i kretanje tj. migracije riba), a koja se nazivaju posebnim staništima. U cilju očuvanja i zaštite ribljeg fonda, *Zakonom* su definisane mere ograničenja, zabrane, kao i mere čije sprovođenje doprinosi unapređenju stanja ribljeg fonda. Upotreba otrovnih, omamljujućih i eksplozivnih sredstava (npr. struja ili eksploziv), kao i upotreba alata (npr. harpun) i metoda (npr. grabuljanje) kojima se uzrokuje ozbiljna šteta na ribama, spadaju u nedozvoljene aktivnosti.

Pravilnikom o načinu, alatima i sredstvima kojima se obavlja privredni ribolov, kao i o načinu, alatima, opremi i sredstvima kojima se obavlja rekreativni ribolov (Službeni glasnik RS, br. 9/2017 i 34/2018) detaljnije je regulisana upotreba pojedinih vrsta ribolovnih alata, kao i vremenske i prostorne primene dozvoljenih alata za ribolov, čime se doprinosi sprečavanju prekomernog i neselektivnog izlova ribe. Prema *Pravilniku* zabranjen je ribolov iz čamca rekreativnim ribolovcima na reci Dunav od 863 rkm do 860 rkm (od HE „Đerdap II" do luke u Prahovu), kao i upotreba svih alata za privredni ribolov na istoj deonici, čime je i slučajni ulov jesetarskih vrsta onemogućen.

Obezbeđivanje nesmetanog razmnožavanja, migracija i očuvanja ribljeg fonda predstavlja preduslov za odobravanje izvođenja radova i izgradnje na vodenim staništima. Propisana je i obaveza očuvanja fizičkih, hemijskih, bioloških i ambijentalnih odlika, očuvanje ustaljenog kvaliteta vode, kao i sprečavanje ugrožavanja zdravstvenog stanja, života i opstanka riba i narušavanja faunističkog sastava ribolovne vode. Zabranjene su izmene hidrološkog režima staništa riba koje mogu uticati negativno na životni ciklus, a

6.1. Legal framework regulating the conservation status of fish species and application of protective measures in the territory of the republic of Serbia

6.1.1. National legislation

One of the ways to manage fish populations is to regulate the exploitation of commercially important species, which ensures the maintenance and survival of stable populations. If there were no restrictions on fishing set by national legislation, many species would have disappeared from our waters long ago. In addition to conserving species that are important for commercial and recreational fishing, human food or material gain, certain laws also protect rare or threatened species that are natural values of great importance for biodiversity conservation.

The management of fish stocks (i.e. all species of fish, molluscs, crustaceans and other aquatic organisms protected and sustainably exploited) in all waters where fish live in the territory of the Republic of Serbia, including the protection and exploitation of fish as a natural resource and good of general interest, with the aim of ensuring the same structure and rate of exploitation over time, is regulated by the *Law on Protection and Sustainable Use of Fish Stocks* (Official Gazette of RS, No. 128/2014 and 95/2018 – other law) and a series of regulations, the most important of which is the *Regulation on Measures for the Conservation and Protection of Fish Stocks* (Official Gazette of RS, No. 56/2015 and 94/2018). The *Law on Protection and Sustainable Use of Fish* Stocks prescribes measures for the protection of fish and fish fry and their habitats, as well as the designation of areas important for the biological needs of fish (e.g. spawning, overwintering, growth, feeding and movement, i.e. fish migration) as special habitats. In order to conserve and protect fish stocks, the *Law* establishes measures of restriction and prohibition, as well as measures whose implementation contributes to the improvement of the state of fish populations. The use of poisons, stupefying agents (e.g. electricity) and explosives, as well as the use of tools (e.g. harpoons) and methods (e.g. dredging with treble hooks) that cause serious harm to fish are prohibited activities.

The *Rulebook on Methods, Tools and Means for Commercial Fishing, and Methods, Tools, Equipment and Means for Recreational Fishing* (Official Gazette of RS, No. 9/2017 and 34/2018) regulates in detail the use of certain types of fishing gear as well as the temporal and spatial application of the permitted fishing gear, which helps to prevent excessive and unselective fishing. According to the *Rulebook*, fishing from boats is prohibited for recreational fishers on the Danube from rkm 863 to rkm 860 (from the hydroelectric power plant "Đerdap II" to the port in Prahovo), as is the use of all fishing gear for commercial fishing in the same section, which prevents accidental catching of sturgeon species.

Ensuring the unimpeded reproduction, migration and conservation of fish populations is a prerequisite for the authorisation of works and construction projects in aquatic habitats. The obligation to maintain the physical, chemical, biological and ecological characteristics, to preserve the established water quality and to prevent the endangering of the health status, life and survival of fish as well as the disturbance of the faunistic composition of fishing waters is prescribed. It is

posebno na mrest riba. Zabranjen je unos alohtonih vrsta riba u ribolovnu vodu, unošenje vrsta riba iz regionalno udaljenih geografskih područja, kao i vrsta koje potiču iz geografski bližih, ali međusobno izolovanih slivova. Za potrebe jačanja prirodnih populacija riba u ribolovnim vodama dozvoljeno je plansko i kontrolisano poribljavanje isključivo autohtonim vrstama riba sa sertifikovanim poreklom. Značajne mere zaštite vrsta predstavljaju i spasavanje riba i translokacija, odnosno selektivni ribolov. Ukoliko dođe do promena fizičkih, hemijskih ili bioloških odlika ribolovne vode, a koje ugrožavaju ili mogu ugrožavati ribe, potrebno je preduzeti mere kako bi se sačuvao riblji fond. U ovim slučajevima moguće je izvršiti izlov ugrožene ribe radi spasavanja, kao i premeštanje, odnosno translokaciju u drugu ribolovnu vodu. Selektivni ribolov u cilju sprečavanja razvoja alohtonih vrsta ili prenamnožavanja pojedinih vrsta riba na ribarskom području moguće je vršiti na osnovu posebne dozvole.

U skladu sa *Zakonom o zaštiti i održivom korišćenju ribljeg fonda*, na svim ribolovnim vodama na teritoriji Republike Srbije ustanovljeno je 17 ribarskih područja (osim na ribolovnim vodama u okviru granica zaštićenih područja) koja su utvrđena *Rešenjem o ustanovljavanju ribarskih područja* (Službeni glasnik RS, br. 90/2015). Ova ribarska područja ustupaju se konkursom na korišćenje za period od 10 godina. Na svakom pojedinačnom zaštićenom području proglašava se posebno ribarsko područje, čiji je korisnik upravljač tog zaštićenog područja. Svi korisnici ribarskih područja u obavezi su da donose programe upravljanja ribarskim područjima, koji, između ostalog, sadrže i mere za zaštitu i održivo korišćenje ribljeg fonda. Ove mere propisane su važećom legislativom u oblasti zaštite i održivog korišćenja ribljeg fonda, kao i zaštite prirode, a utvrđuju se i aktom o uslovima zaštite prirode koji izdaje, u zavisnosti od kategorije zaštićenog područja (I, II ili III), ministarstvo nadležno za poslove zaštite životne sredine, nadležni organ pokrajine ili pak nadležni zavod za zaštitu prirode. Programima upravljanja ribarskim područjima korisnici su u obavezi da odrede i pojedine ribolovne vode ili njihove delove za posebna staništa značajna za biološke potrebe riba kao što su: mrest, zimovanje, rast, ishrana i kretanje (migracija) riba.

Način vršenja rekreativnog i privrednog ribolova i lova ekonomski značajnih vrsta regulisan je *Naredbom o merama za očuvanje i zaštitu ribljeg fonda*, kojom su definisane vrste za koje je trajno zabranjen lov, odnosno, vrste za koje je utvrđen trajni lovostaj (Tabela 10), zatim vrste za koje je zabranjen ulov u određenom periodu tokom godine (Tabela 11) i lov ispod određene veličine (Tabela 12), dnevno dozvoljene količine autohtonih vrsta riba u rekreativnom ribolovu i vrste za koje je dozvoljen neograničen lov u rekreativnom i privrednom ribolovu.

Osim očuvanja najugroženijih vrsta riba koje se sprovodi zabranom njihovog izlova u okviru svakog vida ribolova, osim u naučnoistraživačke svrhe, najvažnije mere usmerene su na očuvanje njihovih staništa u odnosu na prostor koji naseljavaju i samog kvaliteta staništa. S druge strane, utvrđen lovostaj u određenom periodu godine predstavlja zabranu lova vrste u vreme koje je specifično za datu vrstu (najčešće obuhvata period mresta), u cilju obezbeđivanja mogućnosti za reprodukciju i ostavljanje potomstva.

prohibited to change the hydrological regime of the fish habitat, which may have a negative impact on the life cycle and especially on fish spawning. The introduction of non-native fish species into the fishing water, the introduction of fish species from regionally distant areas as well as species from geographically closer but isolated watersheds is prohibited. In order to strengthen the natural fish populations in the fishing waters, planned and controlled stocking is only permitted with native fish species with proof of origin. Important species protection measures are fish rescue and translocation as well as selective fishing. If changes occur in the physical, chemical or biological characteristics of the fishing water that threaten or may threaten the fish, measures must be taken to conserve the fish population. In these cases, it is possible to catch threatened fish to save them or to translocate them to another fishing water. Selective fishing to prevent the development of non-native species or the overpopulation of certain fish species in the fishing area can be carried out on the basis of a special permit.

In accordance with the *Law on Protection and Sustainable Use of Fish Stocks*, 17 fishing areas have been established in all fishing waters in the territory of the Republic of Serbia (except for fishing waters within the boundaries of protected areas), established by the *Decision on the Determination of Fishing Areas* (Official Gazette of RS, No. 90/2015). These fishing areas are allocated for management through a tendering process for a period of 10 years. In each individual protected area, a special fishing area is designated, the user of which is the administrator of the respective protected area. All users of fishing areas are required to adopt fisheries management programmes that include measures for the protection and sustainable use of fish stocks. These measures are prescribed in the current legislation in the field of protection and sustainable use of fish stocks, as well as nature conservation, and are established by the legal act on the conditions of nature conservation, which is issued by the competent ministry of environmental protection, the competent provincial authority or the competent nature conservation institute, depending on the category of the protected area (I, II or III). Under fisheries management programmes, users are required to designate certain fishing waters or parts thereof as special habitats important for the biological needs of fish, such as: spawning, overwintering, growth, feeding and movement (migration).

The manner of recreational and commercial fishing and fishing of commercially important species is regulated by the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, which specifies the species for which fishing is permanently prohibited (Table 10), the species for which fishing is prohibited during a particular season (Table 11), the minimum landing size (Table 12), the daily catch limit for native fish species in recreational fisheries, and the species for which fishing is permitted without limit in recreational and commercial fisheries.

Apart from the conservation of the most threatened fish species, which is carried out by prohibiting their fishing in all fisheries except for scientific research purposes, the main measures aim to preserve their habitats in terms of the space they inhabit and the quality of the habitat itself. On the other hand, the fixed closed season in a certain period of the year represents a prohibition to hunt a particular species at a specific time (mostly during the spawning season) in order to ensure the possibility of reproduction and the leaving of offspring.

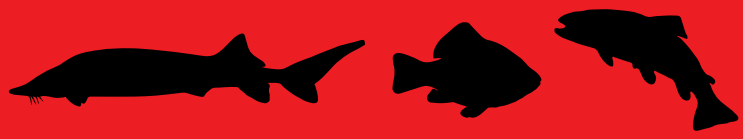


Tabela 10. Pregled vrsta riba za koje je utvrđen trajni lovostaj.

Table 10. Overview of fish species for which a permanent ban on fishing has been imposed.

Narodni naziv vrste / Vernacular name of species	Naučni naziv vrste / Scientific name of species
ruska (navedena kao dunavska) jesetra / Russian (Danube) sturgeon	*Acipenser gueldenstaedtii*
sim / ship sturgeon	*Acipenser nudiventris*
kečiga / sterlet	*Acipenser ruthenus*
pastruga / starry sturgeon	*Acipenser stellatus*
atlantska jesetra / Atlantic sturgeon	*Acipenser sturio*
velika pliska (navedena kao pegunca) / Balkan shemaya	*Alburnus sava* (navedena kao / listed as *Alburnus chalcoides*)
crnomorska haringa / Pontic shad	*Alosa immaculata*
azovska (navedena kao dunavska) haringa / Azov shad	*Alosa tanaica* (navedena kao / listed as *Alosa caspia*)
jegulja (evropska) / European eel	*Anguilla anguilla*
strumička mrena (navedena kao istočna mrenka) / Strymon barbel	*Barbus strumicae* (navedena kao / listed as *Barbus cyclolepis*)
zlatni karaš / crucian carp	*Carassius carassius*
veliki vijun (navedena kao vijunica) / Balkan loach	*Cobitis elongata*
karpatska paklara / Carpathian brook lamprey	*Eudontomyzon danfordi*
ukrajinska paklara / Ukrainian brook lamprey	*Eudontomyzon mariae*
drimska paklara / Drin brook lamprey	*Eudontomyzon stankokaramani*
dunavska paklara / Danubian brook lamprey	*Eudontomyzon vladykovi*
Balonov balavac / Balon's ruffe	*Gymnocephalus baloni*
moruna / beluga	*Huso huso*
belka, belica / sunbleak	*Leucaspius delineatus*
Karamanova bodorka / Dalmatian (Albanian) roach	*Leucos basak* (navedena kao / listed as *Rutilus karamani*)
čikov / weatherfish	*Misgurnus fossilis*
strumička brkica (navedena kao vijun) / Struma stone loach	*Oxynoemacheilus bureschi*
brcak, šaradan (navedena kao drimski šaradan) / Albanian roach	*Pachychilon pictum*
balkanski, zlatni vijun / Balkan golden loach	*Sabanejewia balcanica*
bugarska brkica (navedena kao bugarski vijun) / Bulgarian golden loach	*Sabanejewia bulgarica*
glavatica / marble trout	*Salmo marmoratus*
svetlica / vairone	*Telestes souffia*
linjak / tench	*Tinca tinca*
crnka / European mudminnow	*Umbra krameri*
mali vretenar / streber	*Zingel streber*
veliki vretenar / zingel	*Zingel zingel*

Tabela 11. **Pregled vrsta riba za koje je utvrđen vremenski period zabrane lova.**

Table 11. **Overview of fish species for which a closed season has been imposed.**

Narodni naziv vrste / Vernacular name of species	Naučni naziv vrste / Scientific name of species	Period lovostaja / Closed season
deverika / common bream	*Abramis brama*	od 15. aprila do 31. maja / from April 15 to May 31
mrena / common barbel	*Barbus barbus*	od 15. aprila do 31. maja / from April 15 to May 31
skobalj, podust / common nase	*Chondrostoma nasus*	od 15. aprila do 31. maja / from April 15 to May 31
šaran / common carp	*Cyprinus carpio*	od 1. aprila do 31. maja / from April 1 to May 31
štuka / northern pike	*Esox lucius*	od 1. februara do 31. marta / from February 1 to March 31
mladica / huchen	*Hucho hucho*	od 1. marta do 31. avgusta / from March 1 to August 31
bucov / asp	*Leuciscus aspius* (navedena kao / listed as *Aspius aspius*)	od 15. aprila do 15. juna / from April 15 to June 15
jaz / ide	*Leuciscus idus*	od 15. aprila do 31. maja / from April 15 to May 31
plotica / cactus roach	*Rutilus virgo* (navedena kao / listed as *Rutilus pigus*)	od 15. aprila do 31. maja / from April 15 to May 31
primorska (drimska) pastrmka / Balkan brook trout	*Salmo farioides*	od 1. oktobra do 1. marta / from October 1 to March 1
makedonska pastrmka / Macedonian trout	*Salmo macedonicus*	od 1. oktobra do 1. marta / from October 1 to March 1
potočna pastrmka / brown trout	*Salmo trutta*	od 1. oktobra do 1. marta / from October 1 to March 1
smuđ / pikeperch	*Sander lucioperca*	od 1. marta do 30. aprila / from March 1 to April 30
smuđ kamenjar / Volga pikeperch	*Sander volgensis*	od 1. marta do 30. aprila / from March 1 to April 30
som / wels catfish	*Silurus glanis*	od 1. maja do 15. juna / from May 1 to June 15
klen / chub	*Squalius cephalus*	od 15. aprila do 31. maja / from April 15 to May 31
lipljen / European grayling	*Thymallus thymallus*	od 1. marta do 31. maja / from March 1 to May 31

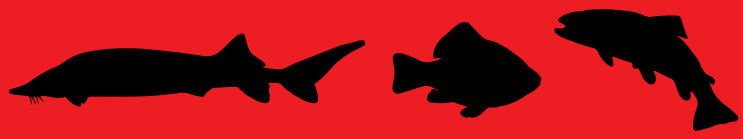
Minimalne veličine jedinki dozvoljene za izlov utvrđuju se u cilju obezbeđivanja izlova polno zrelih, adultnih primeraka koje su već imale priliku da se mreste i ostave potomstvo. Dužine riba određene su tako da je ribolovom moguće obuhvatiti samo polno zrele jedinke riba.

The minimum landing size of fish is set to ensure that only sexually mature adult specimens, which have already had the opportunity to spawn and produce offspring, are caught. The smallest fish measurement of each fish species at which it is legal to keep a fish is determined to secure that.

Tabela 12. **Pregled vrsta riba za koje je utvrđena minimalna lovna mera (SL – standardna dužina tela, meri se od vrha njuške do osnove repnog peraja).**

Table 12. **Overview of fish species for which a minimum landing size has been established (SL – standard body length measured from the tip of the snout to the base of the caudal fin).**

Narodni naziv vrste / Vernacular name of species	Naučni naziv vrste / Scientific name of species	Minimalna lovna mera / Minimum landing size (SL/cm)
deverika / common bream	*Abramis brama*	20
potočna mrena / Danube barbel	*Barbus balcanicus* (navedena kao / listed as *B. peloponnesius*)	15
mrena / common barbel	*Barbus barbus*	25
skobalj, podust / common nase	*Chondrostoma nasus*	20
šaran / common carp	*Cyprinus carpio*	30
štuka / northern pike	*Esox lucius*	40



Narodni naziv vrste / Vernacular name of species	Naučni naziv vrste / Scientific name of species	Minimalna lovna mera / Minimum landing size (SL/cm)
bugarska krkuša / Aegean gudgeon	*Gobio bulgaricus* (navedena kao / listed as *Gobio* spp.)	10
krkuša, govedarica / Danube gudgeon	*Gobio obtusirostris* (navedena kao / listed as *Gobio* spp.)	10
skadarska krkuša / Skadar gudgeon	*Gobio skadarensis* (navedena kao / listed as *Gobio* spp.)	10
mladica / huchen	*Hucho hucho*	100
bucov / asp	*Leuciscus aspius* (navedena kao / listed as *Aspius aspius*)	30
jaz / ide	*Leuciscus idus*	20
manić / burbot	*Lota lota*	25
grgeč, bandar / perch	*Perca fluviatilis*	10
Keslerova krkuša / Kessler's gudgeon	*Romanogobio kesslerii* (navedena kao / listed as *Gobio* spp.)	10
tankorepa krkuša / Danubian longbarbel gudgeon	*Romanogobio uranoscopus* (navedena kao / listed as *Gobio* spp.)	10
govedarka / Danube white-finned gudgeon	*Romanogobio vladykovi* (navedena kao / listed as *Gobio* spp.)	10
plotica / cactus roach	*Rutilus virgo* (navedena kao / listed as *Rutilus pigus*)	20
primorska (drimska) pastrmka / Balkan brook trout	*Salmo farioides*	25
makedonska pastrmka / Macedonian trout	*Salmo macedonicus*	25
potočna pastrmka / brown trout	*Salmo trutta*	25
smuđ / pikeperch	*Sander lucioperca*	40
smuđ kamenjar / Volga pikeperch	*Sander volgensis*	25
som / wels catfish	*Silurus glanis*	60
klen / chub	*Squalius cephalus*	20
lipljen / European grayling	*Thymallus thymallus*	30
nosara, šljivar / vimba bream	*Vimba vimba*	15

U cilju zaštite ribolovnih vrsta, određena su i ograničenja za količine riba koje je moguće uloviti. Rekreativni ribolovac dnevno može uloviti najviše 5 kg autohtonih vrsta riba. Dnevni ulov rekreativnog ribolovca ograničen je na jedan komad mladice, zbirno tri komada manića, potočne pastrmke, makedonske pastrmke, primorske (drimske) pastrmke, lipljena, štuke, šarana, soma, smuđa, smuđa kamenjara i bucova, odnosno deset komada zbirno za ploticu, jaza, skobalja, mrene, klena i deverike. Ukoliko jedan ulovljen primerak jedne od autohtonih vrsta prelazi masu od 5 kg, ograničenje dnevnog ulova u komadima ne važi, već se u takvim slučajevima smatra da je ispunjen dnevni ulov rekreativnog ribolovca.

Pomenutom *Naredbom* takođe je definisano da je prilikom obavljanja rekreativnog i privrednog ribolova dozvoljen neograničen izlov svih alohtonih vrsta riba: sivog tolstolobika *Hypophthalmichthys nobilis* (navedenog kao *Arystichthys nobilis*), belog tolstolobika *H. molitrix*, belog amura *Ctenopharyngodon idella*, obe vrste

To protect fishing species, catch limits have been set. A recreational angler may not catch more than 5 kg of native fish per day. The daily catch of a recreational angler is limited to one individual of huchen, a total of three individuals of burbot, brown trout, Macedonian trout, Balkan brook trout, grayling, pike, carp, wels catfish, pikeperch, Volga pikeperch and asp, and a total of ten individuals of cactus roach, ide, nase, barbel, chub and common bream. If a caught individual of one of the native species exceeds the weight of 5 kg, the daily catch limit in individual specimens does not apply and in such cases the daily catch limit for a recreational angler is deemed to be fulfilled.

The aforementioned *Regulation* also states that recreational and commercial fisheries may catch all non-native fish species without restriction: bighead carp *Hypophthalmichthys nobilis* (listed as *Arystichthys nobilis*), silver carp *H. molitrix*, grass carp *Ctenopharyngodon idella*, both species of American bullheads *Ameiurus melas* and *A. nebulosus*, pumpkinseed *Lepomis gibbosus*, topmouth gudgeon *Pseudorasbora parva*,

američkog somića *Ameiurus melas* i *A. nebulosus*, sunčice *Lepomis gibbosus*, amurskog čebačoka *Pseudorasbora parva*, amurskog spavača *Perccottus glenii*, velikoustog basa *Micropterus salmoides*, babuške *Carassius gibelio*, kalifornijske (dužičaste) pastrmke *Oncorhynchus mykiss*, ohridske pastrmke *Salmo letnica* (ne živi u Srbiji), jezerske zlatovčice *Salvelinus umbla* (navedene kao *S. alpinus*), potočne zlatovčice *Salvelinus fontinalis*, svih vrsta glavoča iz rodova *Babka*, *Knipowitschia*, *Neogobius* i *Ponticola* (navedenih kao *Neogobius* spp.), i šilca kratkokljunog *Syngnathus abaster*.

Ribe se najčešće posmatraju kao resurs, odnosno dobro od koga čovečanstvo ima korist, ali predstavljaju i prirodnu vrednost, deo sveukupne biološke raznovrsnosti i važnu komponentu akvatičnih životnih zajednica i ekosistema. Integralnu zaštitu i očuvanje autohtonog, izvornog diverziteta i genofonda riba, kao i zaštitu vode kao resursa i staništa samih vrsta i njihovih zajednica, reguliše *Zakon o zaštiti prirode* (Službeni glasnik RS, br. 36/2009, 88/2010, 91/2010 – ispr., 14/2016, 95/2018 – dr. zakon, i 71/2021). Status pojedinih vrsta riba kao prirodnih vrednosti bliže je definisan *Pravilnikom o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* (Službeni glasnik RS, br. 5/2010, 47/2011, 32/2016 i 98/2016). Zaštita strogo zaštićenih divljih vrsta sprovodi se zabranom njihovog korišćenja, pa je tako za određene vrste riba definisan trajni lovostaj, u skladu sa propisima iz oblasti zaštite i korišćenja ribljeg fonda, zabranom uništavanja i preduzimanja svih aktivnosti kojima se mogu ugroziti ove vrste i njihova staništa, kao i preduzimanjem mera i aktivnosti na upravljanju njihovim populacijama. S druge strane, zaštita određenih vrsta riba, za koje je utvrđen status „zaštićenih divljih vrsta", sprovodi se ograničenjem korišćenja pod uslovima i na način koji su usklađeni sa propisima iz oblasti ribarstva, zatim zabranom uništavanja i preduzimanja drugih aktivnosti kojima se nanosi šteta vrstama i njihovim staništima, kao i preduzimanjem mera i aktivnosti na upravljanju populacijama.

U zakonima su definisane kaznene odredbe za prestupe i prekršaje koji su posledica kršenja definisanih mera očuvanja vrsta riba i njihovih staništa. *Pravilnikom o načinu određivanja i visini naknade štete nanete ribljem fondu* (Službeni glasnik RS, br. 3/2016) utvrđena je visina naknade po pojedinačnim primercima u slučaju nanete štete. Međutim, očuvanje vrsta je moguće jedino ukoliko se naselja riba i njihova staništa zajedno štite od negativnih uticaja.

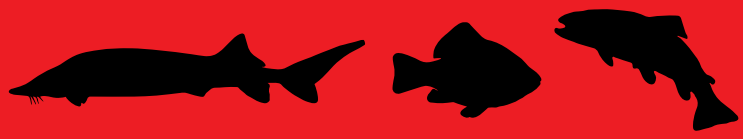
Korišćenje prostora, prirodnih resursa i područja zaštićenih prirodnih dobara regulisano je, između ostalog, određivanjem uslova pod kojima se to korišćenje može odvijati. Zavodi za zaštitu prirode na osnovu odredbi *Zakona o izmenama i dopunama Zakona o zaštiti prirode* (Službeni glasnik RS, br. 71/2021), izdaju akt o uslovima zaštite prirode u vidu rešenja, a na osnovu podnetog zahteva, i to samo za zaštićena područja III kategorije i izvan zaštićenih područja. Za nacionalne parkove i zaštićena područja I i II kategorije koje proglašava Vlada Republike Srbije, akt o uslovima zaštite prirode izdaje ministarstvo nadležno za poslove zaštite životne sredine, a za zaštićena područja koja proglašava nadležni organ autonomne pokrajine, izdaje nadležni organ autonomne pokrajine. U postupku izdavanja akta o uslovima zaštite prirode za zaštićena područja I i II kategorije pribavlja se stručna osnova koju izdaje nadležni zavod za zaštitu prirode.

Amur sleeper *Perccottus glenii*, largemouth bass *Micropterus salmoides*, Prussian carp *Carassius gibelio*, rainbow trout *Oncorhynchus mykiss*, Ohrid trout *Salmo letnica* (does not live in Serbia), lake char *Salvelinus umbla* (listed as *S. alpinus*), brook trout *Salvelinus fontinalis*, all gobiid species of the genera *Babka*, *Knipovichia*, *Neogobius* and *Ponticola* (listed as *Neogobius* spp.) and black-striped pipefish *Syngnathus abaster*.

Fish are mostly considered a resource, i.e. a commodity from which humanity benefits, but they are also a natural asset, part of the overall biodiversity and an important component of aquatic communities and ecosystems. The integrative protection and conservation of the native, original diversity and gene pool of fish, as well as the protection of water as a resource and habitat for species and their communities, is regulated by the *Law on Nature Protection* (Official Gazette of RS, No. 36/2009, 88/2010, 91/2010 – Corrigendum, 14/2016, 95/2018 – other law, and 71/2021). The status of certain fish species as natural assets is further defined by the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* (Official Gazette of RS, No. 5/2010, 47/2011, 32/2016 and 98/2016). The protection of strictly protected wild species is carried out by prohibiting their exploitation and, for certain fish species, imposing a permanent ban on fishing in accordance with the rules on the protection and exploitation of fish stocks, prohibiting destruction and all activities that may threaten these species and their habitats, as well as measures and activities to manage their populations. On the other hand, the protection of certain fish species, for which the status of "protected wild species" has been established, is carried out by restricting their exploitation under conditions and in a manner harmonised with the rules in the field of fisheries, as well as by prohibiting destruction and all other activities that may threaten these species and their habitats, as well as measures and activities to manage their populations.

The legislation provides for criminal penalties for offences and misdemeanours arising from breaches of the established conservation measures for fish species and their habitats. The *Regulation on the Method of Determining and on the Compensation Amount for the Damage to the Fish Stock* (Official Gazette of RS, No. 3/2016) establishes the amount of compensation for each individual specimen in case of damage. However, species conservation is only possible if fish assemblages and their habitats are protected from negative impacts.

The use of land, natural resources and protected assets is regulated, inter alia, by establishing the conditions under which such use may take place. On the basis of the provisions of the *Law Amending the Law on Nature Protection* (Official Gazette of RS, No. 71/2021), the nature conservation institutes issue an act on the nature conservation conditions only for protected areas in the category III and outside protected areas, in the form of a decision based on the application submitted. For national parks and protected areas of categories I and II, declared by the Government of the Republic of Serbia, the act on conditions of nature protection shall be enacted by the competent ministry of environmental protection, and for protected areas declared by the competent authority of the autonomous province, it shall be enacted by the competent authority of the autonomous province. When enacting a law on nature conservation conditions for protected areas in categories I and II, an expert basis shall be obtained from the competent institute for nature conservation. The conditions



Uslove je potrebno pribaviti prilikom izrade osnova programa upravljanja i korišćenja prirodnih resursa, kao i prostorno-planske i projektno-tehničke dokumentacije, odnosno kada nosilac projekta (pravno ili fizičko lice) koristi prirodne resurse, obavlja građevinske i druge radove, aktivnosti i intervencije koje mogu imati negativan uticaj na prirodu, posebno na stanje biodiverziteta zaštićenih područja, staništa zaštićenih i strogo zaštićenih vrsta, kao i na druge elemente ekološke mreže Republike Srbije.

Akt (rešenje) o uslovima zaštite prirode sadrži i:

- stručnu osnovu;
- procenu da li se planirani radovi i aktivnosti mogu realizovati sa stanovišta ciljeva zaštite prirode i donetih propisa i dokumenata;
- pravni i stručni osnov za utvrđene uslove i mere, odnosno zabrane i ograničenja.

Stručna osnova, između ostalog, sadrži i:

- podatke o prirodnim vrednostima, između ostalog i o životinjskom svetu (vrstama riba);
- podatke o ustanovljenim režimima i merama zaštite i korišćenja prirodnih vrednosti i dobara i ekološki značajnih područja;
- uslove, odnosno zabrane i ograničenja pod kojima se planirani radovi i aktivnosti mogu realizovati, kao i potrebu ocene prihvatljivosti;
- biološke, tehničke i tehnološke mere zaštite prirode koje treba primeniti;
- kompenzacijske mere i druge mere nadoknade, uključujući i novčanu.

Izdavanje rešenja o uslovima zaštite prirode predstavlja veoma značajan mehanizam za propisivanje i sprovođenje mera zaštite vrsta riba i njihovih staništa, pošto je ovaj akt pravno obavezujući. Ovo znači da je neophodno obezbediti ispunjenost uslova, odnosno ugraditi ih u sve planove, osnove, programe, projekte, radove i aktivnosti za koje su uslovi zaštite prirode i pribavljeni.

Mere zaštite vrsta riba i njihovih staništa (uz zabranu ili ograničenja realizacije određenih projekata, radova i aktivnosti), kao i posebne mere, usmerene su na zaštićena područja, odnosno područja u obuhvatu ekološke mreže Republike Srbije (ekološki značajna područja i ekološki koridori od međunarodnog značaja, kao i ekološki koridori od lokalnog značaja), kao i na identifikovana staništa određenih vrsta riba i tipove staništa.

Mere i uslovi kojih se treba pridržavati jesu:

- zabrana radova i aktivnosti kao što su eksploatacija prirodnih resursa i regulacija vodotoka na određenim područjima, ukoliko su ugrožene vrste riba ili drugi akvatični organizmi koji imaju određeni status zaštite na nacionalnom i međunarodnom nivou;
- ograničenje radova u određenom periodu godine kako bi se obezbedio povoljan status zaštite neke vrste riba, odnosno omogućio nesmetan reproduktivni ciklus jedne ili više vrsta;
- zabrana ili ograničenje radova u priobalnoj zoni usled prisustva jedne ili više retkih i ugroženih vrsta u toj zoni, u cilju očuvanja staništa za te vrste;
- vremenski periodi zabrana ili ograničenja ne mogu se generalizovati i zavise od područja i prisutnih vrsta na njemu.

must be obtained when preparing the basis of the natural resources management and use programme, as well as spatial planning and technical project documentation, i.e. when the project owner (legal or natural person) uses natural resources, carries out construction and other works, activities and interventions that may have a negative impact on nature, especially on the state of biodiversity of protected areas, habitats of protected and strictly protected species, as well as other elements of the ecological network of the Republic of Serbia.

The law (decision) on nature conservation conditions also contains:

- technical basis;
- assessment of whether the planned works and activities can be carried out in the light of the nature conservation objectives and the adopted regulations and documents;
- legal and technical basis for the established conditions and measures, i.e. prohibitions and restrictions.

The technical basis includes, among other things:

- data on natural values, including wildlife (fish species);
- data on existing regulations and measures for the protection and use of natural values and assets and ecologically significant areas;
- conditions, i.e. prohibitions and restrictions under which the proposed works and activities may be carried out and the need for an impact assessment;
- biological, technical and technological conservation measures to be applied;
- compensatory measures and other compensatory measures, including financial measures.

The adoption of a decision on conservation conditions is a very important instrument for the establishment and implementation of measures to protect fish species and their habitats, as this act is legally binding. This means that it is necessary to ensure compliance with the conditions, i.e. to include them in all plans, bases, programmes, projects, works and activities for which the nature conservation conditions have been obtained.

Measures for the protection of fish species and their habitats (with prohibitions or restrictions on the implementation of certain projects, works and activities), along with special measures, are directed at protected areas, i.e. areas within the ecological network of the Republic of Serbia (ecologically significant areas and ecological corridors of international importance, as well as ecological corridors of local importance), as well as designated habitats of certain fish species and habitat types.

The measures and conditions to be followed are:

- prohibition of works and activities such as the exploitation of natural resources and the regulation of watercourses in certain areas when fish species or other aquatic organisms that have a certain protection status at national and international level are at risk;
- restricting work during a specific period of the year in order to ensure a favourable conservation status of a particular fish species, i.e. to allow the unimpeded reproductive cycle of one or more species;
- prohibition or restriction of work in the coastal zone because of the presence of one or more rare and endangered species in that zone, in order to preserve the habitat for those species;
- duration of the prohibitions or restrictions cannot be generalised and depends on the particular area and the species found there.

U zaštićenim područjima ove mere propisane su *Zakonom o zaštiti prirode* i *Uredbom o režimima zaštite* (Službeni glasnik RS, br. 31/2012), aktima o zaštiti zaštićenih područja i pravilnicima koji definišu unutrašnji red i čuvarsku službu na zaštićenom području. Za područja u postupku zaštite, koja se nalaze na sajtu Ministarstva zaštite životne sredine, a za koja su objavljena Obaveštenja o pokretanju zaštite i koja se smatraju zaštićenim, mere su propisane u studijama zaštite koje predstavljaju naučne i/ili stručne osnove kojima se utvrđuju vrednosti područja koja se stavljaju pod zaštitu.

U skladu sa *Pravilnikom o kriterijumima za izdvajanje tipova staništa, o tipovima staništa, osetljivim, ugroženim, retkim i za zaštitu prioritetnim tipovima staništa i o merama zaštite za njihovo očuvanje* (Službeni glasnik RS, br. 35/2010), određeni tipovi staništa u okviru kopnenih površinskih voda značajni su i za očuvanje vrsta riba i drugih akvatičnih organizama. Značaj ovih tipova staništa prepoznat je i na međunarodnom nivou (Natura 2000 i Emerald staništa), a na nacionalnom, zaštita je neophodna zbog njihove retkosti, osetljivosti i ugroženosti.

Mere zaštite za očuvanje za zaštitu prioritetnih tipova vodenih i vlažnih staništa (kopnene površinske vode, močvarna, tresavska, ritska i slatinska staništa) prema ovom *Pravilniku* uključuju sledeće:

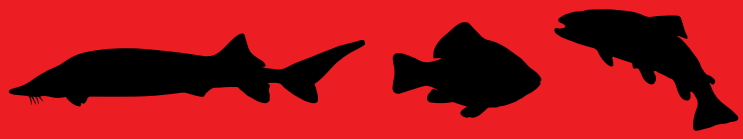
- očuvati vodena i vlažna staništa u što prirodnijem stanju, a prema potrebi izvršiti njihovu revitalizaciju;
- očuvati biološke vrste značajne za tipove staništa; ne unositi strane (alohtone) vrste i genetski modifikovane organizme;
- očuvati i poboljšati povezanost vodotoka;
- osigurati neophodnu količinu vode u vodenim, močvarnim i tresavskim staništima koja je nužna za opstanak staništa; održavati povoljni režim voda za očuvanje vodenih i vlažnih staništa;
- očuvati povoljna fizičko-hemijska i biološka svojstva vode za dati tip staništa ili ih poboljšati, ukoliko su nepovoljna za opstanak staništa;
- očuvati povoljan sastav i koncentracije mineralnih i organskih nutrijenata u vodi i tlu vodenih i vlažnih staništa;
- sprečavati procese daljeg prevođenja prirodnih i polupriродnih vodenih i vlažnih staništa za druge namene;
- obezbediti raznolikost staništa na vodotocima očuvanjem neutvrđenih obala, sprudova, brzaka, slapova i dr., i povoljnu dinamiku voda (meandriranje, prenošenje i odlaganje nanosa, povremeno prirodno plavljenje rukavaca i dr.);
- prilikom antropogenih aktivnosti eksploatacije šljunka i peska, regulacije vodotoka, izgradnji nasipa, kanala, ribnjaka i sl., voditi računa da se, koliko god je moguće očuva postojanje niskih, blago iskošenih priobalnih površina; vađenje šljunka obavljati na povišenim terasama ili na neaktivnom poplavnom području, a izbegavati vađenje šljunka u aktivnim rečnim koritima i plavnim područjima;
- u zaštiti od štetnog delovanja voda prednost dati korišćenju prirodnih retenzija i vodotoka kao prostora za zadržavanje poplavnih voda, odnosno za njihovo oticanje;
- ne iskorištavati sedimente iz rečnih sprudova; zabraniti otvaranje novih eksploatacija treseta na preostalim tresavskim površinama.

In protected areas, these measures are prescribed by the *Law on Nature Protection* and the *Decree on Protection Regimes* (Official Gazette of RS, No. 31/2012), acts on the protection of protected areas and regulations on internal order and guard service in the protected area. For areas under protection procedure, listed on the website of the Ministry of Environmental Protection and for which notices on the initiation of protection procedure have been published and which are considered to be protected, measures are prescribed in protection studies that form the scientific and/or technical basis for determining the values of the protected area.

According to the *Regulation on Criteria for Selection of Habitat Types, on Habitat Types, Sensitive, Endangered, Rare and on Protection of Priority Habitat Types and on Protection Measures for their Preservation* (Official Gazette of RS, No. 35/2010), certain habitat types within inland surface waters are also important for the conservation of fish species and other aquatic organisms. The importance of these habitat types is also recognised at international level (Natura 2000 and Emerald Habitats) and their rarity, sensitivity and vulnerability require protection at national level.

Conservation measures for the protection of priority aquatic and wetland habitat types (inland surface waters, swamps, bogs, marshes and salt marshes) under this *Regulation* shall include the following:

- maintaining aquatic and wetland habitats in as natural a state as possible and, where necessary, restoring them to their natural state;
- conservation of biological species important for the habitat types; no introduction of alien (non-native) species and genetically modified organisms;
- maintaining and improving the connectivity of watercourses;
- ensuring the quantity of water necessary for the survival of aquatic, marsh and bog habitats; maintaining a favourable water regime for the conservation of aquatic and wetland habitats;
- maintain the physico-chemical and biological properties of water that are favourable for a particular habitat type or improve them if they are unfavourable for the survival of the habitat;
- maintain the favourable composition and concentration of mineral and organic nutrients in the water and soil of aquatic and wetland habitats;
- prevent the further conversion of natural and semi-natural aquatic and wetland habitats for other purposes;
- ensure habitat diversity in watercourses by maintaining natural banks, backshores, rapids, waterfalls, etc. and favourable water dynamics (meanders, sediment transport and deposition, occasional natural flooding of backwater areas, etc.);
- anthropogenic activities of gravel and sand extraction, regulation of watercourses, construction of levees, canals, fish ponds, etc. shall be carried out in such a way as to preserve, as far as possible, low, gently sloping coastal areas; gravel extraction shall be carried out on high terraces or disused floodplains and gravel extraction shall be avoided in active riverbeds and floodplains;
- when protecting against harmful effects of water, natural retention basins and watercourses shell preferably be used as retention areas for floods, i.e. for runoff;
- no exploitation of backshore sediments; prohibition of the development of new peat extraction areas in the remaining peat bogs.



Za ekološki značajna područja i ekološke koridore od međunarodnog značaja ekološke mreže Republike Srbije, propisane mere definisane su *Uredbom o ekološkoj mreži* (Službeni glasnik RS, br. 102/2010), a usmerene su na očuvanje biološke i predeone raznovrsnosti, održivo korišćenje i obnavljanje prirodnih resursa i dobara i unapređenje zaštićenih područja, tipova staništa i staništa divljih vrsta, sa ciljem očuvanja povoljnog stanja ekološki značajnih područja i unapređivanja narušenog stanja delova ekološke mreže.

Mere zaštite ekološke mreže, koje se odnose i na zaštitu vrsta riba, između ostalog obuhvataju:

- zabranu uništavanja i narušavanja staništa, kao i uništavanje i uznemiravanje divljih vrsta;
- zabranu promene namene površina pod prirodnom i poluprirodnom vegetacijom;
- zabranu promene morfoloških i hidroloških osobina područja od kojih zavisi funkcionalnost koridora;
- stimulaciju tradicionalnih vidova korišćenja prostora koji doprinose očuvanju i unapređivanju biodiverziteta;
- preduzimanje mera kojima se obezbeđuju sprečavanje, odnosno smanjenje, kontrola i sanacija svih oblika zagađivanja.

In situ mere koje podrazumevaju primenu aktivnih mera zaštite (kao što su zaštita, očuvanje i oporavak populacija na njihovim prirodnim staništima, očuvanje prirodnih ekosistema) nemaju uvek dovoljno brze efekte potrebne za očuvanje pojedinih ugroženih vrsta. U takvim slučajevima, potrebno je primeniti *ex situ* mere, odnosno očuvanje genetičkih resursa van prirodnih staništa date vrste. Ove mere najčešće podrazumevaju formiranje banke gena, sakupljanje i gajenje matičnih primeraka riba i mlađi, veštačko razmnožavanje, kao i izradu planova i programa za vraćanje mlađi u zaštićena ili obnovljena staništa. Za pojedine vrste riba, kao što su jesetarske vrste, *ex situ* zaštita nema alternativu. Brza implementacija *ex situ* mera posebno je bitna za ekonomski značajne vrste koje se redovno eksploatišu, kao i vrste koje su usled tradicionalnog korišćenja postale ugrožene i stekle status zaštićenih vrsta, a koje su i dalje predmet nedozvoljenog izlova.

Akvakultura, pored osnovne uloge u obezbeđivanju hrane za sve veći broj ljudi na našoj planeti, ima i veoma važnu ulogu u razmnožavanju ugroženih vrsta riba, kao i gajenju njihove mlađi za poribljavanje ribolovnih voda. Ona predstavlja potencijal za ponovno naseljavanje (repopulaciju) ugroženih vrsta u vode u kojima im je opala brojnost, unošenje u vode iz kojih su nestale (reintrodukcija) ili za dalji uzgoj u *ex situ* uslovima (Marković *et al.*, 2016). Ovakav pristup je u potpunosti u saglasnosti sa odredbama *Zakona o zaštiti prirode* i dozvoljenim radnjama sa strogo zaštićenim divljim vrstama.

U akvakulturi, evidentan je nedostatak uzgoja i proizvodnje mlađi autohtonih i ugroženih vrsta riba u veštačkim uslovima za potrebe poribljavanja, čime bi se moglo popraviti stanje populacija u prirodnim ribolovnim vodama. Na osnovu tržišnih zahteva, uzgajanje ovih vrsta pokazalo se ekonomski neopravdanim i dugotrajnim procesom, a sam veštački mrest u ribnjacima neisplativim i neodrživim. Uzrok tome jeste nepostojanje obavezujućih strateški definisanih programa i planova (npr. akcioni planovi za vrste) i njihovo kontinuirano sprovođenje, koje bi imalo za cilj smanjenje ribolovnog pritiska na prirodne populacije i očuvanje i unapređenje stanja ovih vrsta u našim rekama (Galamboš, 2018).

For ecologically significant areas and ecological corridors of international importance of the ecological network of the Republic of Serbia, the prescribed measures are set out in the *Regulation on the Ecological Network* (Official Gazette of RS, No. 102/2010) and aim at preserving biological and landscape diversity, sustainable use and restoration of natural resources and assets and improvement of protected areas, habitat types and habitats of wild species, with the aim of maintaining the favourable condition of ecologically significant areas and improving the degraded condition of parts of the ecological network.

Measures to protect the ecological network, which also relate to the protection of fish species, include:

- prohibition of habitat destruction and disturbance, and destruction and disturbance of wild species;
- prohibition of conversion of areas with natural and semi-natural vegetation;
- prohibition of alteration of the morphological and hydrological features of the area, on which the functionality of the corridor depends;
- promoting traditional forms of land use that contribute to the conservation and enhancement of biodiversity;
- taking preventive measures, i.e. reduction, control and remediation of all forms of pollution.

In situ measures that involve the application of active conservation measures (such as protection, maintenance and restoration of populations in their natural habitats, conservation of natural ecosystems) do not always have the rapid impact required for the conservation of certain threatened species. In such cases, *ex situ* measures must be taken, i.e. the conservation of genetic resources outside the natural habitats of the species concerned. These measures usually include the establishment of a gene bank, the collection and rearing of fish and juveniles, artificial propagation, and the development of plans and programmes for the return of juveniles to protected or restored habitats. For certain fish species, such as sturgeon, *ex situ* protection is without alternative. Rapid implementation of *ex situ* measures is particularly important for commercially important species that are regularly exploited and for species that are threatened due to traditional use and have attained protected species status but are still illegally fished.

Aquaculture plays a fundamental role not only in providing food for a growing number of people on our planet, but also in propagating threatened fish species and rearing their juveniles for stocking fishing waters. It offers the possibility of repopulation of threatened species into waters where their populations have declined, their reintroduction into waters from which they have disappeared or for further rearing under *ex situ* conditions (Marković *et al.*, 2016). This approach is fully in line with the provisions of the *Law on Nature Protection* and permissible actions for strictly protected wild species.

There is an apparent lack of rearing and production of juveniles of native and threatened fish species in aquaculture under artificial conditions for stocking purposes that could improve the status of populations in natural fishing waters. Due to market demand, the rearing of these species proved to be economically unviable and lengthy, and artificial spawning in fish ponds was unprofitable and unsustainable. This is due to the lack of binding, strategically defined programmes and plans (e.g. species action plans) and their continuous implementation, which would aim to reduce fishing pressure on natural populations and maintain and improve the status of these species in our rivers (Galamboš, 2018).

6.1.2. Primena međunarodne legislative u Republici Srbiji

Nacionalna legislativa u oblasti zaštite ribljeg fonda, kao i zaštite prirode, zasniva se na opšteprihvaćenim pravilima međunarodnog prava i potvrđenim međunarodnim ugovorima i ratifikovanim konvencijama (Galamboš, 2018). Od svih međunarodnih konvencija koje je Srbija ratifikovala, posebno se izdvajaju Bernska i Bonska konvencija.

Cilj **Bernske konvencije** (*engl.* Bern Convention on the Conservation of European Wildlife and Natural Habitats) (*Zakon o potvrđivanju Konvencije o očuvanju evropske divlje flore i faune i prirodnih staništa*, Službeni glasnik RS – Međunarodni ugovori, br. 102/2007) jeste očuvanje ugroženih i osetljivih divljih životinja i biljaka, uključujući i migratorne vrste, kao i njihovih prirodnih staništa. Države potpisnice obavezale su se da će sprovesti sve potrebne pravne i administrativne postupke u cilju zaštite i očuvanja vrsta koje su navedene u prilozima Konvencije. U Dodatku II nalaze se strogo zaštićene, a u Dodatku III zaštićene, odnosno manje ugrožene, ali ranjive divlje vrste životinja.

Bonska konvencija (*engl.* Convention on the Conservation of Migratory Species of Wild Animals) (*Zakon o potvrđivanju Konvencije o očuvanju migratornih vrsta divljih životinja*, Službeni glasnik RS – Međunarodni ugovori, br. 102/2007) jedan je od temeljnih propisa u oblasti zaštite prirode, nastao sa ciljem očuvanja migratornih vrsta divljih životinja na čitavom području njihovog rasprostranjenja. Konvencija služi kao pravni okvir koji omogućuje zasebne međunarodne instrumente za očuvanje migratornih vrsta ili najčešće grupa vrsta na čitavom području njihovog rasprostranjenja. Ugrožene migratorne vrste kojima preti izumiranje uvrštene su u Dodatak I Konvencije. Države potpisnice Konvencije obavezale su se da za njih osiguraju mere stroge zaštite, očuvanje i/ili restauraciju staništa, te ublažavaju prepreke na migratornim putevima. Konvencija takođe podržava direktnu međudržavnu saradnju prilikom očuvanja pojedinih vrsta. Migratorne vrste čije očuvanje u prirodi zavisi od međudržavne saradnje, uvrštene su u Dodatak II Konvencije.

Konvencija o međunarodnom prometu ugroženih vrsta divlje faune i flore ili CITES (*engl.* Convention on International Trade in Endangered Species of Wild Fauna and Flora), odnosno Vašingtonski sporazum o zaštiti vrsta, jeste međunarodni sporazum koji se u Republici Srbiji primenjuje na osnovu usvojenog *Zakona o potvrđivanju Konvencije o međunarodnom prometu ugroženih vrsta divlje faune i flore* (Službeni list SRJ – Međunarodni ugovori, br. 11/2001). Cilj konvencije jeste sprečavanje gubitka biodiverziteta uz sprovođenje mera kojima bi se smanjio stepen ugrožavanja preživljavanja, a koji je prouzrokovan prekomernom eksploatacijom i trgovinom živog sveta od strane čoveka. Sve vrste navedene na CITES listama predmet su i *Pravilnika o prekograničnom prometu i trgovini zaštićenim vrstama* (Službeni glasnik RS, br. 99/2009 i 6/2014), donetog na osnovu *Zakona o zaštiti prirode* i CITES konvencije, a sa ciljem kontrole međunarodnog prometa ugroženih i zaštićenih divljih vrsta, njihovih delova i derivata. *Pravilnikom* se bliže utvrđuju uslovi pod kojima se može obavljati njihov uvoz, izvoz, unos, iznos ili tranzit, trgovina i uzgoj, izdavanje dozvola i drugih akata, podnošenje dokumentacije uz zahtev za izdavanje dozvola itd.

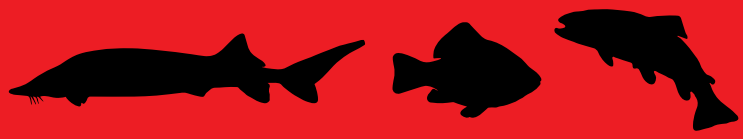
6.1.2. Application of international legislation in the Republic of Serbia

National legislation in the field of fish stock protection as well as nature conservation is based on generally accepted rules of international law and confirmed international agreements and ratified conventions (Galamboš, 2018). Of all the international conventions that Serbia has ratified, the Bern Convention and the Bonn Convention stand out.

The aim of the **Bern Convention** on the Conservation of European Wildlife and Natural Habitats (*Law on Ratification of the Convention on the Conservation of European Wild Flora and Fauna and Natural Habitats*, Official Gazette of RS – International Treaties, No. 102/2007) is to conserve endangered and vulnerable flora and fauna, including migratory species and their natural habitats. Signatory States have undertaken to implement all necessary legal and administrative procedures to protect and conserve the species listed in the Appendices to the Convention. Appendix II lists strictly protected fauna species and Appendix III lists protected fauna species, i.e. less threatened but vulnerable animal species.

The **Bonn Convention** on the Conservation of Migratory Species of Wild Animals (*Law on the Ratification of the Convention on the Conservation of Migratory Species of Wild Animals*, Official Gazette of RS – International Treaties, No. 102/2007) is one of the basic regulations in the field of nature conservation, created with the aim of conserving migratory species of wild animals throughout their range. The Convention serves as a legal framework that allows separate international instruments for the conservation of migratory species or, more commonly, groups of species throughout their range. Endangered migratory species that are threatened with extinction are listed in Appendix I of the Convention. Signatory states to the Convention are committed to taking strong protective measures for them, conserving and/or restoring habitats and removing obstacles to migratory routes. The Convention also supports direct interstate cooperation for the conservation of certain species. Migratory species whose conservation in the wild depends on intergovernmental cooperation are listed in Appendix II of the Convention

The **Convention on International Trade in Endangered Species of Wild Fauna and Flora**, known as **CITES** or the Washington Convention, is an international agreement applied in the Republic of Serbia on the basis of the adopted *Law on Ratification of the Convention on International Trade in Endangered Species of Wild Fauna and Flora* (Official Gazette of FRY – International Treaties No. 11/2001). The objective of the Convention is to prevent the loss of biodiversity while taking measures to reduce the level of threat to the survival of the species caused by human overexploitation and international trade in specimens of wild animals and plants. All species listed on CITES are subject to the *Rulebook on Transboundary Movement and Trade in Protected Species* (Official Gazette of RS, No. 99/2009 and 6/2014), adopted under the *Law on Nature Protection* and CITES to control international trade in endangered and protected wild species, their parts and derivatives. The *Rulebook* sets out the conditions under which import, export, introduction, removal or transit, trade and cultivation, issuance of permits and other acts, submission of documents with the application for permits, etc. can be carried out.



Ciljevi **Konvencije o biološkoj raznovrsnosti** (*engl.* Convention on Biological Diversity) (*Zakon o potvrđivanju Konvencije o biološkoj raznovrsnosti*, Službeni list SRJ – Međunarodni ugovori, br. 11/2001) jesu očuvanje biološke raznovrsnosti, održivo korišćenje njenih komponenti i poštena i pravedna podela koristi koje proističu iz korišćenja genetičkih resursa, između ostalog odgovarajućim pristupom genetičkim resursima i odgovarajućim transferom relevantnih tehnologija, uzimajući u obzir sva prava na ove resurse i tehnologije, kao i odgovarajućim finansiranjem. Prema članu 8. Konvencije, svaka država potpisnica će, u meri u kojoj je to moguće i odgovarajuće, sprečavati unošenje, kontrolisati ili iskorenjivati alohtone vrste koje ugrožavaju ekosisteme, staništa ili vrste. Smernice o prevenciji, introdukciji i ublažavanju uticaja alohtonih vrsta nalaze se na linku https://www.cbd.int/decision/cop/?id=7197.

Uz pomenute konvencije, od značaja za zaštitu i očuvanje riba jeste i **Direktiva o očuvanju prirodnih staništa i divlje faune i flore – Direktiva o staništima** (*engl.* Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora – Habitats Directive), koja je jedna od najznačajnijih za proces pridruživanja Evropskoj uniji sa aspekta zaštite prirode i uspostavljanja evropske ekološke mreže Natura 2000. To je pravni akt koji na teritorijama zemalja članica Evropske unije reguliše očuvanje prirodnih staništa i određenih divljih životinjskih i biljnih vrsta. Uz transponovanje Direktive u nacionalnu legislativu i primenu pomoćne tehničke dokumentacije Evropske komisije i Evropskog tematskog centra za biodiverzitet (ETC/BD) u procesu uspostavljanja mreže Natura 2000, neophodna je i njena implementacija u smislu sprovođenja mera i aktivnosti na zaštiti i obnavljanju prirodnih staništa i populacija divljih vrsta, a sa ciljem očuvanja njihovog povoljnog stanja.

Vrste u Prilogu II Direktive o staništima jesu životinjske i biljne vrste od zajedničkog interesa čije očuvanje zahteva proglašenje posebno zaštićenih područja. Država kandidat za EU priprema nacionalnu listu „predloženih područja od značaja za zajednicu" (*engl.* proposed Sites of Community Importance, pSCIs) u okviru mreže Natura 2000. U okviru procesa evaluacije i usvajanja predloženih područja na nivou EU, a potom i odobravanja nacionalne liste od strane Evropske komisije, nakon pristupanja Evropskoj uniji područja bivaju odobrena kao „područja od značaja za zajednicu" (SCIs), kasnije nazvana „posebna područja očuvanja" (*engl.* Special Areas of Conservation, SACs). Prilog IV sadrži životinjske i biljne vrste od zajedničkog interesa za zajednicu kojima je potrebna stroga zaštita na celokupnom arealu unutar svake države, a u Prilogu V su životinjske i biljne vrste od zajedničkog interesa za zajednicu zbog čijeg se uzimanja iz prirode i eksploatacije mogu primeniti mere upravljanja.

U odnosu na očuvanje prirodnih populacija riba, potrebno je odrediti područja kako bi se očuvala njihova reprezentativnost u svim rečnim slivovima i u okviru definisanih biogeografskih regiona. Reofilne vrste (npr. jesetarske vrste, haringe, bucov, sabljarka, mladica, vretenari) koje naseljavaju velike vodotoke, u okviru svog životnog ciklusa migriraju između odgovarajućeg staništa za hranjenje, prezimljavanje i mrest. Svako izdvojeno područje za ove vrste treba da obuhvata više od 10 km rečnog sistema, a pojavljivanje vrste na tom području mora biti poznato duže vreme, ili se odabere područje koje mora da bude deo za repatrijaciju, tj. vraćanje u pri-

The objectives of the **Convention on Biological Diversity** (*Law on the Ratification of the Convention on Biological Diversity*, Official Gazette of FRY – International Treaties, No. 11/2001) are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources, including appropriate access to genetic resources and appropriate transfer of relevant technologies, taking into account all rights over such resources and technologies, and appropriate funding. Under Article 8 of the Convention, each State Party should, to the extent feasible and appropriate, prevent, control or eradicate the introduction of alien species that threaten ecosystems, habitats or species. Guidance on the prevention, introduction and mitigation of alien species can be found at https://www.cbd.int/decision/cop/?id=7197.

In addition to the above-mentioned conventions, **Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora – Habitats Directive**, which is also relevant for the protection and conservation of fish, is one of the most important conventions for the accession process to the European Union from the point of view of nature conservation and the establishment of the European ecological network Natura 2000. This is a legal act regulating the conservation of natural habitats and certain species of wild fauna and flora in the territory of the Member States of the European Union. In addition to the transposition of the Directive into national law and the application of the technical support documents of the European Commission and the European Topic Centre on Biological Diversity (ETC/BD) in the establishment of the Natura 2000 network, its implementation is also required with regard to the implementation of measures and activities for the protection and restoration of natural habitats and populations of wild species with the aim of maintaining their favourable status.

The species in Annex II of the Habitats Directive are animal and plant species of community interest whose conservation requires the designation of special areas of conservation. The EU candidate country draws up a national list of "proposed Sites of Community Importance" (pSCI) within the Natura 2000 network. As part of the process of evaluation and adoption of the proposed sites at EU level and subsequent approval of the national list by the European Commission, the sites will be recognised as "Sites of Community Importance" (SCIs) and later as "Special Areas of Conservation" (SACs), after accession to the European Union. The Annex IV lists animal and plant species of community interest in need of strict protection throughout their range in the individual states, and Annex V lists animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures.

With regard to the conservation of natural fish populations, it is necessary to define areas in order to maintain their representativeness in all river basins and within defined biogeographical regions. Rheophilic species (e.g. sturgeons, shads, asp, sichel, huchen, zingel and streber) inhabiting large streams migrate between suitable habitats for feeding, overwintering and spawning as part of their life cycle. Any designated area for these species should cover more than 10 km of the river system and the species' occurrence in this area must have been known for a long time Oran area must be selected that is part of the repatriation, i.e. return to the natural habitat. For species that live in habitats with slow-moving and stagnant water, such as the weatherfish

rodno stanište. U odnosu na vrste kao što su čikov i crnka, koje naseljavaju staništa sporotekućih i stajaćih voda, treba obuhvatati vlažna, močvarna i druga slična područja oko velikih reka. U malim brdsko-planinskim potocima i rekama treba izdvojiti područja od značaja za očuvanje vrsta kao što su potočna mrena, peš, vijuni, krkuše itd., koja mogu biti i na svega nekoliko kilometara toka ako su im populacije dovoljno brojne i vijabilne (Hošek & Dušek, 2016).

Okvirna direktiva EU o vodama (*engl.* Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy – Water Framework Directive), koja je usvojena 2000. godine i čija je transpozicija u legislativu Republike Srbije u toku u okviru *Zakona o vodama* (Službeni glasnik RS, br. 30/2010, 93/2012, 101/2016, 95/2018 i 95/2018 – dr. zakon), predstavlja još jedan pokretač za dostizanje održivog upravljanja vodama u Evropi, a samim tim i za zaštitu staništa slatkovodnih vrsta riba u Evropi. Direktiva od zemalja članica zahteva postizanje dobrog ekološkog statusa površinskih (slatkih) voda u Evropi, uz izdvajanje zaštićenih oblasti koje su u funkcionalnoj zavisnosti od statusa vode.

6.2. Sprovođenje mera zaštite

U cilju unapređenja statusa zaštite vrsta riba i sprečavanja daljeg gubitka njhovih populacija, neophodno je sprovođenje već definisanih mera zaštite, kao i utvrđivanje novih, specifičnijih mera na smanjenju ili (gde je to moguće) čak i potpunoj eliminaciji ugrožavajućih faktora za ribe. Merama je podjednako potrebno obuhvatiti i vrste i njihova staništa. Veoma je značajno utvrđivanje odgovarajuće zaštite područja koja su prepoznata kao najznačajnija za opstanak vrsta riba. Za zaštitu najugroženijih vrsta, potrebno je izraditi i usvojiti akcione planove, kojima će se detaljnije definisati ciljevi, instrumenti i mere upravljanja i zaštite. Slične akcione planove zaštite i održivog korišćenja bilo bi poželjno izraditi i za vrste koje se love, kao što su lipljen, štuka, som, smuđ, šaran. Sprovođenje monitoringa vrsta omogućiće bolje upoznavanje stanja populacija vrsta, njihovog rasprostranjenja i ugroženosti, što će poslužiti kao stručna osnova za planiranje i izradu programa za *ex situ* zaštitu. Postojeću zabranu unošenja alohtonih vrsta potrebno je najstrožije sprovoditi i kontrolisati, uz jačanje svesti prvenstveno rekreativnih ribolovaca, zatim i akvarista i vlasnika ribnjaka za komercijalni uzgoj o značaju sprečavanja daljeg širenja kao i unošenja alohtonih vrsta, koje su često i veoma invazivne. Podloga za sve mere jeste zakonodavni okvir na nacionalnom nivou, odnosno nivou Evropske unije. U bliskoj saradnji sa naučnim i stručnim institucijama, u zakonskim i podzakonskim aktima potrebno je redovno ažurirati spiskove ugroženih vrsta, kao i potrebne mere zaštite na osnovu identifikovanih ugrožavajućih faktora.

Neke od mera zaštite ne odnose se direktno na zaštitu staništa i/ili vrsta, već je njihov doprinos značajan za vrste posredno, kroz pokušaj rešavanja sistemskih problema unutar pojedinih sektora, uzrokovanih nedovoljnim finansijskim sredstvima, obimnom administracijom i birokratijom, niskom ekološkom svešću, nepoštovanjem propisa i neusklađenim i nedorečenim propisima:

- izrada akcionih planova za ugrožene vrste riba;
- izrada Crvene liste i Crvene knjige riba;

and the European mudminnow, wetlands, marshes and similar areas along large rivers should be included. In small mountain streams and rivers, areas of conservation importance should be designated for species such as the Danube barbel, European bullhead, loaches, gudgeons, etc., which may be only a few kilometres long if their populations are sufficiently numerous and viable (Hošek & Dušek, 2016).

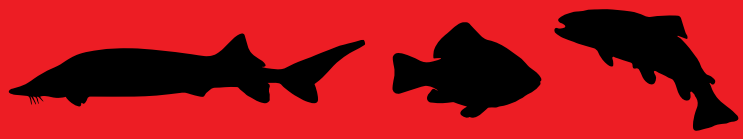
The Directive 2000/60/ EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy – **Water Framework Directive**, which was adopted in 2000 and whose transposition into the legislation of the Republic of Serbia is underway within the framework of the *Law on Water* (Official Gazette of RS, No. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018 – other law), represents another driving force for the achievement of sustainable water management in Europe and consequently for the protection of freshwater fish habitats in Europe. The Directive obliges Member States to achieve good ecological status of surface freshwaters in Europe, by designating protected areas that are functionally dependent on water status.

6.2. Implementation of protective measures

In order to improve the conservation status of fish species and prevent further loss of their populations, the conservation measures already established must be implemented and new, more specific measures must be established to reduce or (if possible) even eliminate the factors that threaten fish. The measures should apply equally to the species and their habitats. It is very important to define the appropriate protection of areas recognised as particularly important for the survival of fish species. For the protection of the most threatened species, action plans need to be developed and adopted, defining in more detail the objectives, instruments and measures of management and protection. It would be desirable to establish similar action plans for the protection and sustainable use of fish species such as grayling, pike, catfish, pikeperch and carp. The implementation of species monitoring will provide a better understanding of the status of species populations, their distribution and threats, which will serve as a technical basis for the planning and development of *ex situ* conservation programmes. The existing ban on the introduction of non-native species must be strictly enforced and controlled. At the same time, recreational fishers in particular, but also aquarists and owners of fish ponds for commercial breeding, must be made aware of the importance of preventing the further spread and introduction of non-native species, which are often highly invasive. The basis for all measures is the legal framework at national level as well as at European Union level. In close cooperation with scientific and professional institutions, the lists of threatened species as well as the necessary conservation measures based on the identified threat factors must be regularly updated in the legal and administrative regulations.

Some of the conservation measures do not directly target habitat and/or species conservation, but indirectly make an important contribution by attempting to address systemic problems within specific sectors caused by insufficient funding, extensive administration and bureaucracy, low environmental awareness, non-compliance and inconsistent and vague regulations:

- development of action plans for threatened fish species;



- unapređenje istraženosti statusa i stanja vrsta/populacija riba;
- vršenje procene stanja populacija riba, posebno ugroženih i zaštićenih vrsta;
- identifikacija i definisanje posebnih staništa za pojedine ugrožene vrste riba;
- sprečavanje smanjenja ili gubitka staništa ili presecanja migratornih puteva brojnih zaštićenih, ali i ekonomski važnih vrsta usled izgradnje brana i formiranja akumulacija na rečnim tokovima;
- utvrđivanje jedinstvene metodologije za procenu populacija, biomase i godišnje produkcije riba i utvrđivanja dozvoljene količine za izlov kroz rekreativni i privredni ribolov;
- povećavanje visina naknade za nanetu štetu za strogo zaštićene i zaštićene vrste riba u cilju destimulisanja nepoštovanja lovostaja i krivolova;
- subvencionisanje i započinjanje veštačkog mresta i uzgoja ugroženih i zaštićenih vrsta riba u akvakulturi uz podršku i koordinaciju nadležnih državnih organa, za potrebe poribljavanja i unapređenja populacija u otvorenim vodama;
- pojednostavljenje zakonskih odredbi vezano za veštački mrest i uzgoj ugroženih i zaštićenih vrsta riba za potrebe reintrodukcije i jačanje populacija autohtonih vrsta riba;
- propisivanje obaveze i načina obeležavanja ribe (posebno ugroženih i zaštićenih vrsta) koja je poreklom iz uzgoja, u cilju sprečavanja zloupotreba prodaje ribe poreklom iz krivolova;
- organizovanje otkupa ribe od privrednih ribara sa ciljem praćenja porekla i prometa ribe;
- unapređenje vođenja adekvatne evidencije ulova u rekreativnom, sportskom i privrednom ribolovu u potpunosti u skladu sa stvarnim izlovom, čime se omogućuje praćenje trendova populacija riba;
- unapređenje sudske prakse u pogledu odgovarajućeg procesuiranja prekršaja i krivičnih dela koja se tiču krivolova, ilegalne trgovine i nanošenja štete vrstama riba, a naročito strogo zaštićenih i zaštićenih vrsta;
- vršenje edukacije i jačanje svesti zaposlenih u policiji, upravi carina, sudovima i tužilaštvima, sa ciljem pridavanja većeg značaja prekršajima i krivičnim delima i izricanja odgovarajućih mera za kršenje propisa;
- vršenje edukacije i obezbeđivanje dodatne obuke zaposlenih u policiji, upravi carina, tužilaštvu i sudovima, u cilju efikasnijeg rada na slučajevima krivolova, ilegalne trgovine i nanošenja štete vrstama riba;
- jačanje kapaciteta inspekcija, prvenstveno kroz povećanje broja inspektora i poboljšanje opremljenosti;
- jačanje kapaciteta sektora ribarstva nadležnog administrativnog organa (kadrovskih i materijalno-tehničkih);
- jačanje stručnog kapaciteta korisnika ribarskih područja;
- jačanje kapaciteta ribočuvarske službe (brojno stanje, oprema, vozila i plovila, finansijska sredstva);
- pooštravanje kriterijuma po pitanju kapaciteta i opremljenosti potencijalnog korisnika ribarskog područja u postupku dodele ribarskih područja.

- compilation of the Red List and Red Book of fishes;
- improve research on the status and condition of fish species/populations;
- assessing the status of fish populations, especially threatened and protected species;
- identification and designation of special habitats for certain threatened fish species;
- prevent the reduction or loss of habitat or the disruption of migration routes of many protected and commercially important species through the construction of dams and the creation of reservoirs on river courses;
- introduce a uniform method for assessing populations, biomass and annual production of fish, and for setting allowable catches for recreational and commercial fisheries;
- increase compensation amounts for damage to strictly protected and protected fish species to discourage non-compliance with fisheries regulations and poaching;
- promote and start artificial propagation and rearing of threatened and protected fish species in aquaculture, with the support and in coordination with the competent state authorities, in order to rebuild stocks and improve populations in open waters;
- simplify legislation on artificial spawning and rearing of threatened and protected fish species for the purpose of reintroducing and enhancing populations of native fish species;
- establish the obligation and method of marking farmed fish (especially threatened and protected species) to prevent abuses in the sale of fish derived from poaching;
- organise the purchase of fish from commercial fishers with the aim of monitoring the origin and trade of fish;
- improve the maintenance of adequate catch records in recreational, sport and commercial fisheries in full accordance with actual catches, which will allow monitoring of fish population trends;
- improve judicial practice with a view to adequately prosecuting misdemeanours and criminal acts related to poaching, illegal trade and harm to fish species, in particular strictly protected and protected species;
- education and awareness-raising of police, customs, judicial and prosecutorial personnel with the aim of raising the profile of misdemeanours and criminal acts and punishing violations appropriately;
- education and training of police, customs, prosecutors and court personnel to work more effectively in cases of poaching, illegal trade and harm to fish species;
- strengthening inspection capacity, in particular by increasing the number of inspectors and improving equipment;
- strengthening the capacity of the fisheries sector of the competent management authority (in terms of human and material/technical resources);
- strengthening the professional capacity of users of fishing areas;
- strengthening the capacity of the fisheries inspection service (number, equipment, vehicles and vessels, financial resources);
- tightening the criteria related to the capacity and equipment of the potential user of fishing areas when allocating fishing areas.

7

STRUKTURA TEKSTOVA O UGROŽENIM VRSTAMA U SRBIJI

Aleksandar Hegediš i Jasmina Krpo-Ćetković

STRUCTURE OF TEXTS ON THREATENED FISH SPECIES IN SERBIA

Aleksandar Hegediš and Jasmina Krpo-Ćetković

7. STRUKTURA TEKSTOVA O UGROŽENIM VRSTAMA RIBA U SRBIJI

Aleksandar Hegediš i Jasmina Krpo-Ćetković

U *Crvenu knjigu faune Srbije V – ribe* uključene su sve ugrožene autohtone vrste riba za koje je postojao makar i jedan publikovan, ili na drugi pouzdan način dostupan nalaz, u vodama sva tri sliva koji se nalaze na teritoriji Srbije. Svaka od navedenih vrsta obrađena je prema unapred koncipiranom obrascu. Obim obrade raspoloživih podataka nije uvek bio isti, iz jednostavnog razloga što su pojedine vrste riba, posebno one najugroženije, zahtevale više detalja i preciznijih opisa od šire rasprostranjenih vrsta. S druge strane, za pojedine vrste količina dostupnih podataka bila je veoma mala, zbog čega su obim rasprostranjenja (EOO) i površina naseljavanja (AOO) za takve vrste delimično potcenjeni. Pouzdanost procene za vrste čiji se prirodni areal nalazi isključivo na području Kosova i Metohije nije visoka, jer za takve vrste ne postoji objektivan uvid u stanje populacija u poslednje dve decenije.

7.1. Narodna i naučna imena, taksonomski status i sinonimi

Za svaku vrstu navedeno je narodno ime, uglavnom citirano prema Simonović (2001). Uz narodno ime, navedena su i važeća naučna imena, koja su citirana prema Kottelat & Freyhof (2007) i FishBase (Froese & Pauly, 2022). Uz narodna i važeća naučna imena, za svaku vrstu data je i taksonomska pripadnost višim sistematskim kategorijama: porodica, red, nadred, klasa i razdeo. Za svaku vrstu dat je pregled sinonima prema FishBase, osim za vrste koje su opisane u neposrednoj prošlosti i za sada nemaju sinonime (kao što je *Alburnus sava*, na primer). Pored toga, za svaku vrstu data su i narodna imena na engleskom, francuskom, nemačkom i ruskom jeziku, ukoliko postoje.

7.2. Status vrste u međunarodnim konvencijama i nacionalnoj legislativi i nova procena statusa ugroženosti u Srbiji

Za svaku obrađenu vrstu dat je tabelarni pregled statusa zaštite i konzervacionog statusa u Evropi i Srbiji. U okviru međunarodne zaštite obuhvaćen je status ugroženosti prema IUCN Crvenoj listi ugroženih vrsta kroz kategorije RE, CR, EN, VU, NT, LC, DD, kao i prisustvo na listama u različitim konvencijama i direktivama vezanim za međunarodnu zaštitu (CITES konvencija, Evropska direktiva o staništima, Bernska konvencija i Bonska konvencija). U okviru zaštite u Srbiji, dat je status svake vrste prema *Pravilniku o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* (zaštićene i strogo zaštićene vrste) i *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* (trajni lovostaj, vremenski ograničen lovostaj, minimalna lovna mera i ograničenje dnevnog ulova). Navedene su i prethodne procene statusa ugroženosti, prema Simonović (2001). I na kraju, za svaku vrstu data je, na osnovu definisanih kriterijuma, nova procena IUCN statusa ugroženosti i zaštite u Srbiji, prema standardnim kategorijama.

7. STRUCTURE OF TEXTS ON THREATENED FISH SPECIES IN SERBIA

Aleksandar Hegediš and Jasmina Krpo-Ćetković

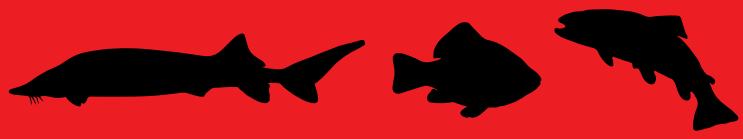
The *Red Book of Fauna of Serbia V – Fishes* includes all endangered native fish species for which there was at least one published or otherwise reliably available record in the waters of all three basins in the territory of Serbia. Each of the species mentioned is processed according to a predefined pattern. The amount of processing of the available data was not always the same for the simple reason that certain fish species, especially the most threatened ones, required more details and more precise descriptions than the more widespread species. On the other hand, the amount of data available for some species was very small, so that the extent of occurrence (EOO) and the area of occupancy (AOO) for these species were sometimes underestimated. The reliability of the assessment of species whose natural range extends exclusively to the territory of Kosovo and Metohija is not very high, as there is no objective insight into the status of populations over the last two decades for these species.

7.1. Vernacular and scientific names, axonomic status and synonyms

A vernacular name is given for each species, usually cited from Simonović (2001). In addition to the vernacular name, the valid scientific names are also listed, cited from Kottelat & Freyhof (2007) and FishBase (Froese & Pauly, 2022). In addition to the vernacular and valid scientific names, higher taxonomic ranks are given for each species: family, order, superorder, class and phylum. For each species, an overview of synonyms according to FishBase is given, except for species described in the immediate past for which no synonyms currently exist (such as *Alburnus sava*). In addition, the vernacular names in English, French, German and Russian are also given for each species, where they exist.

7.2. Status of the species in international conventions and national legislation and reassessed threat status in Serbia

For each species listed, a tabular overview of the protection and conservation status in Europe and Serbia is provided. In the context of international protection, the threat status according to the IUCN Red List of Threatened Species is indicated by the categories RE, CR, EN, VU, NT, LC, DD as well as by the presence on the lists of various conventions and directives related to international protection (CITES, European Habitats Directive, Bern Convention and Bonn Convention). In the context of protection in Serbia, the status of each species is indicated in accordance with the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* (protected and strictly protected species) and the *Regulation on Measures for the Conservation and Protection of Fish Stocks* (permanent ban on fishing, fixed closed season, minimum landing size and daily catch limit). A previous assessment of the threat status is also listed according to Simonović (2001). Finally,



7.3. Rasprostranjenje

Osnovni podaci o rasprostranjenju u okviru celokupnog areala navedeni su za sve obrađene vrste. Za neke vrste dati su nešto detaljniji podaci o rasprostranjenju u rekama i stajaćim vodama u Srbiji. Rasprostranjenost vrsta ilustrovana je pomoću UTM mreže 10×10 km. Karte su urađene na osnovu dostupnih literaturnih podataka i rezultata višegodišnjih terenskih istraživanja, koji su obuhvaćeni u jedinstvenu bazu podataka. Na osnovu sakupljenih i pohranjenih podataka generisane su odgovarajuće UTM karte za svaku obrađenu vrstu. Kao i nova procena statusa ugroženosti, i karte su takođe urađene u *Aplikaciji za procenu ugroženosti vrsta u Srbiji prema IUCN kriterijumima* (Niketić, 2021) na osnovu 14.920 podataka o rasprostranjenju riba u Srbiji integrisanih u *Bazu podataka o distribuciji potencijalno ugroženih vrsta Srbije* (Lakušić, 2020). Na kartama su za obeležavanje pojedinačnih nalaza korišćeni različiti simboli (Tabela 13).

7.4. Opis vrste

Za svaku vrstu dat je kraći morfološki i anatomski opis vrste, što bi, uz fotografiju, trebalo da omogući svim zainteresovanim čitaocima bliže upoznavanje sa osnovnim karakteristikama svake od obrađenih vrsta. Osim opisa, navedeni su i podaci o uobičajenoj i/ili maksimalnoj dužini tela, masi tela i dužini života. Za većinu vrsta prikazana je totalna dužina tela (TL), koja se meri od vrha njuške do kraja najduže žbice repnog peraja, dok je za neke vrste data standardna dužina tela (SL), koja se meri od vrha njuške do osnove repnog peraja. Opisi vrsta dati su na osnovu dostupnih referenci koje su navedene na kraju knjige.

a new assessment of threat status and protection in Serbia was made for each species based on established criteria, according to the IUCN standard categories.

7.3. Distribution

For all species listed, basic information on distribution throughout the range is provided. For some species, more detailed data on distribution in rivers and standing waters in Serbia are given. The distribution of the species is presented in a 10×10 km UTM grid. The maps were prepared on the basis of available literature data and the results of many years of field research, which were combined in a single database. Based on the collected and stored data, corresponding UTM maps were created for each listed species. In addition to the new threat status assessment, the maps were also produced in the *Application for the assessment of threats to species in Serbia according to the IUCN criteria* (Niketić, 2021), based on 14,920 data on the distribution of fish in Serbia, which were integrated into the *Database on the distribution of potentially threatened species in Serbia* (Lakušić, 2020). Different symbols were used in the maps to identify individual records (Table 13).

7.4. Description of the species

For each species, a brief morphological and anatomical description of the species is given, which, together with the photograph, should enable all interested readers to become familiar with the basic characteristics of each of the species listed. In addition to the description, information is given on the usual and/or maximum body length, body mass and life expectancy. For most species, the total body length (TL), measured from the tip of the snout to the end of the longer lobe of the caudal fin, is

Tabela 13. Simboli na kartama rasprostranjenja.

Table 13. Symbols on distribution maps.

	LITERATURNI / LITERATURE	tačan literaturni podatak / accurate literature record
	TERENSKI / FIELD	tačan i proverljiv terenski podatak / accurate and verifiable field record
	LITERATURNI I TERENSKI / LITERATURE AND FIELD	tačan i literaturni i terenski podatak / accurate literature and field record
	TAKSON JE IŠČEZAO / TAXON IS EXTINCT	podatak o nalazu je tačan, ali je vrsta iščezla sa datog lokaliteta / the information about the record is correct, but the species has disappeared from the indicated location
	ADVENTIVAN / ADVENTITIOUS	podatak o nalazu je tačan, ali se odnosi na adventivne (alohotne) populacije, odnosno na populacije koje se nalaze izvan svog prirodnog areala / the information about the record is correct, but they refer to adventitious (allochthonous) populations, i.e. populations outside their natural range
	NEPOUZDAN / UNRELIABLE	nepouzdan (sumnjiv) podatak / unreliable (questionable) record
	NETAČAN / INCORRECT	pogrešan objavljen podatak – "greška" koju je ustanovio neosporni autoritet za grupu / incorrect published record – an "error" identified by an unquestioned authority for the group
	STEPEN PRECIZNOSTI MANJI OD 20×20 KM A VEĆI OD 10×10 KM / DEGREE OF ACCURACY LESS THAN 20×20 KM BUT MORE THAN 10×10 KM	podatak za koji nije bilo moguće odrediti preciznost lokacije 10×10 km ili manje / record for which it was not possible to determine the accuracy of the location 10×10 km or less

U opis svake vrste uključena je i tzv. perajna formula, koja najčešće obuhvata leđno (D) i podrepno (A) peraje, nešto ređe grudno (P) i trbušno (V), a u nekoliko slučajeva i repno peraje (C). Perajna formula na primeru štuke (*Esox lucius*) izgleda ovako: D VI–X + 13–16; A III–VIII + 10–14; P I + 12–16; V I + 12–19. Ovo znači da štuka ima jedno leđno peraje sa 6 do 10 tvrdih negranatih žbica i 13 do 16 mekih granatih žbica, podrepno sa 3 do 8 tvrdih negranatih i 10 do 14 mekih granatih žbica, grudno sa jednom tvrdom negranatom i 12 do 16 mekih granatih žbica, i trbušno peraje sa jednom tvrdom negranatom i 12 do 19 mekih granatih žbica. U slučaju da vrsta ima dva leđna peraja, kao što je to na primer mali vretenar (*Zingel streber*), onda se ta peraja obeležavaju kao: D1 VII–IX; D2 I–III + 11–13, što znači da u prvom leđnom peraju ima 7 do 9 tvrdih negranatih žbica, a u drugom leđnom peraju 1 do 3 tvrde negranate i 11 do 13 mekih granatih žbica. Kod mnogih vrsta riba, poslednje dve granate žbice u leđnom i podrepnom peraju polaze iz iste pteriogiofore (kosti koja nosi žbice), tako da te dve žbice neki autori broje kao 1½, a neki kao 2 žbice. Mi smo se opredelili da ove dve žbice navodimo odvojeno, tako da ono što bi kod nekih autora bilo prikazano kao 7–8½ u ovoj knjizi navedeno je kao 7–9.

Kod nekih vrsta taksonomski značaj imaju i ždrelni zubi koji se nalaze na poslednjem paru škržnih lukova. Njihov broj i raspored prikazani su u vidu zubne formule (*engl.* dental formula). Npr. zubna formula DF 2.5–4(5).2 označava da su zubi raspoređeni u dva reda, sa 2 zuba u spoljašnjem i 5 zuba u unutrašnjem redu levog škržnog luka, i sa 4 (ponekad 5) zuba u unutrašnjem i 2 zuba u spoljašnjem redu desnog škržnog luka.

7.5. Populacione karakteristike

Za pojedine vrste riba u vodama Srbije praktično i nema podataka o populacionim odlikama. Nedovoljna sredstva koja se odvajaju za istraživanja u ihtiologiji ne omogućavaju duga, precizna i relativno skupa terenska istraživanja. Prilikom izrade programa upravljanja ribarskim područjima vrše se procene veličine populacije u pojedinim ribolovnim vodama, ali samo za ekonomski značajne vrste. Treba naglasiti da se te procene vrše na osnovu jednokratnog uzorkovanja, što ih čini veoma grubim i prilično nepouzdanim. U ovoj knjizi autori su se oslanjali na IUCN procene populacionih trendova, kao i na sopstvena iskustva.

7.6. Ekologija vrste i stanište

Obrada vrste obuhvatila je i osnovne informacije o ekologiji vrste (mrest, plodnost, ishrana i drugo), kao i o staništima u kojima vrsta živi (tip vode, mikrostanište u okviru šireg vodenog staništa, dubinu na kojoj vrsta živi, kao i druge stanišne preferencije). Slično opisu vrste, i ovi podaci namenjeni su široj čitalačkoj publici i imaju informativno-edukativni karakter. Pored toga, podaci o ekologiji i staništima određene vrste mogu dobro da posluže u donošenju adekvatnih mera očuvanja i zaštite, naročito za vrste koje su ugrožene ili su predmet privrednog i rekreativnog ribolova.

given, while for some species the standard body length (SL), measured from the tip of the snout to the base of the caudal fin, is given. The species descriptions are based on the references listed at the end of the book.

The description of each species includes the so-called fin formula, which usually includes the dorsal (D) and anal (A) fins, more rarely the pectoral (P) and ventral/pelvic (V) fins, and in a few cases the caudal (C) fin. The fin formula using the northern pike (*Esox lucius*) as an example is as follows: D VI–X + 13–16; A III–VIII + 10–14; P I + 12–16; V I + 12–19. This means that the pike has a dorsal fin with 6 to 10 spines and 13 to 16 soft rays, an anal fin with 3 to 8 spines and 10 to 14 soft rays, a pectoral fin with one spine and 12 to 16 soft rays and a ventral fin with one spine and 12 to 19 soft rays. If the species has two dorsal fins, such as the streber (*Zingel streber*), these fins are labelled as follows: D1 VII–IX; D2 I–III + 11–13, meaning that the first dorsal fin has 7 to 9 spines and the second dorsal fin has 1 to 3 spines and 11 to 13 soft rays. In many fish species, the last two soft rays of the dorsal and anal fins arise from the same pterygiophore (the bone that supports the rays), so these two rays are counted as 1½ rays by some authors and as 2 rays by others. We have chosen to list these two rays separately, so that what some authors list as 7-8½ is listed in this book as 7-9.

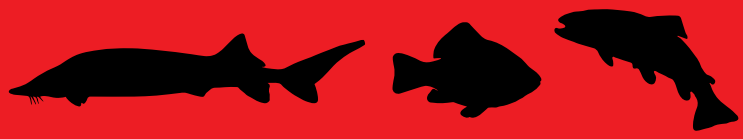
In some species, the pharyngeal teeth, which are located on the last pair of gill arches, also have taxonomic significance. Their number and arrangement is presented in the form of a dental formula. For example, the dental formula DF 2.5–4(5).2 means that the teeth are arranged in two rows, with 2 teeth in the outer and 5 teeth in the inner row of the left gill arch, and with 4 (sometimes 5) teeth in the inner and 2 teeth in the outer row of the right gill arch.

7.5. Population trends

For certain fish species in Serbian waters, there is practically no data on population characteristics. The insufficient funds allocated for ichthyological research do not allow for lengthy, accurate and relatively expensive field research. When developing a fisheries management programme, estimates of population size in specific fishing waters are made, but only for commercially important species. It must be emphasised that these estimates are made on the basis of one-off samples, which makes them very crude and rather unreliable. In this book, the authors have relied on IUCN estimates of population trends as well as their own experience.

7.6. Species ecology and habitat

Species editing included basic information on the ecology of the species (spawning, fecundity, feeding, etc.) and the habitats in which the species lives (type of waterbody, microhabitat within the larger aquatic habitat, depth at which the species lives, and other habitat preferences). Similar to the species description, these data are intended for a wider readership and are informative and educational in nature. In addition, data on the ecology and habitats of a particular species can help to inform appropriate conservation and protection measures, especially for species that are threatened or subject to commercial and recreational fishing.



7.7. Ribolovni značaj

Za svaku vrstu data je i kratka ocena njenog ribolovnog značaja. U Srbiji, privredni (komercijalni) ribolov obavlja se na Dunavu, Savi i Tisi, dok je rekreativni ribolov moguć, pored ove tri reke, i na svim drugim tekućim i stajaćim vodama. Izuzetak su manji delovi ribolovnih voda koji su definisani kao posebna staništa riba i u kojima je zabranjen svaki oblik ribolova, osim onog koji se vrši u cilju naučnih istraživanja. Međutim, treba imati u vidu da je u Srbiji tridesetak vrsta riba strogo zaštićeno i da za njih važi trajni lovostaj, tako da se ribolovno koristi između 25 i 30 vrsta, od čega oko 20% čine alohtone vrste.

7.8. Faktori ugrožavanja

Prilikom procene ugrožavajućih faktora za pojedine vrste u ovoj knjizi oslanjali smo se na IUCN podatke, kao i na sopstvena iskustvena opažanja koja su stečena tokom dugogodišnjih terenskih istraživanja. Procenu ugrožavajućih faktora za svaku vrstu prati i tabelarno-numerički prikaz prema Klasifikacionoj šemi faktora ugrožavanja prema IUCN (verzija 3.3).

7.9. Postojeće mere zaštite

Za svaku vrstu naveden je status zaštite prema odgovarajućoj nacionalnoj legislativi koja podrazumeva *Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i *Naredbu o merama za očuvanje i zaštitu ribljeg fonda*.

7.10. Predložene mere zaštite

Na osnovu postojećih mera zaštite i sagledavanja ugrožavajućih faktora, za svaku vrstu predložene su dodatne mere zaštite njihovih populacija i staništa. Takođe, sagledane su i potrebe za naučnim istraživanjima čiji bi rezultati unapredili zaštitu u svim njenim aspektima. Predložene mere zaštite i potrebe za naučnim istraživanjima prikazane su tabelarno-numerički, prema šiframa datim u okviru Klasifikacione šeme predloženih mera zaštite prema IUCN (verzija 2.0) i Klasifikacione šeme predloženih naučnih istraživanja prema IUCN (verzija 2.0).

7.7. Importance in fisheries

For each species, a brief assessment of its fisheries importance is given. In Serbia, commercial fishing is carried out in the rivers Danube, Sava and Tisza, while recreational fishing is also possible in all other flowing and standing waters. An exception is made for smaller parts of fishing waters defined as special fish habitats, where any form of fishing is prohibited, except for that practised for scientific research purposes. However, it should be taken into account that in Serbia about thirty fish species are strictly protected and subject to a permanent ban on fishing, so that between 25 and 30 species are used for fishing, of which about 20% are non-native species.

7.8. Threats

In assessing the threat factors for each species in this book, we have drawn on both IUCN data and our own empirical data from many years of field research. The assessment of threat factors for each species is complemented by a tabular-numerical presentation according to the IUCN Threats Classification Scheme (Version 3.3).

7.9. Conservation actions in place

For each species, the conservation status is indicated in accordance with the relevant national legislation, which includes the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and the *Regulation on Measures for the Conservation and Protection of Fish Stocks*.

7.10. Conservation actions needed

Based on the existing conservation measures and taking into account the threat factors, additional conservation measures for each species have been proposed for their populations and habitats. The need for scientific research, the results of which would improve protection in all its aspects, was also considered. The conservation actions required and the scientific research needed are presented in tabular-numerical form according to the codes of the IUCN Conservation Actions Classification Scheme (Version 2.0) and the IUCN Research Needed Classification Scheme (Version 2.0).

8

PREGLED UGROŽENIH VRSTA RIBA U FAUNI SRBIJE

OVERVIEW OF THREATENED FISH SPECIES IN THE FAUNA OF SERBIA

8.1.

Regionalno iščezle vrste (RE)

Regionally extinct species (RE)

ATLANTSKA JESETRA
Acipenser sturio Linnaeus, 1758

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Acipenser sturio* Linnaeus, 1758

Sinonimi

Sturio vulgaris Rafinesque, 1810; *Acipenser latirostris* Parnell, 1831-37; *Acipenser attilus* Gray, 1851; *Acipenser hospitus* Krøyer, 1852; *Acipenser sturioides* Malm, 1861; *Acipenser yarrellii* Duméril, 1867; *Acipenser milberti* Duméril, 1870; *Acipenser fitzingerii* Duméril, 1870; *Acipenser ducissae* Duméril, 1870; *Acipenser nehelae* Duméril, 1870; *Acipenser podapos* Duméril, 1870; *Acipenser valenciennii* Duméril, 1870; *Acipenser laevissimus* Duméril, 1870; *Acipenser europaeus* Brusina, 1902

Narodno ime: Atlantska jesetra
Englesko ime: Atlantic sturgeon
Francusko ime: Esturgeon d'Europe
Nemačko ime: Europäische Stör
Rusko ime: Атлантический осётр

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, atlantska jesetra smatra se kritično ugroženom vrstom (CR) prema kriterijumima A2cde; D (Gessner *et al*., 2010e, 2022a). Jedina preostala populacija nalazi se u slivu reke Garone u Francuskoj i u stalnom je opadanju. Na osnovu IUCN kriterijuma, atlantska jesetra u Srbiji ima status regionalno iščezle vrste (RE).

Rasprostranjenje

Atlantska jesetra je nekada bila široko rasprostranjenja vrsta. Naseljavala je istočnu, tj. evropsku obalu Atlantika – istorijski areal obuhvatao je područje od Severnog i Belog mora na severu, do Maroka na jugu, kao i severni Mediteran i pripadajuća mora (Jadransko, Jonsko, Egejsko, Crno more itd.) sve do Rodosa, a povremeno je beležena je i na Islandu (Williot *et al*., 1997; Gessner *et al*., 2010e, 2022a). Anadromna je vrsta i ulazila je u skoro sve velike reke, pritoke pomenutih mora. Danas je ograničena samo na sliv reke Garone (Francuska) (Kottelat & Freyhof, 2007). Prisustvo u vodama Srbije malo je verovatno, zato što krajni donji tok Dunava predstavlja najbliži poznati lokalitet u kome se ova vrsta javljala (Simonović, 2001). Postoje istorijski izveštaji o ulovu ove vrste u Đerdapskoj klisuri i u Dunavu u blizini Beograda (Ristić, 1963; Lenhardt *et al*., 2006; Jarić *et al*., 2009) (Slika 52).

ATLANTIC STURGEON
Acipenser sturio Linnaeus, 1758

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Acipenser sturio* Linnaeus, 1758

Synonyms

Sturio vulgaris Rafinesque, 1810; *Acipenser latirostris* Parnell, 1831-37; *Acipenser attilus* Gray, 1851; *Acipenser hospitus* Krøyer, 1852; *Acipenser sturioides* Malm, 1861; *Acipenser yarrellii* Duméril, 1867; *Acipenser milberti* Duméril, 1870; *Acipenser fitzingerii* Duméril, 1870; *Acipenser ducissae* Duméril, 1870; *Acipenser nehelae* Duméril, 1870; *Acipenser podapos* Duméril, 1870; *Acipenser valenciennii* Duméril, 1870; *Acipenser laevissimus* Duméril, 1870; *Acipenser europaeus* Brusina, 1902

Vernacular name: Atlantska jesetra
English name: Atlantic sturgeon
French name: Esturgeon d'Europe
German name: Europäische Stör
Russian name: Атлантический осётр

National threat category assessed according to IUCN criteria

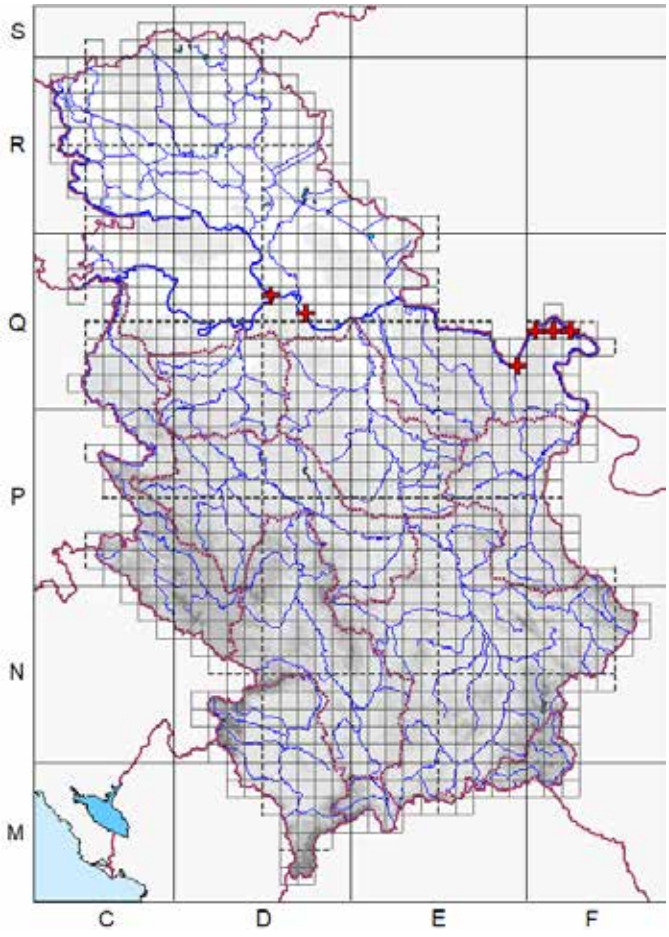
At the global level, the Atlantic sturgeon is classified as Critically Endangered (CR) under criteria A2cde; D) (Gessner *et al*., 2010e, 2022a). The only remaining population is in the Garonne watershed in France and is steadily declining. In Serbia, the Atlantic sturgeon is classified as Regionally Extinct (RE) according to IUCN criteria.

Distribution

The Atlantic sturgeon used to be a more widespread species. It inhabited the eastern, i.e. European, Atlantic coast – its historical range included the area from the North Sea and the White Sea in the north to Morocco in the south, as well as the northern Mediterranean and adjacent seas (Adriatic, Ionian, Aegean, Black Seas, etc.) to Rhodes, and it has occasionally been recorded in Iceland (Williot *et al*., 1997; Gessner *et al*., 2010e, 2022a). It is an anadromous species and entered almost all major rivers and tributaries of the aforementioned seas. Today it is restricted only to the Garonne watershed (France) (Kottelat & Freyhof, 2007). Its occurrence in the waters of Serbia is unlikely, as the extreme lower reach of the Danube is the nearest known place where this species occurs (Simonović, 2001). There are historical reports of catches of this species in the Đerdap Gorge and in the Danube near Belgrade (Ristić, 1963; Lenhardt *et al*., 2006; Jarić *et al*., 2009) (Figure 52).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Atlantska jesetra / Atlantic sturgeon – *Acipenser sturio*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**CR A2cde; D**
	CITES konvencija	**Dodatak / Appendix I**
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II, IV**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix II Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix I, II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat status (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**RE Strogo zaštićena vrsta / Strictly protected species**



Slika 52. **Rasprostranjenje *Acipenser sturio* u Srbiji.**

Figure 52. **Distribution of *Acipenser sturio* in Serbia.**

Slika 53. Atlantska jesetra *Acipenser sturio* (foto: Wrangel, https://www.dreamstime.com/stock-photo-european-sea-sturgeon-acipenser-sturio-also-known-as-atlantic-image80052888).

Figure 53. Atlantic sturgeon *Acipenser sturio* (photo: Wrangel, https://www.dreamstime.com/stock-photo-european-sea-sturgeon-acipenser-sturio-also-known-as-atlantic-image80052888).

Opis vrste

Telo je izduženo i vretenasto, pokriveno sa pet uzdužnih nizova ploča (leđni, dva bočna i dva trbušna) (Slika 53). Prva leđna ploča srasla je sa glavom i nalazi se ispred nivoa oka. Odnos visine i širine ploča bočnog niza manji je od 2:1. Između leđnog i bočnih nizova nalaze se sitne rombične pločice. Leđa su maslinasto-plava, zelenkasto-smeđa do crnkasta sa zlatnim tačkama, bokovi svetliji sa srebrnim tačkama, dok je trbuh beo. Rostrum je šiljat, uzak i umerene dužine, a donja usna prekinuta u sredini. Usta su donja, a brkovi bez resa i na pola rastojanja od vrha rostruma do prednje ivice gornje usne ili bliže ustima. Leđno peraje smešteno je daleko pozadi, grudna peraja su sa snažnim bodljama, dok je repno peraje heterocerkno. Leđnih ploča ima 9–16, bočnih 24–39 i trbušnih 9–14. Peraja: D 30–44; A 23–30. Branhiospina u prvom škržnom luku ima 18–25 (Bauchot, 1987). Najveća zabeležena dužina iznosi 6 m, a masa tela 1.000 kg (Kottelat & Freyhof, 2007). Danas retko prelazi 2 m (Bauchot, 1987). Maksimalna zabeležena dužina života je 100 godina (Muus & Dahlström, 1968).

Populacione karakteristike

Na globalnom nivou, populacioni trend ove vrste je opadajući. Prema navodima IUCN-a, poslednja reprodukcija atlantske jesetre u prirodi bila je 1994. godine. Broj polno zrelih jedinki u poslednjoj preostaloj populaciji u prirodi kreće se od 20 do 750, dok je ukupni broj jedinki oko 2.000 (Gessner *et al*., 2010e, 2022a). Od 1995. godine, iz uzgoja je u prirodu u par navrata oslobođeno nekoliko desetina hiljada jedinki ove vrste (Rouault *et al*., 2008; Rochard, 2011).

Ekologija vrste

Atlantska jesetra je anadromna vrsta. Obično se sreće na dubini od 5 m do 60 m i u vodi čija se temperatura kreće od 10 °C do 18 °C. Živi solitarno. Karakteriše je spor rast i dug životni vek. Polnu zrelost stiče sa 9–13 (mužjaci) i 11–18 (ženke) godina (Kottelat & Freyhof, 2007). Relativna plodnost (broj jaja po kg telesne mase) iznosi 0,8–2,4 miliona jaja, koja ženka polaže u dubljim delovima velikih reka sa jakim strujama, na šljunkovitom ili kamenitom dnu (Williot *et al*., 2011). Mužjaci se mreste svake, a ženke svake druge godine, od marta do avgusta, kada temperatura pređe 20 °C i tada dolazi

Description of the species

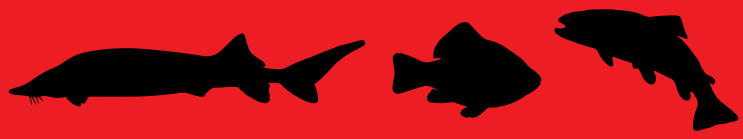
The body is elongated and spindle-shaped, covered with five longitudinal rows of scutes (dorsal, two lateral and two ventral) (Figure 53). The first dorsal scute is fused with head and is located anterior to the eye level. The ratio of height to width of the scutes of the lateral rows is less than 2:1. There are small rhombic plates between the dorsal and lateral rows. The dorsum is olivaceous blue, greenish brown to black with golden spots, the flanks are lighter with silver spots, while the belly is white. The rostrum is pointed, narrow and of medium length, the lower lip is interrupted at centre. The mouth is inferior, barbels not fimbriate and lie midway between the tip of the rostrum and the anterior edge of the upper lip or closer to the mouth. The dorsal fin is located far back, the pectoral fins have strong spines, while the caudal fin is heterocercal. There are 9–16 dorsal, 24–39 lateral and 9–14 ventral scutes. Fins: D 30–44; A 23–30. There are 18–25 gill rakers on the first gill arch (Bauchot, 1987). The greatest recorded length is 6 m and the body mass is 1,000 kg (Kottelat & Freyhof, 2007). Today, it rarely exceeds 2 m (Bauchot, 1987). The maximum life expectancy is 100 years (Muus & Dahlstroem, 1968).

Population trends

On a global scale, the population trend of this species is declining. According to the IUCN, the last reproduction of the Atlantic sturgeon in the wild took place in 1994. The number of sexually mature individuals in the last remaining population in the wild ranges from 20 to 750, while the total number of individuals is about 2,000 (Gessner *et al*., 2010e, 2022a). Since 1995, tens of thousands of individuals of this species have been released several times from aquaculture into the wild (Rouault *et al*., 2008; Rochard, 2011).

Ecology of the species

The Atlantic sturgeon is an anadromous species. It is usually found at depths of 5 to 60 m and in waters with temperatures between 10 °C and 18 °C. Individuals are solitary. It is characterised by slow growth and a long life span. They reach sexual maturity at 9–13 (males) and 11–18 (females) years (Kottelat & Freyhof, 2007). Relative fecundity (number of eggs per kg of body mass) is 0.8-2.4 million eggs, which the female deposits on gravelly or rocky bottoms in the deeper parts of large rivers with strong currents (Williot *et al*., 2011). Males spawn every year and females every other year, from March to August, when



do migracija (Kottelat & Freyhof, 2007). Većina jedinki u proleće ulazi u reke i mresti se u leto iste godine, dok jedinke koje migriraju na leto prezimljuju u rekama i mreste se na proleće sledeće godine. Tokom migracija se ne hrani. Većina juvenilnih jedinki ostaje u rekama 2–4 godine, dok neke migrijaju i tokom prvog leta (Williot *et al*., 1997). Hrani se polihetama, mekušcima, rakovima, larvama insekata i sitnom ribom (Kottelat & Freyhof, 2007). Može da hibridizuje sa ruskom jesetrom (*A. gueldenstaedtii*), mada retko (Holčík *et al*., 1989).

Stanište

Atlantska jesetra naseljava obalne delove mora i estuara, gde je dno meko. U slatkovodnim ekosistemima vezana je za estuare i velike reke (Kottelat & Freyhof, 2007).

Ribolovni značaj

Na globalnom nivou, atlantska jesetra je kao vrsta pod trajnim lovostajem izgubila privredni značaj (Gessner *et al*., 2010e, 2022a; Lassalle *et al*., 2010; Williot *et al*., 2011). Lovljena je zbog mesa i ikre. U Srbiji nema podataka o privrednom značaju ove vrste (Smederevac-Lalić *et al*., 2011a).

Faktori ugrožavanja

Atlantska jesetra je najugroženija vrsta ribe u Evropi (Williot *et al*., 1997, 2011; Lepage *et al*., 2000; Kottelat & Freyhof, 2007; Jarić *et al*., 2009; Gessner *et al*., 2010e, 2022a; Lassalle *et al*., 2010). Nekada je prekomerni i neodrživi lov bio glavni ugrožavajući faktor. Danas to predstavljaju tzv. sporadični ulov i eksploatacija šljunka u reci Garoni, kao i ostali oblici degradacije staništa pogodnih za mrest ove vrste: izgradnja brana i plovnih puteva, regulacija toka i zagađenje, a sve više se govori i o uticaju klimatskih promena (Gessner *et al*., 2010e, 2022a). Specifičan životni ciklus atlantske jesetre i velika potražnja za mesom i ikrom ove vrste čini je jako osetljivom na negativne promene koje izaziva čovek.

the temperature rises above 20 °C and migration begins (Kottelat & Freyhof, 2007). Most individuals migrate to the rivers in spring and spawn in summer of the same year, while individuals that migrate in summer overwinter in rivers and spawn in spring of the following year. During migration, it does not feed. Most juveniles remain in rivers for 2 to 4 years, while some migrate during their first summer (Williot *et al*., 1997). It feeds on polychaetes, molluscs, crustaceans, insect larvae and small fishes (Kottelat & Freyhof, 2007). It can hybridise, although rarely, with the Russian sturgeon (*A. gueldenstaedtii*), (Holčík *et al*., 1989).

Habitat

At the sea, the Atlantic sturgeon occurs in coastal and estuarine zones, on soft bottom. In freshwaters, it inhabits estuaries and large rivers (Kottelat & Freyhof, 2007).

Importance in fisheries

On a global scale, the Atlantic sturgeon has lost its commercial importance as fishing is permanently banned (Gessner *et al*., 2010e, 2022a; Lassalle *et al*., 2010; Williot *et al*., 2011). It is hunted for its meat and roe. In Serbia, there are no data on the commercial importance of this species (Smederevac-Lalić *et al*., 2011a).

Threats

The Atlantic sturgeon is the most threatened fish species in Europe (Williot *et al*., 1997, 2011; Lepage *et al*., 2000; Kottelat & Freyhof, 2007; Jarić *et al*., 2009; Gessner *et al*., 2010e, 2022a; Lassalle *et al*., 2010). In the past, excessive and unsustainable fishing was the main threat. Today, it is the so-called sporadic fishing and the exploitation of gravel in the Garonne, as well as other forms of destruction of the habitat suitable for spawning of this species: the construction of dams and waterways, the regulation of runoff and pollution, but also the effects of climate change are increasingly discussed (Gessner *et al*., 2010e, 2022a). The specific life cycle of the Atlantic sturgeon and the high demand for meat and roe of this species make it very sensitive to negative human-induced changes.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	3.2, 4.3, 5.4.3, 5.4.4, 7.2.11, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

Atlantska jesetra se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Na globalnom nivou treba smanjiti ribolovni pritisak i zagađenje, sprečiti regulaciju tokova i izgradnju brana, zaštititi mrestilišta, sprovoditi *ex situ* zaštitu, kao i uspostaviti zakone na nacionalnim nivoima, ukoliko ih nema.

Conservation actions in place

The Atlantic sturgeon is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

At the global level, fishing pressure and pollution should be reduced, flow regulation and the construction of dams prevented, spawning areas protected, *ex situ* protection implemented, and legislation enacted at the national level if none already exists.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.1, 2.3, 3.3.1, 3.4.1, 4.1, 4.3, 5.1.2

Neophodna su i istraživanja i praćenja veličine, distribucije i trendova populacije. Kako je prisustvo ove vrste u Srbiji malo verovatno, treba razmotriti opravdanost i primenu predloženih mera zaštite.

Research and monitoring of population size, distribution and trends is also necessary. As the occurrence of this species in Serbia is unlikely, the justification and application of the proposed conservation measures should be assessed.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.5, 1.6, 2.1, 3.1

AUTOR / AUTHOR: Dušan Nikolić

8.2.

Kritično ugrožene vrste (CR)

Critically endangered species (CR)

RUSKA JESETRA
Acipenser gueldenstaedtii Brandt and Ratzeburg, 1833

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Acipenser gueldenstaedtii* Brandt and Ratzeburg, 1833

Sinonimi

Acipenser gueldenstaedtii Brandt & Ratzeburg, 1833; *Acipenser aculeatus* Lovetsky, 1834; *Acipenser medius* Heckel, 1836; *Acipenser macrophthalmus* Heckel, 1836; *Acipenser brevirostris* Heckel, 1836; *Acipenser gueldenstaedtii scobar* Antipa, 1909; *Acipenser gueldenstaedti scaber* Antipa, 1909; *Acipenser gueldenstaedti golis* Antipa, 1909; *Acipenser gueldenstaedti longirostris* Antipa, 1909; *Acipenser colchicus* Marti, 1940; *Acipenser gueldenstadtii colchica* Marti, 1940; *Acipenser gueldenstaedtii colchicus* Marti, 1940; *Acipenser gueldenstaedti* var. *colchicus* Marti, 1940; *Acipenser gueldenstaedti tanaica* Marti, 1940; *Acipenser gueldenstaedtii colchicus danubicus* Movchan, 1967

Narodno ime: Ruska (dunavska) jesetra
Englesko ime: Russian sturgeon, Danube sturgeon
Francusko ime: Ocsiètre, Esturgeon du Danube
Nemačko ime: Russische Stör, Ossietra-Stör
Rusko ime: Русский осётр

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ruska jesetra smatra se kritično ugroženom vrstom (CR) prema kriterijumima A2bcde (Gessner *et al*., 2010b). Na osnovu procene brojnosti populacije na teritoriji Srbije, ruskoj jesetri dodeljen je status kritično ugrožene vrste (CR), prema kriterijumima C2a(ii)b. Uočeno je kontinuirano opadanje brojnosti, dok je udeo odraslih jedinki u subpopulaciji procenjen na 90–100%, sa ekstremnim fluktuacijama u njihovom broju. Veličina prostora na kome se vrsta pojavljuje (EOO) u Srbiji iznosi 874 km², dok je površina naseljavanja (AOO) svega 10 km². Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥50% u narednih 10 godina (kriterijum E).

Rasprostranjenje

Ruska jesetra naseljava basene Kaspijskog, Crnog i Azovskog mora i ulazi u njihove pritoke radi mresta (Gessner *et al*., 2010b). Prilikom migracije u Dunav, pre izgradnje hidroelektrane „Đerdap I" i „Đerdap II", jedinke su dolazile do Bratislave, a ponekad i do Beča i Regensburga (Birstein *et al*., 1997b). Postoje veoma retki i sporadični nalazi ruske jesetre u srednjem toku Dunava (Mađarska, Slovačka) za koje se veruje da su primerci potamodromnih formi, mada to može biti posledica slučajnih unošenja iz brojnih uzgajališta (Friedrich, 2018). U Srbiji se danas njihovo prisustvo beleži samo nizvodno od brane „Đerdap II" (od 863 rkm do 845,6 rkm) (Slika 54).

RUSSIAN STURGEON
Acipenser gueldenstaedtii Brandt and Ratzeburg, 1833

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Acipenser gueldenstaedtii* Brandt and Ratzeburg, 1833

Synonyms

Acipenser gueldenstaedtii Brandt & Ratzeburg, 1833; *Acipenser aculeatus* Lovetsky, 1834; *Acipenser medius* Heckel, 1836; *Acipenser macrophthalmus* Heckel, 1836; *Acipenser brevirostris* Heckel, 1836; *Acipenser gueldenstaedtii scobar* Antipa, 1909; *Acipenser gueldenstaedti scaber* Antipa, 1909; *Acipenser gueldenstaedti golis* Antipa, 1909; *Acipenser gueldenstaedti longirostris* Antipa, 1909; *Acipenser colchicus* Marti, 1940; *Acipenser gueldenstadtii colchica* Marti, 1940; *Acipenser gueldenstaedtii colchicus* Marti, 1940; *Acipenser gueldenstaedti* var. *colchicus* Marti, 1940; *Acipenser gueldenstaedti tanaica* Marti, 1940; *Acipenser gueldenstaedtii colchicus danubicus* Movchan, 1967

Vernacular name: Ruska (dunavska) jesetra
English name: Russian sturgeon, Danube sturgeon
French name: Ocsiètre, Esturgeon du Danube
German name: Russische Stör, Ossietra-Stör
Russian name: Русский осётр

National threat category assessed according to IUCN criteria

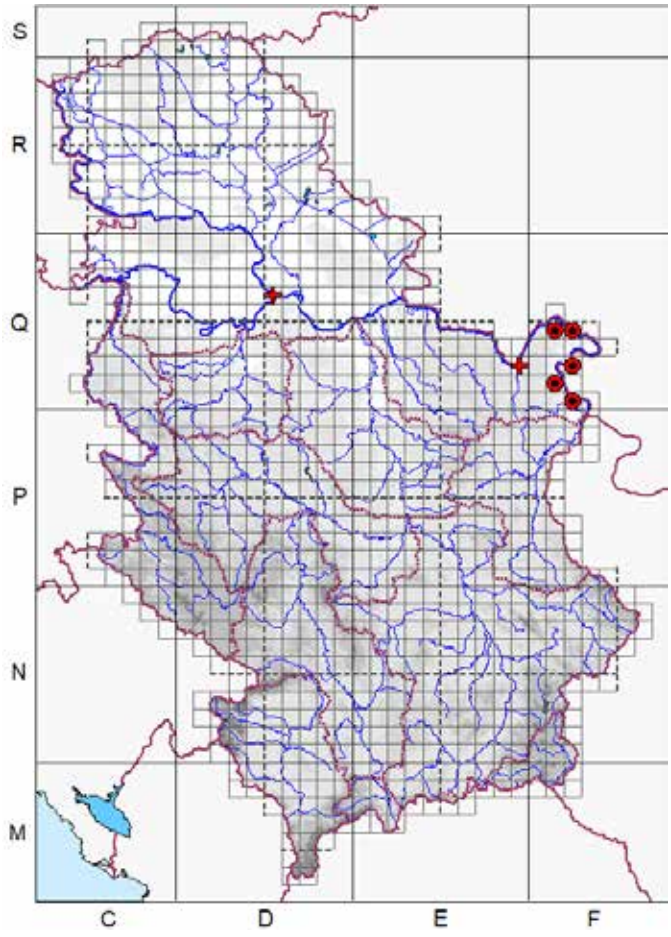
At the global level, the Russian sturgeon is classified as Critically Endangered (CR) under criteria A2bcde (Gessner *et al*., 2010b). Based on the assessment of population numbers in the territory of Serbia, the Russian sturgeon is classified as Critically Endangered (CR) according to criteria C2a(ii)b. A continuing population decline was observed and the proportion of mature individuals in the subpopulation was estimated at 90-100%, with extreme fluctuations in their number. The extent of occurrence in Serbia (EOO) is 874 km² and the area of occupancy (AOO) is only 10 km². The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥50% in the next 10 years.

Distribution

The Russian sturgeon inhabits the basins of the Caspian, Black and Azov Seas and migrates to their tributaries to spawn (Gessner *et al*., 2010b). During its migration to the Danube, before the construction of the hydroelectric power plants "Đerdap I" and "Đerdap II", individuals came as far as Bratislava and sometimes as far as Vienna and Regensburg (Birstein *et al*., 1997b). There are very rare and sporadic records of the Russian sturgeon in the middle reach of the Danube (Hungary, Slovakia), which are probably individuals of potamodromous forms, although this could be the result of accidental introductions from numerous fish farms (Friedrich, 2018). In Serbia, their occurrence is currently recorded only downstream of the dam "Đerdap II" (from rkm 863 to rkm 845.6) (Figure 54).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Ruska (dunavska) jesetra / Russian sturgeon – *Acipenser gueldenstaedtii*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**CR A2bcde**
	CITES konvencija	**Dodatak / Appendix I**
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat status (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR C2a(ii)b; E Strogo zaštićena vrsta / Strictly protected species**



Slika 54. **Rasprostranjenje *Acipenser gueldenstaedtii* u Srbiji.**

Figure 54. **Distribution of *Acipenser gueldenstaedtii* in Serbia.**

Slika 55. Ruska (dunavska) jesetra *Acipenser gueldenstaedtii* (foto: E. Podolnaya, https://www.dreamstime.com/russian-sturgeon-acipenser-gueldenstaedtii-russian-sturgeon-diamond-sturgeon-danube-sturgeon-acipenser-gueldenstaedtii-image205235712).

Figure 55. Russian sturgeon *Acipenser gueldenstaedtii* (photo: E. Podolnaya, https://www.dreamstime.com/russian-sturgeon-acipenser-gueldenstaedtii-russian-sturgeon-diamond-sturgeon-danube-sturgeon-acipenser-gueldenstaedtii-image205235712).

Opis vrste

Telo ruske jesetre je izduženo i vretenasto (Slika 55). Leđa i bokovi su tamni, sa različitim nijansama sivkasto-crne, sivkasto-smeđe ili zlatno-smeđe boje (Kalmykov *et al*., 2014). Trbuh je beo ili žućkast. Boja ploča varira od skoro bele do žućkasto zlatne. Glava je prekrivena koštanim pločama, dok se duž tela proteže pet nizova ploča (leđni, dva bočna i dva trbušna). Rostrum je kratak i zaobljen. Donja usna nije kontinuirana, već je prekinuta u sredini. Brkovi su obli i ne dopiru do gornje usne, dok im je baza bliža vrhu rostruma. Ploča u leđnom nizu ima 7–19, u bočnom 24–44, i u trbušnom 6–13. Peraja: D 27–48; A 16–35. Branhiospina u prvom škržnom luku ima 16–36 (Svetovidov, 1964; Fischer *et al*., 1987). Može da naraste do 236 cm dužine (Kottelat & Freyhof, 2007) i 115 kg mase (Birstein, 1993). Prosečna dužina i masa tela iznose 129,5 cm i 12,7 kg kod mužjaka, odnosno 145,8 cm i 22,15 kg kod ženki (Alavi-Yaganeh *et al*., 2013). Mužjaci mogu da žive do 52, a ženke do 62 godine (Shljahtin, 2006).

Populacione karakteristike

Najveća preostala populacija ruske jesetre nalazi se u Volgi i u Kaspijskom moru. Ipak, zbog prekomernog izlova (komercijalnog i ilegalnog) i razaranja staništa, ova populacija je opala oko deset puta, sa skoro tri miliona primeraka, koliko je zabeleženo u periodu 1976–1980. godina, na 355.000 primeraka, koliko je zabeleženo u periodu 1991–1995. godina (Tavakoli *et al*., 2018). Procenjuje se da je populacija u severozapadnom delu Crnog mora (delta Dunava) brojala oko 209.000 jedinki (Bloesch *et al*., 2006). Najčešće procene stanja populacije u Dunavu zasnovane su na statistikama ulova koje nisu uključivale ilegalni ulov, a koji u nekim slučajevima predstavlja i do 90% ukupnog ulova (Reinartz, 2002).

Na osnovu podataka o ulovu ruske jesetre (u periodu 1960–1997. godina) u Srbiji, procena rizika izumiranja ukazuje na to da već sredinom XXI veka može doći do nestanka ove vrste u Dunavu (Lenhardt *et al*., 2006). Sa druge strane, na osnovu analize vijabilnosti populacije, ukoliko je veličina populacije iznad 1.000 jedinki, moguća je održivost na duže staze (Jarić *et al*., 2010). Takođe, podaci o sporadičnim nalazima ruske jesetre u srednjem toku Dunava, kao i analiza elemenata u grudnom peraju primerka

Description of the species

The body of the Russian sturgeon is elongated and spindle-shaped (Figure 55). The dorsum and flanks are dark, with varying shades of greyish black, greyish brown or golden brown (Kalmykov *et al*., 2014). The ventral side is white or yellowish. The colour of the scutes varies from almost white to yellowish-gold. The head is covered with bony plates, while five rows of scutes (dorsal, two lateral and two ventral) extend over the body. The rostrum is short and blunt. The lower lip is not continuous, but interrupted at centre. Barbels are round, do not reach the upper lip, and their base is closer to the top of the rostrum. There are 7-19 dorsal, 24-44 lateral and 6-13 ventral scutes. Fins: D 27–48; A 16–35. There are 16-36 gill rakers on the first gill arch (Svetovidov, 1964; Fischer *et al*., 1987). It can grow up to 236 cm long (Kottelat & Freyhof, 2007) and weigh 115 kg (Birstein, 1993). The average body length and mass are 129.5 cm and 12.7 kg for males and 145.8 cm and 22.15 kg for females, respectively (Alavi-Yaganeh *et al*., 2013). Males can live up to 52 years and females up to 62 years (Shljahtin, 2006).

Population trends

The largest remaining population of Russian sturgeon lives in the Volga and the Caspian Sea. However, due to overfishing (commercial and illegal) and habitat destruction, this population has declined tenfold, from nearly three million individuals in 1976–1980 to 355,000 individuals in 1991–1995 (Tavakoli *et al*., 2018). It is estimated that the population in the northwestern part of the Black Sea (Danube delta) comprises about 209,000 individuals (Bloesch *et al*., 2006). The most common estimates of the status of the population in the Danube are based on catch statistics, which do not include illegal catches, which in some cases account for up to 90% of the total catch (Reinartz, 2002).

Based on data on catches of Russian sturgeon (in the period 1960–1997) in Serbia, the extinction risk assessment shows that this species could disappear from the Danube as early as the middle of the 21st century (Lenhardt *et al*., 2006). On the other hand, population viability analysis shows that long-term persistence is possible if the population size is above 1,000 individuals (Jarić *et al*., 2010). Data on sporadic records of the Russian sturgeon in the middle reach of the Danube, as well as the analysis of elements in the pectoral fin of

ulovljenog ispod brane „Đerdap II" (a koji nije napuštao slatkovodni sistem), ukazuje na moguće postojanje rezidentnih potamodromnih formi (Jarić *et al*., 2011). Postojanju ovakvih formi ipak nije sigurno zbog brojnih uzgajališta ruske jesetre, iz kojih je moguće bekstvo jedinki.

Ekologija vrste

Ruska jesetra je anadromna vrsta (migrira u reke radi mresta). Mresti se od aprila do jula, a početak migracija može biti i tokom proleća i tokom jeseni. Jedinke koje na proleće ulaze u reke mreste se iste godine u donjim tokovima reka, pri temperaturi od 19 °C do 22 °C (Birstein *et al*., 1997a). Jedinke koje u reke ulaze na jesen, mreste se sledeće godine uzvodnije u odnosu na prolećne migrante, pri temperaturi od 9 °C do 13 °C. U Dunavu, ruska jesetra polaže između 29.500 i 406.800 jaja (što je znatno manje u odnosu na reke u slivu Kaspijskog jezera) (Bloesch *et al*., 2006). Obično se mrest odigrava tokom ranih jutarnjih časova. Larve plutaju sa strujom, da bi mlade jedinke kasnije migrirale ka plićim staništima, pre odlaska u more. Tokom nizvodnog kretanja, larve i juvenilne jedinke mogu biti plen drugih riba. Nakon tri godine provedene u slatkim vodama, mladi migriraju u more (Gessner *et al*., 2010b). U moru ostaju do polne zrelosti, koju mužjaci dostižu između 8 i 13 godina, a ženke između 10 i 16 godina (Shljahtin, 2006; Tavakoli *et al*., 2018). Dok su u moru, jedinke se u plitkim vodama hrane mekušcima, rakovima i sitnijom ribom (Sokolov & Berdicheskii, 1989). Juvenilne jedinke u Dunavu uglavnom se hrane raznim račićima, polihetama i insektima. Solitarne su ribe, ali se udružuju za vreme mresnih migracija i zimovanja.

Stanište

Dok su u moru, žive na muljevitoj i peskovitoj podlozi priobalnih zona i estuara. Mlade jedinke se tokom leta nalaze na dubini između 2 m i 5 m, iznad peskovitog dna, dok odrasle jedinke, u zavisnosti od doba godine, borave na dubinama između 2 m i 100 m (Vecsei, 2001). U velikim rekama borave u dubljim delovima (2 m do 30 m) sa umerenom do brzom strujom, gde se mreste na kamenitoj i šljunkovitoj podlozi, pri brzini vodene struje od 1 m/s do 1,5 m/s (Bloesch *et al*., 2006; Vecsei, 2001). Larve su nalažene na velikim dubinama sa brzom rečnom strujom. U Dunavu, mlađe jedinke ostaju u dubljim delovima toka.

Ribolovni značaj

Ruska jesetra predstavlja ekonomski vrednu ribu, pri čemu je čak 64% ukupne mase ribe jestivo (Vlasenko *et al*., 1989). U nutritivnom smislu, kavijar ruske jesetre odmah je iza kavijara morune po kvalitetu. Nakon izgradnje brane „Đerdap I", došlo je do naglog porasta ulova ruske jesetre, da bi posle izgradnje brane „Đerdap II" došlo do pada ulova od preko 90% (Gessner *et al*., 2010b). Kako je ustanovljen trajni lovostaj za ovu vrstu, ona više nema privredan značaj.

a specimen caught below the dam "Đerdap II" (which did not leave the freshwater system), also indicate the possible existence of resident potamodromous forms (Jarić *et al*., 2011). However, the presence of such forms is not certain, as there are numerous fish farms for Russian sturgeon from which individuals can escape.

Ecology of the species

The Russian sturgeon is an anadromous species (migrates to rivers to spawn). They spawn from April to July, although the onset of migration can also be in spring and autumn. Individuals that migrate to the rivers in spring spawn later in the year in the lower reaches of rivers at temperatures of 19–22 °C (Birstein *et al*., 1997a). Individuals migrating to the rivers in autumn spawn the following year further upstream than the spring migrants, at temperatures of 9–13 °C. In the Danube, Russian sturgeon lay between 29,500 and 406,800 eggs (which is significantly less compared to Caspian basin rivers) (Bloesch *et al*., 2006). Spawning usually takes place in the early morning hours. The larvae swim with the current, while the juveniles later migrate to shallower habitats before reaching the sea. During the downstream migration, larvae and juveniles can be preyed upon by other fish. After three years in freshwater, juveniles migrate to the sea (Gessner *et al*., 2010b). They remain in the sea until sexual maturity, which males reach between 8 and 13 years and females between 10 and 16 years (Shljahtin, 2006; Tavakoli *et al*., 2018). In the sea, they feed on molluscs, crustaceans and small fishes in shallow waters (Sokolov & Berdicheskii, 1989). Juveniles in the Danube feed mainly on various crustaceans, polychaetes and insects. They are solitary, but swarm during spawning migration and hibernation.

Habitat

At sea, they live on the muddy and sandy substrate of coastal and estuarine zones. During the summer, juveniles stay at depths between 2 and 5 m above the sandy bottom, while adults stay at depths between 2 and 100 m, depending on the season (Vecsei, 2001). In large rivers, they live in deeper areas (2 to 30 m) with moderate to swift current, where they spawn on stony and gravelly substrates in strong currents with velocities of 1–1.5 m/s (Bloesch *et al*., 2006; Vecsei , 2001). The larvae are found at great depths with fast river currents. In the Danube, younger individuals stay in the deeper parts of the stream.

Importance in fisheries

The Russian sturgeon is a commercially valuable fish, with up to 64% of the total weight of the fish being edible (Vlasenko *et al*., 1989). In terms of nutritional value, Russian sturgeon caviar is equal in quality to beluga caviar. After the construction of the "Đerdap I" dam, there was a sudden increase in Russian sturgeon catches, and after the construction of the "Đerdap II" dam, catches decreased by over 90% (Gessner *et al*., 2010b). Since a permanent ban on fishing has been imposed on this species, it is no longer of commercial importance.

Faktori ugrožavanja

Kompleksan životni ciklus ruske jesetre, koji podrazumeva kasno polno sazrevanje, povremeni mrest i duge migracije, čini ovu vrstu podložnom negativnom uticaju ljudskih aktivnosti. Ova vrsta je u čitavom svom arealu pod pritiskom prekomernog (legalnog i ilegalnog) ulova, zagađenja voda, uništavanja i fragmentacije staništa (kao posledica regulacije toka i izgradnje brana). Izgradnja brane „Đerdap II" skratila je migratornu rutu crnomorskih migratornih vrsta na 863 km toka Dunava, a u Srbiji na svega 17,6 km (od 863 rkm do 845,6 rkm). U periodu između 1990. i 2009. godine, stopa izlova ruske jesetre bila je veća nego teoretska stopa izlova, koja bi obezbedila održivi maksimalni izlov. Izmene vodotoka na području Đerdapske klisure, koje su počele u periodu 1890-1896. godina, delimično su onemogućile pristup gornjem delu Dunava, dok je izgradnja brana „Đerdap I" i „Đerdap II" to potpuno onemogućila, a takođe je i dovela do promene uslova sredine. Takođe, zbog sposobnosti ruske jesetre da hibridizuje sa drugim jesetarskim vrstama, prisustvo hibrida u prirodnom staništu ima velike negativne posledice na genetiku prirodnih populacija.

Threats

The complex life cycle of the Russian sturgeon, which includes late sexual maturity, occasional spawning and long migrations, makes this species vulnerable to the negative impacts of human activities. Throughout its range, this species is under pressure from excessive fishing (legal and illegal), water pollution, habitat destruction and fragmentation (due to flow regulation and dam construction). The construction of the dam "Đerdap II" shortened the migratory route of the Black Sea migratory species to 863 km of the Danube and in Serbia to only 17.6 km (from rkm 863 to rkm 845.6). In the period between 1990 and 2009, the catch rate of Russian sturgeon was higher than the theoretical catch rate that would have allowed a sustainable maximum catch. Changes in the watercourse in the area of the Đerdap Gorge, which began in 1890–1896, partially prevented access to the upper part of the Danube, while the construction of the dams "Đerdap I" and "Đerdap II" made it completely impossible and also led to a change in environmental conditions. As the Russian sturgeon is able to hybridise with other sturgeon species, the presence of hybrids in the natural habitat has a significant negative impact on the genetics of the natural populations.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 5.4.2, 5.4.3, 5.4.4, 7.2.11, 9.2.1, 9.2.3

Postojeće mere zaštite

Ruska jesetra se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The Russian sturgeon is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

U okviru *Akcionog plana upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al.*, 2005), neke od predloženih mere zaštite jesu: naučna istraživanja bioloških karakteristika i proučavanje genetičke strukture populacija, zaštita staništa i omogućavanje pristupa mrestilištima, standardizovana realizacija veštačkog mresta u cilju poribljavanja i reintrodukcije, usaglašavanje različitih zakonskih akata i nadzor nad njihovim sprovođenjem, unapređivanje nacionalne legislative u oblasti zaštite prirode i održivog korišćenja ribljeg fonda, razvijanje regionalne i internacionalne saradnje.

Conservation actions needed

Within the framework of the *Action plan for sturgeon species management in fishery waters of the Republic of Serbia* (Lenhardt *et al.*, 2005), the following conservation actions are needed: scientific research on biological characteristics and study of the genetic structure of populations, protection of habitats and enabling access to spawning grounds, standardised implementation of artificial spawning for the purpose of stock rebuilding and reintroduction, harmonisation of various legal acts and monitoring of their implementation, improvement of national legislation in the field of nature conservation and sustainable use of fish stocks, development of regional and international cooperation.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.3, 3.1.1, 3.1.2, 5.1.2

Neophodna su detaljnija istraživanja veličine, distribucije i trendova populacije ruske jesetre, životne istorije i ekologije ove vrste, eksploatacije i faktora ugrožavanja, kao i aktivnosti koje treba preduzeti.

More detailed studies are needed on the Russian sturgeon population size, distribution and trends, as well as on its life history and ecology, exploitation and threats, and on actions to be taken.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1, 3.2, 3.3

AUTOR / AUTHOR: Gorčin Cvijanović

SIM
Acipenser nudiventris Lovetsky, 1828

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Acipenser nudiventris* Lovetsky, 1828

Sinonimi

Acipenser schypa Güldenstädt, 1772; *Acipenser schypa* Bonnaterre, 1788; *Acipenser turritus* Fitzinger & Heckel, 1836; *Acipenser glaber* Fitzinger, 1836; *Acipenser nudiventris derjavini* Borzenko, 1950

Narodno ime: Sim
Englesko ime: Ship sturgeon, Bastard sturgeon
Francusko ime: Esturgeon a barbillons frangés
Nemačko ime: Glattdick
Rusko ime: Шип

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, sim se smatra kritično ugroženom vrstom (CR) prema kriterijumima A2cde (Gessner *et al*., 2010c; Freyhof *et al*., 2022). Na osnovu procene brojnosti populacije na teritoriji Srbije, simu je dodeljen status kritično ugrožene vrste (CR), prema kriterijumima C2a(i,ii)b. Uočeno je kontinuirano opadanje brojnosti sa ekstremnim fluktuacijama u broju odraslih jedinki, pri čemu je procenjeno da je njihov maksimalni broj u svakoj populaciji manji od 50, dok je ukupan broj zrelih jedinki između 50 i 250. Veličina prostora na kome se vrsta pojavljuje (EOO) u Srbiji iznosi 14.239 km², dok je površina naseljavanja (AOO) svega 36 km². Osim toga, ustanovljeni su i značajno fragmentisan areal i mali broj lokaliteta na kojima je vrsta pronađena.

Rasprostranjenje

Sim nastanjuje slivove Crnog, Azovskog, Kaspijskog i Aralskog mora (Avetisov, 1992; Reinartz, 2002; Vecsei *et al*., 2002; Kottelat & Freyhof, 2007). Formira anadromne i rezidentne populacije, a u Dunavu je bio prisutan samo rezidentni tip (Hensel & Holčík, 1997; Lenhardt *et al*., 2005). Pre izgradnje hidroelektrane „Đerdap I" jedinke ove vrste su migrirale sve do Komarna i Bratislave (Avetisov, 1992; Guti, 2006). U Srbiji postoje zabeleženi nalazi u Dunavu na području Apatina, Beograda i Đerdapske klisure (Slika 56). Smatra se da su jedinke sima povremeno zalazile i u Savu, Dravu i Tisu (Simonović *et al*., 2005).

Opis vrste

Telo sima je izduženo i vretenasto (Slika 57). Pokriveno je sa pet uzdužnih nizova ploča. Prva leđna ploča veća je od ostalih, stoji pod nagibom u odnosu na profil glave i srasla je sa njom. Donja usna je kontinuirana (celovita) i po ovoj osobini se sim razlikuje od drugih

SHIP STURGEON
Acipenser nudiventris Lovetsky, 1828

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Acipenser nudiventris* Lovetsky, 1828

Synonyms

Acipenser schypa Güldenstädt, 1772; *Acipenser schypa* Bonnaterre, 1788; *Acipenser turritus* Fitzinger & Heckel, 1836; *Acipenser glaber* Fitzinger, 1836; *Acipenser nudiventris derjavini* Borzenko, 1950

Vernacular name: Sim
English name: Ship sturgeon, Bastard sturgeon
French name: Esturgeon a barbillons frangés
German name: Glattdick
Russian name: Шип

National threat category assessed according to IUCN criteria

At the global level, the ship sturgeon is classified as Critically Endangered (CR) under criteria A2cde (Gessner *et al*., 2010c; Freyhof *et al*., 2022). Based on the assessment of population numbers in the territory of Serbia, the ship sturgeon is classified as Critically Endangered (CR) according to criteria C2a(i,ii)b. A continuing population decline with extreme fluctuations in the number of mature individuals has been observed, with the maximum number in each population estimated to be less than 50, while the total number of mature individuals ranges from 50 to 250. The extent of occurrence in Serbia (EOO) is 14,239 km², while the area of occupancy (AOO) is only 36 km². Furthermore, a severely fragmented distribution area and a low number of locations where the species occurs were observed.

Distribution

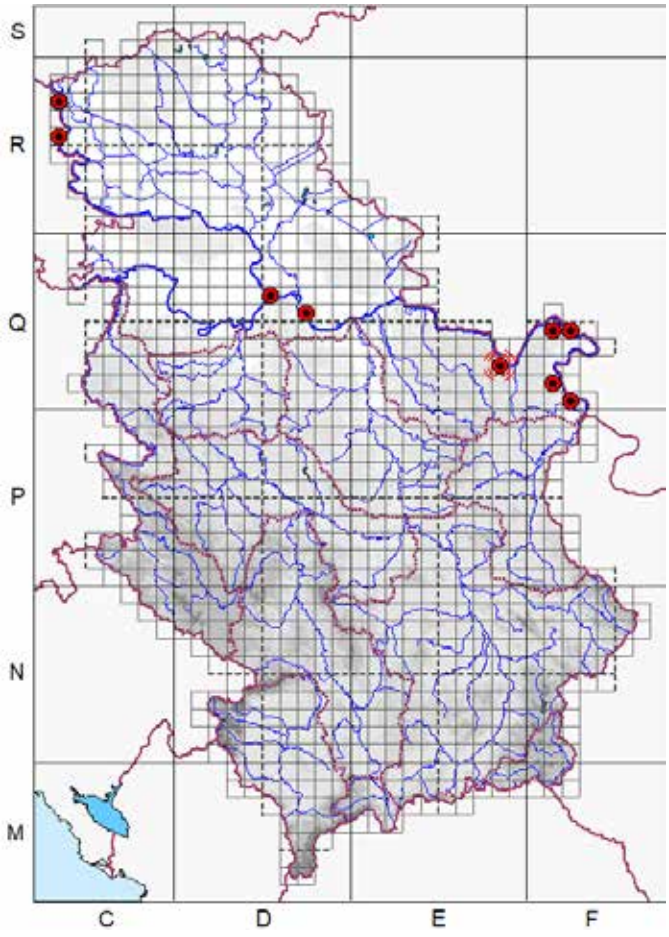
The ship sturgeon inhabits the basins of the Black, Azov, Caspian and Aral Seas (Avetisov, 1992; Reinartz, 2002; Vecsei *et al*., 2002; Kottelat & Freyhof, 2007). It forms anadromous and resident populations, with only the resident type occurring in the Danube (Hensel & Holčík, 1997; Lenhardt *et al*., 2005). Before the construction of the hydroelectric power plant "Đerdap I", individuals of this species migrated as far as Komarno and Bratislava (Avetisov, 1992; Guti, 2006). In Serbia, records have been made in the Danube in the area of Apatin, Belgrade and the Đerdap Gorge (Figure 56). Individuals are believed to have occasionally entered the Sava, Drava and Tisza rivers (Simonović *et al*., 2005).

Description of the species

The body of the ship sturgeon is elongated and spindle-shaped (Figure 57). It is covered with five longitudinal rows of scutes. The first dorsal scute is larger than following ones, fused with head, forming an obtuse angle with head profile. The lower lip is continuous (complete)

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Sim / Ship sturgeon – *Acipenser nudiventris*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**CR A2cde**
	CITES konvencija	**Dodatak / Appendix II**
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Appendix I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR C2a(i,ii)b Strogo zaštićena vrsta / Strictly protected species**



Slika 56. **Rasprostranjenje *Acipenser nudiventris* u Srbiji.**

Figure 56. **Distribution of *Acipenser nudiventris* in Serbia.**

Slika 57. Sim *Acipenser nudiventris* (https://www.tursar.ru/page-joy.php?j=2444).

Figure 57. Ship sturgeon *Acipenser nudiventris* (https://www.tursar.ru/page-joy.php?j=2444).

jesetarskih vrsta. Brkovi su resasti i nalaze se na sredini rastojanja između vrha njuške i gornje usne. Rostrum je zašiljen na vrhu i srednje je dužine. Kod odraslih jedinki boja leđa je obično maslinasto-siva ili sivo-plava, dok su bokovi svetliji. Trbuh je beo. Juvenilne jedinke mogu biti iste boje kao adulti ili tamnosive do gotovo crne na leđima i boku, dok je trbuh bele boje. Leđnih ploča ima 11–17, bočnih 49–70, dok trbušnih ima 10–16. Peraja: D 45–57; A 23–37. Branhiospina u prvom škržnom luku ima 24–42 (Svetovidov, 1964; Fischer *et al*., 1987). Može da naraste do 220 cm dužine i 80 kg mase (Rochard *et al*., 1991; Kottelat & Freyhof, 2007). Prosečna dužina ženki je 175 cm, a mužjaka 140 cm (Sokolov & Vasilev, 1989). Životni vek iznosi preko 30 godina, a maksimalna zabeležena starost je 36 godina (Sokolov & Vasilev, 1989).

Populacione karakteristike

Podaci o populacionim karakteristikama sima veoma su oskudni. Smatra se da je na ivici izumiranja u svom prirodnom arealu (Avetisov, 1992), a sumnja se da je brojnost populacija opala za više od 99% tokom poslednje tri generacije (Freyhof *et al*., 2022). Noviji podaci ukazuju na to da su prirodne populacije sima iščezle iz Aralskog i Azovskog mora, dok u Crnom moru postoji još samo populacija iz reke Rioni, a u Kaspijskom moru populacija iz reke Ural (Freyhof *et al*., 2022). Populacije sima u Crnom i Azovskom moru uvek su bile retke (Sokolov & Vasilev, 1989). U Crnom moru, najveći broj jedinki mrestio se u reci Rioni i retko u rekama Don i Kuban, dok se u Dunavu nalazila rezidentna populacija, i to u gornjem i srednjem toku. Smatra se da je vrsta izumrla još ranije u donjem toku (Guti, 2006; Birstein, 1997a, 1997b; Hensel & Holčík, 1997). Novija istraživanja ukazuju na to da je vrsta funkcionalno iščezla iz celog Dunava, jer su u srednjem toku u periodu od 2000. do 2010. godine ulovljene samo tri jedinke (Jarić *et al*. 2016; Reinartz & Slavcheva, 2016).

Na području Srbije, u periodu od 1948. do 1954. godine registrovano je samo pet jedinki, a 2003. godine, u Dunavu kod Apatina, zabeležena je jedna jedinka (Lenhardt *et al*., 2005, 2006; Simonović

and this feature distinguishes the ship sturgeon from other species of the family. Barbels are fimbriate and lie midway between the tip of the snout and the upper lip. The rostrum is pointed at the top and of medium length. In adults, the dorsum is usually olive-grey or grey-blue, while the flanks are lighter. The belly is white. Juveniles may be the same colour as adults or dark grey to almost black on the dorsum and flanks, while the belly is white. There are 11-17 dorsal, 49-70 lateral and 10-16 ventral scutes. Fins: D 45–57; A 23–37. There are 24–42 gill rakers on the first gill arch (Svetovidov, 1964; Fischer *et al*., 1987). It can grow up to 220 cm long and weigh 80 kg (Rochard *et al*., 1991; Kottelat & Freyhof, 2007). The average length of females is 175 cm, and that of males is 140 cm (Sokolov & Vasilev, 1989). Life expectancy is over 30 years, and the maximum recorded age is 36 years (Sokolov & Vasilev, 1989).

Population trends

Data on the population characteristics of the ship sturgeon are very sparse. It is considered to be on the verge of extinction in its natural range (Avetisov, 1992), and population size is suspected to have declined by more than 99% in the last three generations (Freyhof *et al*., 2022). Recent data suggest that natural populations of ship sturgeon have disappeared in the Aral and Azov Seas, while there is only one population left from the Rioni River in the Black Sea, and one population from the Ural River in the Caspian Sea (Freyhof *et al*., 2022). The populations of ship sturgeon in the Black and Azov Seas have always been rare (Sokolov & Vasilev, 1989). In the Black Sea, most individuals spawned in the Rioni and less frequently in the Don and the Kuban, while in the Danube a resident population was found in the upper and middle reaches. It is assumed that the species became extinct even earlier in the lower reaches (Guti, 2006; Birstein, 1997a, 1997b; Hensel & Holčík, 1997). Recent studies suggest that the species has functionally disappeared from the entire Danube, as only three individuals were caught in the middle reach in the period from 2000 to 2010 (Jarić *et al*. 2016; Reinartz & Slavcheva, 2016).

In the territory of Serbia, only five individuals were recorded in the period from 1948 to 1954, and in 2003 one individual was recorded in the Danube near Apatin, (Lenhardt *et al*., 2005, 2006; Simonović

et al., 2005). Nedostatak empirijskih podataka onemogućava kvantitativne analize o stanju populacija i za sada je još uvek nejasno da li su neke izolovane pojedinačne starije jedinke sima preostale u ovom delu Dunava (Meulenbroek *et al*., 2022).

Ekologija vrste

Sim je anadromna vrsta (migrira u reke radi mresta). Postoji i nemigratorna forma koja stalno živi u slatkim vodama i ta forma se nalazila u Dunavu (Hensel & Holčík, 1997; Reinartz, 2002; Guti, 2006). Juvenilne jedinke mogu da provedu od 2 do 8 godina u rekama, pre nego što migriraju u more. U tom periodu veliki broj njih ugine tokom zime, zbog predatora i gladi (Vecsei *et al*., 2002). Migraciju započinju tokom proleća ili jeseni. Mužjaci polnu zrelost stiču između 6 i 13 godina, a ženke između 12 i 22 godina starosti (Kottelat & Freyhof, 2007). Ženke polažu od 200.000 do 1.000.000 jaja (Sokolov & Berdicheskii, 1989). Mužjaci se razmnožavaju na svakih godinu do dve dana, dok se ženke mreste svake 2 do 3 godine. Mreste se u rekama od aprila do juna, na temperaturama od 10 °C do 15 °C (Kottelat & Freyhof, 2007). Hrane se larvama insekata, mekušcima i rakovima, a adultne jedinke u morima hrane se i ribama (Sokolov & Vasilev, 1989; Vecsei *et al*., 2002). Uglavnom je solitarna vrsta (Kottelat & Freyhof, 2007).

Stanište

Odrasli sim živi u moru u blizini obala, u estuarima i u dubljim delovima velikih reka, od 30 m do 60 m dubine, na muljevito-peskovitoj podlozi, na temperaturi između 10–20 °C (Bauchot, 1987; Baench & Riehl, 1991). Iz mora migrira u reke, gde se mresti u glavnom toku, na kamenitoj i šljunkovitoj podlozi, uz veću brzinu vodene struje (Reinartz, 2002; Vecsei *et al*., 2002; Kottelat & Freyhof, 2007).

Ribolovni značaj

Na osnovu istorijskih podataka brojnost populacije sima u Dunavu nikada nije bila velika. Takođe, u prošlosti je bilo izuzetno teško proceniti kada se sim uočavao, jer ga ribari nisu uvek razlikovali od ruske jesetre i kečige (Guti, 2006). Ova vrsta je u potpunosti izgubila privredni značaj nakon što je uspostavljen njen trajni lovostaj (Reinartz, 2002; Jarić *et al*., 2009; Smederevac-Lalić *et al*., 2011a).

Faktori ugrožavanja

Specifičan i veoma kompleksan životni ciklus jesetarskih vrsta (kasno polno sazrevanje, povremeni mrest i duga migratorna kretanja) čini ih vrlo podložnim negativnim promenama izvazvanim ljudskim aktivnostima, kao što su dugotrajan i neodrživ ulov (legalan i ilegalan), posebno zbog kavijara, povećanje broja ribara, veća efikasnost ribolovnih alata, zagađenje vode, kao i uništavanje i fragmentacija staništa izgradnjom brana (Avetisov, 1992; Reinartz, 2002; Lenhardt *et al*., 2006; Smederevac-Lalić *et al*., 2011a). Ilegalan i prekomeran ribolov (prelov) zbog mesa i kavijara značajno je uticao na smanjenje brojnosti populacije sima (Gessner *et al*., 2010c).

Izgradnja hidroelektrana „Đerdap I" i „Đerdap II" na području Đerdapske klisure i regulacija toka Dunava blokirali su migratorni

et al., 2005). The lack of empirical data prevents quantitative analyses on the status of the populations, and at present it is still unclear whether isolated single older individuals of the ship sturgeon still exist in this part of the Danube (Meulenbroek *et al*., 2022).

Ecology of the species

The ship sturgeon is an anadromous species (migrates to rivers to spawn). There is also a non-migratory form that lives permanently in freshwaters, and this form has been found in the Danube (Hensel & Holčík, 1997; Reinartz, 2002; Guti, 2006). Juveniles can spend 2–8 years in rivers before migrating to the sea. During this time, a large number of them die in winter, due to predation and starvation (Vecsei *et al*., 2002). They begin their migration in spring or autumn. Males reach sexual maturity at the age of 6 to 13 years, and females at the age of 12 to 22 years (Kottelat & Freyhof, 2007). Females lay between 200,000 and 1,000,000 eggs (Sokolov & Berdicheskii, 1989). Males reproduce every 1–2 years, while females spawn every 2–3 years. They spawn in rivers from April to June at temperatures of 10 °C to 15 °C (Kottelat & Freyhof, 2007). They feed on insect larvae, molluscs and crustaceans, and adult individuals in the sea also eat fish (Sokolov & Vasilev, 1989; Vecsei *et al*., 2002). It is mostly a solitary species (Kottelat & Freyhof, 2007).

Habitat

At sea, adult ship sturgeon live close to shores and estuaries, and in freshwater in the deeper parts of large rivers at depths of 30–60 m on silty-sandy substrates, and at temperatures between 10–20 °C (Bauchot, 1987; Baench & Riehl, 1991). It migrates from the sea to the rivers, where it spawns in the strong currents of the main course, on stony and gravelly substrates (Reinartz, 2002; Vecsei *et al*., 2002; Kottelat & Freyhof, 2007).

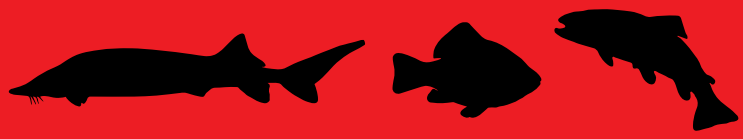
Importance in fisheries

Historical data show that the ship sturgeon population in the Danube was never large. Moreover, in the past it was extremely difficult to determine when a ship sturgeon was observed, as fishers could not always distinguish it from Russian sturgeon and sterlet (Guti, 2006). This species has completely lost its commercial importance after a permanent ban on fishing was imposed (Reinartz, 2002; Jarić *et al*., 2009; Smederevac-Lalić *et al*., 2011a).

Threats

The specific and very complex life cycle of sturgeon species (late sexual maturity, occasional spawning and long migratory movements) makes them very vulnerable to negative changes caused by human activities, such as long-term and unsustainable fishing (legal and illegal), especially for caviar, increase in the number of fishers, higher fishing gear efficiency, water pollution, and habitat destruction and fragmentation due to dam construction (Avetisov, 1992; Reinartz, 2002; Lenhardt *et al*., 2006; Smederevac-Lalić *et al*., 2011a). Illegal and excessive fishing (overfishing) for meat and caviar has a significant impact on the reduction of the ship sturgeon population (Gessner *et al*., 2010c).

The construction of the hydroelectric power plants "Đerdap I" and "Đerdap II" in the area of the Đerdap Gorge and the regulation of the Danube flow blocked the migration route not only of this sturgeon species but also of others, which led to a considerable decline in their



put, ne samo ovoj, već i drugim jesetarskim vrstama, i na taj način prouzrokovali značajan pad brojnosti njihovih populacija. Osim toga, u poslednjih par decenija, zagađenje u Dunavu znatno se povećalo (Lenhardt *et al*., 2005, 2006; Smederevac-Lalić *et al*., 2011a). Moguće je da mala veličina populacija sima predstavlja uzrok njegove slabe otpornosti na sve negativne antropogene uticaje i promene u staništu, zbog čega je ova vrsta veoma podložna izumiranju (Jarić *et al*., 2009).

populations. Moreover, pollution of the Danube has increased considerably in recent decades (Lenhardt *et al*., 2005, 2006; Smederevac-Lalić *et al*., 2011a). It is possible that the small size of the ship sturgeon population is the cause of its weak resistance to all negative anthropogenic impacts and habitat changes, which is why this species is very much at risk of extinction (Jarić *et al*., 2009).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 5.4.2, 5.4.3, 5.4.4, 7.2.2, 7.2.3, 7.2.8, 7.2.10, 8.1.1, 8.2.2, 9.3.1, 11.2, 12.1

Postojeće mere zaštite

Sim se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

U okviru *Akcionog plana upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al*., 2005), predložene su sledeće mere zaštite: zaštita staništa, omogućavanje pristupa mrestilištima, naučna istraživanja bioloških karakteristika i proučavanje genetičke strukture populacija sima, standardizovana realizacija veštačkog mresta u cilju poribljavanja i reintrodukcije.

Conservation actions in place

The ship sturgeon is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

Within the framework of the Action plan for sturgeon species management in fishery waters of the Republic of Serbia (Lenhardt *et al*., 2005), the following conservation actions are needed: habitat protection, enabling access to spawning grounds, scientific research on biological characteristics and study of the genetic structure of populations, standardised implementation of artificial spawning for the purpose of stocking and reintroduction.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.3, 3.3.1, 3.4.1, 4.3, 5.2

Neophodna su istraživanja veličine, distribucije i trendova populacije sima, životne istorije i ekologije ove vrste, kao i eksploatacije i faktora ugrožavanja.

Research is needed on the ship sturgeon population size, distribution and trends, as well as on its life history and ecology, exploitation and threats.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 3.1

AUTOR / AUTHOR: Milica Jaćimović

PASTRUGA
Acipenser stellatus Pallas, 1771

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Acipenser stellatus* Pallas, 1771

Sinonimi

Acipenser seuruga Bonnaterre, 1788; *Acipenser helops* Pallas, 1814; *Acipenser ratzeburgii* Brandt, 1833; *Acipenser stellatus donensis* Lovetsky, 1834; *Acipenser stellatus illyricus* Brusina, 1902; *Acipenser stellatus danubialis* Brusina, 1902.

Narodno ime: Pastruga
Englesko ime: Starry sturgeon
Francusko ime: Esturgeon etoilé
Nemačko ime: Sternhausen
Rusko ime: Севрюга

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, pastruga se smatra kritično ugroženom vrstom (CR) prema kriterijumima A2bcde (Qiwei, 2010; Mugue *et al.,* 2022). Na osnovu procene brojnosti populacije na teritoriji Srbije, pastrugi je dodeljen status kritično ugrožene vrste (CR), prema kriterijumima C2b. Procenjeno je da je broj polno zrelih jedinki manji od 250, sa ekstremnim fluktuacijama njihove brojnosti. Veličina prostora na kome se vrsta pojavljuje (EOO) u Srbiji iznosi 100 km², dok je površina naseljavanja (AOO) svega 1 km².

Rasprostranjenje

Pastruga nastanjuje Kaspijsko, Crno, Azovsko i Egejsko more, odakle ulazi u reke radi mresta (Qiwei, 2010). Smatra se da je u Egejskom moru danas verovatno izumrla (Barbieri *et al*., 2015), dok jedina preostala populacija u Crnom moru migrira u Dunav radi mresta (Qiwei, 2010). Pre izgradnje đerdapske brane na Dunavu, jedinke pastruge migrirale su do Slovačke. Sretale su se i u većim pritokama Dunava (Savi, Dravi). Danas se u Srbiji njihovo prisustvo beleži samo nizvodno od brane Đerdap II (od 863 rkm do 845,6 rkm), na poslednjih 17,6 kilometara toka Dunava u Srbiji (Slika 58).

Opis vrste

Telo pastruge je izduženo, vretenasto i pokriveno sa pet uzdužnih nizova koštanih ploča (leđni, dva bočna i dva trbušna) (Slika 59). Između nizova ovih ploča mogu biti istaknuti koštani zupci, najčešće zvezdastog oblika, naročito kod juvenilnih jedinki. Vremenom ove tvorevine postaju manje i dublje usađene. Koštane ploče i zupci mogu ponekad odsustvovati u manjoj ili većoj meri. Leđa su

STARRY STURGEON
Acipenser stellatus Pallas, 1771

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Acipenser stellatus* Pallas, 1771

Synonyms

Acipenser seuruga Bonnaterre, 1788; *Acipenser helops* Pallas, 1814; *Acipenser ratzeburgii* Brandt, 1833; *Acipenser stellatus donensis* Lovetsky, 1834; *Acipenser stellatus illyricus* Brusina, 1902; *Acipenser stellatus danubialis* Brusina, 1902.

Vernacular name: Pastruga
English name: Starry sturgeon
French name: Esturgeon etoilé
German name: Sternhausen
Russian name: Севрюга

National threat category assessed according to IUCN criteria

At the global level, the starry sturgeon is classified as Critically Endangered (CR) under criteria A2bcde (Qiwei, 2010; Mugue *et al.,* 2022). Based on the assessment of population size in the territory of Serbia, the starry sturgeon is classified as Critically Endangered (CR) according to criteria C2b. It is estimated that the number of mature individuals is less than 250, with extreme fluctuations in their number. The extent of occurrence in Serbia (EOO) is 100 km², and the area of occupancy (AOO) is only 1 km².

Distribution

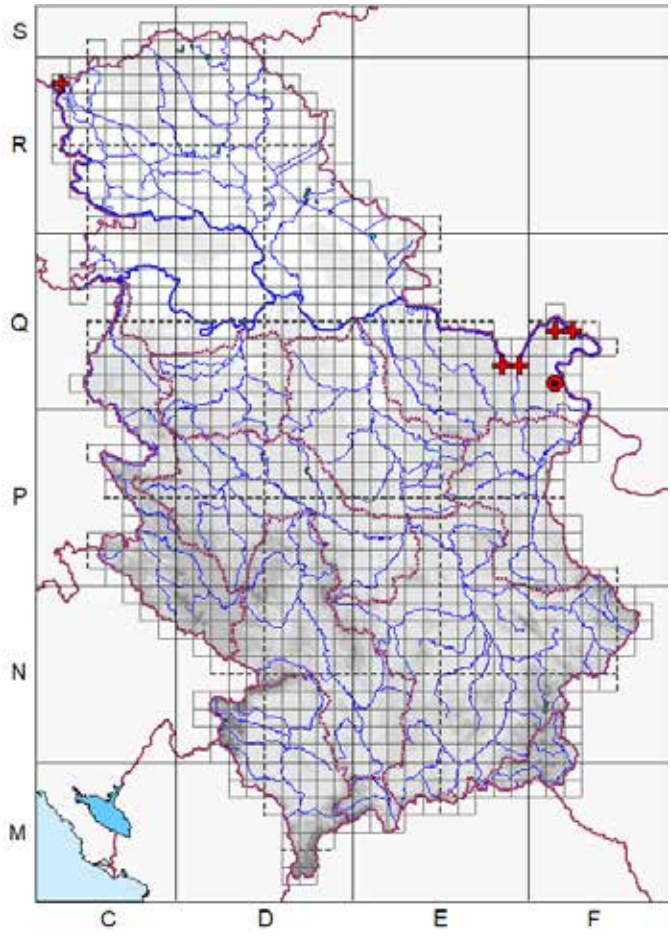
The starry sturgeon lives in the Caspian, Black, Azov and Aegean Seas, from where it enters rivers to spawn (Qiwei, 2010). In the Aegean Sea it is now probably considered extinct (Barbieri *et al*., 2015), while the only remaining population in the Black Sea migrates to the Danube to spawn (Qiwei, 2010). Before the construction of the Đerdap dam on the Danube, individual specimens of starry sturgeon migrated to Slovakia. They were also found in the larger tributaries of the Danube (Sava, Drava). Today, their occurrence in Serbia is recorded only downstream of the dam "Đerdap II" (from rkm 863 to rkm 845.6) on the last 17.6 kilometres of the Danube in Serbia (Figure 58).

Description of the species

The body of the starry sturgeon is elongated, spindle-shaped and covered with five longitudinal rows of scutes (dorsal, two lateral, and two ventral) (Figure 59). Star-shaped bony denticles may protrude between rows of scutes, especially in juveniles. With time, these formations become smaller and more deeply embedded. Bony stellate plates and denticles may sometimes be absent to a lesser or greater extent. The

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Pastruga / Starry sturgeon – *Acipenser stellatus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**CR A2bcde**
	CITES konvencija	**Dodatak / Appendix II**
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III**
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR C2b Strogo zaštićena vrsta / Strictly protected species**



Slika 58. **Rasprostranjenje *Acipenser stellatus* u Srbiji.**

Figure 58. **Distribution of *Acipenser stellatus* in Serbia.**

Slika 59. Pastruga *Acipenser stellatus* (foto: L. Hlasek, https://www.hlasek.com/acipenser_stellatus_f3315.html).

Figure 59. Starry sturgeon *Acipenser stellatus* (photo: L. Hlasek, https://www.hlasek.com/acipenser_stellatus_f3315.html).

skoro crna, bokovi sivi, a trbuh beo. Rostrum je veoma dug (59–65% dužine glave), zašiljen, slabo povijen na gore i dorzoventralno spljošten. Brkovi su bliži gornjoj usni, dok je donja usna prekinuta u sredini (nije kontinuirana). Repno peraje je heterocerkno. Leđnih ploča ima 11–14, bočnih 30–36, dok trbušnih ima 10–11. Peraja: D 40–46; A 24–29. Branhiospina u prvom škržnom luku ima 30–36 (Fischer *et al*., 1987). Naraste do 250 cm dužine (Mousavi & Ghafor, 2014) i 80 kg mase tela (Frimodt, 1995). Maksimalna zabeležena starost iznosi 27 godina (Birstein, 1993).

Populacione karakteristike

Brojnost populacija pastruge u prirodi opada u čitavom arealu. Smatra se da je ukupna brojnost pala sa 83 miliona jedinki u 1988. na 6,7–9,5 miliona u 2008. godini (Khodorevskaya *et al*, 2009). Najveću brojnost ima u Kaspijskom moru, gde trpi veliki ribolovni pritisak (uključujući i ilegalni ribolov). Podaci o stanju populacije i brojnosti u reci Ural, u koju ulazi radi mresta, pokazuju dramatičan pad (najmanje 95%) tokom poslednjih 30 godina, koji se nastavlja i dalje (Pikitch *et al*, 2005; Qiwei, 2010; Mugue *et al.,* 2022). Oko 50% populacije obnavlja se iz veštačkog uzgoja. U Crnom moru, u Rumuniji, brojnost je pala za 72,5% od 2002. do 2005. godine, dok u Azovskom moru od 2004. godine nije ulovljena nijedna polno zrela ženka. Očekivanja su da se taj trend nastavi i dalje (Qiwei, 2010).

Prosečan ulov pastruge u Srbiji (od 1969. do 2006. kada je uspostavljen moratorijum) iznosio je oko 170 kg godišnje, uz veliku neravnomernost godišnjih ulova. S obzirom da je u Srbiji izgradnjom đerdapskih brana mresna migracija prekinuta i da je uveden trajni lovostaj, podaci o ulovu ne postoje od 2006. godine (Lenhardt *et al*., 2005; Smederevac-Lalić, 2013).

Ekologija vrste

Pastruga je anadromna vrsta. Mresti se u rekama od aprila do septembra, na kamenitoj i šljunkovitoj podlozi, sa bržom vodenom strujom (Khodorevskaya *et al*., 2009). Migrira pri visokim temperaturama, kasnije u odnosu na ostale jesetre. Dan provodi na dnu, a noću izlazi na površinu radi ishrane. Mužjaci postaju polno zreli između 6 i 12 godina, a ženke između 8 i 14 godina starosti (*ibid*.). Mužjaci se mreste na dve do tri godine, a ženke na tri do četiri godine. Polažu oko 360.000 jaja. Ukoliko su uslovi sredine nestabilni,

dorsum is almost black, the flanks are grey and the belly is white. The rostrum is very long (59–65% of the head length), pointed at the tip, slightly curved upwards, and compressed dorsoventrally. Barbels are closer to the upper lip, while the lower lip is interrupted at centre (not continuous). The caudal fin is heterocercal. There are 11–14 dorsal, 30–36 lateral and 10–11 ventral scutes. Fins: D 40–46; A 24–29. There are 30–36 gill rakers on the first gill arch (Fischer *et al*., 1987). It grows up to 250 cm long (Mousavi & Ghafor, 2014) and has a body mass of 80 kg (Frimodt, 1995). The highest recorded age is 27 years (Birstein, 1993).

Population trends

The number of starry sturgeon populations living in the wild is declining throughout the area. Total numbers are thought to have declined from 83 million individuals in 1988 to 6.7-9.5 million in 2008 (Khodorevskaya *et al*., 2009). It is most abundant in the Caspian Sea, where it suffers from heavy fishing pressure (including illegal fishing). Data on the status and abundance of the population in the Ural River, where it enters to spawn, show a dramatic decline (at least 95%) over the last 30 years, which continues (Pikitch *et al*., 2005; Qiwei, 2010; Mugue *et al.,* 2022). About 50% of the population is currently being restored through artificial rearing. In the Black Sea in Romania, the population declined by 72.5% between 2002 and 2005, while in the Sea of Azov not a single mature female has been caught since 2004. This trend is expected to continue (Qiwei, 2010).

The average catch of starry sturgeon in Serbia (from 1969 to 2006, when the moratorium was introduced) was about 170 kg per year, and the annual catches were very uneven. Since spawning migration in Serbia was interrupted by the construction of the Đerdap dams and a permanent ban on fishing was imposed, no catch data have been available since 2006 (Lenhardt *et al*., 2005; Smederevac-Lalić, 2013).

Ecology of the species

The starry sturgeon is an anadromous species that. It spawns from April to September in rivers on stony and gravelly substrates with strong water currents (Khodorevskaya *et al.* 2009). It migrates at high temperatures, later than other sturgeons. It spends the day on the bottom and comes to the surface at night to feed. Males become sexually mature between 6 and 12 years of age, and females between 8 and 14 years of age (*ibid*.). Males spawn at 2–3 years, males at 3–4 years. They

mortalitet jaja može biti visok. Mužjaci na mestu mresta ostaju i do šest nedelja, dok ženke mesto mresta napuštaju već posle desetak dana. Larve se izvaljuju posle 4–5 dana, nakon čega ih rečna struja nosi nizvodno. Do mora dospevaju za dva do tri meseca, gde ostaju do polne zrelosti. Hrane se mekušcima, rakovima i sitnijom ribom (Qiwei, 2010).

Stanište

U moru živi u priobalnim zonama i estuarima, boraveći uglavnom u srednjim i gornjim slojevima vodenog stuba, dok na dnu boravi na peskovitim i glinovitim podlogama. U velikim rekama boravi u dubljim delovima sa bržom strujom. Najčešće se mresti u glavnom toku velikih i dubokih reka sa kamenitom ili šljunkovitom podlogom. Ukoliko takvo dno nije dostupno, mrest obavlja i na peskovitom dnu. Nekada se mrest obavlja i na poplavljenim obalama (Kottelat & Freyhof, 2007).

Ribolovni značaj

Vrsta je bila privredno značajna pre ustanovljavanja trajnog lovostaja. Na osnovu podataka Zavoda za statistiku, ulov pastruge veoma je varirao iz godine u godinu. Naime, 1969. i 1970. godine (početak prikupljanja podataka o ulovu) ulovljeno je nešto manje od 2.000 kg, zatim sledeće godine ulov pada na 184 kg, da bi sledeće 32 godine ulov drastično opao na svega par desetina kilograma u pojedinim godinama. U najvećem broju godina ulova čak nije ni bilo (Smederevac-Lalić, 2013).

Faktori ugrožavanja

Ugrožavajući faktori koji nastaju kao posledica višenamenskog korišćenja vodenih resursa uključuju prekomerni ribolov i smanjenje područja koje je naseljavala vrsta, pri čemu se posebno izdvajaju izgradnja brana, prisustvo invazivnih vrsta, bolesti, kao i ispuštanje industrijskih i drugih otpadnih voda. Uzrok smanjenja brojnosti populacije prvenstveno predstavlja morski prelov polno zrelih riba i onemogućavanje prirodne reprodukcije, jer polnu zrelost stiče tek između 6 i 12 godina života (Qiwei, 2010; Mugue *et al.,* 2022), kao i nelegalni ribolov u rekama. CITES konvencijom propisana je zabrana trgovine ikrom (kavijarom) pastruge, što inače predstavlja veoma unosan nelegalan posao. Iako akvakultura znatno doprinosi održavanju brojnosti, ona ne može nadoknaditi štetu koja je nastala prekomernim izlovom ove vrste čija populacija nije u mogućnosti da se prirodno obnovi.

lay about 360,000 eggs. If environmental conditions are unstable, egg mortality can be high. Males remain at the spawning site for up to six weeks, while females leave after only ten days. The larvae hatch after 4–5 days and are then carried downstream by the current. In 2–3 months they reach the sea, where they remain until sexual maturity. They feed on molluscs, crustaceans and small fishes (Qiwei, 2010).

Habitat

At sea, it lives in coastal and estuarine zones and stays mainly in the middle and upper layers of the water column, over sandy and clay bottom. In large rivers, it stays in deeper areas with faster currents. It spawns most often in the main course of large and deep rivers with rocky or gravelly substrate. If such a substrate is not available, it also spawns on sandy bottom. Spawning sometimes also takes place on flooded river banks (Kottelat & Freyhof, 2007).

Importance in fisheries

The species was of commercial importance before the imposition of a permanent ban on fishing. According to on data from the Statistical Office, catches of starry sturgeon fluctuated greatly from year to year. In 1969 and 1970 (when catch data began to be recorded), slightly less than 2,000 kg were caught, the following year the catch dropped to 184 kg, and in the following 32 years catches dropped drastically, in some years amounting to only a few tens of kilogrammes. In most years there were no catches at all (Smederevac-Lalić, 2013).

Threats

Threats resulting from the multipurpose use of water resources include overfishing and the reduction of areas inhabited by the species due to the construction of dams, the occurrence of invasive species, diseases and the discharge of industrial and other effluents. The reason for the decline in the population is primarily the overfishing of mature fish in the sea and the prevention of natural reproduction, as sexual maturity is not reached until the age of 6 to 12 years (Qiwei, 2010; Mugue *et al.,* 2022), as well as illegal fishing in rivers. The convention CITES prohibits the trade in starry sturgeon roe (caviar), which is otherwise a very lucrative illegal business. Even though aquaculture makes an important contribution to the conservation of stocks, it cannot compensate for the damage caused by overfishing of this species, as population cannot regenerate naturally.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 5.4.2, 7.2.11, 8.1.1, 8.1.2, 8.3, 9.2.3, 12.1

Postojeće mere zaštite

Pastruga se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The starry sturgeon is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

Na globalnom nivou, neophodno je usklađivanje regulative između zemalja u kojima ova vrsta živi, smanjenje zagađenja, izgradnja funkcionalnih ribljih staza, očuvanje prirodnog mresta, kao i povećanje stepena gajenja u akvakulturi (Qiwei, 2010). U okviru *Akcionog plana upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al*., 2005), predložene su sledeće mere zaštite: zaštita staništa, omogućavanje pristupa mrestilištima, naučna istraživanja bioloških karakteristika i proučavanje genetičke strukture populacija, standardizovana realizacija veštačkog mresta u cilju poribljavanja i reintrodukcije, razvijanje regionalne i internacionalne saradnje.

Conservation actions needed

At the global level, there is a need to harmonise regulations among countries where this species lives, reduce pollution, build functional fish ladders, conserve natural spawning grounds and improve aquaculture breeding (Qiwei, 2010). Within the framework of the *Action plan for sturgeon species management in fishery waters of the Republic of Serbia* (Lenhardt *et al*., 2005), the following conservation actions were proposed: habitat protection, enabling access to spawning grounds, scientific research on biological characteristics and study of the genetic structure of populations, standardised implementation of artificial spawning for stocking and reintroduction, development of regional and international cooperation.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	2.1, 2.3, 3.1.1, 3.1.2, 3.3.1, 5.1.1, 5.1.2, 5.2

Neophodna su istraživanja veličine, distribucije i trendova populacije pastruge, životne istorije i ekologije ove vrste, ulova, upotrebe i faktora ugrožavanja, kao i izrada planova upravljanja i trgovine.

Research is needed on the starry sturgeon population size, distribution, and trends as well as on its life history and ecology, catch, exploitation, threats and the development of management and trade plans.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.3, 3.1

AUTOR / AUTHOR: Željka Višnjić-Jeftić

STRUMIČKA PLISKA
Alburnoides strymonicus Chichkoff, 1940

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Alburnoides strymonicus* Chichkoff, 1940

Sinonimi

Alburnoides bipunctatus strymonicus Chichkoff, 1940

Narodno ime: Strumička pliska
Englesko ime: Strymon spirlin

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, status strumičke pliske nije procenjen prema IUCN kriterijumima (NE). U Srbiji, strumička pliska ima status kritično ugrožene vrste (CR) prema kriterijumima B2ab(i,ii,iii). Obim rasprostranjenja (EOO) u Srbiji izmosi 599 km², dok je površina naseljavanja (AOO) svega 3 km². Osim toga, ustanovljen je i mali broj lokaliteta na kojima se vrsta javlja (≤5), kao i kontinuirano smanjivanje površine naseljavanja i opadanje kvaliteta staništa.

Rasprostranjenje

Strumička pliska naseljava sliv reke Strume (Stierandová *et al.*, 2016; Barbieri *et al.*, 2017). U Srbiji je registrovana u slivu Dragovištice (Slika 60).

Opis vrste

Telo je bočno spljošteno i na poprečnom preseku ovalno (Slika 61). Boja tela je zelenkasto-smeđa, na leđima tamnija, a na trbuhu žućkasto-bela. Tamnosiva linija pruža se sredinom tela, od operkuluma do osnove repnog stabla (Porcellotti, n.d.c). Usta su terminalna, a njuška blago zašiljena (Barbieri *et al.*, 2017). Peraja: D III + 8–10; A III + 11–13. Ima 8–10 krljušti između bočne linije i osnove leđnog peraja i 3–4 krljušti između bočne linije i osnove trbušnih peraja. Broj krljušti u bočnoj liniji je 44–48. Maksimalna zabeležena standardna dužina tela (SL) iznosi 8,3 cm (*ibid.*).

Populacione karakteristike

Populacioni trend ove vrste nije poznat. Iako postoje lokalno brojne populacije širom areala, izostaje iz vodotoka koji su pregrađeni (Porcellotti, n.d.c; Oikonomou *et al.*, 2019).

Ekologija vrste

Polnu zrelost dostiže u drugoj godini života. Razmnožava se od maja do juna, pri temperaturi vode od 14 °C do 24 °C. Mrest je porcioni i ponavlja se 3–4 puta sa razmacima od oko 15 dana (Porcellotti, n.d.c). Litofilna je vrsta i polaže jaja između kamenja ili direktno

STRYMON SPIRLIN
Alburnoides strymonicus Chichkoff, 1940

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Alburnoides strymonicus* Chichkoff, 1940

Synonyms

Alburnoides bipunctatus strymonicus Chichkoff, 1940

Vernacular name: Strumička pliska
English name: Strymon spirlin

National threat category assessed according to IUCN criteria

At the global level, the Strymon spirlin is classified as Not Evaluated (NE) as its status has not been assessed according to IUCN criteria. In Serbia, the Strymon spirlin is classified as Critically Endangered (CR) according to criteria B2ab(i,ii,iii). The extent of occurrence (EOO) in Serbia is 599 km², while the area of occupancy (AOO) is only 3 km². Furthermore, a low number of locations where the species occurs (≤5) as well as a continuing decline of the area of occupancy and habitat quality were observed.

Distribution

The Strymon spirlin inhabits the Struma watershed (Stierandová *et al.*, 2016; Barbieri *et al.*, 2017). In Serbia, it is recorded in the Dragovištica watershed (Figure 60).

Description of the species

The body is laterally flattened and oval in cross-section (Figure 61). The colour of the body is greenish-brown, darker on the back and yellowish-white on the belly. A dark grey line runs down the middle of the body from the operculum to the base of the caudal peduncle (Porcellotti, n.d.c). The mouth is terminal and the snout is slightly pointed (Barbieri *et al.*, 2017). Fins: D III + 8–10; A III + 11–13. There are 8–10 scale rows between the lateral line and the dorsal fin origin and 3–4 scale rows between the lateral line and the ventral fin origin. The number of lateral line scales is 44–48. The maximum recorded standard body length (SL) is 8.3 cm (*ibid.*).

Population trends

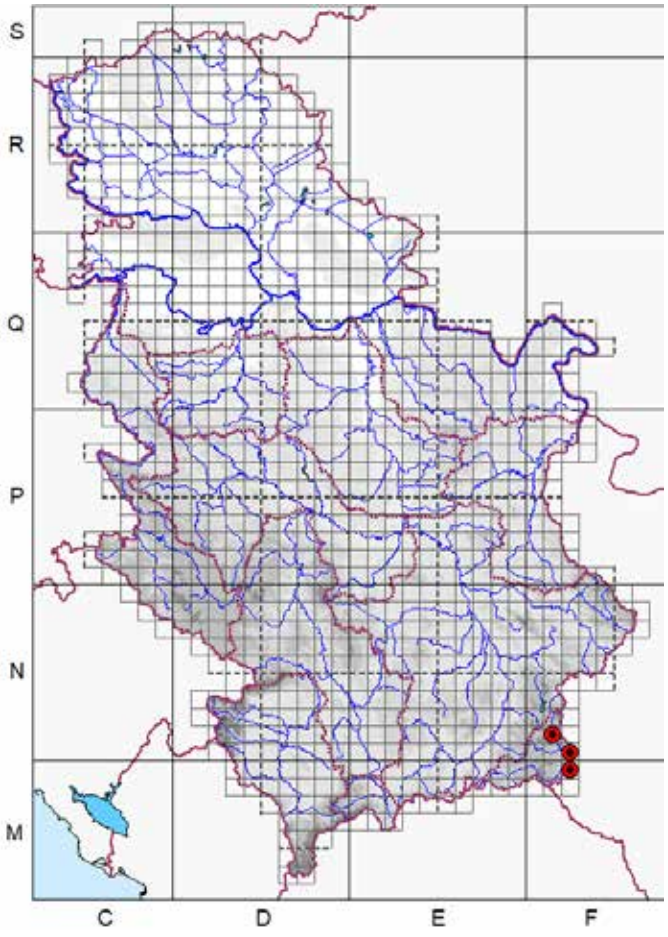
The population trends of this species are unknown. Although locally abundant populations exist throughout its range, it is absent from dammed watercourses (Porcellotti, n.d.c; Oikonomou *et al.*, 2019).

Ecology of the species

The Strymon spirlin reaches sexual maturity in its second year. It reproduces from May to June at a water temperature of 14 °C to 24 °C. Spawning takes place in portions and is repeated 3–4 times at intervals of about 15 days (Porcellotti, n.d.c). The Strymon spirlin is

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Strumička pliska / Strymon spirlin – *Alburnoides strymonicus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	-
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	-
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR B2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 60. Rasprostranjenje *Alburnoides strymonicus* u Srbiji.

Figure 60. Distribution of *Alburnoides strymonicus* in Serbia.

Slika 61. Strumička pliska *Alburnoides strymonicus* (http://kyustendil-konche-nature.eu/en_US/research/kyustendil/).

Figure 61. Strymon spirlin *Alburnoides strymonicus* (http://kyustendil-konche-nature.eu/en_US/research/kyustendil/).

na kamenje, mrtvo lišće ili drvene fragmente. Zadržava se uz obalu. Formira jata koja se sastoje od jedinki različitog uzrasta. Hrani se larvama akvatičnih insekata i račićima, a u manjoj meri konzumira i alge i detritus. Kopneni insekti koji upadnu u vodu takođe čine značajan udeo u ishrani (*ibid*.).

Stanište

Strumička pliska naseljava potoke i reke sa jakim vodenim strujama i šljunkovitim do kamenitim dnom (Stefanov, 2017).

Ribolovni značaj

Strumička pliska nema nikakav ribolovni značaj.

Faktori ugrožavanja

Među faktorima ugrožavanja izdvajaju se izmene staništa usled regulacije vodotoka, izgradnja derivacionih mini-hidroelektrana, odnosno brana, sa pratećim efektima (delimična ili potpuna izmena ekosistema praćena kanalisanjem ili usporavanjem toka, promenom temperaturnog režima i koncentracije kiseonika, zabarivanjem staništa, izraženijom sedimentacijom i zamućenošću vode), zatim unos alohtonih vrsta riba i uzgoj pastrmke, kao i različiti tipovi zagađenja.

a lithophilous species and lays its eggs between stones or directly on rocks, dead leaves or wood fragments, and stays close to the shore. Forms schools consisting of individuals of different ages. It feeds on larvae of aquatic insects and crustaceans, and to a lesser extent on algae and detritus. Terrestrial insects that enter the water also make up a large part of its diet (*ibid*.).

Habitat

The Strymon spirlin inhabits streams and rivers with strong currents and a gravelly to rocky bottom (Stefanov, 2017).

Importance in fisheries

The Strymon spirlin is of no fishery importance.

Threats

Threats include habitat alteration through regulation of water flow, construction of mini-hydropower plants, i.e. dams, with associated impacts (partial or complete ecosystem alteration through channelling or slowing down of the river, alteration of temperature regime and oxygen concentration, siltation of habitat, increased sedimentation and water turbidity), followed by introduction of non-native fish species and trout farming, and various types of pollution.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4, 7.2.2, 7.2.11, 7.3, 8.1, 9.3.4

Postojeće mere zaštite

Strumička pliska nije obuhvaćena postojećim merama zaštite.

Conservation actions in place

The Strymon spirlin does not fall under the existing conservation measures.

Predložene mere zaštite

Potrebno je ograničiti uzgoj pastrmke i regulaciju vodotoka u kojima ova vrsta živi, sprečiti izgradnju novih brana, zagađenje, kao i unos alohtonih vrsta riba. Takođe, izgradnja funkcionalnih ribljih staza i poštovanje biološkog minimuma bili bi izuzetno značajni.

Conservation actions needed

It is necessary to limit trout farming and regulate the watercourses where this species lives in order to prevent the construction of new dams, pollution and the introduction of non-native fish species. The construction of functional fish ladders and respecting the biological minimum of water flow would also be extremely important.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.1, 2.2, 5.4.2

Neophodna su istraživanja veličine, distribucije i trendova populacije, životne istorije, ekologije, kao i faktora ugrožavanja ove vrste.

Research is needed on the population size, distribution and trends, as well as the life history, ecology and threats of this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Dušan Nikolić

CRNOMORSKA HARINGA
Alosa immaculata Bennett, 1835

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Clupeiformes
Porodica: Clupeidae
Vrsta: *Alosa immaculata* Bennett, 1835

Sinonimi

Clupea pontica Eichwald, 1838; *Alosa kessleri pontica* (Eichwald, 1838); *Alosa pontica* (Eichwald, 1838); *Alosa pontica pontica* (Eichwald, 1838); *Caspialosa kessleri pontica* (Eichwald, 1838); *Caspialosa pontica* (Eichwald, 1838); *Clupea eichwaldii* Grimm, 1901; *Alosa pontica* var. *moriac* Antipa, 1909

Narodno ime: Crnomorska haringa
Englesko ime: Pontic shad
Francusko ime: Alose du Pont-Euxin
Nemačko ime: Donauhering
Rusko ime: Черноморско-азовская проходная сельдь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, crnomorska haringa smatra se ranjivom vrstom (VU) prema kriterijumima B2ab(v) (Freyhof & Kottelat, 2008c; Freyhof, 2010a). U Srbiji, crnomorska haringa predstavlja kritično ugroženu vrstu (CR) zbog uočenog/procenjenog opadanja i ekstremnih fluktuacija površine naseljavanja (AOO iznosi 20 km²), kvaliteta staništa, broja naseljenih lokaliteta i broja odraslih jedinki – kriterijumi B2ab(i,ii,iii,iv,v)c(i,ii,iii,iv). Obim rasprostranjenja (EOO) u Srbiji iznosi 4.679 km².

Rasprostranjenje

Odrasle jedinke žive u Crnom i Azovskom moru, odakle ulaze u pritoke radi mresta. Naseljava vode Bugarske, Gruzije, Moldavije, Rumunije, Rusije, Srbije, Turske i Ukrajine, a pre izgradnje đerdapskih brana, Dunavom je u migraciji stizala i do Mađarske (Freyhof & Kottelat, 2008c). Nekada je bila prisutna u celom toku Dunava kroz Srbiju, a ulazila je i u veće pritoke, Savu i Tisu. Od izgradnje đerdapskih brana retko se sreće u velikim rekama Srbije (postoji jedan nalaz kod Smedereva iz 2020. godine), a glavno stanište redukovano je na deo toka Dunava od ušća Timoka do brane „Đerdap II", tj. na svega 17,6 km toka (od 863 rkm do 845,6 rkm) (Slika 62).

Opis vrste

Telo crnomorske haringe je vitko, bočno spljošteno, sa izraženim trbušnim grebenom koji je pokriven krljuštima (Slika 63). Ne poseduje bočnu liniju. Boja tela na leđnoj strani je zelenkasto-plava, a bokovi su srebrnasto-beli sa ljubičastom nijansom. Ima tamnu tačku iza škržnog poklopca, a ponekad i druge iza nje, duž bokova.

PONTIC SHAD
Alosa immaculata Bennett, 1835

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Clupeiformes
Family: Clupeidae
Species: *Alosa immaculata* Bennett, 1835

Synonyms

Clupea pontica Eichwald, 1838; *Alosa kessleri pontica* (Eichwald, 1838); *Alosa pontica* (Eichwald, 1838); *Alosa pontica pontica* (Eichwald, 1838); *Caspialosa kessleri pontica* (Eichwald, 1838); *Caspialosa pontica* (Eichwald, 1838); *Clupea eichwaldii* Grimm, 1901; *Alosa pontica* var. *moriac* Antipa, 1909

Vernacular name: Crnomorska haringa
English name: Pontic shad
French name: Alose du Pont-Euxin
German name: Donauhering
Russian name: Черноморско-азовская проходная сельдь

National threat category assessed according to IUCN criteria

At the global level, the Pontic shad is classified as Vulnerable (VU) under criteria B2ab(v) (Freyhof & Kottelat, 2008c; Freyhof, 2010a). In Serbia, the Pontic shad is classified as Critically Endangered (CR) due to observed/estimated declines and extreme fluctuations of the area of occupancy (AOO is 20 km²), habitat quality, number of locations and number of mature individuals – criteria B2ab(i,ii,iii,iv,v) c(i,ii,iii,iv). The extent of occurrence (EOO) in Serbia is 4,679 km².

Distribution

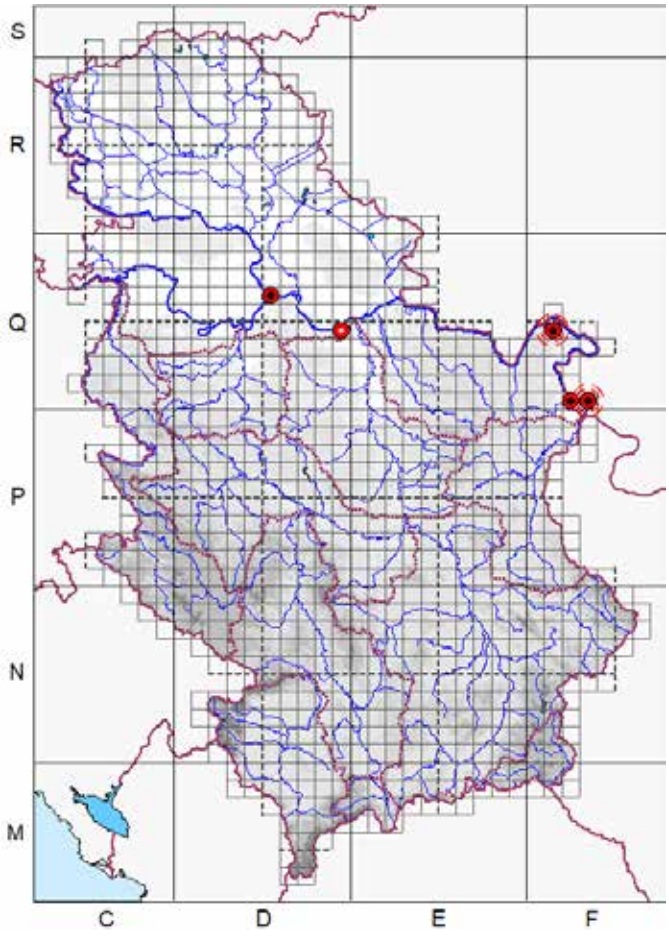
The adults live in the Black and Azov Seas, from where they migrate to tributaries to spawn. It inhabits the waters of Bulgaria, Georgia, Moldova, Romania, Russia, Serbia, Turkey and Ukraine, and before the construction of the Đerdap dams it migrated through the Danube to Hungary (Freyhof & Kottelat, 2008c). It used to be widespread throughout the course of the Danube through Serbia and also occurred in the larger tributaries, the Sava and the Tisza. Since the construction of the Đerdap dams, it is rarely found in the major rivers of Serbia (there is one record near Smederevo from 2020), and the main habitat has been reduced to the part of the Danube from the mouth of the Timok to the "Đerdap II" dam, i.e. to only 17.6 km of the stream (from rkm 863 to rkm 845.6) (Figure 62).

Description of the species

The body of the Pontic shad is slender, laterally flattened, and has a pronounced ventral keel covered with scales (Figure 63). It has no lateral line. The colour of the body on the back is greenish-blue, the flanks are silvery-white with a purple tinge. It has a dark blotch be-

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Crnomorska haringa / Pontic shad – *Alosa immaculata*		Status
Međunarodna zaštita / International protection	IUCN Red List	**VU B2ab(v)**
	CITES konvencija	-
	Evropska direktiva o staništima (navedena kao *Alosa* spp.) / European Habitats Directive (listed as *Alosa* spp.)	**Prilog / Annex II, V**
	Bernska konvencija (navedena kao *A. pontica*) / Bern Convention (listed as *A. pontica*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR B2ab(i,ii,iii,iv,v)c(i,ii,iii,iv) Strogo zaštićena vrsta / Strictly protected species**



Slika 62. **Rasprostranjenje *Alosa immaculata* u Srbiji.**

Figure 62. **Distribution of *Alosa immaculata* in Serbia.**

Slika 63. Crnomorska haringa *Alosa immaculata* (https://dunare.ro/cum-sa-prindem-scrumbie-la-dunare/).

Figure 63. Pontic shad *Alosa immaculata* (https://dunare.ro/cum-sa-prindem-scrumbie-la-dunare/).

Gornja vilica je sa izraženim središnjim udubljenjem. Na vilicama, nepčanoj i ralastoj kosti nalaze se dobro razvijeni zubi. Peraja: D III–IV + 13–15; A III–IV + 15–19. Branhiospine su tanke, broj ne prelazi 70 (47–69), na prvom škržnom luku obično 50–60, dužine približno kao i škržni filamenti. Maksimalna zabeležena standardna dužina tela (SL) iznosi 39 cm, a maksimalna zabeležena starost 7 godina (Kolarov, 1991). Od druge dve vrste roda *Alosa* koje žive u Crnom moru, azovske (*A. tanaica*) i crnomorsko-azovske haringe (*A. maeotica*), koja ne ulazi u Dunav, razlikuje se na osnovu broja branhiospina na prvom škržnom luku (Whitehead, 1985).

Populacione karakteristike

Brojnost populacija opada na globalnom nivou. Ulovi se kreću u proseku oko 1.000 tona godišnje, a 70% ulova ostvaruju rumunski ribari (Navodaru & Waldman, 2003). Dugogodišnja istraživanja ukazala su na to da je visina ulova ciklična, tj. da posle nekoliko godina sa visokim ulovom sledi nekoliko godina sa niskim ulovom (Navodaru & Waldman, 2003). Pretpostavlja se da solarna aktivnost, kroz klimatske i hidrološke cikluse, ima uticaja na dinamiku populacija crnomorske haringe (Lenhardt *et al.*, 2016). Bez obzira na prirodne fluktuacije brojnosti, prekomeran ulov početkom XX veka drastično je smanjio brojnost populacija ove vrste (Tiganov *et al.*, 2013). Populacione karakteristike za Srbiju nisu dovoljno istražene (Višnjić-Jeftić *et al.*, 2009; Višnjić-Jeftić, 2012).

Ekologija vrste

Crnomorska haringa je anadromna vrsta koja radi reprodukcije migrira u reke koje se ulivaju u Crno i Azovsko more. Polnu zrelost dostiže od treće do pete godine. Mresti se od marta/aprila, kada temperatura vode dostigne 6–9 °C, do sredine avgusta, obično u donjim tokovima reka (Kottelat & Freyhof, 2007). Ikru odlaže porciono. Ikra je pelagična, a apsolutna plodnost (ukupan broj jaja koje ženka položi) kod dunavskih migranata iznosi 13.914–136.288 jaja (Navodaru, 1993). Nakon izvaljivanja, mlađ brzo migrira nizvodno ka moru, od jula do septembra, ali ostaje u estuarima i blizini ušća

hind the operculum and sometimes a few more along the flanks. The upper jaw has a distinct median notch. The jaws, palatine and vomer bones with well developed teeth. Fins: D III–IV + 13–15; A III–IV + 15–19. Gill rakers thin, their number not exceeding 70 (47–69), usually 50–60 on the first gill arch, about as long as the gill filaments. The maximum standard body length (SL) is 39 cm, the maximum age 7 years (Kolarov, 1991). It differs from the other two species of the genus Alosa living in the Black, the Azov shad (*A. tanaica*) and the Black Sea shad (*A. maeotica*), the latter of which does not enter the Danube, by the number of gill rakers on the first gill arch (Whitehead, 1985).

Population trends

Populations are declining worldwide. The average catches is about 1,000 tonnes per year and 70% of the catch is taken by Romanian fishers (Navodaru & Waldman, 2003). Long-term studies have shown that the level of catches is cyclical, i.e. several years of high catches are followed by several years of low catches (Navodaru & Waldman, 2003). Solar activity is thought to influence the dynamics of Pontic shad stocks through climatic and hydrological cycles (Lenhardt *et al.*, 2016). Regardless of natural population fluctuations, overfishing in the early 20th century drastically reduced the abundance of this species (Tiganov *et al.*, 2013). Population characteristics in Serbia have not been sufficiently studied (Višnjić-Jeftić *et al.*, 2009; Višnjić-Jeftić, 2012).

Ecology of the species

The Pontic shad is an anadromous species that migrates to rivers of the Black and Azov Seas to reproduce. It reaches sexual maturity at the age of three to five years. It spawns from March/April, when the water temperature reaches 6–9 °C, until mid-August, usually in the lower reaches of the rivers (Kottelat & Freyhof, 2007). The roe is deposited in portions. The eggs are pelagic and the absolute fecundity (total number of eggs laid by a female) is 13,914–136,288 eggs in Danube migrants (Navodaru, 1993). After hatching, the juveniles migrate rapidly downstream to the sea from July to September, but remain in and near the estuaries until winter. The Pontic shad spawns only once

do zime. Crnomorska haringa se u procesu mresta nalazi samo jednom ili dva puta u životu (Ciolac, 2004). Mrest se u Dunavu odvija između 500 rkm i 180 rkm i između 743 rkm i 496 rkm toka (Kolarov, 1985). Odrasle jedinke koje migriraju u Dunav uglavnom su stare od 2 do 7 godina, pri čemu jedinke uzrasta od oko 3 godine čine više od 50% migratorne populacije, dok jedinke stare 6–7 godina čine samo oko 1% ukupne populacije (Navodaru, 1996). Dok je u moru, hrani se zooplanktonom (posebno raćićima) i sitnim ribama. Prema Đikanović *et al.* (2018), tokom mresnih migracija u Dunavu u ishrani preovladava makrozoobentos, a nađeni su i alge, detritus i nešto terestričnih insekata. Ovo je u suprotnosti sa uobičajenim mišljenjem da crnomorska haringa prestaje da se hrani tokom mresnih migracija iz mora u reku (Rozdina *et al.*, 2015).

Stanište

Crnomorska haringa je eurihalina, pelagična vrsta koja naseljava slatkovodnu, brakičnu i morsku sredinu, na dubinama od 3 m do 90 m (Kolarov, 1991). Migrira uglavnom do sredine toka velikih reka crnomorskog sliva. Za mrest preferira vode sa jakom strujom u glavnom rečnom toku. U periodu polaganja jaja izlazi blizu površine, na 2–3 m dubine.

Ribolovni značaj

Crnomorska haringa je ekonomski značajna vrsta u podunavskim državama koje se nalaze nizvodno od Srbije. Komercijalni ulov u okviru ribarstva kao privredne grane ima ekonomsku vrednost od oko 2 milona dolara godišnje (Navodaru, 1996). U Srbiji je bila značajna za ulove do izgradnje đerdapskih brana. Nakon stavljanja pod trajni lovostaj u Srbiji, privredni značaj gubi se u potpunosti (Višnjić-Jeftić, 2012).

Faktori ugrožavanja

Prelov, izgradnja brana, zagađenje Crnog mora i reka u koje migrira radi mresta, kao i gubitak staništa jesu glavni ugrožavajući faktori. Imajući u vidu da se mresti u glavnom, brzom toku reke, dominantni faktor ugrožavanja jeste formiranje akumulacija u drugoj polovini XX veka i usporavanje toka kao posledica izgradnje brana (Freyhof & Kottelat, 2008c; Freyhof, 2010a).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threat factors according to the IUCN classification scheme	5.4.1, 5.4.2, 7.2.11

Postojeće mere zaštite

Crnomorska haringa se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj. U Bugarskoj se ova vrsta nalazi u Crvenoj knjizi kao ranjiva vrsta jer se beleži konstantan pad brojnosti, a period zabrane lova traje od polovine aprila do polovine maja. U Rumuniji, gde se intenzivno lovi, nije na listi ugroženih vrsta, ali je na određenim de-

or twice in its lifetime (Ciolac, 2004). Spawning occurs in the Danube between rkm 500 and rkm 180 and between rkm 743 and rkm 496 (Kolarov, 1985). Adults migrating to the Danube are usually between 2 and 7 years old, with individuals around 3 years old accounting for more than 50% of the migrating population, while individuals 6–7 years old account for only about 1% of the total population (Navodaru, 1996). In the sea, it feeds on zooplankton (especially crustaceans) and small fishes. According to Đikanović *et al.* (2018), macrozoobenthos predominates in the diet during spawning migration in the Danube, and algae, detritus and some terrestrial insects were also found. This is in contrast to the widespread opinion that Pontic shad stop feeding during the spawning migration from the sea to the river (Rozdina *et al.*, 2015).

Habitat

The Pontic shad is a euryhaline, pelagic species that lives in fresh, brackish and marine waters at depths of 3 to 90 m (Kolarov, 1991). It migrates mainly to middle reaches of large rivers of the Black Sea basin. It spawns in strong currents, close to the surface, often at 2-3 m depth in the main channel.

Importance in fisheries

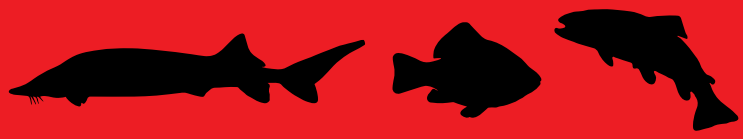
The Pontic shad is a commercially important species in the Danube countries downstream of Serbia. The commercial catch has an economic value in the fishing industry of about 2 million dollars per year (Navodaru, 1996). In Serbia, it was important for catches until the construction of the Đerdap dams. After a permanent ban on fishing was imposed in Serbia, its economic importance was completely lost (Višnjić-Jeftić, 2012).

Threats

Overfishing, the construction of dams, the pollution of the Black Sea and the rivers into which they migrate to spawn, and the habitat loss are the main threats. Considering that they spawn in the fast mainstream of rivers, the most important threat is the formation of reservoirs in the second half of the 20th century and the slowing down of the flow due to the construction of dams (Freyhof & Kottelat, 2008c; Freyhof, 2010a).

Conservation actions in place

The Pontic shad is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species. In Bulgaria, this species is classified as vulnerable in the Red Book because its population is constantly decreasing and the fishing ban is in force from mid-April to mid-May. In Romania, where it is



lovima toka Dunava pre ušća zabranjen komercijalni ribolov kako bi se zaštitila u periodu mresta.

Predložene mere zaštite

Predložene mere zaštite podrazumevaju adekvatno upravljanje populacijama i izlovom ove vrste na evropskom nivou. Imajući u vidu činjenicu da su brane jedan od dominantnih faktora ugrožavanja, neophodno je postavljenje ribljih staza i liftova na branama.

intensively fished, it is not on the list of threatened species, but commercial fishing is banned in certain sections of the Danube before the river mouth to protect it during the spawning season.

Conservation actions needed

The conservation actions needed require appropriate management of populations and fisheries for this species at European level. As dams are one of the biggest threats, fish ladders need to be installed at the dams.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	2.3, 3.1.1

Predložena naučna istraživanja baziraju se na izučavanju ulova, faktora ugrožavanja i trendova populacije ove vrste.

The scientific research needed is based on the study of catches, threats and population trends of this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.4, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Željka Višnjić-Jeftić

JEGULJA
Anguilla anguilla (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Anguilliformes
Porodica: Anguillidae
Vrsta: *Anguilla anguilla* (Linnaeus, 1758)

Sinonimi

Muraena anguilla Linnaeus, 1758; *Anguilla vulgaris* Shaw, 1803; *Anguilla vulgaris* Rafinesque, 1810; *Anguilla mediorostris* Risso, 1827; *Anguilla acutirostris* Risso, 1827; *Anguilla latirostris* Risso, 1827; *Anguilla fluviatilis* Anslijn, 1828; *Muraena platyrhina* Ekström, 1831; *Muraena oxyrhina* Ekström, 1831; *Anguilla canariensis* Valenciennes, 1843; *Anguilla cloacina* Bonaparte, 1846; *Anguilla nilotica* Heckel, 1846; *Anguilla migratoria* Krøyer, 1846; *Anguilla platyrhynchus* Costa, 1850; *Anguilla callensis* Guichenot, 1850; *Leptocephalus brevirostris* Kaup, 1856; *Anguilla aegyptiaca* Kaup, 1856; *Anguilla ancidda* Kaup, 1856; *Anguilla altirostris* Kaup, 1856; *Anguilla platycephala* Kaup, 1856; *Anguilla capitone* Kaup, 1856; *Anguilla morena* Kaup, 1856; *Anguilla melanochir* Kaup, 1856; *Anguilla kieneri* Kaup, 1856; *Anguilla cuvieri* Kaup, 1856; *Anguilla bibroni* Kaup, 1856; *Anguilla savignyi* Kaup, 1856; *Anguilla marginata* Kaup, 1856; *Anguilla microptera* Kaup, 1856; *Anguilla nilotica* Kaup, 1857; *Anguilla eurystoma* Heckel & Kner, 1858; *Anguilla hibernica* Couch, 1865; *Anguilla oblongirostris* Blanchard, 1866; *Anguilla brevirostris* Cisternas, 1877; *Anguilla linnei* Malm, 1877.

Narodno ime: Jegulja
Englesko ime: European eel
Francusko ime: Anguille d'Europe
Nemačko ime: Europäischer Aal
Rusko ime: Речной угорь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, jegulja se smatra kritično ugroženom vrstom (CR) prema kriterijumima A2bd+4bd (Pike *et al*., 2020). Na osnovu procene brojnosti populacije na teritoriji Srbije, jegulji je dodeljen status kritično ugrožene vrste (CR), prema kriterijumima C1+2b. Uočeno je kontinuirano opadanje brojnosti, dok je udeo adultnih jedinki <250, sa ekstremnim fluktuacijama u njihovom broju. Veličina prostora na kome se vrsta pojavljuje (EOO) u Srbiji iznosi 69.029 km², dok je površina naseljavanja (AOO) samo 92 km².

Rasprostranjenje

Jegulja naseljava obale Atlanskog okeana, od Skandinavije do Maroka. Sreće se u većini evropskih reka koje se ulivaju u severni Atlantik, Baltičko more, Sredozemno more, kao i Crno i Belo more (Deelder, 1984). Migrira duboko u kopno duž rečnih tokova, pa

EUROPEAN EEL
Anguilla anguilla (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Anguilliformes
Family: Anguillidae
Species: *Anguilla anguilla* (Linnaeus, 1758)

Synonyms

Muraena anguilla Linnaeus, 1758; *Anguilla vulgaris* Shaw, 1803; *Anguilla vulgaris* Rafinesque, 1810; *Anguilla mediorostris* Risso, 1827; *Anguilla acutirostris* Risso, 1827; *Anguilla latirostris* Risso, 1827; *Anguilla fluviatilis* Anslijn, 1828; *Muraena platyrhina* Ekström, 1831; *Muraena oxyrhina* Ekström, 1831; *Anguilla canariensis* Valenciennes, 1843; *Anguilla cloacina* Bonaparte, 1846; *Anguilla nilotica* Heckel, 1846; *Anguilla migratoria* Krøyer, 1846; *Anguilla platyrhynchus* Costa, 1850; *Anguilla callensis* Guichenot, 1850; *Leptocephalus brevirostris* Kaup, 1856; *Anguilla aegyptiaca* Kaup, 1856; *Anguilla ancidda* Kaup, 1856; *Anguilla altirostris* Kaup, 1856; *Anguilla platycephala* Kaup, 1856; *Anguilla capitone* Kaup, 1856; *Anguilla morena* Kaup, 1856; *Anguilla melanochir* Kaup, 1856; *Anguilla kieneri* Kaup, 1856; *Anguilla cuvieri* Kaup, 1856; *Anguilla bibroni* Kaup, 1856; *Anguilla savignyi* Kaup, 1856; *Anguilla marginata* Kaup, 1856; *Anguilla microptera* Kaup, 1856; *Anguilla nilotica* Kaup, 1857; *Anguilla eurystoma* Heckel & Kner, 1858; *Anguilla hibernica* Couch, 1865; *Anguilla oblongirostris* Blanchard, 1866; *Anguilla brevirostris* Cisternas, 1877; *Anguilla linnei* Malm, 1877.

Vernacular name: Jegulja
English name: European eel
French name: Anguille d'Europe
German name: Europäischer Aal
Russian name: Речной угорь

National threat category assessed according to IUCN criteria

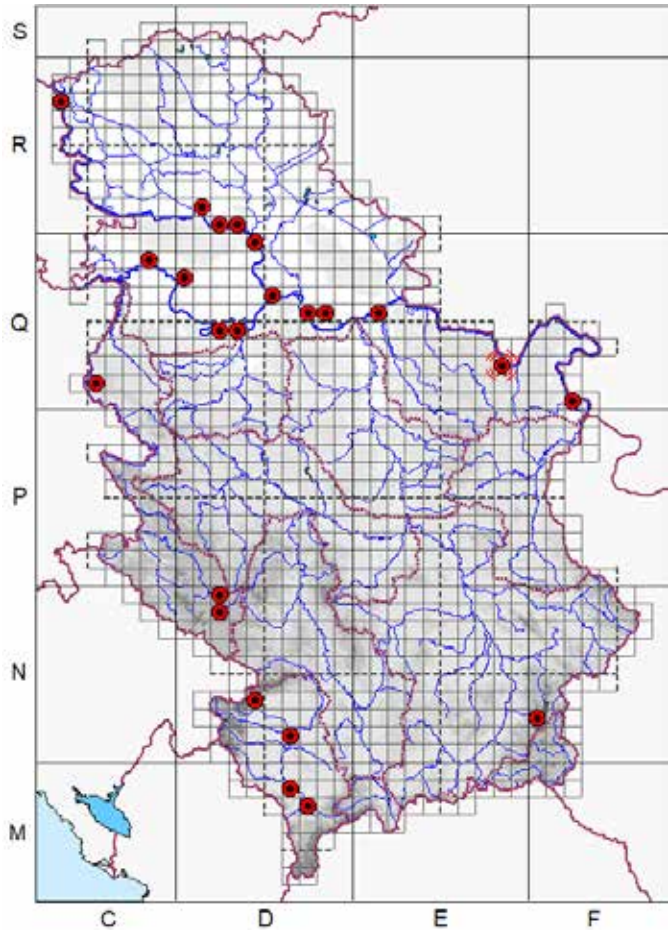
At the global level, the European eel is classified as Critically Endangered (CR) under criteria A2bd+4bd (Pike *et al*., 2020). Based on the assessment of population size in the territory of Serbia, the European eel is classified as Critically Endangered (CR) according to criteria C1+2b. A continuing decline in population size is observed and the percentage of mature individuals is <250, with extreme fluctuations in their number. The extent of occurrence in Serbia (EOO) is 69,029 km², while the area of occupancy (AOO) is only 92 km².

Distribution

The European eel inhabits the coasts of the Atlantic Ocean, from Scandinavia to Morocco. It is found in most European rivers that flow into the North Atlantic, the Baltic Sea, the Mediterranean Sea as well as the Black and White Seas (Deelder, 1984). It migrates along river

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Jegulja / European eel – *Anguilla anguilla*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**CR A2bd+4bd**
	CITES konvencija	**Dodatak / Appendix II**
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR C1+2b Strogo zaštićena vrsta / Strictly protected species**



Slika 64. **Rasprostranjenje *Anguilla anguilla* u Srbiji.**

Figure 64. **Distribution of *Anguilla anguilla* in Serbia.**

Slika 65. Jegulja *Anguilla anguilla* (foto: L. Hlasek, https://www.hlasek.com/anguilla_anguilla_hd7529.html).

Figure 65. European eel *Anguilla anguilla* (foto: L. Hlasek, https://www.hlasek.com/anguilla_anguilla_hd7529.html).

se zato može naći i u vodotocima na većim nadmorskim visinama (Kottelat & Freyhof, 2007). U Srbiji se pojedinačno sreće u većim i srednjim nizijskim i brdskim rekama (Dunav, Sava, Drina, Vapa, Beli Drim) (Slika 64). Nađena je i u Vlasinskom jezeru, u koje je stigla poribljavanjem (Simić *et al*., 2008b; Hegediš *et al*., 2019b).

Opis vrste

Telo jegulje veoma je izduženo, zmijoliko i pokriveno veoma sitnim krljuštima koje su duboko utisnute u kožu (Slika 65). Boja tela je ujednačena, bez pega, tačaka ili pruga. Leđa su većinom tamnozelena ili smeđa, a trbuh beo do žućkast. Početak osnove leđnog peraja nalazi se znatno iza grudnih peraja. Trbušna peraja su odsutna. Usta su terminalna, sa brojnim sitnim, oštrim zubima. Vertikalni škržni otvori su mali. Leđno, repno i podrepno peraje spojeni su u jedinstveno peraje koje se pruža od sredine leđa do analnog otvora, sa minimalnim brojem od 500 granatih zrakova (Keith & Allardi, 2001). Peraja: D 243–275; A 175–249; P 15–21 (Berg, 1962). Kičmenih pršljenova ima 110–120. Maksimalna zabeležena dužina tela iznosi 133 cm (Bauchot, 1986), a masa 6,6 kg (Dekker *et al*., 1998). Mužjaci su obično manji od ženki. Maksimalna zabeležena starost je 23 godine (Simon, 2015).

Populacione karakteristike

Na globalnom nivou utvrđen je izrazito opadajući trend u populacijama jegulje, što je dovelo do statusa kritično ugrožene vrste. Za populaciju jegulje u Srbiji do sada nisu utvrđivani ni veličina ni trendovi, kao ni drugi populacioni parametri. Prema poslednjim saznanjima, jegulja se u Srbiji uglavnom sreće pojedinačno, ali redovno, u ulovima alasa i ribolovaca u Dunavu, ređe Savi i Tisi, a slučajno i u drugim manjim rekama i stajaćim vodama. Ukupan ulov u vodama Srbije praćen je i evidentiran u periodu od 1951. do 1968. godine, nakon čega se prestalo sa tom praksom. Na bazi ankete alasa koja je urađena 2019. godine, došlo se do procene

courses deep inland, so that it can also be found at higher altitudes (Kottelat & Freyhof, 2007). In Serbia, it is sporadically found in larger and medium-sized lowland and mountain rivers (Danube, Sava, Drina, Vapa, White Drim) (Figure 64). It has also been found in Lake Vlasina, where it arrived through stocking (Simić *et al*., 2008b; Hegediš *et al*., 2019b).

Description of the species

The body of the European eel is very elongated, anguilliform, and covered with very small scales deeply embedded in the skin (Figure 65). The body colour is uniform, without spots, specks or stripes. The dorsum is usually dark green or brown, the belly is white to yellowish. The origin of the dorsal fin is far behind the pectoral fins. Ventral fins are not present. The mouth is terminal, with numerous small, sharp teeth. The vertical gill openings are small. The dorsal, caudal and anal fins are fused into a single fin extending from the middle of the dorsum to the anus, with at least 500 soft rays (Keith & Allardi, 2001). Fins: D 243–275; A 175–249; P 15–21 (Berg, 1962). The number of vertebrae is 110–120. Maximum recorded body length is 133 cm (Bauchot, 1986) and mass 6.6 kg (Dekker *et al*., 1998). Males are usually smaller than females. The maximum age is 23 years (Simon, 2015).

Population trends

A significant decline in European eel populations has been observed globally, resulting in the species being classified as Critically Endangered. For the eel population in Serbia, neither the size nor the trends or other population parameters have been determined so far. According to the latest information, the European eel in Serbia occurs mostly individually but regularly in the catches of professional and recreational fishers in the Danube, less frequently in the Sava and Tisza rivers, and incidentally in other smaller rivers and standing waters. The total catch in Serbian waters was monitored and recorded from 1951 to 1968, after which the practice was discontinued. Based

prosečnog ukupnog godišnjeg ulova jegulje u vodama Srbije od oko 1.352 kg u periodu od 2006. do 2018. godine (Hegediš, 2007; Hegediš *et al*., 2019b).

Ekologija vrste

Jegulja spada u grupu katadromnih riba, koja radi reprodukcije migrira u Sargasko more. Nakon mresta, odrasle jedinke ugibaju, a Golfska struja nosi leptocefalus larve do atlanske obale Evrope, kao i do mediteranskih obala, i ta migracija traje oko dve do tri godine (Tesch, 2003). Nakon metamorfoze leptocefalusa u stadijum staklaste jegulje (potpuno providne), mlađ migrira u reke gde se metamorfoza završava elver stadijumom (potpuna pigmentisanost). Juvenilni stadijum naziva se žuta ili smeđa jegulja i obično traje 6–12 godina kod mužjaka i 9–20 godina kod ženki (Bauchot, 1986). Nakon toga dolazi do metamorfoze u srebrni stadijum koji obavlja aktivnu mresnu migraciju do Sargaskog mora. Hrani se čitavim spektrom akvatične faune, i slatkovodne i marinske, uključujući i ribe, rakove, školjke i polihete (Deelder, 1984).

Stanište

Jegulja je solitarna, teritorijalna, pridnena vrsta koja naseljava vodena staništa sa muljevitim, peskovitim i kamenitim dnom, gde obično obitava u šupljinama i rupama (Deelder, 1984). Može da živi u slatkovodnoj, brakičnoj i morskoj sredini. U Srbiji se pojedinačno sreće u različitim tipovima voda, od stajaćih voda (kanali, bare, akumulacije), preko nizijskih, sporotekućih reka, do brzih vodotoka mrenskog i pastrmskog regiona.

Ribolovni značaj

Iako je imala mali ribolovni značaj, do kraja šezdesetih godina prošlog veka jegulja je spadala u vrste za koju su u Srbiji vođene evidencije ulova. Tako je, na primer, 1966. godine ulovljeno 970 kg jegulje, dok je poslednji put ulov evidentiran 1968. godine, kada je ulovljeno 325 kg jegulje. Nakon toga, evidencija ulova ove vrste u Srbiji više nije vođena. Zbog trajnog lovostaja jegulja više nema značaj u komercijalnom i rekreativnom ribolovu (Hegediš *et al*., 2019b).

Faktori ugrožavanja

Imajući u vidu da jegulja u Srbiji naseljava vode crnomorskog i jadranskog sliva, može se reći da su njene populacije izložene čitavom spektru prirodnih i antropogenih ugrožavajućih faktora, i da u tom pogledu dele sudbinu ostalih populacija u čitavom arealu. Ovi faktori, pre svega, uključuju pregrađivanje tokova i ometanje i ograničavanje migracija, efekte klimatskih promena, gubitak i degradaciju staništa, efekte invazivnih vrsta, parazitizam, efekte zagađenja različitog porekla i obima, neodrživ izlov i drugo. Pojavljivanje i značaj pojedinih faktora varira od područja do područja unutar areala.

on the poll of professional fishers from 2019, it was estimated that the average annual eel catch in Serbian waters in the period from 2006 to 2018 was about 1,352 kg (Hegediš, 2007; Hegediš *et al*., 2019b).

Ecology of the species

The European eel belongs to the group of catadromous fish that migrate to the Sargasso Sea to reproduce. After spawning, the adults die and the Gulf Stream carries the leptocephalus larvae to the Atlantic and Mediterranean coasts of Europe, and this migration lasts about two to three years (Tesch, 2003). After the metamorphoses of leptocephalus into the glass eel stage (completely transparent), the juveniles migrate into rivers, where the metamorphosis ends with the elver stage (completely pigmented). The juvenile stage is called yellow or brown eel and usually lasts 6–12 years for males and 9–20 years for females (Bauchot, 1986). It then metamorphoses into the silver stage, which undertakes an active spawning migration into the Sargasso Sea. It feeds on a wide range of aquatic life, both freshwater and marine, including fish, crustaceans, molluscs and polychaetes (Deelder, 1984).

Habitat

The European eel is a solitary, territorial, demersal species that lives in aquatic habitats with muddy, sandy and rocky bottoms, where it usually occupies crevices and holes (Deelder, 1984). It can live in in fresh, brackish and marine waters. In Serbia, it occurs individually in different types of waterbodies, from standing waters (canals, ponds, reservoirs) to slow-flowing rivers in the lowlands and fast-flowing waters in the barbel and trout zones.

Importance in fisheries

Despite its low fisheries importance, the European eel was one of the species for which catch records were kept in Serbia until the end of the 1960s. In 1966, for example, 970 kg of eel were caught, while the last catch was recorded in 1968 at 325 kg. After that, no records of catches of this species were kept in Serbia. Due to the permanent ban on fishing, the European eel is no longer important for commercial and recreational fisheries (Hegediš *et al*., 2019b).

Threats

Considering that the European eel in Serbia lives in the waters of the Black Sea and the Adriatic Basin, it can be said that its populations are exposed to the full spectrum of natural and anthropogenic threats and in this respect share the fate of other populations throughout its range. These factors include, in particular, the damming of rivers and the obstruction and restriction of migration, the effects of climate change, habitat loss and degradation, the impact of invasive species, parasitic infestations, the effects of pollution of varying origin and magnitude, unsustainable fishing and others. The occurrence and importance of certain factors varies from area to area within the range.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 1.2, 1.3, 2.1.3, 2.2.2, 2.3.3, 3.1, 3.3, 4.1, 4.2, 5.1, 5.4.1, 7.2.1, 7.2.2, 7.2.3, 7.2.5, 7.2.6, 7.2.7, 7.2.9, 7.2.10, 7.3, 8.1.1, 8.1.2, 8.4, 9.1.1, 9.1.2, 9.2.2, 9.3.3, 9.4, 9.5.1, 9.6.1, 9.6.2, 11.1, 11.2, 11.4, 11.5

Postojeće mere zaštite

Jegulja se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj, iako ova zabrana ribolova nema efekata na nivou panmiktične populacije koja odlikuje jegulju kao vrstu. U vodama Srbije sreću se lutajuće jedinke, uglavnom iz centralne Evrope, čija je sudbina u vreme metamorfoze iz žutog u srebrni stadijum i početka mresnih migracija potpuno neizvesna.

Predložene mere zaštite

Zbog reproduktivnih specifičnosti ove vrste, uvođenje minimalne lovne mere ne bi imalo svrhu. Ostale konzervacione mere bi se odnosile na održivo upravljanje, zaštitu i obnovu prirodnih procesa u područjima i staništima u kojima jegulja obitava, kontrolu invazivnih vrsta i formalnu edukaciju ribolovaca.

Conservation actions in place

The European eel is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing for this species is imposed, although this fishing ban has no effect on the size of the panmictic population that characterises the European eel as a species. Some wandering individuals are found in the waters of Serbia, mainly from Central Europe, and their fate at the time of metamorphosis from the yellow to the silver stage and the beginning of spawning migration is completely uncertain.

Conservation actions needed

Due to the peculiarities of reproduction of this species, the introduction of a minimum landing size would not be effective. Other conservation measures include sustainable management, protection and restoration of natural processes in the areas and habitats where the European eel lives, control of invasive species and formal education of anglers.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 1.2, 2.1, 2.2, 2.3, 3.1.1, 3.1.2, 4.1, 5.1.1, 5.1.2, 5.4.1, 5.4.2

Istraživanja na jegulji u vodama Srbije jesu potrebna, ali su ograničena pre svega zbog nedostatka dostupnog materijala. Buduća istraživanja trebalo bi da obuhvate praćenje distribucije i pojavljivanja u ulovima u vodama Srbije, kao i praćenje faktora koji ugrožavaju ovu vrstu. Ova istraživanja bi morala da obuhvate i monitoring populacionih trendova, praćenje stanja staništa, kao i praćenje tržišta. Svakako je potrebno razviti i implementirati konzervacione planove vezane za jegulju.

Research on the European eel in Serbian waters is necessary, but limited mainly because of the lack of available material. Future research should extend to monitoring the distribution and abundance of catches in Serbian waters, as well as the factors threatening this species. These studies would also need to include monitoring of population trends, habitat conditions and market surveillance. There is certainly a need to develop and implement conservation plans for the European eel.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2, 3.1, 3.3, 3.4

AUTOR / AUTHOR: Aleksandar Hegediš

OHRIDSKI VIJUN
Cobitis ohridana Karaman, 1928

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cobitidae
Vrsta: *Cobitis ohridana* Karaman, 1928

Sinonimi

Cobitis taenia ohridana Karaman, 1928

Narodno ime: Ohridski vijun
Englesko ime: Ohrid spined loach
Nemačko ime: Ohrid-Steinbeißer
Rusko ime: Охридская щиповка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ohridski vijun nema status ugrožene vrste (Crivelli, 2006b). U Srbiji, ohridski vijun ima status kritično grožene vrste (CR), kako zbog veličine obima rasprostranjenja (EOO iznosi 100 km²), tako i zbog veoma male površine naseljavanja (AOO iznosi 1 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Ohridski vijun je endemična vrsta jugoistočnog dela sliva Jadranskog mora. Naseljava sliv Drima i reku Vojušu, kao i Ohridsko i Skadarsko jezero sa Moračom (Bohlen *et al*., 2003; Crivelli, 2006b; Šanda *et al*., 2008; Grapci-Kotori *et al*., 2020. Rasprostranjena je u Severnoj Makedoniji, Crnoj Gori, Albaniji, Srbiji i Grčkoj. U Srbiji za sada postoji samo jedan nalaz u slivu Belog Drima (Grapci-Kotori *et al*., 2020) (Slika 66).

Opis vrste

Telo ohridskog vijuna je vretenasto i izduženo, a glava krupna i bočno spljoštena (Slika 67). Boja leđa je tamnožuta, dok su bokovi svetložuti. Usta su donja, sa 3 para brkova. Na telu se razlikuju četiri uzdužne pigmentne zone, pri čemu je treća pigmentna zona uža od druge pigmentne zone i sastoji se od samo jednog reda sitnih tačaka (Kottelat & Freyhof, 2007). Okrugla tamna mrlja u gornjem delu osnove repnog peraja, karakteristična za vijune, često nedostaje ili je sitna i bleda. Na početku grudnih peraja mužjaka nalazi se koštani izraštaj. Obično naraste do 6–8 cm, a maksimalna zabeležena dužina tela iznosi 15 cm (Služben vesnik na RM, 2011). Mužjaci su sitniji od ženki.

OHRID SPINED LOACH
Cobitis ohridana Karaman, 1928

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cobitidae
Species: *Cobitis ohridana* Karaman, 1928

Synonyms

Cobitis taenia ohridana Karaman, 1928

Vernacular name: Ohridski vijun
English name: Ohrid spined loach
German name: Ohrid-Steinbeißer
Russian name: Охридская щиповка

National threat category assessed according to IUCN criteria

At the global level, the Ohrid spined loach is not classified as a threatened species and has the status of Least Concern (LC) (Crivelli, 2006b). In Serbia, the species is classified as Critically Endangered (CR) due to the small extent of occurrence (EOO is 100 km²) and the very small area of occupancy (AOO is 1 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Ohrid spined loach is endemic to the southeastern part of the Adriatic Sea basin. It inhabits the Drim watershed and the Aoös/Vjosa River, as well as Lakes Ohrid and Skadar with Morača (Bohlen *et al*., 2003; Crivelli, 2006b; Šanda *et al*., 2008; Grapci-Kotori *et al*., 2020. The species is distributed in Northern Macedonia, Montenegro, Albania, Serbia and Greece. In Serbia, there is so far only one record in the White Drim watershed (Grapci-Kotori *et al*., 2020) (Figure 66).

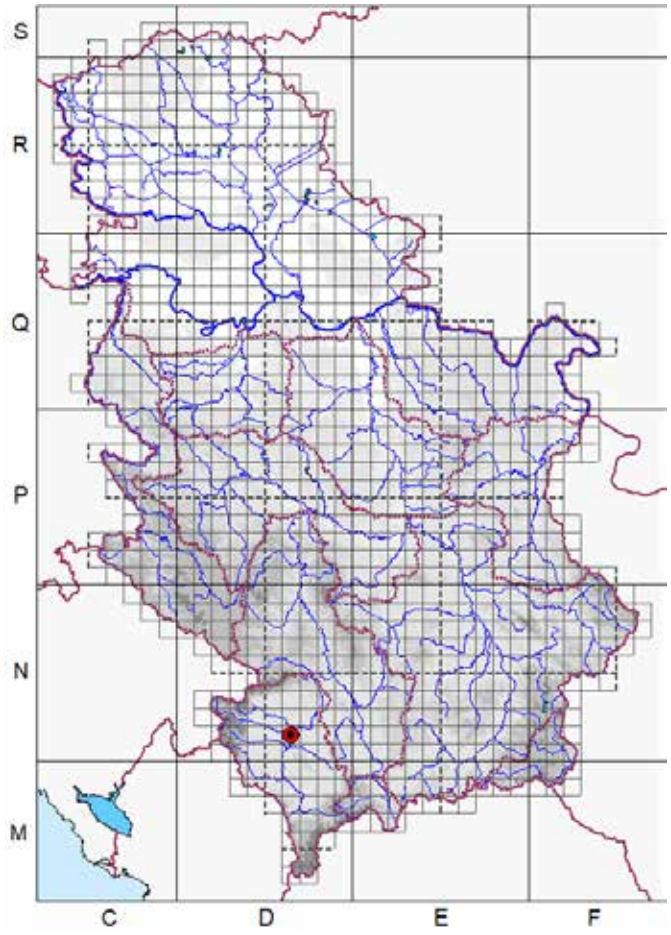
Description of the species

The body of the Ohrid spined loach is spindle-shaped and elongated, the head is large and laterally flattened (Figure 67). The colour of the dorsum is dark yellow, while the sides are light yellow. The mouth is inferior and has three pairs of barbels. Four longitudinal pigment zones can be seen on the body, the third pigment zone being narrower than the second and consisting of only one row of dots (Kottelat & Freyhof, 2007). The round dark spot on the upper part of the caudal fin base, characteristic of loaches, is often absent or small and faint. There is a bony plate at the base of the pectoral fins of males. It usually grows up to 6-8 cm long, and the maximum recorded body length is 15 cm (Official Gazette of RM, 2011). Males are smaller than females.

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Ohridski vijun / Ohrid spined loach – *Cobitis ohridana*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Cobitis taenia*)	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Cobitis taenia*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi (navedena kao / listed as *Cobitis taenia*)	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Cobitis taenia ohridana*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) /daily catch limit of 5 kg (measure applies to all native species)



Slika 66. Rasprostranjenje *Cobitis ohridana* u Srbiji.

Figure 66. Distribution of *Cobitis ohridana* in Serbia.

Slika 67. Ohridski vijun *Cobitis ohridana* (foto: L. Piálek).

Figure 67. Ohrid spined loach *Cobitis ohridana* (photo: L. Piálek).

Populacione karakteristike

Populacije ohridskog vijuna veoma su brojne i ne pokazuju trend opadanja (Bohlen *et al*., 2003; Crivelli, 2008b).

Ekologija vrste

Ohridski vijun dostiže polnu zrelost u drugoj ili trećoj godini života, pri dužini od oko 3,8 cm (Šanda *et al*., 2009). Mresti se od aprila do jula. Pri parenju, mužjak prati ženku do delova staništa gusto obraslih filamentoznim algama i zatim se prstenasto uvija oko ženke u delu tela iza leđnog peraja (Kottelat & Freyhof, 2007). Ikru polaže na pesak ili na akvatične biljke. Plodnost ženke je relativno velika i iznosi od 100.000 do 150.000 jaja (Služben vesnik na RM, 2011). Ohridski vijun je aktivan noću, a tokom dana se ukopava u supstrat. Hrani se beskičmenjacima bentosa i detritusom.

Stanište

Ohridski vijun je bentopelagična vrsta. Naseljava reke i litoralne delove jezera sa muljevitim ili peskovitim dnom, a zadržava se na mestima obraslim filamentoznim algama i submerznom vegetacijom (Bohlen *et al*., 2003; Kottelat & Freyhof, 2007). Preferira čistu i mirnu vodu (Šanda *et al*., 2008).

Ribolovni značaj

Ohridski vijun nema nikakav značaj ni u rekreativnom ni u komercijalnom ribolovu.

Faktori ugrožavanja

Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla, pregrađivanjem i regulacijom tokova, vađenjem peska i šljunka iz rečnog korita, kao i unošenjem alohtonih invazivnih vrsta, mada se smatra da je ohridski vijun vrsta koja je otporna na degradaciju staništa (Crivelli, 2006b).

Population trends

The populations of Ohrid spined loach are very numerous and show no declining trend (Bohlen *et al*., 2003; Crivelli, 2008b).

Ecology of the species

The Ohrid spined loach reaches sexual maturity in its second or third year of life at a length of about 3.8 cm (Šanda *et al*., 2009). It spawns from April to July. When mating, the male follows the female to a part of the habitat densely covered with filamentous algae and then forms a complete ring around the female's body behind the dorsal fin (Kottelat & Freyhof, 2007). The females lay their eggs on sand or on aquatic plants. The fecundity of the females is relatively high, ranging from 100,000 to 150,000 eggs (Official Gazette of RM, 2011). The Ohrid spined loach is active at night and burrows into the substrate during the day. It feeds on benthic invertebrates and detritus.

Habitat

The Ohrid spined loach is a benthopelagic species. It inhabits rivers and lakeshores with muddy or sandy bottoms and stays in places densely covered with filamentous algae and submerged vegetation (Bohlen *et al*., 2003; Kottelat & Freyhof, 2007). It prefers clean and calm water (Šanda *et al*., 2008).

Importance in fisheries

The Ohrid spined loach is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

The threats mainly relate to the habitat pollution by sewage from various sources, the damming and regulation of watercourses, the extraction of sand and gravel from the riverbed, and the introduction of alien invasive species, although the Ohrid spined loach is considered a species resistant to habitat degradation (Crivelli, 2006b).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	3.2, 7.2.8, 7.2.11, 7.3, 8.1.1, 9.1.1, 9.1.3, 9.3.4

Postojeće mere zaštite

Ohridski vijun se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu nisu propisane posebne mere zaštite, ali je obuhvaćena ograničenjem dnevnog ulova na 5 kg kao autohtona vrsta.

Predložene mere zaštite

Ne postoje specifične mere zaštite vrste koje se predlažu. Trebalo bi poboljšati opšte mere koje se tiču sprečavanja degradacije staništa, zagađenja vode i pregrađivanja vodotoka.

Conservation actions in place

The Ohrid spined loach is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, no specific conservation measures are set for this species, but as a native species it falls under the daily catch limit of 5 kg.

Conservation actions needed

No specific species protection measures are proposed. General measures to prevent habitat degradation, water pollution and damming of streams should be improved.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1

S obzirom da o ovoj vrsti nema dovoljno podataka, neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije, kao i faktora ugrožavanja. Novije molekularne analize ukazuju na mogućnost postojanja još jedne vrste roda *Cobitis* u Ohrid-Drim-Skadar sistemu, zbog čega su neophodna i dodatna taksonomska istraživanja (Perdices *et al*., 2008).

In the absence of sufficient data on this species, population size, distribution and trends, life history and ecology, as well as threats need to be studied. Recent molecular analyses suggest the possibility of the existence of another species of the genus *Cobitis* in the Ohrid-Drim-Skadar system, so further taxonomic studies are needed (Perdices *et al*., 2008).

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.5, 1.6, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

MORUNA
Huso huso (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Huso huso* (Linnaeus, 1758)

Sinonimi

Acipenser huso Linnaeus, 1758; *Acipenser albula* Forster, 1767; *Acipenser beluga* Forster, 1767; *Acipenser shyp* Forster, 1767; *Huso ichthyocolla* Bonaparte, 1846; *Acipenser vallisnerii* Molin, 1851; *Huso huso maeoticus* Sal'nikov & Malyatskii, 1934; *Huso huso ponticus* Sal'nikov & Malyatskii, 1934; *Huso huso caspicus* Babushkin, 1942; *Huso huso orientalis* Lelek, 1987

Narodno ime: Moruna
Englesko ime: Beluga, Great Sturgeon
Francusko ime: Bélouga
Nemačko ime: Beluga-Stör, Europäischer Hausen
Rusko ime: Белуга

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, moruna se smatra kritično ugroženom vrstom (CR) prema kriterijumima A2bcd (Gessner *et al*., 2010a). U Srbiji, moruna takođe ima status kritično ugrožene vrste prema više kriterijuma. Uočeno je smanjenje veličine populacije od 80–90%, procenjeno direktnim opažanjem i odgovarajućim indeksom brojnosti (pad broja polno zrelih ženki), koje se dešava usled opadanja kvaliteta staništa, potencijalnog nivoa eksploatacije (ilegalni izlov), kao i efekata introdukcije drugih vrsta, hibridizacije, patogena, polutanata, kompetitora i parazita (kriterijumi A2abcde). Takođe je uočena mala veličina populacije (<250 jedinki) za koju se procenjuje dalje kontinuirano opadanje i ekstremno kolebanje broja zrelih jedinki u svakoj subpopulaciji (kriterijumi C1+2a(i)b). Broj adultnih jedinki procenjen je na <50 (kriterijum D). Veličina prostora na kome se vrsta pojavljuje (EOO) u Srbiji iznosi 200 km², dok je površina naseljavanja (AOO) svega 6 km².

Rasprostranjenje

Moruna je nastanjivala Crno, Kaspijsko, Azovsko i Jadransko more i njihove basene. Iščezla je iz Jadranskog i Azovskog mora zbog prelova i izgradnje brana na rekama u koje migrira zbog mresta. Jedina preostala prirodna populacija u Kaspijskom moru migrira u reku Ural, a jedina preostala populacija u Crnom moru migrira u Dunav, dok su sve ostale populacije skoro sasvim nestale, takođe zbog prelova i izgradnje brana. Pre izgradnje đerdapskih brana jedinke su migrirale uzvodno do Nemačke, a ulazile su i u veće pritoke Dunava (Savu i Dravu). Nakon izgradnje brana, njihovo prisustvo beleži se samo nizvodno od brane „Đerdap II" (Slika 68).

BELUGA
Huso huso (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Huso huso* (Linnaeus, 1758)

Synonyms

Acipenser huso Linnaeus, 1758; *Acipenser albula* Forster, 1767; *Acipenser beluga* Forster, 1767; *Acipenser shyp* Forster, 1767; *Huso ichthyocolla* Bonaparte, 1846; *Acipenser vallisnerii* Molin, 1851; *Huso huso maeoticus* Sal'nikov & Malyatskii, 1934; *Huso huso ponticus* Sal'nikov & Malyatskii, 1934; *Huso huso caspicus* Babushkin, 1942; *Huso huso orientalis* Lelek, 1987

Vernacular name: Moruna
English name: Beluga, Great Sturgeon
French name: Bélouga
German name: Beluga-Stör, Europäischer Hausen
Russian name: Белуга

National threat category assessed according to IUCN criteria

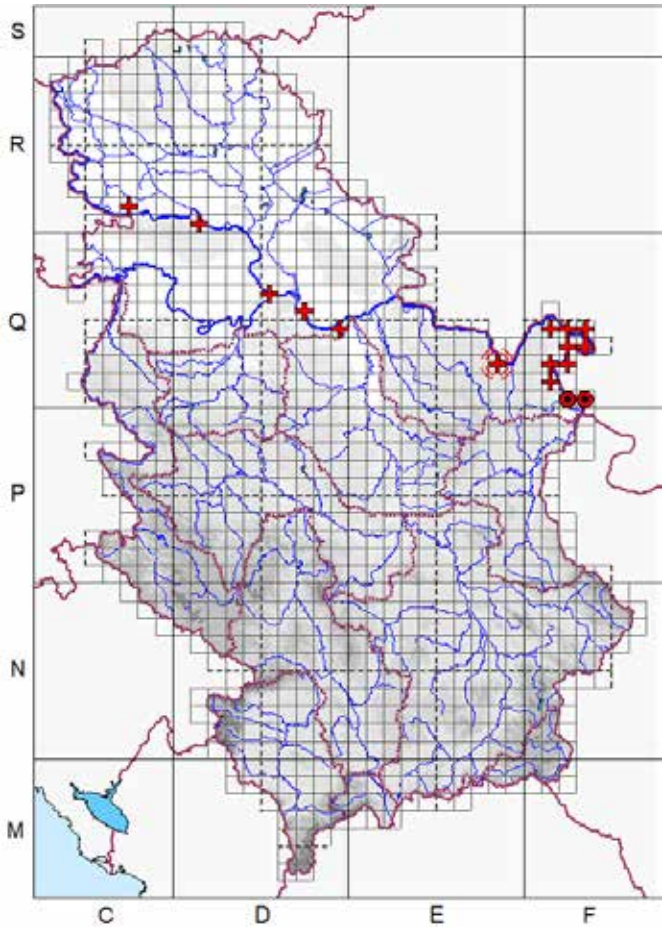
At the global level, the beluga is classified as Critically Endangered (CR) under criteria A2bcd (Gessner *et al*., 2010a). In Serbia, it is also classified as Critically Endangered (CR) according to several criteria. Through direct observation and the appropriate index of abundance (decline in the number of mature females), a decline in population size of 80–90% has been observed due to decline of habitat quality, potential levels of exploitation (illegal fishing) and introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites (criteria A2abcde). In addition, a small population size (<250 individuals) was also observed, for which a further continuing decline and extreme fluctuations in the number of mature individuals in each subpopulation are estimated (criteria C1+2a(i)b). The number of mature individuals was estimated at <50 (criterion D). The extent of occurrence in Serbia (EOO) is 200 km², and the area of occupancy (AOO) is only 6 km².

Distribution

The beluga inhabited the Black, Caspian, Azov and Adriatic Seas and their basins. In the Adriatic Sea and the Sea of Azov it has disappeared due to overfishing and the construction of dams in the rivers where it migrates to spawn. The only remaining natural population in the Caspian Sea is migrating to the Ural River, and the only remaining population in the Black Sea is migrating to the Danube, while all other populations have almost completely disappeared, also due to overfishing and the construction of dams. Before the construction of the Đerdap dams, individuals migrated upstream to Germany and entered the larger tributaries of the Danube (Sava and Drava). After the construction of the dams, they were only recorded downstream of the dam "Đerdap II" (Figure 68).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Moruna / Beluga – *Huso huso*		Status
Međunarodna zaštita / International protection	IUCN Red List	**CR A2bcd**
	CITES konvencija	**Dodatak / Appendix II**
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix II, III**
	Bonska konvencija / Bonn Convention	**Dodatak / Appendix II**
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR A2abcde; C1+2a(i)b; D Strogo zaštićena vrsta / Strictly protected species**



Slika 68. Rasprostranjenje *Huso huso* u Srbiji.

Figure 68. Distribution of *Huso huso* in Serbia.

Slika 69. Moruna *Huso huso* (foto: M. Яковлєв, https://commons.wikimedia.org/wiki/File:%D0%91%D1%96%D0%BB%D1%83%D0%B3%D0%B0_(Huso_huso).jpg).

Figure 69. Beluga *Huso huso* (photo: M. Яковлєв, https://commons.wikimedia.org/wiki/File:%D0%91%D1%96%D0%BB%D1%83%D0%B3%D0%B0_(Huso_huso).jpg).

Opis vrste

Telo morune je izduženo, vretenasto i pokriveno sa pet uzdužnih nizova koštanih ploča (leđni, dva bočna i dva trbušna) (Slika 69). Rostrum (rilo) je relativno kratak i zdepast. Usta su veoma široka. Brkovi su pljosnati i dugi, dopiru skoro do usta. Donja usna je prekinuta u sredini (nije kontinuirana). Leđa su pepeljasto-siva do zelenkasta, bokovi svetliji, a trbuh beo. Leđnih ploča ima 11–14, bočnih 41–52, dok trbušnih ima 9–11. Peraja: D 62–73; A 28–41. Branhiospina na prvom škržnom luku ima 16–22 (Svetovidov, 1964; Fisher *et al*., 1987). Najveći dokumentovani primerak bio je dug 8 m, sa masom od 3.200 kg, ali su jedinke uglavnom ispod 5 m dužine i 1.000 kg mase tela (Kottelat & Freyhof, 2007). Maksimalna zabeležena starost iznosi 118 godina (Beverton, 1987).

Populacione karakteristike

Populacije morune značajno opadaju i njihovo obnavljanje potiče uglavnom iz veštačkog uzgoja. Globalne statistike pokazuju da je ulov od 90-tih godina XX veka opao za 93% (Gessner *et al*., 2010a). Nekada je moruna bila najzastupljenija jesetarska vrsta u slivu Dunava i intenzivno se izlovljavala još tokom srednjeg veka (XI–XV vek). U XVI veku došlo je do pada ulova, ali je eksploatacija nastavljena i tokom narednih vekova (Guti, 2006). Usled hidromorfoloških zahvata na rekama, poslednjih decenija vrsta je pretrpela dalje smanjenje populacije i ograničenje rasprostranjenosti. Nakon izgradnje brane „Đerdap II", migracija je ograničena na 863 km toka Dunava, a u Srbiji na svega 17,6 km (od 863 rkm do 845,6 rkm).

Ekologija vrste

Moruna je vrsta karakteristična po svom veoma dugom životu (može živeti duže od 100 godina), kasnom periodu sazrevanja i velikim dimenzijama tela (najveća je slatkovodna riba na svetu). Anadromna je vrsta, što znači da migrira iz mora u reke radi mresta. U moru živi u pelagijalu. Mresti se na kamenitoj i šljunkovitoj podlozi, u dubokim delovima velikih reka sa brzom strujom (Kottelat & Freyhof, 2007). Mužjaci dostižu polnu zrelost sa 10–16 godina, a ženke sa 14–20 godina starosti. Mreste se svake 3–4 godine u periodu od aprila do juna, kada je protok veliki, pri temperaturama

Description of the species

The body of the beluga is elongated, spindle-shaped and covered with five longitudinal rows of scutes (dorsal, two lateral, and two ventral) (Figure 69). The rostrum is relatively short and stout. The mouth is very large. Barbels are flat and long, reaching almost to the mouth. The lower lip is interrupted at centre (not continuous). The dorsum is ash-grey to greenish, the flanks are lighter, and the belly is white. There are 11–14 dorsal, 41–52 lateral and 9–11 ventral scutes. Fins: D 62–73; A 28–41. There are 16–22 gill rakers on the first gill arch (Svetovidov, 1964; Fisher *et al*., 1987). The largest documented specimen was 8 m long and weighed 3,200 kg, but most individuals are less than 5 m long and have a body weight of 1,000 kg (Kottelat & Freyhof, 2007). The maximum age was reported as 118 years (Beverton, 1987).

Population trends

Beluga populations are in steep decline and their recovery is mainly through artificial propagation. Worldwide statistics show that catches have declined by 93% since the 1990s (Gessner *et al*., 2010a). In the past, the beluga was the most common sturgeon species in the Danube basin and was already intensively fished in the Middle Ages (11th to15th century). In the 16th century, catches declined, but exploitation continued in the following centuries (Guti, 2006). As a result of hydromorphological interventions in rivers, the species has suffered a further population decline and restriction in distribution in recent decades. After the construction of the dam "Đerdap II", migration was restricted to 863 km of the Danube and in Serbia to only 17.6 km (from rkm 863 to rkm 845.6).

Ecology of the species

The beluga is a species characterised by a very long life span (it can live for more than 100 years), late sexual maturity and large body dimensions (it is the largest freshwater fish in the world). It is an anadromous fish, which means that it migrates from the sea to rivers to spawn. At sea, it is pelagic. It spawns on rocky and gravelly substrates in the deep parts of large rivers with fast currents (Kottelat & Freyhof, 2007). Males reach sexual maturity at the age of 10–16 years, females at the age of 14-20 years. They spawn every 3-4 years from April to June during high water levels

vode između 9 °C i 17 °C. Za mrest, najvažniji su uslovi staništa, tj. podloga, brzina i protok vode. Imaju složeni obrazac mresta koji uključuje jedan pik u kasnu zimu i proleće (mart, češće april i maj) i drugi u kasnu jesen. Primerci koji migriraju tokom jeseni ostaju u rekama do sledećeg proleća. Larve i mlađ vodena struja u rekama nosi do mora gde žive dok ne dostignu polnu zrelost. Pravi je predator, hrani se ribom, rakovima, mekušcima i amfipodama. U juvenilnom stadijumu hrani se organizmima bentosa i planktona, dok je odraslima riba primarna hrana (Kottelat & Freyhof, 2007).

Stanište

Bentopelagična je vrsta koja naseljava morske, slatkovodne i brakične vode umerenog pojasa do dubina od 180 m, i opsega temperatura vode od 10 °C do 20 °C (Baensch & Riehl, 1991; Kottelat & Freyhof, 2007).

Ribolovni značaj

Moruna je vekovima imala veliki ribolovni značaj jer se ribolov pre svega zasnivao na velikoj vrednosti kavijara, ali se i njeno meso cenilo. Od 2003. do 2006. godine Srbija je primenjivala propise CITES konvencije kojom su određene kvote godišnjeg dozvoljenog izlova za svaku zemlju crnomorskog sliva (Smederevac-Lalić *et al*., 2011a). Izlov morune i ostalih jesetarskih vrsta zabranjen je u Dunavu od 2006. godine, ali i dalje postoji ilegalan izlov (Smederevac-Lalić, 2013).

Faktori ugrožavanja

Osnovni faktori ugrožavanja morune jesu izgradnja brana i regulacija tokova, intenzivan izlov, zagađenje voda, razvijen rečni saobraćaj, nedostatak staništa, pojava alohtonih invazivnih vrsta i promena genetičkog statusa populacija (Gessner *et al*., 2010a). Dugotrajan i neodrživ izlov zbog cenjenog mesa i ikre (od koje se pravi najskuplji i najcenjeniji krupan crni kavijar), uz povećanje broja ribara i sve efikasnije ribolovne alate, uticali su na pad brojnosti populacije i gotovo doveli do nestanka ove vrste u mnogim područjima. Izgradnja hidroelektrana na Dunavu i regulacija toka blokirali su migratorni put i na taj način prouzrokovali fragmentaciju i uništavanje staništa. U poslednjih par decenija sve veće zagađenje voda prouzrokovano antropogenim faktorima uticalo je na pogoršanje uslova za život u rekama i morima, što takođe doprinosi padu brojnosti (Reinartz, 2002).

and at water temperatures between 9 °C and 17 °C. The habitat conditions are most important for spawning, namely the substrate, flow velocity and flow rate. They have a complex spawning behaviour that includes a peak in late winter and spring (March, more often April and May) and another in late autumn. Specimens that migrate in the autumn remain in the rivers until the following spring. The larvae and juveniles are carried by river currents to the sea, where they live until sexual maturity. It is a true predator and feeds on fish, crustaceans, molluscs and amphipods. In the juvenile stage it feeds on benthic and planktonic organisms, while fish are the main food of the adults (Kottelat & Freyhof, 2007).

Habitat

It is a benthopelagic species inhabiting marine, fresh and brackish waters of the temperate zone to a depth of 180 m, with water temperatures between 10 °C and 20 °C (Baensch & Riehl, 1991; Kottelat & Freyhof, 2007).

Importance in fisheries

For centuries, the beluga was of great importance to fisheries, based primarily on the high value of its caviar, but its meat was also prized. From 2003 to 2006, Serbia applied the provisions of CITES, which sets the annual allowable catch quotas for each country in the Black Sea basin (Smederevac-Lalić *et al*., 2011a). Fishing for beluga and other sturgeon species has been banned in the Danube since 2006, but illegal fishing still occurs (Smederevac-Lalić, 2013).

Threats

The main factors threatening the beluga are dam construction and flow regulation, intensive fishing, water pollution, increased river traffic, lack of habitat, the appearance of non-native invasive species and changes in the genetic status of populations (Gessner *et al*., 2010a). Long-term and unsustainable exploitation of the valuable meat and roe (from which the most expensive and valuable large black caviar is produced), as well as the increasing number of fishers and increasingly efficient fishing gear, have caused the decline of populations and almost led to the disappearance of this species in many areas. The construction of hydroelectric power plants on the Danube and the regulation of its flow have blocked the migration route, leading to habitat fragmentation and destruction. In recent decades, increasing water pollution due to anthropogenic factors has led to a deterioration of living conditions in rivers and seas, which also contributes to the decline of populations (Reinartz, 2002).

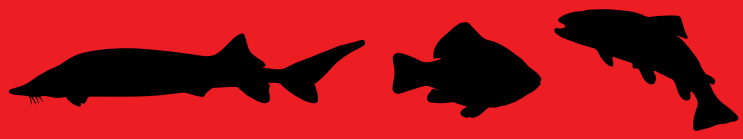
Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	4.3, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 7.2.11, 8.1.1, 9.2.3, 9.3.3, 12.1

Postojeće mere zaštite

Moruna se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj. Prema *Pravilniku o načinu, alatima i sredstvima kojima se obavlja privredni ribolov, kao i o načinu, alatima, opremi i sredstvima*

Conservation actions in place

The beluga is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species. According to the *Rulebook on Methods, Tools and Means*



kojima se obavlja rekreativni ribolov nije dozvoljena upotreba alata za privredni ribolov kojima se nekada lovila moruna (pampurski struk). Od 2006. godine stupio je na snagu moratorijum (potpuna zabrana izlova) na čitavom području Dunava i Crnog mora, koji je i dalje na snazi.

Predložene mere zaštite

Predložene mere zaštite tiču se svih jesetarskih vrsta i mogu se podeliti na tri osnovne oblasti: programi očuvanja i održivog upravljanja postojećim populacijama (koji uključuju i edukativne programe i razvoj međunarodne i nacionalne legislative), dalja naučna istraživanja, veštački mrest i poribljavanje jedinkama iz uzgoja (*ex situ* zaštita). U okviru *Akcionog plana upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al*., 2005) predložene su sledeće mere zaštite: zaštita staništa, omogućavanje pristupa mrestilištima, naučna istraživanja bioloških karakteristika i proučavanje genetičke strukture populacija, standardizovana realizacija veštačkog mresta u cilju poribljavanja i reintrodukcije.

for Commercial Fishing, and Methods, Tools, Equipment and Means for Recreational Fishing, it is not allowed to use tools for commercial fishing that have been used to catch beluga (unbaited longlines). Since 2006, a moratorium (complete ban on fishing) has been in force in the entire Danube and Black Sea area and is still in force.

Conservation actions needed

The conservation actions needed affect all sturgeon species and can be divided into three basic areas: Conservation programmes and sustainable management of existing populations (which includes education programmes and the development of international and national legislation), further scientific research, artificial spawning and stocking with captive bred fish (*ex situ* conservation). Within the framework of the *Action plan for sturgeon species management in fishery waters of the Republic of Serbia* (Lenhardt *et al*., 2005), the following conservation measures were proposed: habitat protection, enabling access to spawning grounds, scientific research on the biological characteristics and study of the genetic structure of populations, standardised implementation of artificial spawning for the purpose of stocking and reintroduction.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 2.3, 3.1.1, 3.1.2, 3.4.1, 3.4.2, 4, 5.1.1, 5.1.2, 5.2

Neophodna su dalja istraživanja i praćenja stanja veličine, distribucije i trendova populacije morune, životne istorije i ekologije ove vrste, kao i eksploatacije i faktora ugrožavanja. Potrebno je osavremeniti i aktuelizovati konzervacione akcione planove i razviti i implementirati odgovarajuće programe monitoringa populacionih trendova i stanja uslova u staništu.

Further research and monitoring of the beluga population size, distribution and trends, as well as on its life history and ecology, exploitation and threats are needed. There is also a need to modernise and update conservation action plans and to develop and implement appropriate programmes to monitor population trends and habitat conditions.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2, 3.1, 3.4

AUTOR / AUTHOR: Marija Smederevac-Lalić

RUMUNSKI ZLATNI VIJUN
Sabanejewia romanica (Băcescu, 1943)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cobitidae
Vrsta: *Sabanejewia romanica* (Băcescu, 1943)

Sinonimi

Cobitis caspia romanica Băcescu, 1943; *Cobitis romanica* Băcescu, 1943

Narodno ime: Rumunski zlatni vijun
Englesko ime: Romanian golden loach
Nemačko ime: Rumänischer Steinbeißer

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, rumunski zlatni vijun ima status gotovo ugrožene vrste (NT) (Freyhof & Kottelat, 2008t). U Srbiji, usled ekstremno visokog rizika od izumiranja, ima status kritično ugrožene vrste (CR). Obim rasprostranjenja (EOO) iznosi 300 km², dok je procenjena površina koju vrsta naseljava veoma mala (AOO iznosi 3 km²) i fragmentisana. Prognozirano kontinuirano opadanje obima rasprostranjenja i površine naseljavanja, opadanje kvaliteta staništa, broja naseljenih lokaliteta i subpopulacija, kao i ekstremne fluktuacije površine naseljavanja, ukazuju na ugroženost vrste prema kriterijumima B2ab(i,ii,iii,iv)c(ii).

Rasprostranjenje

Rumunski zlatni vijun je endemit Dunavskog sliva. Naseljeva neke pritoke Dunava i Tise u Rumuniji (Kottelat & Freyhof, 2007), a u Srbiji je prisutan u istočnom delu zemlje, u tri pritoke Dunava kratkog toka: Rečka, Slatinska reka i Zamna (Marić *et al*., 2022) (Slika 70).

Opis vrste

Telo rumunskog zlatnog vijuna je izduženo i bočno spljošteno (Slika 71). Na repnom stablu prisutan je slabo razvijen masni greben. Glava je bočno spljoštena, bez krljušti, a usta su donja, sa tri para brkova. Na bočnim stranama glave nalazi se podočna jama sa dvostrukom bodljom. Glava je prekrivena tamnim mrljama, dok se duž svetlih bokova tela pruža tanka, tamna, isprekidana središnja linija. Na ovoj liniji se nalazi 9-13 elipsoidnih ili kružnih tamnih mrlja. Na leđima se nalazi niz od 10-13 pravougaonih tamnih mrlja, dok se između bočnog i leđnog niza nalaze sitnije izdužene mrlje, uglavnom raspoređene u dva nepravilna niza. Na gornjoj strani glave prisutne su dve tamnije trake u obliku slova V, dok su na repnoj osnovi uočljive dve tamnije polumesečaste mrlje. Peraja su providna, pri čemu se na leđnom i repnom peraju nalazi nekoliko nepravilnih redova sitnih tačaka (Ivanova & Dobrovolov, 1999). Peraja:

ROMANIAN GOLDEN LOACH
Sabanejewia romanica (Băcescu, 1943)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cobitidae
Species: *Sabanejewia romanica* (Băcescu, 1943)

Synonyms

Cobitis caspia romanica Băcescu, 1943; *Cobitis romanica* Băcescu, 1943

Vernacular name: Rumunski zlatni vijun
English name: Romanian golden loach
German name: Rumänischer Steinbeißer

National threat category assessed according to IUCN criteria

At the global level, the Romanian golden loach is classified as Near Threatened (NT) (Freyhof & Kottelat, 2008t). In Serbia, the species is classified as Critically Endangered (CR) due to an extremely high risk of extinction. The extent of occurrence (EOO) is 300 km², while the estimated area of occupancy is very small (AOO is 3 km²) and fragmented. The projected continuing decline in extent of occurrence and area of occupancy, habitat quality, number of locations and subpopulations, and extreme fluctuations in area of occupancy indicate that the species is threatened under criteria B2ab(i,ii,iii,iv)c(ii).

Distribution

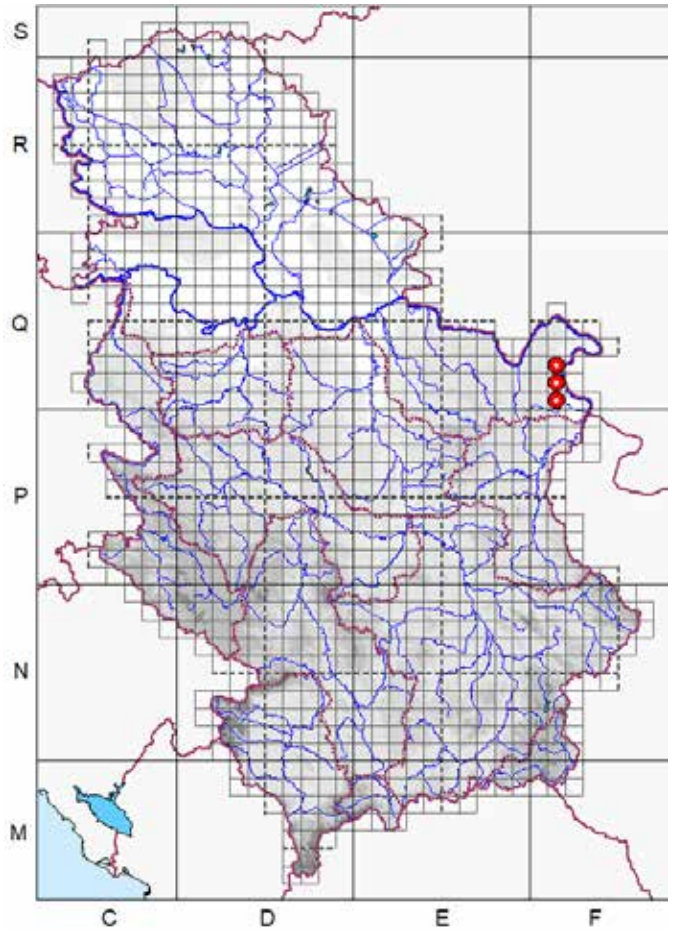
The Romanian golden loach is endemic to the Danube basin. It inhabits some tributaries of the Danube and the Tisza in Romania (Kottelat & Freyhof, 2007), and in Serbia it is found in the eastern part of the country in three short tributaries of the Danube: Rečka, Slatinska reka and Zamna (Marić *et al*., 2022) (Figure 70).

Description of the species

The body of the Romanian golden loach is elongated and laterally flattened (Figure 71). The adipose crest on the caudal peduncle is poorly developed. The head is laterally flattened, without scales, the mouth is inferior and has three pairs of barbels. On the sides of the head there is a suborbital double spine in a groove under the eye. The head is covered with dark spots. Along the pale flanks there is a thin, dark, interrupted line and 9–13 ellipsoidal or circular dark blotches in the mid-lateral row. On the dorsum there is a row of 10–13 rectangular dark spots, while between the lateral and dorsal rows there are smaller elongated spots, generally arranged in two irregular rows. There are two darker V-shaped bands on the top of the head, and two darker crescent-shaped spots at the caudal base. The fins are transparent, with several irregular rows of small spots on the dorsal and caudal fins (Ivanova & Dobrovolov, 1999). Fins: D I–II + 6–9; A I–II

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Rumunski zlatni vijun / Romanian golden loach – *Sabanejewia romanica*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**NT**
	CITES konvencija	–
	Evropska direktiva o staništima / European Habitats Directive	–
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	–
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	–
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	–
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	–
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR B2ab(i,ii,iii,iv)c(ii) Strogo zaštićena vrsta / Strictly protected species**



Slika 70. **Rasprostranjenje *Sabanejewia romanica* u Srbiji.**

Figure 70. **Distribution of *Sabanejewia romanica* in Serbia.**

Slika 71. Rumunski zlatni vijun *Sabanejewia romanica* (foto: Đ. Gajić).

Figure 71. Romanian golden loach *Sabanejewia romanica* (photo: Đ. Gajić).

D I–II + 6–9; A I–II + 5–8; P I + 5–9; V I–II + 5–7; C I + 10–12 + I (Ivanova & Dobrovolov, 1999; Marić *et al.*, 2022). Jedinke dostižu dužinu do 12 cm (Bănărescu, 1964).

Populacione karakteristike

Današnji areal vrste fragmentisan je u velikoj meri, a uočen je i kontinuirani pad brojnosti. Na teritoriji Srbije vrsta je prvi put registrovana 2021. godine (Marić *et al.*, 2022). Usled velike suše i odvođenja vode, srednji delovi toka Rečke i Zamne nisu bili kontinuirani u vreme uzorkovanja što se odrazilo i na nisku brojnost vrste, koja je pronađena u zabarenim ostacima rečnog toka. Slatinska reka predstavlja najočuvanije stanište, sa kontinuiranim tokom, na kome su registrovane jedinke različitog uzrasta. Iako su podaci o strukturi i brojnosti populacija rumunskog zlatnog vijuna u Srbiji oskudni, nalazi ukazuju na nepovoljan populacioni status.

Ekologija vrste

Mresti se u udubljenjima između kamenja ili na vegetaciji, u periodu od maja do jula (Kottelat & Freyhof, 2007). Mlađ obitava u mirnim delovima toka, sa sitnim peskom i muljem. U toku dana, jedinke su neaktivne i ukopane u podlogu, iz koje im viri samo deo glave. Hrani se uglavnom noću, prikupljajući sa dna alge, beskičmenjake i detritus (Bănărescu, 1964).

Stanište

Rumunski zlatni vijun je bentosna vrsta koja obično živi u manjim vodotocima u brdsko planinskim područjima, u tzv. regionu lipljena, a retko se može naći i u nizvodnijim delovim toka, u tzv. regionu mrene (Bănărescu, 1964). Naseljava plitka, peskovita ili šljunkovita staništa, sa umereno brzim tokom, bistrom i hladnom vodom temperature 10–18 °C (Baensch & Riehl, 1997).

Ribolovni značaj

Rumunski zlatni vijun nema ribolovni značaj.

+ 5–8; P I + 5–9; V I–II + 5–7; C I + 10–12 + I (Ivanova & Dobrovolov, 1999; Marić *et al.*, 2022). Individuals reach a length of up to 12 cm (Bănărescu, 1964).

Population trends

The current range of the species is highly fragmented and a continuing population decline has been observed. In the territory of Serbia, the species was first recorded in 2021 (Marić *et al.*, 2022). Due to severe drought and water runoff, the middle sections of the Rečka and Zamna rivers were not continuous at the time of sampling, which is also reflected in the low abundance of species observed in the ponds remaining from the river course. The Slatinska reka is the best preserved habitat with continuous flow where individuals of different ages have been found. Although few data are available on the structure and abundance of the Romanian golden loach populations in Serbia, the results indicate an unfavourable population status.

Ecology of the species

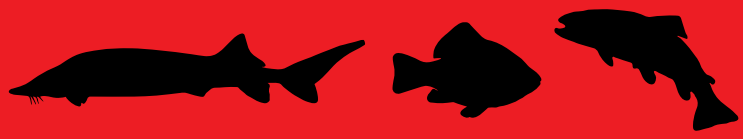
It spawns from May to July in crevices between stones or on vegetation (Kottelat & Freyhof, 2007). Juveniles live in calm stream sections with fine sand and silt. During the day, individuals are inactive and buried in the substrate, from which only part of the head protrudes. It feeds mainly at night, picking up algae, invertebrates and detritus from the bottom (Bănărescu, 1964).

Habitat

The Romanian golden loach is a demersal species that usually lives in smaller streams in mountainous regions, in the so-called grayling zone, and is only rarely found in the downstream parts, in the barbel zone (Bănărescu, 1964). It inhabits shallow, sandy or gravelly habitats with moderately fast current, clear and cold water with temperature of 10–18 °C (Baensch & Riehl, 1997).

Importance in fisheries

The Romanian golden loach is of no fishery importance.



Faktori ugrožavanja

Najizrazitiji faktori ugrožavanja koji su doprineli gubitku staništa i smanjenju brojnosti populacija, posebno u rumunskom delu areala vrste, jesu regulacija reka, izgradnja hidrotehničkih objekata, odvođenje vode i zagađenje (Freyhof & Kottelat, 2008t). Na teritoriji Srbije najznačajniji faktori ugrožavanja odnose se na fragmentaciju staništa, promenu vodnog režima, tipa i kvaliteta staništa, usled velikih suša i odvođenja vode za ljudske potrebe.

Threats

The main threats that have contributed to habitat loss and population decline, especially in the Romanian part of the species range, are river regulation, construction of hydrotechnical facilities, water withdrawal and pollution (Freyhof & Kottelat, 2008t). In Serbia, the main threats are habitat fragmentation, changes in water regime, habitat type and quality due to major droughts, and water withdrawal for human needs.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.4, 7.2.8, 7.2.11, 7.3, 11.1, 11.2, 11.3

Postojeće mere zaštite

U Srbiji trenutno ne postoje mere zaštite koje se odnose na rumunskog zlatnog vijuna.

Conservation actions in place

The Romanian golden loach is currently not covered by the existing conservation measures in Serbia.

Predložene mere zaštite

Za očuvanje populacija rumunskog zlatnog vijuna potrebno je sprovesti zaštitu i revitalizaciju staništa, kao i strogu kontrolu odvođenja vode i zabranu izgradnje hidrotehničkih objekata koji utiču na fragmentaciju i promenu kvaliteta staništa. Vrsti treba dodeliti odgovarajuće administrativne mere zaštite, odnosno uključiti je u *Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva*, kao i u *Naredbu o merama za očuvanje i zaštitu ribljeg fonda*. Lokalno stanovništvo treba informisati o biološkom značaju vrste, faktorima ugrožavanja i planovima za njen oporavak.

Conservation actions needed

In order to maintain the population of the Romanian golden loach, the protection and revitalisation of the habitat, as well as strict control of water drainage and a ban on the construction of hydrotechnical facilities that lead to fragmentation and alteration of habitat quality, are necessary. The species should be protected through appropriate administrative measures, i.e. it should be included in the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and in the *Regulation on Measures for the Conservation and Protection of Fish Stocks*. The local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 4, 5.1.1, 5.1.2, 5.4.1, 5.4.2

Neophodno je sprovoditi detaljna i redovna istraživanja osnovnih bioloških parametara, kao što su analize veličine i distribucije populacija, populacionih trendova, odlika životne istorije, ekologije, genetičke strukture i faktora ugrožavanja. Posebnu pažnju treba obratiti na genetičku karakterizaciju populacija iz Srbije i Rumunije, jer rumunske populacije možda mogu poslužiti kao donorske pri sprovođenju konzervacionih aktivnosti na teritoriji Srbije. Rezultate istraživanja treba implementirati u mere zaštite, oporavka i upravljanja staništima i vrstom, uz redovan nadzor sprovođenja mera.

It is necessary to conduct detailed and regular studies on basic biological parameters, such as analyses of population size and distribution, population trends, life history characteristics, ecology, genetic structure and threats. Special attention should be paid to the genetic characterisation of populations from Serbia and Romania, as the Romanian populations can serve as donors for the implementation of conservation measures in the territory of Serbia. The research results should be translated into habitat and species conservation, restoration and management measures, the implementation of which will be monitored regularly.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2.1, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Saša Marić

GLAVATICA
Salmo marmoratus Cuvier, 1829

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Salmoniformes
Porodica: Salmonidae
Vrsta: *Salmo marmoratus* Cuvier, 1829

Sinonimi

Salmo trutta marmoratus Cuvier, 1829; *Salar genivittatus* Heckel & Kner, 1858

Narodno ime: Glavatica
Englesko ime: Marble trout
Francusko ime: Truite marbrée
Nemačko ime: Marmorierte Forelle
Rusko ime: Мраморная форель

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, glavatica nema status ugrožene vrste (Crivelli, 2006j). U Srbiji, zbog visokog rizika od izumiranja, glavatica ima status kritično ugrožene vrste (CR). Usled uočenog i prognoziranog kontinuiranog opadanja broja odraslih jedinki u svakoj subpopulaciji vrsta je ugrožena prema kriterijumu C2a(i). Kvantitativna analiza (kriterijum E), ukazuje na to da je verovatnoća iščezavanja u prirodi ≥50% u narednih 10 godina ili tri generacije. Obim rasprostranjenja (EOO) u Srbiji iznosi 466 km², dok je površina naseljavanja (AOO) svega 2 km².

Rasprostranjenje

Glavatica je endemična vrsta Jadranskog sliva u kome naseljava više rečnih sistema, počevši od sistema reke Po u Italiji do sistema Crnog Drima u Severnoj Makedoniji (Kottelat & Freyhof, 2007; Schöffmann *et al*., 2019). Na teritoriji Srbije, glavatica je registrovana u Belom Drimu i pritokama – Istočkoj reci i Miruši (Marković, 1962; Šorić, 1990) (Slika 72).

Opis vrste

Telo glavatice je izduženo, cilindrično, blago bočno spljošteno, pokriveno sitnim krljuštima (Slika 73). Boja tela adultnih jedinki je srebrnkasta, maslinasto-smeđa ili maslinasto-zelena. Na dorzalnoj strani glave i tela nalaze se tamnije pege nejednake veličine, koje na bokovima prelaze u izuvijane linije (Kottelat & Freyhof, 2007), što vrsti daje mramorasti izgled po kome je i dobila stručno ime. Juvenilne jedinke karakteriše prisustvo crvenkastih pega na bokovima tela, koje su uglavnom retke kod adultnih jedinki. Glavatica se odlikuje velikom glavom, koja čini oko 25% ukupne dužine tela, po čemu je i dobila narodno ime. Vilice su snažne, izdužene i nose velike i jake zube. Prošireni zadnji kraj gornjovilične kosti premašuje

MARBLE TROUT
Salmo marmoratus Cuvier, 1829

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Salmoniformes
Family: Salmonidae
Species: *Salmo marmoratus* Cuvier, 1829

Synonyms

Salmo trutta marmoratus Cuvier, 1829; *Salar genivittatus* Heckel & Kner, 1858

Vernacular name: Glavatica
English name: Marble trout
French name: Truite marbrée
German name: Marmorierte Forelle
Russian name: Мраморная форель

National threat category assessed according to IUCN criteria

At the global level, the marble trout is not classified as a threatened species and has the status of Least Concern (LC) (Crivelli, 2006j). In Serbia, the species is classified as a Critically Endangered (CR) due to a high risk of extinction. Based on the observed and projected continuing decline in the number of mature individuals in each subpopulation, the species is threatened under criterion C2a(i). The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥50% in the next 10 years or three generations. The extent of occurrence (EOO) in Serbia is 466 km², while the area of occupancy (AOO) is only 2 km².

Distribution

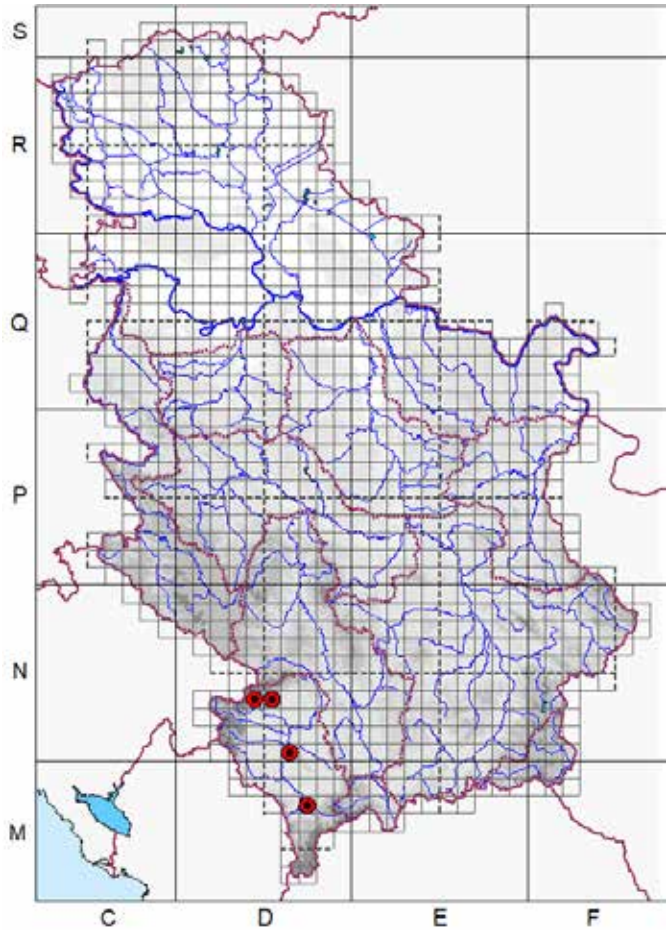
The marble trout is endemic to the Adriatic Sea basin, where it inhabits several river systems, starting from the Po river system in Italy to the Black Drim system in Northern Macedonia (Kottelat & Freyhof, 2007; Schoeffmann *et al*., 2019). In the territory of Serbia, the Glavatica is recorded in the White Drim and its tributaries – Istočka reka and Miruša (Marković, 1962; Šorić, 1990) (Figure 72).

Description of the species

The body of the marble trout is elongated, cylindrical, slightly flattened laterally and covered with small scales (Figure 73). The body colour of adults is silvery, olive brown or olive green. On the dorsal side of the head and body are darker spots of uneven size, which merge into curved lines on the sides (Kottelat & Freyhof, 2007), giving the species a marbled appearance and earning it its scientific name. Juveniles are characterised by reddish spots on the flanks, which are rare in adults. The marble trout is characterised by a large head, which accounts for about 25% of the total body length, hence its vernacular name "glavatica" in Serbian (glava/head). The jaws are strong, elongated, with large and strong teeth. The broadened posterior end of the upper jaw protrudes

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Glavatica / Marble trout – *Salmo marmoratus*	Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**CR C2a(i); E Strogo zaštićena vrsta / Strictly protected species**



Slika 72. **Rasprostranjenje *Salmo marmoratus* u Srbiji.**

Figure 72. **Distribution of *Salmo marmoratus* in Serbia.**

Slika 73. Glavatica *Salmo marmoratus* (foto: J. Schöffmann).

Figure 73. Marble trout *Salmo marmoratus* (photo: J. Schöffmann).

zadnju ivicu oka (Šorić, 1990). Leđno i podrepno peraje imaju kratku osnovu (Podgornik, 2014). Peraja: D III–IV + 10–11; A II–IV + 7–9; P I–II +12–14; V 0–II + 8–9; C 19 (Karaman, 1927; Povž *et al*., 1996). Broj krljušti u bočnoj liniji je 112–137 (Šorić, 1990; Povž *et al*., 1996), a broj piloričnih cekuma je 24–71 (Karaman, 1927; Šorić, 1990). Glavatica je najveći salmonidni predstavnik mediteranskog basena, može dostići dužinu do 140 cm (Svetina & Verce, 1969) i masu do 30 kg (Aganović, 1979). Maksimalna zabeležena starost je 12 godina (Pintar, 1991), međutim ovaj podatak dat je za jedinku koja je bila manjih dimenzija od maksimalno zabeleženih, tako da je navedena starost verovatno potcenjena.

Populacione karakteristike

Populacije imaju trend opadanja brojnosti u čitavom arealu, sa izuzetkom populacija iz sliva Soče u Sloveniji (Mrakovčić *et al*., 2006; Georgiev, 2011; Schöffmann *et al*., 2019; Balkan Trout Restoration Group, 2020). Najkritičnija situacija jeste na području Severne Makedonije (sliv Crnog Drima) i Albanije (sliv Drima), gde su populacije glavatice u fazi iščezavanja ili su sa nekih lokaliteta već iščezle (Georgiev, 2011; Schöffmann *et al*., 2019). Za područje Srbije ima veoma malo dostupnih podataka, ali najverovatnije da je i populacija iz sliva Belog Drima u fazi iščezavanja. Postoje literaturni podaci iz druge polovine prošlog veka o prisustvu glavatice u Belom Drimu i pritokama (Marković, 1962), od kojih se poslednji odnose na nalaz dve jedinke u donjem toku Miruše (Šorić, 1990). Za prvu dekadu ovog veka postoje nepotvrđene informacije o izlovu dve jedinke iz Belog Drima (Grapci-Kotori *et al*., 2010). Međutim, u poslednjem istraživanju ihtiofaune Belog Drima, koje je sprovedeno 2017. i 2019. godine, među 21 registrovanom vrstom nije bilo nalaza glavatice (Grapci-Kotori *et al*., 2020).

Ekologija vrste

Mužjaci glavatice dostižu polnu zrelost u drugoj ili trećoj, a ženke u četvrtoj ili petoj godini života. Glavatica se mresti na peskovitoj ili šljunkovitoj podlozi, od novembra do januara, pri temperaturi vode nižoj od 6 °C. Mrest je najintenzivniji u toku noći za vreme mladog meseca. Obično traje oko mesec dana, ali u nekim

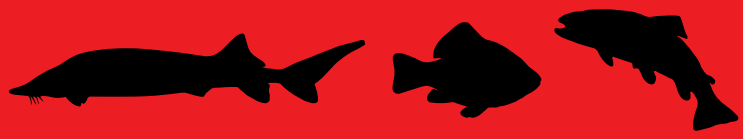
beyond the posterior edge of the eye (Šorić, 1990). The dorsal and anal fins have a short base (Podgornik, 2014). Fins: D III–IV + 10–11; A II–IV + 7–9; P I–II +12–14; V 0–II + 8–9; C 19 (Karaman, 1927; Povž *et al*., 1996). The number of scales in the lateral line is 112–137 (Šorić, 1990; Povž *et al*., 1996), and the number of pyloric caeca is 24–71 (Karaman, 1927; Šorić, 1990). The marble trout is the largest salmonid in the Mediterranean, it can reach a length of up to 140 cm (Svetina & Verce, 1969) and a mass of up to 30 kg (Aganović, 1979). The reported maximum age is 12 years (Pintar, 1991), but this is an individual that was smaller than the maximum size observed, so this age is probably underestimated.

Population trends

Populations show a declining trend throughout the area, with the exception of populations from the Soča basin in Slovenia (Mrakovčić *et al*., 2006; Georgiev, 2011; Schoeffmann *et al*., 2019; Balkan Trout Restoration Group, 2020). The situation is most critical in Northern Macedonia (Black Drim basin) and Albania (Drim basin), where marble trout populations are in the process of disappearing or have already disappeared from some localities (Georgiev, 2011; Schoeffmann *et al*., 2019). Very few data are available for Serbia, but it is very likely that the population from the White Drim watershed is also in the process of extinction. There are literary data on the occurrence of the marble trout in the White Drim and its tributaries from the second half of the last century (Marković, 1962), the most recent of which refers to the record of two individuals in the lower reaches of the Miruša (Šorić, 1990). For the first decade of this century, there is unconfirmed information on the catch of two individuals from the White Drim (Grapci-Kotori *et al*., 2010). However, in the latest survey of the fish fauna of the White Drim, conducted in 2017 and 2019, no marble trout was found among the 21 species recorded (Grapci-Kotori *et al*., 2020).

Ecology of the species

Males reach sexual maturity in their second or third year, females in their fourth or fifth year. The marble trout spawns from November to January at a water temperature of less than 6 °C on sandy or gravelly substrates. Spawning is most intense during the new moon night. The spawning season usually lasts about a month, but in some tributaries



pritokama može trajati svega par dana. Mrest obično ne uslovljava obimnije migratorne aktivnosti, osim pri visokom vodostaju glavnih vodotoka ili u slučaju jezerskih populacija, kada se mrest može obaviti u pritokama (Kottelat & Freyhof, 2007). Ženka polaže do 4.000 jaja (Povž & Sket, 1990), a razvoj larvi do izvaljivanja traje oko 40–45 dana (Ocvirk, 1994; Kottelat & Freyhof, 2007). Mlade jedinke se hrane akvatičnim i terestričnim beskičmenjacima, dok su odrasle jedinke dominantno piscivorne grabljivice (Kottelat & Freyhof, 2007), kod kojih se javlja i kanibalizam (Podgornik, 2014).

Stanište

Glavatica tipično nastanjuje vodotoke sa maksimalnom letnjom temperaturom do 15 °C. Starije jedinke naseljavaju dublje rečne ili jezerske ekosisteme, dok mlađe jedinke najčešće borave u plićoj vodi iznad šljunkovitog dna, bliže rečnim obalama (Povž *et al*., 1996).

Ribolovni značaj

S obzirom da u Srbiji nema potvrđenih nalaza više od 30 godina, glavatica nema ribolovni značaj. U pojedinim delovima areala predstavlja popularnu vrstu za rekreativni ribolov. Međutim, zbog opadanja brojnosti ili iščezavanja pojedinih populacija, rekreativni ribolov je najzastupljeniji u slivu Soče u Sloveniji, gde su populacije brojne i gde se ribolov obavlja pod strogim nadzorom (Povž *et al*., 1996).

Faktori ugrožavanja

Populacije iz sistema Skadar-Drim (Crna Gora, Srbija, Albanija i Severna Makedonija) nisu introgresirane (tj. nisu ugrožene introdukcijom alohtonih linija potočne pastrmke sa kojima bi hibridizovale), tako da introgresija ne predstavlja glavni ugrožavajući faktor kao u drugim delovima areala areala (Razpet *et al*., 2007; Snoj *et al*., 2010), već su primarno ugrožene neodrživim ribolovom (uglavnom nelegalnim) (Schöffmann *et al*., 2019). Glavatica kao vršni predator nema prirodnih neprijatelja i nije plašljiva, tako da predstavlja lak plen za lov harpunom, odnosno krivolov. Uz navedene posebne faktore, zajednički ugrožavajući faktori za sve populacije iz areala vrste odnose se na narušavanje staništa usled korišćenja, regulacije i zagađenja vodotoka, kao i globalnih klimatskih promena (Crivelli, 2006j; Kottelat & Freyhof, 2007).

only a few days. Spawning does not usually require extensive migrations, except when water levels in the main watercourses are high or in the case of lake populations, when spawning may occur in tributaries (Kottelat & Freyhof, 2007). The female lays up to 4,000 eggs (Povž & Sket, 1990) and larval development to hatching takes about 40-45 days (Ocvirk, 1994; Kottelat & Freyhof, 2007). Juveniles feed on aquatic and terrestrial invertebrates, while adults are predominantly piscivorous (Kottelat & Freyhof, 2007), with cannibalism also occurring (Podgornik, 2014).

Habitat

The marble trout typically inhabits streams with a maximum summer temperature of up to 15 °C. Older specimens live in the deeper parts of river and lake ecosystems, while younger specimens usually reside in shallower water above the gravel bottom and closer to the river bank (Povž *et al*., 1996).

Importance in fisheries

As there have been no confirmed records in Serbia for more than 30 years, the marble trout has no fishery importance. In some parts of the area it is a popular species for recreational fishing. However, due to the decline or disappearance of certain populations, recreational fishing is most common in the Soča basin in Slovenia, where populations are numerous and fishing is conducted under strict supervision (Povž *et al*., 1996).

Threats

The populations of the Skadar-Drim system (Montenegro, Serbia, Albania and Northern Macedonia) are not introgressive (i.e. they are not threatened by the introduction of non-native brown trout lineages with which they would hybridise), so introgression is not the main threat factor as it is in other parts of the range (Razpet *et al*., 2007; Snoj *et al*., 2010), but are primarily threatened by unsustainable (mainly illegal) fishing (Schoeffmann *et al*., 2019). As an apex predator, the marble trout has no natural enemies and is not fearful, making it an easy prey for harpoon fishing, i.e. poaching. Threats common to all populations in the species' range, in addition to the specific threats mentioned above, include habitat degradation due to water use, regulation and pollution, and global climate change (Crivelli, 2006j; Kottelat & Freyhof, 2007).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 3.3, 5.4.2, 7.2.1, 7.2.2, 7.2.3, 7.2.8, 7.2.11, 7.3, 8.1.2, 9.1, 9.4, 11

Postojeće mere zaštite

Glavatica se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Potrebno je sprovesti zaštitu i revitalizaciju staništa na području Belog Drima od ušća Dečanske Bistrice do mesta Zlokućane, koje

Conservation actions in place

The marble trout is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to carry out the protection and revitalisation of the habitat in the section of the White Drim from the mouth of the Dečans-

se nalazi izvan granica Predela izuzetnih odlika „Miruša" („Službeni glasnik RS", br. 5/1998), kao i zabranu izgradnje hidrotehničkih objekata koji utiču na promenu kvaliteta staništa i strogu kontrolu funkcionisanja već izgrađenih. Takođe je potrebno zabraniti introdukciju alohtonih pastrmskih linija i poribljavanje lokaliteta koje nastanjuje glavatica autohtonom primorskom pastrmkom ribnjačkog porekla, jer adaptacija na ribnjačke uslove života može dovesti do gubitka prirodnog instinkta, koji ograničava hibridizaciju primorske pastrmke i glavatice. Pošto je u pitanju malobrojna populacija glavatice, neophodno je ustanovljavanje veštačkog mresta i poribljavanja u cilju njenog oporavka, ako se pokaže da brojnost populacije dozvoljava sprovođenje navedenih aktivnosti. Lokalno stanovništvo treba informisati o biološkom značaju vrste, ugroženosti i planovima za njen oporavak.

ka Bistrica to the town of Zlokućane, which is outside the boundaries of the Landscape of exceptional quality "Miruša" (Official Gazette of RS, No. 5/1998), as well as a ban on the construction of hydrotechnical facilities that affect the change in the quality of habitats, and strict control of the operation of the facilities already built. Furthermore, the introduction of non-native trout lines and stocking of the area inhabited by the marble trout with native Balkan brook trout from fish ponds, as adaptation to living conditions in fish ponds may lead to the loss of the natural instinct limiting hybridisation of Balkan brook trout and marble trout. Since the population of marble trout is small, artificial spawning and stocking measures must be introduced for its recovery if it is found that the size of the population allows the implementation of the above measures. The local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.2, 3.3.1, 3.4, 4, 5.4.4

Neophodno je sprovesti istraživanja osnovnih bioloških parametara populacije glavatice iz sliva Belog Drima, kao što su analize veličine populacije, distribucije, populacionog trenda, odlika životne istorije, ekologije, genetičke strukture i faktora ugrožavanja. Na osnovu dobijenih rezultata potrebno je napraviti plan zaštite i upravljanja područjem, kao i plan zaštite i oporavka vrste, uz redovan nadzor sprovođenja planova.

It is necessary to study the basic biological parameters of the marble trout population in the White Drim watershed, such as the analysis of population size, distribution, population trend, life history traits, ecology, genetic structure and threats. Based on the results obtained, a plan for the protection and management of the area and a plan for the protection and recovery of the species must be drawn up, the implementation of which must be monitored regularly.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.4

AUTOR / AUTHOR: Saša Marić

8.3.

Ugrožene vrste (EN)

Endangered species (EN)

KEČIGA
Acipenser ruthenus Linnaeus, 1758

Taksonomski status

Razdeo: Chordata
Klasa: Acipenseriformes
Nadred: Chondrostei
Red: Acipenseriformes
Porodica: Acipenseridae
Vrsta: *Acipenser ruthenus* Linnaeus, 1758

Sinonimi

Acipenser pygmaeus Pallas, 1814; *Acipenser kostera* Fitzinger, 1832; *Acipenser marsiglii* Barndt, 1833; *Acipenser kamensis* Lovetsky, 1834; *Acipenser gmelini* Fitzinger, 1836; *Acipenser dubius* Heckel, 1836; *Acipenser ruthenus leucotica* Brandt, 1853; *Acipenser ruthenus grisescens* Brandt, 1853; *Acipenser kankreni* Duméril, 1870; *Acipenser lovetzkyi* Duméril, 1870; *Sterledus ruthenus sibiricus* Dybowski, 1874; *Acipenser jeniscensis* Herzenstein, 1895; *Acipenser ruthenus* var. *albinea* Brusina, 1902; *Acipenser ruthenus* var. *birostrata* Brusina, 1902; *Acipenser ruthenus* var. *obtusirostra* Brusina, 1902; *Acipenser ruthenus* var. *septemcarinata* Brusina, 1902; *Acipenser ruthenus* var. *alba* Antipa, 1909; *Acipenser ruthenus* var. *erytraea* Antipa, 1909; *Acipenser ruthenus rutzskyi* Johansen, 1946

Narodno ime: Kečiga
Englesko ime: Sterlet
Francusko ime: Sterlet
Nemačko ime: Sterlet
Rusko ime: Стерлядь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, kečiga se smatra ugroženom vrstom (EN) prema kriterijumima A2cde (Gessner *et al*., 2010d, 2022). U Srbiji, kečiga predstavlja ugroženu vrstu (EN), koja može postati kritično ugrožena ukoliko se nastavi dejstvo nepovoljnih faktora. Sam obim rasprostranjenja (EOO) ove vrste nije mali i iznosi 41.230 km², ali je uočeno/procenjeno njegovo kontinuirano opadanje. Takođe je uočeno/procenjeno i opadanje površine naseljavanja (AOO iznosi 220 km²), kvaliteta staništa, broja subpopulacija i broja odraslih jedinki, kao i ekstremne fluktuacije u obimu rasprostranjenja, površini naseljavanja i broju subpopulacija – kriterijumi B2ab(i,ii,iii,iv,v)c(i,ii,iii). Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥20% u narednih 20 godina (kriterijum E).

Rasprostranjenje

Kečiga je vrsta koja naseljava reke u slivovima Kaspijskog, Crnog, Azovskog, Baltičkog, Barencovog i Karskog mora, dok u oblasti Sibira nastanjuje reke na području između reka Ob i Jenisej (Sokolov & Berdicheskii, 1989). Posebno je brojna u slivovima Volge, Urala i Dunava. Zbog uzgoja, unesena je slučajno ili namerno širom Evrope, mada nema samoodrživih populacija. U Dunavu je stalno nalažena uzvodno do Beča, često kod Linca i Regenzburga, pa i kod

STERLET
Acipenser ruthenus Linnaeus, 1758

Taxonomic status

Phylum: Chordata
Class: Acipenseriformes
Superorder: Chondrostei
Order: Acipenseriformes
Family: Acipenseridae
Species: *Acipenser ruthenus* Linnaeus, 1758

Synonyms

Acipenser pygmaeus Pallas, 1814; *Acipenser kostera* Fitzinger, 1832; *Acipenser marsiglii* Barndt, 1833; *Acipenser kamensis* Lovetsky, 1834; *Acipenser gmelini* Fitzinger, 1836; *Acipenser dubius* Heckel, 1836; *Acipenser ruthenus leucotica* Brandt, 1853; *Acipenser ruthenus grisescens* Brandt, 1853; *Acipenser kankreni* Duméril, 1870; *Acipenser lovetzkyi* Duméril, 1870; *Sterledus ruthenus sibiricus* Dybowski, 1874; *Acipenser jeniscensis* Herzenstein, 1895; *Acipenser ruthenus* var. *albinea* Brusina, 1902; *Acipenser ruthenus* var. *birostrata* Brusina, 1902; *Acipenser ruthenus* var. *obtusirostra* Brusina, 1902; *Acipenser ruthenus* var. *septemcarinata* Brusina, 1902; *Acipenser ruthenus* var. *alba* Antipa, 1909; *Acipenser ruthenus* var. *erytraea* Antipa, 1909; *Acipenser ruthenus rutzskyi* Johansen, 1946

Vernacular name: Kečiga
English name: Sterlet
French name: Sterlet
German name: Sterlet
Russian name: Стерлядь

National threat category assessed according to IUCN criteria

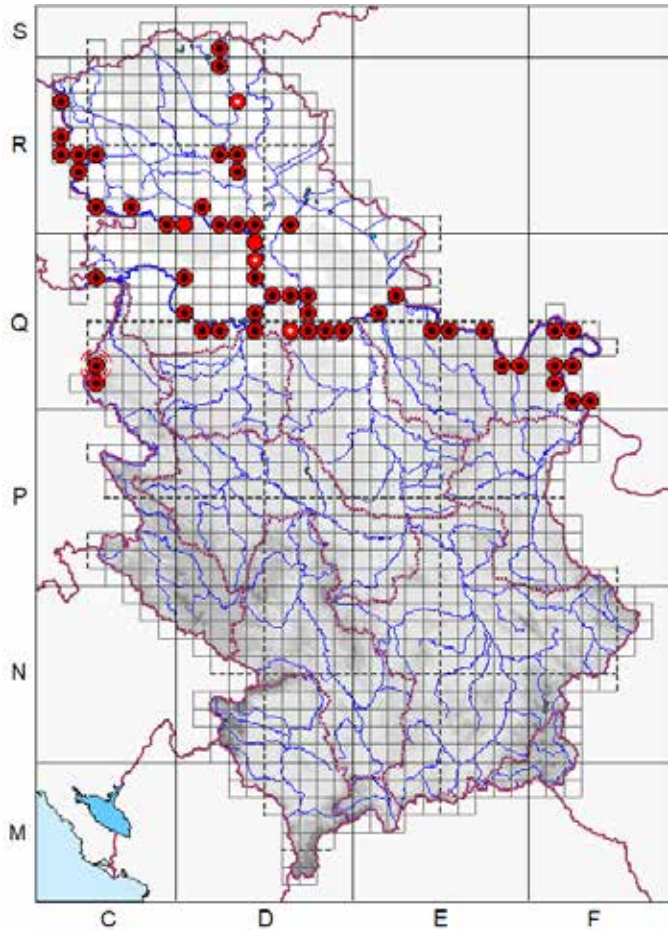
At the global level, the sterlet is classified as Endangered (EN) under criteria A2cde (Gessner *et al*., 2010d, 2022). In Serbia, the species is classified as an Endangered (EN) and may face extinction if negative factors continue to affect it. The extent of occurrence (EOO) of the sterlet is not small at 41,230 km², but its continuing decline has been observed/estimated. Furthermore, a decline in area of occupancy (AOO is 220 km²), habitat quality, number of subpopulations and number of mature individuals, as well as extreme fluctuations in extent of occurrence, area of occupancy, and number of subpopulations were observed/estimated – criteria B2ab(i,ii,iii,iv,v)c(i,ii,iii). The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥20% in the next 20 years.

Distribution

The sterlet is a species inhabiting rivers in the basins of the Caspian, Black Sea, Azov, Baltic, Barents and Kara Seas, while in the Siberian region it inhabits rivers in the area between the Ob and Yenisei rivers (Sokolov & Berdicheskii, 1989). It is particularly numerous in the watersheds of the Volga, Ural and Danube rivers. Through farming, it has been accidentally or intentionally introduced throughout Europe, although there are no self-sustaining populations. In the Danube it

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Kečiga / Sterlet – *Acipenser ruthenus*		Status
Međunarodna zaštita / International protection	IUCN Red List	EN A2cde
	CITES konvencija	Dodatak / Appendix II
	Evropska direktiva o staništima / European Habitats Directive	Prilog / Annex V
	Bernska konvencija / Bern Convention	Dodatak / Appendix III
	Bonska konvencija / Bonn Convention	Dodatak / Appendix II
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	Prilog / Annex II
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	Trajni lovostaj / Permanent ban on fishing
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	LR/lc
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	EN B2ab(i,ii,iii,iv,v)c(i,ii,iii); E Strogo zaštićena vrsta / Strictly protected species



Slika 74. **Rasprostranjenje *Acipenser ruthenus* u Srbiji.**

Figure 74. **Distribution of *Acipenser ruthenus* in Serbia.**

Slika 75. Kečiga *Acipenser ruthenus* (foto: Wrangel, https://www.dreamstime.com/stock-photo-sterlet-acipenser-ruthenus-rudd-scardinius-erythropthalmu-erythropthalmus-wildlife-animal-image56357816).

Figure 75. Sterlet *Acipenser ruthenus* (photo: Wrangel, https://www.dreamstime.com/stock-photo-sterlet-acipenser-ruthenus-rudd-scardinius-erythropthalmu-erythropthalmus-wildlife-animal-image56357816).

Ulma, ali je danas iščezla iz nemačkog dela toka (Hensel & Holčík, 1997). U Srbiji je prisustvo kečige zabeleženo duž celog toka Dunava i u donjim delovima Save, Tise, Tamiša i Drine (Slika 74), mada je verovatno ima i u Velikoj Moravi i delu Zapadne Morave.

Opis vrste

Telo kečige je izduženo i vretenasto (Slika 75). Leđa su tamnosive do maslinasto-sive boje, dok je trbuh svetložut do crvenkast. Telo je pokriveno sa pet uzdužnih nizova ploča. Rostrum je uzak i izdužen. Između vrha rostruma i prednje ivice gornje usne nalaze se dva para dugih i resastih brkova. Donja usna je prekinuta u sredini. Ploča u leđnom nizu ima 12–17, u bočnom nizu 56–71, dok ploča u trbušnom nizu ima 10–19. Peraja: D 32–54; A 16–34. Branhiospina u prvom škržnom luku ima 11–27 (Keith & Allardi, 2001; Kottelat & Freyhof, 2007). Naraste do 125 cm dužine i 16 kg mase tela (Berg, 1962; Birstein, 1993). Životni vek je oko 25 godina, mada je primećeno da u uzgoju može da živi i do 33 godine (Shljahtin, 2006).

Populacione karakteristike

Jedna od posledica prekomernog izlova kečige jeste promena uzrasne i dužinske strukture populacije, u smislu pomeranja ka mlađim uzrasnim i manjim dužinskim klasama. Sredinom XX veka, u uzrasnoj strukturi populacija kečige iz gornjeg dela Dunava u Srbiji preovladavale su jedinke uzrasta od 2 do 4 godine, dok su u donjem delu Dunava preovladavale jedinke uzrasta od 3 do 5 godina. Sada se ulov kečige uglavnom sastoji od jedinki koje se nalaze u prvoj i drugoj godini života, uz retke primerke odraslih i polno zrelih jedinki.

Najbrojnije populacije kečige u Srbiji nalaze se u okolini Beograda i Zemuna, sa preko 1.000 jedinki, tako da je dugotrajna održivost populacija na ovom području verovatna. U Tisi je brojnost jedinki koje učestvuju u mrestu znatno manja od 1.000 (Cvijanović *et al.*, 2017), a kako je izgradnja brane kod Novog Bečeja onemogućila pristup uzvodnim mestima za mrest, dugotrajna vijabilnost ove populacije nije verovatna.

used to be regularly found upstream to Vienna, often near Linz and Regensburg, and even near Ulm, but today it has disappeared from the German part of the river (Hensel & Holčík, 1997). In Serbia, the sterlet has been recorded along the entire Danube section and in the lower parts of the Sava, Tisza, Tamiš and Drina rivers (Figure 74), although it probably also occurs in the Great Morava and part of the West Morava.

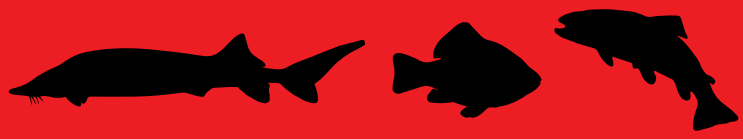
Description of the species

The body of the sterlet is elongated and spindle-shaped (Figure 75). The dorsum is dark grey to olive grey, while the belly is pale yellow to reddish. The body is covered with five longitudinal rows of scutes. The rostrum is narrow and elongated. Between the tip of the rostrum and the anterior margin of the upper lip there are two pairs of long and fimbriated barbels. The lower lip is interrupted at centre. There are 12–17 dorsal, 56–71 lateral and 10–19 ventral scutes. Fins: D 32–54; A 16–34. There are 11–27 gill rakers on the first gill arch (Keith & Allardi, 2001; Kottelat & Freyhof, 2007). It grows up to 125 cm long and reaches a body weight of 16 kg (Berg, 1962; Birstein, 1993). Life expectancy is about 25 years, although in aquaculture it has been observed to live up to 33 years (Shljahtin, 2006).

Population trends

One of the consequences of the sterlet overfishing is the change in the age and length structure of the population towards younger age and smaller length classes. In the mid-20th century, the age structure of the sterlet population in the upper part of the Danube in Serbia was dominated by individuals aged 2 to 4 years, while in the lower part of the Danube individuals aged 3 to 5 years predominated. Today, catches consist mainly of individuals in their first and second year of life and rarely of adult and mature specimens.

The most numerous sterlet populations in Serbia are located in the vicinity of Belgrade and Zemun and include more than 1,000 individuals, so that long-term persistence of populations in this area is likely. In the Tisza, the number of individuals participating in spawning is well below 1,000 (Cvijanović *et al.*, 2017), and as the construction of the dam at Novi Bečej has prevented access to upstream spawning sites, the long-term viability of this population is questionable.



Ekologija vrste

Kečiga je potamodromna vrsta, koja naseljava velike nizijske reke. U Dunavu se mresti u periodu april–maj, tokom visokih voda, kada kreće u uzvodne migracije radi mresta. Na migraciju prvo kreću mužjaci (pri temperaturi vode od 9 °C), da bi ih sledile ženke pri temperaturi vode oko 12 °C. Mužjaci brojčano dominiraju na mestima za mrest, sa 60–70% (Sokolov & Berdicheskii, 1989). Mrest se obavlja na šljunkovitoj podlozi sa brzim protokom vode, gde ženka polaže od 7.000 do 137.600 jaja, a inkubacija traje 4–5 dana (Sokolov & Berdicheskii, 1989; Birstein, 1993; Reinartz, 2002; Bloesch *et al*., 2006). Nakon izvaljivanja, larve se transportuju nizvodno vodenim strujama do mesta sa sporijom strujom (i obično peščanim supstratom), gde prelaze na egzogenu ishranu planktonskim i bentosnim organizimima. Mrestilišta nakon mresta prvo napuštaju ženke, dok mužjaci ostaju još neko vreme na lokaciji. Nakon napuštanja mrestilišta, kečige se spuštaju nizvodno do peščanih sprudova i kanala sa muljevitim dnom, gde se intenzivno hrane (Sokolov & Berdicheskii, 1989). Mužjaci postaju polno zreli između 3 i 5 godina, a ženke između 4 i 7 godina (Reinartz, 2002; Lenhardt *et al*., 2005). Ishrana kečige u Dunavu uglavnom se sastoji od larvi insekata, uz gamaridne račiće i pijavice (Đikanović *et al*., 2014). Kečiga može da hibridizuje sa drugim jesetarskim vrstama u Dunavu (ruskom jesetrom, morunom, simom i pastrugom) (Dudu *et al*., 2011).

Stanište

Naseljava velike reke, najčešće u delovima sa bržom rečnom strujom i velikom dubinom, u kojima je dno uglavnom kamenito, šljunkovito ili peščano (Birstein, 1993). Pri porastu nivoa vode zalazi u plavne zone da se hrani. Mresti se u delovima sa brzom rečnom strujom i šljunkovitom, ređe peskovito-šljunkovitom podlogom (Sokolov & Berdicheskii, 1989). Postoje dva tipa mesta za mrest: mesta na dnu reka i plavne zone. Dubina mresta u koritima reka je između 7 m i 15 m, ali se smatra da je 10 m optimalna dubina. Mlade jedinke nastanjuju plitke delove reka tokom prvog leta. U akumulacijama, kečige uglavnom borave u uzvodnom delu akumulacije gde su struja i uslovi slični onima u reci.

Ribolovni značaj

U Srbiji je udeo kečige u ulovu privrednih ribara nekada bio 8–10% (Smederevac-Lalić, 2013). Do uvođenja potpune zabrane izlova kečige, ribolov je bio najintenzivniji na Dunavu, gde je višestruko nadmašivao ulov iz ostalih reka. Nakon uvođenja trajnog lovostaja kečige na teritoriji Srbije 2019. godine, prestao je njen privredni značaj, mada je i dalje prisutan ilegalni izlov.

Faktori ugrožavanja

Opadanje brojnosti kečige posledica je negativnog uticaja ljudi, preko niza faktora poput prekomernog (legalnog i ilegalnog) izlova, narušavanja prirodnih staništa izgradnjom brana i drugih vodoprivrednih objekata, kao i zagađenja. Rezultati analiza trendova određenih vrsta u ulovu privrednih ribara, za period od 1969. do 2010. godine, pokazali su pad brojnosti kečige (Jarić *et al*., 2012; Smederevac, 2013). Izgradnja brana uticala je na prirodna staništa

Ecology of the species

The sterlet is a potamodromous species that inhabits large lowland rivers. It spawns in the Danube during high water from April to May, when it begins to migrate upstream to spawn. The males start their migration first (at a water temperature of 9 °C), followed by the females at a water temperature of about 12 °C. The males dominate the spawning grounds by 60-70% (Sokolov & Berdicheskii, 1989). Spawning takes place on a gravel substrate in a strong current, where the female lays between 7,000 and 137,600 eggs and incubation lasts 4-5 days (Sokolov & Berdicheskii, 1989; Birstein, 1993; Reinartz, 2002; Bloesch *et al*., 2006). After hatching, the larvae are transported downstream by the water current to areas with slower currents (and usually sandy substrate) where they feed on planktonic and benthic organisms. After spawning, females leave the spawning grounds first, while the males remain on site for some time. After leaving the spawning grounds, individuals move downstream to sandbars and channels with a muddy bottom, where they feed intensively (Sokolov & Berdicheskii, 1989). Males become sexually mature at the age of 3 to 5 years, and females at the age of 4 to7 years (Reinartz, 2002; Lenhardt *et al*., 2005). The diet of the sterlet in the Danube consists mainly of insect larvae, together with gammarids and leeches (Đikanović *et al*., 2014). The sterlet can hybridise with other sturgeon species in the Danube (Russian sturgeon, beluga, ship sturgeon and starry sturgeon) (Dudu *et al*., 2011).

Habitat

Inhabits large rivers, usually in sections with swift current and great depth, where the bottom is usually rocky, gravelly or sandy (Birstein, 1993). When the water level rises, it moves into the floodplains to feed. It spawns in areas with strong current and gravelly, rarely sandy-gravelly substrate (Sokolov & Berdicheskii, 1989). There are two types of spawning sites: river bottom and floodplains. The spawning depth in riverbeds ranges from 7 to 15 m, with 10 m as the optimal depth. Juveniles stay in the shallow parts of rivers during their first summer. In reservoirs, the sterlet generally stays in the upstream part of the reservoir, where the current and conditions are similar to those in the river.

Importance in fisheries

In Serbia, the share of sterlet in the catches of professional fishers used to be 8–10% (Smederevac-Lalić, 2013). Until the introduction of a complete ban on sterlet fishing, fishing in the Danube was the most intensive, exceeding catches from other rivers many times over. After a permanent hunting ban on sterlet was imposed in the territory of Serbia in 2019, its commercial importance has decreased, although illegal fishing still persists.

Threats

The decline in sterlet populations is the result of the negative influence of humans through a number of factors such as excessive fishing (legal and illegal), destruction of natural habitats through the construction of dams and other water management facilities, and pollution. The results of the analysis of trends in certain species caught by professional fishers in the period from 1969 to 2010 showed a decline in the number of sterlet in the catches (Jarić *et al*., 2012; Smederevac, 2013). The construction of dams affected the natural habitats of sterlet by leading

kečige, tako što je dovodila do promene (i određene pravilnosti) u proticanju, a samim time i do spiranja dna reke u nizvodnim sekcijama i zamenom sedimentom koji je poreklom od erozije sedimenta duž toka reke. Takođe, izgradnja brana imala je izuzetan uticaj na promenu sastava hrane dunavske kečige, pošto je zbog formiranja akumulacija i promene uslova sredine došlo i do promene u sastavu bentosne faune invertebrata. Povišene koncentracije toksičnih metala i njihovo negativno dejstvo na organe kečiga u slivu Dunava posledica su bentosnog načina života i ishrane invertebratama u sedimentu (u kome su prisutni toksični metali) (Jarić *et al*., 2011). Prisustvo hibrida kečige i drugih jesetarskih vrsta u Dunavu, bilo prirodnih ili iz uzgoja, predstavlja najbrži vid pretnje ugroženim vrstama. Neadekvatni programi poribljavanja takođe nanose štetu prirodnim populacijama dunavske kečige.

to a change (and a certain regularity) of the flow and consequently to the washing out of the river bed in the downstream sections and its replacement by sediments originating from sediment erosion along the river course. The construction of dams also had an extraordinary impact on changing the food composition of the Danube sterlet, as the formation of reservoirs and the altered environmental conditions also changed the composition of the benthic invertebrate fauna. Elevated concentrations of toxic metals and their negative effects on sterlet organs in the Danube basin are a consequence of the benthic way of life and feeding on invertebrates living in the sediment (where toxic metals are present) (Jarić *et al*., 2011). The presence of hybrid sturgeon and other sturgeon species in the Danube, whether natural or farmed, is the most rapid form of threat to endangered species. Inadequate stocking programmes also harm the natural populations of Danube sturgeon.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 5.4.2, 7.2.11, 9.2.3

Postojeće mere zaštite

Kečiga se nalazi u Prilogu II *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status zaštićene vrste. Na osnovu *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The sterlet is listed in Annex II of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

U okviru *Akcionog plana upravljanja jesetarskim vrstama u ribolovnim vodama Republike Srbije* (Lenhardt *et al*., 2005), neke od predloženih mera zaštite jesu razvijanje regionalne saradnje, naučna istraživanja bioloških karakteristika i proučavanje genetičke strukture populacija, zaštita staništa i omogućavanje pristupa mrestilištima, kao i usaglašavanje različitih zakonskih akata. Budući da se kod kečige javlja veća smrtnost odraslih jedinki i kraće vreme sazrevanja u odnosu na ostale jesetarske vrste, poribljavanje juvenilnim jedinkama imalo bi pozitivniji efekat na veličinu populacije nego poribljavanje odraslim jedinkama.

Conservation actions needed

Within the framework of the *Action plan for sturgeon species management in fishery waters of the Republic of Serbia* (Lenhardt *et al*., 2005), the necessary conservation measures include the development of regional cooperation, scientific research on biological characteristics and study of the genetic structure of populations, protection of habitats and enabling access to spawning grounds, and harmonisation of various legal acts. As sterlet have a higher adult mortality rate and a shorter maturation period compared to other sturgeon species, stocking juveniles would have a more positive impact on population size than stocking adults.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	3.1.1, 3.1.2, 3.3.1, 5.1.2

Neophodna su istraživanja veličine, distribucije i trendova populacija kečige, životne istorije i ekologije, eksploatacije i faktora ugrožavanja, kao i planiranje aktivnosti koje treba preduzeti.

More detailed studies are needed on the sterlet population size, distribution and trends, as well as on its life history and ecology, exploitation and threats, and on actions to be taken.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6

AUTOR / AUTHOR: Gorčin Cvijanović

TESALIJSKA PLISKA
Alburnoides thessalicus Stephanidis, 1950

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Alburnoides thessalicus* Stephanidis, 1950

Sinonimi

Alburnoides bipunctatus thessalicus Stephanidis, 1950

Narodno ime: Tesalijska pliska
Englesko ime: Thessalian spirlin

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, status tesalijske pliske nije procenjen prema IUCN kriterijumima (NE). U Srbiji, tesalijska pliska ima status ugrožene vrste (EN), kako zbog veličine obima rasprostranjenja (EOO iznosi 666 km²), tako i zbog male površine naseljavanja (AOO iznosi 20 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Tesalijska pliska naseljava slivove reka Penej, Aliakmon i Vardar (Stierandová *et al*., 2016; Barbieri *et al*., 2017). U Srbiji naseljava sliv reke Pčinje (Slika 76).

Opis vrste

Telo tesalijske pliske je visoko i bočno spljošteno, a dorzalna strana tela konveksna (Slika 77). Bočna linija, duž koje se pruža dvostruka tamna linija, zakrivljena je prema dole. Leđa su smeđe-zelenkasta i tamnija od ostatka tela (Porcellotti, n.d.b). Glava je trouglasta, a usta subterminalna do skoro terminalna. Njuška je blago do izrazito zaobljena, dužine približno jednake prečniku oka. Peraja: D III + 7–9; A III + 11–14; P 11–14; V 6–7. Ima 9–10 krljušti između bočne linije i osnove leđnog peraja i 3–5 krljušti između bočne linije i osnove trbušnih peraja. Parna peraja duža su kod mužjaka. Broj krljušti u bočnoj liniji je 44–50. Naraste do 9,1 cm standardne dužine tela (SL). Ženke su krupnije od mužjaka (Barbieri *et al*. 2017).

Populacione karakteristike

Populacioni trend ove vrste nije poznat. Iako postoje lokalno brojne populacije širom areala, izostaje iz vodotoka koji su pregrađeni (Porcellotti, n.d.b; Oikonomou *et al*., 2019).

THESSALIAN SPIRLIN
Alburnoides thessalicus Stephanidis, 1950

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Alburnoides thessalicus* Stephanidis, 1950

Synonyms

Alburnoides bipunctatus thessalicus Stephanidis, 1950

Vernacular name: Tesalijska pliska
English name: Thessalian spirlin

National threat category assessed according to IUCN criteria

At the global level, the Thessalian spirlin is classified as Not Evaluated (NE) as its status has not been assessed according to IUCN criteria. In Serbia, the Thessalian spirlin is classified as Endangered (EN) due to the small extent of occurrence (EOO is 666 km²) and the small area of occupancy (AOO is 20 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Thessalian spirlin inhabits the basins of the Pinios, Aliakmon and Vardar rivers (Stierandová *et al*., 2016; Barbieri *et al*., 2017). In Serbia, it inhabits the watershed of the Pčinja River (Figure 76).

Description of the species

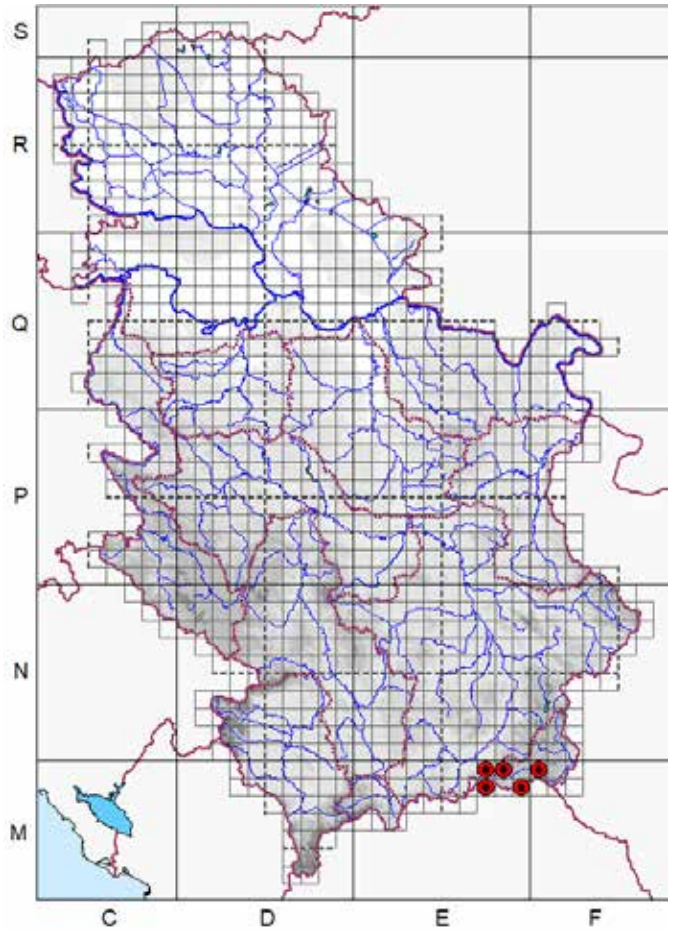
The body of the Thessalian spirlin is high and laterally flattened, and the dorsal side of the body is convex (Figure 77). The lateral line, along which a double dark line extends, is curved downwards. The dorsum is brown-green and darker than the rest of the body (Porcellotti, n.d.b). The head is triangular and the mouth is subterminal to almost terminal. The snout is slightly to strongly rounded and has a length approximately equal to the diameter of the eye. Fins: D III + 7–9; A III + 11–14; P 11–14; V 6–7. There are 9–10 scale rows between the lateral line and the dorsal fin origin and 3–5 scale rows between the lateral line and the ventral fin origin. In males the paired fins are longer. The number of scales in the lateral line is 44–50. Grows to a standard body length (SL) of 9.1 cm. Females are larger than males (Barbieri *et al*. 2017).

Population trends

The population trends of this species are unknown. Although there are locally abundant populations throughout its range, it is absent from dammed watercourses (Porcellotti, n.d.b; Oikonomou *et al*., 2019).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Tesalijska pliska – *Alburnoides thessalicus*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	–
	CITES konvencija	–
	Evropska direktiva o staništima / European Habitats Directive	–
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	–
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	–
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	–
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	–
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 76. **Rasprostranjenje *Alburnoides thessalicus* u Srbiji.**

Figure 76. **Distribution of *Alburnoides thessalicus* in Serbia.**

Slika 77. Tesalijska pliska *Alburnoides thessalicus* (foto: S. Zogaris).

Figure 77. Thessalian spirlin *Alburnoides thessalicus* (photo: S. Zogaris).

Ekologija vrste

Polnu zrelost dostiže u drugoj godini života. Mresti se sredinom proleća, od maja do juna (Porcellotti, n.d.b; Barbieri *et al.* 2017). Mrest je porcioni i ponavlja se 3–4 puta sa razmacima od oko 15 dana (Porcellotti, n.d.b). Litofilna je vrsta i polaže jaja između kamenja ili direktno na kamenje, mrtvo lišće ili drvene fragmente. Hrani se larvama akvatičnih insekata i račićima, a u manjoj meri konzumira i alge i detritus. Kopneni insekti koji upadnu u vodu takođe čine značajan udeo u ishrani (*ibid.*).

Stanište

Tesalijska pliska naseljava potoke i reke sa jakim vodenim strujama i kamenitim ili šljunkovitim dnom (Barbieri *et al.* 2017). Preferira hladne vode u planinskim predelima, mada se može naći i u nizijskim delovima sporijeg toka sa muljevitim dnom (Porcellotti, n.d.b).

Ribolovni značaj

Tesalijska pliska nema nikakav ribolovni značaj.

Faktori ugrožavanja

Među faktorima ugrožavanja izdvajaju se izmene staništa zbog regulacije vodotoka, izgradnja derivacionih mini-hidroelektrana, odnosno brana, sa pratećim efektima (delimična ili potpuna izmena ekosistema praćena kanalisanjem ili usporavanjem toka, promenom temperaturnog režima i koncentracije kiseonika, zabarivanjem staništa, izraženijom sedimentacijom i zamućenošću vode), zatim unos alohtonih vrsta riba i uzgoj pastrmke, kao i različiti tipovi zagađenja.

Ecology of the species

It reaches sexual maturity in the second year of life and spawns in mid-spring, from May to June (Porcellotti, n.d.b; Barbieri *et al.* 2017). Spawning occurs in portions and is repeated 3–4 times at intervals of about 15 days (Porcellotti, n.d.b). It is a lithophilous species and lays eggs between stones or directly on rocks, dead leaves or wood fragments. It feeds on larvae of aquatic insects and crustaceans, and to a lesser extent on algae and detritus. Terrestrial insects that fall into the water also make up a large part of the diet (*ibid.*).

Habitat

The Thessalian spirlin inhabits streams and rivers with strong currents and rocky or gravelly bottoms (Barbieri *et al.* 2017). It prefers cold waters in mountainous regions, but also occurs in lowland areas with slower currents and muddy bottoms (Porcellotti, n.d.b).

Importance in fisheries

The Thessalian spirlin is of no fishery importance.

Threats

Threats include habitat alteration through regulation of water flow, construction of mini-hydropower plants, i.e. dams, with associated impacts (partial or complete ecosystem alteration through channelling or slowing of water flow, alteration of temperature regime and oxygen concentration, siltation of habitat, increased sedimentation and turbidity of water), followed by introduction of non-native fish species and trout farming, and various types of pollution.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4, 7.2.2, 7.2.11, 7.3, 8.1, 9.3.4

Postojeće mere zaštite

Tesalijska pliska nije obuhvaćena postojećim merama zaštite.

Predložene mere zaštite

Potrebno je ograničiti uzgoj pastrmke i regulaciju vodotoka u kojima tesalijska pliska živi, sprečiti izgradnju novih brana, zagađenje, kao i unos alohtonih vrsta riba. Takođe, izgradnja funkcionalnih ribljih staza i poštovanje biološkog minimuma bili bi izuzetno značajni.

Conservation actions in place

The Thessalian spirlin is not covered by the existing conservation measures.

Conservation actions needed

It is necessary to restrict trout farming and regulate the watercourses where the Thessalian spirlin lives to prevent the construction of new dams, pollution and the introduction of non-native fish species. The construction of functional fish ladders and respecting the biological minimum would also be extremely important.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.1, 2.2, 5.4.2

Neophodna su istraživanja veličine, distribucije i trendova populacije, životne istorije, ekologije, kao i faktora ugrožavanja ove vrste.

The population size, distribution and trends as well as the life history, ecology and threat factors of this species still need to be researched.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Dušan Nikolić

STRUMIČKA MRENA
Barbus strumicae Karaman, 1955

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cyprinidae
Vrsta: *Barbus strumicae* Karaman, 1955

Sinonimi

Barbus cyclolepis strumicae Karaman, 1955

Narodno ime: Strumička mrena
Englesko ime: Strymon barbel

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, strumička mrena nema status ugrožene vrste (Freyhof & Kottelat, 2008f). U Srbiji, strumička mrena ima status ugrožene vrste (EN) kako zbog veličine obima rasprostranjenja (EOO iznosi 449 km²), tako i zbog male površine naseljavanja (AOO iznosi 20 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Strumička mrena naseljava sliv Egejskog mora u Grčkoj, Bugarskoj i Severnoj Makedoniji, od jezera Volvi na zapadu do reke Nestos na istoku (Kottelat & Freyhof, 2007). U Srbiji je registrovana u Dragovištici i njenim pritokama (Božičkoj i Brankovačkoj reci) (Slika 78). Ranije se smatralo da u slivu Strume živi *B. cyclolepis* (Economidis, 1995; Marić *et. al*., 2004), ali su kasnija istraživanja pokazala da se radi o *B. strumicae* (Economidis *et al.* 2009; Simonović *et al.* 2018).

Opis vrste

Telo strumičke mrene je izduženo i na poprečnom preseku ovalno (Slika 79). Usta su donja, sa 2 para brkova. Od ostalih vrsta roda *Barbus* na Balkanskom poluostrvu razlikuje se po sledećim karakteristikama: poslednja negranata žbica u leđnom peraju ima nazubljenu zadnju ivicu, glava, telo i peraja imaju upadljive crne tačkice koje su manje od zenice i koje telu daju mramorasti izgled, repno peraje ima nekoliko crnih tačkica, a donja usna je sa zadebljalim srednjim delom. Ima 13–16 krljušti između bočne linije i osnove leđnog peraja i 9–11 krljušti između bočne linije i osnove trbušnih peraja. U bočnoj liniji ima 59–64 krljušti. Naraste do 24 cm. Najveća zabeležena starost iznosi 7 godina (Kottelat & Freyhof, 2007).

Populacione karakteristike

Veličina populacija i populacioni trendovi strumičke mrene nisu poznati (Sapounidis *et al*., 2015).

STRYMON BARBEL
Barbus strumicae Karaman, 1955

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cyprinidae
Species: *Barbus strumicae* Karaman, 1955

Synonyms

Barbus cyclolepis strumicae Karaman, 1955

Vernacular name: Strumička mrena
English name: Strymon barbel

National threat category assessed according to IUCN criteria

At the global level, the Strymon barbel is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008f). In Serbia, the Strymon barbel is classified as Endangered (EN) due to the small extent of occurrence (EOO is 449 km²) and the small area of occupancy (AOO is 20 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Strymon barbel inhabits the Aegean basin in Greece, Bulgaria and Northern Macedonia, from Lake Volvi in the west to the Nestos River in the east (Kottelat & Freyhof, 2007). In Serbia, it is recorded in the Dragovištica River and its tributaries (Božička reka and Brankovačka reka) (Figure 78). Earlier it was assumed that *B. cyclolepis* lives in the Struma watershed (Economidis, 1995; Marić *et al*., 2004), but later studies showed that it is a different species, B. strumicae (Economidis *et al.* 2009; Simonović *et al.* 2018).

Description of the species

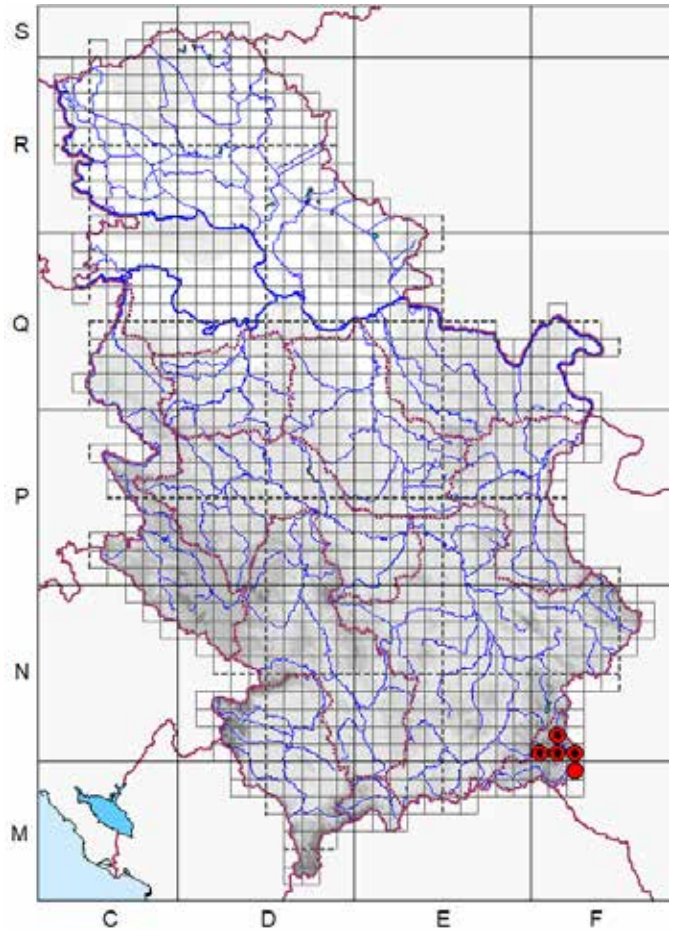
The body of the Strymon barbel is elongated and oval in cross-section (Figure 79). The mouth is inferior and has two pairs of barbels. It differs from the other species of the genus *Barbus* in the Balkan Peninsula by the following characteristics: the last simple dorsal ray has a serrated posterior margin, the head, body and fins have conspicuous black spots that are smaller than the pupil and give the body a marbled appearance, the caudal fin has several black dots, and the lower lip has a swollen median pad. There are 13–16 scale rows between the lateral line and the dorsal fin origin, and 9–11 scale rows between the lateral line and the ventral fin origin. In the lateral line there are 59–64 scales. It grows up to 24 cm. The oldest age recorded is 7 years (Kottelat & Freyhof, 2007).

Population trends

The population size and population trends of the Strymon barbel are unknown (Sapounidis *et al*., 2015).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Strumička mrena / Strymon barbel – *Barbus strumicae*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima (navedena kao *Barbus* spp.) / European Habitats Directive (listed as *Barbus* spp.)	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi (navedena kao / listed as *Barbus cyclolepis*)	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Barbus cyclolepis*)	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Barbus cyclolepis*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 78. **Rasprostranjenje *Barbus strumicae* u Srbiji.**

Figure 78. **Distribution of *Barbus strumicae* in Serbia.**

Slika 79. Strumička mrena *Barbus strumicae* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_4.jpg).

Figure 79. Strymon barbel *Barbus strumicae* (photo: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_4.jpg).

Ekologija vrste

Strumička mrena je bentopelagična i reofilna vrsta. Polnu zrelost stiče sa 2 godine starosti, a mresti se u junu (Kottelat & Freyhof, 2007). Uglavnom se hrani faunom dna (pre svega larvama insekata), ali i biljnim ostacima (Sapounidis *et al*., 2015).

Stanište

Strumička mrena naseljava delove reka i potoka sa čistom vodom i brzacima, u kojima dominira mešovita podloga od šljunka i peska (Kottelat & Freyhof, 2007; Apostolou & Koutrakis 2009).

Ribolovni značaj

Zbog trajnog lovostaja, strumička mrena u Srbiji nema ribolovni značaj. U drugim delovima areala često predstavlja sporedni ulov u krivolovu drugih vrsta, zbog čega se lokalno javlja i prelov (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008f).

Faktori ugrožavanja

Glavni faktor ugrožavanja ove vrste jeste degradacija i fragmentacija staništa izgradnjom mini-hidrocentrala na čitavom slivnom području reke Dragovištice, gde je ova vrsta jedino i prisutna u Srbiji. Ostali globalni faktori ugrožavanja uključuju opadanje kvaliteta vode usled zagađenja izazvanog poljoprivrednim aktivnostima i prekomernog vodozahvatanja, kao i krivolov i suše izazvane klimatskim promenama (Freyhof & Kottelat, 2008f).

Ecology of the species

The Strymon barbel is a benthopelagic and rheophilic species. It reaches sexual maturity at the age of 2 years and spawns in June (Kottelat & Freyhof, 2007). It feeds mainly on bottom fauna (mainly insect larvae), but also on plant debris (Sapounidis *et al*., 2015).

Habitat

The Strymon barbel inhabits stretches of rivers and streams with clear water and riffles dominated by a mixed substrate of gravel and sand (Kottelat & Freyhof, 2007; Apostolou & Koutrakis 2009).

Importance in fisheries

Since a permanent ban on fishing has been imposed on this species, the Strymon barbel has no fishery importance in Serbia. In other parts of its range, it is often bycatch in poaching of other species, which is why there is even overfishing locally (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008f).

Threats

The most important threat to this species is habitat degradation and fragmentation due to the construction of mini-hydropower plants throughout the Dragovištica watershed, where this species is found only in Serbia. Other global threats include declining water quality due to pollution from agricultural activities and excessive water withdrawal, as well as poaching and climate change-induced droughts (Freyhof & Kottelat, 2008f).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 7.2.8, 7.2.9, 9.3.4, 11.2

Postojeće mere zaštite

Strumička mrena se, pod naučnim nazivom *Barbus cyclolepis*, nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo

Conservation actions in place

The Strymon barbel is listed (as Barbus cyclolepis) in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status

zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu, navedenu kao *Barbus cyclolepis*, propisan je trajni lovostaj.

Predložene mere zaštite

Mere zaštite treba usmeriti ka sprečavanju degradacije staništa, pregrađivanja vodotoka i zagađenja vode.

of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a permanent ban on fishing is imposed on this species (listed as *Barbus cyclolepis*).

Conservation actions needed

Conservation measures should aim to prevent habitat destruction, damming of watercourses and water pollution.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 3.2, 5.1.1, 5.4.1

Neophodna su i dalja istraživanja veličine, distribucije i trendova populacije, životne istorije i ekologije ove vrste, kao i faktora ugrožavanja.

Further research is needed on the population size, distribution and trends, life history and ecology of this species, and threat factors.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.3, 1.4, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Stefan Skorić

VARDARSKI SKOBALJ
Chondrostoma vardarense Karaman, 1928

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Chondrostoma vardarense* Karaman, 1928

Sinonimi

Chondrostoma nasus vardarensis Karaman, 1928; *Chondrostoma vardarensis* Karaman, 1928

Narodno ime: Vardarski skobalj
Englesko ime: Vardar nase
Francusko ime: Nase de Vardar
Rusko ime: Вардарски подуст

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, vardarski skobalj ima status gotovo ugrožene vrste (NT) (Crivelli, 2006a). U Srbiji, vardarski skobalj ima status ugrožene vrste (EN), kako zbog veličine obima rasprostranjenja (EOO iznosi 399 km²), tako i zbog male površine naseljavanja (AOO iznosi 4 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Vardarski skobalj nastanjuje sliv Egejskog mora, od reke Marice do reke Penej, na području Turske, Bugarske, Grčke i Severne Makedonije, kao i sliv Jadranskog mora, gde je zabeležen u reci Vojuši (Kottelat & Freyhof, 2007). U Srbiji naseljava reku Pčinju (Slika 80).

Opis vrste

Telo vardarskog skobalja umereno je izduženo i bočno spljošteno, sa malom glavom u odnosu na telo (Slika 81). Usta su ravna, a donja vilica ima debeli i snažni rožni sloj. Boja tela je sivo-zelena na leđima, a bokovi i trbuh su srebrni. Od ostalih vrsta roda *Chondrostoma* koje žive na Balkanskom poluostrvu razlikuje se po tome što ima 8½ granatih žbica u leđnom peraju, 9½ granatih žbica u podrepnom peraju, 8–9 krljušti između bočne linije i osnove leđnog peraja i 5–6 krljušti između bočne linije i osnove trbušnih peraja. Broj krljušti u bočnoj liniji je 57–66, a broj branhiospina na prvom škržnom luku 28–38. Naraste do 35 cm (Kottelat & Freyhof, 2007).

Populacione karakteristike

Vardarski skobalj ima široko raspostranjenje, ali populacije nisu brojne (Crivelli, 2006a). Smatra se da brojnost populacija kontinuirano opada, i da će, zbog pregrađivanja vodotoka i povećane se-

VARDAR NASE
Chondrostoma vardarense Karaman, 1928

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Chondrostoma vardarense* Karaman, 1928

Synonyms

Chondrostoma nasus vardarensis Karaman, 1928; *Chondrostoma vardarensis* Karaman, 1928

Vernacular name: Vardarski skobalj
English name: Vardar nase
French name: Nase de Vardar
Russian name: Вардарски подуст

National threat category assessed according to IUCN criteria

At the global level, the Vardar nase is classified as Near Threatened (NT) (Crivelli, 2006a). In Serbia, the species is classified as Endangered (EN) due to the small extent of occurrence (EOO is 399 km²) and the small area of occupancy (AOO is 4 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Vardar nase inhabits the Aegean Sea basin, from the Maritsa River to the Pinios River, in Turkey, Bulgaria, Greece and Northern Macedonia, as well as the Adriatic Sea basin, where it has been recorded in the Aoös/Vjosa River (Kottelat & Freyhof, 2007). In Serbia, it inhabits the Pčinja River (Figure 80).

Description of the species

The body of the Vardar nase is moderately elongated and laterally flattened, with a head small in proportion to the body (Figure 81). The mouth is straight and the lower lip has a thick, strong cornified sheath. The body colour is grey-green on the back, and the sides and belly are silvery. It differs from other species of the genus Chondrostoma living in the Balkan Peninsula by having 8½ branched rays in the dorsal fin, 9½ branched rays in the dorsal fin, 8–9 scale rows between the lateral line and the dorsal fin origin, and 5–6 scale rows between the lateral line and the ventral fin origin. The number of scales in the lateral line is 57–66, and the number of gill rakers on the first gill arch is 28–38. Grows up to 35 cm (Kottelat & Freyhof, 2007).

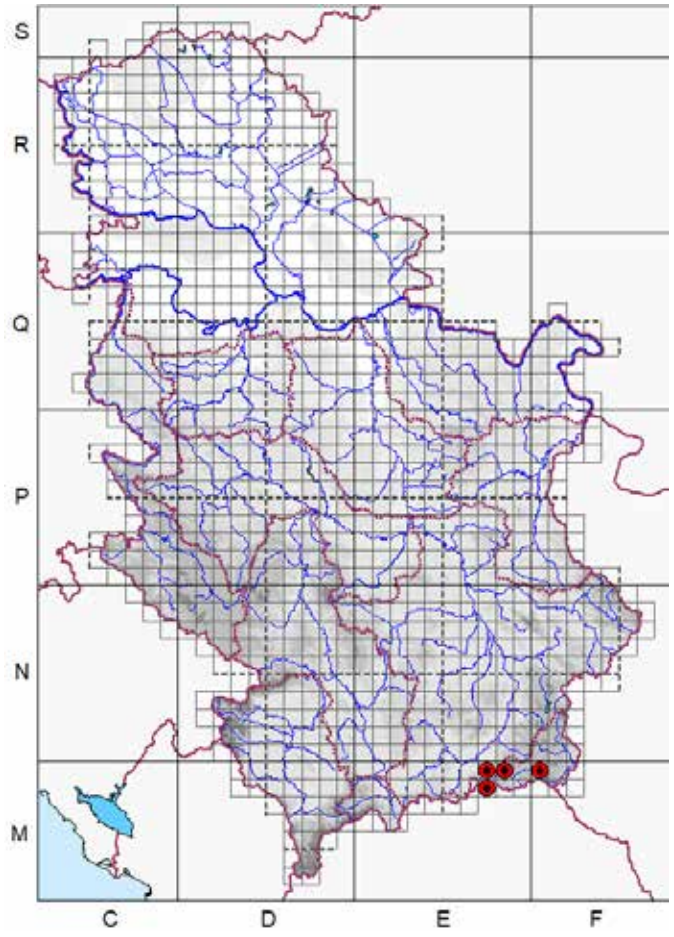
Population trends

The Vardar nase has a wide range, but populations are not numerous (Crivelli, 2006a). Populations are thought to be in steady

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Vardarski skobalj / Vardar nase – *Chondrostoma vardarense*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**NT**
	CITES konvencija	–
	Evropska direktiva o staništima / European Habitats Directive	–
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	–
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	–
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 80. Rasprostranjenje *Chondrostoma vardarense* u Srbiji.

Figure 80. Distribution of *Chondrostoma vardarense* in Serbia.

Slika 81. Vardarski skobalj *Chondrostoma vardarense* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_8.jpg).

Figure 81. Vardar nase *Chondrostoma vardarense* (photo: Y. Kapakos,https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_8.jpg).

dimentacije, u sledećih 10 godina verovatno doći do smanjenja od 30% (Crivelli, 2006a). Veličina populacija i populacioni trendovi vardarskog skobalja u Srbiji nisu poznati.

Ekologija vrste

Vardarski skobalj je bentopelagična, reofilna i potamodromna vrsta (Kottelat & Freyhof, 2007; Angelov *et al.*, 2020). Tokom početka perioda mresta u aprilu (Zhelev *et al.*, 2018), jedinke migriraju iz većih reka u pritoke, gde se mreste u brzacima i slapovima, među kamenjem (Kottelat & Freyhof, 2007; Angelov *et al.*, 2018). Migracije se odvijaju unutar rečnog sistema i tom prilikom jedinke ne prelaze velike udaljenosti (Meulenbroek *et al.*, 2018). Odrasle jedinke hrane se uglavnom filamentoznim algama, detritusom i epilitskim algama, a mogu konzumirati i beskičmenjake bentosa, kao što su crvi, insekti, račići, puževi (Porcellotti, n.d.i).

Stanište

Živi u rekama i potocima, na kamenitoj podlozi, sa brzim ili jakim protokom vode (Kottelat & Freyhof, 2007). Može se naći i u nizijskim vodotocima (Crivelli, 1996).

Ribolovni značaj

Vardarski skobalj nema nikakav značaj ni u rekreativnom ni u komercijalnom ribolovu.

Faktori ugrožavanja

Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla, vodozahvatanjem, pregrađivanjem, regulacijom tokova i gubitkom staništa (Crivelli, 1996). Introdukcije alohtonih invazivnih vrsta i negativni efekti klimatskih promena pre svega suša, takođe predstavljaju pretnju (Crivelli, 2006a; Mina *et al.*, 2014).

decline, with a 30% decrease expected over the next 10 years, due to damming of watercourses and increased sedimentation (Crivelli, 2006a). The population size and population trends of the Vardar nase are not known in Serbia.

Ecology of the species

The Vardar nase is a benthopelagic, rheophilic and potamodromous species (Kottelat & Freyhof, 2007; Angelov *et al.*, 2020). At the beginning of the spawning season in April (Zhelev *et al.*, 2018), individuals migrate from larger rivers to tributaries, where they spawn in rapids and riffles among stones (Kottelat & Freyhof, 2007; Angelov *et al.*, 2018). The migrations take place within the river system and individuals do not travel long distances (Meulenbroek *et al.*, 2018). Adults feed mainly on filamentous algae, detritus and epilithic algae and may also eat benthic invertebrates such as worms, insects, crustaceans and snails (Porcellotti, n.d.i).

Habitat

It lives in rivers and streams on stony substrates with fast or strong currents (Kottelat & Freyhof, 2007). It also occurs in lowland watercourses (Crivelli, 1996).

Importance in fisheries

The Vardar nase is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

The threats are mainly related to habitat pollution from effluents from various sources, water withdrawal, damming and regulation of watercourses, and habitat loss (Crivelli, 1996). Other threats include the introduction of non-native invasive species and the negative impacts of climate change, especially drought (Crivelli, 2006a; Mina *et al.*, 2014).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2, 7.3, 9.3, 11.1, 11.2

Postojeće mere zaštite

U Srbiji, vardarski skobalj nije obuhvaćen postojećim merama zaštite.

Predložene mere zaštite

Za ovu vrstu nisu predviđene posebne mere zaštite. Bilo bi poželjno sprečiti zagađenje otpadnim vodama i unos alohtonih vrsta riba. Takođe, trebalo bi ograničiti regulaciju vodotokova.

Conservation actions in place

The Vardar nase is not covered by the existing conservation measures in Serbia.

Conservation actions needed

There are no specific protective measures for this species. It would be desirable to prevent pollution from sewage and the introduction of non-native fish species. The regulation of watercourses should also be restricted.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Neophodna su istraživanja veličine, distribucije i trendova populacije, životne istorije i ekologije ove vrste, kao i faktora ugrožavanja.

Research into population size, distribution and trends as well as life history, ecology and threats is necessary.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1,1.2, 1.3, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Milica Jaćimović

BUGARSKA KRKUŠA
Gobio bulgaricus Drensky, 1926

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Gobionidae
Vrsta: *Gobio bulgaricus* Drensky, 1926

Sinonimi

Gobio gobio bulgarica Drensky, 1926

Narodno ime: Bugarska krkuša
Englesko ime: Aegean gudgeon
Nemačko ime: Bulgarischer Gründling
Rusko ime: Болгарский пескарь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, bugarska krkuša ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008k). U Srbiji, bugarska krkuša ima status ugrožene vrste (EN), kako zbog veličine obima rasprostranjenja (EOO iznosi 981 km^2), tako i zbog male površine naseljavanja (AOO iznosi 12 km^2). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa i broja naseljenih lokaliteta – kriterijumi B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv).

Rasprostranjenje

Bugarska krkuša je endemit egejskog sliva i široko je rasprostranjena vrsta u Severnoj Makedoniji, Bugarskoj, Grčkoj i Turskoj. U Srbiji je registrovana u reci Nerodimki u blizini bifurkacije (Ibrahimi *et al*., 2019), kao i u Božičkoj reci i Dragovištici (Slika 82).

Opis vrste

Bugarska krkuša se odlikuje izduženim, vretenastim telom koje je pokriveno relativno velikim cikloidnim krljuštima (Slika 83). Boja tela je sivkasto-smeđa po leđima i bokovima, trbuh je srebrnkasto-beo. Duž bokova se pruža 5–6 nejasno definisanih tamnijih mrlja. Na repnom i leđnom peraju nalaze se tamne mrlje. Od drugih krkuša jadranskog i egejskog sliva razlikuje se po sledećim karakterima: između anusa i početka podrepnog peraja postoji 4–6 krljušti, dužina glave čini 25–29% standardne dužine tela (SL), a grudi su pokrivene krljuštima između grudnih peraja, pri čemu se krljušti pružaju i ispred osnove grudnih peraja. Interorbitalni razmak je 1,1–1,5 puta veći od prečnika oka. Broj krljušti u bočnoj liniji je 35–38. Naraste malo preko 9 cm (Kottelat & Freyhof, 2007).

Populacione karakteristike

Podataka o veličini populacija i populacionim trendovima nema, iako je česta vrsta, a lokalno može biti i veoma brojna (Freyhof &

AEGEAN GUDGEON
Gobio bulgaricus Drensky, 1926

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Gobionidae
Species: *Gobio bulgaricus* Drensky, 1926

Synonyms

Gobio gobio bulgarica Drensky, 1926

Vernacular name: Bugarska krkuša
English name: Aegean gudgeon
German name: Bulgarischer Gründling
Russian name: Болгарский пескарь

National threat category assessed according to IUCN criteria

At the global level, the Aegean gudgeon is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008k). In Serbia, the species is classified as Endangered (EN) due to the small extent of occurrence (EOO is 981 km^2) and the small area of occupancy (AOO is 12 km^2). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality and the number of locations, were observed - criteria B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv).

Distribution

The Aegean gudgeon is endemic to the Aegean Sea basin and a widespread species in Northern Macedonia, Bulgaria, Greece and Turkey. In Serbia, it has been recorded in the Nerodimka River near the bifurcation (Ibrahimi *et al*., 2019) as well as in Božička reka and Dragovištica (Figure 82).

Description of the species

The Aegean gudgeon is characterised by an elongated, spindle-shaped body covered with relatively large cycloid scales (Figure 83). The colour of the body is grey-brown on the back and sides, the belly is silvery white. There are 5–6 indistinct darker spots on the flanks. The caudal and dorsal fins are covered with dark spots. It differs from other gudgeons from the Adriatic and Aegean Sea basins by the following characteristics: 4–6 scales between the anus and the anal fin origin, the head length is 25–29% of the standard body length (SL), and the breast is covered with scales between the pectoral fins, with the scales extending forward beyond the base of the pectoral fins. The interorbital space is 1.1–1.5 times the eye diameter. The number of scales in the lateral line is 35–38. It grows to just over 9 cm (Kottelat & Freyhof, 2007).

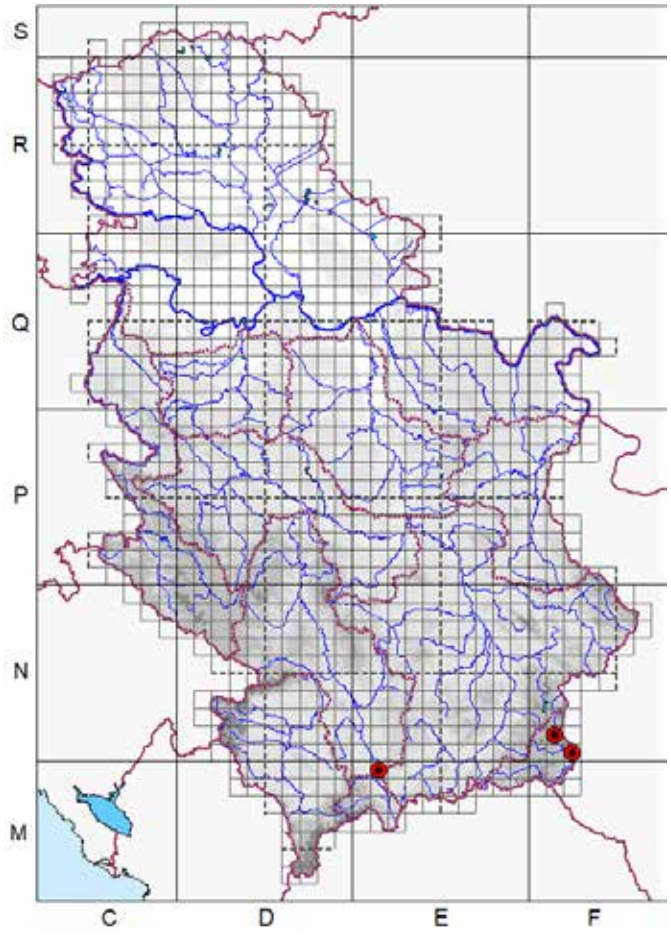
Population trends

There are no data on population size and trends, although it is a common species that can be locally abundant (Freyhof & Kottelat,

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Bugarska krkuša / Aegean gudgeon – *Gobio bulgaricus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Gobio* spp.)	**MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii,iv)+2ab(i,ii,iii,iv) Strogo zaštićena vrsta / Strictly protected species**

*MLM – minimalna lovna mera 10 cm, ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) /
*MLM – minimum landing size at 10 cm standard length, ODU – daily catch limit of 5 kg (measure applies to all native species)



Slika 82. **Rasprostranjenje *Gobio bulgaricus* u Srbiji.**

Figure 82. **Distribution of *Gobio bulgaricus* in Serbia.**

Slika 83. Bugarska krkuša *Gobio bulgaricus* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141029_0.jpg).

Figure 83. Aegean gudgeon *Gobio bulgaricus* (photo: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141029_0.jpg).

Kottelat, 2008k). Postoji procena za minimalno vreme udvostručavanja populacije koje iznosi u proseku 1,4–4,4 godine (Porcellotti, n.d.f).

Ekologija vrste

Bugarska krkuša je sitna bentopelagična vrsta. Jedinke se u tekućicama ravnomerno raspoređuju duž toka (Porcellotti, n.d.f). Leti obitavaju u plitkim zonama, a zimi su u dubljoj vodi, u tišacima i virovima. Polno sazreva pri dužini od oko 4 cm (Saç & Özuluğ, 2020). Mrest se odvija od proleća do početka leta. Tokom mresnog perioda, polno zrele jedinke se okupljaju u jata i obavljaju kratke lokalne mresne migracije (Porcellotti, n.d.f). Mrest se obavlja u delovima toka sa manjom dubinom, gde je voda nezagađena i sa visokim sadržajem rastvorenog kiseonika, a podloga kamenita ili šljunkovita. Jaja su lepljiva, polažu se na tvrdi supstrat i tu ostaju do izleganja. Ishrana se pretežno sastoji od bentosnih beskičmenjaka, uglavnom insekata i njihovih larvi, rakova, anelida i mekušaca (Saç & Özuluğ, 2020). Pored toga, u ishrani koristi i detritus, a ređe mlađ i jaja drugih vrsta riba (Porcellotti, n.d.f).

Stanište

Bugarska krkuša naseljava srednje i gornje zone tekućica (Porcellotti, n.d.f), sa visokim sadržajem rastvorenog kiseonika, umerenom strujom i mešanim supstratom sa širim peskovitim površinama (Kottelat & Freyhof, 2007).

Ribolovni značaj

Bugarska krkuša nema nikakav ribolovni značaj. Povremeno se ulovi pri rekreativnom ribolovu na druge ciprinide. Ponekad se koristi kao mamac za grabljive ribe (Porcellotti, n.d.f).

2008k). There is an estimate for a minimum population doubling time of 1.4-4.4 years on average (Porcellotti, n.d.f).

Ecology of the species

The Aegean gudgeon is a small benthopelagic species. In streams, individuals are evenly distributed along the course (Porcellotti, n.d.f). In summer they live in shallow areas, in winter in deeper waters, in pools and riffles. It is sexually mature at a length of about 4 cm (Saç & Oezuluğ, 2020). Spawning takes place from spring to early summer. During the spawning season, sexually mature individuals gather in shoals and perform short local spawning migrations (Porcellotti, n.d.f). Spawning occurs in river sections of shallower depth where the water is not polluted, has a high dissolved oxygen content and rocky or gravelly substrate. Eggs are sticky, laid on a hard substrate and remain there until hatching. The diet consists mainly of benthic invertebrates, especially insects and their larvae, crustaceans, annelids and molluscs (Saç & Oezuluğ, 2020). In addition, it also feeds on detritus and, less frequently, on juveniles and eggs of other fish species (Porcellotti, n.d.f).

Habitat

The Aegean gudgeon inhabits the middle and upper stretches of streams (Porcellotti, n.d.f), with high dissolved oxygen content, moderate flow and mixed substrate with wider sandy areas (Kottelat & Freyhof, 2007).

Importance in fisheries

The Aegean gudgeon is of no fishery importance. It is occasionally caught in recreational fishing for other cyprinids. It is sometimes used as bait for predatory fish (Porcellotti, n.d.f).

Faktori ugrožavanja

Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla (naselja i urbane zone, industrijski i poljoprivredni objekti), regulacijom i pregrađivanjem tokova, izgradnjom brana, kao i gubitkom staništa. Takođe, stalnu pretnju predstavlja i introdukcija alohtonih invazivnih vrsta i negativni efekti klimatskih promena.

Threats

The threats are mainly related to habitat pollution by effluents from various sources (settlements and urban areas, industrial and agricultural facilities), regulation and damming of watercourses, construction of dams and habitat loss. Other threats include the introduction of non-native invasive species and the negative impacts of climate change.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.3, 7.2.11, 7.3, 8.1, 9.1.3, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

Bugarska krkuša nije obuhvaćena postojećim merama zaštite.

Conservation actions in place

The Aegean gudgeon does not fall under the existing conservation measures.

Predložene mere zaštite

Poželjno bi bilo sprečiti ili smanjiti zagađenje otpadnim vodama, kao i ograničiti regulaciju vodotoka i izgradnju novih brana. Neophodno je sprečiti negativne efekte unosa alohtonih vrsta riba. Posebnu pažnju bi trebalo posvetiti izgradnji funkcionalnih ribljih staza uz poštovanje biološkog minimuma prilikom eksploatacije vodnih potencijala.

Conservation actions needed

It would be desirable to prevent or reduce pollution from sewage and to limit the regulation of watercourses and the construction of new dams. It is necessary to prevent the negative effects of the introduction of non-native fish species. Particular attention should be paid to the construction of functional fish ladders, respecting the biological minimum in the use of water resources.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Neophodna su populaciona istraživanja veličine, distribucije i trendova, kao i životne istorije i ekologije ove vrste.

The population size, distribution and trends as well as the life history, ecology and threat factors of this species still need to be researched.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR: Aleksandar Hegediš

MLADICA
Hucho hucho (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Salmoniformes
Porodica: Salmonidae
Vrsta: *Hucho hucho* (Linnaeus, 1758)

Sinonimi

Salmo hucho Linnaeus, 1758

Narodno ime: Mladica
Englesko ime: Huchen, Danube salmon
Francusko ime: Huchon
Nemačko ime: Huchen, Donaulachs
Rusko ime: Дунайский лосóсь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, mladica ima status ugrožene vrste (EN) prema kriterijumima B2ab(ii,iii) (Freyhof & Kottelat, 2008n). U Srbiji, mladica takođe ima status ugrožene vrste (EN). Iako je obim rasprostranjenja vrste u Srbiji relativno veliki (EOO iznosi 5.785 km²), površina koju vrsta naseljava (AOO) iznosi svega 30 km². Usled fragmentisanog rasprostranjenja i površine naseljavanja, kao i prognoziranog kontinuiranog opadanja broja naseljenih lokaliteta ili subpopulacija i broja odraslih jedinki (10–20% u narednih 10 godina ili tri generacije), vrsta je ugrožena prema kriterijumima B2ab(iv,v). Kvantitativna analiza (kriterijum E), ukazuje na to da je verovatnoća iščezavanja u prirodi ≥20% u narednih 20 godina ili pet generacija.

Rasprostranjenje

Mladica je endemit Dunavskog sliva, sa prirodnim arealom na području Nemačke, Austrije, Češke, Slovačke, Poljske, Mađarske, Slovenije, Hrvatske, Bosne i Hercegovine, Crne Gore, Srbije, Ukrajine i Rumunije. Zbog svoje ribolovne atraktivnosti, lokalno je introdukovana i u neke druge evropske vode, kao što su Odra, Visla, Bodensko jezero, Rajna, Duero, Taho, Rona itd., u kojima se održava poribljavanjem (Kottelat & Freyhof, 2007). Prirodne populacije mladice u Srbiji naseljavaju Vapu, Uvac, Poblaćnicu, Lim, srednji tok Drine, Trešnjicu i gornji tok Ibra sa pritokom Goduljom (Slika 84). Osim navedenih populacija, mladica je prisutna na još četiri lokaliteta na koje je translocirana iz sistema Drine – Moravica, Đetinja, Nišava i Mlava (Hegediš *et al.*, 2005; Marić *et al.*, 2009).

Opis vrste

Telo mladice je izduženo, valjkasto, pokriveno sitnim krljuštima (Slika 85). Glava je duga, bočno spljoštena, sa velikim usnim otvorom. Gornja vilica je duga, zadnjim krajem premašuje zadnju ivicu oka. Na vilicama se nalaze jaki konični zubi, koji su u obliku

HUCHEN
Hucho hucho (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Salmoniformes
Family: Salmonidae
Species: *Hucho hucho* (Linnaeus, 1758)

Synonyms

Salmo hucho Linnaeus, 1758

Vernacular name: Mladica
English name: Huchen, Danube salmon
French name: Huchon
German name: Huchen, Donaulachs
Russian name: Дунайский лосóсь

National threat category assessed according to IUCN criteria

At the global level, the huchen is classified as Endangered (EN) under criteria B2ab(ii,iii) (Freyhof & Kottelat, 2008n). In Serbia, the species is also classified as Endangered (EN). Although the extent of occurrence in Serbia is relatively large (EOO is 5,785 km²), the area of occupancy (AOO) is only 30 km². Due to the fragmented extent of occurrence and area of occupancy, as well as the projected continuing decline in the number of locations or subpopulations and in the number of mature individuals (10-20% in the next 10 years or three generations), the species is threatened according to criteria B2ab(iv,v). The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥20% in the next 20 years or five generations.

Distribution

The huchen is endemic to the Danube basin with a natural range in Germany, Austria, the Czech Republic, Slovakia, Poland, Hungary, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, Serbia, Ukraine and Romania. Because of its fishing attractiveness, it has been introduced locally into some other European waters such as the Oder, Vistula, Lake Constance, Rhine, Douro, Tagus, Rhône etc., where it is maintained only by stocking (Kottelat & Freyhof, 2007). Natural populations of the huchen in Serbia exist in Vapa, Uvac, Poblaćnica, Lim, the middle reaches of the Drina, Trešnjica and the upper reaches of the Ibar with its tributary Godulja (Figure 84). In addition to the above-mentioned populations, the species occurs in four other locations to which it was translocated from the Drina system – Moravica, Đetinja, Nišava and Mlava (Hegediš *et al.*, 2005; Marić *et al.*, 2009).

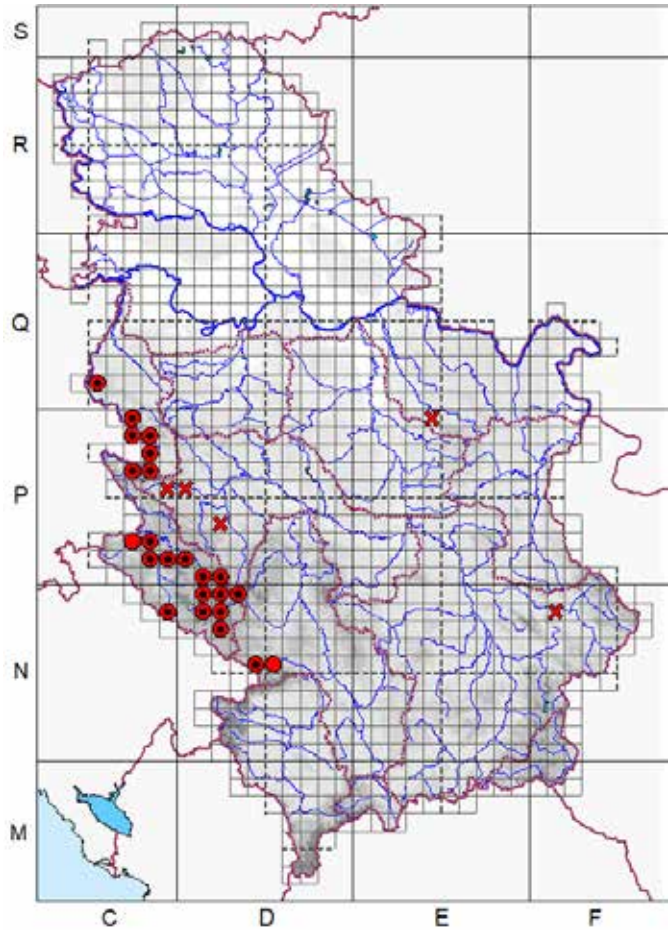
Description of the species

The body of the huchen is elongated, cylindrical and covered with small scales (Figure 85). The head is long, laterally flattened, and has a large mouth opening. The upper jaw is long, its posterior end protruding

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Mladica / Huchen – *Hucho hucho*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**EN B2ab(ii,iii)**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II, V**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex II**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**L, MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**VU**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B2ab(iv,v); E Strogo zaštićena vrsta / Strictly protected species**

*L – lovostaj od 1. marta do 31. avgusta, MLM – minimalna lovna mera 100 cm, ODU – ograničenje dnevnog ulova na jedan komad /
*L – closed season from March 1 to August 31, MLM – minimum landing size at 100 cm standard length, ODU – daily catch limit of 1 individual



Slika 84. **Rasprostranjenje *Hucho hucho* u Srbiji.**

Figure 84. **Distribution of *Hucho hucho* in Serbia.**

Slika 85. Mladica *Hucho hucho* (foto: S. Marić).

Figure 85. Huchen *Hucho hucho* (photo: S. Marić).

potkovice raspoređeni na nepčanim kostima i zadnjem rubu ralaste kosti, dok sa tela ralaste kosti odsustvuju (Vuković & Ivanović, 1971). Leđa su smeđe ili sive boje sa zelenim odsjajem, bokovi su svetliji od leđa, a stomak je beličast sa srebrnim odsjajem. U periodu mresta jedinke imaju intenzivniju, bakarno crvenu obojenost. Na glavi i telu nalaze se crne pege, koje nisu prisutne na perajima. Peraja (grudna, trbušna, leđno i podrepno) su relativno mala, žućkaste ili crvenkaste nijanse. Repno peraje je veliko, udubljeno, tamno obrubljeno (Aganović, 1979). Masno peraje je krupno, sa osnovom dužine preko 50% u odnosu na dužinu osnove podrepnog peraja (Holčík, 1995). Peraja: D III–IV + 8–11; A III–IV + 7–9; V I + 8–9. Broj krljušti u bočnoj liniji je 180–200, a broj piloričnih cekuma oko 200 (Vuković i Ivanović, 1971). Mladica spada među najveće salmonidne vrste na svetu i među najveće slatkovodne ribe Evrope. Primerci mogu dostići dužinu od oko 180 cm i masu od oko 60 kg (Kottelat & Freyhof, 2007). Mladica je dugoživeća vrsta, za koju se smatra da može dostići starost od 30 ili više godina (Witkowski *et al*., 2013), mada su jedinke starosti od 20 godina veoma retke.

Populacione karakteristike

Mladica je u prošlosti bila česta vrsta, prisutna u srednjim i većim vodotocima, uključujući i glavni tok Dunava (Holčík *et al*., 1988). Međutim, procenjuje se da je od kraja XIX veka mladica eliminisana sa 70–90% nekadašnjeg areala. Današnji areal je u velikoj meri fragmentisan, a vrsta ima kontinuiran pad brojnosti. Područje bivše Jugoslavije karakteriše umereno smanjenje areala (oko 35%), i većina preostalih staništa vrste (oko 65%) nalazi se u ovom regionu (Freyhof *et al*., 2015).

Izraziti primer gubitka staništa na teritoriji Srbije jeste sistem Zapadne Morave, koji je nekada predstavljao značajno stanište mladice. Jedina preostala populacija u sistemu Zapadne Morave prisutna je u gornjem toku Ibra, na profilu dužine oko 15 km, od jezera Gazivode do državne granice sa Crnom Gorom. U pitanju je malobrojna, izolovana, veoma ugrožena populacija (Marić *et al*., 2009). Sistem Drine čini oko 27% ukupnog areala vrste (Freyhof

beyond the posterior margin of the eye. There are strong, conical teeth on the jaws, arranged in a horseshoe shape on the palatine bones and on the posterior margin of the vomer, while they are absent from the body of the vomer (Vuković & Ivanović, 1971). The dorsum is brown or grey with a green sheen, the flanks are lighter than the back, and the belly is whitish with a silvery sheen. During the spawning season, individuals have a more intense, copper-red colouration. There are black spots on the head and body, which are not present on the fins. The fins (pectoral, ventral, dorsal and anal) are relatively small and yellowish or reddish in colour. The caudal fin is large, deeply emarginated and dark fringed (Aganović, 1979). The adipose fin is large, with a base length of more than 50% of the base length of the anal fin (Holčík, 1995). Fins: D III–IV + 8–11; A III–IV + 7–9; V I + 8–9. The number of scales in the lateral line is 180–200 and the number of pyloric caeca is about 200 (Vuković and Ivanović, 1971). The huchen is one of the largest salmonid species in the world and one of the largest freshwater fish in Europe. Individuals can reach a length of about 180 cm and a mass of about 60 kg (Kottelat & Freyhof, 2007). The huchen is a long-lived species that can to reach an age of 30 years or more (Witkowski *et al*., 2013), although specimens of 20 years are very rare.

Population trends

The huchen was a common species in the past, occurring in medium and larger watercourses, including the main course of the Danube (Holčík *et al*., 1988). However, it is estimated that the species has been extirpated from 70-90% of its former range since the end of the 19th century. The present range is largely fragmented and populations are continuously declining. The range is moderately declining in the area of the former Yugoslavia (about 35%) and most of the remaining habitats of the species (about 65%) are in this region (Freyhof *et al*., 2015).

A clear example of habitat loss in the territory of Serbia is the West Morava system, which was once an important habitat for the huchen. The only remaining population in the West Morava watershed is located in the upper reaches of the Ibar River, on a profile of about 15 km, from Lake Gazivode to the state border with Montenegro. It is a small, isolated and highly threatened population (Marić *et al*., 2009). The Drina

et al., 2015), i odlikuje se najbrojnijim fondom mladice u čitavom arealu (Holčík *et al*., 1988). Međutim, u gornjim delovima sistema (Tara, Piva, Sutjeska, tok Drine kroz BiH), populacije imaju trend opadanja, dok je trend povoljniji u Ćehotini, Limu i Poblaćnici. Iako su podaci o strukturi populacija mladice oskudni za sistem Drine kroz Srbiju, postoje indikacije da je populaciona struktura narušena i da na većini rečnih profila postoji trend pada brojnosti (Marić *et al*., 2009; Witkowski *et al*., 2013; Freyhof *et al*., 2015). Reintrodukovane populacije u Moravici i Đetinji pokazuju stabilan populacioni trend. U Nišavu i Mlavu mladica je skoro introdukovana i prerano je za procenu trenda populacija.

Za očuvanje genetičke varijabilnosti i adaptivnog kapaciteta, odnosno za dugoročni opstanak populacija mladice, neophodno je da populacija broji oko 1.000 polno zrelih jedinki, što znači da male, izolovane populacije dugoročno nemaju perspektivu opstanka (Frankham *et al*., 2014).

Ekologija vrste

Mužjaci mladice dostižu polnu zrelost u trećoj ili četvrtoj godini života, pri masi od 1 kg do 2 kg. Ženke dostižu polnu zrelost u četvrtoj ili petoj godini života, pri masi od 2 kg do 3 kg. Mladica se mresti na peskovitoj ili šljunkovitoj podlozi, u periodu od marta do maja, kada temperatura vode dostigne 6–10 °C, u glavnim rečnim tokovima ili u njihovim pritokama. Mrest se obično obavlja u toku dana. Mužjak brani ženku od drugih mužjaka (Kottelat & Freyhof, 2007). Ženka repom kopa plitku jamu (Muus & Dalhström, 1967), prečnika 1–3 m, dubine 10–20 cm (Kottelat & Freyhof, 2007). Nakon oplodnje, ženka ikru zatrpava supstratom (Esteve *et al*., 2013), a par obično ostaje u blizini mesta mresta koje čuva do dve sedmice. Inkubacija ikre traje 25–40 dana, u zavisnosti od temperature vode (Kottelat & Freyhof, 2007). Mlade jedinke se uglavnom hrane beskičmenjacima, a od jeseni iste godine jedu i mlađ drugih vrsta riba. Odrasle jedinke su gotovo isključivo piscivorni predatori, koji se mogu hraniti i vodozemcima, gmizavcima, vodenim pticama i sitnim sisarima (Aganović, 1979; Holčík, 1995).

Stanište

Mladica je bentopelagična, litofilna vrsta koja obično naseljava veće brdsko-planinske reke sa brzim tokom i čistom, hladnom vodom temperature do 15 °C, mada podnosi i temperaturu vode do 20–22 °C (Holčík *et al*., 1988). Za razliku od drugih salmonidnih vrsta, toleriše vrednosti rastvorenog kiseonika do 5 mg/l. Osim reka, mladica može naseljavati hladne i čiste jezerske ekosisteme (Holčík, 1995). Starije jedinke su teritorijalne, biraju virove, zasenčene delove toka, delove toka sa većim preprekama u rečnom koritu ili oko ušća manjih pritoka. Mlađ najčešće boravi u blizini mesta gde se izvaljala, u manjim pritokama ili u mirnijoj, plićoj vodi glavnog rečnog toka. Ukoliko je mrest obavljen u pritokama, mlađ se tokom odrastanja postepeno spušta nizvodno u glavne vodotoke (Holčík *et al*., 1988).

Ribolovni značaj

Mladica nije značajana vrsta sa aspekta komercijalnog ribolova, ali spada među najatraktivnije vrste za rekreativni ribolov va-

system accounts for about 27% of the total range of the species (Freyhof *et al*., 2015) and is characterised by the richest huchen stock in the entire range (Holčík *et al*., 1988). However, in the upper parts of the system (Tara, Piva, Sutjeska, Drina in Bosnia and Herzegovina) the population is declining, while the trend in Ćehotina, Lim and Poblaćnica is more favourable. Although data on the population structure of huchen in the Drina system in Serbia are sparse, there is evidence that the population structure is disturbed and that there is a trend of declining numbers in most river profiles (Marić *et al*., 2009; Witkowski *et al*., 2013; Freyhof *et al*., 2015). The reintroduced populations in Moravica and Đetinja show a stable population trend. In Nišava and Mlava, the huchen was introduced only recently and it is too early to assess population trends.

For the maintenance of genetic variability and adaptability, i.e. for the long-term survival of huchen populations, it is necessary that the population contains about 1,000 sexually mature individuals, which means that small, isolated populations have no long-term chance of survival (Frankham *et al*., 2014).

Ecology of the species

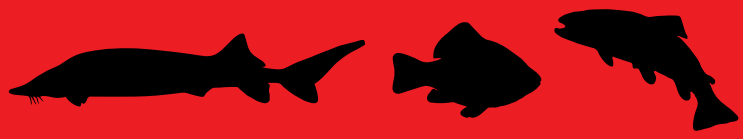
Male huchen reach sexual maturity in their third or fourth year of life, at a weight of 1 to 2 kg. Females reach sexual maturity in the fourth or fifth year of life, at a weight of 2 to 3 kg. The huchen spawn from March to May, when the water temperature reaches 6–10 °C, on sandy or gravelly substrates in the main course or in tributaries. Spawning usually takes place during the day. The male defends the female against other males (Kottelat & Freyhof, 2007). The female digs a shallow hole (Muus & Dalhstroem, 1967) 1–3 m in diameter and 10–20 cm deep with her tail (Kottelat & Freyhof, 2007). After fertilisation, the female covers the eggs with substrate (Esteve *et al*., 2013), and the pair usually remains near the spawning site, which they guard for up to two weeks. Incubation of the eggs lasts 25–40 days, depending on water temperature (Kottelat & Freyhof, 2007). Juveniles feed primarily on invertebrates and from autumn of the first year also on juveniles of other fish species. Adults are almost exclusively piscivorous and may also feed on amphibians, reptiles, waterfowl and small mammals (Aganović, 1979; Holčík, 1995).

Habitat

The huchen is a benthopelagic, lithophilous species that usually inhabits larger mountain rivers with fast flow and clear, cold water with a temperature of up to 15 °C, although it tolerates water temperatures of up to 20–22 °C (Holčík *et al*., 1988). Unlike other salmonid species, it tolerates dissolved oxygen levels of up to 5 mg/l. Apart from rivers, it can also live in cold and clean lakes (Holčík, 1995). Older individuals are territorial and choose riffles, shady stretches, sections with larger obstacles in the riverbed or around the mouth of smaller tributaries. Juveniles tend to stay close to where they hatched, in smaller tributaries or in calmer, shallower waters of the main course. If spawning occurred in tributaries, juveniles gradually descend downstream into the main course as they grow (Holčík *et al*., 1988).

Importance in fisheries

The huchen is not a significant species for commercial fishing, but it is one of the most attractive species for recreational bait fishing.



ralicom. Ribolovnoj atraktivnosti vrste doprinosi njena veličina, snaga, izgled, izuzetan otpor i aktivna borba kojom se suprostavlja ribolovcu.

Faktori ugrožavanja

Najizrazitiji faktori ugrožavnja koji su doprineli gubitku staništa, posebno u zapadnom delu areala vrste, jesu regulacija reka, izgradnja hidroelektrana, industrijsko i poljoprivredno zagađenje (Witkowski *et al*., 2013; Freyhof *et al*., 2015). Takođe, poribljavanje kao mera oporavka autohtonih populacija koje se prirodno reprodukuju, često proizvodi više štete nego koristi, jer može dovesti do izmene genetičke strukture, povećavanja kompeticije ili predatorskog pritiska, unošenja bolesti itd. (Cowx, 1994c; Weiss *et al*., 2011; Ihut *et al*., 2014). Postoje indicije da je Drina na teritoriji Srbije poribljavana mladicom iz Slovenije, koja pripada posebnoj genetičkoj grupi, pri čemu je za dalja poribljavanja lokaliteta na teritoriji Srbije korišćena drinska mladica, bez prethodnog testiranja genetičke strukture matičnih jedinki, kao ni strukture recipijentskih populacija (Marić *et al*., 2014). Narušavanje genetičkog identiteta nije jedina pretnja, veoma značajni faktori ugrožavanja na teritoriji Srbije odnose se na prekomeran izlov, nedostupnost prirodnih plodišta i narušavanje staništa izgradnom hidroenergetskih objekata, koji su uzrokovali promenu vodnog režima, tipa i kvaliteta staništa (Marić *et al*., 2009; Witkowski *et al*., 2013).

Od svih navedenih pretnji u regionu zapadnog Balkana, kao najopasnija po opstanak populacija mladice je potencijalna izgradnja oko 100 hidroelektrana različitih dimenzija, koje bi uticale na gubitak oko 1.000 km današnjih staništa, odnosno 60–70% populacija mladice u regionu. Preostale populacije bi bile male, izrazito fragmentisane bez potencijala za dugoročni opstanak (Freyhof *et al*., 2015).

The attractiveness of the species for angling is determined by its size, strength, appearance, exceptional resistance and active fight against the angler.

Threats

The main threat factors that have contributed to habitat loss, especially in the western part of the species' range, are river regulation, construction of hydroelectric dams, and industrial and agricultural pollution (Witkowski *et al*., 2013; Freyhof *et al*., 2015). Stocking as a measure to restore native populations that reproduce naturally also often does more harm than good, as it can lead to changes in genetic structure, increased competition or predation, introduction of diseases, etc. (Cowx, 1994c; Weiss *et al*., 2011; Ihut *et al*., 2014). There is evidence that the river Drina in the territory of Serbia was stocked with huchen from Slovenia belonging to a specific genetic group and that the Drina huchen was used for further stocking in Serbia without prior examination of the genetic structure of the parent individuals and the structure of the recipient populations (Marić *et al*., 2014). The disruption of genetic identity is not the only threat and other very important threats in Serbia are overfishing, the unavailability of natural spawning grounds as well as habitat destruction through the construction of hydropower plants, which leads to a change in the water regime and in habitat type and quality (Marić *et al*., 2009; Witkowski *et al*., 2013).

Of all the threats in the Western Balkans region, the most dangerous to the survival of the huchen population is the potential construction of about 100 hydropower plants of different sizes, which would result in the loss of about 1,000 km of current habitats, i.e. 60–70% of the huchen population in the region. The remaining populations would be small, highly fragmented and have no potential for long-term survival (Freyhof *et al*., 2015).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 3.3, 5.4.2, 6.3, 7.2.11, 7.2.2, 7.2.3, 7.2.10, 7.3, 8.3, 9.1, 9.4, 11

Postojeće mere zaštite

Mladica se nalazi u Prilogu II *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je lovostaj od 1. marta do 31. avgusta, minimalna lovna mera od 100 cm, i ograničenje dnevnog ulova na jedan komad. U cilju očuvanja fonda mladice na teritoriji Srbije urađena su i dve studije, *Akcioni plan upravljanja mladicom u ribolovnim vodama Republike Srbije* (Hegediš *et al*., 2005) i *Istraživanje životnog ciklusa i populacionih karakteristika mladice u Srbiji* (Marić *et al*., 2009). Međutim, preporuke ovih studija nedovoljno su implementirane u praksi.

Conservation actions in place

The huchen is listed in Annex II of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a closed season from March 1 to August 31, a minimum landing size at 100 cm standard length and a daily catch limit of one individual are set for this species. Two studies were conducted for the conservation of huchen populations in Serbia: *Action plan for fisheries management with huchen stocks in catchments of the Republic of Serbia* (Hegediš *et al*., 2005) and *Research of life history and population traits of huchen in Serbia* (Marić *et al*., 2009). However, the recommendations of these studies are insufficiently implemented in practice.

Predložene mere zaštite

Na rekama koje predstavljaju staništa mladice na teritoriji Srbije, pored postojećih velikih brana, planirana je i izgradnja više desetina hidroelektrana različitih dimenzija (Javno, 2014), od kojih su mnoge predviđene na rekama koje su prirodna plodišta mladice (Po-

Conservation actions needed

In addition to the existing large dams, the construction of dozens of hydropower plants of various sizes is planned on the rivers that are habitats of the huchen in the territory of Serbia (Javno, 2014), many of them on the rivers that are the natural spawning grounds of the

blaćnica, Trešnjica, Rogačica i Godulja). Bez ikakve sumnje, izgradnja ovih objekata dovela bi do potpune devastacije već narušenih staništa, što implicira da bi dugoročni opstanak mladice na teritoriji Srbije bio nemoguć.

Za očuvanje populacija mladice potrebno je sprovesti preporuke iz akcionih planova (Hegediš *et al*., 2005; Marić *et al*., 2009), koje se objedinjeno odnose na zaštitu i revitalizaciju staništa, posebno u delovima toka koji predstavljaju plodišta mladice, kao i zabranu izgradnje hidrotehničkih objekata koji utiču na promenu kvaliteta staništa i strogu kontrolu funkcionisanja već izgrađenih.

Takođe je potrebno uskladiti načine ribolova sa brojnošću i strukturom populacija, zabraniti introdukciju alohtonih linija i izbegavati poribljavanje autohtonim materijalom zbog mogućih negativnih posledica (smanjenje varijabilnosti, vijabilnosti, reproduktivnog kapaciteta populacija, prenošenja infekcija itd.) (Waples, 1991; Campton, 1995). Veštački mrest i poribljavanje autohtonim materijalom potrebno je sprovoditi samo u izuzetnim slučajevima, kada druge metode revitalizacije ne daju rezultate. Lokalno stanovništvo treba informisati o biološkom značaju vrste, faktorima ugrožavanja i planovima za njen oporavak.

huchen (Poblaćnica, Trešnjica, Rogačica and Godulja). The construction of these facilities would undoubtedly lead to the complete destruction of already damaged habitats, which means that long-term survival of the huchen in the territory of Serbia would be impossible.

In order to preserve the huchen populations, it is necessary to implement the recommendations from the action plans (Hegediš *et al*., 2005; Marić *et al*., 2009), which overall refer to the protection and revitalisation of the habitat, especially in the stream sections that represent the spawning grounds of the huchen, as well as to the prohibition of the construction of hydrotechnical facilities that cause a change in habitat quality and to the strict control of the operation of the facilities that have already been built.

In addition, fishing methods must be adapted to the size and structure of the populations, the introduction of non-native species must be prohibited, and stocking with native material must be avoided because of possible negative consequences (reduction of variability, viability, reproductive capacity, transmission of infections, etc.) (Waples, 1991; Campton, 1995). Artificial spawning and stocking with native material should only be done in exceptional cases when other methods of revival are not successful. The local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.1.1, 3.2, 4, 5.4.2

U cilju zaštite i revitalizacije staništa i populacija mladice, neophodno je sprovoditi detaljna i redovna istraživanja osnovnih bioloških parametara, kao što su analize veličine populacija i populacionih trendova, genetičke strukture i faktora ugrožavanja. Rezultate istraživanja treba implementirati u mere zaštite, oporavka i upravljanja staništima i vrstom, uz redovan nadzor sprovođenja mera.

In order to protect and revitalise the huchen habitat and populations, detailed and regular studies of basic biological parameters are needed, such as the analysis of population size and development, genetic structure and threats. Research results should be translated into measures for the protection, restoration and management of the species and its habitats, with regular monitoring of their implementation.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.4, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.4

AUTOR / AUTHOR: Saša Marić

KARAMANOVA BODORKA, ŽUTALJ, BABUR
Leucos basak Heckel, 1843

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Leucos basak* Heckel, 1843

Sinonimi

Rutilus basak Heckel, 1843; *Leucos aula ohridana* Karaman, 1924; *Rutilus basak ohridanus* Karaman, 1924; *Rutilus ohridanus* Karaman, 1924; *Leucos aula prespensis* Karaman, 1924; *Rutilus ohridanus prespensis* Karaman, 1924; *Rutilus prespensis* Karaman, 1924; *Rutilus aula karamani* Vladykov & Petit, 1930; *Rutilus rubella karamani* Fowler, 1977; *Rutilus karamani* Fowler, 1977; *Rutilus prespensis vukovici* Marić, 1988

Narodno ime: Karamanova bodorka, žutalj, babur, grunec
Englesko ime: Dalmatian roach, Albanian roach, Croatian roach
Nemačko ime: Basak-Plötze

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, Karamanova bodorka ne smatra se ugroženom vrstom (Crivelli, 2006d, 2006e). U Srbiji, Karamanova bodorka ima status ugrožene vrste (EN), kako zbog malog obima rasprostranjenja (EOO iznosi 241,5 km²), tako i zbog male površine naseljavanja (AOO iznosi 8 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Karamanova bodorka naseljava jezera i sporotekuće reke jadranskog sliva, od jugoistočnih delova Hrvatske (jezera i male reke kraj Imotskog, reka Neretva sa pritokama), Bosne i Hercegovine (reka Neretva sa pritokama), Crne Gore (Skadarsko jezero), do Severne Makedonije (Ohridsko i Prespansko jezero) i Albanije (Crivelli 2006c, 2006d, 2006e, 2006f; Matić-Skoko *et al.* 2010). U Srbiji naseljava vode jadranskog sliva (Slika 86). Introdukovana je u Vlasinsko jezero (Simonović, 2001).

Opis vrste

Karamanova bodorka ima izduženo telo i malu glavu (Slika 87). Trbuh je zaobljen i bez grebena. Krupnije jedinke mogu da imaju grbu na leđima. Usta su terminalna ili blago subterminalna, malih dimenzija. Rostrum je oštar i sa gornje strane ispupčen. Tokom reproduktivnog perioda mužjaci ne dobijaju bradavičaste izraštaje na krljuštima i glavi, po čemu se rod *Leucos* razlikuje od roda *Rutilus* (Bianco & Ketmaier, 2014). Telo je uniformno srebrnkaste boje, bez

DALMATIAN (ALBANIAN) ROACH
Leucos basak Heckel, 1843

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Leucos basak* Heckel, 1843

Synonyms

Rutilus basak Heckel, 1843; *Leucos aula ohridana* Karaman, 1924; *Rutilus basak ohridanus* Karaman, 1924; *Rutilus ohridanus* Karaman, 1924; *Leucos aula prespensis* Karaman, 1924; *Rutilus ohridanus prespensis* Karaman, 1924; *Rutilus prespensis* Karaman, 1924; *Rutilus aula karamani* Vladykov & Petit, 1930; *Rutilus rubella karamani* Fowler, 1977; *Rutilus karamani* Fowler, 1977; *Rutilus prespensis vukovici* Marić, 1988

Vernacular name: Karamanova bodorka, žutalj, babur, grunec
English name: Dalmatian roach, Albanian roach, Croatian roach
German name: Basak-Plötze

National threat category assessed according to IUCN criteria

At the global level, the Dalmatian roach is not classified as a threatened species and has the status of Least Concern (LC) (Crivelli, 2006d, 2006e). In Serbia, the Dalmatian roach is classified as Endangered (EN) due to the small extent of occurrence (EOO is 241.5 km²) and the small area of occupancy (AOO is 8 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

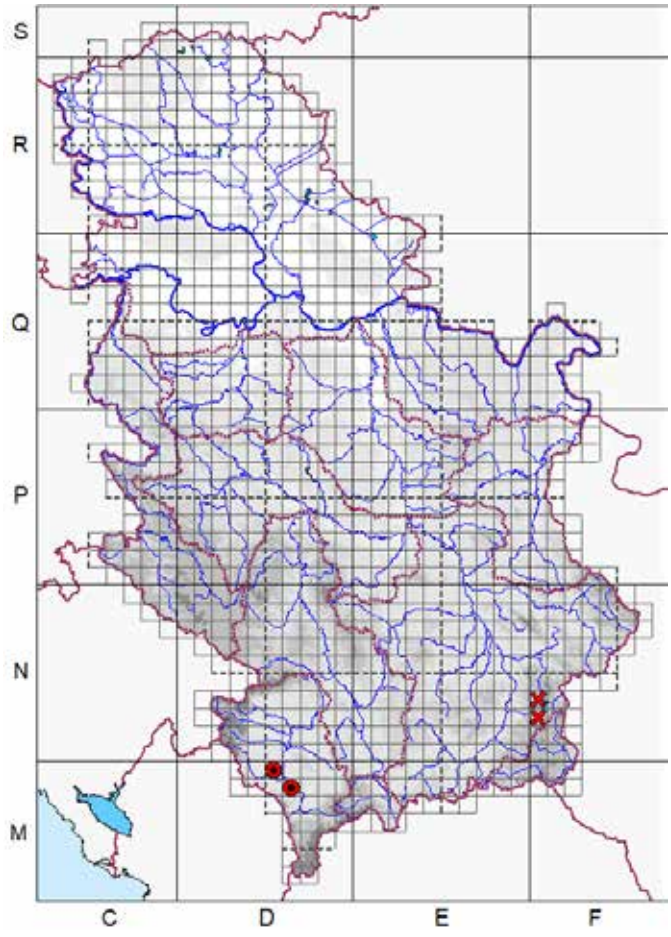
The Dalmatian roach inhabits the lakes and slow-flowing rivers of the Adriatic Sea basin, from the southeastern parts of Croatia (lakes and small rivers near Imotski, the Neretva with its tributaries), Bosnia and Herzegovina (the Neretva with its tributaries), Montenegro (Lake Skadar), to Northern Macedonia (Lakes Ohrid and Prespa), and Albania (Crivelli 2006c, 2006d, 2006e, 2006f; Matić-Skoko *et al.* 2010). In Serbia, it inhabits the waters of the Adriatic Sea basin (Figure 86). It was introduced into Lake Vlasina (Simonović, 2001).

Description of the species

The Dalmatian roach has an elongated body and a small head (Figure 87). The belly is rounded, without a keel. Larger animals may have a hump on the back. The mouth is terminal or slightly subterminal and small. The rostrum is sharp and convex on the upper side. During the reproductive season, the nuptial tubercles on the scales and head of males are absent, which distinguishes the genus *Leucos* from the genus *Rutilus* (Bianco & Ketmaier, 2014). The body is uniformly silvery in

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Karamanova bodorka, žutalj, babur / Dalmatian roach – *Leucos basak*		**Status**
Međunarodna zaštita / International protection	IUCN Red List (navedena kao / listed as *Rutilus karamani*)	**LC**
	CITES konvencija / European Habitats Directive	-
	Evropska direktiva o staništima	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi (navedena kao / listed as *Rutilus karamani*)	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Rutilus karamani*)	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 86. **Rasprostranjenje *Leucos basak* u Srbiji.**

Figure 86. **Distribution of *Leucos basak* in Serbia.**

Slika 87. Karamanova bodorka *Leucos basak* (foto: D. Jelić).

Figure 87. Dalmatian roach *Leucos basak* (photo: D. Jelić).

pruge po sredini bokova. Oči su žućkaste boje. Peraja su žućkasta ili bledosiva. Peritonealna membrana je crna. Početak leđnog peraja je u nivou početka trbušnih peraja. Najduža žbica podrepnog peraja, kada se položi, premašuje kraj osnove tog peraja. Polni dimorfizam se ogleda u dužini grudnih peraja (kod mužjaka, ova peraja dosežu do početka osnove trbušnih peraja). Peraja: D III + 8–10 (najčešće 9); A III + 7–10; P I + 14–15; V I + 7–8 (najčešće 8). Bočna linija je potpuna i ima 36–41 krljušti. U prvom škržnom luku ima 8–12 (najčešće 9–10) kratkih branhiospina. Ždrelni zubi su jednoredni, DF 5–5 (najčešće) ili 5–4. Prosečna dužina iznosi 12–14 cm, a može dostići dužinu od 23 cm (Dulčić *et al*., 2009).

Populacione karakteristike

Nema podataka o populacionim karakteristikama Karamanove bodorke u Srbiji. Smatra se da populacija u Ohridskom jezeru ima veliku brojnost, dok je populacija u Prespanskom jezeru stabilna ili uvećava brojnost (Crivelli 2006e, 2006f). Populacije u slivu Neretve su stabilne (iako u samoj reci nije česta vrsta), a na nekim lokalitetima (Hutovo blato) i brojne (Tutman *et al*., 2018).

Ekologija vrste

Polnu zrelost stiče u drugoj i trećoj godini života. Mresti se na šljunkovitom ili kamenitom dnu, ili na dnu prekrivenom akvatičnom vegetacijom, u blizini obala. Ženka polaže oko 100.000 jaja koja se lepe za podlogu (Tutman *et al*. 2018). Period inkubacije traje 9–10 dana, na temperaturama vode između 13 °C i 17 °C (Kottelat & Freyhof, 2007). Mresti se tokom aprila i maja. Karamanova bodorka je vrsta koja tokom leta živi u manjim jatima, dok se tokom zime formiraju velika jata. Hrani se larvama insekata, crvima, planktonom i biljnim materijalom (Tutman *et al*. 2018).

Stanište

Nastanjuje široki spektar staništa, većinom plitkih, sa dobro razvijenom akvatičnom vegetacijom. Može se naći u potocima,

colour, without a mid-lateral band on the flanks. The eyes are yellowish. The fins are yellowish or pale grey. The peritoneal membrane is black. The origin of the dorsal fin is at the level of the origin of the ventral fins. The longest spine of the anal fin, when laid down, projects beyond the end of the base of this fin. Sexual dimorphism is evident in the length of the pectoral fins (in males these fins extend to the origin of the ventral fins). Fins: D III + 8–10 (most often 9); A III + 7–10; P I + 14–15; V I + 7–8 (most often 8). The lateral line is complete and has 36–41 scales. There are 8–12 (most often 9–10) short gill rakers on the first gill arch. The pharyngeal teeth are in a single row, DF 5–5 (most often) or 5–4. The average length is 12–14 cm, it can reach 23 cm (Dulčić *et al*., 2009).

Population trends

There are no data on the population trends of the Dalmatian roach in Serbia. It is assumed that the population in Lake Ohrid is very large, while the population in Lake Prespa is stable or increasing (Crivelli 2006e, 2006f). Populations in the Neretva basin are stable (although the species is not abundant in the river itself), and in some places (Hutovo blato) even numerous (Tutman *et al*., 2018).

Ecology of the species

The Dalmatian roach reaches sexual maturity in the second and third year of life. It spawns on gravelly or rocky substrate or on substrate with aquatic vegetation, near the shore. The female lays about 100,000 eggs that adhere to the substrate (Tutman *et al*. 2018). The incubation period lasts 9–10 days, at water temperatures between 13 °C and 17 °C (Kottelat & Freyhof, 2007). The spawning season is in April and May. The Dalmatian roach is a species that lives in small shoals in summer, while large shoals are formed in winter. It feeds on insect larvae, worms, plankton and plant material (Tutman *et al*. 2018).

Habitat

The Dalmatian roach inhabits a wide range of habitats, mostly shallow, with well-developed aquatic vegetation. It occurs in

rekama umerenog ili sporog toka, mrtvajama, močvarnim oblastima, jezerima i akumulacijama (Kottelat & Freyhof, 2007). Najčešće se nalazi u hladnijim (15–17 °C) sporotekućim i stajaćim vodama (Tutman *et al*. 2018).

Ribolovni značaj

U Srbiji nema nikakav ribolovni značaj. Populacije u Skadarskom jezeru love se u rekreativnom, ali i u privrednom ribolovu (Marić, 2018).

Faktori ugrožavanja

Jedan od problema sa kojim se suočava ova vrsta jeste modifikacija staništa u vidu hidroloških izmena vodnog režima, kao i nekontrolisano crpljenje slatke vode i zagađenje. Problem predstavlja i introdukcija invazivnih vrsta. Zasipanje vodotoka dovodi do smanjenja dubine i gubitka mrestilišta, kao i do ograničenja kretanja jedinki i sprečavanja kontakta između delova populacija (Tutman *et al*. 2018).

streams, rivers with moderate or slow flow, marshes, wetlands, lakes and reservoirs (Kottelat & Freyhof, 2007). It is most common in colder (15–17 °C), slow-flowing and standing waters (Tutman *et al*. 2018).

Importance in fisheries

In Serbia, the Dalmatian roach is of no fishery importance. The populations in Lake Skadar are used for both recreational and commercial fishing (Marić, 2018).

Threats

Some of the problems faced by this species are habitat alteration in the form of hydrological changes in the water regime, uncontrolled withdrawal of freshwater and pollution. The introduction of invasive species is also a problem. The filling of watercourses leads to a reduction in water depth and loss of spawning sites, as well as to a restriction of the migrations of individuals and prevents contact between parts of populations (Tutman *et al*. 2018).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 8.1.1

Postojeće mere zaštite

Karamanova bodorka se, pod naučnim nazivom *Rutilus karamani*, nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu, navedenu kao *Rutilus karamani*, propisan je trajni lovostaj.

Conservation actions in place

The Dalmatian roach is listed (as *Rutilus karamani*) in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species (listed as *Rutilus karamani*).

Predložene mere zaštite

Poželjno bi bilo izraditi konzervacione planove i odgovarajuće monitoring programe. Osim toga, potrebno je zaštititi staništa sa razvijenom akvatičnom vegetacijom, s obzirom da su neophodna za mrest ove vrste.

Conservation actions needed

It would be desirable to establish conservation plans and appropriate monitoring programmes. Furthermore, it is necessary to protect habitats with developed aquatic vegetation, as they are necessary for spawning of this species.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 1.2, 2.1, 2.2

Potrebna su taksonomska i populaciona istraživanja, kao i istraživanja ekologije vrste i ugrožavajućih faktora. Neophodno je utvrditi veličinu populacija, populacione trendove, kao i stepen fragmentisanosti populacija.

Taxonomic and population studies are needed, as well as studies on the ecology of the species and on threat factors. It is necessary to determine the size, trends and degree of fragmentation of populations.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.5, 1.6, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Srđan Subotić

STRUMIČKA BRKICA
Oxynoemacheilus bureschi (Drensky, 1928)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Nemacheilidae
Vrsta: *Oxynoemacheilus bureschi* (Drensky, 1928)

Sinonimi

Barbatula bureschi (Drensky, 1928); *Nemacheilus bureschi* Drensky, 1928; *Orthrias brandti bureschi* (Drensky, 1928)

Narodno ime: Strumička brkica, Burešijeva brkica
Englesko ime: Struma stone loach

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, strumička brkica ne smatra se ugroženom vrstom (Crivelli, 2006c). U Srbiji ima status ugrožene vrste (EN), kako zbog malog obima rasprostranjenja (EOO iznosi 241,5 km²), tako i zbog male površine naseljavanja (AOO iznosi 8 km²). Osim toga, ustanovljen je i mali broj lokaliteta na kojima se vrsta javlja (≤5), kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1a-b(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Strumička brkica je endemična za egejski sliv jugoistočnog dela Balkanskog poluostrva. Naseljava slivove Strume, Vardara i Meste, u Severnoj Makedoniji, Bugarskoj i severnoj Grčkoj (Sedivá *et al*., 2010; Kottelat & Freyhof, 2007). Vrsta je prvi put zabeležena početkom XX veka u Strumi, a zatim u Mesti, dok se se prvi nalaz u reci Vardar opisuje krajem XX veka. Registrovana je i u severozapadnoj Turskoj (Fricke *et al*., 2007). U Srbiji je zabeležena u Pčinji (Slika 88).

Opis vrste

Telo strumičke brkice je izduženo, napred više dorzoventralno spljošteno, u sredini valjkasto, a pozadi više bočno spljošteno (Slika 89). Dijametar oka iznosi 21–26% dužine glave. Adultni mužjaci imaju podočnu izraslinu u obliku zakrilca. Repno stablo je znatno niže od visine tela. Bočna linija je potpuna i doseže do osnove repa. Boja tela je smeđa, sa brojnim nepravilnim svetlijim mrljama duž tela. Leđno peraje ima 8-9 granatih žbica. Repno peraje je zasečeno. Naraste do 8,5 cm (Petriki *et al*., 2011).

Populacione karakteristike

Za ovu vrstu nema podataka o populacionim trendovima (Crivelli, 2006c).

STRUMA STONE LOACH
Oxynoemacheilus bureschi (Drensky, 1928)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Nemacheilidae
Species: *Oxynoemacheilus bureschi* (Drensky, 1928)

Synonyms

Barbatula bureschi (Drensky, 1928); *Nemacheilus bureschi* Drensky, 1928; *Orthrias brandti bureschi* (Drensky, 1928)

Vernacular name: Strumička brkica, Burešijeva brkica
English name: Struma stone loach

National threat category assessed according to IUCN criteria

At the global level, the Struma stone loach is not classified as a threatened species and has the status of Least Concern (LC) (Crivelli, 2006c). In Serbia, the species is classified as Endangered (EN) due to the small extent of occurrence (EAO is 241.5 km²) and the small area of occupancy (AOO is 8 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Struma stone loach is endemic to the Aegean Basin in the south-eastern part of the Balkan Peninsula. It inhabits the Struma, Vardar and Nestos basins in Northern Macedonia, Bulgaria and northern Greece (Sedivá *et al*., 2010; Kottelat & Freyhof, 2007). The species was first recorded in the Struma in the early 20th century and subsequently in the Nestos, while the first finding in the Vardar River dates from the late 20th century. It has also been recorded in northwestern Turkey (Fricke *et al*., 2007). In Serbia, it has been found in the Pčinja (Figure 88).

Description of the species

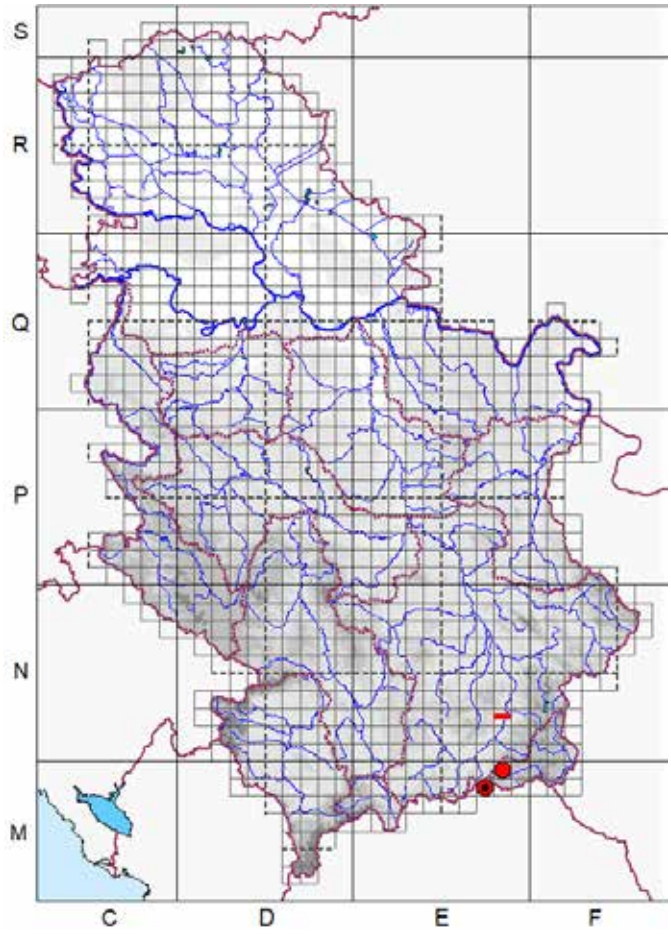
The body of the Struma stone loach is elongated, more dorsoventrally flattened at the front, cylindrical in the middle and more laterally flattened at the back(Figure 89). The eye diameter is 21–26% of the head length. Adult males have a suborbital flap. The depth of the caudal peduncle is much less than the body height. The lateral line is complete and extends to the caudal base. The body colour is brown, with numerous irregular lighter spots along the body. The dorsal fin has 8–9 branched rays. The caudal fin is forked. It grows up to 8.5 cm long (Petriki *et al*., 2011).

Population trends

There are no data on population trends for this species (Crivelli, 2006c).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Strumička brkica / Struma stone loach – *Oxynoemacheilus bureschi*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 88. **Rasprostranjenje *Oxynoemacheilus bureschi* u Srbiji.**

Figure 88. **Distribution of *Oxynoemacheilus bureschi* in Serbia.**

Slika 89. Strumička brkica *Oxynoemacheilus bureschi* (foto: A. Kohoutová Šedivá, https://www.fishbase.se/images/species/Oxbur_u1.jpg).

Figure 89. Struma stone loach *Oxynoemacheilus bureschi* (photo: A. Kohoutová Šedivá, https://www.fishbase.se/images/species/Oxbur_u1.jpg).

Ekologija vrste

Malo se zna o biologiji strumičke brkice. Mresti se u junu na supstratu od šljunka, kamena ili podvodne vegetacije u plitkoj vodi. Polno zrela postaje pri dužini od 5 cm (Maitland, 2000). Aktivna je noću i hrani se beskičmenjacima dna, naročito crvima i larvama insekata (Kottelat & Freyhof, 2007).

Stanište

Strumička brkica je slatkovodna, pridnena vrsta. Naseljava umereno hladne tekuće vode sa šljunkovitim dnom, obično u brzacima i bukovima. Preferira veće potoke i nema je u manjim potocima i kanalisanim tokovima (Crivelli, 2006c; Kottelat & Freyhof, 2007).

Ribolovni značaj

Strumička brkica nema ribolovni značaj.

Faktori ugrožavanja

Osnovni faktori ugrožavanja jesu regulacija i pregrađivanje vodotoka, vodozahvatanje, zagađenje koje izazivaju otpadne gradske, industrijske i poljoprivredne vode, kao i prisustvo invazivnih vrsta (Crivelli, 2006c). U Srbiji, strumička brkica naseljava Pčinju, koja je fragmentisana malim derivacionim hidroelektranama čija izgradnja populacije čini ranjivim, tako da svaka dalja degradacija i uništavanje staništa mogu dovesti do ugrožavanja opstanka vrste u toj reci (Javno, 2014).

Ecology of the species

Little is known about the biology of the Struma stone loach. It spawns in June on gravelly or stony substrate or in submerged vegetation in shallow water. It becomes sexually mature at a length of 5 cm (Maitland, 2000). It is nocturnal and feeds on bottom invertebrates, especially worms and insect larvae (Kottelat & Freyhof, 2007).

Habitat

The Struma stone loach is a demersal freshwater species. It lives in moderately cold streams with a gravelly bottom, usually in riffles and rapids. It prefers larger streams and is absent from smaller or canalised streams (Crivelli, 2006c; Kottelat & Freyhof, 2007).

Importance in fisheries

The Struma stone loach is of no fishery importance.

Threats

The greatest threats arise from stream regulation and damming, water withdrawal, pollution from municipal, industrial and agricultural effluents, and the presence of invasive species (Crivelli, 2006c). In Serbia, the Struma stone loach inhabits the Pčinja River, which is fragmented by small diversion hydropower plants whose construction threatens the population, so that any further habitat degradation and destruction may threaten the survival of the species in this river (Javno, 2014).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 7.2.11, 8.1.1, 9.1.3, 9.2.3, 9.3.4, 11.2

Postojeće mere zaštite

Strumička brkica se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg* fonda za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Trebalo bi sprečiti degradaciju staništa, zagađivanje vode i pregrađivanje vodotoka.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.3

Zbog nedostatka podataka, neophodna su istraživanja taksonomije, veličine populacija, životne istorije i ekologije, faktora ugrožavanja i populacionih trendova ove vrste, kao i razvijanje odgovarajućih programa monitoringa.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.5, 1.6, 3.1

Conservation actions in place

The Struma stone loach is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

Habitat destruction, water pollution and damming of watercourses should be prevented.

Due to the lack of data, research into the taxonomy, population size, life history and ecology, threat factors and population trends of this species is needed, as well as the development of appropriate monitoring programmes.

AUTOR / AUTHOR: Željka Višnjić-Jeftić

STRUMIČKI PIJOR
Phoxinus strymonicus Kottelat, 2007

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Phoxinus strymonicus* Kottelat, 2007

Sinonimi

Nema

Narodno ime: Strumički pijor
Englesko ime: Aegean minnow
Nemačko ime: Ägäische Elritze

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, strumički pijor ima status ugrožene vrste (EN) prema kriterijumima B1ab(iii) (Freyhof & Kottelat, 2008o). U Srbiji, strumički pijor takođe ima status ugrožene vrste (EN), kako zbog veličine obima rasprostranjenja (EOO iznosi 599 km²), tako i zbog male površine naseljavanja (AOO iznosi 20 km²). Osim toga, ustanovljen je i mali broj lokaliteta (≤5) na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Strumički pijor naseljava potoke i rečice u slivu Strume (sliv Egejskog mora) u Grčkoj i Bugarskoj (Kottelat & Freyhof, 2007). Do 2007. godine, nalazi pijora u rekama ovog sliva vođeni su kao nalazi *P. phoxinus*, kada je, na osnovu nekih morfoloških karakteristika, opisana nova vrsta *P. strymonicus* (Kottelat 2007). U Srbiji naseljava sliv Dragovištice (Slika 90).

Opis vrste

Leđa strumičkog pijora su smeđe boje (Slika 91). Duž sredine tela nalazi se tamna linija i 12–14 crnih mrlja. Od drugih vrsta roda *Phoxinus* u Evropi razlikuje se po odsustvu ili prisustvu jako malog broja krljušti na grudima. Visina repnog stabla stane 2,1–2,5 puta u njegovu dužinu. Dužina glave iznosi 27–29% standardne dužine tela (SL), predorzalna dužina 56–60%, i preanalna 62–68%. Početak podrepnog peraja nalazi se najčešće u visini poslednje žbice leđnog peraja (Kottelat, 2007). Peraja: D III + 7; A III + 7; P I + 14; V I + 7. Broj krljušti u bočnoj liniji iznosi 78–86 (Palandačić *et al.*, 2017). Najveća zabeležena standardna dužina tela (SL) iznosi 4,8 cm (Kottelat, 2007).

Populacione karakteristike

Populacioni trend ove vrste nije poznat.

AEGEAN MINNOW
Phoxinus strymonicus Kottelat, 2007

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Phoxinus strymonicus* Kottelat, 2007

Synonyms

None

Vernacular name: Strumički pijor
English name: Aegean minnow
German name: Ägäische Elritze

National threat category assessed according to IUCN criteria

At the global level, the Aegean minnow is classified as Endangered (EN) under criteria B1ab(iii) (Freyhof & Kottelat, 2008o). In Serbia, the Aegean minnow is also classified as Endangered (EN) due to the small extent of occurrence (EOO is 599 km²) and the small area of occupancy (AOO is 20 km²). In addition, a low number of locations where the species occurs (≤5) and a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Aegean minnow inhabits streams and rivers in the Struma Basin (Aegean Sea basin) in Greece and Bulgaria (Kottelat & Freyhof, 2007). Until 2007, the records of the minnow in the rivers of this basin were considered as records of *P. phoxinus*, when a new species *P. strymonicus* was described on the basis of some morphological characteristics (Kottelat 2007). In Serbia it inhabits the Dragovištica watershed (Figure 90).

Description of the species

The dorsum of the Aegean minnow is brown in colour (Figure 91). There is a dark mid-lateral band on the flanks and 12–14 black spots. It differs from other species of the genus *Phoxinus* in Europe by the absence of breast scales or by the presence of only small patches of breast scales. The depth of the caudal peduncle is 2.1–2.5 times its length. The head length is 27–29% of the standard body length (SL), the predorsal length is 56–60% SL and the preanal length is 62–68% SL. The origin of the anal fin is usually in front of the base of the last dorsal spine (Kottelat, 2007). Fins: D III + 7; A III + 7; P I + 14; V I + 7. The number of scales in the lateral line is 78–86 (Palandačić *et al.*, 2017). The largest recorded standard body length (SL) is 4.8 cm (Kottelat, 2007).

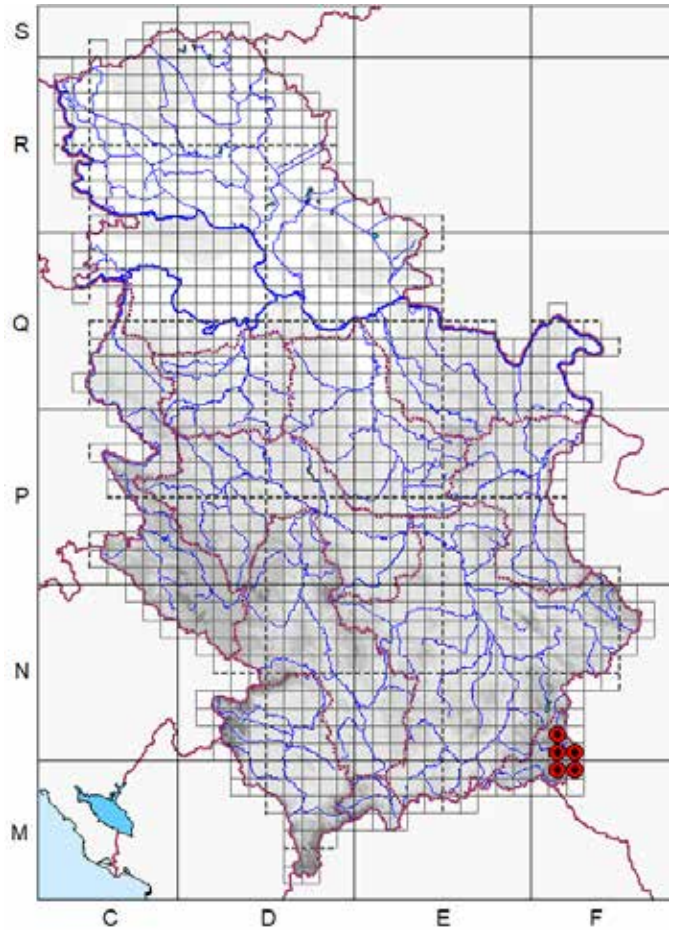
Population trends

The population trends of this species are unknown.

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Strumički pijor / Aegean minnow – *Phoxinus strymonicus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**EN B1ab(iii)**
	CITES konvencija	–
	Evropska direktiva o staništima / European Habitats Directive	–
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	–
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	–
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(i,ii,iii) +2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / ODU – daily catch limit of 5 kg (measure applies to all native species)



Slika 90. **Rasprostranjenje *Phoxinus strymonicus* u Srbiji.**

Figure 90. **Distribution of *Phoxinus strymonicus* in Serbia.**

Slika 91. Strumički pijor *Phoxinus strymonicus* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141236_1.jpg).

Figure 91. Aegean minnow *Phoxinus strymonicus* (photo: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141236_1.jpg).

Ekologija vrste

S obzirom da je strumički pijor relativno skoro opisan kao posebna vrsta, njegova ekologija je slabo poznata. Pretpostavlja se da ima slične ekološke karakteristike kao i *P. phoxinus*.

Stanište

Strumički pijor preferira mesta gusto obrasla vegetacijom u malim potocima sa čistom i hladnom vodom, blizu izvorišta (Kottelat & Freyhof, 2007), a sreće se i u kanalima za navodnjavanje na manjim nadmorskim visinama (Kottelat, 2007).

Ribolovni značaj

Ova vrsta nema nikakav ribolovni značaj.

Faktori ugrožavanja

Kao i za druge vrste iz sliva Dragovištice, glavni faktor ugrožavanja strumičkog pijora jesu degradacija i fragmentacija staništa usled izgradnje mini-hidrocentrala na čitavom slivnom području. Ostale populacije ugrožava i prekomerno vodozahvatanje, zagađivanje vode poreklom od poljoprivrednih aktivnosti, kao i suše izazvane klimatskim promenama.

Ecology of the species

Since the Aegean minnow was described as a distinct species relatively recently, its ecology is poorly known. It is assumed that it has similar ecological characteristics to *P. phoxinus*.

Habitat

The Aegean minnow prefers densely vegetated places in small streams with clear and cold water fed with spring water (Kottelat & Freyhof, 2007) and is also found in irrigation canals at lower altitudes (Kottelat, 2007).

Importance in fisheries

The Aegean minnow is of no fishery importance.

Threats

As with other species in the Dragovištica watershed, the main factor threatening the Aegean minnow is the destruction and fragmentation of its habitat due to the construction of mini-hydropower plants throughout the watershed. Other populations are threatened by excessive water withdrawal, water pollution from agricultural activities and droughts caused by climate change.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 7.2.9, 9.3.4, 11.2

Postojeće mere zaštite

Strumički pijor nije obuhvaćen postojećim merama zaštite.

Conservation actions in place

The Aegean minnow is not covered by the existing protection measures.

Predložene mere zaštite

Potrebno je sprečiti izgradnju novih brana, a na postojećim održavati funkcionalnost ribljih staza i poštovanje biološkog minimuma. Takođe bi trebalo sprečiti degradaciju staništa i zagađivanje vode.

Conservation actions needed

It is necessary to prevent the construction of new dams, to maintain the functionality of fish ladders and to respect the biological minimum at existing dams. Habitat destruction and water pollution should also be prevented.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	2.1, 2.3

Zbog nedostatka podataka, neophodna su dalja istraživanja taksonomije, životne istorije, ekologije, faktora ugrožavanja i populacionih trendova ove vrste, kao i razvoj odgovarajućih programa monitoringa.

Due to the lack of data, further research is needed on the taxonomy, life history, ecology, threat factors and population trends of this species, as well as the development of appropriate monitoring programmes.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.3, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Stefan Skorić

PRIMORSKA (DRIMSKA) PASTRMKA
Salmo farioides Karaman, 1938

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Salmoniformes
Porodica: Salmonidae
Vrsta: *Salmo farioides* Karaman, 1938

Sinonimi

Nema

Narodno ime: Primorska (drimska) pastrmka
Englesko ime: Balkan brook trout, Adriatic brown trout
Nemačko ime: Dinarische Forelle

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, status ugroženosti primorske pastrmke nije procenjen prema IUCN kriterijumima (NE). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodi ≥20% u narednih 20 godina ili pet generacija, primorska pastrmka ima status ugrožene vrste (EN). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 3.936 km², dok je površina naseljavanja (AOO) svega 7,5 km².

Rasprostranjenje

Primorska pastrmka naseljava rečne sisteme na istočnoj obali Jadranskog mora, od Krke na severu, preko Neretve, do sistema Skadar-Drim na jugu (Karaman, 1938). Prema novijim razmatranjima *Salmo farioides* uključuje više taksona, i areal je proširen na severu do Zrmanje, a na jugu do reke Alfios, pritoke Jonskog mora (Kottelat & Freyhof, 2007).

Na teritoriji Srbije, primorska pastrmka je registrovana u Belom Drimu sa pritokama – Pećka Bistrica, Dečanska Bistrica, Erenik, Istočka reka, Miruša, Prizrenska Bistrica i Plavska reka (Šorić, 1990; Marković, 1962, Marić *et al.*, 2006, 2017b; Grapci-Kotori *et al.*, 2020) (Slika 92). Krajem 70-ih godina prošlog veka, primorska pastrmka je introdukovana, najverovatnije iz sistema Drima, u sistem reke Pčinje (egejski sliv), u okviru koga je danas prisutna samo u reci Tripušnici. Populacija se odlikuje odsustvom gena karakterističnih za autohtone populacije pastrmki egejskog sliva (Marić *et al.*, 2006, 2017b).

Opis vrste

Telo primorske pastrmke je kompaktno i relativno visoko (Slika 93). Boja tela je veoma varijabilna. Na bočnim stranama glave nalaze se crne pege, dok su na bokovima tela prisutne crne i crvene pege nejednake veličine, oblika i zastupljenosti, a posebno kod mužjaka dominiraju crne pege. Kod jedinki krupnijih od 15 cm, oko crvenih pega prisutan je svetliji rub. Rostrum je zatupast. Gornja vilica se sužava prema zadnjem kraju, koji doseže do zadnje ivice oka. Zubi

BALKAN BROOK TROUT, ADRIATIC BROWN TROUT
Salmo farioides Karaman, 1938

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Salmoniformes
Family: Salmonidae
Species: *Salmo farioides* Karaman, 1938

Synonyms

None

Vernacular name: Primorska (drimska) pastrmka
English name: Balkan brook trout, Adriatic brown trout
German name: Dinarische Forelle

National threat category assessed according to IUCN criteria

At the global level, the Balkan brook trout is classified as Not Evaluated (NE) as its status has not been assessed according to IUCN criteria. In Serbia, the species is classified as Endangered (EN) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥20% in the next 20 years or five generations. The extent of occurrence of the species (EOO) in Serbia is 3,936 km², while the area of occupancy (AOO) is only 7.5 km².

Distribution

The Balkan brook trout inhabits the river systems on the eastern coast of the Adriatic Sea, from the Krka River in the north to the Neretva and the Skadar-Drim system in the south (Karaman, 1938). According to recent considerations, *Salmo farioides* includes more taxa, and its range extends north to Zrmanja and south to the Alpheios River, a tributary of the Ionian Sea (Kottelat & Freyhof, 2007).

In the territory of Serbia, the Balkan brook trout is registered in the White Drim with its tributaries Pećka Bistrica, Dečanska Bistrica, Erenik, Istočka reka, Miruša, Prizrenska Bistrica and Plavska reka (Šorić, 1990; Marković, 1962, Marić *et al.*, 2006, 2017b; Grapci-Kotori *et al.*, 2020) (Figure 92). In the late 1970s, the Balkan brook trout, most likely originating from the Drim system, was introduced into the Pčinja river system (Aegean Sea basin), where it is now found only in the Tripušnica river. The population is characterised by the absence of genes characteristic of native trout populations of the Aegean Sea basin (Marić *et al.*, 2006, 2017b).

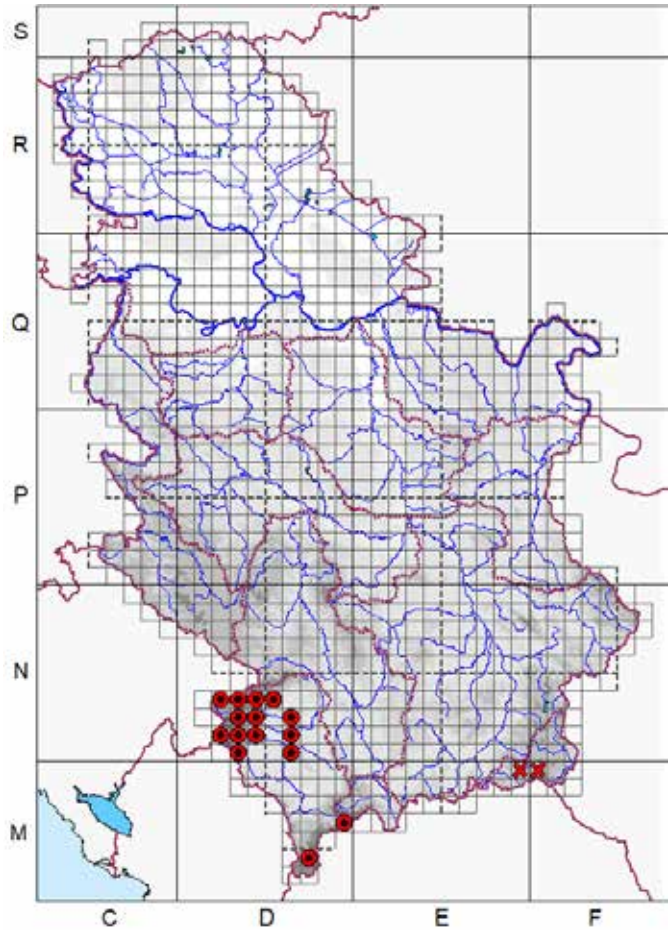
Description of the species

The body of the Balkan brook trout is compact and relatively high (Figure 93). The body colour is very variable. Black spots are present on the sides of the head, while black and red spots of varying size, shape and distribution are present on flanks, the black spots predominating in males. In individuals larger than 15 cm, the red spots are surrounded by a lighter margin. The rostrum is blunt. The upper jaw

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Primorska (drimska) pastrmka / Balkan brook trout – *Salmo farioides*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	-
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**L, MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN** **E** **Strogo zaštićena vrsta / Strictly protected species**

*L – lovostaj od 1. oktobra do 1. marta, MLM – minimalna lovna mera 25 cm, ODU – ograničenje dnevnog ulova na tri komada /
L – closed season from 1 October to 1 March, MLM – minimum landing size at 25 cm standard length, ODU – daily catch limit of 3 individuals



Slika 92. **Rasprostranjenje *Salmo farioides* u Srbiji.**

Figure 92. **Distribution of *Salmo farioides* in Serbia.**

Slika 93. Primorska (drimska) pastrmka *Salmo farioides* (foto: J. Schöffmann).

Figure 93. Balkan brook trout *Salmo farioides* (photo: J. Schöffmann).

na ralastoj kosti raspoređeni su u obliku cik-cak linije. Peraja: D IV + 8–11; A III–IV + 7–9; P I + 11–13; V I–II + 7–8; C 19. Broj krljušti u bočnoj liniji je 106–128, a broj piloričnih cekuma je 32–58 (Karaman, 1927; Šorić, 1990). Prema Vukoviću i Ivanoviću (1971), primorska pastrmka može dostići dužinu oko 60 cm, što je najverovatnije potcenjena dimenzija, jer su u Skadarskom jezeru lovljene pastrmke (strun – *Salmo dentex*) mase preko 10 kg, što znači da su morale biti duže nego što je navedeno (Ivanović, 1973). Genetičke analize ukazuju da strun nije zasebna vrsta, već da predstavlja fenotipsku varijantu primorske pastrmke, koja je evoluirala usled specifične lokalne adaptacije (Mrdak *et al*., 2006; Snoj *et al*., 2010).

Populacione karakteristike

Populacije imaju trend opadanja brojnosti širom areala (Marić & Krivokapić, 1997; Mrakovčić *et al*., 2006; Muhamedagić *et al*., 2008). Za teritoriju Srbije postoje literaturni podaci iz druge polovine prošlog veka o veoma brojnim populacijama u sistemu Belog Drima (Marković, 1962). Međutim, u poslednjih 20 godina malo je dostupnih podataka na osnovu kojih bi se mogla dati objektivna procena stanja i trenda populacija. Za prve dve dekade ovog veka postoje informacije o malobrojnom prisustvu primorske pastrmke u gornjem i srednjem toku Belog Drima, u odnosu na potencijal staništa (Grapci-Kotori *et al*., 2010, 2020). Alohtona populacija iz Tripušnice lokalizovana je na nekoliko kilometara u gornjem toku reke. U pitanju je malobrojna populacija, koja se odlikuje niskim parametrima genetičkog diverziteta, zbog čega je dugoročna perspektiva opstanka ove populacije nepovoljna (Marić *et al*., 2017b).

Ekologija vrste

Jedinke primorske pastrmke dostižu polnu zrelost u drugoj ili trećoj godini života. Mrest se odvija u plitkoj vodi, na peskovitoj ili šljunkovitoj podlozi. Otpočinje u oktobru pri temperaturi vode višoj od 10 °C, i traje do februara (Drecun, 1984; Marić & Rako-

tapers towards the posterior end, which extends to the posterior margin of the eye. The teeth on the vomer are arranged in a zigzag line. Fins: D IV + 8–11; A III–IV + 7–9; P I + 11–13; V I–II + 7–8; C 19. The number of scales in the lateral line is 106–128, and the number of pyloric caeca is 32–58 (Karaman, 1927; Šorić, 1990). According to Vuković and Ivanović (1971), the Balkan brook trout can reach a length of about 60 cm, which is most likely an underestimated size, because individuals caught in Lake Skadar (dentex trout – *Salmo dentex*) weighed more than 10 kg, which means that they must have been longer than indicated (Ivanović, 1973). Genetic analyses suggest that the dentex trout is not a separate species, but a phenotypic variant of the Balkan brook trout that evolved due to a specific local adaptation (Mrdak *et al*., 2006; Snoj *et al*., 2010).

Population trends

Populations show a declining trend throughout the area (Marić & Krivokapić, 1997; Mrakovčić *et al*., 2006; Muhamedagić *et al*., 2008). For the territory of Serbia, there are literature data from the second half of the last century on very numerous populations in the White Drim watershed (Marković, 1962). In the last 20 years, however, there are few data on the basis of which an objective assessment of the population status and trends could be made. For the first two decades of this century, there is information on the low abundance of the Balkan brook trout in the upper and middle reaches of the White Drim relative to the potential of the habitat (Grapci-Kotori *et al*., 2010, 2020). The non-native population in Tripušnica is limited to a few kilometres in the upper reaches of the river. It is a small population characterised by low genetic diversity parameters, therefore the long-term prospects for the survival of this population are unfavourable (Marić *et al*., 2017b).

Ecology of the species

The Balkan brook trout reach sexual maturity in their second or third year of life. Spawning takes place in shallow water on sandy or

čević, 2015). Radi mresta obično preduzima migratorne aktivnosti manjeg obima, iz donjeg u gornji tok reke, ili u slučaju jezerskih populacija u pritoke. Ženke polažu do 3.000 jaja (Vuković & Ivanović, 1971; Drecun, 1984; Marić & Rakočević, 2015). Mlade jedinke se hrane akvatičnim i terestričnim beskičmenjacima, dok su odrasle jedinke gotovo isključivo piscivorni predatori.

Stanište

Primorska pastrmka obično nastanjuje potoke i reke sa brzim tokom, čistom, hladnom vodom, bogatom kiseonikom (Kottelat & Freyhof, 2007). Starije jedinke naseljavaju dublje rečne ili jezerske ekosisteme, dok mlađe jedinke preferiraju plića staništa, bliže rečnim obalama.

Ribolovni značaj

Primorska pastrmka nema privredni značaj, ali je popularna vrsta za lokalni rekreativni ribolov.

Faktori ugrožavanja

Populacije primorske pastrmke iz Srbije, Albanije, Severne Makedonije i Grčke autohtonog su porekla i nisu introgresirane (tj. nisu ugrožene introdukcijom alohtonih linija potočne pastrmke sa kojima bi hibridizovale), tako da introgresija ne predstavlja ugrožavajući faktor kao u drugim delovima areala (Bernatchez, 2001; Snoj *et al*., 2010; Marić *et al*., 2017b; Škraba Jurlina *et al*., 2018; Grapci-Kotori *et al*., 2020). Zajednički ugrožavajući faktori za sve populacije primorske pastrmke jesu prekomeran ribolov, narušavanje staništa usled korišćenja, regulacije i zagađenja vodotoka, kao i globalne klimatske promene (Mrakovčić *et al*., 2006; Muhamedagić *et al*., 2008; Schöffmann *et al*., 2019).

gravelly substrate. It begins in October, when the water temperature is above 10 °C, and lasts until February (Drecun, 1984; Marić & Rakočević, 2015). To spawn, it usually makes short migrations from the lower to the upper reaches of the river or to tributaries in the case of lake populations. Females lay up to 3,000 eggs (Vuković & Ivanović, 1971; Drecun, 1984; Marić & Rakočević, 2015). Juveniles feed on aquatic and terrestrial invertebrates, while adults are almost exclusively piscivorous.

Habitat

The Balkan brook trout generally live in streams and rivers with fast-flowing, clear, cold, and oxygen-rich water (Kottelat & Freyhof, 2007). Older specimens live in deeper river or lake ecosystems, while younger specimens prefer shallower habitats near the shore.

Importance in fisheries

The Balkan brook trout is not commercially important, but it is a popular species for local recreational fishing.

Threats

The Balkan brook trout populations from Serbia, Albania, North Macedonia and Greece are native and are not introgressed (i.e. they are not threatened by the introduction of non-native brown trout lines with which they would hybridise), so introgression is not a threat, unlike in other parts of its range (Bernatchez, 2001; Snoj *et al*., 2010; Marić *et al*., 2017b; Škraba Jurlina *et al*., 2018; Grapci-Kotori *et al*., 2020). The common threats to all populations of the Balkan brook trout are overfishing, habitat destruction through exploitation, regulation and pollution of watercourses, and global climate change (Mrakovčić *et al*., 2006; Muhamedagić *et al*., 2008; Schöffmann *et al*., 2019).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 3.3, 5.4.2, 7.2.1, 7.2.2, 7.2.3, 7.2.9, 7.3, 9.1, 9.4, 11

Postojeće mere zaštite

U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za primorsku (drimsku) pastrmku propisan je lovostaj od 1. oktobra do 1. marta, minimalna lovna mera od 25 cm, i ograničenje dnevnog ulova na tri komada.

Predložene mere zaštite

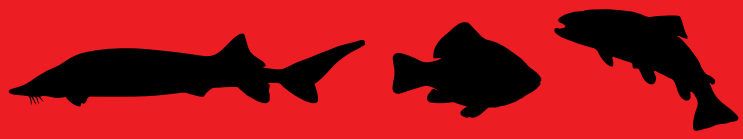
Potrebno je sprovesti zaštitu i revitalizaciju staništa, posebno u delovima toka koji predstavljaju plodišta primorske pastrmke, zabraniti izgradnju hidrotehničkih objekata koji utiču na promenu kvaliteta staništa i strogo kontrolisati funkcionisanje već izgrađenih. Takođe, potrebno je uskladiti načine ribolova sa brojnošću i strukturom populacija, zabraniti introdukciju alohtonih pastrmskih linija i izbegavati poribljavanje autohtonim materijalom zbog pojave mogućih negativnih posledica (smanjenje varijabilnosti, vijabilnosti, reproduktivnog kapaciteta populacije, prenošenja infekcija itd.) (Waples, 1991; Campton, 1995). Veštački mrest i poribljavanje autohtonim materijalom potrebno je sprovesti u izuzetnim slučajevima, kada druge metode revitalizacije ne daju očekivane rezultate, i to na lokalitetima na kojima primorska pastrmka ne koegzistira sa glav-

Conservation actions in place

Under the *Regulation on Measures for the Conservation and Protection*, a closed season from October 1 to March 1, a minimum landing size at 25 cm standard length and a daily catch limit of 3 individuals are set for this species.

Conservation actions needed

It is necessary to implement the protection and revitalisation of habitats, especially in river sections that are spawning grounds for the Balkan brook trout, to prohibit the construction of hydrotechnical facilities that cause a change in the quality of the habitat and to strictly control the operation of the facilities already built. Furthermore, fishing methods must be adapted to the size and structure of the populations, the introduction of non-native trout lines must be prohibited, and stocking with native material must be avoided due to possible negative consequences (reduction of variability, viability, reproductive capacity, transmission of infections, etc.) (Waples, 1991; Campton, 1995). Artificial spawning and stocking with native material should only be carried out in exceptional cases where other methods of revival do not produce the expected results, i.e. in places where sea trout do not coexist with the marble trout



aticom (*S. marmoratus*). Lokalno stanovništvo treba informisati o biološkom značaju vrste, ugroženosti i planovima za njen oporavak.

(*S. marmoratus*). The local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.1.1, 3.2, 4, 5.4.4

Neophodno je sprovesti detaljna istraživanja osnovnih bioloških parametara populacija iz sliva Belog Drima, kao što su analize veličine populacija, distribucije, populacionih trendova, odlika životne istorije, ekologije, genetičke strukture i faktora ugrožavanja. U poslednjih 15 godina, istraživanja su obuhvatila preliminarnu genetičku karakterizaciju primorske pastrmke iz Belog Drima (Grapci-Kotori *et al*., 2020), Pećke Bistrice, Prizrenske Bistrice, Plavske reke i Tripušnice (Marić *et al*., 2006; 2017b), kao i preliminarnu procenu brojnosti i faktora ugrožavanja u gornjem i srednjem toku Belog Drima (Grapci-Kotori *et al*., 2010, 2020). Međutim, za odgovorno sprovođenje kozervacionih aktivnosti neophodno je sprovesti raznovrsnija i opsežnija istraživanja.

There is a need for in-depth research on the basic biological parameters of the White Drim basin populations, such as analysis of population size, distribution, population trends, life history traits, ecology, genetic structure and threats. In the last 15 years, research has included preliminary genetic characterisation of coastal trout from the White Drim (Grapci-Kotori *et al*., 2020), Pećka Bistrica, Prizrenska Bistrica, Plavska reka and Tripušnica (Marić *et al*., 2006; 2017b), and preliminary assessment of abundance and threats in the upper and middle reaches of the White Drim (Grapci-Kotori *et al*., 2010, 2020). However, more diverse and comprehensive research is needed for responsible implementation of conservation measures.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.4

AUTOR / AUTHOR: Saša Marić

MAKEDONSKA PASTRMKA
Salmo macedonicus (Karaman, 1924)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Salmoniformes
Porodica: Salmonidae
Vrsta: *Salmo macedonicus* (Karaman, 1924)

Sinonimi

Trutta fario macedonica Karaman, 1924

Narodno ime: Makedonska pastrmka
Englesko ime: Macedonian trout
Nemačko ime: Makedonische forelle

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, makedonska pastrmka smatra se vrstom za koju nema dovoljno podataka (DD) (Crivelli, 2006i). U Srbiji ima status ugrožene vrste (EN). Iako je obim rasprostranjenja (EOO) vrste u Srbiji veliki (EOO iznosi 2.843 km²), površina koju vrsta naseljava (AOO) iznosi svega 5 km². Usled malog broja naseljenih lokaliteta, kao i prognoziranog kontinuiranog opadanja broja naseljenih lokaliteta ili subpopulacija i broja odraslih jedinki, vrsta je ugrožena prema kriterijumima B1ab(iv,v)+2ab(iv,v).

Rasprostranjenje

Makedonska pastrmka naseljava rečne sisteme u slivu Egejskog mora, od gornjeg toka Vardara na zapadu, preko Strume, do Meste na istoku (Karaman, 1924, 1938; Drensky, 1930; Barbieri *et al*., 2015).

Na teritoriji Srbije, makedonska pastrmka je registrovana u sistemu Vardara – Lepenac sa pritokama (Čerenačka reka, Tisova reka, Suva reka, Blateštica, Muršička reka i Kaluđerska reka), i u sistemu Strume – Dragovištica sa pritokama (Božička reka, Lisinska reka, Ljubatska reka i Brankovačka reka) (Marković, 1962; Marić *et al*., 2004, 2006, 2017b) (Slika 94). Introdukovana je u sistem reke Nišave 90-ih godina prošlog veka, iz sistema Strume u Bugarskoj. Introdukcija je izvršena preko reke Jerme, u kojoj je danas ova vrsta dominantno prisutna (Marić *et al*., 2022).

Opis vrste

Telo makedonske pastrmke je vretenasto i blago bočno spljošteno (Porcellotti, n.d.h) (Slika 95). Na glavi i bokovima tela prisutne su crvenkasto-smeđe pege, različitih nijansi (od crne do crvene), veličine i oblika. Na glavi i trupu pege su nešto tamnije i krupnije u odnosu na repni region. Leđa su žućkasto-smeđe boje, sa retkim, sitnim pegama ili bez pega. Glava je zašiljena i uska. Usta su duboko usečena, a uska gornja vilica zadnjim krajem dopire do zadnje ivice oka ili je čak premašuje (Karaman, 1927; Porcellotti, n.d.h). Zubi su jaki i oštri, na ralastoj kosti raspoređeni u dva reda (Vuković &

MACEDONIAN TROUT
Salmo macedonicus (Karaman, 1924)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Salmoniformes
Family: Salmonidae
Species: *Salmo macedonicus* (Karaman, 1924)

Synonyms

Trutta fario macedonica Karaman, 1924

Vernacular name: Makedonska pastrmka
English name: Macedonian trout
German name: Makedonische forelle

National threat category assessed according to IUCN criteria

At the global level, the Macedonian trout is classified as Data Deficient (DD) (Crivelli, 2006i). In Serbia, the species is classified as Endangered (EN). Although the extent of occurrence (EOO) of the species in Serbia is large (EOO is 2,843 km²), the area of occupancy (AOO) is only 5 km². Due to the low number of locations where the species occurs, as well as the projected continuing decline in the number of locations or subpopulations and the number of mature individuals, the species is threatened according to criteria B1ab(iv,v)+2ab(iv,v).

Distribution

The Macedonian trout inhabits river systems in the Aegean Sea basin, from the headwaters of the Vardar in the west to the Struma and the Nestos in the east (Karaman, 1924, 1938; Drensky, 1930; Barbieri *et al*., 2015).

In the territory of Serbia, the Macedonian trout is recorded in the Vardar system – in the Lepenac with its tributaries (Čerenačka reka, Tisova reka, Suva reka, Blateštica, Muršička reka and Kaluđerska reka), and in the Struma system – in the Dragovištica with its tributaries (Božička reka, Lisinska reka, Ljubatska reka and Brankovačka reka) (Marković, 1962; Marić *et al*., 2004, 2006, 2017b) (Figure 94). It was introduced into the Nišava river system from the Struma system in Bulgaria in the 1990s. The introduction took place via the Jerma River, where this species is now predominant (Marić *et al*., 2022).

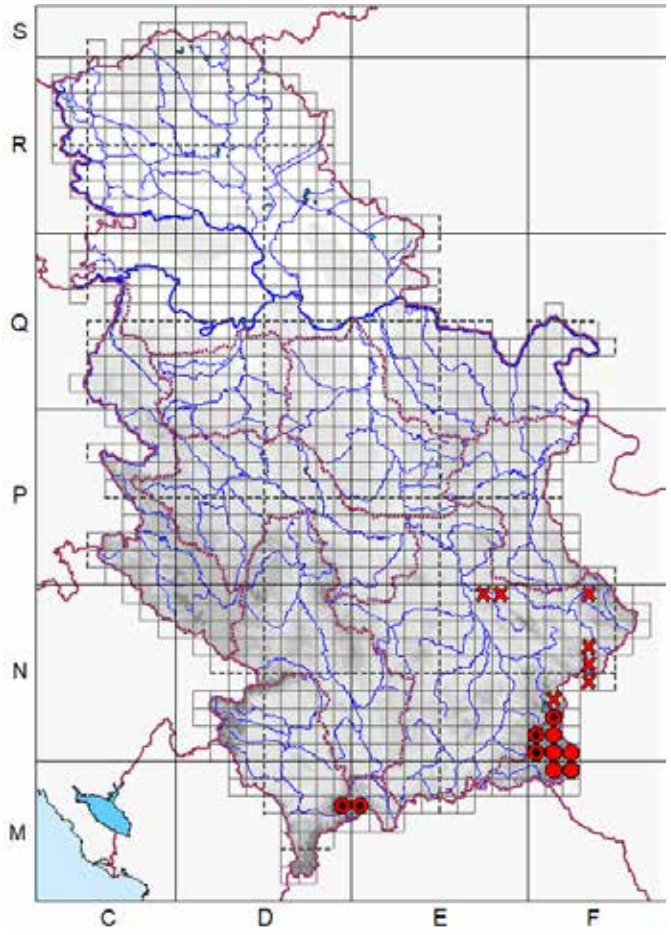
Description of the species

The body of the Macedonian trout is spindle-shaped and slightly flattened laterally (Porcellotti, n.d.h) (Figure 95). On the head and flanks there are reddish-brown spots of different shades (from black to red), size and shape. The spots on the head and body are slightly darker and larger than in the caudal region. The dorsum is yellowish-brown, with rare small spots or without spots. The head is pointed and narrow. The mouth is large and the narrow upper jaw reaches or even surpasses the posterior margin of the eye (Karaman, 1927; Porcellotti,

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Makedonska pastrmka / Macedonian trout – *Salmo macedonicus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**DD**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**L, MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B1ab(iv,v)+2ab(iv,v) Strogo zaštićena vrsta / Strictly protected species**

*L – lovostaj od 1. oktobra do 1. marta, MLM – minimalna lovna mera 25 cm, ODU – ograničenje dnevnog ulova na tri komada /
L – closed season from October 1 to March 1, MLM – minimum landing size at 25 cm standard length, ODU – daily catch limit of 3 individuals



Slika 94. **Rasprostranjenje *Salmo macedonicus* u Srbiji.**

Figure 94. **Distribution of *Salmo macedonicus* in Serbia.**

Slika 95. Makedonska pastrmka *Salmo macedonicus* (foto: J. Schöeffmann).

Figure 95. Macedonian trout *Salmo macedonicus* (photo: J. Schöeffmann).

Ivanović, 1971; Porcellotti, n.d.h). Na dorzalnom peraju nalaze se crvenkasto-smeđe pege, a podrepno i repno peraje imaju crvenkastu nijansu. Zadnja ivica repnog peraja je udubljena. Peraja: D IV + 10–11; A IV + 8; P I +12–13; V II + 8; C 19. Broj krljušti u bočnoj liniji je 120, a broj piloričnih cekuma je 32–43 (Karaman, 1927). Može dostići dužinu do 50 cm (Porcellotti, n.d.h) i masu do 3 kg (Vuković & Ivanović, 1971).

Populacione karakteristike

Populacije makedonske pastrmke imaju trend opadanja brojnosti u čitavom arealu (Crivelli, 2006i; Barbieri *et al*., 2015; Marić *et al*., 2017b). Za teritoriju Srbije postoje literaturni podaci iz druge polovine prošlog veka o uglavnom brojnim populacijama u sistemu Dragovištice i Lepenca (Marković, 1962). Međutim, za populaciju iz sistema Lepenca nema novijih podataka, dok za populaciju iz sistema Dragovištice postoje podaci sa početka ovog veka, koji ukazuju na to da gustina populacije opada (Marić *et al*., 2004). Kako su u međuvremenu uslovi na staništu pogoršani izgradnjom većeg broja malih hidroelektrana, a mere zaštite nisu implementirane, može se očekivati dalji trend opadanja brojnosti. Alohtona populacija iz gornjeg toka Jerme u potpunosti je potisnula autohtonu populaciju potočne pastrmke, a pokazuje i dalji trend širenja u sistemu Nišave. Ova populacija se odlikuje i relativno visokim parametrima genetičkog diverziteta, što ukazuje na mogućnost dugoročne perspektive njenog opstanka (Marić *et al*., 2022).

Ekologija vrste

Mužjaci dostižu polnu zrelost u drugoj, a ženke u trećoj ili četvrtoj godini života. Mrest se odvija u plitkoj, protočnoj vodi, na peskovitoj ili šljunkovitoj podlozi. Mrest otpočinje u oktobru i traje do januara. Radi mresta obično preduzimaju manje migratorne aktivnosti, iz donjeg u gornji tok reke. Ženke polažu do 2.000 jaja na kg telesne mase. U ishrani makedonske pastrmke prisutni su akvatični

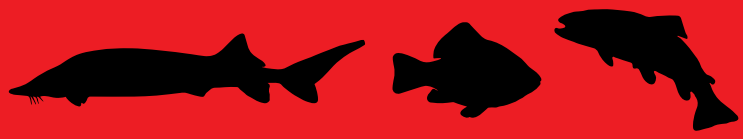
n.d.h). The teeth are strong and sharp, arranged in two rows on the vomer (Vuković & Ivanović, 1971; Porcellotti, n.d.h). There are reddish-brown spots on the dorsal fin, and the anal and caudal fins have a reddish tinge. The posterior margin of the caudal fin is emarginated. Fins: D IV + 10–11; A IV + 8; P I +12–13; V II + 8; C 19. The number of scales in the lateral line is 120 and the number of pyloric caeca is 32–43 (Karaman, 1927). It can reach a length of up to 50 cm (Porcellotti, n.d.h) and a mass of up to 3 kg (Vuković & Ivanović, 1971).

Population trends

Macedonian trout populations show a declining trend throughout the area (Crivelli, 2006i; Barbieri *et al*., 2015; Marić *et al*., 2017b). For the territory of Serbia, there are literary data from the second half of the last century on mostly numerous populations in the Dragovištica and Lepenac watersheds (Marković, 1962). However, there are no recent data for the population in the Lepenac watershed, while for the population in the Dragovištica watershed there are data from the beginning of this century, indicating that the population density is decreasing (Marić *et al*., 2004). In the meantime, as habitat conditions have deteriorated due to the construction of numerous small hydropower plants and protection measures have not been implemented, a further decline is to be expected. The non-native population from the upper reaches of the Jerma has completely displaced the native brown trout population and also shows a further tendency to spread in the Nišava system. This population is characterised by relatively high parameters of genetic diversity, which indicates the possibility of long-term survival prospects (Marić *et al*., 2022).

Ecology of the species

Males reach sexual maturity in their second year, females in their third or fourth year. Spawning takes place in shallow, running waters on sandy or gravelly substrates. The spawning season begins in October and lasts until January. Smaller migrations usually take place from the lower to the upper reaches of the river to spawn. Females lay up to 2,000 eggs per



i terestrični beskičmenjaci, dok se odrasle jedinke hrane i ribama, punoglavcima i žabama (Ribar, n.d.).

Stanište

Makedonska pastrmka nastanjuje čiste, aerisane potoke i reke, u kojima je temperatura vode u najvećem delu godine između 10 °C i 17 °C (Porcellotti, n.d.h). Starije jedinke preferiraju staništa sa dubljom vodom, dok mlađe jedinke borave u plićim staništima, bliže obalama.

Ribolovni značaj

Makedonska pastrmka nema privredni značaj, ali je popularna vrsta za lokalni rekreativni ribolov.

Faktori ugrožavanja

Introdukcija alohtonih linija potočne pastrmke i hibridizacija sa autohtonim populacijama makedonske pastrmke (introgresija) nije prisutna na teritoriji Srbije, u sistemu Lepenca i Dragovištice, tako da introgresija ne predstavlja ugrožavajući faktor kao u drugim delovima areala (Marić *et al*., 2017b, 2022). Zajednički ugrožavajući faktori za sve populacije vrste jesu prekomeran ribolov, narušavanje staništa usled korišćenja, regulacije i zagađenja vodotoka, kao i globalne klimatske promene (Crivelli, 2006i; Schöffmann *et al*., 2019). Na teritoriji Srbije, glavni faktori ugrožavanja jesu prekomeran ribolov i narušavanje staništa izgradnjom brojnih hidroenergetskih objekata, koji su uzrokovali promenu vodnog režima, tipa i kvaliteta staništa (Marić *et al*., 2022).

kg of body mass. The Macedonian trout feeds on aquatic and terrestrial invertebrates, while adults also eat fish, tadpoles and frogs (Ribar, n.d.).

Habitat

The Macedonian trout lives in clean, aerated streams and rivers where the water temperature is between 10 °C and 17 °C most of the year (Porcellotti, n.d.h). Older specimens prefer habitats with deeper water, while younger specimens reside in shallower habitats near the shore.

Importance in fisheries

The Macedonian trout is not commercially important, but is a popular species for local recreational fishing.

Threats

The introduction of non-native lineages of brown trout and hybridisation with native populations of Macedonian trout (introgression) is not present in Serbia in the watersheds of the Lepenac and Dragovištica rivers, so introgression is not a threat, unlike in other parts of its range (Marić *et al*., 2017b, 2022). The common threats to all populations are overfishing, habitat destruction through exploitation, regulation and pollution of watercourses, and global climate change (Crivelli, 2006i; Schoeffmann *et al*., 2019). In Serbia, the main threats are excessive fishing and habitat destruction due to the construction of numerous hydropower plants, which lead to a change in the water regime, habitat type and quality (Marić *et al*., 2022).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 3.3, 5.4.2, 7.2.1, 7.2.2, 7.2.8, 7.2.9, 7.3, 9.1, 9.4, 11.1, 11.2

Postojeće mere zaštite

U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za makedonsku pastrmku propisan je lovostaj od 1. oktobra do 1. marta, minimalna lovna mera od 25 cm, i ograničenje dnevnog ulova na tri komada.

Predložene mere zaštite

Potrebno je sprovesti zaštitu i revitalizaciju staništa, posebno u delovima toka koji predstavljaju plodišta makedonske pastrmke, zabraniti izgradnju hidrotehničkih objekata koji utiču na promenu kvaliteta staništa i strogo kontrolisati funkcionisanje već izgrađenih. Takođe je potrebno uskladiti načine ribolova sa brojnošću i strukturom populacija, zabraniti introdukciju alohtonih pastrmskih linija i izbegavati poribljavanje autohtonim materijalom zbog mogućih negativnih posledica (smanjenje varijabilnosti, vijabilnosti, reproduktivnog kapaciteta populacija prenošenja infekcija itd. (Waples, 1991; Campton 1995). Veštački mrest i poribljavanje autohtonim materijalom potrebno je sprovoditi samo u izuzetnim slučajevima, kada druge metode revitalizacije ne daju rezultate. Lokalno stanovništvo treba informisati o biološkom značaju vrste, faktorima ugrožavanja i planovima za njen oporavak.

Conservation actions in place

Under the *Regulation on Measures for the Conservation and Protection of the Macedonian Trout Fish Stock*, a closed season from October 1 to March 1, a minimum landing size at 25 cm standard length and a daily catch limit of 3 individuals are set for this species.

Conservation actions needed

It is necessary to implement the protection and revitalisation of habitats, especially in the river sections that are the spawning grounds of the Macedonian trout, to prohibit the construction of hydrotechnical facilities that affect the quality of the habitat and to strictly control the operation of those that have already been built. Furthermore, fishing methods must be adapted to the size and structure of the populations, the introduction of non-native trout lines must be prohibited, and stocking with native material must be avoided because of the possible negative consequences (reduction of variability, viability, reproductive capacity, transmission of infections, etc.) (Waples, 1991; Campton 1995). Artificial spawning and stocking with native material should only be carried out in exceptional cases where other methods of recovery are unsuccessful; the local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.1.1, 3.2, 4, 5.4.4

Neophodno je sprovesti istraživanja osnovnih bioloških parametara populacija iz sistema Lepenca, kao što su analize veličine populacija, distribucije, populacionih trendova, odlika životne istorije, ekologije i faktora ugrožavanja. U poslednje dve dekade utvrđena je genetička identifikacija makedonske pastrmke, što je od suštinskog značaja za potencijalno uspostavljanje akvakulture, koja bi za ovu vrstu mogla biti uspešno sprovedena, jer su populacije geografski izolovane, neintrogresirane i genetički uniformne unutar sliva (Marić *et al*., 2006, 2017b, 2022). Za populacije iz sistema Dragovištice, neophodno je nastaviti praćenje veličine, strukture i trenda populacija.

It is necessary to study the basic biological parameters of the populations of the Lepenac system, such as the analysis of population size, distribution, population trends, life history characteristics, ecology and threats. In the last two decades, the genetic identification of the Macedonian trout has been determined, which is essential for the potential establishment of aquaculture that could be successfully implemented for this species, as the populations in the watershed are geographically isolated, non-introgressed and genetically uniform (Marić *et al*., 2006, 2017b, 2022). For the populations of the Dragovištica system, it is necessary to continue monitoring the size, structure and trends of the populations.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.4

AUTOR / AUTHOR: Saša Marić

LIPLJEN
Thymallus thymallus (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Salmoniformes
Porodica: Salmonidae
Vrsta: *Thymallus thymallus* (Linnaeus, 1758)

Sinonimi

Salmo thymallus Linnaeus, 1758; *Salmo thymus* Bonnaterre, 1788; *Thymallus vexillifer* Fitzinger, 1832; *Thymallus vulgaris* Nilsson, 1832; *Thymallus vexillifer* Perty, 1832; *Thymallus decorus* Koch, 1840; *Thymallus umbrosa* Gistel, 1848; *Thymallus gymnothorax* Valenciennes, 1848; *Thymallus gymnogaster* Valenciennes, 1848; *Thymallus thymallus kamensis* Lukash, 1929

Narodno ime: Lipljen
Englesko ime: European grayling
Francusko ime: Ombre commun
Nemačko ime: Europäische Äsche
Rusko ime: Европейский хариус

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, lipljen nema status ugrožene vrste (Freyhof, 2011h). U Srbiji, zbog visokog rizika od izumiranja u prirodi, lipljenu je dodeljena kategorija ugrožene vrste (EN). Iako je obim rasprostranjenja (EOO) u Srbiji veliki (EOO iznosi 6.311 km²), površina naseljavanja (AOO) iznosi svega 18 km². Usled male površine naseljavanja, malog broja naseljenih lokaliteta, prognoziranog kontinuiranog opadanja broja naseljenih lokaliteta ili subpopulacija i broja odraslih jedinki, vrsta je ugrožena prema kriterijumima B2ab(iv,v). Kvantitativna analiza (kriterijum E), ukazuje da je verovatnoća iščezavanja u prirodi ≥20% u narednih 20 godina ili pet generacija.

Rasprostranjenje

Prirodni areal lipljena proteže se od severne Norveške i severozapadnog dela Rusije na severu do Zapadnog Balkana (reka Ljuča i Plavsko jezero) na jugu, i od Velike Britanije i Francuske na zapadu do planine Ural i reke Kare na istoku. Prisutan je u basenima Barencovog, Belog, Severnog, Baltičkog, Crnog i Kaspijskog mora, Atlantskog okeana zaključno sa slivom Loare na jugu, u Sredozemnom moru u slivu Rone, i u više rečnih sistema severnog Jadrana, od reke Po do Soče (Janković, 1960; Northcote, 1995; Kottelat & Freyhof, 2007).

Autohtone populacije lipljena u Srbiji naseljavaju reke crnomorskog sliva: Lim, Poblaćnicu, srednji tok Drine i gornji tok Ibra (Janković, 1960, 2010; Marić *et al*., 2011) (Slika 96). Osim navedenih populacija, lipljen je prisutan u još četiri reke u koje je introdukovan:

EUROPEAN GRAYLING
Thymallus thymallus (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Salmoniformes
Family: Salmonidae
Species: *Thymallus thymallus* (Linnaeus, 1758)

Synonyms

Salmo thymallus Linnaeus, 1758; *Salmo thymus* Bonnaterre, 1788; *Thymallus vexillifer* Fitzinger, 1832; *Thymallus vulgaris* Nilsson, 1832; *Thymallus vexillifer* Perty, 1832; *Thymallus decorus* Koch, 1840; *Thymallus umbrosa* Gistel, 1848; *Thymallus gymnothorax* Valenciennes, 1848; *Thymallus gymnogaster* Valenciennes, 1848; *Thymallus thymallus kamensis* Lukash, 1929

Vernacular name: Lipljen
English name: European grayling
French name: Ombre commun
German name: Europäische Äsche
Russian name: Европейский хариус

National threat category assessed according to IUCN criteria

At the global level, the European grayling is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011h). In Serbia, the species is classified as Endangered (EN) due to a high risk of extinction in the wild. Although the extent of occurrence (EOO) in Serbia is large (EOO is 6,311 km²), the area of occupancy (AOO) is only 18 km². Due to the small area of occupancy, the low number of locations where the species occurs, the projected continuing decline in the number of locations or subpopulations and the number of mature specimens, the species is threatened according to criteria B2ab(iv,v). The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥20% in the next 20 years or five generations.

Distribution

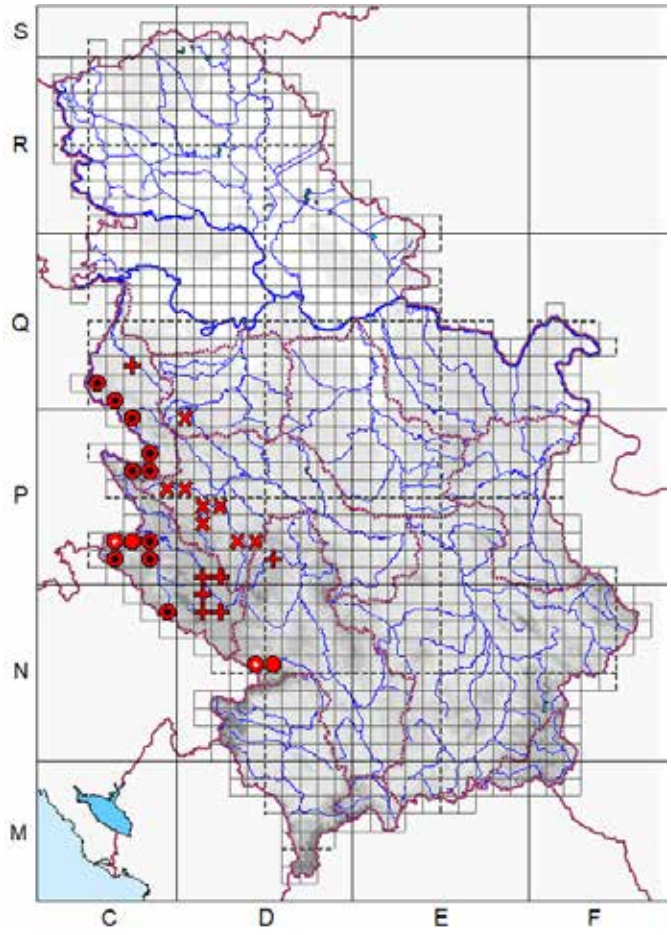
The natural range of the European grayling extends from northern Norway and the northwestern part of Russia in the north to the Western Balkans (Ljuča River and Lake Plav) in the south, and from Great Britain and France in the west to the Ural Mts. and Kara River in the east. It occurs in the Barents Sea, White Sea, North Sea, Baltic Sea, Black Sea, and Caspian Sea basins as well as in the Atlantic Ocean basin, including the Loire Basin to the south, in the Mediterranean Sea basin in the Rhône watershed, and in several river systems of the northern Adriatic Sea, from the Po to the Soča (Janković, 1960; Northcote, 1995; Kottelat & Freyhof, 2007).

The native European grayling populations in Serbia live in the rivers of the Black Sea basin: Lim, Poblaćnica, the middle reaches of the Drina and the upper reaches of the Ibar (Janković, 1960, 2010; Marić *et al*., 2011) (Figure 96). In addition to the above-mentioned

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Lipljen / European grayling – *Thymallus thymallus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex II**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**L, MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/nt**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**EN B2ab(iv,v); E Strogo zaštićena vrsta / Strictly protected species**

*L – lovostaj od 1. marta do 31. maja, MLM – minimalna lovna mera 30 cm, ODU – ograničenje dnevnog ulova na tri komada /
L – closed season from 1 March to 31 May, MLM minimum landing size at 30 cm standard length, ODU – daily catch limit of 3 individuals



Slika 96. **Rasprostranjenje *Thymallus thymallus* u Srbiji.**

Figure 96. **Distribution of *Thymallus thymallus* in Serbia.**

Slika 97. Lipljen *Thymallus thymallus* (foto: S. Marić).

Figure 97. European grayling *Thymallus thymallus* (photo: S. Marić).

Veliki Rzav (introdukcija iz crnomorskog sliva Slovenije), Moravica (iz Studenice, Drine i Une), Đetinja (iz Drine) i Gradac (iz crnomorskog sliva Slovenije, Drine i Une).

Opis vrste

Telo lipljena je izduženo, bočno spljošteno sa ispupčenim leđima, pokriveno krupnim šestougaonim krljuštima (Slika 97). Glava je mala, zašiljena. Usni otvor je takođe mali i blago ventralno postavljen. Gornja vilica je duža od donje, a svojim zadnjim krajem obično doseže prednju ivicu oka (Kottelat & Freyhof, 2007). Na vilicama se nalaze kukasti zubi, dok su na ralastoj kosti zubi jedva uočljivi (Vuković & Ivanović, 1971). Leđa i bokovi tela su smeđe ili plavo-sive boje, sa srebrnim ili zlatno-zelenim odsjajem. Stomak je sivkaste boje sa žutim prelivom. Na bokovima tela, obično do nivoa trbušnih peraja, mogu se nalaziti sitne crne tačke, a duž bokova pružaju se i sive linije. Iznad trbušnih peraja na bokovima tela javlja se crvena mrlja veličine nekoliko centimetara. Grudna, trbušna i podrepno peraje imaju žutu ili narandžastu nijansu. Leđno peraje je veoma visoko i dugo, metalno plave boje sa krupnim, crvenim i ljubičastim pegama. Repno peraje je urezano, i crvenkasto-žuto obojeno. Masno peraje je sivo sa crvenim prelivom po obodu (Janković, 1960). U periodu mresta boja je intenzivnija, a kod mužjaka se povećava zadnji deo leđnog peraja, koje je i inače duže nego kod ženki (Vuković & Ivanović, 1971). Peraja: D V–X + 13–17; A IV + 8–16; P I + 10–16; V II + 8–15. Broj krljušti u bočnoj liniji je 78–98, a broj piloričnih cekuma je 12–37 (Janković, 1960). Lipljen obično dostiže dužinu do 50 cm i masu do 1 kg (Vuković & Ivanović, 1971), dok u veoma pogodnim uslovima može dostići dužinu i do 60 cm i masu od 2 kg do 3 kg (Muus & Dahlström, 1968). Maksimalna zabeležena masa tela iznosi 6,7 kg (Liedes, 1961), a starost 14 godina (Muus & Dahlström, 1968). Centralnoevropske populacije žive kraće od severnih populacija, do 10 godina (Jesenšek & Šumer, 2004).

populations, grayling occurs in four other rivers into which it has been introduced: the Veliki Rzav (introduction from the Slovenian Black Sea basin), the Moravica (from the Studenica, Drina and Una), Đetinja (from the Drina) and the Gradac (from the Slovenian Black Sea basin and from the Drina and Una).

Description of the species

The body of the European grayling is elongated, laterally flattened with a convex back, covered with large hexagonal scales (Figure 97). The head is small and pointed. The mouth opening is also small and slightly ventrally positioned. The upper jaw is longer than the lower jaw, and its posterior end usually extends to the anterior margin of the eye (Kottelat & Freyhof, 2007). There are hooked teeth on the jaws, while the teeth on the vomer are barely visible (Vuković & Ivanović, 1971). The dorsum and flanks are brown or blue-grey, with a silvery or golden-green tinge. The belly is greyish with a yellow tinge. Small black dots can be seen on the flanks, usually up to the level of the ventral fins, and grey lines run along the sides of the body. On the flanks, above the ventral fins on the sides of the body, there is a red spot several centimetres in size. The pectoral, ventral and anal fins have a yellow or orange colouration. The dorsal fin is very high and long, metallic blue with large red and purple spots. The caudal fin is emarginated and reddish-yellow in colour. The adipose fin is grey with a red margin (Janković, 1960). During spawning, the colour is more intense and the length of the posterior part of the dorsal fin, which is already longer in males than in females, increases further in males (Vuković & Ivanović, 1971). Fins: D V–X + 13–17; A IV + 8–16; P I + 10–16; V II + 8–15. The number of scales in the lateral line is 78–98 and the number of pyloric caeca is 12–37 (Janković, 1960). The European grayling usually reaches a length of up to 50 cm and a mass of up to 1 kg (Vuković & Ivanović, 1971), while under very favourable conditions it can reach a length of up to 60 cm and a mass of 2 to 3 kg (Muus & Dahlstroem, 1968). The highest recorded body mass is 6.7 kg (Liedes, 1961), and the age is 14 years (Muus & Dahlstroem, 1968). Central European populations live for a shorter time than northern populations, up to 10 years (Jesenšek & Šumer, 2004).

Populacione karakteristike

Veliki broj populacija ima trend pada brojnosti u čitavom arealu, a pojedine populacije su već iščezle (Jesenšek & Šumer, 2004; Gum *et al*., 2009). Iz literaturnih izvora koji datiraju iz 60-ih godina prošlog veka, postoje informacije o brojnim populacijama lipljena u crnomorskom slivu Srbije (Janković, 1960; Marković, 1962). Krajem prošlog veka došlo je do iščezavanja autohtonih populacija iz Vape, Uvca, Jadra i Studenice. Od recentnih, najugroženija je populacija iz gornjeg toka Ibra, čija je distribucija ograničena na oko 15 km toka. Za ovu populaciju utvrđene su najniže vrednosti genetičkog diverziteta u regionu, i jasno je da bez efikasne i odlučne primene konzervacionih mera populacija ne može opstati. Za razliku od ibarske populacije, populacija iz Lima karakteriše se umerenim, a iz Drine najvišim vrednostima genetičkog diverziteta u odnosu na ostale regionalne populacije iz sliva Save i Morave (Marić *et al*., 2011, 2012). Za limsku i drinsku populaciju može se zaključiti da imaju povoljnu perspektivu opstanka, uz odgovorno upravljanje, kao i očuvanje i unapređenje staništa. Od introdukovanih populacija, postoje istraživanja za populaciju u Velikom Rzavu, kod koje je utvrđeno naglo smanjenje brojnosti (Marić *et al*., 2011), što ukazuje da će za dugoročni opstanak ove, ali najverovatnije i ostalih introdukovanih populacija, biti neophodna intenzivna pomoć korisnika.

Ekologija vrste

U umerenom klimatu mužjaci lipljena obično dostižu polnu zrelost u drugoj, a ženke u trećoj ili četvrtoj godini života. Lipljen se mresti na peskovitoj ili šljunkovitoj podlozi, u vodi umerene brzine, obično na dubini od 20 do 40 cm (Kottelat & Freyhof, 2007). Mrest se odvija u periodu od marta do maja, pri temperaturi vode 6–10 °C, u glavnim rečnim tokovima, jezerima ili u njihovim pritokama (Janković, 1960). Migracije radi mresta najintenzivnije su u toku noći za vreme punog meseca (Kottelat & Freyhof, 2007). Ženke u zavisnosti od veličine, mase i starosti polažu 2.000–11.000 jaja (Janković, 1960). Inkubacija traje 3–4 nedelje, pri temperaturi vode 8,5–10 °C. Mlade jedinke se hrane sitnim beskičmenjacima dna i planktonom, dok se odrasle jedinke hrane akvatičnim i terestričnim insektima, račićima, crvima, kao i sitnijom ribom (Vostradovsky, 1973; Jesenšek & Šumer, 2004).

Stanište

Lipljen ne zalazi visoko u planinske potoke kao potočna pastrmka (Vuković i Ivanović, 1971). Naseljava nešto mirniji deo rečnog toka, sa čistom, hladnom vodom, prosečne temperature 5–11 °C, retko preko 18 °C (u toku letnjeg perioda), bogatom kiseonikom (Baensch & Riehl, 1991). Jezerske populacije nastanjuju litoralnu i pelašku zonu hladnih i čistih jezerskih ekosistema. Starije jedinke su teritorijalne, sa tendencijom grupisanja van sezone mresta u hijerarhijski organizovana jata koja borave u dubljoj vodi (Fabricius & Gustafson, 1955; Northcote, 1995). Mužjaci su izrazito teritorijalni tokom mresta (Poncin, 1996). Mlađe jedinke najčešće borave u mirnijoj, plićoj vodi (40–75 cm dubine, u zavisnosti od starosti), iznad šljunkovitog dna, bliže rečnim obalama (Jesenšek & Šumer, 2004).

Population trends

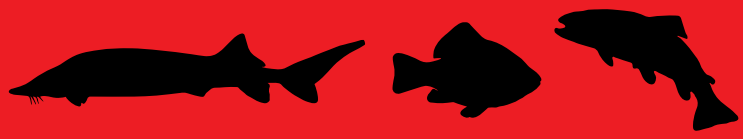
Numerous populations are declining throughout the area, and some populations have already disappeared (Jesenšek & Šumer, 2004; Gum *et al*., 2009). From literary sources dating back to the 1960s, there is information about numerous grayling populations in the Black Sea basin in Serbia (Janković, 1960; Marković, 1962). At the end of the last century, the native populations of the Vapa, Uvac, Jadar and Studenica disappeared. Of the recent populations, the most threatened is the population from the upper reaches of the Ibar, whose distribution is limited to about 15 km of the river. This population has been found to have the lowest levels of genetic diversity in the region, and it is clear that the population cannot survive without effective and decisive conservation measures. In contrast to the Ibar population, the Lim population is characterised by moderate and the Drina population by the highest genetic diversity compared to other regional populations from the Sava and Morava basins (Marić *et al*., 2011, 2012). It can be concluded for the Lim and Drina populations that they have a favourable survival prospects with responsible management and habitat conservation and improvement. Of the introduced populations, there are studies for the population in the Veliki Rzav, where a sudden population decline was noted (Marić *et al*., 2011), suggesting that intensive administrative support will be required for the long-term survival of this and most likely other introduced populations as well.

Ecology of the species

In temperate climates, males usually reach sexual maturity in their second year of life and females in their third or fourth year of life. The grayling spawn on sandy or gravelly substrate in waters with moderate current, usually at a depth of 20 to 40 cm (Kottelat & Freyhof, 2007). Spawning takes place in the period from March to May at a water temperature of 6–10 °C in the main river channels, lakes or in their tributaries (Janković, 1960). Spawning migrations are most intense during the night of the full moon (Kottelat & Freyhof, 2007). Depending on size, mass and age, females lay 2,000-11,000 eggs (Janković, 1960). The incubation period lasts 3–4 weeks at a water temperature of 8.5–10 °C. Juveniles feed on small bottom invertebrates and plankton, while adults feed on aquatic and terrestrial insects, crustaceans, worms, and small fishes (Vostradovsky, 1973; Jesenšek & Šumer, 2004).

Habitat

The European grayling does not enter mountain streams as high as the brown trout (Vuković and Ivanović, 1971). It inhabits a somewhat calmer part of the river course with clean, cold water with an average temperature of 5–11 °C, rarely above 18 °C (in summer), and rich in oxygen (Baensch & Riehl, 1991). Lake populations inhabit littoral and pelagic zones of cold and clean lake ecosystems. Older individuals are territorial and tend to aggregate in hierarchically organised shoals outside of the spawning season, residing in deeper water (Fabricius & Gustafson, 1955; Northcote, 1995). Males are very territorial during spawning (Poncin, 1996). Younger specimens usually stay in calmer, shallower waters (40–75 cm deep, depending on age), above the gravel bottom, closer to the banks (Jesenšek & Šumer, 2004).



Ribolovni značaj

Lipljen nije značajan sa aspekta komercijalnog ribolova, ali spada među najatraktivnije salmonidne vrste za rekreativni ribolov (Jesenšek & Šumer, 2004). Vrsta je takođe veoma atraktivna zbog svog izgleda, elegantnih pokreta, čak i mirisa (dok su jedinke u svežem stanju), koji podseća na miris majčine dušice (*Thymus*), po čemu je rod navodno i dobio latinsko ime *Thymallus* (Maclean, 1980).

Faktori ugrožavanja

Introdukcija alohtonih linija lipljena i hibridizacija sa autohtonim populacijama (introgresija), prisutna je širom areala vrste, a posebno u zapadnim delovima areala (Duftner *et al*., 2005; Gum *et al*., 2006). Introgresija je najčešće uzrokovana intenzivnim poribljavanjem, koje je preduzimano radi ublažavanja redukcije brojnosti izvornih populacija, usled jakog ribolovnog pritiska i pogoršanja kvaliteta staništa. Istraživanja genetičke strukture autohtonih populacija na teritoriji Srbije ukazuju na tragove introgresiranosti drinske populacije savskim lipljenom iz Slovenije (Marić *et al*., 2011). Osim genetičke kontaminacije, lipljen je veoma osetljiv na promene protoka, temperature i bistrine vode, kao i na promene intenziteta sedimentacionih procesa, do kojih dolazi usled narušavanja staništa korišćenjem i regulacijom vodotoka i usled globalnih klimatskih promena (Northcote, 1995; Jesenšek & Šumer, 2004). Lipljen je osetljiviji na zagađenje u odnosu na ostale salmonidne vrste, a u očuvanim populacijama predstavlja lakši plen ribolovcima i piscivornim pticama.

Na teritoriji Srbije, glavni faktori ugrožavanja odnose se na prekomeran izlov i narušavanje staništa izgradnom hidroenergetskih objekata, koji su uzrokovali promenu vodnog režima, tipa i kvaliteta staništa (Marić *et al*., 2011).

Importance in fisheries

The European grayling is of no commercial fishery importance, but is one of the most attractive salmonid species for recreational fishing (Jesenšek & Šumer, 2004). The species is also attractive because of its appearance, elegant movements, and even its odour (when fresh), which is reminiscent of the smell of thyme (*Thymus*), which is probably why the genus received its Latin name *Thymallus* (Maclean, 1980).

Threats

The introduction of non-native grayling lineages and hybridisation with native populations (introgression) occurs throughout the species' range, especially in the western parts (Duftner *et al*., 2005; Gum *et al*., 2006). In most cases, introgression is caused by intensive stocking carried out to mitigate the decline of the original populations due to intense fishing pressure and habitat degradation. Studies of the genetic structure of the native populations in the territory of Serbia indicate traces of introgression of the Drina population by the grayling from the Slovenian section of the Sava (Marić *et al*., 2011). In addition to genetic contamination, the grayling is very sensitive to changes in flow, water temperature and clarity, as well as to changes in the intensity of sedimentation processes caused by habitat disturbance resulting from the exploitation and regulation of watercourses and from global climate changes (Northcote, 1995; Jesenšek & Šumer, 2004). The grayling is more sensitive to pollution than other salmonid species, and in protected populations it is easy prey for fishers and piscivorous birds.

In Serbia, the main threats are overfishing and habitat destruction through the construction of hydroelectric power plants, which lead to a change in the water regime, habitat type and quality (Marić *et al*., 2011).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 3.3, 5.4.2, 6.3, 7.2.1, 7.2.2, 7.2.3, 7.2.11, 7.3, 8.1, 8.2, 9.1.3, 9.2.3, 9.3.4, 9.4, 11

Postojeće mere zaštite

Lipljen se nalazi u Prilogu II *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je lovostaj od 1. marta do 31. maja, minimalna lovna mera od 30 cm i ograničenje dnevnog ulova na tri komada.

Predložene mere zaštite

Na sve četiri reke koje predstavljaju prirodna staništa lipljena (Poblaćnica, Lim, Drina i Ibar), planirana je izgradnja većeg broja hidroelektrana (Javno, 2014). Izgradnja novih objekata uz već postojeće, dovela bi u pitanje opstanak lipljena na teritoriji Srbije, a Poblaćnica koja je značajno plodište lipljena iz sliva Lima, bila bi potpuno devastirana.

Za očuvanje populacija lipljena potrebno je sprovesti zaštitu i revitalizaciju staništa, posebno u delovima toka koji predstavljaju plodišta lipljena, kao i zabraniti izgradnju hidrotehničkih objekata koji utiču na promenu kvaliteta staništa i strogo kontroli-

Conservation actions in place

The European grayling is listed in Annex II of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a closed season from March 1 to May 31, a minimum landing size at 30 cm standard length and a daily catch limit of 3 individuals are set for this species.

Conservation actions needed

The construction of a large number of hydropower plants is planned on all four rivers representing natural habitats of the European grayling (Poblaćnica, Lim, Drina and Ibar) (Javno, 2014). The construction of new hydropower plants in addition to the existing ones would jeopardise the survival of the European grayling in the territory of Serbia, and the Poblaćnica, which is an important spawning area for the European grayling in the Lim basin, would be completely destroyed.

In order to conserve grayling populations, it is necessary to protect and revitalise the habitat, especially in river sections that are spawning grounds for grayling, as well as to prohibit the construction of hydrotech-

sati funkcionisanje već izgrađenih. Takođe je potrebno uskladiti načine ribolova sa brojnošću i strukturom populacija, zabraniti introdukciju alohtonih linija i izbegavati poribljavanje autohtonim materijalom zbog mogućih negativnih posledica (smanjenje varijabilnosti, vijabilnosti, reproduktivnog kapaciteta prenošenja infekcija itd.) (Waples, 1991; Campton 1995; Northcote, 1995). Veštački mrest i poribljavanje autohtonim materijalom potrebno je sprovesti samo u izuzetnim slučajevima, kada druge metode revitalizacije ne daju rezultate. Lokalno stanovništvo treba informisati o biološkom značaju vrste, faktorima ugrožavanja i planovima za njen oporavak.

nical facilities that alter the quality of the habitat and to strictly control the operation of those that have already been constructed. Furthermore, fishing methods must be adapted to size and structure of the populations, the introduction of non-native species must be prohibited and stocking with native material must be avoided because of possible negative consequences (reduction of variability, viability, reproductive capacity, transmission of infections, etc.) (Waples, 1991; Campton 1995; Northcote, 1995). Artificial spawning and stocking with native material should only be carried out in exceptional cases where other methods of revitalisation are unsuccessful. The local citizens should be informed about the biological importance of the species, the threats and the plans for its recovery.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.1.1, 3.2, 4, 5.4.2

U cilju zaštite i revitalizacije staništa i populacija lipljena, neophodno je sprovoditi detaljna i redovna istraživanja osnovnih bioloških parametara, kao što su analize veličine populacija i populacionih trendova, odlika životne istorije, ekologije, genetičke strukture i faktora ugrožavanja. Rezultate istraživanja treba implementirati u akcioni plan zaštite, oporavka i upravljanja staništima i vrstom, uz redovan nadzor sprovođenja planova.

For the protection and recovery of European grayling habitats and populations, detailed and regular studies of basic biological parameters are needed, such as analyses of population size and trends, life history traits, ecology, genetic structure and threats. The research results should be incorporated into an action plan for habitat and species protection, restoration and management, with regular monitoring of the plan's implementation.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 3.1, 3.2, 3.4

AUTOR / AUTHOR: Saša Marić

8.4.

Ranjive vrste (VU)

Vulnerable species (VU)

OHRIDSKA UKLJEVICA
Alburnoides ohridanus (Karaman, 1928)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Alburnoides ohridanus* (Karaman, 1928)

Sinonimi

Alburnus bipunctatus ohridanus Karaman, 1928; *Alburnoides bipunctatus ohridanus* (Karaman, 1928)

Narodno ime: Ohridska ukljevica
Englesko ime: Ohrid spirlin
Francusko ime: Spirlin d'Ohrid
Nemačko ime: Ohrid Schneider
Rusko ime: Охридская быстрянка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ohridska ukljevica ima status ranjive vrste (VU) prema kriterijumu D2 (Freyhof & Kottelat, 2008a). U Srbiji, ohridska ukljevica takođe ima status ranjive vrste (VU) zbog malog obima rasprostranjenja (EOO iznosi 999 km²), male površine naseljavanja (AOO iznosi 24 km²) i malog broja lokaliteta na kojima se vrsta javlja – kriterijumi B1ab+2ab. Kvantitativna analiza (kriterijum E), ukazuje da je verovatnoća iščezavanja u prirodi ≥10% u narednih 100 godina.

Rasprostranjenje

Ohridska ukljevica je endemična vrsta Ohrid-Drim-Skadar sistema. Naseljava Ohridsko jezero, sliv Belog Drima, reku Bojanu, Skadarsko jezero, a prisutna je i u Morači do ušća Zete i Zeti do Danilovgrada (Šanda *et al*., 2009; Talevski *et al*., 2009; Marić & Milošević, 2011; Grapci-Kotori *et al*, 2020). U Srbiji, registrovana je na više lokaliteta u slivu Belog Drima (Slika 98).

Opis vrste

Telo ohridske ukljevice je izduženo i bočno spljošteno, umerene visine (Slika 99). Bočna linija je zakrivljena prema dole odmah iza škržnih otvora i pruža se dosta ispod uzdužne ose tela. Bočnu liniju čini karakterističan dvostruki niz pora. Glava je srednje veličine, a usta su terminalna i blago okrenuta nagore (Kottelat & Freyhof, 2007). Dijametar oka jednak je interorbitalnom razmaku, a veći je od dužine njuške (Bogutskaya *et al*., 2010). Leđa su sivkasto do maslinasto-zelene boje. Po sredini bokova postoji dosta tamno pigmentisanih mrlja, manje ili više pravilno raspoređenih u kratke nizove. Trbuh je srebrnkasto–beo. Dužina repnog stabla je 1,6–1,8 puta veća od njegove visine. Podrepno peraje se odlikuje sa 12 granatih žbica. U bočnoj liniji je 42–44 + 2–3 krljušti, dok je broj kič-

OHRID SPIRLIN
Alburnoides ohridanus (Karaman, 1928)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Alburnoides ohridanus* (Karaman, 1928)

Synonyms

Alburnus bipunctatus ohridanus Karaman, 1928; *Alburnoides bipunctatus ohridanus* (Karaman, 1928)

Vernacular name: Ohridska ukljevica
English name: Ohrid spirlin
French name: Spirlin d'Ohrid
German name: Ohrid Schneider
Russian name: Охридская быстрянка

National threat category assessed according to IUCN criteria

At the global level, the Ohrid spirlin is classified as Vulnerable (VU) under criterion D2 (Freyhof & Kottelat, 2008a). In Serbia, the species is also classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 999 km²), the small area of occupancy (AOO is 24 km²) and the low number of locations where it occurs – criteria B1ab+2ab. The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

The Ohrid spirlin is endemic to the Ohrid-Drim-Skadar system. It inhabits Lake Ohrid, the White Drim watershed, the Bojana River, Lake Skadar, and is also found in the Morača River up to the confluence with the Zeta River as well as in the Zeta River up to Danilovgrad (Šanda *et al*., 2009; Talevski *et al*., 2009; Marić & Milošević, 2011; Grapci-Kotori *et al*., 2020). In Serbia, it has been recorded in several locations in the White Drim watershed (Figure 98).

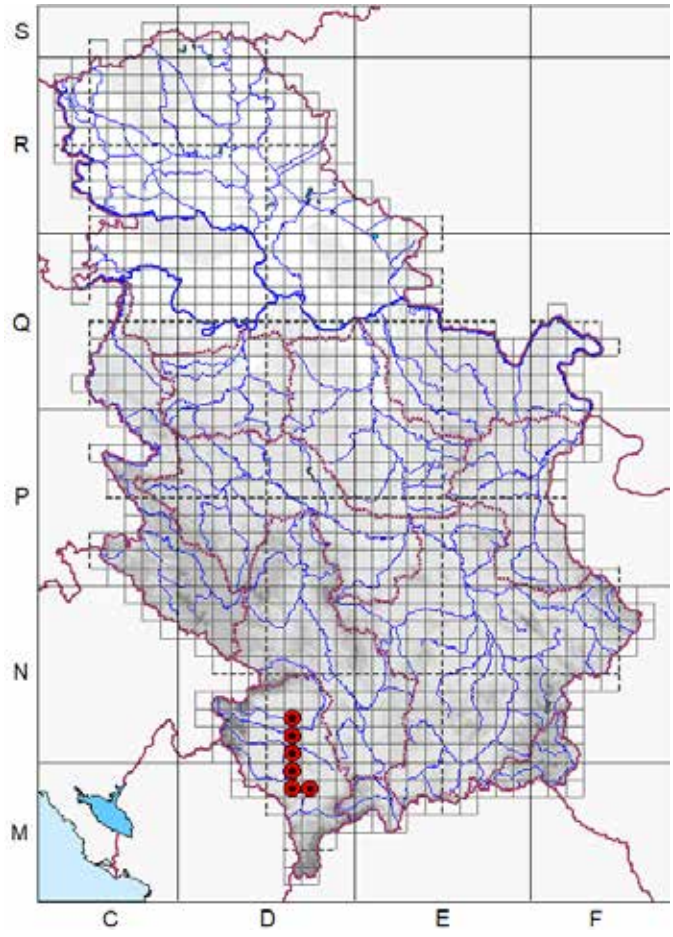
Description of the species

The body of the Ohrid spirlin is elongated and laterally flattened, of moderate height (Figure 99). The lateral line curves downwards just behind the gill openings and runs well below the longitudinal axis of the body. The lateral line is formed by a characteristic double row of pores. The head is medium-sized and the mouth is terminal and slightly upturned (Kottelat & Freyhof, 2007). The eye diameter corresponds to the interorbital distance and is larger than the length of the snout (Bogutskaya *et al*., 2010). The dorsum is greyish to olive green in colour. Along the middle of the flanks there are many dark pigmented spots, more or less regularly arranged in short rows. The ventral side is silvery white. The length of the caudal peduncle is 1.6–1.8 times its height. The dorsal fin is characterised by 12 branched rays.

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Ohridska ukljevica / Ohrid spirlin – *Alburnoides ohridanus*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**VU D2**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention (navedena kao / listed as *Alburnoides bipunctatus*)	**Dodatak / Appendix III**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Alburnoides bipunctatus ohridanus*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab+2ab; E Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 98. **Rasprostranjenje *Alburnoides ohridanus* u Srbiji.**

Figure 98. **Distribution of *Alburnoides ohridanus* in Serbia.**

Slika 99. Ohridska ukljevica *Alburnoides ohridanus* (foto: D. Ulqini).

Figure 99. Ohrid spirlin *Alburnoides ohridanus* (photo: D. Ulqini).

menih pršljenova 38–40 (Kottelat & Freyhof, 2007; Bogutskaya *et al*., 2010). Naraste do 15 cm (obično do 9 cm) (Kottelat & Freyhof, 2007).

Populacione karakteristike

Nema podataka o populacionim trendovima ohridske ukljevice. Noviji podaci ukazuju na značajnu brojnost populacija na nekim lokalitetima (Ritterbusch *et al*., 2017; Grapci-Kotori *et al*., 2020).

Ekologija vrste

Ohridska ukljevica je bentopelagična vrsta koja preferira umerene temperaturne uslove u staništu. Mresti se u maju i junu (Kottelat & Freyhof, 2007). Mrest je porcioni, odvija se u plićacima, a ikru polaže na šljunkovitu ili kamenitu podlogu (Talevska & Talevski, 2015). Ohridska ukljevica se uglavnom hrani larvama insekata i drugim beskičmenjacima. U ishrani u značajnoj meri učestvuju i insekti koji lebde u vazduhu iznad same površine vode (Porcellotti, n.d.a).

Stanište

Ohridska ukljevica živi u jezerima, kao i rekama i potocima sa manjom brzinom toka. U jezerima obično obitava u obalskoj zoni (Kottelat & Freyhof, 2007), a u tekućoj vodi preferira tišake i virove sa šljunkovitim dnom.

Ribolovni značaj

Vrsta nema nikakav ribolovni značaj.

Faktori ugrožavanja

Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa, što uključuje zagađenje otpadnim vodama različitog porekla (naselja i urbane zone, industrijski i poljoprivredni objekti, posebno oni za salmonidnu akvakulturu), pregrađivanje tokova i izgradnju brana, regulaciju tokova, kao i gubitak staništa. Takođe, stalnu pret-

There are 42–44 + 2–3 scales in the lateral line, while the number of vertebrae is 38–40 (Kottelat & Freyhof, 2007; Bogutskaya *et al*., 2010). It grows up to 15 cm (usually up to 9 cm) (Kottelat & Freyhof, 2007).

Population trends

There are no data on population trends of the Ohrid spirlin. Recent data indicate a significant population density at some locations (Ritterbusch *et al*., 2017; Grapci-Kotori *et al*., 2020).

Ecology of the species

The Ohrid spirlin is a benthopelagic species that prefers temperate conditions in its habitat. It spawns in May and June (Kottelat & Freyhof, 2007). Spawning takes place in portions in shallow waters and on gravelly or stony substrates (Talevska & Talevski, 2015). The Ohrid spirlin feeds mainly on insect larvae and other invertebrates. Insects flying above the water surface make up a considerable part of the diet (Porcellotti, n.d.a).

Habitat

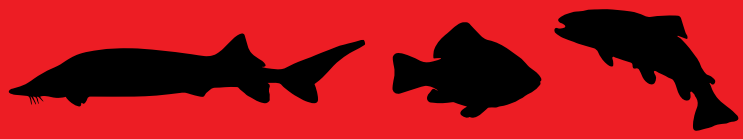
The Ohrid spirlin lives in lakes, but also in rivers and streams with slower currents. In lakes it usually stays in the littoral zone (Kottelat & Freyhof, 2007), and in streams it prefers pools and riffles with a gravelly bottom.

Importance in fisheries

The Ohrid spirlin is of no fishery importance.

Threats

Threatening factors are mainly related to habitat pollution by effluents from various sources (settlements and urban areas, industrial and agricultural facilities, especially for salmonid aquaculture), damming and regulation of watercourses, construction of dams and habitat loss. A constant threat is also the introduction



nju predstavlja i introdukcija alohtonih invazivnih vrsta, kao i negativni efekti klimatskih promena.

of non-native invasive species and the negative impacts of climate change.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.3, 7.2.11, 7.3, 8.1.1, 9.1.3, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

Ohridska ukljevica nije obuhvaćena postojećim merama zaštite.

Conservation actions in place

The Ohrid spirlin is not covered by the existing conservation measures.

Predložene mere zaštite

Bilo bi poželjno sprečiti zagađenje otpadnim vodama i unos alohtonih vrsta riba, ograničiti regulaciju vodotoka i izgradnju novih brana. Posebnu pažnju bi trebalo posvetiti sprečavanju negativnih efekata salmonidne akvakulture i izgradnji funkcionalnih ribljih staza uz poštovanje biološkog minimuma prilikom eksploatacije vodnih potencijala.

Conservation actions needed

It would be desirable to prevent pollution from sewage and the introduction of non-native fish species, to limit the regulation of watercourses and the construction of new dams. Particular attention should be paid to avoiding negative impacts of salmonid aquaculture and the construction of functional fish ladders, while respecting the biological minimum in the use of water resources.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.1, 2.2

Neophodna su istraživanja veličine, distribucije i trendova populacije, životne istorije i ekologije ove vrste.

Research into the size, distribution and population trends, life history and ecology of this species is necessary.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Aleksandar Hegediš

VELIKA PLISKA *Alburnus sava* Bogutskaya, Zupančič, Jelić, Diripasko & Naseka, 2017

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Alburnus sava* Bogutskaya, Zupančič, Jelić, Diripasko & Naseka, 2017

Sinonimi

Nema

Narodno ime: Velika pliska, pegunica, pegunca
Englesko ime: Balkan shemaya
Nemačko ime: Seelaube
Rusko ime: Шемая

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, status ugroženosti velike pliske nije procenjen prema IUCN kriterijumima (NE). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodi ≥10% u narednih 100 godina, velika pliska ima status ranjive vrste (VU). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 21.987 km², dok je površina naseljavanja (AOO) 40 km².

Rasprostranjenje

Velika pliska je opisana iz reke Kupe, pritoke Save (Bogutskaya *et al*., 2017). Nađena je i u Dravi, Savi, Bosni i Drini, u Sloveniji, Hrvatskoj i Bosni i Hercegovini (Mrakovičić *et al*., 2006; Bogutskaya *et al*., 2017; Vucić *et al*. 2017). U Srbiji je zabeležena u Savi, donjem toku Drine, Zapadnoj Moravi i Dunavu nizvodno od Beograda (Slika 100). Ranije je velika pliska svrstavana u danas nevažeći rod *Chalcalburnus* (Kottelat & Freyhof, 2007). S obzirom da se juvenilne i subadultne jedinke teško razlikuju od ukljeve (*A. alburnus*), moguće je da je rasprostranjenje velike pliske veće nego što se do sada mislilo (Vucić *et al*., 2017).

Opis vrste

Velika pliska ima izduženo i bočno spljošteno telo (Slika 101). Boja tela je sivo-zelena na leđima, srebrnasta po bokovima, dok je trbuh beo. Usta su terminalna. Osnova podrepnog peraja počinje u nivou kraja ili malo iza osnove dorzalnog peraja. Peraja: D III + 9; A III + 16–17. Bočna linija ima 63–64 krljušti, broj branhiospina je 23–27, a kičmenih pršljenova 44–45. Ždrelni zubi su dvoredni, DF 2.5–5.2. Maksimalna zabeležena dužina tela iznosi 21,8 cm (Bogutskaya *et al*. 2017).

BALKAN SHEMAYA *Alburnus sava* Bogutskaya, Zupančič, Jelić, Diripasko & Naseka, 2017

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Alburnus sava* Bogutskaya, Zupančič, Jelić, Diripasko & Naseka, 2017

Synonyms

None

Vernacular name: Velika pliska, pegunica, pegunca
English name: Balkan shemaya
German name: Seelaube
Russian name: Шемая

National threat category assessed according to IUCN criteria

At the global level, the Balkan shemaya is classified as Not Evaluated (NE) as its status has not been assessed according to IUCN criteria. In Serbia, the species is classified as Vulnerable (VU) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence of the species (EOO) in Serbia is 21,987 km², while the area of settlement (AOO) is 40 km².

Distribution

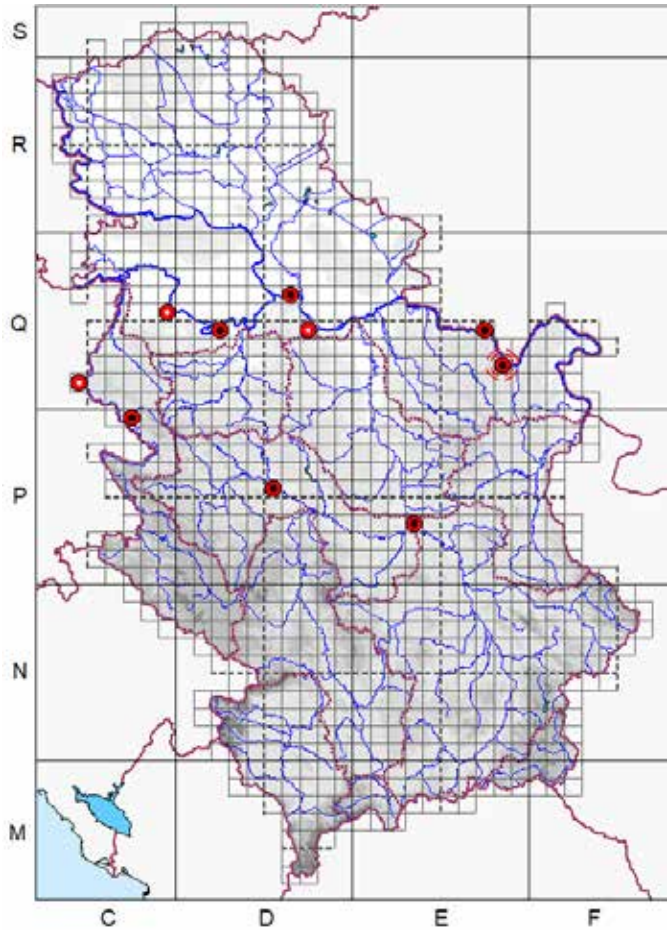
The Balkan shemaya has been described from the river Kupa, a tributary of the Sava (Bogutskaya *et al*., 2017). It has also been found in the Drava, Sava, Bosna and Drina rivers in Slovenia, Croatia and Bosnia and Herzegovina (Mrakovičić *et al*., 2006; Bogutskaya *et al*., 2017; Vucić *et al*. 2017). In Serbia, it has been recorded in the Sava River, the lower reaches of the Drina River, the West Morava and the Danube River downstream of Belgrade (Figure 100). Previously, the Balkan shemaya was classified in the currently invalid genus Chalcalburnus (Kottelat & Freyhof, 2007). As juvenile and subadult individuals are difficult to distinguish from the common bleak (A. alburnus), it is possible that the range of the Balkan shemaya is larger than previously thought (Vucić *et al*., 2017).

Description of the species

The Balkan shemaya has an elongated and laterally flattened body (Figure 101). The colour of the body is grey-green on the back and silvery on the flanks, while the belly is white. The mouth is terminal. The base of the anal fin begins at the posterior end of the dorsal fin or just behind it. Fins: D III + 9; A III + 16–17. The lateral line has 63–64 scales, the number of gill rakers is 23–27 and the number of vertebrae is 44–45. The pharyngeal teeth are in two rows, DF 2.5–5.2. The maximum recorded body length is 21.8 cm (Bogutskaya *et al.* 2017).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Velika pliska / Balkan shemaya – *Alburnus sava*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	-
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Chalcalburnus chalcoides*)	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Chalcalburnus chalcoides*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi (navedena kao / listed as *Alburnus chalcoides*)	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Alburnus chalcoides*)	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Chalcalburnus chalcoides*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Zaštićena vrsta / Protected species**



Slika 100. **Rasprostranjenje *Alburnus sava u* u Srbiji.**

Figure 100. **Distribution of *Alburnus sava* in Serbia.**

Slika 101. Velika pliska *Alburnus sava* (foto: Bogutskaya *et al.* 2017, https://commons.wikimedia.org/wiki/File:Alburnus_sava_(MNCN_291345)_01.jpg).

Figure 101. Balkan shemaya *Alburnus sava* (photo: Bogutskaya *et al.* 2017, https://commons.wikimedia.org/wiki/File:Alburnus_sava_(MNCN_291345)_01.jpg).

Populacione karakteristike

Populacioni trend velike pliske nije poznat. Iako se relativno retko nađe u ulovima alasa i rekreativnih ribolovaca, velika pliska nije retka vrsta. Postoje podaci da u Drini obitava veoma brojna populacija i da je prilikom jedne kontrole rada riblje staze na brani u Malom Zvorniku dominirala među uočenim vrstama.

Ekologija vrste

Velika pliska je potamodromna, bentopelagična vrsta koja preferira umerene temperaturne uslove (Bogutskaya *et al.*, 2017). Mresti se u proleće, kada obavlja lokalne migracije do manjih pritoka. U njima se, na plitkim brzacima, odvija mrest. Živi u jatima.

Stanište

Velika pliska se sreće u tokovima sa šljunkovito-kamenitim dnom i umerenim i brzim strujanjem vode, kao i u velikim nizijskim rekama sporog toka sa glinovitim i peskovito-muljevitim dnom (Bogutskaya *et al.*, 2017). Obično obitava u gornjim slojevima vodenog stuba.

Ribolovni značaj

Nema privredno-ekonomski značaj, a pojedinačni primerci koji se nađu u ulovima alasa kategorišu se kao „bela riba nižeg kvaliteta". Rekreativno-ribolovni značaj je mali.

Faktori ugrožavanja

Velika pliska nije izložena posebnim faktorima ugrožavanja, pre svega jer ima mali ribolovni značaj. Glavni faktori ugrožavanja vezani su za rečne ekosisteme i prirodna staništa riba, i uključuju izgradnju brana, fragmentaciju staništa, probleme sa alohtonim invazivnim vrstama, kao i posledice u staništima izazvane klimatskim promenama.

Population trends

The population trends of the species are unknown. Although the Balkan shemaya is relatively rare in the catches of professional and recreational fishers, it is not a rare species. There is information that a very large population lives in the Drina River and that it dominated among the species observed during an inspection of the operation of the fish ladder at the dam in Mali Zvornik.

Ecology of the species

The Balkan shemaya is a potamodromous, benthopelagic species that prefers temperate conditions (Bogutskaya *et al.*, 2017). It spawns in spring when it makes local migrations to smaller tributaries. Spawning takes place there in shallow riffles. Lives in shoals.

Habitat

The Balkan shemaya occurs in streams with gravelly-stony bottoms and moderate to rapid current, and in large, slow-flowing lowland rivers with clayey and sandy-silty bottoms (Bogutskaya *et al.*, 2017). It usually lives in the upper layers of the water column.

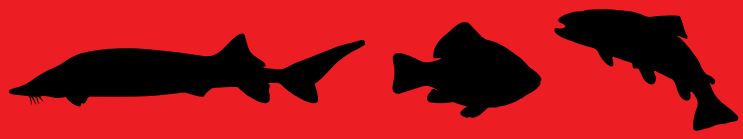
Importance in fisheries

It is of no commercial fishery importance, and the individual specimens found in the catches of professional fishers are classified as "white fish of inferior quality". It is of little importance for recreational fishing.

Threats

The Balkan shemaya is not subject to any particular threats, primarily because it has low fishery importance. The main threats are related to river ecosystems and natural fish habitats and include dam construction, habitat fragmentation, problems with non-native invasive species, and climate change impacts on habitats.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 7.3, 8.1.1, 9.1.3, 9.2.3, 9.3.4, 11.1



Postojeće mere zaštite

Velika pliska se, pod naučnim nazivom *Alburnus chalcoides*, nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu (navedenu kao *Alburnus chalcoides*) propisan je trajni lovostaj.

Predložene mere zaštite

Na nivou rečnih ekosistema i akvatičnih staništa mogu se primeniti mere vezane za upravljanje i zaštitu vodenih resursa, kao što su zaštita pojedinih područja i staništa, kontrola problematičnih alohtonih vrsta, restauracija staništa i prirodnih procesa u njima i slično.

Conservation actions in place

The Balkan shemaya is listed (as *Alburnus chalcoides*) in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent catch is required for this species (listed as *Alburnus chalcoides*).

Conservation actions needed

At the level of river ecosystems and aquatic habitats, measures can be taken in relation to the management and protection of water resources, such as the protection of specific areas and habitats, the control of problematic alien species, the restoration of habitats and natural processes within them, etc.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Velika pliska je slabo proučena vrsta, čime se otvara polje za razvijanje regionalne saradnje kroz naučna istraživanja bioloških karakteristika i genetičke strukture populacija. Posebno bi značajno bilo detaljnije rasvetliti taksonomske (na genetičkom nivou) i ekološke sličnosti i razlike između velike pliske i geografski bliskih vrsta iz roda *Alburnus*.

The Balkan shemaya is an understudied species that opens the field for the development of regional cooperation through scientific research on biological traits and genetic structure of populations. It would be particularly important to study in more detail the taxonomic (at the genetic level) and ecological similarities and differences between the Balkan shemaya and the geographically close species of the genus *Alburnus*.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 3.1, 3.4

AUTOR / AUTHOR: Aleksandar Hegediš

OHRIDSKA PLAŠICA
Alburnus scoranza Heckel & Kner, 1857

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Alburnus scoranza* Heckel & Kner, 1857

Sinonimi

Alburnus scoranza Bonaparte, 1845

Narodno ime: Ohridska plašica
Englesko ime: Ohrid bleak
Francusko ime: Ablette d'Ohrid
Nemačko ime: Ohrid-See Ukelei
Rusko ime: Охридская уклейка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ohridska plašica nema status ugrožene vrste (Freyhof & Kottelat, 2008b). U Srbiji, ohridska plašica ima status ranjive vrste (VU), kako zbog malog obima rasprostranjenja (EOO iznosi 1.199 km²), male površine naseljavanja (AOO iznosi 28 km²) i malog broja lokaliteta na kojima se vrsta javlja – kriterijumi B1ab+2ab. Kvantitativna analiza (kriterijum E), ukazuje da je verovatnoća iščezavanja u prirodi ≥10% u narednih 100 godina.

Rasprostranjenje

Ohridska plašica je endemična vrsta jugoistočnog dela sliva Jadranskog mora u Srbiji, Crnoj Gori, Severnoj Makedoniji, Albaniji i Grčkoj. Živi u slivovima Ohridskog i Skadarskog jezera i reke Drim, kao i u rekama Vojuša, Škumba i Maća (Bogutskaya & Ahnelt, 2019; Cake & Miho, 2005; Economou *et al*., 2007; Šanda *et al*., 2009; Barbieri *et al*., 2015) . U Srbiji živi u slivu Belog Drima (Slika 102).

Opis vrste

Telo ohridske plašice je izduženo i bočno spljošteno (Slika 103). Leđa su tamnosiva, trbuh je srebrnkast, a peraja su bezbojna i providna. Trbušni greben, koji se proteže od osnove trbušnih peraja do analnog otvora, nije pokriven krljuštima (Buj *et al*., 2010). Kod polno zrelih mužjaka na glavi i grudnim perajima javljaju se kvržice u vreme mresta (Bogutskaya & Ahnelt, 2019). Početak podrepnog peraja ispod ili odmah iza osnove poslednje granate žbice leđnog peraja. Peraja: D III + 9; A III + 13–15. Broj krljušti u bočnoj liniji je 46–53, broj kičmenih pršljenova 41–42, a broj branhiospina, koje su tanke, kratke i nenazubljene, iznosi 15–22 (Kottelat & Freyhof, 2007; Buj *et al*., 2010). Ždrelni zubi su dvoredni, DF 2.5–5.2 (Šorić, 2006). Naraste do 18 cm i ima životni vek do 5 godina (Kottelat & Freyhof, 2007; Milošević & Mrdak, 2016).

OHRID BLEAK
Alburnus scoranza Heckel & Kner, 1857

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Alburnus scoranza* Heckel & Kner, 1857

Synonyms

Alburnus scoranza Bonaparte, 1845

Vernacular name: Ohridska plašica
English name: Ohrid bleak
French name: Ablette d'Ohrid
German name: Ohrid-See Ukelei
Russian name: Охридская уклейка

National threat category assessed according to IUCN criteria

At the global level, the Ohrid bleak is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008b). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 1,199 km²), the small area of occupancy (AOO is 28 km²) and the low number of locations where it occurs – criteria B1ab+2ab. The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

The Ohrid bleak is endemic to the southeastern part of the Adriatic Sea basin in Serbia, Montenegro, Northern Macedonia, Albania and Greece. It lives in the basins of Ohrid and Skadar lakes and the Drim River, as well as in the Aoös/Vjosa, Shkumbin and Mat rivers (Bogutskaya & Ahnelt, 2019; Cake & Miho, 2005; Economou *et al*., 2007; Šanda *et al*., 2009; Barbieri *et al*. , 2015). In Serbia, it lives in the White Drim watershed (Figure 102).

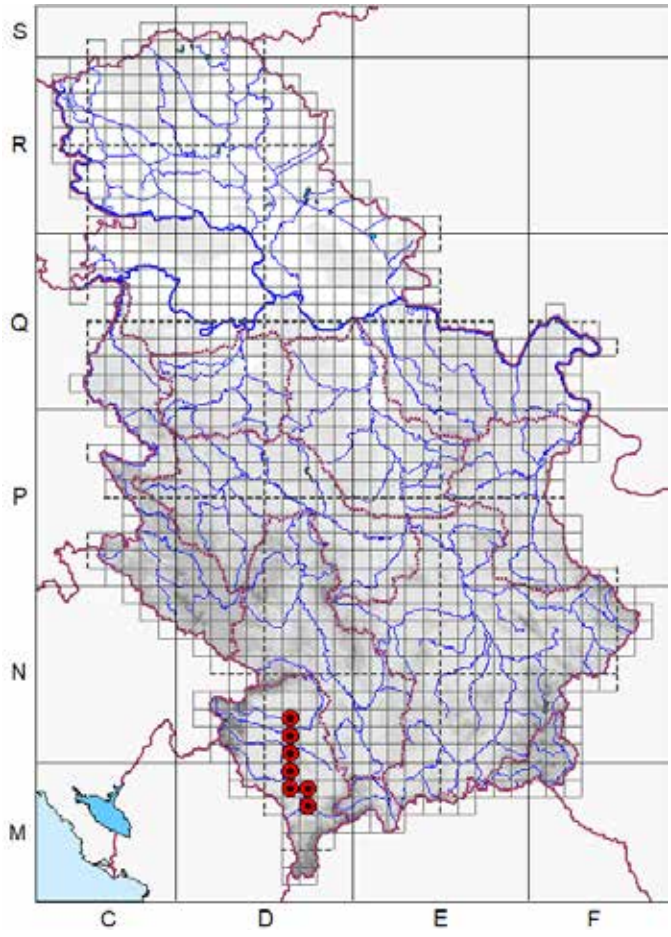
Description of the species

The body of the Ohrid bleak is elongated and laterally flattened (Figure 103). The back is dark grey, the belly is silvery and the fins are colourless and translucent. The ventral keel, which extends from the base of the ventral fins to the anal opening, is scaleless (Buj *et al*., 2010). In sexually mature males, nuptial tubercles appear on the head and pectoral fins during spawning (Bogutskaya & Ahnelt, 2019). The origin of the anal fin is below or just behind the base of the last branched dorsal ray. Fins: D III + 9; A III + 13–15. The number of scales in the lateral line is 46–53, the number of vertebrae is 41–42 and the number of gill rakers, which are thin, short and not denticulated, is 15–22 (Kottelat & Freyhof, 2007; Buj *et al*., 2010). The pharyngeal teeth are in two rows, DF 2.5–5.2 (Šorić, 2006). It grows up to 18 cm and has a life expectancy of up to 5 years (Kottelat & Freyhof, 2007; Milošević & Mrdak, 2016).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Ohridska plašica / Ohrid bleak – *Alburnus scoranza*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Alburnus albidus*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab+2ab; E Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 102. **Rasprostranjenje *Alburnus scoranza* u Srbiji.**

Figure 102. **Distribution of *Alburnus scoranza* in Serbia.**

Slika 103. Ohridska plašica *Alburnus scoranza* (foto: L. Piálek).

Figure 103. Ohrid bleak *Alburnus scoranza* (photo: L. Piálek).

Populacione karakteristike

Populacioni trend ohridske plašice nije poznat, iako su populacije brojne.

Ekologija vrste

Ohridska plašica dostiže polnu zrelost sa godinu dana. Mresti se od marta do jula. Najintenzivniji mrest odvija se u maju, pri temperaturi od 18 °C do 23 °C. Mrest se odvija u litoralu jezera ili migrira u reke, gde se mresti u plitkim brzacima (Freyhof & Kottelat, 2008b). Ikru polaže na podlogu od peska, šljunka ili kamena, na dubini od 0,3 m, a period inkubacije traje 4 dana (Kottelat & Freyhof, 2007). Hrani se uglavnom zooplanktonskim račićima. Živi u velikim jatima.

Stanište

Ohridska plašica je bentopelagična vrsta. Živi u jezerima i jezerskim pritokama (Kottelat & Freyhof, 2007).

Ribolovni značaj

U Srbiji, ova vrsta nema nikakav privredni značaj. U Ohridskom jezeru lovi se intenzivno i ulov ohridske plašice predstavlja oko 30% ukupnog ulova svih vrsta, a u Skadarskom jezeru predstavlja najznačajniju ribolovnu vrstu (Točko, 1975; Burzanović & Marić, 2010; Milošević & Talevski, 2015).

Faktori ugrožavanja

Nema posebnih ugrožavajućih faktora i pored toga što je područje rasprostranjenja ohridske plašice malo (Freyhof & Kottelat, 2008b). Smatra se da je pad ulova u Skadarskom jezeru, koji se beleži u novije vreme, rezultat prelova (Burzanović & Marić, 2010). Ugrožavajući faktori odnose se na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla, pregrađivanjem i regulacijom tokova, kao i unošenjem alohtonih invazivnih vrsta.

Population trends

The population trends of the Ohrid bleak are not known, although populations are abundant.

Ecology of the species

The Ohrid bleak reaches sexual maturity at the age of one year. It spawns from March to July. The most intense spawning season is in May, at a temperature of 18–23 °C. It spawns in the littoral zone of lakes or migrates into tributaries to spawn in shallow riffles (Freyhof & Kottelat, 2008b). It deposits eggs on sand, gravel or stony bottom at a depth of 0.3 m, and the incubation period lasts 4 days (Kottelat & Freyhof, 2007). Feeds mainly on zooplankton crustaceans. Forms large schools.

Habitat

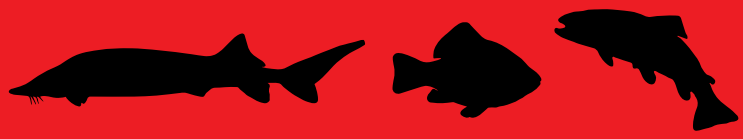
The Ohrid bleak is a benthopelagic species. It lives in lakes and lake tributaries (Kottelat & Freyhof, 2007).

Importance in fisheries

In Serbia, this species is of no commercial fishery importance. It is intensively fished in Lake Ohrid and the catch of the Ohrid bleak accounts for about 30% of the total catch of all species and in Lake Skadar it is the most important fishing species (Točko, 1975; Burzanović & Marić, 2010; Milošević & Talevski, 2015).

Threats

There are no particular threat factors, although the distribution range of the Ohrid bleak is small (Freyhof & Kottelat, 2008b). It is assumed that the recent decline in catches in Lake Skadar is due to overfishing (Burzanović & Marić, 2010). Threatening factors relate to threats to the habitat from pollution with sewage from various sources, impoundment and regulation of outflows, and introduction of non-native invasive species.



Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 7.3, 8.1.1, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Ohridska plašica nije obuhvaćena postojećim merama zaštite.

Predložene mere zaštite

Ne postoje specifične mere zaštite vrste koje se predlažu. Trebalo bi poboljšati opšte mere koje se tiču sprečavanja degradacije staništa, zagađenja vode i pregrađivanja vodotoka.

Conservation actions in place

The Ohrid bleak is not covered by the existing conservation measures.

Conservation actions needed

No specific species protection measures are proposed. General measures to prevent habitat degradation, water pollution, and damming of watercourses should be strengthened.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1

S obzirom da su populacioni trendovi ove vrste nepoznati, neophodna su istraživanja veličine, distribucije i trendova populacija, kao i faktora ugrožavanja.

As the population trends of this species are not known, the population size, distribution and trends, as well as threats need to be studied.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

OHRIDSKA BRKICA
Barbatula sturanyi (Steindachner, 1892)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Nemacheilidae
Vrsta: *Barbatula sturanyi* (Steindachner, 1892)

Sinonimi

Nemacheilus sturanyi Steindachner, 1892

Narodno ime: Ohridska brkica
Englesko ime: Ohrid stone loach
Rusko ime: Охридский усатый голец

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ohridska brkica nema status ugrožene vrste (Freyhof & Kottelat, 2008e). U Srbiji, ohridska plašica ima status ranjive vrste (VU) zbog malog obima rasprostranjenja (EOO iznosi 499 km²), male površine naseljavanja (AOO iznosi 20 km²) i malog broja lokaliteta na kojima se vrsta javlja – kriterijumi B1ab+2ab. Kvantitativna analiza (kriterijum E), ukazuje da je verovatnoća iščezavanja u prirodi ≥10% u narednih 100 godina.

Rasprostranjenje

Ohridska brkica naseljava basen Ohridskog jezera, Crni i Beli Drim i pritoke (Šanda *et al*., 2008; Grapci-Kotori *et al.*, 2020). U Srbiji živi u slivu Belog Drima (Slika 104).

Opis vrste

Telo ohridske brkice je vretenasto i izduženo. Glava je široka i dorzoventralno spljoštena, a oči su dorzalno postavljene (Slika 105). Usta su donja, okružena sa šest brkova, četiri sa gornje strane i dva u uglovima usta. Telo je sive do sivo-smeđe boje, prošarano tamnosmeđim nepravilnim mrljama. Stomak je svetložut do beo. Bokovi odraslih jedinki prekriveni su kvržicama u vreme mresta (Služben vesnik na RM, 2011). Početak osnove leđnog peraja nalazi se nešto ispred početka osnove trbušnih peraja. Zadnja ivica repnog peraja je ravna. Naraste do 10 cm standardne dužine tela (SL) (Kottelat & Freyhof, 2007). Životni vek ove vrste je do 8 godina (Služben vesnik na RM, 2011).

Populacione karakteristike

Populacioni trend ohridske brkice nije poznat.

Ekologija vrste

Ohridska brkica dostiže polnu zrelost u drugoj ili trećoj godini života. Mresti se u proleće, od aprila do maja, ređe u martu. Ikru polaže na pesak ili kamen. Mrest je porcioni. Plodnost ženke iznosi

OHRID STONE LOACH
Barbatula sturanyi (Steindachner, 1892)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Nemacheilidae
Species: *Barbatula sturanyi* (Steindachner, 1892)

Synonyms

Nemacheilus sturanyi Steindachner, 1892

Vernacular name: Ohridska brkica
English name: Ohrid stone loach
Russian name: Охридский усатый голец

National threat category assessed according to IUCN criteria

At the global level, the Ohrid stone loach is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008e). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 499 km²), the small area of occupancy (AOO is 20 km²) and the low number of locations where it occurs – criteria B1ab+2ab. The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

The Ohrid stone loach inhabits the basin of Lake Ohrid as well as the Black and White Drim and their tributaries (Šanda *et al*., 2008; Grapci-Kotori *et al*., 2020). In Serbia, it lives in the White Drim watershed (Figure 104).

Description of the species

The body of the Ohrid stone loach is spindle-shaped and elongated. The head is broad and dorsoventrally flattened, and the eyes are positioned dorsally (Figure 105). The mouth is inferior, surrounded by six barbels, four on the upper side and two in the corners of the mouth. The body is grey to grey-brown and covered with dark brown irregular spots. The belly is pale yellow to white. The flanks of the adults are covered with tubercles during the spawning season (Official Gazette of RM, 2011). The origin of the dorsal fin is slightly in front of the origin of the ventral fins. The caudal fin is truncated. It grows up to 10 cm standard body length (SL) (Kottelat & Freyhof, 2007). The life expectancy of this species is up to 8 years (Official Gazette of RM, 2011).

Population trends

The population trends of the Ohrid stone loach are unknown.

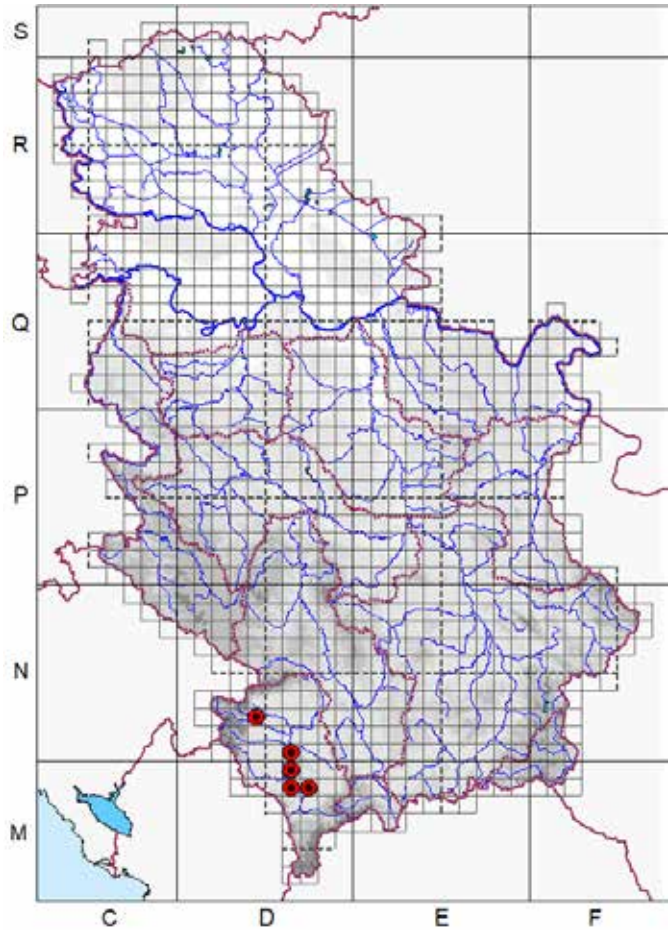
Ecology of the species

The Ohrid stone loach reaches sexual maturity in its second or third year. It spawns in spring, from April to May, less frequently in

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Ohridska brkica / Ohrid stone loach – *Barbatula sturanyi*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Barbatula barbatula sturanyi*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab+2ab; E Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 104. **Rasprostranjenje *Barbatula sturanyi* u Srbiji.**

Figure 104. **Distribution of *Barbatula sturanyi* in Serbia.**

Slika 105. Ohridska brkica *Barbatula sturanyi* (foto: S. Zogaris).

Figure 105. Ohrid stone loach *Barbatula sturanyi* (photo: S. Zogaris).

oko 6.000 jaja, dijametra oko 1-1,5 mm. Hrani se sitnim beskičmenjacima bentosa, a adulti osim toga konzumiraju i ikru drugih riba. Juvenilne jedinke formiraju mala jata, dok odrasli žive solitarno (Služben vesnik na RM, 2011).

Stanište

Ohridska brkica je pridnena vrsta. Naseljava litoralnu zonu jezera, kao i rečice i potoke sa kamenitim i šljunkovitim dnom (Kottelat & Freyhof, 2007; Šanda *et al*., 2008). Preferira čistu i bistru vodu.

Ribolovni značaj

Ohridska brkica nema nikakav značaj ni u rekreativnom ni u komercijalnom ribolovu.

Faktori ugrožavanja

Nisu poznati posebni ugrožavajući faktori i pored toga što je područje rasprostranjenja ohridske brkice malo (Freyhof & Kottelat, 2008e). Ugrožavajući faktori se odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla, pregrađivanjem i regulacijom tokova, kao i unošenjem alohtonih invazivnih vrsta.

March. It lays its eggs on sand or stone. Spawning takes place in portions. The fecundity of the female is about 6,000 eggs with a diameter of about 1–1.5 mm. It feeds on small benthic invertebrates, and adults also eat eggs of other fish. The juveniles form small schools, while the adults are solitary (Official Gazette of RM, 2011).

Habitat

The Ohrid stone loach is a demersal species. It inhabits the littoral zone of lakes as well as rivers and streams with rocky and gravelly bottoms (Kottelat & Freyhof, 2007; Šanda *et al*., 2008). It prefers clean and clear water.

Importance in fisheries

The Ohrid stone loach is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

No specific threats are known, although its range is small (Freyhof & Kottelat, 2008e). The threats include habitats pollution by effluents from various sources, damming and regulation of watercourses, and the introduction of non-native invasive species.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 7.3, 8.1.1, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Ohridska brkica nije obuhvaćena postojećim merama zaštite.

Predložene mere zaštite

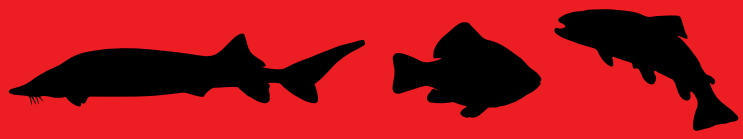
Ne postoje specifične mere zaštite vrste koje se predlažu. Trebalo bi poboljšati opšte mere koje se tiču sprečavanja degradacije staništa, zagađenja vode i pregrađivanja vodotoka.

Conservation actions in place

The Ohrid stone loach does not fall under the existing conservation measures.

Conservation actions needed

No specific species protection measures are proposed. General measures to prevent habitat degradation, water pollution and river damming should be strengthened.



Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1

S obzirom da o ovoj vrsti nema dovoljno podataka, neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije, kao i faktora ugrožavanja.

As there is insufficient data on this species, population size, distribution and trends, life history and ecology, and threat factors need to be studied.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

OHRIDSKA (CRNA) MRENA
Barbus rebeli Koller, 1926

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cyprinidae
Vrsta: *Barbus rebeli* Koller, 1926

Sinonimi

Barbus meridionalis rebeli Koller, 1926

Narodno ime: Ohridska mrena, crna mrena
Englesko ime: Western Balkan barbel
Francusko ime: Barbillon des Balkans occidentaux
Nemačko ime: Westbalkan-Barbe
Rusko ime: Усач балканский

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ohridska mrena nema status ugrožene vrste (Freyhof, 2011a). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodi ≥10% u narednih 100 godina, ohridska mrena ima status ranjive vrste (VU). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 1.889 km², dok je površina nasljavanja (AOO) 48 km².

Rasprostranjenje

Ohridska mrena je endemična vrsta jugoistočnog dela sliva Jadranskog mora i smatra se da živi u Srbiji, Crnoj Gori, Severnoj Makedoniji, Albaniji i Grčkoj (Kottelat & Freyhof, 2007), s tim što, prema novijim podacima, u Grčkoj možda ipak žive druge vrste ovog roda (Marková *et al*., 2010; Barbieri *et al*., 2015). Naseljava slivove Ohridskog i Skadarskog jezera i reke Drim, kao i reku Vojušu (Economou *et al*., 2007; Marić *et al*., 2012). U Srbiji živi u slivu Belog Drima (Slika 106). Taksonomski status vrste nije još dovoljno istražen, tako da molekularne analize ukazuju na mogućnost postojanja kriptičnih vrsta (Tsigenopoulos & Berrebi, 2000; Marková *et al*., 2010).

Opis vrste

Na telu, glavi i perajima ohridske mrene nalaze se mnogobrojne sitne crne tačke, koje su nešto krupnije i tamnije na leđima (Slika 107). Usta su poludonja, mesnata, a gornja usna je isturena. Ima dva para brkova. Poslednja negranata žbica leđnog peraja je mekana i nenazubljena sa zadnje strane. Zadnja ivica leđnog peraja je prava do blago konkavna. Od ostalih vrsta roda *Barbus* i *Luciobarbus* koje žive na Balkanskom poluostvru razlikuje se po broju krljušti u bočnoj liniji kojih ima 47–55, kao i po broju krljušti iznad bočne linije do osnove leđnog peraja kojih ima 10–12 i broju krljušti ispod bočne linije do osnove trbušnih peraja kojih ima 7–9 (Kottelat & Freyhof,

WESTERN BALKAN BARBEL
Barbus rebeli Koller, 1926

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cyprinidae
Species: *Barbus rebeli* Koller, 1926

Synonyms

Barbus meridionalis rebeli Koller, 1926

Vernacular name: Ohridska mrena, crna mrena
English name: Western Balkan barbel
French name: Barbillon des Balkans occidentaux
German name: Westbalkan-Barbe
Russian name: Усач балканский

National threat category assessed according to IUCN criteria

At the global level, the Western Balkan barbel is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011a). In Serbia, the species is classified as Vulnerable (VU) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence of the species (EOO) in Serbia is 1,889 km², while the area of occupancy (AOO) is 48 km².

Distribution

The Western Balkan barbel is endemic to the southeastern part of the Adriatic Sea basin and is found in Serbia, Montenegro, Northern Macedonia, Albania and Greece (Kottelat & Freyhof, 2007), although recent data suggest that other species of this genus may live in Greece (Marková *et al*., 2010; Barbieri *et al*., 2015). It inhabits the basins of Lake Ohrid and Lake Skadar, as well as the Drim and Aoös/Vjosa rivers (Economou *et al*., 2007; Marić *et al*., 2012). In Serbia, it lives in the White Drim watershed (Figure 106). The taxonomic status of the species has not been sufficiently studied, so molecular analyses suggest the possibility of the existence of cryptic species (Tsigenopoulos & Berrebi, 2000; Marková *et al*., 2010).

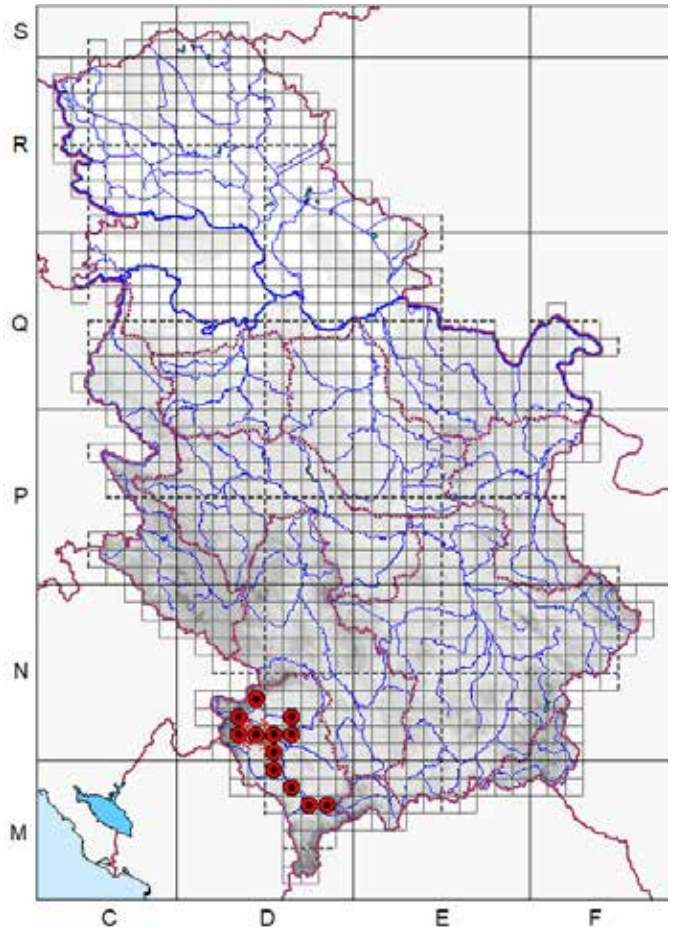
Description of the species

There are numerous small black spots on the body, head and fins of the Western Balkan barbel, which are slightly larger and darker on the back (Figure 107). The mouth is subterminal, fleshy, and the upper lip is protruding. It has two pairs of barbels. The last simple dorsal ray is weak and not serrated posteriorly. The posterior margin of the dorsal fin is straight to slightly concave. It differs from other species of the genus *Barbus* and *Luciobarbus* living in the Balkan Peninsula by the number of scales in the lateral line, which is 47–55, and by the number of scale rows between the lateral line and the dorsal fin

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Ohridska (crna) mrena / Western Balkan barbel – *Barbus rebeli*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Barbus* spp.)	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Barbus peloponnesius rebeli*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 106. **Rasprostranjenje *Barbus rebeli* u Srbiji.**

Figure 106. **Distribution of *Barbus rebeli* in Serbia.**

Slika 107. Ohridska (crna) mrena *Barbus rebeli* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_2.jpg).

Figure 107. Western Balkan barbel *Barbus rebeli* (photo: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_140904_2.jpg).

2007). Branhiospina na prvom škržnom luku ima 6–11, obično 8 (Marić *et al*., 2012). Maksimalna zabeležena standarna dužina tela (SL) iznosi 25 cm (Kottelat & Freyhof, 2007).

Populacione karakteristike

Populacioni trend ohridske mrene nije poznat, iako su populacije brojne (Freyhof, 2011a; Ibrahimi *et al*., 2019).

Ekologija vrste

Period mresta ohridske mrene traje od maja do avgusta, kada temperatura vode dostigne 19–25 °C (Služben vesnik na RM, 2011). Na mrestilištu se formiraju grupe od 2–3 ili više jedinki, od kojih su jedna ili dve ženke, koje su krupnije od mužjaka. Ženke polažu jaja u litoralnoj zoni na dubini od 1 m do 4 m, na peskovitoj ili šljunkovitoj podlozi. Ikra sadrži ihtiotoksin koji je štiti od predatora. Hrani se beskičmenjacima dna.

Stanište

Ohridska mrena je bentopelagična vrsta. Živi u jezerima, rekama i potocima. U rekama i potocima preferira delove toka sa čistom vodom i brzacima (Kottelat & Freyhof, 2007).

Ribolovni značaj

U nekim područjima ohridska mrena ima značaja u privrednom i rekreativnom ribolovu (Freyhof, 2011a; Ibrahimi *et al*., 2019).

Faktori ugrožavanja

I pored lokalne brojnosti, populacije ohridske mrene veoma su fragmentisane (Ibrahimi *et al*., 2019). Posebno su ugrožene populacije koje žive u potocima koji tokom leta presušuju (Kottelat & Freyhof, 2007). Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama razli-

origin, which is 10–12, and the number of scale rows between the lateral line and the ventral fin origin, which is 7–9 (Kottelat & Freyhof, 2007). There are 6–11 gill rakers on the first gill arch, usually 8 (Marić *et al*., 2012). The maximum recorded standard body length (SL) is 25 cm (Kottelat & Freyhof, 2007).

Population trends

The population trends of the Western Balkan barbel are unknown, although populations are abundant (Freyhof, 2011a; Ibrahimi *et al*., 2019).

Ecology of the species

The spawning season of the Western Balkan barbel lasts from May to August, when the water temperature reaches 19–25 °C (Official Gazette of RM, 2011). At the spawning site, groups of 2 to 3 or more individuals are formed, of which one or two are females that are larger than the males. Females lay their eggs in the littoral zone at a depth of 1 to 4 m on sandy or gravelly substrate. The roe contains ichthyotoxin, which protects it from predators. It feeds on benthic invertebrates.

Habitat

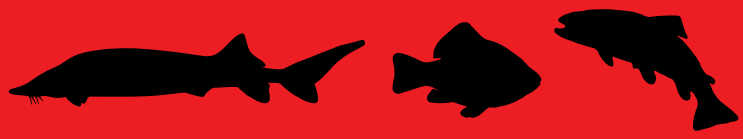
The Western Balkan barbel is a benthopelagic species. It inhabits lakes, rivers and streams. In rivers and streams it prefers parts with clear water and riffles (Kottelat & Freyhof, 2007).

Importance in fisheries

In some areas, the Western Balkan barbel is important for commercial and recreational fishing (Freyhof, 2011a; Ibrahimi *et al*., 2019).

Threats

Despite their local abundance, Western Balkan barbel populations are highly fragmented (Ibrahimi *et al*., 2019). Populations living in streams that dry up in summer are particularly at risk (Kottelat &



čitog porekla, pregrađivanjem i regulacijom tokova, kao i unošenjem alohtonih invazivnih vrsta.

Freyhof, 2007). Threats are mainly related to habitat pollution by effluents from various sources, damming and regulation of watercourses, and the introduction of non-native invasive species.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	5.4.1, 7.2.11, 7.3, 9.1.3, 9.2.3, 9.3.4, 9.4, 11.2

Postojeće mere zaštite

Ohridska mrena nije obuhvaćena postojećim merama zaštite.

Predložene mere zaštite

Trebalo bi poboljšati opšte mere koje se tiču sprečavanja degradacije staništa, zagađenja vode i pregrađivanja vodotoka. S obzirom da se prelov izdvaja kao značajan ugrožavajući faktor, potrebno je sprovoditi detaljnije vođenje statistike ulova.

Conservation actions in place

The Western Balkan barbel is not covered by the existing conservation measures.

Conservation actions needed

General measures to prevent habitat destruction, water pollution and damming of watercourses should be improved. As overfishing is a significant threat factor, catch statistics need to be kept more accurately.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1

Zbog nedostatka podataka, neophodna su istraživanja taksonomije, kao i veličine i distribucije populacija, populacionih trendova, životne istorije, ekologije i faktora ugrožavanja.

Due to the lack of data, research is needed on taxonomy as well as population size and distribution, population trends, life history, ecology and threat factors.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.4, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

ZLATNI KARAŠ
Carassius carassius (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cyprinidae
Vrsta: *Carassius carassius* (Linnaeus, 1758)

Sinonimi

Carassius moles Normann, 1840; *Cyprinus carassius* Linnaeus, 1758; *Carassius carassius carassius* (Linnaeus, 1758); *Cyprinus moles* Agassiz, 1835; *Carassius humilis* Heckel, 1837; *Cyprinus charax* Lesniewski, 1837; *Carassius charax* (Lesniewski, 1837); *Carassius vulgaris* Nordmann, 1840; *Cyprinus moles* Valenciennes, 1842; *Carassius linnaei* Bonaparte, 1845; *Cyprinus gibelio minutus* Kessler, 1856; *Carassius gibelio minutus* (Kessler, 1856); *Carassius oblongus* Heckel & Kner, 1858; *Carassius linnei* Malm, 1877; *Carassius linnei lacustrus* Malm, 1877; *Carassius linnei piscinarum* Malm, 1877

Narodno ime: Zlatni karaš, barski karaš
Englesko ime: Crucian carp
Francusko ime: Carasin commun
Nemačko ime: Karausche
Rusko ime: Золотой карась

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, zlatni karaš ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008g). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina, zlatni karaš ima status ranjive vrste (VU). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 64.934 km², dok je površina naseljavanja (AOO) 264 km².

Rasprostranjenje

Zlatni karaš živi u slivovima Severnog, Baltičkog, Belog, Barencovog, Crnog i Kaspijskog mora. U egejskom slivu naseljava samo reku Maricu. Na istoku se prostire do reke Kolime u Sibiru, a na zapadu do Rajne i slivova istočne obale Engleske. Nema ga u basenu Severnog mora u Švedskoj i Norveškoj u basenu Baltičkog mora severno od 66° N. Introdukovan je u vode Italije, Engleske i Francuske. U Srbiji naseljava veće nizijske reke crnomorskog basena, kao što su Dunav, Tisa i Sava, ali ga ima i u slivu Velike Morave i Drine (Slika 108). Široko je rasprostranjena vrsta u Vojvodini, gde naseljava praktično sve tekuće i stajaće vode, kao i kanalsku mrežu sistema DTD.

CRUCIAN CARP
Carassius carassius (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cyprinidae
Species: *Carassius carassius* (Linnaeus, 1758)

Synonyms

Carassius moles Normann, 1840; *Cyprinus carassius* Linnaeus, 1758; *Carassius carassius carassius* (Linnaeus, 1758); *Cyprinus moles* Agassiz, 1835; *Carassius humilis* Heckel, 1837; *Cyprinus charax* Lesniewski, 1837; *Carassius charax* (Lesniewski, 1837); *Carassius vulgaris* Nordmann, 1840; *Cyprinus moles* Valenciennes, 1842; *Carassius linnaei* Bonaparte, 1845; *Cyprinus gibelio minutus* Kessler, 1856; *Carassius gibelio minutus* (Kessler, 1856); *Carassius oblongus* Heckel & Kner, 1858; *Carassius linnei* Malm, 1877; *Carassius linnei lacustrus* Malm, 1877; *Carassius linnei piscinarum* Malm, 1877

Vernacular name: Zlatni karaš, barski karaš
English name: Crucian carp
French name: Carasin commun
German name: Karausche
Russian name: Золотой карась

National threat category assessed according to IUCN criteria

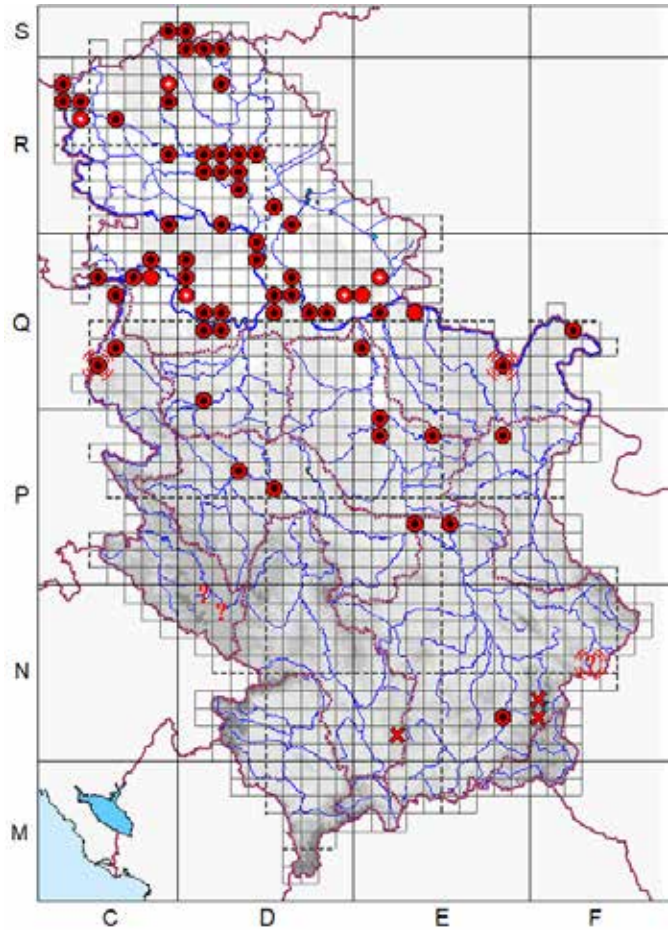
At the global level, the crucian carp is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008g). In Serbia, the species is classified as Vulnerable (VU) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence of the species (EOO) in Serbia is 64,934 km², while the area of occupancy (AOO) is 264 km².

Distribution

The crucian carp lives in the basins of the North, Baltic, White, Barents, Black and Caspian Seas. In the Aegean Sea basin, it inhabits only the Maritsa River. Eastwards, its range extends to the Kolyma drainage in Siberia and westwards to the Rhine and eastern drainages of England. It is absent from the North Sea basin in Sweden and Norway and from the Baltic Sea basin north of 66° N. It has been introduced into the waters of Italy, England and France. In Serbia, it inhabits the large lowland rivers of the Black Sea basin, such as the Danube, Tisza and Sava, but also occurs in the Great Morava and Drina basins (Figure 108). The species is widespread in Vojvodina, where it inhabits practically all running and standing waters, as well as the canal network of the system DTD.

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Zlatni karaš / Crucian carp – *Carassius carassius*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**VU**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Strogo zaštićena vrsta / Strictly protected species**



Slika 108. **Rasprostranjenje *Carassius carassius* u Srbiji.**

Figure 108. **Distribution of *Carassius carassius* in Serbia.**

Slika 109. Zlatni karaš *Carassius carassius* (foto: R. Stefanek, https://www.dreamstime.com/crucian-carp-carassius-carassius-beautiful-clean-pound-freshwater-fish-crucian-carp-carassius-carassius-beautiful-image107330302).

Figure 109. Crucian carp *Carassius carassius* (photo: R. Stefanek, https://www.dreamstime.com/crucian-carp-carassius-carassius-beautiful-clean-pound-freshwater-fish-crucian-carp-carassius-carassius-beautiful-image107330302).

Opis vrste

Telo zlatnog karaša je visoko i bočno spljošteno (Slika 109). Usta su terminalno postavljena. Boja tela je zlatno-zelenkasta. Juvenilne jedinke u bazi repne drške imaju crnu fleku koja može da se zadrži i kod adultnih jedinki. Leđno peraje ima konveksnu ivicu. Peraja: D III–IV + 13–22; A II-III + 5–8; P I + 12–15; V II + 7–8. Broj krljušti u bočnoj liniji je 31–36, broj kičmenih pršljenova 32, a broj branhiospina 23–33 (Spillman, 1961). Ždrelni zubi su jednoredni, DF 5–5. Obično naraste do 15 cm, a najveća zabeležena dužina iznosi 64 cm (Koli, 1990). Može dostići težinu i do 5 kg. Životni vek ove vrste je do 10 godina (Kottelat & Freyhof, 2007).

Populacione karakteristike

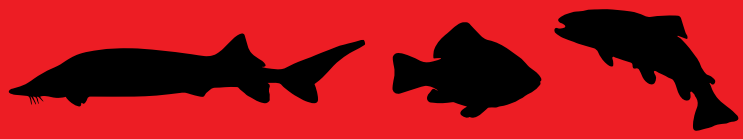
Zlatni karaš je u prošlosti bio veoma česta vrsta u našim nizijskim sporotekućim rekama, plavnim zonama, barama i močvarama. Gubitkom staništa i introdukcijom srebrnog karaša (babuške) sredinom XX veka, populacije zlatnog karaša značajno se smanjuju u narednim decenijama (Freyhof & Kottelat, 2008g). Postoji veoma mali broj lokaliteta u Srbiji na kojima je zlatni karaš zabeležen u poslednjih 20 godina.

Description of the species

The body of the crucian carp is high and laterally flattened (Figure 109). The mouth is terminal. The colour of the body is golden-greenish. Juveniles have a black spot at the base of the caudal peduncle, which may remain in adults. The dorsal fin has a convex margin. Fins: D III–IV + 13–22; A II–III + 5–8; P I + 12–15; V II + 7–8. The number of scales in the lateral line is 31–36, the number of vertebrae 32 and the number of gill rakers is 23–33 (Spillman, 1961). The pharyngeal teeth are in a single row, DF 5–5. It usually grows up to 15 cm long, and the greatest recorded length is 64 cm (Coli, 1990). It can reach a weight of up to 5 kg. The life expectancy of this species is up to 10 years (Kottelat & Freyhof, 2007).

Population trends

In the past, the crucian carp was a very common species in our slow-flowing lowland rivers, floodplains, ponds and marshes. Due to habitat loss and the introduction of the Prussian carp in the middle of the 20th century, populations of crucian carp declined considerably in the following decades (Freyhof & Kottelat, 2008). In Serbia, there are only a very small number of sites where crucian carp have been recorded in the last 20 years.



Ekologija vrste

Polnu zrelost stiče sa 3–4 godine starosti. Mresti se od maja do jula kada temperatura vode pređe 18 °C. Često se jedna ženka mresti sa nekoliko mužjaka, a može da se mresti 3–5 puta godišnje ukoliko su uslovi odgovarajući (Kottelat & Freyhof, 2007). Zabeležene su dve morfe ove vrste – kada se nalazi na staništima na kojima odsustvuje predator, često formira velike populacije sitnijih jedinki, sa manjom visinom tela, a ukoliko je predator prisutan, razvijaju se krupnije jedinke sa znatno višim leđima (Poléo *et al*., 1995; Vøollestad *et al*., 2004). Omnivorna je vrsta. Hrani se planktonom, faunom dna, biljkama i detritusom. U ishrani mladih jedinki dominiraju planktonski račići (uglavnom Cladocera), dok već pri dužini od 3 cm počinje ishranu bentosnim organizmima (Penttinen & Holopainen, 1992). Smatra se da je slab kompetitor, jer uglavnom odsustvuje iz voda sa bogatom ihtiofaunom i više predatorskih vrsta (Kottelat & Freyhof, 2007).

Stanište

Naseljava uglavnom sporotekuće reke i stajaće vode sa gustom vodenom vegetacijom. Zlatni karaš je izrazito limnofilna vrsta i preferira zabarena i močvarna staništa. U staništima sa većim brojem predatora obično se zadržava u blizini priobalne vegetacije, dok se na staništima sa manje predatora može naći i u otvorenijim vodama. Tolerantan je na visoke letnje temperature i niske koncentracije rastvorenog kiseonika. Mresti se u gustoj podvodnoj vegetaciji (Kottelat & Freyhof, 2007).

Ribolovni značaj

U prošlosti, zlatni karaš je predstavljao značajan ulov rekreativnih ribolovaca, ali sa introdukcijom alohtonih vrsta i smanjenjem brojnosti populacija, ova vrsta postala je redak sporedni ulov. S obzirom na status zaštite, zabranjen je rekreativni i privredni ribolov zlatnog karaša.

Faktori ugrožavanja

Areal ove vrste u Srbiji poslednjih decenija konstantno se smanjuje, a glavni uzrok jeste širenje alohtonih vrsta riba i gubitak staništa. Veliki broj staništa zlatnog karaša izgubljen je isušivanjem plavnih područja za potrebe poljoprivrede i gubljenjem plavnih zona izgradnjom odbrambenih nasipa. Izgradnja kanalske mreže DTD nesumnjivo je dovela do pada brojnosti populacija, jer ovaj sistem ne predstavlja adekvatno stanište za zlatnog karaša. Od alohtonih vrsta posebno se izdvaja srebrni karaš (babuška) sa kojim je zlatni karaš u kompeticiji za hranu i stanište. Pored toga, ove dve vrste hibridizuju, pa se tako gubi autohtoni genofond (Wheeler, 2000; Hänfling *et al*., 2005). Povećano zagađenje usled poljoprivrednih aktivnosti, čiji se produkti slivaju u otvorene vode, dovode do nekontrolisanog cvetanja algi i povećanog opterećenja vodenih ekosistema koje ova vrsta naseljava.

Ecology of the species

It reaches sexual maturity at the age of 3–4 years. It spawns from May to July when the water temperature is above 18 °C. Often a female spawns with several males and can spawn 3-5 times a year under favourable conditions (Kottelat & Freyhof, 2007). Two morphs of this species have been noted – when it occurs in habitats where predators are absent, it often forms large populations of smaller individuals with a lower body depth, and when the predator is present, larger individuals with significantly higher backs develop (Poléo *et al*., 1995; Vøollestad *et al*., 2004). The species is an omnivore. It feeds on plankton, bottom fauna, plants and detritus. Juveniles feed mainly on planktonic crustaceans (mainly Cladocera), while from a length of 3 cm they begin to feed on benthic (Penttinen & Holopainen, 1992). It is considered a weak competitor, as it is usually absent from waters with a rich fish fauna and abundant predatory species (Kottelat & Freyhof, 2007).

Habitat

It mainly inhabits slow-flowing rivers and standing waters with dense aquatic vegetation. The crucian carp is an extremely limnophilic species and prefers backwater and marshy habitats. In waters with more predatory species, it tends to stay near coastal vegetation, while in waters with fewer predators it is found in more open waters. It is tolerant of high summer temperatures and low dissolved oxygen concentrations. It spawns in dense submerged vegetation (Kottelat & Freyhof, 2007).

Importance in fisheries

In the past, the crucian carp was important part of the catch of recreational fishers, but with the introduction of non-native species and the decline of its populations, this species has become a rare catch. Due to its protected status, the crucian carp is prohibited for recreational and commercial fishing.

Threats

The range of this species in Serbia has been steadily declining in recent decades, and the main reason for this is the spread of non-native fish species and habitat loss. Due to the draining of floodplains for agricultural purposes and the loss of floodplains through the construction of protective levees, numerous habitats of the crucian carp have been lost. The construction of the canal network DTD has undoubtedly led to a decline in populations, as this system does not provide a suitable habitat for the golden crucian carp. Among the non-native species, the Prussian carp stands out, with which the crucian carp competes for food and habitat. Furthermore, these two species hybridise, resulting in a loss of the native gene pool (Wheeler, 2000; Haenfling *et al*., 2005). Increased pollution from agricultural activities, whose runoff flows into open waters, leads to uncontrolled algal blooms and increased stress on the aquatic ecosystems in which this species lives.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.2, 7.2.3, 8.1.1, 8.1.2, 8.3, 9.3, 9.3.1, 9.3.3

Postojeće mere zaštite

Zlatni karaš se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru N*aredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Neophodno je zaštititi i očuvati u neizmenjenom stanju staništa na kojima su prisutne populacije zlatnog karaša, odnosno vratiti ih u prvobitno stanje. Potrebno je smanjiti brojnost populacija srebrnog karaša (babuške) ukoliko se nalaze na istim staništima. Veštački mrest i reintrodukcija na staništa sa kojih je zlatni karaš nestao, odnosno pojačavanje prirodnih populacija poribljavanjem, značajno bi doprineli oporavku ove vrste u Srbiji. Rekreativni ribolovci imaju problema sa razlikovanjem zlatnog i srebrnog karaša, posebno u zabarenim staništima na kojima i srebrni karaš može da poprimi obojenost sličnu zlatnom karašu, zbog čega je potrebno vršiti edukaciju ribolovaca kako ne bi greškom lovili zlatnog karaša.

Conservation actions in place

The crucian carp is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to protect the habitats where crucian carp populations occur and to maintain them in an unaltered state, i.e. to return them to their original state. Prussian carp populations must be reduced if they occur in the same habitats. Artificial spawning and reintroduction in habitats from which the crucian carp has disappeared, namely strengthening natural populations through stocking, would contribute significantly to the recovery of this species in Serbia. Recreational anglers have problems distinguishing crucian carp from Prussian carp, especially in limited habitats where Prussian carp can also take on a similar colouration to crucian carp; therefore, it is necessary to educate anglers so that they do not accidentally catch crucian carp.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.2, 2.3, 3.3.1, 3.4.1, 4.2

Potrebno je utvrditi distribuciju ove vrste u Srbiji, odrediti brojnost i veličinu populacija i uspostaviti monitoring sistem kojim bi se dugotrajno pratila brojnost populacija. Pored toga, potrebno je utvrditi potencijalne ugrožavajuće faktore koji ranije nisu detektovani, kao i formirati akcioni plan oporavka ove vrste.

It is necessary to determine the distribution of this species in Serbia, to determine the number and size of the populations and to establish a monitoring system to observe the number of populations over a long period of time. In addition, it is necessary to identify potential threat factors that have not yet been detected and to establish an action plan for the recovery of this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.5, 2.1, 3.1, 3.4

AUTOR / AUTHOR: Branko Miljanović

OHRIDSKI SKOBALJ
Chondrostoma ohridanum Karaman, 1924

Taksonomski status*

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Chondrostoma ohridanum* Karaman, 1924

*Taksonomski status ohridskog skobalja nije jasan. Značajan broj autora smatra da je u sistemu Ohrid-Drim-Skadar reč o običnom skobalju *C. nasus*. Drugi autori, posebno oni koji su se bavili ihtiofaunom Crne Gore i Kosova i Metohije, smatraju da sistem Ohrid-Drim-Skadar naseljava ohridski skobalj kao posebna vrsta. FishBase vrstu *C. ohridanum* i podvrstu *C. nasus ohridanum* vodi kao sinonime za *C. nasus*, ali se u opisu distribucije *C. nasus* navodi da skobalj iz sliva Drima, uključujući i Ohridsko i Skadarsko jezero, predstavlja posebnu vrstu (Froese & Pauly, 2022). IUCN Red List ne prepoznaje *C. ohridanum* kao posebnu vrstu, s tim što se u taksonomskoj noti takođe navodi da *C. nasus* iz sliva Drima, Skadarskog i Ohridskog jezera izgleda predstavlja zasebnu vrstu (Freyhof, 2011b). Opis vrste i ostale karakteristike ohridskog skobalja u ovom prikazu dati su uglavnom na osnovu publikovanih podataka za područje Crne Gore.

Sinonimi

Chondrostoma nasus ohridanum Karaman, 1924; *Chondrostoma nasus lumi* Poljakov, Filipi & Basho, 1958

Narodno ime: Ohridski skobalj
Englesko ime: Ohrid nase
Francusko ime: Nase d'Ohrid
Nemačko ime: Ohrid-See nase

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

U Srbiji, ohridski skobalj predstavlja ranjivu vrstu (VU), koja može postati kritično ugrožena ili iščeznuti zbog ograničene površine naseljavanja (AOO iznosi 16 km²) i malog broja lokaliteta, ukoliko se nastavi dejstvo nepovoljnih faktora (kriterijum D2). Procenjuje se da će obim rasprostranjenja ove vrste (EOO), koji iznosi 874 km², kontinuirano opadati, uz smanjenje površine naseljavanja i kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Ohridski skobalj naseljava vode u Ohrid-Drim-Skadar sistemu, kao i sliv Vojuše i reke Maća, Išmi i Erzen u Albaniji (Marić & Šorić, 2009; Talevski *et al*. 2017). Široko je rasprostranjen u Crnoj Gori, gde obitava u Bojani, Skadarskom i Šaskom jezeru, reci Zeti i srednjem i donjem toku Morače i nekim manjim pritokama (Mrdak, 2009). U Srbiji, ohridski skobalj je registrovan u rekama jadranskog sliva, na više lokaliteta u Belom Drimu i pritokama (Istočka reka, Klina, Pećka Bistrica, Dečanska Bistrica, Erenik, Topluga) (Slika 110).

OHRID NASE
Chondrostoma ohridanum Karaman, 1924

Taxonomic status*

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Chondrostoma ohridanum* Karaman, 1924

*The taxonomic status of the Ohrid nase is not clear. A considerable number of authors believe that the common nase *C. nasus* lives in the Ohrid-Drim-Skadar system. Other authors, especially those who have studied the fish fauna of Montenegro and Kosovo and Metohija, are of the opinion that the Ohrid-Drim-Skadar system is inhabited by the Ohrid nase as a distinct species. FishBase lists the species *C. ohridanum* and the subspecies *C. nasus ohridanum* as synonyms of *C. nasus*, but the description of the *C. nasus* distribution states that the nase from the Drim basin, including Lake Ohrid and Lake Skadar, is a separate species (Froese & Pauly, 2022). The IUCN Red List does not recognise *C. ohridanum* as a distinct species, although the taxonomic note also states that *C. nasus* from the Drim, Skadar and Ohrid basins appears to be a distinct species (Freyhof, 2011b). The description of the species and other characteristics of the Ohrid nase in the following text is mainly based on published data for the territory of Montenegro.

Synonyms

Chondrostoma nasus ohridanum Karaman, 1924; *Chondrostoma nasus lumi* Poljakov, Filipi & Basho, 1958

Vernacular name: Ohridski skobalj
English name: Ohrid nase
French name: Nase d'Ohrid
German name: Ohrid-See nase

National threat category assessed according to IUCN criteria

In Serbia, the Ohrid nase is classified as Vulnerable (VU) and may face extinction if negative factors continue to affect it (criterion D2), due to the restricted area of occupancy (AOO is 16 km²) and number of locations where the species occurs. The extent of occurrence of this species (EOO), which is 874 km², is expected to steadily decline along with a decline in the area of occupancy and habitat quality – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

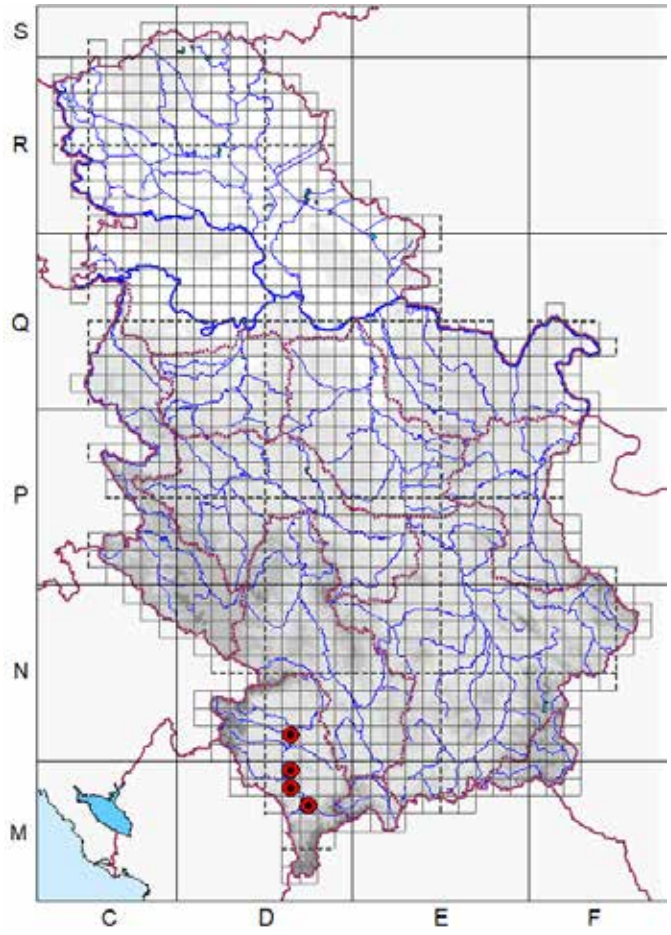
Distribution

The Ohrid nase inhabits the Ohrid-Drim-Skadar system, as well as the Aoös/Vjosa watershed and the Mat, Ishmi and Erzen rivers in Albania (Marić & Šorić, 2009; Talevski *et al.* 2017). It is widespread in Montenegro, where it lives in Bojana, Lake Skadar and Lake Šasko, the Zeta River, as well as in the middle and lower reaches of the Morača and some smaller tributaries (Mrdak, 2009). In Serbia, the Ohrid nase is recorded in the rivers of the Adriatic Sea basin in several localities in the White Drim and its tributaries (Istočka reka, Klina, Pećka Bistrica, Dečanska Bistrica, Erenik, Topluga) (Figure 110).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Ohridski skobalj – *Chondrostoma ohridanum*		Status
Međunarodna zaštita / International protection	IUCN Red List	-
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Chondrostoma nasus ohridanus*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab(i,ii,iii)+2ab(i,ii,iii); D2 Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 110. Rasprostranjenje *Chondrostoma ohridanum* u Srbiji.

Figure 110. Distribution of *Chondrostoma ohridanum* in Serbia.

Slika 111. Ohridski skobalj *Chondrostoma ohridanum* (foto: D. Marić).

Figure 111. Ohrid nase *Chondrostoma ohridanum* (photo: D. Marić).

Opis vrste

Ohridski skobalj se odlikuje izduženim i bočno spljoštenim telom, i relativno malom glavom u odnosu na telo (Slika 111). Usta su široka, a donja vilica ima debeli i snažni rožni sloj sa vrlo oštrom gornjom ivicom koja služi za struganje obraštaja sa čvrste podloge. Boja tela varira u zavisnosti od starosti i polne zrelosti jedinki i mesta boravka. Manje jedinke su žućkaste sa sjajnim srebrnkastim bokovima, posebno na mestima sa razvijenom vegetacijom. Veći primerci imaju zelenkasta leđa sa crnim nijansama i odrazima plave boje, što je naročito izraženo kod mužjaka, dok su bokovi tela svetlosivi sa izraženim srebrnkastim odrazom. Trbuh je beličast. Dorzalno peraje počinje nešto pre osnove ventralnog peraja. I dorzalno i podrepno peraje imaju konkavnu gornju ivicu. Peraja : D (II) III (IV) + (7–8) 9 (10); A III (IV) + 9–10 (11); P I + (13–14) 16–18 (19); V 2 + (7) 8–9. Broj krljušti u bočnoj liniji je (54–55) 56–64 (65). Branhiospina na prvom škržnom luku ima (20–24) 25–32 (33), a kičmenih pršljenova 44–47 (48). Ždrelni zubi su jednoredni, DF 6-6 (5-6, 6-5). Naraste do 50 cm. Ženke žive do 8, mužjaci do 6 godina (Marić & Šorić, 2009).

Populacione karakteristike

Veličina populacija i populacioni trendovi ohridskog skobalja u Srbiji nisu poznati, iako je u pitanju cenjena vrsta u rekreativnom ribolovu.

Ekologija vrste

Ohridski skobalj je bentopelagična, potamodromna vrsta. Mresti se od aprila do maja, pri temperaturi od 7–14 °C (Marić & Šorić, 2009; Ritterbusch *et al*., 2017). Ohridskog skobalja odlikuje visoka plodnost. Ikru polaže na pesak, obično u tekućoj vodi. Hrani se uglavnom zelenim algama i sitnim beskičmenjacima bentosa (Copepoda, Ostracoda). U vreme mresta često vrši lokalne migracije do manjih rečica i potoka radi reprodukcije.

Description of the species

The Ohrid nase is characterised by an elongated and laterally flattened body and a relatively small head in relation to the body (Figure 111). The mouth is wide, and the lower jaw has a thick, strong cornified sheath with a very sharp upper edge, which serves to scrape the aufwuchs from the solid surface. Body colour varies depending on the age and sexual maturity of the individuals and the location. Smaller individuals are yellowish with silvery flanks, especially in places with dense vegetation. Larger individuals have a greenish back with black shading and blue reflexes, which are particularly pronounced in males, and the flanks are light grey with a distinct silvery reflex. The belly is whitish. The dorsal fin origin is just before the base of the ventral fin. Both the dorsal fin and the anal fin have a concave upper edge. Fins: D (II) III (IV) + (7–8) 9 (10); A III (IV) + 9–10 (11); P I + (13–14) 16–18 (19); V 2 + (7) 8–9. The number of scales in the lateral line is (54–55) 56–64 (65). The number of gill rakers on the first gill arch is (20–24) 25–32 (33) and the number of vertebrae is 44–47 (48). The pharyngeal teeth are in a single row, DF 6–6 (5–6, 6–5). It grows up to 50 cm long. Females live up to 8 years and males up to 6 years (Marić & Šorić, 2009).

Population trends

The population size and trends of the Ohrid nase in Serbia are not known, although it is a valued species in recreational fisheries.

Ecology of the species

The Ohrid nase is a benthopelagic, potamodromous species. It spawns from April to May, at a temperature of 7–14 °C (Marić & Šorić, 2009; Ritterbusch *et al*., 2017). The Ohrid nase is characterised by high fecundity. The eggs are deposited on sand, mostly in running water. It feeds mainly on green algae and small benthic invertebrates (Copepoda, Ostracoda). During spawning, it often migrates locally to smaller rivers and streams to reproduce.

Stanište

Naseljava stajaće i sporotekuće vode sa visokim sadržajem kiseonika (između 6 mg/l i 13 mg/l) i temperaturom od 6 °C do 26 °C (Marić & Šorić. 2009). Preferira kamenitu i šljunkovitu podlogu. U jezerima uglavnom obitava u litoralnoj zoni.

Habitat

It inhabits stagnant and slow-flowing waters with a high oxygen content (between 6 and 13 mg/l) and temperatures of 6 °C to 26 °C (Marić & Šorić 2009). It prefers stony and gravelly substrates. In lakes it usually lives in the littoral zone.

Ribolovni značaj

U Srbiji, ohridski skobalj nema veliki ribolovni značaj. Cenjen je među rekreativnim ribolovcima, iako ne spada u ribu visokog kvaliteta zbog dosta sitnih kostiju. Međutim, u Crnoj Gori, u Skadarskom jezeru, do kraja šezdesetih godina XX veka ohridski skobalj je bio vrsta sa velikim ekonomskim značajem (lovio se u količinama i do 200 t na godišnjem nivou), nakon čega ulov naglo opada za 81% i sada čini samo 4% od ukupnog ulova ribe u jezeru (Vujačić, 1949; Pešić *et al*., 2018). U Ohridskom jezeru predstavlja jednu od komercijalno najznačajnih vrsta (Talevski *et al*., 2017).

Importance in fisheries

In Serbia, the Ohrid nase is not of great fisheries importance. It is appreciated by recreational fishers, although it is not a high-quality fish because of its many small bones. However, in Montenegro, in Lake Skadar, the Ohrid nase was a species of great commercial importance until the late 1960s (it was caught in quantities of up to 200 t per year). After that, the catch declined sharply by 81% and now accounts for only 4% of the total fish catch in the lake (Vujačić, 1949; Pešić *et al*., 2018). In Lake Ohrid, it is one of the most commercially important species (Talevski *et al*., 2017).

Faktori ugrožavanja

Ugrožavajući faktori uglavnom se odnose na ugrožavanje staništa, kao što je zagađivanje otpadnim vodama različitog porekla (naselja i urbane zone, industrijski i poljoprivredni objekti), pregrađivanje tokova i izgradnja brana, kao i regulacija tokova i gubitak staništa. Introdukcije alohtonih invazivnih vrsta i negativni efekti klimatskih promena predstavljaju stalnu pretnju.

Threats

The threats are mainly related to habitat pollution by effluents from various sources (settlements and urban areas, industrial and agricultural facilities), damming and regulation of watercourses, construction of dams, and habitat loss. The introduction of non-native invasive species and the negative impacts of climate change are a constant threat.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.3, 5.4.1, 5.4.2, 7.2.11, 7.3, 8.1, 9.1.3, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

U Srbiji, ohridski skobalj nije obuhvaćen postojećim merama zaštite.

Conservation actions in place

The Ohrid nase is not covered by the existing conservation measures in Serbia.

Predložene mere zaštite

Potrebno je sprečiti zagađenje otpadnim vodama i eventualni unos alohtonih vrsta riba, ograničiti regulaciju vodotoka i svesti izgradnju novih brana samo na neophodni nivo. Posebnu pažnju trebalo bi posvetiti sprečavanju negativnih efekata malih pastrmskih ribnjaka i izgradnji funkcionalnih ribljih staza, uz poštovanje biološkog minimuma prilikom eksploatacije vodnih potencijala.

Conservation actions needed

It is necessary to prevent pollution from sewage and the possible introduction of non-native fish species, to limit the regulation of watercourses and to limit the construction of new dams to what is necessary. Special attention should be paid to avoiding negative impacts from small trout ponds and the construction of functional fish ladders, keeping the biological minimum in mind when using water resources.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Neophodna su istraživanja veličine populacija, njihove distribucije i trendova, životne istorije i ekologije ove ciprinidne vrste, kao i monitoring populacionih procesa.

Research is needed on population size, distribution and trends, life history and ecology of this cyprinid species, and monitoring of population trends.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Aleksandar Hegediš

DRIMSKA PAKLARA
Eudontomyzon stankokaramani Karaman, 1974

Taksonomski status

Razdeo: Chordata
Klasa: Petromyzonti
Red: Petromyzontiformes
Porodica: Petromyzontidae
Vrsta: *Eudontomyzon stankokaramani* Karaman, 1974

Sinonimi

Eudontomyzon vladykovi stankokaramani Karaman, 1974

Narodno ime: Drimska paklara
Englesko ime: Drin brook lamprey
Francusko ime: Lamproie de ruisseau du Drin
Nemačko ime: Drin-Bachneunauge

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, drimska paklara ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008i). U Srbiji, drimska paklara ima status ranjive vrste (VU), kako zbog malog obima rasprostranjenja (EOO iznosi 1.677 km²), tako i zbog male površine naseljavanja (AOO iznosi 40 km²). Osim toga, ustanovljen je i mali broj lokaliteta na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Drimska paklara je endemična vrsta sliva reke Drim, uključujući i basene Ohridskog i Skadarskog jezera, sa arealom koji obuhvata oko 25.000 km² (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008i). U Srbiji, nalazi se samo na području Kosova i Metohije, u Belom Drimu, Istočkoj reci, Pećkoj Bistrici i Ereniku (Ribniku) (Holčík & Šorić, 2004) (Slika 112).

Opis vrste

Oblik tela drimske paklare sličan je jegulji (Slika 113). Adultne jedinke imaju tamnosiva leđa i bokove i srebrno-belu boju abdomena, dok su larve pegave. Umesto vilica ima karakterističan oralni disk kojim se prikači za podlogu. Endolateralna zubna formula je 1-2-1 mada ima i drugih modifikacija, dok su egzolateralni zubi viliformni (četkasti), veoma mali i slabo razvijeni, a često i odsustvuju (Holčík & Šorić, 2004). Iza oka postoji sedam škržnih otvora. Karakteriše se odsustvom parnih peraja, dok repno peraje ima oblik lopate. Kod odraslih jedinki ovo peraje ima sivu ili crnu boju, dok je kod larvi bez pigmentacije. Visina drugog leđnog peraja povećava se sa starošću. Na trupu se nalazi 58–65 miomera i ova karakteristika se ne menja sa metamorfozom iz larve u odraslu jedinku. Maksimalna zabeležena dužina iznosi 20 cm (Kottelat & Freyhof, 2007).

DRIN BROOK LAMPREY
Eudontomyzon stankokaramani Karaman, 1974

Taxonomic status

Phylum: Chordata
Class: Petromyzonti
Order: Petromyzontiformes
Family: Petromyzontidae
Species: *Eudontomyzon stankokaramani* Karaman, 1974

Synonyms

Eudontomyzon vladykovi stankokaramani Karaman, 1974

Vernacular name: Drimska paklara
English name: Drin brook lamprey
French name: Lamproie de ruisseau du Drin
German name: Drin-Bachneunauge

National threat category assessed according to IUCN criteria

At the global level, the Drin brook lamprey is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008i). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 1,677 km²) and the small area of occupancy (AOO is 40 km²). In addition, a low number of locations where the species occurs, a continuing decline in extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

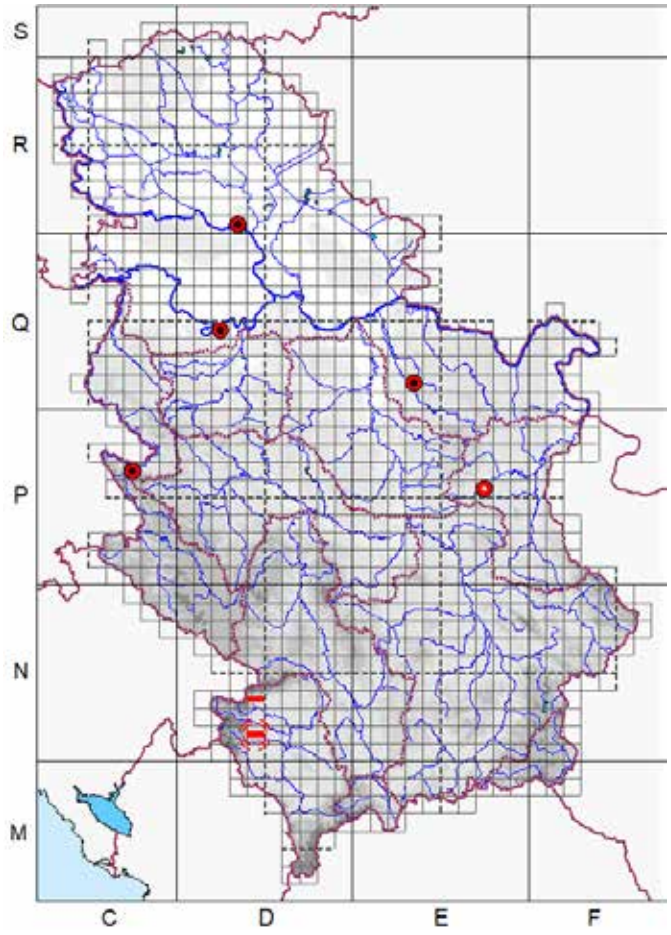
The Drin brook lamprey is endemic to the Drim basin, including the basins of Lake Ohrid and Lake Skadar, with a range of about 25,000 km² (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008i). In Serbia, it occurs only in Kosovo and Metohija, in the White Drim, Istočka reka, Pećka Bistrica and Erenik/Ribnik (Holčík & Šorić, 2004) (Figure 112).

Description of the species

The body shape of the Drin brook lamprey resembles that of an eel (Figure 113). Adults have a dark grey back and flanks and a silvery-white belly, while the larvae are mottled. Instead of jaws, it has a characteristic oral disc that clings to the substrate. The endolateral tooth formula is 1–2–1, although other modifications exist, while the exolateral teeth are villiform (brush-shaped), very small, weakly developed and often absent (Holčík & Šorić, 2004). There are seven gill openings behind the eye. The lampreys are characterised by the absence of paired fins and the caudal fin has a spade-like shape. In adults this fin is grey or black, while in larvae it has no pigmentation. The height of the second dorsal fin increases with age. There are 58–65 myomeres on the trunk, and this feature does not change during metamorphosis from larva to adult. The maximum recorded length is 20 cm (Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Drimska paklara / Drin brook lamprey – *Eudontomyzon stankokaramani*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Eudontomyzon* spp.)	**Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Eudontomyzon danfordi stankokaramani*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**



Slika 112. Rasprostranjenje *Eudontomyzon stankokaramani* u Srbiji.

Figure 112. Distribution of *Eudontomyzon stankokaramani* in Serbia.

Slika 113. Drimska paklara *Eudontomyzon stankokaramani* (https://commons.wikimedia.org/wiki/File:Eudontomyzon_stankokaramani_ammocoete.jpg).

Figure 113. Drin brook lamprey *Eudontomyzon stankokaramani* (https://commons.wikimedia.org/wiki/File:Eudontomyzon_stankokaramani_ammocoete.jpg).

Populacione karakteristike

Ne postoje podaci o veličini populacija i populacionim trendovima na globalnom nivou (Freyhof & Kottelat, 2008i). U Srbiji, populacione krakteristike ove vrste nisu poznate.

Ekologija vrste

Karakteriše se neparazitskim i nepredatorskim načinom života. Larve se hrane silikatnim algama i detritusom (Jażdżewski *et al*., 2016). Migracija za mrest dešava se u okviru reke u kojoj živi, u periodu između juna i jula (Bănăduc, 2008). Mresti se na šljunkovitom ili peskovitom dnu (Levin & Holčík, 2006). Stadijum larve (ammocoete) traje 4–6 godina. Metamorfoziraju verovatno od novembra do aprila. Nakon mresta, odrasle jedinke nastavljaju da žive još 11–13 meseci i zatim uginu (Jażdżewski *et al*., 2016).

Stanište

Larve žive u peskovitoj podlozi bogatoj detritusom ili glinovitim sedimentima, u delovima toka sa sporim kretanjem vode. Adultne jedinke naseljavaju čiste potoke sa dosta kiseonika, u planinskim zonama (Kottelat & Freyhof, 2007).

Ribolovni značaj

Drimska paklara nema ribolovni ni privredni značaj.

Faktori ugrožavanja

Zbog nedostatka podataka, veoma je teško izdvojiti specifične faktore ugrožavanja. Trenutno nisu registrovani ozbiljniji faktori koji bi mogli da dovedu do ugrožavanja ove vrste (Freyhof & Kottelat,

Population trends

There are no data on population size and trends at the global level (Freyhof & Kottelat, 2008i). In Serbia, the population characteristics of this species are not known.

Ecology of the species

The species is characterised by a non-parasitic and non-predatory lifestyle. Larvae feed on diatoms and detritus (Jażdżewski *et al*., 2016). The spawning migration takes place within the river in which it lives between June and July (Bănăduc, 2008). It spawns on gravelly or sandy bottoms (Levin & Holčík, 2006). The larval stage (ammocoete) lasts 4–6 years. Metamorphosis probably takes place from November to April. After spawning, the adults live for another 11–13 months and then die (Jażdżewski *et al*., 2016).

Habitat

Larvae live in sandy, detritus-rich substrate or clay sediments, in stream sections with slow water flow. Adults live in clean, oxygen-rich streams in mountainous regions (Kottelat & Freyhof, 2007).

Importance in fisheries

The Drin brook lamprey is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

Due to the lack of data, it is very difficult to identify specific threats. Currently, there are no known factors of particular severity that could lead to threats to this species (Freyhof & Kottelat, 2008i).

2008i). Ograničeni areal i preferencija ka određenom tipu staništa mogli bi da uvećaju efekte nastale opštim faktorima ugrožavanja, kao što su hidrološke modifikacije i zagađenje vodotoka.

The limited range and preference for a specific habitat type could exacerbate the effects of general threats such as hydrological changes and pollution of watercourses.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.9, 7.3, 9.1.3, 9.4

Postojeće mere zaštite

Drimska paklara se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The Drin brook lamprey is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

Zbog ograničenog areala ove vrste, neophodno je zaštititi staništa i sprečiti njihovu degradaciju. Potrebno je razviti edukativne programe vezane za paklare naših voda i dalje razvijati i usavršavati nacionalnu zakonsku regulativu.

Conservation actions needed

Due to the limited range of this species, it is necessary to protect habitats and prevent their destruction. There is also a need to develop education programmes about lampreys in our waters and to further develop and improve national legislation.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.1, 2.3, 4, 5.2, 5.4.2

Imajući u vidu status endemičnosti i status strogo zaštićene vrste, kao i vrste za koju je propisan trajni lovostaj, neophodna su istraživanja veličine i povezanosti populacija, populacionih trendova i faktora ugrožavanja, uz razvoj odgovarajućih programa monitoringa.

Considering the status of endemic and strictly protected species, as well as species for which a permanent ban on fishing is imposed, the size and connectivity of populations, population trends and threats need to be studied and appropriate monitoring programmes developed.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Srđan Subotić

SKADARSKA KRKUŠA
Gobio skadarensis Karaman, 1937

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Gobionidae
Vrsta: *Gobio skadarensis* Karaman, 1937

Sinonimi

Gobio gobio lepidolaemus skadarensis Karaman, 1937

Narodno ime: Skadarska krkuša
Englesko ime: Skadar gudgeon
Francusko ime: Goujon de Skadar
Nemačko ime: Skadar Gründling
Rusko ime: Скадарский пескарь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, skadarska krkuša ima status ugrožene vrste (EN) prema kriterijumima B1ab(ii,iii)+2ab(ii,iii) (Freyhof & Kottelat, 2008m). U Srbiji, skadarska krkuša ima status ranjive vrste (VU), kako zbog malog obima rasprostranjenja (EOO iznosi 999 km²), male površine naseljavanja (AOO iznosi 24 km²) i malog broja lokaliteta na kojima se vrsta javlja – kriterijumi B1ab+2ab.

Rasprostranjenje

Skadarska krkuša je endemična vrsta jugoistočnog dela sliva Jadranskog mora. Naseljava vode basena Skadarskog jezera u Crnoj Gori i Albaniji (Mendel *et al*., 2008; Marić & Milošević, 2011; Grapci-Kotori, 2020). Brojna je u Morači i pritokama, a posebno u Brestnici i Iverku, malim ravničarskim pritokama reke Zete (Šanda *et al*., 2002; Freyhof & Kottelat, 2008m). Naseljava i sliv reke Vojuše u Albaniji (Shumka *et al*., 2018). U Srbiji naseljava sliv Belog Drima (Slika 114). Još uvek nije u potpunosti razjašnjeno da li se u slivu Belog Drima nalazi ova vrsta ili vrsta *Gobio ohridanus* (Šanda *et al*., 2005, 2009; Talevski *et al*., 2009; Milošević & Talevski, 2015).

Opis vrste

Skadarsku krkušu odlikuje vretenasto telo (Slika 115). Boja tela je sivkasto-zelenkasto-smeđa po leđima i bokovima, dok je trbuh beo. Duž bokova ima 6–7 tamnijih mrlja, koje su često grupisane dve po dve. Na repnom i leđnom peraju nalaze se tamne mrlje. Od drugih krkuša jadranskog i egejskog sliva razlikuje se po dužini glave koja čini 27–30% standardne dužine tela (SL), kao i po tome što grudi nisu pokrivene krljuštima između grudnih peraja, a krljušti ne dosežu dalje od njihovih osnova (Kottelat & Freyhof, 2007). Brkovi dosežu, ili čak premašuju, zadnju ivicu oka. Dužina njuške iznosi 34–42% od dužine glave. Prečnik oka je 1,2–1,4 puta veći od

SKADAR GUDGEON
Gobio skadarensis Karaman, 1937

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Gobionidae
Species: *Gobio skadarensis* Karaman, 1937

Synonyms

Gobio gobio lepidolaemus skadarensis Karaman, 1937

Vernacular name: Skadarska krkuša
English name: Skadar gudgeon
French name: Goujon de Skadar
German name: Skadar Gründling
Russian name: Скадарский пескарь

National threat category assessed according to IUCN criteria

At the global level, the Skadar gudgeon is classified as Endangered (EN) under criteria B1ab(ii,iii)+2ab(ii,iii) (Freyhof & Kottelat, 2008m). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 999 km²), the small area of occupancy (AOO is 24 km²) and the low number of locations where it occurs – criteria B1ab+2ab.

Distribution

Skadar gudgeon is endemic to the southeastern part of the Adriatic Sea basin. It inhabits the basin of Lake Skadar in Montenegro and Albania (Mendel *et al*., 2008; Marić & Milošević, 2011; Grapci-Kotori, 2020). It is numerous in the Morača and its tributaries, and especially in Brestnica and Iverak, small lowland tributaries of the Zeta (Šanda *et al*., 2002; Freyhof & Kottelat, 2008m). It also inhabits the Aoös/Vjosa watershed in Albania (Shumka *et al*., 2018). In Serbia, it inhabits the White Drim watershed (Figure 114). It is not yet entirely clear whether this species or the species *Gobio ohridanus* occurs in the White Drim watershed (Šanda *et al*., 2005, 2009; Talevski *et al*., 2009; Milošević & Talevski, 2015).

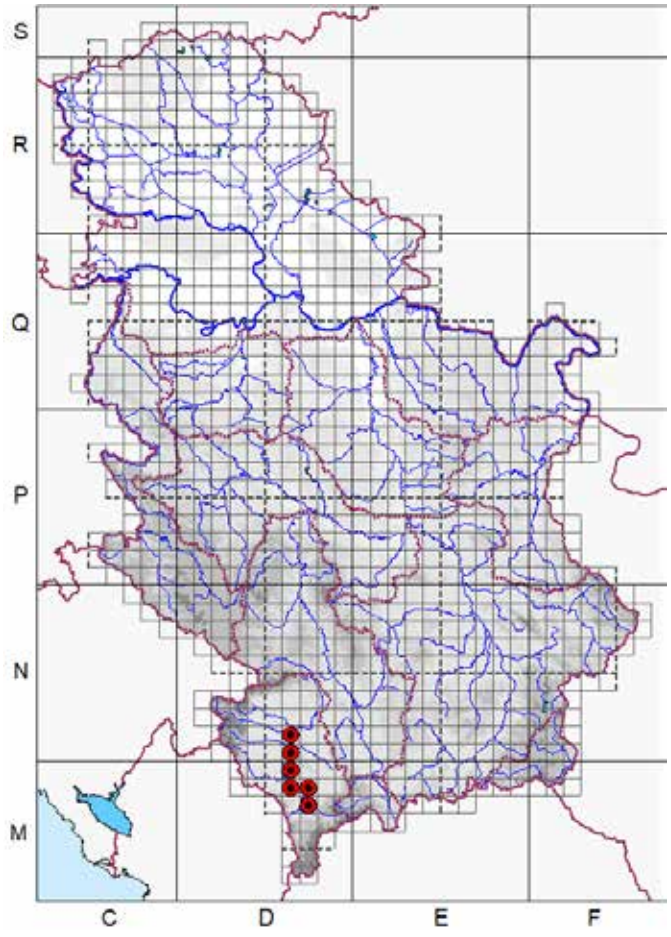
Description of the species

The Skadar gudgeon is characterised by a spindle-shaped body (Figure 115). The colour of the body is grey-brown on the back and sides, while the belly is white. There are 6–7 darker spots on the flanks, often arranged in pairs. The caudal and dorsal fins are covered with dark spots. It differs from other gudgeons in the Adriatic and Aegean Sea basins by the following characteristics: the head length is 27–30% of the standard body length (SL), the breast is scaleless between the pectoral fins, the scales do not reach beyond the pectoral base (Kottelat & Freyhof, 2007). The barbels extend to the posterior margin of the eye or even beyond. The length of the snout is 34–42% of the

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Skadarska krkuša / Skadar gudgeon – *Gobio skadarensis*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**EN B1ab(ii,iii)+2ab(ii,iii)**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Gobio* spp.)	**MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Gobio gobio ohridanus*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab+2ab Zaštićena vrsta / Protected species**

*MLM – minimalna lovna mera 10 cm, ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) /
MLM – minimum landing size at 10 cm standard length, ODU – daily catch limit of 5 kg (measure applies to all native species)



Slika 114. **Rasprostranjenje *Gobio skadarensis* u Srbiji.**

Figure 114. **Distribution of *Gobio skadarensis* in Serbia.**

Slika 115. Skadarska krkuša *Gobio skadarensis* (foto: R. Šanda).

Figure 115. Skadar gudgeon *Gobio skadarensis* (photo: R. Šanda).

interorbitalne distance. Broj krljušti u bočnoj liniji je 37–38 + 3. Naraste do 9 cm standardne dužine tela (SL) (Kottelat & Freyhof, 2007).

Populacione karakteristike

Populacione karakteristike skadarske krkuše nisu poznate. Pretpostavlja se da je prirodno retka vrsta (Freyhof & Kottelat, 2008m).

Ekologija vrste

Nema dovoljno podataka o ekologiji vrste i elementima životnog ciklusa (Freyhof & Kottelat, 2008m).

Stanište

Skadarska krkuša je pridnena vrsta. Preferira staništa sa sporim strujanjem vode i peskovitom i muljevitom podlogom.

Ribolovni značaj

Vrsta nema nikakav ribolovni značaj.

Faktori ugrožavanja

Najznačajnije ugrožavajuće faktore predstavljaju regulacija i pregrađivanje tokova, kao i izgradnja brana, jer izmene hidrološkog režima ugrožavaju staništa i mesta za mrest (Weiss *et al.*, 2018). Osim toga, negativne efekte izaziva i zagađivanje svim tipovima otpadnih voda (komunalnim, industrijskim i poljoprivrednim), kao i introdukcija alohtonih invazivnih vrsta, a ne mogu se isključiti ni klimatske promene (Freyhof & Kottelat, 2008m).

head length. The diameter of the eye is 1.2–1.4 times the interorbital distance. The number of scales in the lateral line is 37–38 + 3. It grows up to 9 cm standard body length (SL) (Kottelat & Freyhof, 2007).

Population trends

The population characteristics of the Skadar gudgeon are not known. It is assumed to be a naturally rare species (Freyhof & Kottelat, 2008m).

Ecology of the species

There is insufficient data on the ecology of the Skadar gudgeon and elements of its life cycle (Freyhof & Kottelat, 2008m).

Habitat

The Skadar gudgeon is a demersal species. It prefers habitats with slow water flow and sandy or muddy substrate.

Importance in fisheries

The species is of no fishery importance.

Threats

The main threat factors are the regulation and damming of watercourses and the construction of dams, as changes in the hydrological regime threaten habitats and spawning grounds (Weiss *et al.*, 2018). Negative impacts are also caused by pollution from all types of wastewater (municipal, industrial and agricultural), the introduction of alien invasive species and climate change cannot be ruled out (Freyhof & Kottelat, 2008m).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 7.2.11, 7.3, 8.1.1, 9.1.1, 9.1.3, 9.2.3, 9.3.4, 11.1, 11.2, 11.5

Postojeće mere zaštite

Skadarska krkuša nije obuhvaćena postojećim merama zaštite.

Conservation actions in place

The Skadar gudgeon is not covered by the existing conservation measures.

Predložene mere zaštite

Trebalo bi ograničiti izgradnju novih brana i zagađenje otpadnim vodama. Poseban oprez se nameće prilikom poribljavanja, kako bi se sprečio unos novih alohtonih vrsta riba. Pažnju bi trebalo posvetiti i izgradnji funkcionalnih ribljih staza na već postojećim objektima, uz poštovanje biološkog minimuma prilikom eksploatacije vodnih potencijala.

Conservation actions needed

The construction of new dams and pollution from sewage should be limited. Special attention should be paid to fish stocking to prevent the introduction of new non-native fish species. Attention should also be paid to creating functional fish ladders at existing facilities, while respecting the biological minimum in the use of water resources.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Kako je u pitanju vrsta o kojoj se malo zna, neophodna su taksonomska istraživanja, istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije, kao i faktora ugrožavanja.

As this is a species about which little is known, taxonomic research, research on population size, distribution and trends, life history and ecology, and threat factors are needed.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.5, 1.6, 3.1, 3.4

AUTOR / AUTHOR: Aleksandar Hegediš

ČIKOV
Misgurnus fossilis (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cobitidae
Vrsta: *Misgurnus fossilis* (Linnaeus, 1758)

Sinonimi

Cobitis fossilis Linnaeus, 1758

Narodno ime: Čikov
Englesko ime: Weatherfish
Francusko ime: Loche d'étang
Nemačko ime: Europäische Schlammpeitzger
Rusko ime: Обыкновенный вьюн

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, čikov se ne smatra ugroženom vrstom (Freyhof, 2011e). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina, čikov ima status ranjive vrste (VU). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 48.306 km², dok je površina naseljavanja (AOO) 224 km².

Rasprostranjenje

Čikov ima široko evroazijsko rasprostranjenje. Naseljava slivove Crnog, Baltičkog i Kaspijskog mora. U Evropi naseljava vode severno od Alpa, od Meze na istok do sliva Neve i jezera Ladoga, u slivu Crnog mora od Dunava na istok do Kubana, u Kaspijskom basenu u slivovima Volge i Urala. Prirodno ga nema u vodama Velike Britanije, Skandinavije, Apeninskog i Pirinejskog poluostrva, Krima i u slivovima Jadranskog, Egejskog i Belog mora. Lokalno je introdukovan u sliv Rone (Francuska) i verovatno u još neke vode (Kottelat & Freyhof, 2007). U Srbiji naseljava velike nizijske reke crnomorskog sliva (Dunav, Sava, Tisa, Tamiš), Veliku Moravu, Zapadnu Moravu, Južnu Moravu, Kolubaru, Pek, Crni Timok, kao i sporotekuće i stajaće vode severno od Save i Dunava na teritoriji Vojvodine (Slika 116).

Opis vrste

Telo čikova je cilindrično, a glava blago bočno spljoštena (Slika 117). Usta su mala, okružena sa 5 pari brkova. Nema podočnu bodlju. Krljušti su sitne i duboko usađene u kožu, a bočna linija je slabo vidljiva. Repno peraje je zaobljeno. Poseduje niz uzdužnih pruga čija se obojenost smenjuje od svetlosmeđe do gotovo crne. Broj tvrdih žbica u perajima je varijabilan. Peraja: D II–IV + 5–6; A II–IV + 5–7; V I–II + 5–6. Broj branhiospina prvog škržnog luka je 14, a broj ždrelnih zuba 11–14 (Hartvich *et al.*, 2010). Postoji polni

WEATHERFISH
Misgurnus fossilis (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cobitidae
Species: *Misgurnus fossilis* (Linnaeus, 1758)

Synonyms

Cobitis fossilis Linnaeus, 1758

Vernacular name: Čikov
English name: Weatherfish
French name: Loche d'étang
German name: Europäische Schlammpeitzger
Russian name: Обыкновенный вьюн

National threat category assessed according to IUCN criteria

At the global level, the weatherfish is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011e). In Serbia, the species is classified as Vulnerable (VU) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence of the species (EOO) in Serbia is 48,306 km², while the area of occupancy (AOO) is 224 km².

Distribution

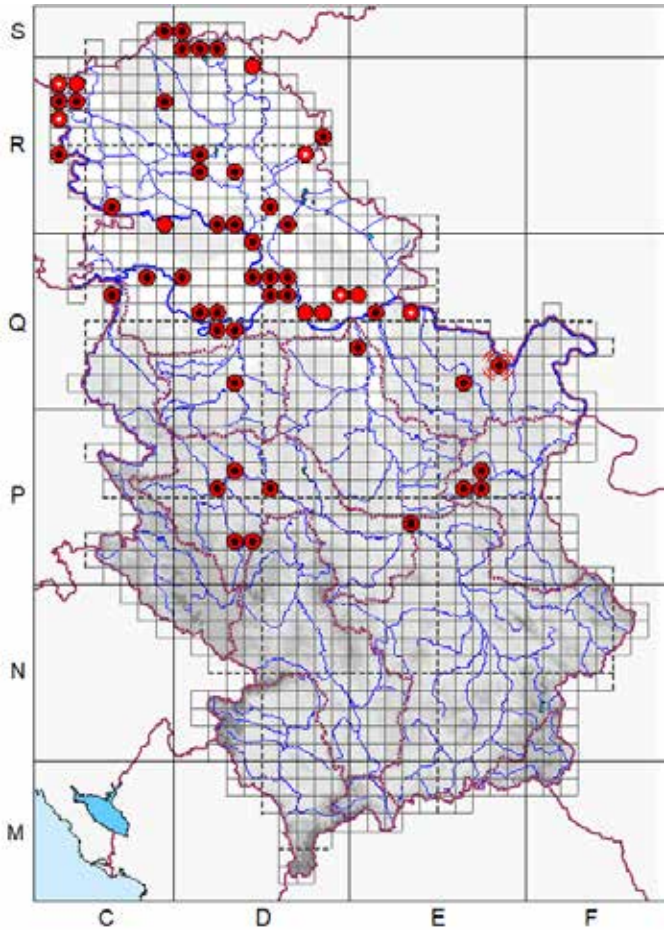
The weatherfish has a wide Eurasian distribution. It inhabits the basins of the Black Sea, the Baltic Sea and the Caspian Sea. In Europe it can be found north of the Alps, from the Meuse eastwards to the Neva basin and Lake Ladoga, in the Black Sea basin from the Danube eastwards to the Kuban, in the Caspian Basin in the Volga and Ural basins. It does not occur naturally in Great Britain, Scandinavia, the Apennine and Iberian Peninsulas, the Crimea and the basins of the Adriatic, Aegean, and White Seas. It has been introduced locally into the Rhône basin (France) and probably into some other waters (Kottelat & Freyhof, 2007). In Serbia, it inhabits large lowland rivers of the Black Sea basin (Danube, Sava, Tisza, Tamiš), Great Morava, West Morava, South Morava, Kolubara, Pek, Crni Timok, as well as slow-flowing and standing waters north of the Sava and Danube in Vojvodina (Figure 116).

Description of the species

The body of the weatherfish is cylindrical and the head is slightly flattened laterally (Figure 117). The mouth is small and surrounded by five pairs of barbels. The suborbital spine is absent in males. The scales are small and deeply embedded in the skin, and the lateral line is barely visible. The caudal fin is rounded. It has a series of longitudinal stripes ranging in colour from light brown to almost black. The number of fin spines is variable. Fins: D II–IV + 5–6; A II–IV + 5–7; V I– II + 5–6.

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Čikov / Weatherfish – *Misgurnus fossilis*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Strogo zaštićena vrsta / Strictly protected species**



Slika 116. **Rasprostranjenje *Misgurnus fossilis* u Srbiji.**

Figure 116. **Distribution of *Misgurnus fossilis* in Serbia.**

Slika 117. Čikov *Misgurnus fossilis* (foto: A. Bajić).

Figure 117. The weatherfish *Misgurnus fossilis* (photo: A. Bajić).

dimorfizam i kod mužjaka je druga žbica u leđnom i u grudnom peraju uvećana i zadebljala. Uobičajena dužina tela je oko 15 cm (Fazekas *et al*., 2009), dok je maksimalna zabeležena dužina tela 30 cm (Muss & Dahlström, 1968). Ženke su krupnije od mužjaka i mogu da dostignu starost od 7 godina, dok mužjaci žive do 6 godina (Pyrzanowski *et al*., 2020).

Populacione karakteristike

Brojnost populacija čikova kontinuirano opada u centralnoj Evropi (Freyhof, 2011e). U Srbiji, u poslednjih nekoliko decenija, brojnost opada, najviše zbog gubitka i zagađenja staništa.

Ekologija vrste

Čikov se mresti u proleće i rano leto, od aprila do jula. Polnu zrelost dostiže sa 2–3 godine, pri dužini od oko 11 cm. Mužjak prati ženku u deo staništa sa gustom vegetacijom gde se odvija reprodukcija. Pri parenju, mužjak se uvija oko ženke u delu tela iza leđnog peraja (Kottelat & Freyhof, 2007). Ženka može da položi od 5.000 do 35.000 jaja (Drozd *et al*., 2009; Harvich *et al*., 2010). Larve imaju krupne spoljašnje, končaste škrge. Optimalna temperatura za razvoj mladih jedinki je između 15 °C i 24 °C (Drozd *et al*., 2009). Adulti čikova su noćne životinje koje dan provode u mulju i pesku. Sušne i mrazne periode godine provode u rupama u mulju koje su obično duboke oko 20–30 cm, ponekad i do 70 cm (Kottelat & Freyhof, 2007). Populacije čikova često broje i do nekoliko stotina jedinki, često gusto naseljenih (Meyer & Hinrichs, 2000). Osetljivi su na zagađenje koje se akumulira u sedimentu. Čikov može da preživi u staništima sa niskim sadržajem kiseonika zahvaljujući kožnoj i intestinalnoj respiraciji. Hrane se larvama insekata i sitnim mekušcima (Kottelat & Freyhof, 2007).

The number of gill rakers on the first gill arch is 14 and the number of pharyngeal teeth is 11–14 (Hartvich *et al*., 2010). Sexual dimorphism is present and the second spine of the dorsal and pectoral fins is enlarged and thickened in males. The usual body length is about 15 cm (Fazekas *et al*., 2009), while the maximum body length is 30 cm (Muss & Dahlstroem, 1968). Females are larger than males and can reach an age of 7 years, while males live up to 6 years (Pyrzanowski *et al*., 2020).

Population trends

The number of weatherfish populations is continuously decreasing in Central Europe (Freyhof, 2011e). In Serbia, populations have declined in recent decades mainly due to habitat loss and pollution.

Ecology of the species

The weatherfish spawns in spring and early summer, from April to July. It reaches sexual maturity at the age of 2–3 years, with a length of about 11 cm. The male follows the female to a part of the habitat with dense vegetation, where reproduction takes place. During mating, the male forms a complete ring around the female's body behind the dorsal fin (Kottelat & Freyhof, 2007). A female can lay between 5,000 and 35,000 eggs (Drozd *et al*., 2009; Harvich *et al*., 2010). The larvae have large external filamentous gills. The optimal temperature for juvenile development is between 15 °C and 24 °C (Drozd *et al*., 2009). Adults are nocturnal and spend the day in mud and sand. They spend the dry and frosty periods of the year in burrows in the mud, which are usually about 20–30 cm deep, occasionally down to 70 cm (Kottelat & Freyhof, 2007). The weatherfish populations often number up to several hundred individuals and are often densely populated (Meyer & Hinrichs, 2000). They are sensitive to pollution that accumulates in the sediment. The weatherfish can survive in oxygen-poor habitats thanks to its ability to breathe through the skin and intestine. They feed on insect larvae and small molluscs (Kottelat & Freyhof, 2007).

Stanište

Naseljava ravničarske stajaće vode (kanale, bare, plavne zone, močvare). Prilagođen je muljevitom dnu i vodi koja je siromašna kiseonikom (Harvich *et al*., 2010). Poseduje sposobnost udisanja atmosferskog kiseonika i u slučaju kada nema dovoljno kiseonika u vodi, odlazi do površine i guta vazduh, iz koga apsorbuje kiseonik u prokrvljenom crevu. Adulti preferiraju staništa obrasla vegetacijom, dok se mlađ češće zatiče u plićacima bogatim detritusom na samoj obali (Meyer & Hinrichs, 2000).

Ribolovni značaj

Nema ribolovni značaj. S obzirom na status zaštite, zabranjen je rekreativni i privredni ribolov ove vrste.

Faktori ugrožavanja

Veliki broj staništa čikova izgubljen je isušivanjem plavnih područja za potrebe poljoprivrede i gubljenjem plavnih zona izgradnjom odbrambenih nasipa (Freyhof, 2011e). Povećano zagađenje poljoprivrednim aktivnostima, čiji se produkti slivaju u otvorene vode, dovode do nekontrolisanog cvetanja algi i povećanog opterećenja vodenih ekosistema koje čikov naseljava. Iako može da preživi u staništima sa niskom koncentracijom kiseonika, osetljiv je na pesticide i organsko zagađenje voda (Harvich *et al*., 2010). S obzirom da preferira stajaće ekosisteme sa malom dubinom vode, za čikova posebno rizični mogu biti duži periodi suše. Ova vrsta je pored stroge zaštite i dalje meta nesavesnih ribolovaca koji je love kao mamac za smuđa i soma. Ne treba zanemariti negativne efekte akvakulture, intenzivnog razvoja rečnog saobraćaja na plovnim rekama, kao i klimatskih promena na uslove u staništu.

Habitat

The weatherfish inhabits standing lowland waters (canals, ponds, floodplains, marshes). It is adapted to muddy substrate and oxygen-poor water (Harvich *et al*., 2010). It is able to breathe atmospheric oxygen, and when the oxygen in the water is insufficient, it swims to the surface and swallows air, from which it absorbs oxygen through its intestine, which is rich in blood vessels. Adults prefer habitats covered with vegetation, while juveniles are more often found in detritus-rich shallow water near the shore (Meyer & Hinrichs, 2000).

Importance in fisheries

The species is of no fishery importance. Due to its protected status, the weatherfish is prohibited for recreational and commercial fishing.

Threats

The drainage of floodplains for agricultural purposes and their loss due to the construction of protective dams have led to the loss of numerous weatherfish habitats (Freyhof, 2011e). Increased pollution from agricultural activities, whose runoff flows into open waters, leads to uncontrolled algal blooms and increased stress on the aquatic ecosystems that weatherfish inhabit. Although it can survive in habitats with low oxygen concentration, it is sensitive to pesticides and organic water pollution (Harvich *et al*., 2010). As it prefers stagnant ecosystems with shallow water depths, prolonged dry periods can be particularly risky for the weatherfish. Despite strict protection, this species is still targeted by unscrupulous fishers who use it as bait for pikeperch and catfish. The negative effects of aquaculture, intensive expansion of river traffic on navigable rivers and climate change on habitat conditions cannot be ignored.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.2, 4.3, 5.4.1, 7.2.3, 7.2.11, 9.1.1, 9.1.2, 9.2.3, 9.3.1, 9.3.3, 11.2

Postojeće mere zaštite

Čikov se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

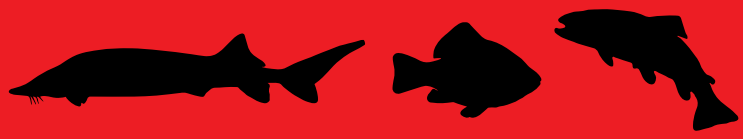
Neophodno je zaštititi i očuvati u neizmenjenom stanju staništa na kojima su prisutne populacije čikova, odnosno vratiti ih u prvobitno stanje, ukoliko je to moguće. Veštački mrest i reintrodukcija na staništa sa kojih je nestao, odnosno pojačavanje prirodnih populacija čikova poribljavanjem, značajno bi doprineli oporavku ove vrste u Srbiji. Pored ovoga, predlaže se i povećana kontrola korišćenja pesticida na obradivim površinama koje se nalaze pored staništa čikova, kao i formiranje zelenih pojaseva koji bi smanjili njihovo spiranje u vodu. Edukacija o ugroženosti ove vrste i važnosti očuvanja doprineće savesnijem odnosu ribolovaca

Conservation actions in place

The weatherfish is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to protect the habitats in which the populations of weatherfish are found and to maintain them in an unaltered state, namely to restore them to their original state if this is possible. Artificial spawning and reintroduction into the habitats from which they have disappeared, i.e. strengthening the natural weatherfish populations through stocking, would contribute significantly to the recovery of this species in Serbia. In addition, stricter control of pesticide use on croplands adjacent to weatherfish habitats and the creation of greenbelts are proposed to reduce the pesticide runoff into water bodies. Educating the public about the threats to this species and the importance



i građanstva prema staništima čikova kao i prema samoj vrsti.

of its protection will help fishers and citizens to be more conscientious about the habitats of the weatherfish and also the species itself.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.1, 2.3, 3.3.1, 3.4.1, 4.1

Potrebno je utvrditi distribuciju čikova u Srbiji, odrediti brojnost i veličinu populacija i uspostaviti sistem monitoringa kojim bi se dugotrajno pratila brojnost populacija. Posebnu pažnju treba obratiti na promene staništa čikova. Pored toga, potrebno je utvrditi potencijalne ugrožavajuće faktore koji ranije nisu detektovani i formirati akcioni plan oporavka ove vrste.

It is necessary to determine the distribution of the weatherfish in Serbia, to determine the number and size of its populations and to establish a monitoring system to observe the number of populations over a long period of time. Special attention should be paid to changes in the habitat of the weatherfish. It is also necessary to identify potential threat factors that have not yet been detected and to establish an action plan for the recovery of this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 2.1, 3.1, 3.4

AUTOR / AUTHOR: Aleksandar Bajić

GOVEDARKA
Romanogobio vladykovi (Fang, 1943)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Gobionidae
Vrsta: *Romanogobio vladykovi* (Fang, 1943)

Sinonimi

Gobio vladykovi Fang, 1943

Narodno ime: Govedarka
Englesko ime: Danube white-finned gudgeon
Francusko ime: Goujon à nageoires blanches du Danube
Nemačko ime: Donau-Weißflossengründling
Rusko ime: Дунайский белоперый пескарь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, govedarka nema status ugrožene vrste (Freyhof & Kottelat, 2008r). U Srbiji, govedarka predstavlja ranjivu vrstu (VU). Obim rasprostranjenja ove vrste (EOO) u Srbiji iznosi 3.562 km², dok površina naseljavanja (AOO) iznosi 24 km². Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina (kriterijum E).

Rasprostranjenje

Govedarka je endemit dunavskog sliva. Živi u samom glavnom toku Dunava, od Nojburga na Dunavu (Nemačka) do ušća, kao i u pritokama (Naseka, 2001). Najzapadnija pritoka Dunava u kojoj živi jeste Morava, u Češkoj i Austriji. U Srbiji je registrovana u rekama Tisa, Tamiš, Karaš i Brzava (Slika 118).

Opis vrste

Telo govedarke je izduženo (Slika 119). Predorzalne krljušti imaju uzdužne epitelijalne kreste. Grlo je golo, bez krljušti. Glava je 1,3 puta duža od maksimalne širine tela. Njuška je kraća ili jednaka postorbitalnom razmaku. Oko je krupno, a dijametar oka je 0,8–1,5 puta veći od interorbitalnog razmaka (Naseka, 2001). Brkovi su dugi, ali ne premašuju zadnju ivicu oka. Leđa su zelenkasto-smeđa, dok je trbuh svetliji. Na bokovima tela, duž bočne linije, ima 8-10 tamnih mrlja. Predorzalna dužina tela veća je od postdorzalne, tako da se leđno peraje nalazi iza sredine tela. Analni otvor se nalazi ili na sredini između početka trbušnih peraja i podrepnog peraja ili nešto bliže podrepnom peraju. Peraja: D III + 8; A II–III + 7; P I + 13–15. U bočnoj liniji nalazi se 37–43 krljušti, broj kičmenih pršljenova je 39–42, a broj branhiospina na prvom škržnom luku 7–9 (Naseka, 2001; Friedrich, *et al*., 2018; Bogutskaya, *et al*., 2019). Maksimalna zabeležena standardna dužina tela (SL) iznosi 11,5 cm. Živi do 4 godine (Kottelat & Freyhof, 2007).

DANUBE WHITE-FINNED GUDGEON
Romanogobio vladykovi (Fang, 1943)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Gobionidae
Species: *Romanogobio vladykovi* (Fang, 1943)

Synonyms

Gobio vladykovi Fang, 1943

Vernacular name: Govedarka
English name: Danube white-finned gudgeon
French name: Goujon à nageoires blanches du Danube
German name: Donau-Weißflossengründling
Russian name: Дунайский белоперый пескарь

National threat category assessed according to IUCN criteria

At the global level, the Danube white-finned gudgeon is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008r). In Serbia, the species is classified as Vulnerable (VU). The extent of occurrence (EOO) in Serbia is 3,562 km², while the area of occupancy (AOO) is 24 km². The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

The Danube white-finned gudgeon is endemic to the Danube basin. It lives in the main course of the Danube, from Neuburg an der Donau (Germany) to the mouth, as well as in its tributaries (Naseka, 2001). The westernmost tributary of the Danube where it occurs is the Morava in the Czech Republic and Austria. In Serbia, it is found in the rivers Tisza, Tamiš, Karaš and Brzava (Figure 118).

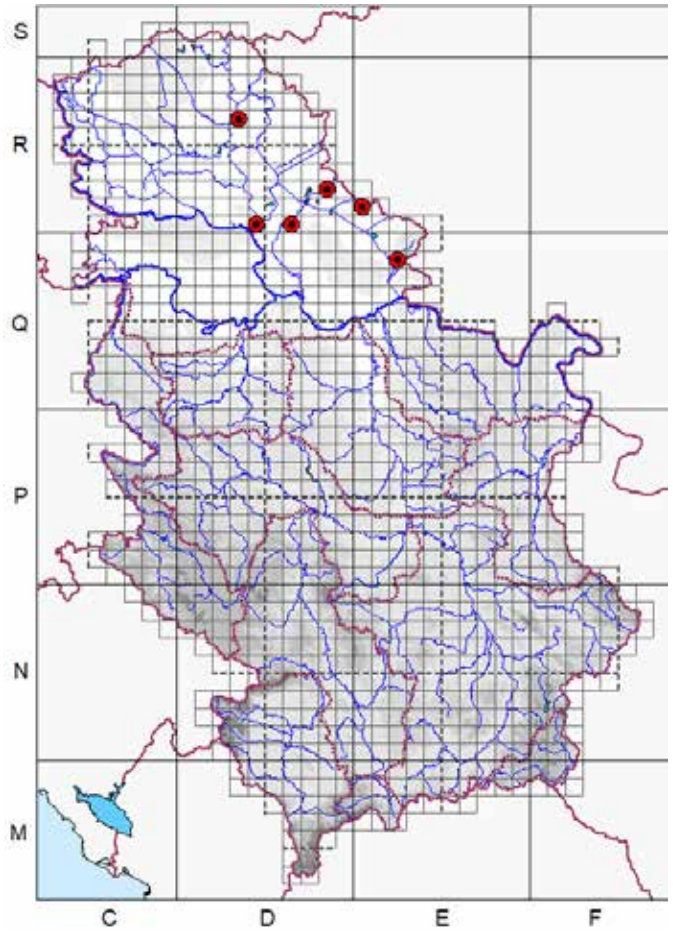
Description of the species

The body of the Danube white-finned gudgeon is elongated (Figure 119). The predorsal scales have longitudinal epithelial crests. The throat is scaleless. The head is 1.3 times as long as the maximum body width. The snout is shorter than or equal to the postorbital distance. The eye is large and its diameter is 0.8–1.5 times larger than the interorbital distance (Naseka, 2001). The barbels are long but do not extend beyond the posterior margin of the eye. The back is greenish-brown, while the belly is lighter. There are 8–10 dark spots on the flanks along the lateral line. The predorsal body length is greater than the postdorsal and the dorsal fin is situated behind the middle part of the body. The anal opening is either midway between the origin of the ventral fins and the anal fin or slightly closer to the anal fin. Fins: D III + 8; A II–III + 7; P I + 13–15. There are 37–43 scales in the lateral line, the number of vertebrae is 39–42 and the number of gill rakers on the first gill arch is 7–9 (Naseka, 2001; Friedrich, *et al*., 2018; Bogutskaya, *et al*., 2019). The maximum recorded standard body length (SL) is 11.5 cm. It lives up to 4 years (Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Govedarka / Danube white-finned gudgeon – *Romanogobio vladykovi*		Status
Međunarodna zaštita / International protection	IUCN Red List	LC
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Gobio albipinnatus*)	-
	Bernska konvencija / Bern Convention (navedena kao / listed as *Gobio albipinnatus*)	Dodatak / Appendix III, Rezolucija / Resolution 6
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fung (navedena kao / listed as *Romanogobio albipinnatus*)	Prilog / Annex I
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Gobio* spp.)	MLM, ODU*
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Gobio albipinnatus vladykovi*)	DD
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	VU E Zaštićena vrsta / Protected species

*MLM – minimalna lovna mera 10 cm, ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) /
MLM – minimum landing size at 10 cm standard length, ODU – daily catch limit of 5 kg (measure applies to all native species)



Slika 118. **Rasprostranjenje *Romanogobio vladykovi* u Srbiji.**

Figure 118. **Distribution of *Romanogobio vladykovi* in Serbia.**

Slika 119. Govedarka *Romanogobio vladykovi* (foto: Y. Kvach, https://commons.wikimedia.org/wiki/File:Romanogobio_vladykovi.jpg).

Figure 119. Danube white-finned gudgeon *Romanogobio vladykovi* (photo: Y. Kvach, https://commons.wikimedia.org/wiki/File:Romanogobio_vladykovi.jpg).

Populacione karakteristike

Govedarka je široko rasprostranjena vrsta u dunavskom basenu, mada je krajem XX veka zabeležen pad brojnosti populacija, najverovatnije usled izgradnje velikih brana na Dunavu (Kottelat & Freyhof, 2007). Od tada se brojnost populacija stabilizovala oko umerenih vrednosti. Populacije su veće u srednjem i donjem toku Dunava (Freyhof & Kottelat, 2008r).

Ekologija vrste

Polnu zrelost dostiže sa dve godine (Kottelat & Freyhof, 2007). Ženke se mreste i do četiri puta tokom jedne sezone, otprilike na svake dve nedelje od maja do jula (Freyhof & Kottelat, 2008r). Aktivna je noću, a hrani se larvama insekata i drugim beskičmenjacima dna (Kottelat & Freyhof, 2007).

Stanište

Govedarka živi u velikim i srednjim nizijskim rekama umerenog toka. Pridnena je vrsta koja preferira peskovito dno (Weiss, 2017). Juvenilne jedinke naseljavaju mirnije delove toka i rukavce. Zabeležene su i jezerske populacije (Kottelat & Freyhof, 2007).

Ribolovni značaj

Ova vrsta nema privredni značaj. U rekreativnom ribolovu ponekad se koristi kao mamac za hvatanje predatorskih vrsta riba (Porcellotti, n.d.g).

Faktori ugrožavanja

Na lokalnom nivou, populacije su ugrožene izgradnjom brana, fragmentacijom staništa, kao i zagađenjem i unošenjem alohtonih vrsta (posebno *Neogobius melanostomus*) (Ramler & Keckeis, 2019).

Population trends

The Danube white-finned gudgeon is a widespread species in the Danube basin, although there was a decline in populations at the end of the 20th century, probably due to the construction of large dams on the Danube (Kottelat & Freyhof, 2007). Since then, population numbers have stabilised at moderate levels. Populations are larger in the middle and lower reaches of the Danube (Freyhof & Kottelat, 2008r).

Ecology of the species

It reaches sexual maturity at the age of two years (Kottelat & Freyhof, 2007). Females spawn up to four times during a season, approximately every two weeks from May to July (Freyhof & Kottelat, 2008r). It is active at night and feeds on insect larvae and other bottom invertebrates (Kottelat & Freyhof, 2007).

Habitat

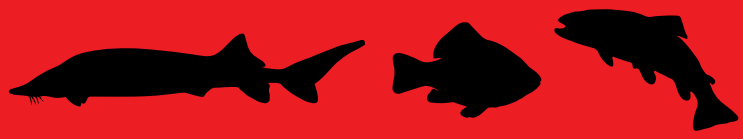
The Danube white-finned gudgeon lives in large and medium-sized lowland rivers with moderate flow. It is a demersal species that prefers a sandy bottom (Weiss, 2017). Juveniles reside in calmer parts of the river and backwaters. Populations have also been found in lakes (Kottelat & Freyhof, 2007).).

Importance in fisheries

This species is of no commercial fishery importance. In recreational fishing, it is sometimes used as bait to catch predatory species (Porcellotti, n.d.g).

Threats

Locally, populations are threatened by the construction of dams, habitat fragmentation and pollution, and the introduction of alien species (especially *Neogobius melanostomus*) (Ramler & Keckeis, 2019).



Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 7.3, 8.1.2, 9.1.3, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

Govedarka se, pod naučnim nazivom *Romanogobio albipinnatus*, nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu, navedenu kao *Gobio* spp., propisana je minimalna lovna mera od 10 cm standardne dužine tela (SL) i ograničenje dnevnog ulova do 5 kg.

Existing conservation measures

The Danube white-finned gudgeon is included under the scientific name *Romanogobio albipinnatus* in Appendix I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. As part of the *Regulation on Measures for the Conservation and Protection of Fish Stocks* for this species, listed as Gobio spp., a minimum catch size of 10 cm standard length (SL) and a daily catch of up to 5 kg are required.

Predložene mere zaštite

Potrebno je sprečiti degradaciju staništa, zagađivanje vode i pregrađivanje vodotoka.

Conservation actions needed

It is necessary to prevent habitat degradation, water pollution and damming of watercourses.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 2.2

S obzirom da o govedarki nema dovoljno podataka, neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije ove vrste, kao i faktora ugrožavanja.

As there is not enough data on the Danube white-finned gudgeon, the size, distribution and trends of its populations, life history and ecology, as well as threats need to be studied.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

SLATKOVODNA SLINGURA
Salariopsis fluviatilis (Asso, 1801)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Blenniiformes
Porodica: Blenniidae
Vrsta: *Salariopsis fluviatilis* (Asso, 1801)

Sinonimi

Blennius fluviatilis Asso, 1801; *Ichthyocoris fluviatilis* (Asso, 1801); *Lipophrys fluviatilis* Asso, 1801; *Salaria fluviatilis* (Asso, 1801); *Blennius frater* Bloch & Schneider, 1801; *Blennius vulgaris* Pollini, 1816; *Salariopsiss varus* Risso, 1827; *Blennius inaequalis* Valenciennes, 1836; *Blennius cagnota* Valenciennes, 1836; *Blennius lupulus* Bonaparte, 1840; *Blennius anticolus* Bonaparte, 1840; *Ichthyocoris pollinii* Bonaparte, 1846; *Blennius alpestris* Blanchard, 1866; *Blenius varus* (non Pallas, 1814)

Narodno ime: Slatkovodna slingura
Englesko ime: Freshwater blenny
Francusko ime: Blennie fluviatile, Baveuse, Blennie cagnette, Cagnote, Chasseur
Nemačko ime: Fluss-Schleimfisch
Rusko ime: Речная собачка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, slatkovodna slingura ne smatra se ugroženom vrstom (Crivelli, 2006h; Freyhof, 2010c). U Srbiji, slatkovodna slingura predstavlja ranjivu vrstu (VU), koja može postati kritično ugrožena ili iščeznuti zbog ograničene površine naseljavanja (AOO iznosi 15 km²) i malog broja lokaliteta, ukoliko se nastavi dejstvo nepovoljnih faktora (kriterijum D2). Obim rasprostranjenja ove vrste (EOO) u Srbiji iznosi 1.199 km².

Rasprostranjenje

Slatkovodna slingura naseljava sliv Sredozemnog mora u Evropi (Albanija, Bugarska, Crna Gora, Francuska, Grčka, Hrvatska, Portugalija, Španija, Italija), Aziji (Izrael, Sirija, Turska) i Africi (Alžir, Maroko) (Crivelli, 1996; 2006h; Kottelat & Freyhof, 2007). Verovatno se proširila i na sliv reke Garone (Francuska), a introdukovana je u jezero Ansi. Navodi se kao invazivna u subalpijskim jezerima Apeninskog poluostrva, ali se pokazalo da je u jezeru Mađore prisutna još od 1836. godine (Kottelat & Freyhof, 2007). U Srbiji živi u jadranskom slivu, u Belom Drimu i pritokama (Slika 120).

Opis vrste

Telo slatkovodne slingure je golo, bez krljušti (Slika 121). Leđa su maslinasto-zelena, sa zeleno-sivim bokovima i sivo-belim stomakom. Na bokovima je prisutno 7–10 nepravilnih tamnih mrlja. Po

FRESHWATER BLENNY
Salariopsis fluviatilis (Asso, 1801)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Blenniiformes
Family: Blenniidae
Species: *Salariopsis fluviatilis* (Asso, 1801)

Synonyms

Blennius fluviatilis Asso, 1801; *Ichthyocoris fluviatilis* (Asso, 1801); *Lipophrys fluviatilis* Asso, 1801; *Salaria fluviatilis* (Asso, 1801); *Blennius frater* Bloch & Schneider, 1801; *Blennius vulgaris* Pollini, 1816; *Salariopsiss varus* Risso, 1827; *Blennius inaequalis* Valenciennes, 1836; *Blennius cagnota* Valenciennes, 1836; *Blennius lupulus* Bonaparte, 1840; *Blennius anticolus* Bonaparte, 1840; *Ichthyocoris pollinii* Bonaparte, 1846; *Blennius alpestris* Blanchard, 1866; *Blenius varus* (non Pallas, 1814)

Vernacular name: Slatkovodna slingura
English name: Freshwater blenny
French name: Blennie fluviatile, Baveuse, Blennie cagnette, Cagnote, Chasseur
German name: Fluss-Schleimfisch
Russian name: Речная собачка

National threat category assessed according to IUCN criteria

At the global level, the freshwater blenny is not classified as a threatened species and has the status of Least Concern (LC) (Crivelli, 2006h; Freyhof, 2010c). In Serbia, the species is classified as Vulnerable (VU) and may face extinction if negative factors continue to affect it (criterion D2), due to the restricted area of occupancy (AOO is 15 km²) and number of locations where the species occurs. The extent of occurrence of this species (EOO) in Serbia is 1,199 km².

Distribution

The freshwater blenny inhabits the Mediterranean Sea basin in Europe (Albania, Bulgaria, Montenegro, France, Greece, Croatia, Portugal, Spain, Italy), Asia (Israel, Syria, Turkey) and Africa (Algeria, Morocco) (Crivelli, 1996; 2006h; Kottelat & Freyhof, 2007). It probably spread in the Garonne basin (France) and was introduced into Lake Annecy. In the subalpine lakes of the Apennine Peninsula it is considered invasive, but in Lake Maggiore it has been documented since 1836 (Kottelat & Freyhof, 2007). In Serbia, it lives in the Adriatic Sea basin, in the White Drim and its tributaries (Figure 120).

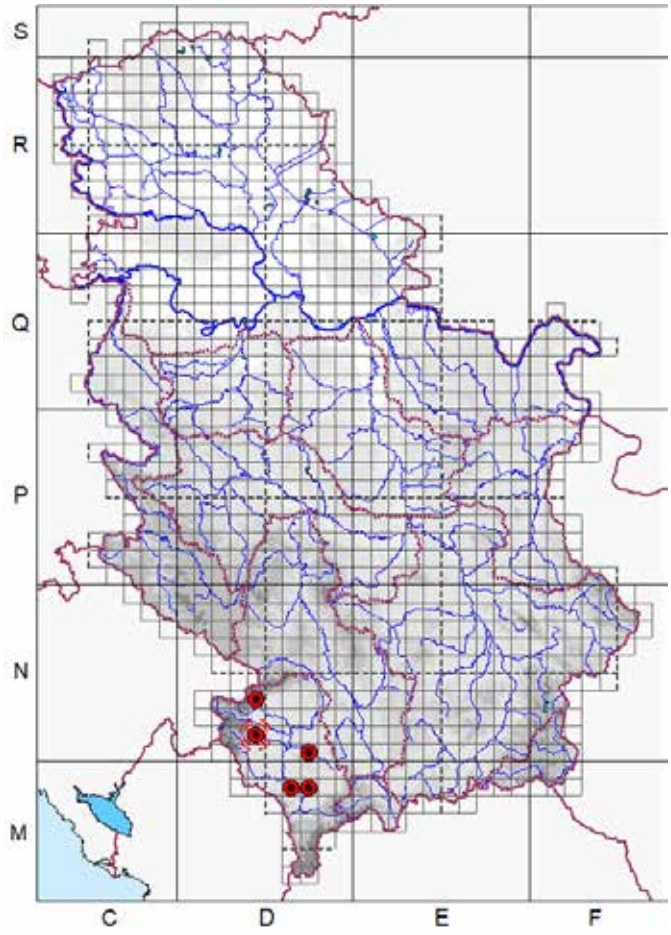
Description of the species

The body of the freshwater blenny is scaleless (Figure 121). The back is olive green with green-grey flanks and a grey-white belly. There are 7–10 irregular dark spots on the flanks and reddish spots

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Slatkovodna slingura / Freshwater blenny – *Salariopsis fluviatilis*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex II**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Parablennius fluviatilis*)	**VU**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **D2** **Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 120. **Rasprostranjenje *Salariopsis fluviatilis* u Srbiji.**

Figure 120. **Distribution of *Salariopsis fluviatilis* in Serbia.**

Slika 121. Slatkovodna slingura *Salariopsis fluviatilis* (foto: A. L. Martín Ojeda, https://www.dreamstime.com/specimen-photographed-aquarium-guadiana-river-basin-spain-freshwater-blenny-salaria-fluviatilis-species-image207373113).

Figure 121. The freshwater blenny *Salariopsis fluviatilis* (photo: A. L. Martín Ojeda, https://www.dreamstime.com/specimen-photographed-aquarium-guadiana-river-basin-spain-freshwater-blenny-salaria-fluviatilis-species-image207373113).

leđnom peraju se nalaze crvenkaste mrlje. Obojenost može da varira i zavisi od pola, veličine i polne aktivnosti jedinke. Iza oka postoji dijagonalna traka sačinjena od sitnih mrlja. Dužina glave iznosi 25–31% standardne dužine tela (SL). Iznad nadočnih lukova ima granate izraštaje sa resicama na vrhu. U gornjoj vilici ima 16–24 zuba, a u donjoj 16–20 zuba. Leđno peraje je dugo, kao i podrepno. Trbušna peraja se nalaze ispred grudnih peraja. Peraja: D XII–XIII + 16–18; A II + 16–19; P I + 13; V 3 (Kottelat, 2004). Kičmenih pršljenova je 36. Maksimalna dužina tela iznosi 15,4 cm (Laporte *et al*., 2012), dok je prosečna dužina oko 8 cm (Muus & Dahlström, 1968). Maksimalna zabeležena starost je 5 godina (Kottelat & Freyhof, 2007).

Populacione karakteristike

Slatkovodna slingura ima stabilne populacije, mada su podaci za ovu vrstu malobrojni. Na nekim lokalitetima populacije imaju malu brojnost, dok su na drugim mestima prisutne populacije velike brojnosti. Populacije su veoma fragmentisane (Crivelli, 2006h; Freyhof, 2010c). U rekama u Francuskoj zabeležen je značajan pad u gustini populacija u periodu od 1990. do 2009. godine (Poulet *et al*., 2011). U Srbiji, populacione krakteristike ove vrste nisu poznate.

Ekologija vrste

Slatkovodna slingura stiče polnu zrelost u prvoj godini. Ženke mogu da se razmnožavaju tri godine, ali većina umire na kraju prve godine. Više ženki može da se mresti sa jednim mužjakom. Mrest je porcioni, a vreme mresta može biti različito: april-jul (Italija i Španija), maj-avgust (Francuska), a na nekim lokacijama (Izrael) mrest traje cele godine, ali je najintenzivniji od marta do jula (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). Za mrest je neophodno da temperatura vode bude iznad 18 °C. Mužjak gradi gnezdo, čisti i čuva oplođena jaja (Bath, 1986). Ženka polaže i do 1.200 jaja (najon the dorsal fin. The colouration can vary and depends on the sex, size and sexual activity of the individual. There is a diagonal band of tiny dots behind the eye. The head length is 25–31% of the standard body length (SL). Above the supraorbital arch is a branched cirrus. There are 16–24 teeth in the upper jaw and 16–20 teeth in the lower jaw. The dorsal and anal fins are long. The ventral fins are jugular (placed in front of pectoral fins). Fins: D XII–XIII + 16–18; A II + 16–19; P I + 13; V 3 (Kottelat, 2004). The number of vertebrae is 36. The maximum length of the body is 15.4 cm (Laporte *et al*., 2012), while the average length is about 8 cm (Muus & Dahlstroem, 1968). The maximum age is 5 years (Kottelat & Freyhof, 2007).

Population trends

The freshwater blenny has stable populations, although data for this species are sparse. At some locations, the populations are small in number, while in other locations populations are abundant. Populations are highly fragmented (Crivelli, 2006h; Freyhof, 2010c). In rivers in France, a significant decline in population density was observed between 1990 and 2009 (Poulet *et al*., 2011). In Serbia, the population characteristics of this species are not known.

Ecology of the species

The freshwater blenny reaches sexual maturity in its first year. Females can reproduce for three years, but most die at the end of the first year. Several females may spawn with one male. Spawning occurs in portions and the timing of spawning may vary: April-July (Italy and Spain), May-August (France), and in some places (Israel) spawning lasts throughout the year, but is most intense from March to July (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). For spawning, the water temperature must be above 18 °C. The male builds the nest, cleans and guards the fertilised eggs (Bath, 1986). The female lays up

češće 200-300), ispod kamenja. Larve se izvaljaju nakon jedne do dve nedelje. Larve su planktonske oko 6 nedelja, dok ne dostignu dužinu od 1,5 cm (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). Odrasle jedinke koje naseljavaju reke krupnije su od jezerskih jedinki. Polni dimorfizam je izraženiji u rekama u odnosu na jezera (Neat *et al*., 2003; Laporte *et al*., 2018). Pridnena je vrsta. Hrani se sitnim beskičmenjacima bentosa, larvama i lutkama insekata, kao i ribljom mlađi. U periodima sa smanjenom količinom hrane, slatkovodna slingura pribegava kanibalizmu i hrani se oplođenim jajima. Ovakvo ponašanje je prisutnije kod mužjaka (Vinyoles *et al*., 1999).

Stanište

Slatkovodna slingura živi u slatkoj i brakičnoj vodi. Odrasle jedinke se javljaju u rekama i potocima, u relativno plitkoj vodi, na malim nadmorskim visinama (Bath, 1986). Ova vrsta se može naći i u litoralnoj zoni jezera, a ponekad i u lagunama sa niskim salinitetom (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). Preferira kamenito dno, ali se u jezerima sitnije jedinke mogu naći i na peskovitom dnu. Za odrasle jedinke koje naseljavaju rečne sisteme, glavni povoljni faktor staništa koji utiče na brojnost populacija jeste veća brzina protoka vode (Laporte *et al*., 2014). Za razmnožavanje jezerskih populacija neophodni su visok vodostaj i dostupnost kamenitnog dna (Gasith & Goren, 2009).

Ribolovni značaj

Slatkovodna slingura nema nikakav ribolovni značaj.

Faktori ugrožavanja

Značajan faktor ugrožavanja jeste narušavanje staništa koje se ogleda u izvlačenju šljunka, zamuljivanju vode, kao i promenama u morfologiji reka (izgradnja brana i kanala koji fragmentiraju stanište). Posebno su ugrožene pelaške larve kojima je neophodno nenarušeno stanište nizvodno od mrestilišta (Kottelat & Freyhof, 2007). Nekontrolisano crpljenje vode i drastičniji sušni periodi mogu ugroziti reprodukciju ove vrste (Crivelli, 1996; 2006h). Pad brojnosti može biti i posledica pritiska alohtonih predatorskih vrsta. Nizak genetički diverzitet i veliki stepen inbridinga takođe su problem u izolovanim populacijama (Laporte *et al*., 2016).

to 1,200 eggs (usually 200-300) under rocks. The larvae hatch after one to two weeks. They are planktonic for about 6 weeks until they reach a length of 1.5 cm (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). Adults living in rivers are larger than those from lakes. Sexual dimorphism is more pronounced in rivers than in lakes (Neat *et al*., 2003; Laporte *et al*., 2018). It is a demersal species. It feeds on small benthic invertebrates, insect larvae and pupae, and juvenile fish. In times of reduced food supply, the freshwater blenny resorts to cannibalism and feeds on fertilised eggs. This behaviour is more common in males (Vinyoles *et al*., 1999).

Habitat

The freshwater blenny lives in fresh and brackish waters. Adults live in rivers and streams in relatively shallow water and at low altitudes (Bath, 1986). This species is also found in the littoral zone of lakes and sometimes in lagoons with low salinity (Kottelat & Freyhof, 2007; Gasith & Goren, 2009). It prefers a rocky bottom, but in lakes smaller individuals can also be found on sandy bottoms. For adults living in rivers, the most important favourable habitat factor affecting population size is a higher water flow velocity (Laporte *et al*., 2014). For lake populations, a high water level and the presence of a rocky bottom are necessary for reproduction (Gasith & Goren, 2009).

Importance in fisheries

The freshwater blenny is of no fishery importance.

Threats

An important risk factor is habitat disturbance, which is reflected in the removal of gravel, siltation of the water and alteration of the river morphology (construction of dams and channels that fragment the habitat). Pelagic larvae are particularly vulnerable and need undisturbed habitats downstream of the spawning grounds (Kottelat & Freyhof, 2007). Uncontrolled water withdrawal and more drastic dry periods can threaten the reproduction of this species (Crivelli, 1996; 2006h). Population declines may also be due to pressure from non-native predatory species. Low genetic diversity and high levels of inbreeding are also a problem in isolated populations (Laporte *et al*., 2016).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	3.2, 7.2.8, 8.1.1, 9.3.1, 9.3.2, 11.2

Postojeće mere zaštite

Slatkovodna slingura se nalazi u Prilogu II *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status zaštićene vrste.

Predložene mere zaštite

Neophodno je smanjiti nivo zagađivanja vode, kao i druge oblike narušavanje staništa. Od posebnog je značaja očuvanje staništa koja naseljavaju larve.

Conservation actions in place

The freshwater blenny is listed in Annex II of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a protected species.

Conservation actions needed

It is necessary to reduce water pollution and other forms of habitat destruction. Of particular importance is the conservation of habitats inhabited by the larvae.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 1.2, 2.1, 2.2, 2.3

Potrebno je utvrditi veličinu populacija, populacione trendove i stepen fragmentisanosti populacija, uz razvoj odgovarajućih programa monitoringa.

It is necessary to determine the size of populations, population trends and the degree of fragmentation of populations, and to develop appropriate monitoring programmes.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Srđan Subotić

DRIMSKO-SKADARSKI KLEN *Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010

Sinonimi

Nema

Narodno ime: Drimsko-skadarski klen
Englesko ime: River Drin chub, Skadar lake chub
Nemačko ime: Drin-Döbel

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, drimsko-skadarski klen nema status ugrožene vrste (Freyhof, 2011g). U Srbiji, drimsko-skadarski klen ima status ranjive vrste (VU) zbog malog obima rasprostranjenja (EOO iznosi 1.199 km²), male površine naseljavanja (AOO iznosi 28 km²) i malog broja lokaliteta na kojima se vrsta javlja – kriterijumi B1ab+2ab.

Rasprostranjenje

Drimsko-skadarski klen naseljava sliv reke Drim i basen Skadarskog jezera u Crnoj Gori, Albaniji i Srbiji. Živi i u Šaskom jezeru, reci Radiki i srednjem i donjem toku Morače i Zete (Zupančič *et al*., 2010; Freyhof, 2011g). Prema novijim istraživanjima, postoji mogućnost da je i klen iz Ohridskog jezera ista vrsta kao i klen iz reke Vojuše u Grčkoj (*Squalius* sp. Aoos) (Kottelat & Freyhof, 2007; Geiger *et al*., 2014). U Srbiji živi u slivu Belog Drima (Slika 122). Ranije se smatralo da je klen koji naseljava sliv Drima *Squalius albus* (Vuković & Ivanović, 1971; Drecun *et al*., 1985; Marić, 1995; Marić & Krivokapić, 1997).

Opis vrste

Telo drimsko-skadarskog klena je iduženo i blago bočno spljošteno (Slika 123). Usta su subterminalna, sa isturenom gornjom usnom. Boja tela je sivkasta sa nizom crno pigmentisanih tačaka duž leđa i bokova, koje formiraju pravilnu mrežastu šaru. Grudna, trbušna, podrepno i repno peraje imaju intenzivnu crnu boju. Kod polno zrelih mužjaka na glavi i leđima razvijaju se mresne kvržice. Zadnja ivica leđnog peraja je ravna, kod nekih jedinki blago konveksna u donjem delu. Leđno peraje se nalazi u ravni ili nešto iza kraja osnove trbušnih peraja. Peraja: D III + 9; A III + 9. Broj krljušti u bočnoj liniji je 43–47 (obično 44–45), broj kičmenih pršljenova 43, a broj branhiospina 8–10 (Zupančič *et al*., 2010). Ždrelni zubi su dvoredni, kukasti i nazubljeni, DF 2.5–5.2. Naraste do 40 cm. Maksimalna zabeležena dužina tela iznosi 47,2 cm, a maksimalna masa 1,2 kg (Milošević & Mrdak, 2016).

RIVER DRIN CHUB *Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010

Synonyms

None

Vernacular name: Drimsko-skadarski klen
English name: River Drin chub, Skadar lake chub
German name: Drin-Döbel

National threat category assessed according to IUCN criteria

At the global level, the River Drin chub is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EAO is 1,199 km²), the small area of occupancy (AOO is 28 km²) and the low number of locations where it occurs – criteria B1ab+2ab.

Distribution

The River Drin chub inhabits the Drim basin and the basin of Lake Skadar in Montenegro, Albania and Serbia. It also lives in Lake Šasko, the Radika River and the middle and lower reaches of the Morača and Zeta rivers (Zupančič *et al*., 2010; Freyhof, 2011g). According to recent studies, there is a possibility that the chub from Lake Ohrid is the same species as the chub from the Aoös/Vjosa River in Greece (*Squalius* sp. Aoos) (Kottelat & Freyhof, 2007; Geiger *et al*., 2014). In Serbia, it lives in the White Drim watershed (Figure 122). Previously, it was assumed that the chub living in the Drim basin was *Squalius albus* (Vuković & Ivanović, 1971; Drecun *et al*., 1985; Marić, 1995; Marić & Krivokapić, 1997).

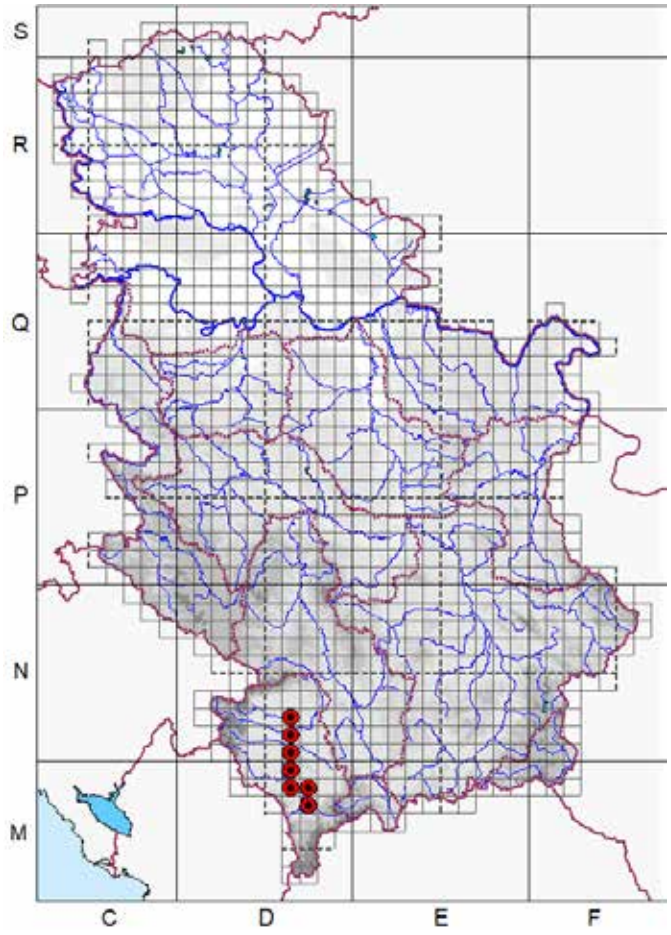
Description of the species

The body of the River Drin chub is elongated and slightly flattened laterally (Figure 123). The mouth is subterminal, with a protruding upper lip. The body colour is greyish with a series of black pigmented spots along the back and flanks forming a regular reticulated pattern. The pectoral, ventral, anal and caudal fins are intensely black in colour. In sexually mature males, nuptial tubercles develop on the head and back. The posterior margin of the dorsal fin is straight, in some specimens it is slightly convex in the lower part. The dorsal fin is in line with or slightly behind the end of the base of the ventral fins. Fins: D III + 9; A III + 9. The number of scales in the lateral line is 43–47 (usually 44–45), the number of vertebrae is 43, and the number of gill rakers is 8–10 (Zupančič *et al.*, 2010). The pharyngeal teeth are in two rows, hooked and serrated, DF 2.5–5.2. It grows up to 40 cm. The maximum recorded body length is 47.2 cm and the maximum mass is 1.2 kg (Milošević & Mrdak, 2016).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Drimsko-skadarski klen / River Drin chub, Skadar lake chub – *Squalius platyceps*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	-
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab+2ab Zaštićena vrsta / Protected species**

*ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) / daily catch limit of 5 kg (measure applies to all native species)



Slika 122. **Rasprostranjenje *Squalius platyceps* u Srbiji.**

Figure 122. **Distribution of *Squalius platyceps* in Serbia.**

Slika 123. Drimsko-skadarski klen *Squalius platyceps* (foto: Zupančič *et al.*, 2010).

Figure 123. River Drin chub *Squalius platyceps* (photo: Zupančič *et al.*, 2010).

Populacione karakteristike

Populacioni trend drimsko-skadarskog klena nije poznat, iako su populacije brojne (Freyhof, 2011g; Grapci-Kotori *et al.*, 2020).

Ekologija vrste

Polnu zrelost stiče krajem prve i u drugoj godini života. Mresti se od aprila do juna, u brzoj vodi sa dosta kiseonika, na podlozi od peska, šljunka ili kamenja. Mrest je porcioni, u razmacima od nekoliko dana. Omnivorna je vrsta, hrani se uglavnom beskičmenjacima dna, ali i algama i detritusom. Odrasle jedinke konzumiraju i ribu i punoglavce. Živi u jatima koja se sastoje uglavnom od jedinki istog uzrasta (Porcellotti, n.d.d).

Stanište

Drimsko-skadarski klen je bentopelagična vrsta. Živi u jezerima i rekama.

Ribolovni značaj

U Srbiji, ova vrsta nema privredni značaj. U Crnoj Gori predstavlja značajnu ribolovnu vrstu u sportsko-rekreativnom ribolovu (Milošević & Talevski, 2015).

Faktori ugrožavanja

Nema posebnih ugrožavajućih faktora i pored toga što je područje rasprostranjenja drimsko-skadarskog klena malo (Freyhof, 2011g). Ugrožavajući faktori se uglavnom odnose na ugrožavanje staništa izazvano zagađivanjem otpadnim vodama različitog porekla, pregrađivanjem i regulacijom tokova, kao i unošenjem alohtonih invazivnih vrsta.

Population trends

The population trends of the River Drin chub are not known, although populations are abundant (Freyhof, 2011g; Grapci-Kotori *et al.*, 2020).

Ecology of the species

It reaches sexual maturity at the end of its first year and in its second year. It spawns from April to June in swift, oxygen-rich water on a substrate of sand, gravel or stones. Spawning takes place in portions at intervals of several days. It is an omnivore and feeds mainly on bottom invertebrates, but also on algae and detritus. Adults also consume fish and tadpoles. It lives in shoals consisting mainly of individuals of the same age (Porcellotti, n.d.d).

Habitat

The River Drin chub is a benthopelagic species. It lives in lakes and rivers.

Importance in fisheries

In Serbia, this species is of no commercial fishery importance. In Montenegro, it is an important fish species in sport and recreational fishing (Milošević & Talevski, 2015).

Threats

Despite the fact that the range of the River Drin chub is small, there are no particular threat factors (Freyhof, 2011g). Threats to the habitat arise mainly from pollution by effluents from various sources, damming and regulation of watercourses, and the introduction of non-native invasive species.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 7.3, 8.1.1, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Drimsko-skadarski klen nije obuhvaćen postojećim merama zaštite.

Conservation actions in place

The River Drin chub does not fall under the existing conservation measures.

Predložene mere zaštite

Ne postoje specifične mere zaštite vrste koje se predlažu. Trebalo bi poboljšati opšte mere koje se tiču sprečavanja degradacije staništa, zagađenja vode i pregrađivanja vodotoka.

Conservation actions needed

No specific species protection measures are proposed. General measures to prevent habitat destruction, water pollution and damming of watercourses should be improved.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1

Zbog nedostatka podataka, neophodna su istraživanja veličine i distribucije populacija, populacionih trendova, životne istorije, ekologije i faktora ugrožavanja.

Due to the lack of data, research on population size and distribution, population trends, life history, ecology and threats is needed.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Jasmina Krpo-Ćetković

VARDARSKI KLEN
Squalius vardarensis Karaman, 1928

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Squalius vardarensis* Karaman, 1928

Sinonimi

Squalius cephalus vardarensis Karaman 1928; *Leuciscus cephalus vardarensis* (Karaman, 1928)

Narodno ime: Vardarski klen
Englesko ime: Vardar chub

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, vardarski klen nema status ugrožene vrste (Freyhof & Kottelat, 2008u). U Srbiji, vardarski klen ima status ranjive vrste (VU), kako zbog veličine obima rasprostranjenja (EOO iznosi 666 km²), tako i zbog veoma male površine naseljavanja (AOO iznosi 24 km²). Osim toga, ustanovljen je i mali broj lokaliteta na kojima se vrsta javlja, kontinuirano smanjivanje obima rasprostranjenja i površine naseljavanja, kao i opadanje kvaliteta staništa – kriterijumi B1ab(i,ii,iii)+2ab(i,ii,iii).

Rasprostranjenje

Vardarski klen nastanjuje reke egejskog sliva, od Sperhiosa do Vardara, u Grčkoj i Severnoj Makedoniji (Kottelat & Freyhof, 2007). U Srbiji je registrovan u slivu Pčinje (Slika 124).

Opis vrste

Telo vardarskog klena je izduženo, leđa su zelenkasta, a stomak beo (Slika 125). Od ostalih vrsta roda *Squalius* sa Balkanskog poluostrva razlikuje se po sledećim morfološkim karakteristikama: usta su terminalna, gornja usna nije isturena, dužina glave je gotovo jednaka visini tela (1–1,2 puta veća) i čini 25–29% standardne dužine tela (SL), a dijametar oka čini 20–26% dužine glave (Kottelat & Freyhof, 2007). Peraja: D III + 8½; A III + 8½; P I + 14–16; V II + 7–8 (Porcellotti, n.d.e; Šorić, 2007). Rastojanje između prve i poslednje granate žbice podrepnog peraja jednako je ili nešto veće od visine repnog stabla. Zadnja ivica podrepnog peraja je konveksna. U bočnoj liniji ima 41–44 krljušti. Najveća zabeležena standardna dužina tela (SL) iznosi 16 cm (Kottelat & Freyhof, 2007).

Populacione karakteristike

Populacioni trend ove vrste nije poznat, ali su populacije brojne (Freyhof & Kottelat, 2008u).

VARDAR CHUB
Squalius vardarensis Karaman, 1928

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Squalius vardarensis* Karaman, 1928

Synonyms

Squalius cephalus vardarensis Karaman 1928; *Leuciscus cephalus vardarensis* (Karaman, 1928)

Vernacular name: Vardarski klen
English name: Vardar chub

National threat category assessed according to IUCN criteria

At the global level, the Vardar chub is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008u). In Serbia, the species is classified as Vulnerable (VU) due to the small extent of occurrence (EOO is 666 km²) and the very small area of occupancy (AOO is 24 km²). In addition, a low number of locations where the species occurs, a continuing decline in the extent of occurrence and area of occupancy, as well as in habitat quality, were observed – criteria B1ab(i,ii,iii)+2ab(i,ii,iii).

Distribution

The Vardar chub inhabits the rivers of the Aegean Sea basin, from Sperchios to Vardar in Greece and Northern Macedonia (Kottelat and Freyhof, 2007). In Serbia, it is recorded in the Pčinja watershed (Figure 124).

Description of the species

The body of the Vardar chub is elongated, the back is greenish and the belly white (Figure 125). It differs from other species of the genus *Squalius* from the Balkan Peninsula in the following morphological features: the mouth is terminal, the upper lip does not protrude, the length of the head is almost equal to the body size (1–1.2 times longer) and accounts for 25–29% of the standard body length (SL) and the eye diameter is 20–26% of the head length (Kottelat & Freyhof, 2007). Fins: D III + 8½; A III + 8½; P I + 14–16; V II + 7–8 (Porcellotti, n.d.e.; Šorić, 2007). The distance between the first and the last branched ray of the anal fin is equal to or slightly greater than the depth of the caudal peduncle. The distal margin of the dorsal fin is convex. There are 41–44 scales in the lateral line. The largest recorded standard body length (SL) is 16 cm (Kottelat & Freyhof, 2007).

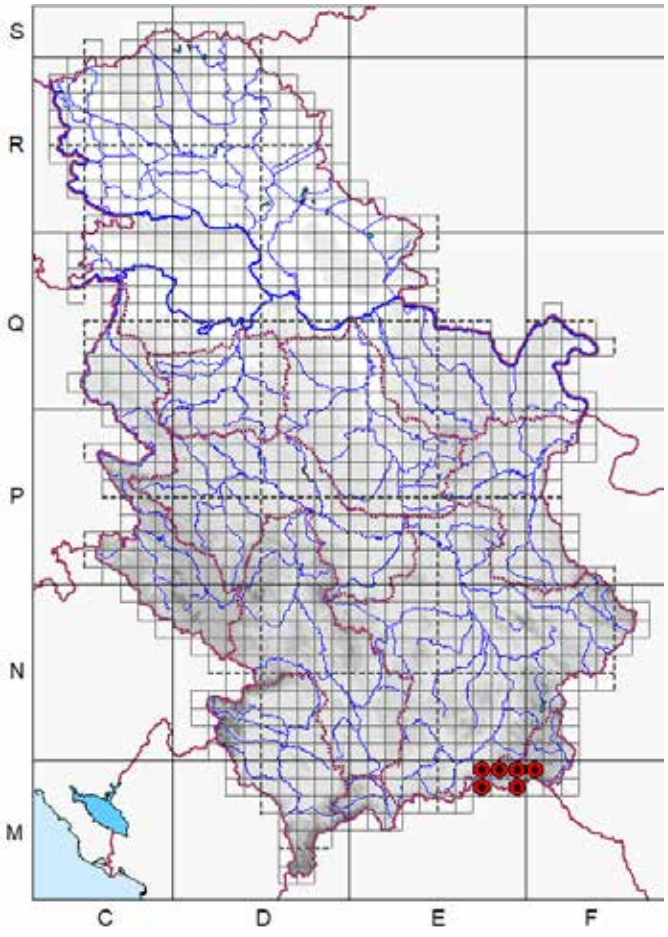
Population trends

The population trends of this species are not known, but populations are abundant (Freyhof & Kottelat, 2008u).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislatio**

	Vardarski klen / Vardar chub – *Squalius vardarensis*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	–
	Evropska direktiva o staništima / European Habitats Directive	–
	Bernska konvencija / Bern Convention	–
	Bonska konvencija / Bonn Convention	–
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex II**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**MLM, ODU**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	–
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU B1ab(i,ii,iii)+2ab(i,ii,iii) Strogo zaštićena vrsta / Strictly protected species**

*L – lovostaj od 15. aprila do 31. maja, MLM – minimalna lovna mera 20 cm, ODU – ograničenje dnevnog ulova na 10 komada ili 5 kg /
L – closed season from April 15 to May 31, MLM – minimum landing size at 20 cm standard length, ODU – daily catch limit of 10 individuals or 5 kg



Slika 124. **Rasprostranjenje *Squalius vardarensis* u Srbiji.**

Figure 124. **Distribution of *Squalius vardarensis* in Serbia.**

Slika 125. Vardarski klen *Squalius vardarensis* (foto: D. Koutsogiannopoulos, https://www.naturagraeca.com/ws/208,,1,2,Freshwater-Fishes).

Figure 125. Vardar chub *Squalius vardarensis* (photo: D. Koutsogiannopoulos, https://www.naturagraeca.com/ws/208,,1,2,Freshwater-Fishes).

Ekologija vrste

Vardarski klen je bentopelagična, reofilna vrsta. Polnu zrelost dostiže u drugoj ili trećoj godini života. Mresti se u maju i junu. Mrest je porcioni, ikru polaže u 2–3 navrata sa razmakom od nekoliko dana. Ishrana je omnivorna, hrani se larvama insekata i drugim beskičmenjacima bentosa, a povremeno kozumira i alge i detritus, kao i terestrične insekte koji upadnu u vodu (Porcellotti, n.d.e).

Stanište

Vardarski klen naseljava potoke i reke sa čistom vodom i jačim vodenim strujanjem, najčešće na mešanom supstratu od kamena, šljunka i peska.

Ribolovni značaj

Vrsta nema poseban ribolovni značaj. Ponekad predstavlja sporedni ulov pri ribolovu drugih vrsta.

Faktori ugrožavanja

Glavni faktor ugrožavanja vardarskog klena jesu degradacija i fragmentacija staništa usled izgradnje mini hidrocentrala na čitavom slivnom području Pčinje. U ostalom delu areala nisu poznati faktori ugrožavanja.

Ecology of the species

The Vardar chub is a benthopelagic, rheophilic species. It reaches sexual maturity at the age of 2–3 years. It spawns in May and June. Spawning takes place in portions, 2–3 times at intervals of several days. It is an omnivore, feeding on insect larvae and other benthic invertebrates and occasionally consuming algae and detritus as well as terrestrial insects that have fallen into the water (Porcellotti, n.d.e).

Habitat

The Vardar chub inhabits streams and rivers with clear water and swift flow, usually on a mixed substrate of rock, gravel and sand.

Importance in fisheries

The species is of no fishery importance. Sometimes it is a bycatch in fishing for other species.

Threats

The most important factor threatening the Vardar chub is the degradation and fragmentation of its habitat due to the construction of mini-hydropower plants throughout the Pčinja River basin. No threats are know for the rest of its range.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.9, 8.1.1, 9.1.3, 9.3.4, 11.2

Postojeće mere zaštite

Vardarski klen nije obuhvaćen postojećim merama zaštite.

Conservation actions in place

The Vardar chub is not covered by the existing protection measures.

Predložene mere zaštite

Potrebno je sprečiti izgradnju novih brana, a na postojećim održavati funkcionalnost ribljih staza uz poštovanje biološkog minimuma.

Conservation actions needed

It is necessary to prevent the construction of new dams and to maintain the functionality of fish ladders at existing dams, taking into account the biological minimum.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.3

Neophodna su istraživanja veličine, distribucije i trendova populacije, životne istorije, ekologije, kao i faktora ugrožavanja ove vrste, uz razvoj odgovarajućih programa monitoringa.

Research on population size, distribution and trends, life history, ecology and factors threatening this species is needed, as well as the development of appropriate monitoring programmes.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Stefan Skorić

LINJAK
Tinca tinca (Linnaeus, 1758)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Tincidae
Vrsta: *Tinca tinca* (Linnaeus, 1758)

Sinonimi

Cyprinus tinca Linnaeus, 1758; *Cyprinus tincaauratus* Bloch, 1782; *Cyprinus zeelt* Lacepède, 1803; *Cyprinus tincaurea* Shaw, 1804; *Tinca vulgaris* Fleming, 1828; *Tinca chrysitis* Fitzinger, 1832; *Tinca italica* Bonaparte, 1836; *Tinca communis* Swainson, 1839 *Tinca limosa* Koch, 1840; *Tinca linnei* Malm, 1877; *Tinca vulgaris cestellae* Segre, 1904

Narodno ime: Linjak
Englesko ime: Tench
Francusko ime: Tanche
Nemačko ime: Schleie
Rusko ime: Линь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, linjak se ne smatra ugroženom vrstom (Freyhof & Kottelat, 2008z; Freyhof, 2010d). U Srbiji, na osnovu kvantitativne analize (kriterijum E) koja ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina, linjak ima status ranjive vrste (VU). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 54.375 km², dok je površina naseljavanja (AOO) 336 km².

Rasprostranjenje

Linjak ima široko evroazijsko rasprostranjenje, ali je zbog veštačkog uzgoja i prenošenja tokom prošlosti originalna distribucija ove vrste i dalje nerazjašnjenja. Nativan je za veći deo Evrope, a prirodno ga nema u Irskoj, Skandinaviji (severno od 61°30' N), istočnom delu basena Jadranskog mora i zapadnoj i južnoj Grčkoj (gde je introdukovan). U Aziji naseljava vode istočno do sliva Jeniseja južno od 60° N. Introdukovan je u Afriku, Tasmaniju, Australiju, Novi Zeland, Indiju, Severnu Ameriku, Čile, a verovatno i šire (Kottelat & Freyhof, 2007). Linjak u Srbiji naseljava sliv Save, Dunava, Velike Morave, Zapadne Morave i Južne Morave, a široko je rasprostranjen u vodama Vojvodine (Slika 126). Uspešno je introdukovan i aklimatizovan u mnogim akumulacijama (Perućac, Zaovine, Vlasinsko jezero i dr.). Postoje publikovani nalazi pojedinačnih primeraka i za vode jadranskog sliva u Srbiji, u koje je takođe introdukovan.

Opis vrste

Linjak je jedina vrsta svoga roda i, kao takav, lako je prepoznatljiv jer ga karakteriše jedinstven spoljašnji izgled (Slika 127). Leđa

TENCH
Tinca tinca (Linnaeus, 1758)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Tincidae
Species: *Tinca tinca* (Linnaeus, 1758)

Synonyms

Cyprinus tinca Linnaeus, 1758; *Cyprinus tincaauratus* Bloch, 1782; *Cyprinus zeelt* Lacepède, 1803; *Cyprinus tincaurea* Shaw, 1804; *Tinca vulgaris* Fleming, 1828; *Tinca chrysitis* Fitzinger, 1832; *Tinca italica* Bonaparte, 1836; *Tinca communis* Swainson, 1839 *Tinca limosa* Koch, 1840; *Tinca linnei* Malm, 1877; *Tinca vulgaris cestellae* Segre, 1904

Vernacular name: Linjak
English name: Tench
French name: Tanche
German name: Schleie
Russian name: Линь

National threat category assessed according to IUCN criteria

At the global level, the tench is not classified a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008z; Freyhof, 2010d). In Serbia, the species is classified as Vulnerable (VU) based on the quantitative analysis (criterion E), which shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence of the species (EOO) in Serbia is 54,375 km², while the area of occupancy (AOO) is 336 km².

Distribution

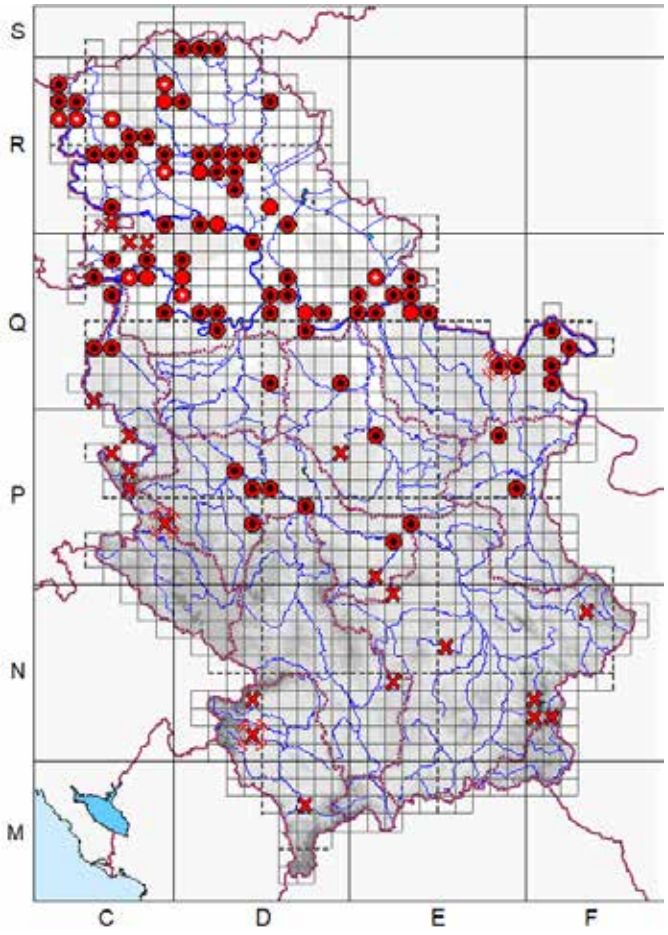
The tench has a large Eurasian range, but due to artificial breeding and transfer in the past, the original distribution of this species is still unclear. It is native to most of Europe and does not occur naturally in Ireland, Scandinavia (north of 61°30' N), the eastern part of the Adriatic Sea basin and western and southern Greece (where it was introduced). In Asia, it occurs east of the Yenisei Basin south of 60° N. It has been introduced to Africa, Tasmania, Australia, New Zealand, India, North America, Chile and probably further afield (Kottelat & Freyhof, 2007). In Serbia, the tench inhabits the Sava, Danube, Great Morava, West Morava and South Morava river basins and is widespread in Vojvodina (Figure 126). It has been successfully introduced and acclimatised in many reservoirs (Perućac, Zaovine, Lake Vlasina, etc.). For the Adriatic Sea basin in Serbia, where it was also introduced, there are published records of individual specimens.

Description of the species

The tench is the only species of its genus and is easily recognised as such because it has a unique external appearance (Figure 127). The

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Linjak / Tench – *Tinca tinca*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Strogo zaštićena vrsta / Strictly protected species**



Slika 126. Rasprostranjenje *Tinca tinca* u Srbiji.

Figure 126. Distribution of *Tinca tinca* in Serbia.

Slika 127. Linjak *Tinca tinca* (foto: A. Bajić).

Figure 127. Tench *Tinca tinca* (photo: A. Bajić).

su maslinasto-zelena, bokovi zelenkasto-žuti, stomak žut, a oči crveno-narandžaste. Poseduje snažno i visoko telo pokriveno sitnim krljuštima koje su duboko usađene u kožu. Trbuh je zaobljen. Usta su terminalna, sa dva brka, po jedan u svakom uglu. Repno stablo je izrazito visoko, dok su peraja zaobljena. Polni dimorfizam se ogleda u tome da mužjaci imaju zadebljalu i pljosnatu drugu žbicu trbušnih peraja i duža trbušna i grudna peraja od ženki. Peraja: D III + 8; A III + 6–8. Bočna linija je potpuna, sa 87–115 krljušti. Ždrelni zubi su jednoredni, DF (4)5-5(4). Na prvom škržnom luku ima 12–13 branhiospina. Naraste do 70 cm i 8 kg, a najveća zabeležena dužina tela iznosi 84 cm (Page & Burr, 2011). Dostiže starost do 20 godina (Kottelat & Freyhof, 2007).

Populacione karakteristike

Linjak je u prošlosti bio veoma česta vrsta u našim nizijskim, sporotekućim rekama, plavnim zonama, barama i močvarama. Gubitkom staništa i introdukcijom invazivnih vrsta, njegova brojnost kostantno opada. U poslednjih desetak godina ponovo se beleži na velikom broju lokaliteta na kojima dugo nije beležen, ali su populacije malobrojne.

Ekologija vrste

Mužjaci polnu zrelost stiču sa 2–3, a ženke sa 3–7 godina starosti. Mresti se od proleća do kasnog leta (od maja do septembra), u plićacima obraslim vegetacijom. Mrest započinje pri temperaturi iznad 19 °C, najčešće između 22 °C i 24 °C (Kottelat & Freyhof, 2007). Polaže preko 400.000 jaja (Pimpicka, 1991), a inkubacija traje

back is olive-green, the flanks are greenish-yellow, the belly is yellow and the eyes are red-orange. It has a heavy and wide body covered with small scales deeply embedded in the skin. The belly is rounded. The mouth is terminal and has two barbels, one at each corner. The caudal peduncle is very deep and the fins are rounded. Sexual dimorphism is weak and limited to males having a very thick and flattened second ray in the ventral fins and longer ventral and pectoral fins than females. Fins: D III + 8; A III + 6–8. The lateral line is complete, with 87–115 scales. The pharyngeal teeth are in a single row, DF (4)5–5(4). There are 12–13 gill rakers on the first gill arch. It grows up to 70 cm and weighs 8 kg, and the largest recorded body length is 84 cm (Page & Burr, 2011). It reaches an age of 20 years (Kottelat & Freyhof, 2007).

Population trends

In the past, the tench was a very common species in our slow-flowing lowland rivers, floodplains, ponds and marshes. Due to habitat loss and the introduction of invasive species, its populations are steadily declining. In the last decade, the species has been reintroduced in numerous locations where it was absent for a long time, but populations are small.

Ecology of the species

Males reach sexual maturity at the age of 2–3 years and females at the age of 3–7 years. They spawn from spring to late summer (from May to September) in shallow waters covered with vegetation. Spawning begins when the temperature is above 19 °C, usually between 22 °C and 24 °C (Kottelat & Freyhof, 2007). It lays over 400,000 eggs (Pim-

3 dana pri temperaturi vode od 20 °C. Ženke mogu da se mreste porciono i do 9 puta godišnje, svakih 11–15 dana, ukoliko povoljni uslovi potraju (Kottelat & Freyhof, 2007). Zimu često provodi zariven u mulj. Tolerantan je na niske koncentracije kiseonika u vodi (O'Maoileidigh & Bracken, 1989). Hrani se uglavnom vodenim beskičmenjacima (mekušcima, račićima, larvama insekata), ali i detritusom i biljnim delovima (Bezmaternykh & Shcherbina, 2018). Mlade jedinke se najčešće hrane zooplanktonom, dok jedinke iznad 20 cm dužine preferiraju organizme bentosa, među kojima dominiraju mekušci (O'Maoileidigh & Bracken, 1989).

Stanište

Linjak preferira delove reka sa sporim tokom, nizijska jezera, bare i kanale, sa muljevitim dnom (Bezmaternykh & Shcherbina, 2018). Dobro se aklimatizuje i u veštačkim akumulacijama, čak i na većim nadmorskim visinama. Tipično stanište je plitka, stajaća voda obrasla gustom vegetacijom.

Ribolovni značaj

U prošlosti, linjak je bio značajan ulov rekreativnih ribolovaca, ali sa introdukcijom alohtonih vrsta i smanjenjem brojnosti populacija, ova vrsta postala je redak sporedni ulov. S obzirom na status zaštite, zabranjen je rekreativni i privredni ribolov ove vrste u Srbiji.

Faktori ugrožavanja

Areal ove vrste u Srbiji poslednjih decenija konstantno se smanjuje, a glavni uzrok jeste širenje alohtonih vrsta riba i gubitak staništa. Alohtone vrste stupaju u kompeticiju sa linjakom, a mikropredatorske vrste hrane se juvenilnim jedinkama linjaka. Veliki broj staništa izgubljen je isušivanjem močvarnih područja za potrebe poljoprivrede i gubljenjem plavnih zona izgradnjom odbrambenih nasipa. Zagađenje poreklom od poljoprivrednih aktivnosti, čiji se produkti slivaju u otvorene vode, dovode do nekontrolisanog cvetanja algi i povećanog opterećenja vodenih ekosistema koje ova vrsta naseljava. Iako je strogo zaštićena vrsta, linjak se i dalje lovi od strane nesavesnih ribolovaca. Povećanim organskim opterećenjem staništa ove vrste dolazi do pojave barskog gasa, koji izaziva trovanje i pomor riba.

picka, 1991) and incubation lasts for 3 days at a water temperature of 20 °C. Females may spawn up to 9 times a year, every 11–15 days, if favourable conditions persists (Kottelat & Freyhof, 2007). It often spends the winter buried in the mud. It is tolerant of low oxygen concentrations in the water (O'Maoileidigh & Bracken, 1989). It feeds mainly on aquatic invertebrates (molluscs, crustaceans, insect larvae), but also on detritus and plant parts (Bezmaternykh & Shcherbina, 2018). Juveniles feed mainly on zooplankton, while individuals longer than 20 cm prefer benthic organisms, especially molluscs (O'Maoileidigh & Bracken, 1989).).

Habitat

The tench prefers slow-flowing parts of rivers, shallow lakes, ponds and channels with muddy bottoms (Bezmaternykh & Shcherbina, 2018). It acclimatises well in artificial reservoirs, even at higher altitudes. The typical habitat is shallow, densely vegetated standing water.

Importance in fisheries

In the past, the tench was important part of the catch of recreational fishers, but with the introduction of non-native species and the decline of its populations, this species has become a rare catch. Due to its protected status, the tench is prohibited for recreational and commercial fishing in Serbia.

Threats

The range of this species in Serbia has steadily declined in recent decades, mainly due to the spread of non-native fish species and habitat loss. Non-native species compete with tench, and micro-predators feed on tench juveniles. Numerous habitats have been lost due to the draining of wetlands for agricultural purposes and the loss of floodplains due to the construction of protective levees. Pollution from agricultural activities, whose runoff flows into open waters, leads to uncontrolled algal blooms and increased stress on the aquatic ecosystems in which this species lives. Although the tench is a strictly protected species, it is still caught by unscrupulous fishers. The increased organic load in the habitat of this species leads to the appearance of the marsh gas, which causes poisoning and death of the fish.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	2.4.2, 4.3, 5.4.1, 7.2.3, 7.2.11, 8.1.1, 9.1.1, 9.3.1, 9.3.3

Postojeće mere zaštite

Linjak se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

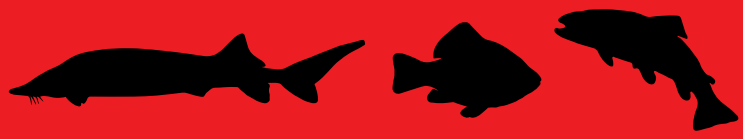
Neophodno je zaštititi i očuvati staništa u neizmenjenom stanju, odnosno vratiti ih u prvobitno stanje, ukoliko je to moguće.

Conservation actions in place

The tench is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to protect habitats and maintain them in an unaltered state, i.e. to return them to their original state if possible. Artificial



Veštački mrest i reintrodukcija na staništa sa kojih je nestao, odnosno pojačavanje prirodnih populacija linjaka poribljavanjem, značajno bi doprineli oporavku ove vrste u Srbiji. Potrebno je edukovati rekreativne ribolovce o važnosti očuvanja linjaka, kako bi se intenzitet krivolova smanjio.

spawning and reintroduction in the habitats from which it disappeared, i.e. strengthening the natural tench populations through stocking, would contribute significantly to the recovery of this species in Serbia. It is important to educate recreational fishers about the importance of protecting tench in order to reduce the intensity of poaching.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.2, 2.3, 3.2, 3.3.1, 3.4.1, 4.2

Iako je učestalost nalaženja linjaka u poslednjoj deceniji nešto veća nego ranije, potrebno je preciznije utvrditi distribuciju linjaka, kao i brojnost i veličinu populacija u Srbiji. Pored toga, potrebno je uspostaviti monitoring kojim bi se dugotrajno pratila brojnost populacija linjaka i utvrditi potencijalne ugrožavajuće faktore koji nisu ranije detektovani, kao i uspostaviti akcioni plan za oporavak ove vrste.

Although tench have been found somewhat more frequently in the last decade than in the past, the distribution and the number and size of its populations in Serbia still need to be determined more precisely. Furthermore, monitoring needs to be established to follow the number of tench populations over a long period of time and to identify potential threat factors that have not yet been detected, as well as to establish an action plan for the recovery of this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.5, 2.1, 3.1, 3.4

AUTOR / AUTHOR: Branko Miljanović

CRNKA
Umbra krameri Walbaum, 1792

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Esociformes
Porodica: Umbridae
Vrsta: *Umbra krameri* Walbaum, 1792

Sinonimi

Cyprinodon umbra Cuvier, 1829; *Umbra lucifuga* Gronow, 1854; *Umbra canina* Károli, 1882; *Umbra krameri pavlovi* Kux & Libosvarsky, 1957

Narodno ime: Crnka, mrguda, rapa, kurjak, krkuša
Englesko ime: European mudminnow
Francusko ime: Poisson-chien
Nemačko ime: Europäischer Hundsfisch
Rusko ime: Европейская евдошка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, crnka se smatra ranjivom vrstom (VU) prema kriterijumima A2c (Freyhof, 2011h). U Srbiji, na osnovu procene brojnosti populacije, crnki je takođe dodeljen status ranjive vrste (VU). Vrstu karakterišu male populacije, pri čemu je broj odraslih jedinki u svakoj od subpopulacija ≤1.000, a prognozira se i njihovo kontinuirano opadanje – kriterijumi C2a(i). Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina (kriterijum E). Obim rasprostranjenja, odnosno veličina prostora na kome se vrsta pojavljuje (EOO), iznosi 12.376 km², dok je površina naseljavanja (AOO) 52 km².

Rasprostranjenje

Crnka je jedina autohtona i reliktna vrsta iz roda *Umbra* prisutna u Evropi (Freyhof & Brooks, 2011; Sekulić *et al*., 2013). Naseljava sliv Dunava od Beča do delte, kao i donji deo sliva Dnjestra (Kottelat & Freyhof, 2007). U Srbiji naseljava nizijske vode crnomorskog sliva (Slika 128). Prema svojoj učestalosti u prirodi, vodi se kao retka vrsta i do sada je registrovana na svega tri područja, dva u slivu Dunava – na lokalitetu Lugomir u severozapadnom delu Bačke (Sekulić *et al*., 2013) i na lokalitetu Livade kod naselja Deliblato u južnom Banatu (Miljanović *et al*., 2016b), i jedno u slivu Save u severnoj Mačvi, u vodotoku Zasavica, kanalima Jovača, Prekopac i Bogaz, i u donjem toku Bakrenog Batra (Sekulić *et al*., 1998a, 2013; Maletin *et al*., 2001). Prema istorijskim podacima iz druge polovine XIX veka, crnka je bila prisutna na plavnom području Dunava kod Negotina, poznatom kao Negotinsko blato (Pančić, 1860), kao i u odvodnom sistemu Save na području Surčina (Medić, 1896). S kraja sedamdesetih godina XX veka navode

EUROPEAN MUDMINNOW
Umbra krameri Walbaum, 1792

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Esociformes
Family: Umbridae
Species: *Umbra krameri* Walbaum, 1792

Synonyms

Cyprinodon umbra Cuvier, 1829; *Umbra lucifuga* Gronow, 1854; *Umbra canina* Károli, 1882; *Umbra krameri pavlovi* Kux & Libosvarsky, 1957

Vernacular name: Crnka, mrguda, rapa, kurjak, krkuša
English name: European mudminnow
French name: Poisson-chien
German name: Europäischer Hundsfisch
Russian name: Европейская евдошка

National threat category assessed according to IUCN criteria

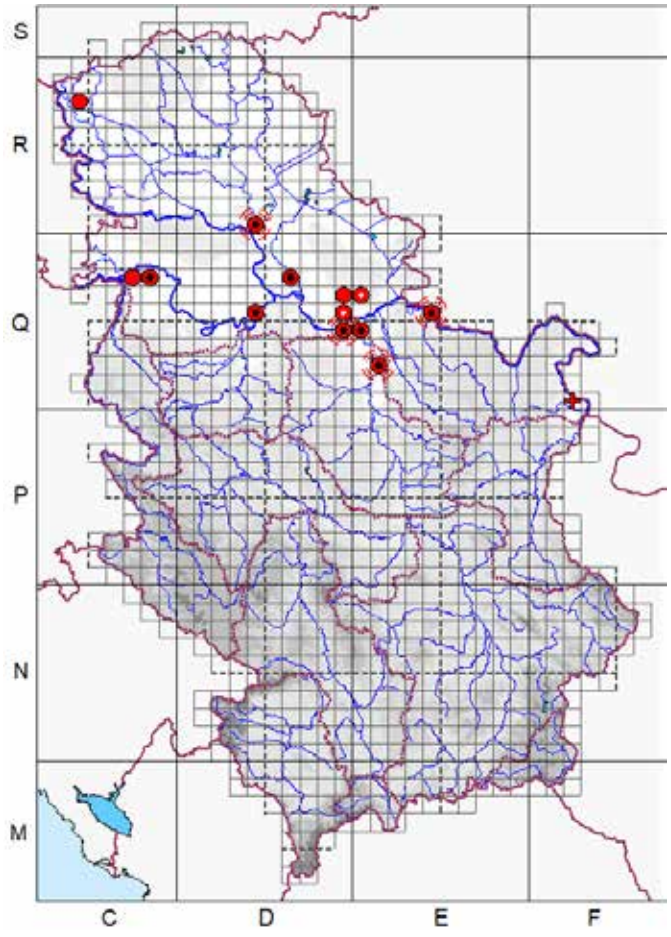
At the global level, the European mudminnow is classified as Vulnerable (VU) under criteria A2c (Freyhof, 2011h). In Serbia, the species is also classified as Vulnerable (VU) based on population size estimates. The species is characterised by small populations, where the number of mature individuals in each subpopulation is ≤1,000 and its continuing decline is predicted – criterion C2a(i). The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years. The extent of occurrence (EOO) is 12,376 km², while the area of occupancy (AOO) is 52 km².

Distribution

The European mudminnow is the only native and relict species of the genus *Umbra* occurring in Europe (Freyhof & Brooks, 2011; Sekulić *et al*., 2013). It inhabits the Danube basin from Vienna to the delta, as well as the lower part of the Dniester basin (Kottelat & Freyhof, 2007). In Serbia, it inhabits lowland waters of the Black Sea basin (Figure 128). In view of its occurrence in the wild, it is considered a rare species and has so far only been recorded in three areas, two of them in the Danube basin – at the locality Lugomir in the northwestern part of Bačka (Sekulić *et al*., 2013) and at the locality Livade near the settlement of Deliblato in southern Banat (Miljanović *et al*., 2016b), and one in the basin of the Sava in northern Mačva, in the Zasavica, the channels Jovača, Prekopac and Bogaz, and the lower reaches of the Bakreni Batar (Sekulić *et al*., 1998a, 2013; Maletin *et al*., 2001). According to historical data from the second half of the 19th century, the European mudminnow was present in the Danube floodplain near Negotin, known as Negotinsko blato (Pančić, 1860), as well as in the Sava drainage system in Surčin (Medić, 1896). From the late 1970s, records were reported for the Morava, Pek and the

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Crnka / European mudminnow – *Umbra krameri*	Status
Međunarodna zaštita / International protection	IUCN Red List	**VU A2c**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix II, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**EN**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU C2a(i); E Strogo zaštićena vrsta / Strictly protected species**



Slika 128. **Rasprostranjenje *Umbra krameri* u Srbiji.**

Figure 128. **Distribution of *Umbra krameri* in Serbia.**

Slika 129. Crnka *Umbra krameri* (foto: N. Sekulić).

Figure 129. European mudminnow *Umbra krameri* (photo: N. Sekulić).

se nalazi za Moravu, Pek i donji tok Tise (Ristić, 1977), područje Glušačke bare, Mačve i Podrinja i rita preko puta Smedereva u Banatu (Mihajlović & Vuković, 1977), a sredinom osamdesetih godina XX veka zabeležena je i u kanalu Sibnica u okviru Pančevačkog rita (Cakić & Hristić, 1987).

Opis vrste

Crnka je mala riba umereno izduženog i neznatno bočno spljoštenog tela, cilindričnog oblika, prekrivenog krupnim i glatkim cikloidnim krljuštima koje lako otpadaju sa tela (Slika 129). Nema pravu bočnu liniju, ali se dužinom gornje polovine tela pruža svetložuta linija. Boja tela je u predelu leđa crvenkasto do tamnosmeđa, dok je u predelu trbuha svetlija. Na glavi i bokovima nalaze se nepravilno razbacane tamnomrke pege i tačke, koje su na leđnom i repnom peraju poređane u jednom redu. Tokom reproduktivnog perioda podrepno peraje mužjaka je sivozelene boje. Glava je velika i zaobljena, rilo kratko, usta mala, oči relativno krupne. Svojim položajem usta daju namrgođen izgled „licu", te joj otuda i naziv mrguda. Gornja vilica je kraća od donje i doseže do sredine očiju. Skoro sva peraja su okruglasta i malo ispupčena, bez bodlji. Prepoznatljiva je i po polukružnoj liniji na zaobljenom dificerknom repnom peraju (Vuković & Ivanović, 1971; Ristić, 1977). Peraja: D II–III + 12–16; A I–II + 5–7; P I 9–14; V I + 5. Broj krljušti u bočnoj liniji je 31–36, ispod i iznad kojih je 5–7 redova krljušti. Prosečna veličina crnke je 5–9 cm, najviše do 17 cm (Povž, 1995b), mase 5–8 g, ali su evidentirani i primerci od 27 g (Wanzenböck, 1995). Živi kratko, maksimalno 5–6 godina, ali obično ne duže od tri godine (Wanzenböck, 1995; Kottelat & Freyhof, 2007).

Populacione karakteristike

Crnka je vrsta čije su populacije značajno smanjene poslednjih decenija XX veka usled isušivanja i zagađivanja staništa, zbog čega

lower reaches of the Tisza (Ristić, 1977), the area of Glušačka bara, Mačva and Podrinje, and the marshland opposite Smederevo in Banat (Mihajlović & Vuković, 1977), and in the mid-1980s it was also found in the Sibnica canal within the Pančevački Rit (Cakić & Hristić, 1987).

Description of the species

The European mudminnow is a small fish with a moderately elongated and laterally slightly flattened body of cylindrical shape, covered with large and smooth cycloid scales that fall off easily (Figure 129). It has no true lateral line, but a pale yellow line running laterally along the upper half of the body. The body colour is reddish to dark brown in the dorsal region, while the belly is lighter. On the head and flanks there are irregularly scattered dark spots and dots, arranged in a single row on the dorsal and caudal fins. During the spawning season the anal fin of the male is grey-green. The head is large and round, the snout is short, the mouth is small and the eyes are relatively large. The position of the mouth gives the "face" a scowling appearance, hence the vernacular name "mrguda" in Serbian (mrgud/scowl). The upper jaw is shorter than the lower jaw and extends to the middle part of the eyes. Almost all fins are rounded and slightly convex, without spines. It can also be recognised by the semicircular line on the rounded diphycercal caudal fin (Vuković & Ivanović, 1971; Ristić, 1977). Fins: D II–III + 12–16; A I–II + 5–7; Q I 9–14; V I + 5. The number of scales in the lateral line is 31–36, with 5–7 scale rows below and above. Average size is 5–9 cm, maximum up to 17 cm (Povž, 1995b), mass is 5–8 g, but specimens of 27 g have been found (Wanzenboeck, 1995). Lifespan is short, maximum 5–6 years, but usually no longer than three years (Wanzenboeck, 1995; Kottelat & Freyhof, 2007).

Population trends

The European mudminnow is a species whose populations have declined significantly in the last decades of the 20th century due to habitat drying and pollution, which is why the species is considered rare and

se vrsta i smatra retkom i ugroženom (Lelek, 1987; Maitland, 2000; Wilhelm, 2003). Brojnost populacija crnke opala je za više od 30% u prvoj deceniji XXI veka i trend opadanja i dalje postoji, dok je sa mnogih lokaliteta već iščezla (Freyhof, 2011i). U pojedinim zemljama smatra se najugroženijom stagnofilnom vrstom ribe (Sehr & Keckeis, 2017) i upravo ta uska specijalizacija na određeni tip staništa uslovljava njen isprekidan areal duž Dunava.

Ekologija vrste

Polnu zrelost dostiže već u prvoj godini života (Wanzenböck, 1995; Kottelat & Freyhof, 2007). Mresti se u plitkoj vodi u proleće, u periodu mart-april (povremeno i u februaru, ili tek u maju), pri temperaturi vode od 12 °C do 16 °C (Kottelat & Freyhof, 2007). Vrsta je fitofilna, ženka polaže ikru među biljke, u plitkoj depresiji na dnu ili u gnezdo od biljnog materijala. Dok se mlađ ne izvalja, ženka je agresivna i čuva jaja u gnezdu (Vuković & Ivanović, 1971; Kottelat & Freyhof, 2007). Ženka polaže do 2.500 jaja (Makara & Stráňai, 1980; Wilhelm, 1998). Jaja su lepljiva, žute do narandžaste boje, a inkubacija traje 4–5 dana (Kováč, 1995). Hrani se zooplanktonom, larvama vodenih insekata, račićima, barskim puževima i školjkama, ribljom mlađi i biljkama (Pavletić, 1954; Povž, 1990b; Guti *et al*., 1991). Teritorijalna je vrsta, živi u manjim jatima od pet do šest jedinki (Vuković & Ivanović, 1971).

Stanište

Crnka je slatkovodna, limnofilna, bentopelagična vrsta, koja živi u stalno ili povremeno stajaćim vodama, kao i sporotekućim vodama nizijskih područja, pri temperaturama vode između 5 °C i 24 °C (Povž, 1995b; Wanzenböck,1995). Naseljava relativno plitke, muljevite vodene površine, obrasle gustom plivajućom i potopljenom makrofitskom vegetacijom, kao što su mrtvaje, močvarna, zabarena i poplavna staništa, bočni rukavci, plitka jezera i kanalske mreže (Povž, 1990a, 1995b; Wanzenböck & Spindler, 1995; Kottelat & Freyhof, 2007). Jedna je od najotpornijih vrsta riba koja podnosi niske koncentracije kiseonika (ispod 0,5 ml/l) i uslove koji su nepovoljni za život drugih vrsta, a za disanje koristi i riblji mehur, uzimajući atmosferski vazduh sa površine vode (Graham, 1997; Kottelat & Freyhof, 2007). Pri opasnosti od isušivanja i u ekstremnim letnjim uslovima zakopava se u mulj (Mrakovčić *et al*., 2006).

Ribolovni značaj

Crnka nije ekonomski značajna vrsta, niti je značajna za privredni i rekreativni ribolov. Nekada se koristila kao hrana svinjama i patkama, kao đubrivo, mamac za soma i morunu, kao i u ljudskoj ishrani (Ristić, 1977; Botta, 1981; Arnold, 1990; Sekulić, 2013). Smatra se korisnom za suzbijanje komaraca (Lelek, 1987), a gaji se i kao akvarijumska riba (Botta, 1981).

Faktori ugrožavanja

Među faktorima ugrožavanja, izdvaja se gubitak staništa usled razvoja i širenja stambenih i urbanih područja i izgradnja objekata uz vodotoke, uticaj malih poljoprivrednih proizvođača i agroindustrijske poljoprivrede kroz prenamenu vlažnih područja, isušivanje

threatened (Lelek, 1987; Maitland, 2000; Wilhelm, 2003). The size of the European mudminnow population has declined by more than 30% in the first decade of the 21st century and the downward trend continues, while it has already disappeared in many locations (Freyhof, 2011i). In some countries, it is considered the most threatened stagnophilic fish species (Sehr & Keckeis, 2017), and it is precisely this narrow specialisation on a specific habitat type that determines its discontinuous range along the Danube.

Ecology of the species

It reaches sexual maturity in its first year of life (Wanzenboeck, 1995; Kottelat & Freyhof, 2007). It spawns in shallow water in spring, in the period March-April (occasionally also in February or only in May), at a water temperature of 12 °C to 16 °C (Kottelat & Freyhof, 2007). The species is phytophilic; the female lays her eggs among plants, in a shallow depression on the bottom or in a nest made of plant material. Until the young hatch, the female is aggressive and guards the eggs in the nest (Vuković & Ivanović, 1971; Kottelat & Freyhof, 2007). The female lays up to 2,500 eggs (Makara & Stráňai, 1980; Wilhelm, 1998). The eggs are sticky, yellow to orange, and incubation period lasts 4–5 days (Kováč, 1995). It feeds on zooplankton, aquatic insect larvae, crustaceans, pond snails and mussels, fish fry and plants (Pavletić, 1954; Povž, 1990b; Guti *et al*., 1991). It is a territorial species that lives in small shoals of five to six individuals (Vuković & Ivanović, 1971).

Habitat

The European mudminnow is a limnophilic, benthopelagic freshwater species that lives both in permanently or occasionally stagnant waters and in slow-flowing lowland waters at water temperatures between 5 °C and 24 °C (Povž, 1995b; Wanzenboeck, 1995). It inhabits relatively shallow, muddy waters with dense floating and submerged macrophyte vegetation, such as oxbows, marshes, still ponds and flooded habitats, side arms, shallow lakes and channel networks (Povž, 1990a, 1995b; Wanzenboeck & Spindler, 1995; Kottelat & Freyhof, 2007). It is one of the most resilient fish species, tolerating low oxygen concentrations (below 0.5 ml/l) and conditions unfavourable to other species. For respiration, it can also use the fish bladder to take in atmospheric air from the water surface (Graham, 1997; Kottelat & Freyhof, 2007). When in danger of drying out and in extreme summer conditions, it buries itself in the mud (Mrakovčić *et al*., 2006).

Importance in fisheries

The European mudminnow is of no fishery importance, neither in recreational nor in commercial fishing. It was formerly used as feed for pigs and ducks, as fertiliser, as bait for catfish and beluga, and as human food (Ristić, 1977; Botta, 1981; Arnold, 1990; Sekulić, 2013). It is considered useful for mosquito control (Lelek, 1987) and is also farmed as an aquarium fish (Botta, 1981).

Threats

Threats include habitat loss due to residential and urban development and expansion and the construction of structures along watercourses, the influence of small-scale agricultural producers and agro-industrial agriculture through the conversion and drying up of

i širenje agroekosistema i šumskih plantaža, regulacija vodotoka i hidromeliorativni zahvati (izgradnja nasipa i ustava zbog usklađivanja hidrološkog režima, izgradnja, pregrađivanje i održavanje kanalske mreže). Takođe, prisustvo i unošenje određenih alohtonih vrsta i njihov uticaj kroz kompeticiju za hranu i stanište i predatorstvo, različito neorgansko i organsko zagađenje komunalnim i industrijskim otpadnim vodama, veštačkim đubrivima, pesticidima, promena namene površina, eutrofikacija, kao i pretvaranje staništa pogodnih za život crnke u deponije otpada nepovoljno utiču na konzervacioni status vrste. Od ostalih negativnih uticaja od kojih zavisi i očuvanje povoljnog stanja populacija jeste tačkasto i ograničeno rasprostranjenje vrste, kao i nedostatak naučnih istraživanja, novih saznanja i podataka o distribuciji, ekologiji i životnoj istoriji vrste.

wetlands, the expansion of agro-ecosystems and forest plantations, the regulation of watercourses and hydro-melioration measures (construction of levees and foundations to balance the hydrological regime, construction, partitioning and maintenance of the canal network). The presence and introduction of certain non-native species and their impacts due to food and habitat competition and predation, various inorganic and organic pollutants from municipal and industrial wastewater, artificial fertilisers, pesticides, land use change, eutrophication, and the conversion of habitats suitable for the European mudminnow into landfills also affect the conservation status of the species. Other negative influences on which the maintenance of the favourable status of the population depends include the spotted and limited distribution of the species as well as the lack of scientific research, new knowledge and data on the distribution, ecology and life history of the species.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.1, 2.1.2, 4.3, 7.2.8, 7.2.11, 7.3, 8.1.2, 8.2.2, 9.1.1, 9.1.2, 9.3.1, 9.3.3, 11.1, 12.1

Postojeće mere zaštite

Crnka se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu ustanovljen je trajni lovostaj. Mere očuvanja vrste i staništa definisane su i uredbama o proglašenju i zaštiti *Specijalnog rezervata prirode Zasavica* (Službeni glasnik RS, br. 19/1997 i 54/2019) i *Specijalnog rezervata prirode Kraljevac* (Službeni glasnik RS, br. 14/2009), dok se staništa u kanalima na lokalitetu Lugomir štite u skladu sa *Uredbom o ekološkoj mreži* (Službeni glasnik RS, br. 102/2010). Prema *Pravilniku o načinu određivanja i visini naknade štete nanete ribljem fondu* (Službeni glasnik RS, br. 84/2009 i 86/2011), za štetu nanetu svakom pojedinačnom primerku ove vrste utvrđena je visina naknade štete od 8.000 dinara.

Conservation actions in place

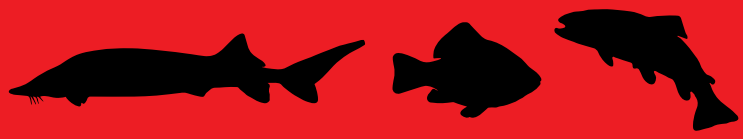
The European mudminnow is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a permanent ban on fishing is imposed on this species. Measures for the conservation of this species and its habitats are also set by the regulations on the designation and protection of the *Special Nature Reserve Zasavica* (Official Gazette of RS, No. 19/1997 and 54/2019) and the *Special Nature Reserve Kraljevac* (Official Gazette of RS, No. 14/ 2009), while the habitats in the canals at the locality Lugomir are protected under the *Regulation on the Ecological Network* (Official Gazette of RS, No. 102/2010). According to the *Regulation on the Method of Determination and the Amount of Compensation for Damage to Fish Stock* (Official Gazette of RS, No. 84/2009 and 86/2011), the compensation for damage to each individual specimen of this species is 8,000 dinars.

Predložene mere zaštite

Potrebno je uvesti upravljanje područjima u kojima je crnka prisutna, sprovoditi dalja istraživanja sličnih staništa u cilju novih nalaza, uvesti kontrolu invazivnih vrsta uz dalju zabranu njihovog unošenja, kao i zabraniti ili kontrolisati regulaciju i pregrađivanje vodotoka u cilju očuvanja poplavnih i močvarnih staništa koja crnka naseljava. Takođe, treba izraditi planove sanacije degradiranih staništa, povećati brojnost populacija sprovođenjem programa *in situ* zaštite uz poboljšanje kvaliteta staništa, kao i *ex situ* zaštite putem veštačkog razmnožavanja u zatočeništvu (akvakulturi), u cilju poribljavanja i reintrodukcije na pogodna staništa, i nastaviti analizu genetičke strukture populacija crnke (Marić *et al*. 2015, 2017a, 2019). Osim toga, neophodno je sprovoditi obrazovanje i podizanje svesti, uspostaviti međunarodnu saradnju i aktivno učešće javnosti vezano za značaj očuvanja vrste i staništa, a posebno kroz obuku za potrebe razmnožavanja u veštačkim uslovima, kao i ekonomski podsticati korisnike područja zbog nemogućnosti obavljanja određenih delatnosti, takođe u cilju očuvanja vrste i staništa.

Conservation actions needed

There is a need to manage areas where the European mudminnow occurs, to conduct further surveys in similar habitats to gain new knowledge, to control invasive species and further prohibit their introduction, and to prohibit or control the regulation and containment of streams in order to preserve floodplain and marsh habitats inhabited by the European mudminnow. In addition, restoration plans for degraded habitats should be developed, population numbers should be increased by the implementation of *in situ* conservation programmes while improving habitat quality, as well as by *ex situ* conservation through artificial propagation in captivity (aquaculture) with the aim of stock enhancement and reintroduction in suitable habitats, and the analysis of the genetic structure of the European mudminnow population should be continued (Marić *et al*. 2015, 2017a, 2019). There is also a need to educate and raise awareness, to establish international cooperation and to actively involve the public in the conservation of the species and its habitats, especially through training on the requirements of reproduction under artificial conditions, as well as to provide economic support to users of the area when it is not possible to carry out certain activities, also in order to conserve the species and its habitats.



Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 1.2, 2, 3.2, 3.3.1, 3.4, 4.2, 4.3, 6.4

Neophodna su istraživanja distribucije, populacionih trendova i faktora ugrožavanja, kao i praćenje preduzetih aktivnosti ili akcija. Takođe je potrebno doneti plan aktivnosti za oporavak vrste i sprovoditi zaštitu staništa i formiranje novih pribežišta. Na osnovu planova upravljanja područjima u kojima je vrsta prisutna, treba vršiti kontinuirani monitoring u cilju praćenja populacionih trendova i stepena očuvanosti staništa.

It is necessary to study the distribution, population trends and threats, and to monitor the activities and measures implemented. It is also necessary to adopt an action plan for the recovery of the species and to implement habitat protection and the creation of new refugia. On the basis of management plans for the areas where the species occurs, continuous monitoring should be carried out to follow population trends and the degree of conservation of habitats.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2.1, 2.2, 3.1, 3.4

AUTORI / AUTHORS: Nenad Sekulić i Laslo Galamboš

MALI VRETENAR
Zingel streber (Siebold, 1863)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Perciformes
Porodica: Percidae
Vrsta: *Zingel streber* (Siebold, 1863)

Sinonimi

Aspro streber Siebold, 1863; *Zingel streber nerensis* Bănărescu & Nalbant, 1979

Narodno ime: Mali vretenar
Englesko ime: Streber
Francusko ime: Apron du Danube
Nemačko ime: Streber
Rusko ime: Малый чоп

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, mali vretenar ne smatra se ugroženom vrstom (Freyhof, 2011j). U Srbiji, mali vretenar predstavlja ranjivu vrstu (VU). Obim rasprostranjenja ove vrste (EOO) u Srbiji iznosi 55.766 km², dok površina naseljavanja (AOO) iznosi 128 km². Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina (kriterijum E).

Rasprostranjenje

Mali vretenar naseljava slivove Dunava i Dnjestra (Kottelat & Freyhof, 2007). U Srbiji nastanjuje Dunav, Savu, Neru, Južnu Moravu, Zapadnu Moravu, Veliku Moravu, Drinu, Jadar, Belicu, Kolubaru, Pek i Mlavu (Slika 130).

Opis vrste

Telo malog vretenara je vretenasto i izduženo, a glava napred zašiljena (Slika 131). Telo je sivkaste do žuto-smeđe boje, sa nepravilnim vertikalnim tamnim mrljama. Trbuh je žućkast. Repno stablo je dugačko i tanko. Dva leđna peraja su razdvojena, a trbušna peraja su skoro dva puta duža od grudnih. Pretposlednja kost škržnog poklopca je nazubljena i završava se bodljom. Peraja: D1 VII–IX; D2 I–III + 11–13; A I–II + 8–12; V I+5. U bočnoj liniji ima 70–83 krljušti. Prosečna dužina malog vretenara je 12–18 cm, a može da naraste do 22 cm (Muus & Dahlström, 1968). Životni vek iznosi 5 godina (Karapetkova & Zivkov, 1995; Stefanov & Trichkova, 2011).

Populacione karakteristike

Populacioni trend malog vretenara nije poznat (Freyhof, 2011j). Podaci o ovoj vrsti nedostaju ili su nepotpuni za većinu evropskih populacija (Freyhof, 2011j).

STREBER
Zingel streber (Siebold, 1863)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Perciformes
Family: Percidae
Species: *Zingel streber* (Siebold, 1863)

Synonyms

Aspro streber Siebold, 1863; *Zingel streber nerensis* Bănărescu & Nalbant, 1979

Vernacular name: Mali vretenar
English name: Streber
French name: Apron du Danube
German name: Streber
Russian name: Малый чоп

National threat category assessed according to IUCN criteria

At the global level, the streber is not classified an endangered species and has the status of Least Concern (LC) (Freyhof, 2011j). In Serbia, the species is classified as Vulnerable (VU). The extent of occurrence (EOO) in Serbia is 55,766 km², while the area of occupancy (AOO) is 128 km². The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

The streber inhabits the Danube and Dniester basins (Kottelat & Freyhof, 2007). In Serbia, it inhabits the Danube, Sava, Nera, South Morava, West Morava, Great Morava, Drina, Jadar, Belica, Kolubara, Pek and Mlava rivers (Figure 130).

Description of the species

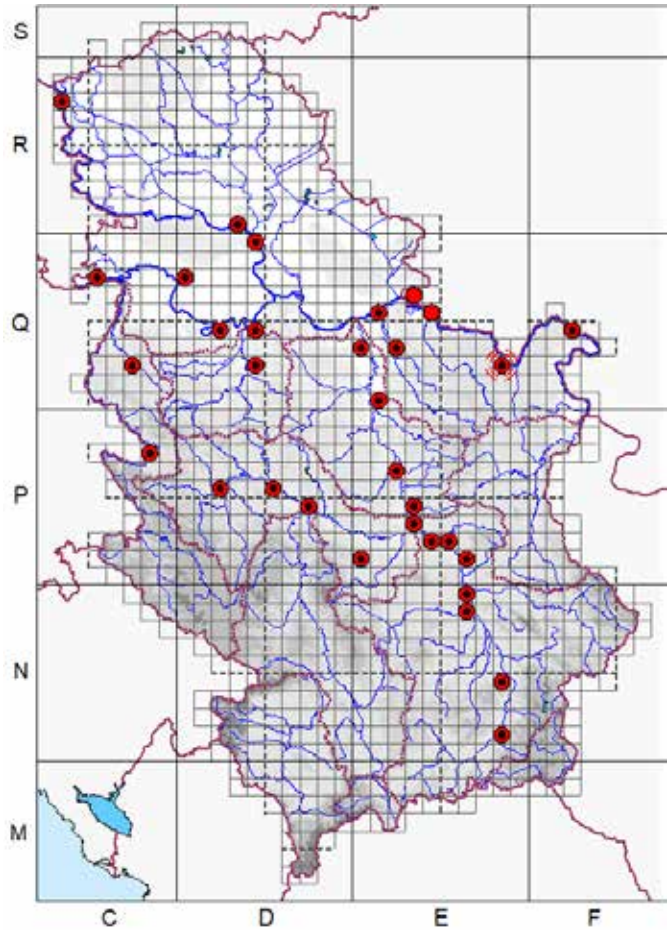
The body of the streber is spindle-shaped and elongated, and the head is pointed in front (Figure 131). The body is grey to yellowish brown, with irregular vertical dark spots. The belly is yellowish. The caudal peduncle is long and thin. The two dorsal fins are separate and the ventral fins are almost twice as long as the pectoral fins. The penultimate bone of the gill cover is serrated and ends in a spine. Fins: D1 VII–IX; D2 I–III + 11–13; A I–II + 8–12; V I+5. There are 70–83 scales in the lateral line. The average length is between 12 and 18 cm, it can grow up to 22 cm long (Muus & Dahlstroem, 1968). Life expectancy is 5 years (Karapetkova & Zivkov, 1995; Stefanov & Trichkova, 2011).

Population trends

The population trends of the streber are not known (Freyhof, 2011j). For most European populations there is no or only incomplete data on this species (Freyhof, 2011j).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Mali vretenar / Streber – *Zingel streber*	Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Strogo zaštićena vrsta / Strictly protected species**



Slika 130. **Rasprostranjenje *Zingel streber* u Srbiji.**

Figure 130. **Distribution of *Zingel streber* in Serbia.**

Slika 131. Mali vretenar *Zingel streber* (foto: A. Bajić).

Figure 131. Streber *Zingel streber* (photo: A. Bajić).

Ekologija vrste

Mali vretenar ima izuzetno brz životni ciklus, jedinke oba pola postaju polno zrele već u prvoj godini života (Brinker *et al*., 2018), dok je embrionalni period relativno dug (Kováč, 2005). U ranim fazama razvića pojavljuju se bodljikave strukture na glavi, što omogućava embrionima i larvama relativno visoku efikasnost zaštite od predatora, a samim tim i preživljavanje. Međutim, nizak fekunditet (svega 300–400 jaja po ženki) (Brinker *et al*., 2018), kao i usko specijaliziovane potrebe po pitanju staništa (reofilna staništa) čine ovu vrstu izuzetno osetljivom na promene u životnoj sredini (Kováč, 2005). Mrest počinje u martu ili aprilu, a ženke polažu lepljiva jaja na kamenitoj podlozi (Kottelat & Freyhof, 2007). Mali vretenar ulaže izuzetno mnogo energetskih resursa u kvalitet reproduktivnih produkata (jaja i mleča) (Kováč, 2005). Ishrana se bazira na beskičmenjacima dna i lov se odvija uglavnom noću u plićim delovima reka. Uglavnom se kreću u malim jatima (Kottelat & Freyhof, 2007).

Stanište

Odrasle jedinke žive u glavnom toku malih i velikih reka, na šljunkovitom i peskovitom dnu, u delovima toka sa jačim strujanjem vode, bogatim kiseonikom. Zahvaljujući vretenastom obliku tela prilagođen je životu u gornjim delovima reka, sa brzim protokom vode (Lusk *et al*., 2004; Kottelat & Freyhof, 2007).

Ribolovni značaj

Zbog trajnog lovostaja i retkosti nema ribolovni značaj. Obično se ulovi slučajno (Simonović, 2001).

Faktori ugrožavanja

Izgradnja hidroelektrana dovela je do usporavanja vodotoka i na taj način ugrozila staništa ove vrste, kojoj su potrebne jake i brze vodene struje. Smatra se da je samo 32% nekadašnjeg areala u dunavskom slivu danas pogodno za malog vretenara (Brinker *et al*., 2018). Značajan deo areala nalazi se uzvodno od brana, zbog čega nije moguća prirodna rekolonizacija. Istraživanja pokazuju da su raspoloživost i dostupnost odgovarajućih staništa faktori koji ogra-

Ecology of the species

The streber has an extremely fast life cycle, individuals of both sexes become sexually mature in the first year of life (Brinker *et al*., 2018), while the embryonic period is relatively long (Kováč, 2005). In the early stages of development, spiny structures appear on the head, providing embryos and larvae with a relatively high level of protection from predators and thus survival. However, the low fecundity (only 300-400 eggs per female) (Brinker *et al*., 2018) and the narrowly specialised habitat requirements (rheophilic habitats) make this species extremely sensitive to environmental changes (Kováč, 2005). The spawning season begins in March or April and females lay sticky eggs on the rocky substrate (Kottelat & Freyhof, 2007). The streber invests a lot of energy resources in the quality of reproductive products (roe and milt) (Kováč, 2005). It feeds on bottom invertebrates and hunts mainly at night in the shallow parts of rivers. They usually move in small shoals (Kottelat & Freyhof, 2007).

Habitat

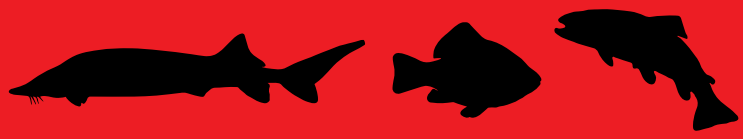
Adults live in the main course of small to large rivers, on gravelly and sandy bottoms, in river parts with stronger, oxygen-rich currents. With its spindle-shaped body, it is adapted to life in the upper parts of rivers with fast water flow (Lusk *et al*., 2004; Kottelat & Freyhof, 2007).

Importance in fisheries

Due to a permanent ban on fishing and its rarity, the streber is of no fishery importance. It is mostly caught accidentally (Simonović, 2001).

Threats

The construction of hydroelectric power plants has led to a slowdown in water flow and threatens the habitats of this species, which needs strong and fast water currents. Today, only 32% of its former range in the Danube Basin is considered suitable for the streber (Brinker *et al*., 2018). A significant part of the range is upstream of dams, so natural recolonisation is not possible. Studies show that the



ničavaju veličinu preostalih subpopulacija (Freyhof, 2011j; Brinker *et al*., 2018). U prošlosti je zagađenje, takođe, negativno uticalo na ovu vrstu, posebno u gornjem toku Dunava. Međutim, stanje se poboljšava čime su se stekli uslovi za obnovu i povećanje brojnosti populacija (Lusk *et al*., 2004; Freyhof, 2011j; Stefanov & Trichkova, 2011).

availability and accessibility of suitable habitats are factors limiting the size of the remaining subpopulations (Freyhof, 2011j; Brinker *et al*., 2018). In the past, pollution also had a negative impact on this species, especially in the upper reaches of the Danube. However, the situation has improved, creating the conditions for population recovery and increase (Lusk *et al*., 2004; Freyhof, 2011j; Stefanov & Trichkova, 2011).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Mali vretenar se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The streber is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

Potrebno je sprečiti regulaciju reka, odnosno izgradnju brana i na taj način sačuvati područja sa bržim vodenim tokom. Takođe, neophodno je sačuvati i obnoviti reofilna staništa, smanjiti zagađivanje vode i povećati povezanost međusobno izolovanih subpopulacija u dunavskom slivu.

Conservation actions needed

It is necessary to prevent the regulation of rivers, i.e. the construction of dams, and thus preserve areas with faster water flow. It is also necessary to preserve and restore rheophilic habitats, reduce water pollution and improve connectivity between isolated subpopulations in the Danube basin.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 2.3, 4.3

Neophodna su dalja istraživanja i praćenja stanja populacija i populacionih trendova malog vretenara, kao i faktora ugrožavanja, uz razvoj odgovarajućih programa monitoringa.

Further research and monitoring of the population status and population trends of the streber, as well as threats, and the development of appropriate monitoring programmes are needed.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1

AUTOR / AUTHOR: Milica Jaćimović

VELIKI VRETENAR
Zingel zingel (Linnaeus, 1766)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Perciformes
Porodica: Percidae
Vrsta: *Zingel zingel* (Linnaeus, 1766)

Sinonimi

Aspro zingel (Linnaeus, 1758); *Perca zingel* (Linnaeus, 1766)

Narodno ime: Veliki vretenar
Englesko ime: Zingel
Francusko ime: Zingel
Nemačko ime: Zingel
Rusko ime: Обыкновенный чоп

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, veliki vretenar ne smatra se ugroženom vrstom (Freyhof, 2011k). U Srbiji, mali vretenar predstavlja ranjivu vrstu (VU). Obim rasprostranjenja ove vrste (EOO) u Srbiji iznosi 55.979 km², dok površina naseljavanja (AOO) iznosi 172 km². Kvantitativna analiza ukazuje na to da je verovatnoća iščezavanja u prirodnom okruženju ≥10% u narednih 100 godina (kriterijum E).

Rasprostranjenje

Veliki vretenar naseljava slivove Dunava i Dnjestra (Freyhof, 2011k). U Srbiji nastanjuje dublje delove reke Dunav, zatim Savu, Drinu, Ibar, Kolubaru, Belicu, Južnu Moravu, Zapadnu Moravu i Veliku Moravu (Slika 132).

Opis vrste

Telo velikog vretenara je izduženo i vretenasto (Slika 133). Ima širok trup, dugu pljosnatu glavu i usko repno stablo. Usta su mala, subterminalna. Na obrazima nema krljušti. Telo je žuto-zelene do zelene boje, sa nepravilnim vertikalno izduženim crnim mrljama koje telu daju mramorast izgled. Trbuh je žućkast. Po ivici škržnog pretpoklopca nalaze se sitne bodlje, a škržni poklopac na ivici ima jednu veću bodlju. Osnova drugog leđnog peraja duža je od prvog. Trbušna peraja su do 1,5 puta duža od grudnih. Trbušna i grudna peraja blisko su postavljena. Repno stablo je umereno tanko i kraće je od osnove drugog leđnog peraja. Peraja: D1 XII–XV; D2 II + 16–20 A I–II + 11–13. Broj krljušti u bočnoj liniji je 82–95. Može da naraste do 49 cm standardne dužine tela (SL) (Kottelat & Freyhof, 2007).

ZINGEL
Zingel zingel (Linnaeus, 1766)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Perciformes
Family: Percidae
Species: *Zingel zingel* (Linnaeus, 1766)

Synonyms

Aspro zingel (Linnaeus, 1758); *Perca zingel* (Linnaeus, 1766)

Vernacular name: Veliki vretenar
English name: Zingel
French name: Zingel
German name: Zingel
Russian name: Обыкновенный чоп

National threat category assessed according to IUCN criteria

At the global level, the zingel is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011k). In Serbia, the species is classified as Vulnerable (VU). The extent of occurrence (EOO) in Serbia is 55,979 km², while the area of occupancy (AOO) is 172 km². The quantitative analysis (criterion E) shows that the probability of extinction in the wild is ≥10% in the next 100 years.

Distribution

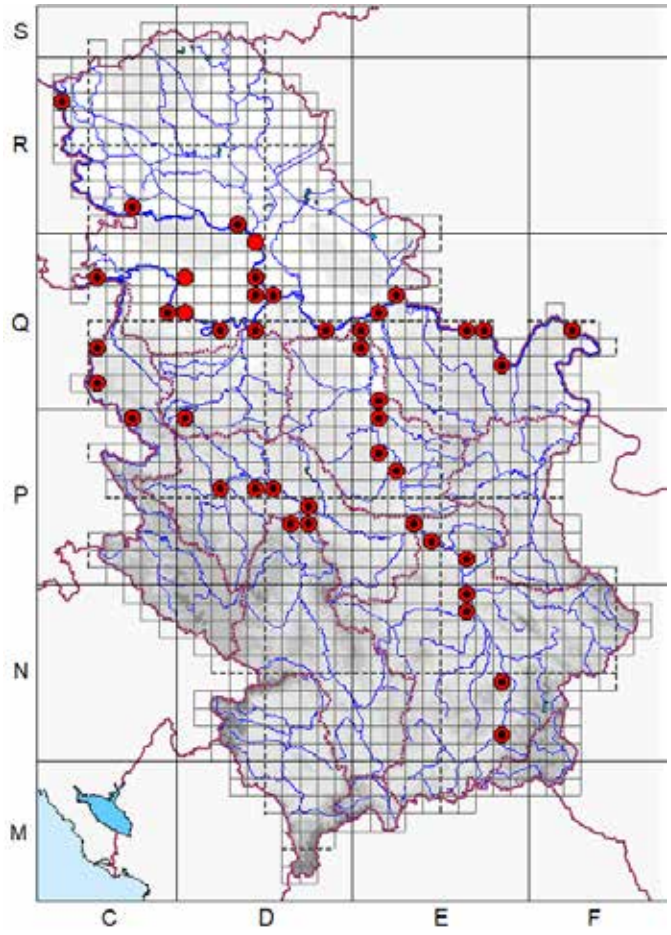
The zingel inhabits the Danube and Dniester basins (Freyhof, 2011k). In Serbia, it inhabits the deeper parts of the Danube and the rivers Sava, Drina, Ibar, Kolubara, Belica, South Morava, West Morava and Great Morava (Figure 132).

Description of the species

The body of the zingel is elongated and spindle-shaped (Figure 133). It has a wide trunk, a long flat head and a slender caudal peduncle. The mouth is small and subterminal. There are no scales on the cheeks. The body is yellow-green to green, with irregular, vertically elongated black spots that give the body a marbled appearance. The belly is yellowish. There are small spines on the edge of the preoperculum, while the operculum has one large spine on its edge. The base of the second dorsal fin is longer than that of the first. The ventral fins are up to 1.5 times longer than the pectoral fins. The ventral and pectoral fins are close together. The caudal peduncle is moderately slender and shorter than the base of the second dorsal fin. Fins: D1 XII–XV; D2 II + 16–20 A I–II + 11–13. The number of scales in the lateral line is 82–95. It can reach up to 49 cm standard body length (SL) (Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Veliki vretenar / Zingel – *Zingel zingel*		Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex V**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/nt**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**VU** **E** **Zaštićena vrsta / Protected species**



Slika 132. **Rasprostranjenje *Zingel zingel* u Srbiji.**

Figure 132. **Distribution of *Zingel zingel* in Serbia.**

Slika 133. Veliki vretenar *Zingel zingel* (foto: L. Hlasek, https://www.hlasek.com/foto/zingel_zingel_he9026.jpg).

Figure 133. Zingel *Zingel zingel* (photo: L. Hlasek, https://www.hlasek.com/foto/zingel_zingel_he9026.jpg).

Populacione karakteristike

O populacionim trendovima i stanju populacija velikog vretenara malo se zna (Freyhof, 2011k). Najčešće se javlja u izolovanim populacijama (Halačka *et al*., 2007). U Srbiji se sreće u ulovima alasa, najčešće kao sporedan, slučajan ulov u ribarskim mrežama, pa se o veličini populacija ne zna dovoljno (Simonović, 2001).

Ekologija vrste

Veliki vretenar polno sazreva u trećoj godini života. Mresti se od marta do aprila, na šljunkovitoj i peskovitoj podlozi (Freyhof, 2011k). Ikru, do 5.000 jaja, polaže na tvrdu podlogu (Maitland, 2000). Tokom razmnožavanja, jedna ženka i više mužjaka čine jedno gusto jato za mrest. Jaja su veoma lepljiva i na taj način se vezuju za šljunak (Kottelat & Freyhof, 2007). Hrani se vodenim insektima, račićima, ikrom i sitnijom ribom (Bănăduc *et al*., 2014). Aktivan je noću (Bănărescu & Bănăduc, 2007). Veliki vretenar je uglavnom solitarna vrsta.

Stanište

Naseljava glavni tok velikih reka sa dubokom i brzotekućom vodom, sa peskovitim, šljunkovitim ili kamenitim dnom (Freyhof, 2011k). U periodu mresta traži delove reka sa dubinom preko 1 m i brzom strujom, na kojima je dno prekriveno šljunkom i detritusom.

Ribolovni značaj

Zbog trajnog lovostaja nema ribolovni značaj u Srbiji. Pre stavljanja pod trajni lovostaj, veliki vretenar je smatran ribom II kategorije kvaliteta, iako ga odlikuje veoma ukusno meso (Simonović, 2001).

Faktori ugrožavanja

Na populacije pre svega utiče izgradnja brana, čime se usporava tok i modifikuje prirodno stanište. Uništavanje lotičkih staništa i fragmentacija usled hidrotehničkih radova, kao i zagađivanje vode i eksploatacija mineralnih supstrata nepovoljno utiče na velikog vretenara (Freyhof, 2011k).

Population trends

Little is known about population trends and the status of zingel populations (Freyhof, 2011k). It mostly occurs in isolated populations (Halačka *et al*., 2007). In Serbia, it is found in the catches of professional fishers, mostly as secondary bycatch in fishing nets, and not enough is known about the size of the population (Simonović, 2001).

Ecology of the species

The zingel becomes sexually mature in its third year of life. It spawns from March to April on gravelly and sandy substrates (Freyhof, 2011k). It lays its eggs (up to 5,000) on hard substrate (Maitland, 2000). During the spawning season, one female and several males form a dense spawning group. The eggs are very sticky and attached to the gravel (Kottelat & Freyhof, 2007). It feeds on aquatic insects, crustaceans, fish eggs and small fishes (Bănăduc *et al*., 2014). It is active at night (Bănărescu & Bănăduc, 2007). The zingel is mostly a solitary species.

Habitat

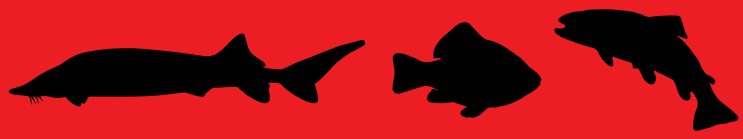
It inhabits the main course of large rivers with deep and fast-flowing water, with sandy, gravelly or rocky bottoms (Freyhof, 2011k). During the spawning season, it seeks out sections of rivers with a depth of more than 1 m and a fast current, where the bottom is covered with gravel and detritus.

Importance in fisheries

Since a permanent ban on fishing was imposed on this species, the zingel is no longer of fishery importance in Serbia. Previously, the zingel was considered a quality fish of the category II, although it is characterised by very tasty meat (Simonović, 2001).

Threats

Populations are mainly affected by the construction of dams, which slow down the flow and alter the natural habitat. Destruction of lotic habitats and fragmentation caused by hydro-engineering works, as well as water pollution and exploitation of mineral substrates, have a negative impact on this species (Freyhof, 2011k).



Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	3.2, 7.2.11, 7.3, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Veliki vretenar se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Potrebno je sprečiti ili ograničiti eksploataciju peska i šljunka na delovima reke koji su pogodni za mrest velikog vretenara, odnosno mesta sa dubljom vodom brzog toka, sa šljunkovitim dnom. Eksploatacija ne bi smela da bude dozvoljena na udaljenosti manjoj od 5 km od mesta mresta. Korisno bi bilo napraviti ihtiološke rezervate sa neizmenjenim delovima rečnog korita, po modelu morskih rezervata. Koridore vodene vegetacije u rekama trebalo bi zaštititi na dužinama od po 25–100 m sa obe strane rečnog korita, jer je taj pojas značajan sa trofičkog i reproduktivnog aspekta za ovu vrstu. Na delovima reka gde postoje brane potrebno je napraviti riblje staze i prolaze. Razvoj nacionalne legislative i edukativnih programa doprineli bi boljoj zaštiti ne samo velikog vretenara, već i drugih autohtonih vrsta riba.

Conservation actions in place

The zingel is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is also necessary to prevent or restrict the exploitation of sand and gravel in river stretches suitable for zingel spawning, i.e. in places with deeper, fast-flowing water and gravelly bottoms. Mining should not be allowed within a radius of 5 km around the spawning site. It would make sense to create ichthyological reserves with unaltered parts of the riverbed, following the example of marine protected areas. The corridors of aquatic vegetation in rivers should be protected over a length of 25-100 m on both sides of the riverbed, as this zone is important for this species from a trophic and reproductive point of view. Fish ladders and passages need to be created in the river sections where dams are located. The development of national legislation and education programmes would contribute to better protection not only of the zingel, but also of other native fish species.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.1, 2.3, 4, 5.1.2, 5.2

Neophodna su dalja istraživanja i praćenja stanja veličine i trendova populacija velikog vretenara, kao i faktora ugrožavanja, uz razvoj i implementaciju odgovarajućih programa monitoringa. Takođe, morali bi se poboljšati i učiniti efikasnijim upravljački planovi koji se odnose na riblji fond i staništa riba.

Further research and monitoring of zingel population size, trends and threatening factors, as well as the development and implementation of appropriate monitoring programmes are needed. Management plans for fish stocks and fish habitats should also be improved and made more effective.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 2.1, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Marija Smederevac-Lalić

8.5.

Gotovo ugrožene vrste (NT)

Near threatened species (NT)

ŠTUKA
Esox lucius Linnaeus, 1758

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Esociformes
Porodica: Esocidae
Vrsta: *Esox lucius* Linnaeus, 1758

Sinonimi

Trematina foveolata Trautschold, 1884; *Lucius lucius* (Linnaeus, 1758); *Luccius vorax* Rafinesque, 1810; *Esox estor* Lesueur, 1818; *Esox lucius variegatus* Fitzinger, 1832; *Esox lucioides* Agassiz & Girard, 1850; *Esox boreus* Agassiz, 1850; *Esox reichertii baicalensis* Dybowski, 1874; *Esox lucius atrox* Anikin, 1902; *Esox lucius bergi* Kaganowsky, 1933; *Esox lucius lucius wiliunensis* Kirillov, 1962

Narodno ime: Štuka
Englesko ime: Northern pike
Francusko ime: Grand brochet
Nemačko ime: Hecht
Rusko ime: Щука

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, štuka se ne smatra ugroženom vrstom (Freyhof, 2010b; NatureServe, 2018). Na području Srbije, rasprostranjenje ove vrste je široko (EOO iznosi 67.743 km²), dok je veličina naseljene površine (AOO) znatno manja, i iznosi 568 km². Na osnovu IUCN kriterijuma, štuka u Srbiji ima status gotovo ugrožene vrste (NT).

Rasprostranjenje

Štuka ima cirkumpolarno rasprostranjenje u Evropi, Aziji i Severnoj Americi (Crossman, 1996; Kottelat & Freyhof, 2007). U Severnoj Americi naseljava reke u slivu Atlantskog, Arktičkog i Tihog okeana, od Labradora do Aljaske, južno do Pensilvanije i Nebraske, kao i Velika jezera i sliv reke Misisipi. U Evropi naseljava slivove Kaspijskog, Aralskog, Crnog, Baltičkog, Belog, Barencovog i Severnog mora, kao i slivove reka Atlantskog basena južno do reke Adur, zatim slivove Rone i reka severne Italije u basenu Sredozemnog mora. Na istoku je široko rasprostranjena duž centralne Azije i Sibira, sve do basena Beringovog mora. Istorijski areal ne obuhvata Pirinejsko poluostrvo, mediteranski deo Francuske, centralnu Italiju, južnu i zapadnu Grčku, istočni basen Jadranskog mora, Island, zapadnu Norvešku i severnu Škotsku. Introdukovana je širom Evrope, kao i u neke države u Africi (Alžir, Etiopija, Maroko, Uganda) (NatureServe, 2018).

U Srbiji naseljava većinu vodotoka crnomorskog sliva (Dunav, Savu, Tisu, Drinu, Kolubaru, Veliku Moravu, Zapadnu Moravu,

NORTHERN PIKE
Esox lucius Linnaeus, 1758

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Esociformes
Family: Esocidae
Species: *Esox lucius* Linnaeus, 1758

Synonyms

Trematina foveolata Trautschold, 1884; *Lucius lucius* (Linnaeus, 1758); *Luccius vorax* Rafinesque, 1810; *Esox estor* Lesueur, 1818; *Esox lucius variegatus* Fitzinger, 1832; *Esox lucioides* Agassiz & Girard, 1850; *Esox boreus* Agassiz, 1850; *Esox reichertii baicalensis* Dybowski, 1874; *Esox lucius atrox* Anikin, 1902; *Esox lucius bergi* Kaganowsky, 1933; *Esox lucius lucius wiliunensis* Kirillov, 1962

Vernacular name: Štuka
English name: Northern pike
French name: Grand brochet
German name: Hecht
Russian name: Щука

National threat category assessed according to IUCN criteria

At the global level, the northern pike is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2010b; NatureServe, 2018). In Serbia, the extent of occurrence is large (EOO is 67,743 km²), while the area of occupancy (AOO) is much smaller at 568 km². The northern pike is classified as Near Threatened (NT) in Serbia.

Distribution

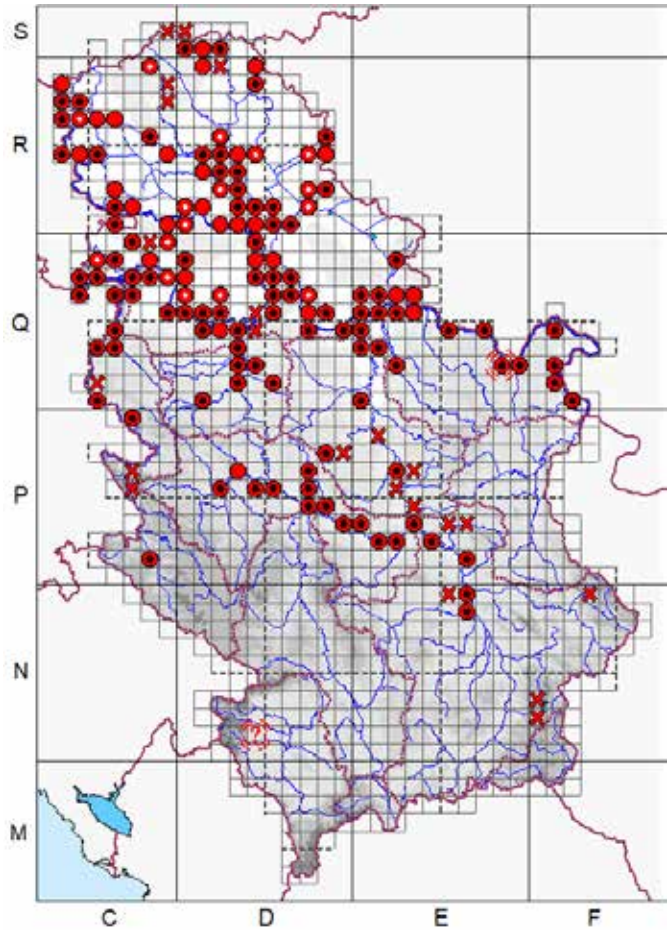
The northern pike has a circumpolar distribution in Europe, Asia and North America (Crossman, 1996; Kottelat & Freyhof, 2007). In North America, it inhabits rivers in the Atlantic, Arctic, and Pacific basins, from Labrador to Alaska, south to Pennsylvania and Nebraska, as well as the Great Lakes and the Mississippi drainage. In Europe, it inhabits the basins of the Caspian, Aral, Black, Baltic, White, Barents and North Seas, as well as the Atlantic basin south to the Adour River and the Mediterranean basin in the Rhône drainage and in northern Italy. In the east, it is widespread in Central Asia and Siberia as far as the Bering Sea basin. Its historical range does not include the Iberian Peninsula, the Mediterranean part of France, central Italy, southern and western Greece, the eastern basin of the Adriatic Sea, Iceland, western Norway and northern Scotland. It has been introduced throughout Europe as well as in some countries in Africa (Algeria, Ethiopia, Morocco, Uganda) (NatureServe, 2018).

In Serbia, it inhabits most of the watercourses of the Black Sea basin (Danube, Sava, Tisza, Drina, Kolubara, Great Morava, West Morava,

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Štuka / Northern pike – *Esox lucius*	Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	-
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex II**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**L, MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Zaštićena vrsta / Protected species**

*L – lovostaj od 1. februara do 31. marta, MLM – minimalna lovna mera 40 cm, ODU – ograničenje dnevnog ulova na 3 komada /
L – closed season from February 1 to March 31, MLM – minimum landing size at 40 cm standard length, ODU – daily catch limit of 3 individuals



Slika 134. Rasprostranjenje *Esox lucius* u Srbiji.

Figure 134. Distribution of *Esox lucius* in Serbia.

Slika 135. Štuka *Esox lucius* (foto: Wrangel, https://www.dreamstime.com/stock-photo-northern-pike-esox-lucius-wildlife-animal-image77217031).

Figure 135. Northern pike *Esox lucius* (photo: Wrangel, https://www.dreamstime.com/stock-photo-northern-pike-esox-lucius-wildlife-animal-image77217031).

Južnu Moravu i druge) (Slika 134). Uneta je u mnoge akumulacije (Vlasina, Zaovinsko jezero), u kojima se dobro aklimatizovala. U Vojvodini naseljava praktično sve tekuće i stajaće vode, kao i kanalsku mrežu sistema DTD.

Opis vrste

Telo štuke je vretenasto, izduženo, sa sitnim utisnutim krljuštima (Slika 135). Boja tela odraslih jedinki je tamnozelena do smeđa, sa sjajnim zlatnim mrljama i nepravilnim prugama po telu. Neparna peraja su žućkasto-crvenkasta. Mlade ribe su zelenkaste boje. Vilice su izdužene i spljoštene u obliku pačjeg kljuna. Donja vilica je duža od gornje i vrhom savijena naviše. U donjoj vilici ima više nizova velikih oštrih zuba. Gornja vilica je sa sitnijim, ali gušće postavljenim zubima. Zubi postoje i na nepčanim kostima i vomeru. Leđno peraje je pomereno ka zadnjoj trećini tela, tako da je njegova osnova praktično iznad osnove podrepnog peraja. Peraja: D VI–X + 13–16; A III–VIII + 10–14; P I + 12–16; V I + 12–19. Broj krljušti u bočnoj liniji je 105–144, a broj kičmenih pršljenova 57–65. Naraste do 1,5 m i dostiže masu od preko 28 kg (Froese & Pauly, 2022). Najstariji zabeleženi primerak imao je 30 godina (Muus & Dahlström, 1968).

Populacione karakteristike

Na globalnom nivou populacioni trendovi ocenjeni su kao stabilni (NatureServe, 2018). Zbog toga što naseljava široki spektar staništa, odlikuje je veliki broj subpopulacija. Veličina adultnih populacija nije poznata, ali su sigurno veoma velike. Trendovi u populacijama u poslednjih 10 godina tj. u poslednje tri generacije verovatno su stabilni.

U Srbiji takođe nema detaljnijih podataka o populacijama štuke, iako je u pitanju veoma značajna vrsta, kako za komercijalni, tako i za rekreativni ribolov. Mogu se naći veoma grubi podaci za pojedine ribolovne vode u programima upravljanja ribarskim područjima, prema kojima se gustina populacija štuke kreće između

South Morava and others) (Figure 134). It was introduced into many reservoirs (Lake Vlasina and Lake Zaovine), where it acclimatised well. In Vojvodina, it lives in practically all running and standing waters, as well as in the canal network of the system DTD.

Description of the species

The body of the northern pike is spindle-shaped, elongated, with small embedded scales (Figure 135). The body colour in adults is dark green to brown, with shiny golden spots and irregular stripes on the trunk. The unpaired fins are yellowish-reddish. Juveniles are greenish in colour. The snout is elongated and flattened and has the shape of a duck's bill. The lower jaw is longer than the upper jaw and its tip is curved upwards. The lower jaw has several rows of large and sharp teeth. The upper jaw has smaller but more densely spaced teeth. Teeth are also present on the palatine bones and vomer. The dorsal fin is located in the posterior third of the body, so that its base is practically above the base of the anal fin. Fins: D VI–X + 13–16; A III–VIII + 10–14; P I + 12–16; V I + 12–19. The number of scales in the lateral line is 105–144 and the number of vertebrae is 57–65. It grows up to 1.5 m and reaches a mass of over 28 kg (Froese & Pauly, 2022). The oldest documented specimen was 30 years old (Muus & Dahlstroem, 1968).

Population trends

On a global scale, population trends are estimated to be stable (NatureServe, 2018). As this species inhabits a wide range of habitats, it is characterised by a large number of subpopulations. The size of the adult populations is not known, but they are certainly large. The population trends over the last 10 years, i.e. the last three generations, are probably stable.

In Serbia, there is also no detailed data on northern pike populations, although it is a very important species, both for commercial and recreational fishing. Very rough data for individual fishing waters can be found in fisheries management programmes, according to which pike population densities range from 2.4 kg/ha in Silver Lake

2,4 kg/ha u Srebrnom jezeru do 663 kg/ha u nekim barama pored Drine (Hegediš *et al*., 2008, 2018; Hegediš, 2013).

Ekologija vrste

Mužjaci dostižu polnu zrelost u trećoj godini života, a najveći broj jedinki oba pola sazreva pri uzrastu od 3 do 4 godine (Kottelat & Freyhof, 2007). U vodama dunavskog sliva polnu zrelost dostiže nešto ranije, mužjaci u drugoj, a ženke u trećoj godini života (Lenhardt & Cakić, 2002). Relativna plodnost je 15.000–45.000 jaja po kg telesne mase (Keith & Allardi, 2001). Mrest obavlja u plitkim plavnim zonama, od februara do juna (Kottelat & Freyhof, 2007). Štuka je solitarna i izrazito grabljiva vrsta. Nije migratorna, ali se može svrstati u potamodromne ribe, jer vrši manje mresne migracije (Morrow, 1980). Kao vizuelni predator uglavnom lovi danju, mada se hrani i noću. Ovo je moguće zahvaljujući senzornim porama lateralnog sistema na ventralnoj strani donje vilice. Već nakon nekoliko meseci starosti gotovo isključivo se hrani ribom, ali jede i žabe, rakove i sitnije vodene ptice ukoliko se nađu u blizini (Morrow, 1980). Kod juvenilnih štuka izražen je i kanibalizam (Gilles *et al*., 1986).

Stanište

Štuka obično naseljava priobalja mirnih, stajaćih i sporotekućih voda, obraslih gustom akvatičnom vegetacijom (Page & Burr, 2011), mada može biti brojna i u bržim i bistrijim rekama, kao na primer u Drini, u kojoj je uobičajena u delu toka od ušća u Savu do brane u Perućcu. U tekućim vodama najčešće obitava uz obalu, gde, skrivena granjem, vegetacijom ili krupnijim kamenjem, vreba plen. U staništima se obično nalazi u plićim delovima, na dubinama od 1 m do 5 m, a u jezerima i akumulacijama može se sresti i na dubinama do 30 m. Pored tipičnih slatkovodnih staništa, štuka naseljava i brakične vode (Froese & Pauly, 2022).

Ribolovni značaj

Mogućnost ribolova tokom cele godine čini štuku izuzetno značajnom vrstom za rekreativni ribolov (NatureServe, 2018). Značajna je i za komercijalni ribolov, iako ne spada u ekonomski najznačajnije vrste i pored ukusnog i kvalitetnog mesa. Na tržištu se uglavnom pojavljuje u svežem stanju. U nekoliko zemalja zabeležen je i izvestan negativni uticaj na druge vrste riba nakon introdukcije štuke (Elvira *et al*., 1996). U Srbiji se štuka gaji u ribnjacima kao prateća vrsta, ali dostupni podaci o ulovu izostaju.

Faktori ugrožavanja

Pored ugrožavajućih faktora koji su karakteristični za višenamensko korišćenje vodnih resursa, gde se posebno izdvaja zagađenje različitog porekla, štuku posebno ugrožava devastacija i nestanak manjih vodenih staništa (bare, kanali), a posebno plavnih zona koje su pogodne za mrest (Kottelat & Freyhof, 2007). Takođe, introdukcija alohtonih invazivnih vrsta kao što su sunčica, cverglan i amurski spavač, koje se hrane ikrom i mlađi drugih riba, pa tako i štuke, mogu imati vrlo negativan uticaj na populacije ove vrste. U novije vreme, razvoj turizma i rekreacije uz povećan ribolovni

to 663 kg/ha in some ponds along the Drina (Hegediš *et al*., 2008 , 2018; Hegediš, 2013`).

Ecology of the species

Males reach sexual maturity in the third year of life, and most individuals of both sexes become sexually mature at the age of 3 to 4 years (Kottelat & Freyhof, 2007). In the waters of the Danube basin, sexual maturity is reached somewhat earlier, namely in the second year of life for males and in the third year of life for females (Lenhardt & Cakić, 2002). Relative fecundity is 15,000-45,000 eggs per kg of body mass (Keith & Allardi, 2001). It spawns in shallow floodplains, from February to June (Kottelat & Freyhof, 2007). The pike is a solitary fish and a voracious predator. It is not migratory, but can be considered a potamodromous fish as it undertakes short spawning migrations (Morrow, 1980). As a visual predator, it hunts mainly during the day, although it also feeds at night. This is due to the sensory pores of the lateral system on the ventral side of the lower jaw. After only a few months, it feeds almost exclusively on fish, but also preys on frogs, crustaceans and smaller waterfowl if they are nearby (Morrow, 1980). Cannibalism is also common in juvenile pike (Gilles *et al*., 1986).

Habitat

The northern pike usually lives near the shore of calm, stagnant and slow-flowing waters covered with dense aquatic vegetation (Page & Burr, 2011), although it can also be abundant in fast and clear rivers, such as the Drina, where it is common in the river section from the mouth of the Sava to the dam in Perućac. In running waters it usually stays along the banks, where it stalks its prey, hidden by branches, vegetation or larger stones. It typically inhabits shallower areas at depths of 1 to 5 m, while in lakes and reservoirs it can be found at depths of up to 30 m. In addition to the typical freshwater habitats, the pike also inhabits brackish waters (Froese & Pauly, 2022).

Importance in fisheries

The year-round fishing opportunity makes the northern pike an extremely important species for recreational fisheries (NatureServe, 2018). It is also important for commercial fisheries, although it is not one of the most commercially important species despite its tasty and high-quality meat. It is usually brought to market fresh. Some negative impacts on other fish species have been noted in several countries following the introduction of northern pike (Elvira *et al*., 1996). In Serbia, northern pike is farmed as an auxiliary species in fish ponds, but no data on catches are available.

Threats

In addition to the threats characteristic of the multipurpose use of water resources, where pollution from various sources is the main concern, the northern pike is mainly threatened by the destruction and disappearance of smaller aquatic habitats (ponds, canals), especially floodplains suitable for spawning (Kottelat & Freyhof, 2007). The introduction of non-native invasive species such as the pumpkinseed, brown and black bullhead and Amur sleeper, which feed on the roe and juveniles of other fish, including pike, can also have a very negative impact on populations of this species. More recently,

pritisak mogu biti značajni ugrožavajući faktor. Ribolov u slučajevima slabe kontrole može uzrokovati krivolov, a u težim slučajevima i prelov. Nikako ne treba isključiti ni negativne efekte klimatskih promena.

the development of tourism and recreational areas with increased fishing pressure can pose a significant threat. If fisheries are poorly controlled, this can lead to poaching and, in worse cases, overfishing. The negative effects of climate change cannot be ruled out either.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1.3, 5.4.1, 5.4.2, 6.1, 7.2.3, 7.3, 8.1, 9.1, 9.3, 11.1, 11.3

Postojeće mere zaštite

Štuka se nalazi u Prilogu II *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je lovostaj od 1. februara do 31. marta, minimalna lovna mera od 40 cm i ograničenje dnevnog ulova na 3 komada. Pored toga, može se reći da se određena zaštita ove vrste ostvaruje i kroz zaštitu staništa koja se nalaze u nacionalnim parkovima, specijalnim rezervatima prirode i parkovima prirode. Iako je vrlo značajna ribolovna vrsta, za štuku, kao i za većinu drugih vrsta riba, ne postoji akcioni plan upravljanja populacijama u vodama Srbije.

Conservation actions in place

The northern pike is listed in Annex II of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a closed season from February 1 to March 31, a minimum landing size at 40 cm standard length and a daily catch limit of 3 individuals are set for this species. In addition, it can be said that some protection of this species is achieved through the habitat protection in national parks, special nature reserves and nature parks. Although it is a very important fish species, for the pike, as for most other fish species, there is no action plan for population management in Serbian waters.

Predložene mere zaštite

Imajući u vidu ribolovni značaj i atraktivnost štuke, bilo bi potrebno izraditi akcioni plan o upravljanju populacijama u ribolovnim vodama Srbije koji bi obuhvatio sve aspekte održivog korišćenja i zaštite. Posebnu pažnju bi trebalo obratiti na zaštitu i održivo korišćenje populacija u pojedinim staništima. U okviru zaštite staništa, od posebnog značaja jesu zaštita i upravljanje vodnim resursima, restauracija staništa i prirodnih procesa, kao i kontrola i upravljanje alohtonim invazivnim vrstama. Bilo bi potrebno obuhvatiti i *ex situ* zaštitu kroz razvoj akvakulture štuke.

Conservation actions needed

Considering the fishery importance and attractiveness of pike, it would be necessary to develop an action plan for population management in Serbian fishery waters, covering all aspects of sustainable exploitation and protection. Special attention should be paid to the protection and sustainable use of populations in specific habitats. Within the framework of habitat protection, the protection and management of water resources, the restoration of habitats and natural processes, and the control and management of non-native invasive species are of particular importance. It would be necessary to incorporate *ex situ* protection through the development of pike aquaculture.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2, 3.1.1, 3.2, 3.4

Pored već predloženog akcionog plana upravljanja populacijama štuke u vodama Srbije, potrebna su dalja detaljnija istraživanja distribucije ove vrste, veličine populacija i aktuelnih trendova. Takođe, buduća istraživanja treba da obuhvate praćenje žetve i održivost aktuelnog korišćenja populacija, praćenje tržišta, praćenje stanja staništa, kao i faktora koji ugrožavaju ovu vrstu.

In addition to the already proposed action plan for the management of pike populations in Serbian waters, further detailed studies on the distribution of this species, population size and current trends are needed. Future research should also include monitoring of catch levels and sustainability of current exploitation, market monitoring, habitat conditions, as well as factors threatening this species.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.4, 1.5, 2, 3

AUTOR / AUTHOR: Aleksandar Hegediš

KARPATSKA PAKLARA
Eudontomyzon danfordi Regan, 1911

Taksonomski status

Razdeo: Chordata
Klasa: Petromyzonti
Red: Petromyzontiformes
Porodica: Petromyzontidae
Vrsta: *Eudontomyzon danfordi* Regan, 1911

Sinonimi

Lampetra danfordi Regan, 1911; *Petromyzon danfordi* Regan, 1911; *Lampetra minor* Grossinger, 1794; *Lampetra bergi* Vladykov, 1925; *Lampetra* (*Eudontomyzon*) *gracilis* Kux, 1967

Narodno ime: Karpatska paklara
Englesko ime: Carpathian brook lamprey
Francusko ime: Lamproie carpathique
Nemačko ime: Donauneunauge
Rusko ime: Венгерская минога

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, karpatska paklara ne smatra se ugroženom vrstom, međutim, sumnja se da brojnost populacija postepeno opada kao posledica ekonomskog razvoja (Freyhof & Kottelat, 2008h). Na području Srbije, veličina rasprostranjenja (EOO) iznosi 6.376 km², dok je veličina naseljene površine (AOO) fragmentisana i iznosi svega 36 km². Na osnovu IUCN kriterijuma, karpatska paklara u Srbiji ima status gotovo ugrožene vrste (NT).

Rasprostranjenje

Karpatska paklara je endemična vrsta dunavskog sliva. Najbrojnija je u rekama Tisi i Tamišu, na području Mađarske, Rumunije, Slovačke, Srbije i Ukrajine (Kottelat & Freyhof, 2007; Froese & Pauly, 2022). U Srbiji naseljava Dunav, Savu, Tisu, Tamiš, i još neke manje reke u crnomorskom slivu (Slika 136).

Opis vrste

Oblik tela karpatske paklare sličan je jegulji, sa sedam okruglih škržnih otvora iza oka (Slika 137). Paklare imaju karakterističan oralni disk koji im služi da se prikače za podlogu ili plen. Glava i leđa su plavo-sive boje, bočna strana ide od sive prema ružičastoj nijansi, dok je trbuh beo. Bočna linija nije pigmentisana. Karakteriše se odsustvom parnih peraja i vilica. Trup ima 58–70 miomera, nije istačkan (išaran) kod larvi, a repno peraje je bezbojno i providno. Prosečna dužina tela je oko 18 cm; adultne jedinke mogu narasti do 30 cm, a larve do 24,5 cm. Maksimalna zabeležena starost iznosi 7 godina (Renaud & Holčík, 1986).

CARPATHIAN BROOK LAMPREY
Eudontomyzon danfordi Regan, 1911

Taxonomic status

Phylum: Chordata
Class: Petromyzonti
Order: Petromyzontiformes
Family: Petromyzontidae
Species: *Eudontomyzon danfordi* Regan, 1911

Synonyms

Lampetra danfordi Regan, 1911; *Petromyzon danfordi* Regan, 1911; *Lampetra minor* Grossinger, 1794; *Lampetra bergi* Vladykov, 1925; *Lampetra* (*Eudontomyzon*) *gracilis* Kux, 1967

Vernacular name: Karpatska paklara
English name: Carpathian brook lamprey
French name: Lamproie carpathique
German name: Donauneunauge
Russian name: Венгерская минога

National threat category assessed according to IUCN criteria

At the global level, the Carpathian brook lamprey is not classified as a threatened species and has the status of Least Concern (LC). However, it is assumed that the number of populations is gradually declining as a result of economic development (Freyhof & Kottelat, 2008h). In Serbia, the extent of occurrence (EOO) is 6,376 km², while the area of occupancy (AOO) is fragmented with only 36 km². The Carpathian brook lamprey is classified as Near Threatened (NT) in Serbia.

Distribution

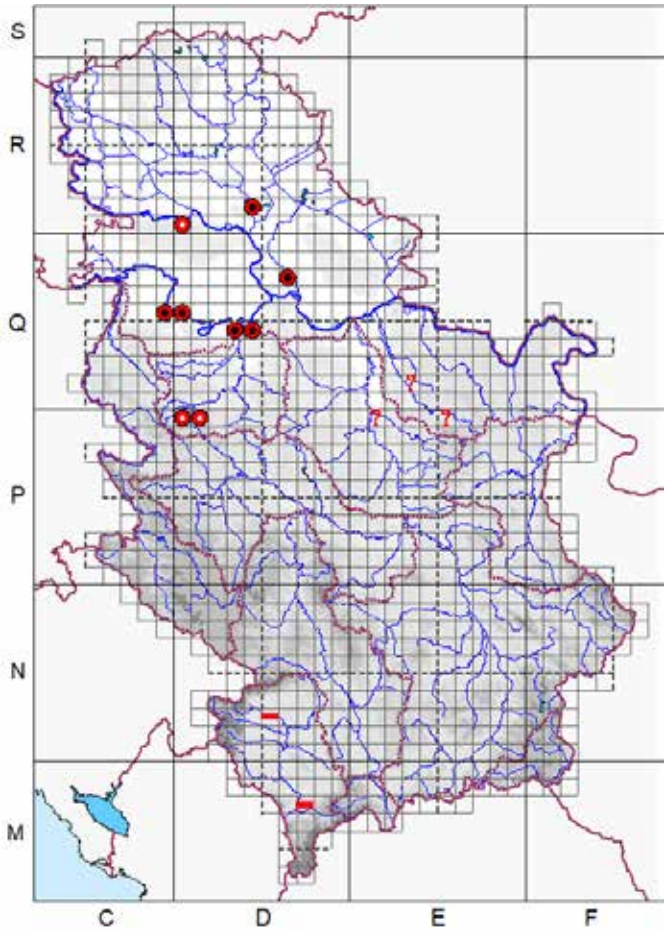
The Carpathian brook lamprey is endemic to the Danube basin. It is most abundant in the rivers Tisza and Tamiš in the territory of Hungary, Romania, Slovakia, Serbia and Ukraine (Kottelat & Freyhof, 2007; Froese & Pauly, 2022). In Serbia, it inhabits the Danube, Sava, Tisza, Tamiš and some other smaller rivers in the Black Sea basin (Figure 136).

Description of the species

The body of the Carpathian brook lamprey resembles that of an eel, with seven round gill openings behind the eye (Figure 137). The lampreys have a characteristic oral disc with which they cling to the substrate or prey. The head and back are blue-grey, the flanks change from grey to a pinkish hue, while the belly is white. The lateral line is not pigmented. It is distinguished by the absence of paired fins and jaws. The trunk has 58–70 myomeres, it is not spotted (mottled) in larvae, and the caudal fin is colourless and hyaline. The average body length is about 18 cm; adults can grow up to 30 cm and larvae up to 24.5 cm long. The maximum age is 7 years (Renaud & Holčík, 1986).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Karpatska paklara / Carpathian brook lamprey – *Eudontomyzon danfordi*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Eudontomyzon* spp.)	**Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Strogo zaštićena vrsta / Strictly protected species**



Slika 136. **Rasprostranjenje *Eudontomyzon danfordi* u Srbiji.**

Figure 136. **Distribution of *Eudontomyzon danfordi* in Serbia.**

Slika 137. Karpatska paklara *Eudontomyzon danfordi* (foto: A. Makara, https://www.andrejmakara.com/index.php/fotozbierky?page=view&catid=94&imgid=127&PageNo=32769&key=3&hit=1).

Figure 137. Carpathian brook lamprey *Eudontomyzon danfordi* (photo: A. Makara, https://www.andrejmakara.com/index.php/fotozbierky?page=view&catid=94&imgid=127&PageNo=32769&key=3&hit=1).

Populacione karakteristike

Pretpostavlja se da brojnost populacija polako opada usled ekonomskog razvoja u zemljama istočne Evrope i kao posledica zagađenja voda i izgradnje brana (Freyhof & Kottelat, 2008h).

Ekologija vrste

Larveni stadijum (ammocoete) traje 3,5–4,5 godine. Larve žive zarivene u pesak i hrane se filtriranjem detritusa i larvama insekata. Metamorfoza obično počinje između jula i avgusta, kada larve postignu dužinu od 19 cm, i traje 1–5 meseci (Kottelat & Freyhof, 2007). Adultna faza traje 17–19 meseci, a jedinke se hrane tokom prvih 12 meseci. U proleće migriraju u gornje delove potoka zbog mresta. Period mresta lokalno varira. Većina jedinki ugine nakon mresta. Fekunditet ženki je od 7.500 do 10.300 jaja (Renaud, 2011). Vodi parazitski i predatorski način života. Odrasle jedinke se hrane krvlju ili mesom živih i uginulih riba. Žrtve traži noću, a danju se krije u podvodnoj vegetaciji ili ispod kamena (Freyhof & Kottelat, 2008h).

Stanište

Naseljava čiste potoke sa dosta kiseonika, u brdskim i planinskim zonama. Larve (ammocoete) nastanjuju peskovitu ili glinovitu podlogu bogatu detritusom (Freyhof & Kottelat, 2008h).

Ribolovni značaj

Karpatska paklara nema ribolovni ni privredni značaj.

Population trends

Populations are thought to be slowly declining due to economic development in Eastern European countries and as a result of water pollution and the construction of dams (Freyhof & Kottelat, 2008h).

Ecology of the species

The larval stage (ammocoete) lasts 3.5–4.5 years. Larvae live burrowed in the sand and feed by filtering detritus and insect larvae. Metamorphosis usually begins between July and August, when the larvae reach a length of 19 cm, and lasts 1–5 months (Kottelat & Freyhof, 2007). The adult phase lasts 17–19 months, feeding only during the first 12 months. In spring they migrate to the upper reaches of the river to spawn. The duration of spawning varies locally. Most individuals die after spawning. The fecundity of females ranges from 7,500 to 10,300 eggs (Renaud, 2011). It leads a parasitic and predatory lifestyle. Adults feed on the blood or flesh of both living and dead fish. At night it searches for prey and during the day it hides in submerged vegetation or under stones (Freyhof & Kottelat, 2008h).

Habitat

It inhabits clean, oxygen-rich streams in hilly and mountainous areas. The larvae (ammocoetes) inhabit sandy or clayey substrates rich in detritus (Freyhof & Kottelat, 2008h).

Importance in fisheries

The Carpathian brook lamprey is of no fishery importance, neither in recreational nor in commercial fishing.

Faktori ugrožavanja

Osnovni faktori ugrožavanja jesu zagađenje i izgradnja brana (Freyhof & Kottelat, 2008h).

Threats

The greatest threats are pollution and the construction of dams (Freyhof & Kottelat, 2008h).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 9.1, 9.3

Postojeće mere zaštite

Karpatska paklara se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The Carpathian brook lamprey is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

Potrebno je poboljšati opšte mere koje se tiču zaštite ihtiofaune i zaštite voda od zagađenja i hidroloških izmena vodenih staništa.

Conservation actions needed

There is a need to improve general measures to protect fish fauna and to protect waters from pollution and hydrological changes in aquatic habitats.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.3

Neophodna su istraživanja i praćenja stanja veličine i trendova populacija karpatske paklare, kao i faktora ugrožavanja.

Research and monitoring of the Carpathian brook lamprey population size and trends, as well as threats, are necessary.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Marija Smederevac-Lalić

UKRAJINSKA PAKLARA
Eudontomyzon mariae (Berg, 1931)

Taksonomski status

Razdeo: Chordata
Klasa: Petromyzonti
Red: Petromyzontiformes
Porodica: Petromyzontidae
Vrsta: *Eudontomyzon mariae* (Berg, 1931)

Sinonimi

Lampetra mariae Berg, 1931; *Eudontomyzon maria* (Berg, 1931); *Petromyzon ponticus* Yashchenko, 1895

Narodno ime: Ukrajinska paklara
Englesko ime: Ukrainian brook lamprey
Francusko ime: Lamproie ukrainienne
Nemačko ime: Ukrainische Bachneunauge
Rusko ime: Украинская минога

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, ukrajinska paklara ne smatra se ugroženom vrstom, međutim, pretpostavlja se da brojnost populacija postepeno opada kao posledica ekonomskog razvoja (Freyhof, 2011c). Na području Srbije, rasprostranjenje ove vrste je široko – EOO iznosi 17.360 km², dok je veličina naseljene površine (AOO) fragmentisana i iznosi svega 20 km². Na osnovu IUCN kriterijuma, ukrajinska paklara u Srbiji ima status gotovo ugrožene vrste (NT).

Rasprostranjenje

Ukrajinska paklara naseljava slivove Baltičkog, Crnog, Egejskog i Kaspijskog mora, a zabeležena je i u gornjem delu sliva Morave (Češka) (Kottelat & Freyhof, 2007; Levin *et al*., 2006, 2016; Levin & Holčík, 2006). U Srbiji naseljava reke crnomorskog sliva, Dunav, Drinu, Savu, Mlavu i Crni Timok (Slika 138).

Opis vrste

Oblik tela ukrajinske paklare sličan je jegulji, sa sedam okruglih škržnih otvora iza oka (Slika 139). Adultne jedinke imaju tamnozelenu, tamnosivu ili crnu boju leđa, dok su bokovi i stomak beli, sa srebrnim odsjajem. Larve su pegave. Karakteriše se odsustvom parnih peraja i vilica. Imaju karakterističan oralni disk koji im služi da se prikače za podlogu. Razlikuje se od drugih vrsta roda *Eudontomyzon* po sledećim karakteristikama: trup ima 60–73 miomera i istačkan (išaran) je kod larvi starijih od 2,5 godine, a repno peraje ima lopatast oblik i tamnosivu do crnu boju kod adultnih jedinki i larvi starijih od 1,5 godine (Holčík & Renaud, 1986; Kottelat & Freyhof, 2007). Karakteristično je i odsustvo tamne mrlje blizu vrha drugog leđnog peraja (Drąg-Kozak *et al*., 2011). Bočna linija je nepigmentisana ili tamno pigmentisana. Prosečna dužina je 18 cm, a može da poraste do 22,2 cm. Životni vek je 5–7 godina (Holčík & Renaud, 1986; Kottelat & Freyhof, 2007).

UKRAINIAN BROOK LAMPREY
Eudontomyzon mariae (Berg, 1931)

Taxonomic status

Phylum: Chordata
Class: Petromyzonti
Order: Petromyzontiformes
Family: Petromyzontidae
Species: *Eudontomyzon mariae* (Berg, 1931)

Synonyms

Lampetra mariae Berg, 1931; *Eudontomyzon maria* (Berg, 1931); *Petromyzon ponticus* Yashchenko, 1895

Vernacular name: Ukrajinska paklara
English name: Ukrainian brook lamprey
French name: Lamproie ukrainienne
German name: Ukrainische Bachneunauge
Russian name: Украинская минога

National threat category assessed according to IUCN criteria

At the global level, the Ukrainian brook lamprey is not classified as a threatened species and has the status of Least Concern (LC). However, it is assumed that the number of populations is gradually declining as a result of economic development (Freyhof, 2011c). In Serbia, the extent of occurrence is large (EOO is 17,360 km²), while the area of occupancy (AOO) is fragmented with only 20 km². The Ukrainian brook lamprey is classified as Near Threatened (NT) in Serbia.

Distribution

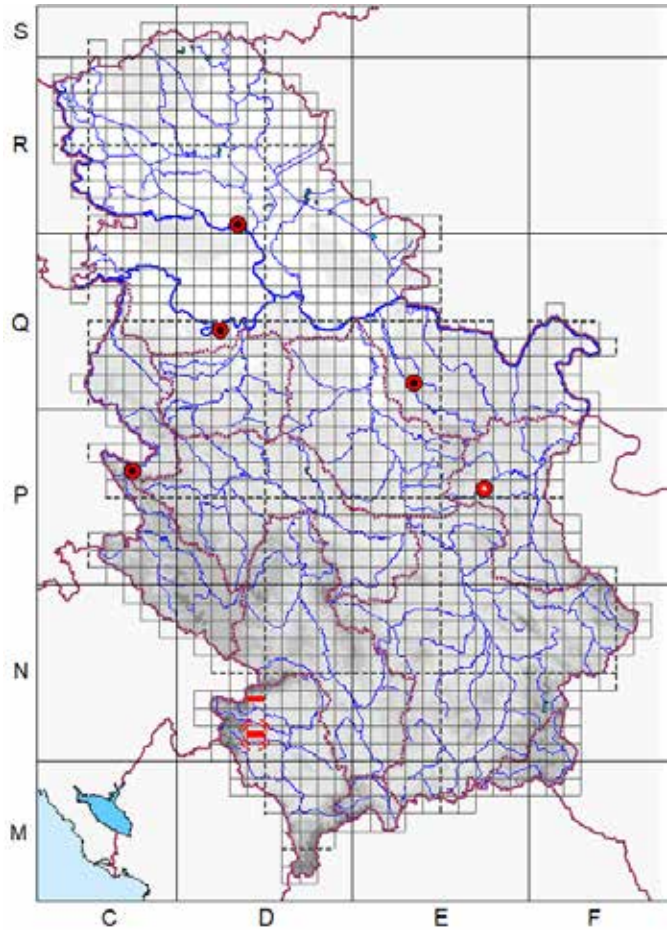
The Ukrainian brook lamprey inhabits the basins of the Baltic, Black, Aegean and Caspian Seas and has also been recorded in the upper part of the Morava Basin (Czech Republic) (Kottelat & Freyhof, 2007; Levin *et al*., 2006, 2016; Levin & Holčík, 2006). In Serbia, it inhabits the rivers of the Black Sea basin, the Danube, the Drina, the Sava, the Mlava and the Crni Timok (Figure 138).

Description of the species

The body shape of the Ukrainian brook lamprey resembles an eel, with seven round gill openings behind the eye (Figure 139). Adults have dark green, dark grey or black dorsum, while the flanks and belly are white with a silvery sheen. The larvae are spotted. They are distinguished by not having paired fins and jaws. They have a characteristic oral disc with which they cling to the substrate. It differs from other species of the genus *Eudontomyzon* by the following characteristics: the trunk has 60–73 myomeres and is spotted (mottled) in larvae older than 2.5 years, and the caudal fin has a spade-like shape and is dark grey to black in adults and larvae older than 1.5 years (Holčík & Renaud, 1986; Kottelat & Freyhof, 2007). The absence of a dark spot near the tip of the second dorsal fin is also characteristic (Drąg-Kozak *et al*., 2011). The lateral line is unpigmented or darkly pigmented. The average length is 18 cm and can be up to 22.2 cm. Life expectancy is 5–7 years (Holčík & Renaud, 1986; Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Ukrajinska paklara / Ukrainian brook lamprey – *Eudontomyzon mariae*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Strogo zaštićena vrsta / Strictly protected species**



Slika 138. **Rasprostranjenje *Eudontomyzon mariae* u Srbiji.**

Figure 138. **Distribution of *Eudontomyzon mariae* in Serbia.**

Slika 139. Ukrajinska paklara *Eudontomyzon mariae* (https://commons.wikimedia.org/wiki/File:Одинока мінога.JPG).

Figure 139. Ukrainian brook lamprey *Eudontomyzon mariae* (https://commons.wikimedia.org/wiki/File:Одинока мінога.JPG)..

Populacione karakteristike

Iako je brojna u Poljskoj i Ukrajini, sumnja se da je populacioni trend ove vrste u postepenom opadanju (Freyhof, 2011c).

Ekologija vrste

Karakteriše se neparazitskim i nepredatorskim načinom života (Kottelat & Freyhof, 2007). Retki slučajevi ektoparazitizma zabeleženi su u Slovačkoj i Ukrajini (Drąg-Kozak *et al*., 2011; Renaud, 2011). Stacionarna je vrsta, mada je primećena mresna migracija adultnih jedinki u reci Don, kao i u nekim rekama u Belorusiji (Levin, 2001; Sarycheva *et al*., 2014). Mresti se tokom aprila i maja u manjim rečicama pri temperaturi vode od 8 °C do 13,5 °C. Na većim nadmorskim visinama mrest se odvija kasnije, pri temperaturi vode od 11 °C do 16 °C (Kottelat & Freyhof, 2007; Levin *et al*., 2016). Podloga na kojoj se odvija mrest je šljunkovita ili peskovita, ponekad i glinovita (Drąg-Kozak *et al*., 2011; Levin *et al*., 2016). Mužjaci kopaju plitka, kružna gnezda na delu vodotoka sa umerenom strujom (Kottelat & Freyhof, 2007). Ženka polaže od 2.200 do 7.000 jaja (Renaud, 2011). Mreste se u grupama od više stotina jedinki. Larve žive 3,5–4,5 godine zarivene u pesku, hraneći se filtraciono algama i detritusom (Kottelat & Freyhof, 2007). Ubrzo nakon sticanja polne zrelosti ulaze u mrest. Adulti se ne hrane i umiru mesec do dva nakon mresta (Jażdżewski *et al*., 2016).

Stanište

Odrasle jedinke žive u potocima, rekama i jezerima sa šljunkovito-peskovitim dnom (Drąg-Kozak *et al*., 2011; Renaud, 2011). Naseljava čiste potoke sa dosta kiseonika, u planinskim i nizijskim zonama. Larve se zakopavaju u peskovito-muljevitu podlogu bogatu detritusom, u područjima sa sporijim strujanjem vode (Kottelat & Freyhof, 2007; Jażdżewski *et al*., 2016).

Population trends

Although abundant in Poland and Ukraine, a gradual decline in the population of this species is suspected (Freyhof, 2011c).

Ecology of the species

The species is characterised by a non-parasitic and non-predatory lifestyle (Kottelat & Freyhof, 2007). Rare cases of ectoparasitism have been recorded in Slovakia and Ukraine (Drąg-Kozak *et al*., 2011; Renaud, 2011). It is a stationary species, although adult spawning migrations have been observed in the Don River as well as in some rivers in Belarus (Levin, 2001; Sarycheva *et al*., 2014). It spawns in April and May in smaller rivers at water temperatures ranging between 8 °C and 13.5 °C. At higher altitudes, spawning takes place later, at water temperatures of 11 °C to 16 °C (Kottelat & Freyhof, 2007; Levin *et al*., 2016). The substrate on which spawning occurs is gravelly or sandy, sometimes clayey (Drąg-Kozak *et al*., 2011; Levin *et al*., 2016). Males dig shallow, circular nests in a stretch of water with a moderate current (Kottelat & Freyhof, 2007). The female lays between 2,200 and 7,000 eggs (Renaud, 2011). They spawn in groups of several hundred individuals. Larvae live 3.5 to 4.5 years buried in sand and feed by filtration of algae and detritus (Kottelat & Freyhof, 2007). Shortly after reaching sexual maturity, they begin to spawn. Adults do not feed and die one to two months after spawning (Jażdżewski *et al*., 2016).

Habitat

Adults live in streams, rivers and lakes with gravelly-sandy bottoms (Drąg-Kozak *et al*., 2011; Renaud, 2011). It inhabits clean, oxygen-rich streams both in mountainous regions and in lowlands. Larvae burrow in sandy-muddy, detritus-rich substrate in areas with slower water flow (Kottelat & Freyhof, 2007; Jażdżewski *et al*., 2016).

Ribolovni značaj

Ukrajinska paklara nema ribolovni i privredni značaj.

Faktori ugrožavanja

Najznačajniji faktori ugrožavanja jesu gubitak i degradacija staništa, nastali kao posledica regulacije vodotoka izradnjom brana (Freyhof, 2011c). Ove intervencije uzokuju promenu nivoa vode koja direktno utiče na pad produkcije ili pak potpuno nestajanje detritusa, što posebno negativno utiče na larve paklara. Eksploatacija peska u donjim tokovima reka takođe ima negativno dejstvo, kao i zagađivanje vode (Mrakovčić *et al*., 2006).

Importance in fisheries

The Ukrainian brook lamprey is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

The greatest threats are habitat loss and degradation caused by the regulation of water flows through the construction of dams (Freyhof, 2011c). These interventions lead to a change in water levels that directly affects the decline in production or the complete disappearance of detritus, which has a particularly negative impact on the larvae of the Ukrainian brook lamprey. The removal of sand in the lower stretches of rivers and water pollution also have negative impacts (Mrakovčić *et al*., 2006).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 9.1, 9.2.3, 9.3.4, 11.1

Postojeće mere zaštite

Ukrajinska paklara se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Potrebno je zaštititi rečne tokove od zagađenja i izgradnje brana. Paklare su generalno manje poznati stanovnici naših voda, zbog čega bi trebalo pronaći više mesta za njih u edukativnim aktivnostima.

Conservation actions in place

The Ukrainian brook lamprey is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to protect rivers from pollution and the construction of dams. Lampreys are generally lesser known inhabitants of our waters, so more space should be given to them in educational activities.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.3, 4

Za očuvanje ove, kao i drugih slabo proučavanih vrsta, od izuzetne važnosti jesu istraživanja o preferencijama specifičnih tipova supstrata i mikrostaništa. Neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije, kao i faktora ugrožavanja. Izrada i implementacija akcionog plana za sve paklare koje se sreću u vodama Srbije predstavlja imperativ za naredni period, kao i izrada programa monitoringa populacionih trendova i stanja uslova u staništu.

For the conservation of these and other poorly studied species, research into preferences for certain substrate types and microhabitats is extremely important. Research is needed on population size, distribution and trends, life history and ecology, and threats. The development and implementation of an action plan for all lampreys found in Serbian waters, as well as the development of a programme to monitor population trends and habitat conditions, are crucial for the next period.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2.1, 3.1, 3.4

AUTOR / AUTHOR: Milica Jaćimović

DUNAVSKA PAKLARA
Eudontomyzon vladykovi Oliva & Zanandrea, 1959

Taksonomski status

Razdeo: Chordata
Klasa: Petromyzonti
Red: Petromyzontiformes
Porodica: Petromyzontidae
Vrsta: *Eudontomyzon vladykovi* Oliva & Zanandrea, 1959

Sinonimi

Eudontomyzon danfordi vladykovi Oliva & Zanandrea, 1959; *Eudontomyzon mariae vladykovi* Oliva & Zanandrea, 1959

Narodno ime: Dunavska paklara
Englesko ime: Vladykov's lamprey, Danubian brook lamprey
Francusko ime: Lamproie de Vladikov
Nemačko ime: Donaubachneunauge

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, dunavska paklara ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008j). Na području Srbije, rasprostranjenje ove vrste je znatno (EOO iznosi 20.496 km²), dok je veličina naseljene površine (AOO) fragmentisana i iznosi svega 40 km². Na osnovu IUCN kriterijuma, dunavska paklara u Srbiji ima status gotovo ugrožene vrste (NT).

Rasprostranjenje

Dunavska paklara je endemit dunavskog sliva i nastanjuje njegov gornji i srednji deo. Može se naći u gornjem delu Dunava severno i zapadno od Drave, kao i u Dravi i Savi (Kottelat & Freyhof, 2007). Javlja se lokalno i u donjem delu sliva Dunava, u sistemu reka Tamiš i Olt, dok u rečnim sistemima Tise i Černe nije zabeležena (Kottelat & Freyhof, 2007). U Srbiji naseljava vode dunavskog sliva. Zabeležena je u Bosutu, Limu, Jadru, Korenitoj reci, Gradcu, Mlavi, Resavi i Pančevačkom ritu (Slika 140).

Opis vrste

Telo dunavske paklare je zmijoliko, slično jegulji (Slika 141). Prva polovina tela je deblja od druge. Leđna strana tela tamnije je obojena u odnosu na trbuh. Iza oka nalazi se sedam okruglih škržnih otvora. Vilice odsustvuju. Poseduje karakterističan oralni disk koji joj služi da se prikači za podlogu. Parna peraja nedostaju. Trup ima 61–67 miomera i nije istačkan (išaran) kod larvi, a bezbojno i providno repno peraje ima lopatast oblik (Docker, 2015). Maksimalna zabeležena dužina tela je 21,2 cm, obično 18 cm (Kottelat & Freyhof, 2007; Muus & Dahlström). Neki autori smatraju da je ova vrsta sinonim za ukrajinsku paklaru, *E. mariae* (Holčík & Renaud, 1986; Renaud, 2011).

VLADYKOV'S LAMPREY
Eudontomyzon vladykovi Oliva & Zanandrea, 1959

Taxonomic status

Phylum: Chordata
Class: Petromyzonti
Order: Petromyzontiformes
Family: Petromyzontidae
Species: *Eudontomyzon vladykovi* Oliva & Zanandrea, 1959

Synonyms

Eudontomyzon danfordi vladykovi Oliva & Zanandrea, 1959; *Eudontomyzon mariae vladykovi* Oliva & Zanandrea, 1959

Vernacular name: Dunavska paklara
English name: Vladykov's lamprey, Danubian brook lamprey
French name: Lamproie de Vladikov
German name: Donaubachneunauge

National threat category assessed according to IUCN criteria

At the global level, the Vladykov's lamprey is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008j). In Serbia, the extent of occurrence is considerable (EOO is 20,496 km²), while the area of occupancy (AOO) is fragmented with only 40 km². The Vladykov's lamprey is classified as Near Threatened (NT) in Serbia.

Distribution

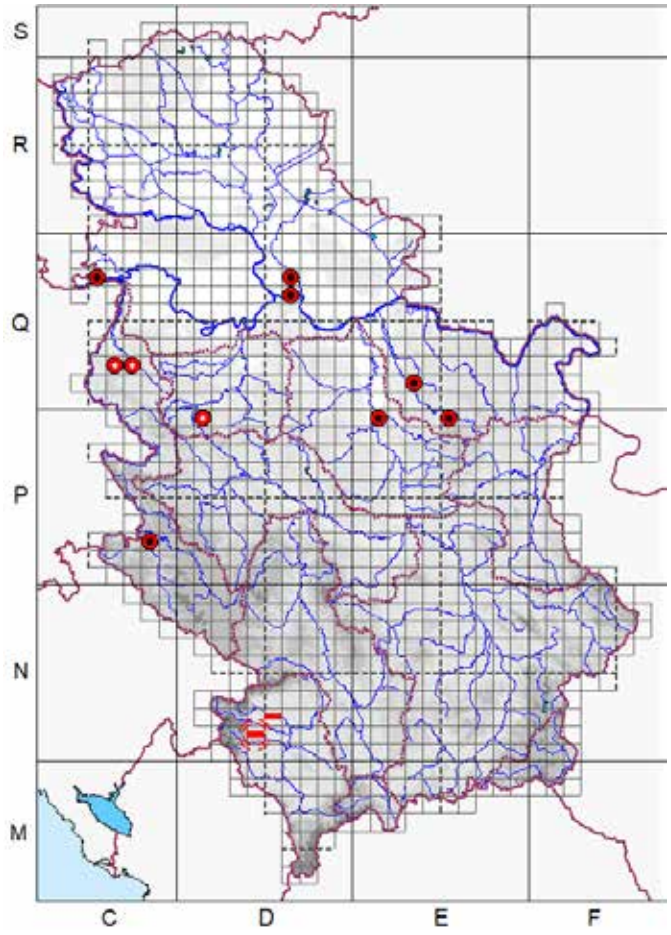
The Vladykov's lamprey is endemic to the Danube basin and inhabits its upper and middle parts. It occurs in the upper reaches of the Danube north and west of the Drava, as well as in the Drava and Sava rivers (Kottelat & Freyhof, 2007). In the lower part of the Danube basin, it occurs locally in the Tamiš and Olt river systems, while it has not been detected in the Tisza and Cerna river systems (Kottelat & Freyhof, 2007). In Serbia, it inhabits the Danube basin. It has been recorded in the Bosut, Lim, Jadar, Korenita reka, Gradac, Mlava, Resava and Pančevački Rit (Figure 140).

Description of the species

The body of the Vladykov's resembles that of an eel (Figure 141). The first half of the body is wider than the second. The back is darker than the belly. There are seven round gill openings behind the eye. The jaws are not present. It has a characteristic oral disc with which it can cling to the substrate. Paired fins are absent. The trunk has 61–67 myomeres and is not spotted (mottled) in larvae, and the colourless and hyaline caudal fin has a spade-like shape (Docker, 2015). The maximum recorded body length is 21.2 cm, usually 18 cm (Kottelat & Freyhof, 2007; Muus & Dahlstroem). Some authors consider this species to be a synonym of the Ukrainian brook lamprey, *E. mariae* (Holčík & Renaud, 1986; Renaud, 2011).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Dunavska paklara / Vladykov's lamprey – *Eudontomyzon vladykovi*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Eudontomyzon mariae*)	**LR/lc**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Strogo zaštićena vrsta / Strictly protected species**



Slika 140. **Rasprostranjenje *Eudontomyzon vladykovi* u Srbiji.**

Figure 140. **Distribution of *Eudontomyzon vladykovi* in Serbia.**

Slika 141. Dunavska paklara *Eudontomyzon vladykovi* (foto: P. Mustafić, https://balkanrivers.net/en/fish-database/eu_vl).

Figure 141. Vladykov's lamprey *Eudontomyzon vladykovi* (foto: P. Mustafić, https://balkanrivers.net/en/fish-database/eu_vl).

Populacione karakteristike

Populacioni trend ove vrste nije poznat. Sumnja se da brojnost populacija postepeno opada (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008j).

Ekologija vrste

Dunavska paklara se karakteriše neparazitskim i nepredatorskim načinom života. Stacionarna je vrsta, a ponekad migrira u okviru reke u kojoj živi. Larve (ammocoete) žive zakopane u pesku ili mulju i hrane se detritusom i algama. Stadijum larve traje 3,5–4,5 godine. Metamorfoza se događa od jula do septembra. Mrest traje od marta do maja, nešto kasnije na većim nadmorskim visinama, kada temperatura vode dostigne 7–10 °C (Kottelat & Freyhof, 2007). Mužjaci kopaju plitka gnezda na delu vodotoka gde je struja umerena. Mužjaci i ženke uginu nakon mresta.

Stanište

Dunavska paklara naseljava čiste, dobro aerisane i brze potoke u brdskim i planinskim zonama. Larve nastanjuju peskovitu podlogu bogatu detritusom ili glineni sediment (Kottelat & Freyhof, 2007).

Ribolovni značaj

Nema značaj u privrednom i rekreativnom ribolovu.

Faktori ugrožavanja

Specifičan i veoma kompleksan životni ciklus dunavske paklare, kasno polno sazrevanje i spor rast, čini je podložnom negativnim promenama izvazvanim ljudskim aktivnostima (Freyhof & Kottelat, 2008j). Moguće je da će brojnost populacija ove vrste polako opadati kao posledica ekonomskog razvoja. Negativni efekti javljaju se kao posledica višenamenskog korišćenja vodotoka, pre svega zbog izmene staništa usled izgradnje brana i zagađenja putem otpadnih voda različitog porekla, koje može biti praćeno eutrofikacijom (Freyhof & Brooks, 2011; Docker, 2015).

Population trends

The population trends of this species are unknown. It is assumed that populations are gradually declining (Kottelat & Freyhof, 2007; Freyhof & Kottelat, 2008j).

Ecology of the species

The Vladykov's lamprey is characterised by a non-parasitic and non-predatory lifestyle. It is a stationary species that sometimes migrates within the river in which it lives. The larvae (ammocoetes) live buried in sand or mud and feed on detritus and algae. The larval stage lasts 3.5–4.5 years. Metamorphosis takes place from July to September. The spawning season lasts from March to May or somewhat later at higher altitudes when water temperature reaches 7–10 °C (Kottelat & Freyhof, 2007). Males dig shallow nests in the part of the watercourse where the current is moderate. Males and females die after spawning.

Habitat

The Vladykov's lamprey inhabits clean, well-aerated, swift streams in hilly and mountainous areas. Larvae inhabit a sandy, detritus-rich substrate or clay sediment (Kottelat & Freyhof, 2007).

Importance in fisheries

The species is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

The specific and very complex life cycle of the Vladykov's lamprey, its late sexual maturity and slow growth make it vulnerable to negative changes caused by human activities (Freyhof & Kottelat, 2008j). It is possible that populations of this species will slowly decline as a result of economic development. Negative impacts result from multipurpose use of water resources, especially habitat alteration due to the construction of dams and pollution by effluents from various sources, which may be accompanied by eutrophication (Freyhof & Brooks, 2011; Docker, 2015).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	1, 7.2.11, 9.1, 9.2.3, 9.3

Postojeće mere zaštite

Dunavska paklara se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Najvažnije konzervacione mere odnose se na restauraciju, zaštitu i adekvatno upravljanje staništima i procesima koji se odvijaju u vodenim ekosistemima koje naseljavaju paklare. Potrebno je razviti i odgovarajuće edukativne programe za te namene.

Conservation actions in place

The Vladykov's lamprey is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

The most important conservation measures concern the restoration, protection and appropriate management of habitats and processes in the aquatic ecosystems in which lampreys live. To this end, it is necessary to develop appropriate educational programmes.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.3, 4, 5.4.2

Neophodna su istraživanja životnog ciklusa, populacionih i ekoloških odlika i ugrožavajućih faktora dunavske paklare, kao i primena već propisanih zakonskih mera. Bilo bi potrebno sačiniti akcioni plan za paklare u vodama Srbije, uz razvoj odgovarajućih programa monitoringa.

Research into the life cycle, population, ecological characteristics and threat factors of the Vladykov's lamprey is necessary, as is the implementation of the legal measures already prescribed. It would be necessary to establish an action plan for lampreys in Serbian waters and develop appropriate monitoring programmes.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 2.1, 3.1, 3.4

AUTOR / AUTHOR: Dušan Nikolić

BALONOV BALAVAC
Gymnocephalus baloni Holčík & Hensel, 1974

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Perciformes
Porodica: Percidae
Vrsta: *Gymnocephalus baloni* Holčík & Hensel, 1974

Sinonimi

Nema

Narodno ime: Balonov balavac
Englesko ime: Balon's ruffe, Danube ruffe
Francusko ime: Grémille de Balon
Nemačko ime: Donaukaulbarsch, Balons Kaulbarsch
Rusko ime: Ёрш Балона

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, Balonov balavac ne smatra se ugroženom vrstom (Freyhof, 2011d). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 14.752 km², dok je površina naseljavanja (AOO) 40 km². Balonov balavac u Srbiji ima status gotovo ugrožene vrste (NT) jer trenutno ne ispunjava kriterijume ugroženosti, ali bi mogao biti klasifikovan kao ugrožena vrsta u bliskoj budućnosti.

Rasprostranjenje

Balonov balavac naseljava sliv reke Dunav, od Nemačke do delte, kao i sliv reke Dnjepar (od Kijeva do delte), a pretpostavlja se da naseljava i sliv reke Dnjestar. U Srbiji nastanjuje Dunav, Savu i Tisu (Slika 142).

Opis vrste

Telo Balonovog balavca je visoko, iznosi 27–30% standardne dužine tela (SL), i malo bočno spljošteno (Slika 143). Boja tela se kreće od žuto-smeđe do sive, sa 4–6 tamnijih nepravilnih vertikalnih pruga koje mogu odsustvovati kod mužjaka u sezoni parenja, ali se kod ženki zadržavaju (Specziár & Vida, 1995). Stomak je žute boje. Glava je velika, bez krljušti, sa tupim, zaobljenim rostrumom. Ima 2–3 operkularne bodlje. Leđna peraja su spojena, ali sa jasnom razlikom između prednjeg i zadnjeg dela. Prednji deo čine tvrde, oštre negranate bodlje, dok je zadnji deo sa mekim granatim žbicama. Ugao između zadnje ivice leđnog peraja i repne drške je 90–95°. Membrana koja spaja dve tvrde žbice na podrepnom peraju je duboko usečena. Peraja: D XIV–XVI + 10–15; A II + 5–6. Bočna linija ima 35–39 krljušti. Maksimalna zabeležena dužina iznosi 15 cm (Kottelat & Freyhof, 2007).

Populacione karakteristike

Balonov balavac je brojna vrsta, bez fragmentisanih populacija i sa nepoznatim populacionim trendom (Freyhof, 2011d). U gornjem

BALON'S RUFFE, DANUBE RUFFE
Gymnocephalus baloni Holčík & Hensel, 1974

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Perciformes
Family: Percidae
Species: *Gymnocephalus baloni* Holčík & Hensel, 1974

Synonyms

None

Vernacular name: Balonov balavac
English name: Balon's ruffe, Danube ruffe
French name: Grémille de Balon
German name: Donaukaulbarsch, Balons Kaulbarsch
Russian name: Ёрш Балона

National threat category assessed according to IUCN criteria

At the global level, the Balon's ruffe is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof, 2011d). In Serbia, the extent of occurrence (EOO) is 14,752 km², while the area of occupancy (AOO) is 40 km². The Balon's ruffe is classified as Near Threatened (NT) in Serbia, as it does not currently meet the threat criteria, but could be classified as a threatened species in the near future.

Distribution

The Balon's ruffe inhabits the Danube basin from Germany to the delta, as well as the Dnieper River basin (from Kiev to the delta), and it is thought to occur in the Dniester basin as well. In Serbia, it inhabits the Danube, Sava and Tisza rivers (Figure 142).

Description of the species

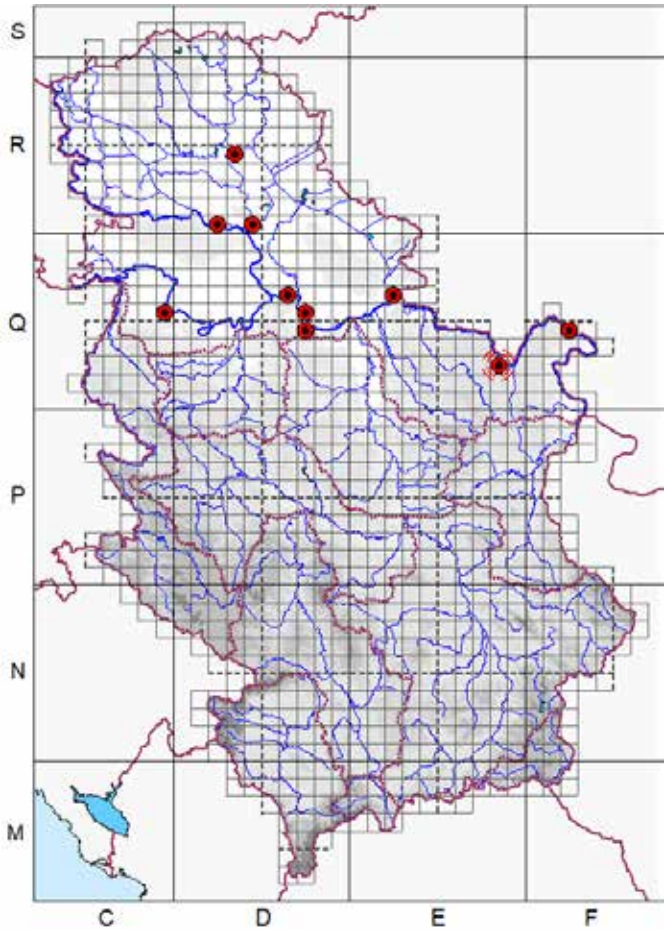
The body of the Balon's ruffe is tall, 27–30% of the standard body length (SL), and slightly flattened laterally (Figure 143). The body colour ranges from yellowish brown to grey, with 4–6 darker, irregular longitudinal stripes, which may be absent in males during the spawning season, but present in females (Specziár & Vida, 1995). The belly is yellow. The head is large and scaleless, with a blunt, rounded rostrum. It has 2–3 opercular spines. The dorsal fins are fused together, but with a distinct difference between the anterior and posterior parts. The anterior part consists of hard, sharp spines, while the posterior part has soft, branched rays. The angle between the posterior dorsal fin margin and the caudal peduncle is 90–95°. The membrane connecting two rays in the anal fin is deeply notched. Fins: D XIV–XVI + 10–15; A II + 5–6. The lateral line has 35–39 scales. Maximum recorded length is 15 cm (Kottelat & Freyhof, 2007).

Population trends

The Balon's ruffe is a numerous species, without fragmented populations and with unknown population trend (Freyhof, 2011d). In

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Balonov balavac / Balon's ruffe, Danube ruffe – *Gymnocephalus baloni*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	**Prilog / Annex II, IV**
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Strogo zaštićena vrsta / Strictly protected species**



Slika 142. **Rasprostranjenje *Gymnocephalus baloni* u Srbiji.**

Figure 142. **Distribution of *Gymnocephalus baloni* in Serbia.**

Slika 143. Balonov balavac *Gymnocephalus baloni* (foto: L. Hlasek, https://www.hlasek.com/foto/gymnocephalus_baloni_k3603.jpg).

Figure 143. Balon's ruffe *Gymnocephalus baloni* (photo: L. Hlasek, https://www.hlasek.com/foto/gymnocephalus_baloni_k3603.jpg).

i donjem toku Dunava relativna brojnost populacija je izrazito niska u odnosu na ukupnu brojnost ihtiofaune (0,01–0,02%), dok se u srednjem toku beleži povećanje relativne brojnosti (0,42%) (Kováč, 2015). U Srbiji, populacione karakteristike ove vrste nisu poznate.

Ekologija vrste

Mužjaci polno sazrevaju između prve i druge godine života, a ženke godinu dana kasnije. Tokom mresta, migrira iz glavnog toka reke u priobalje i plavne zone, pretežno na mesta sa mirnom vodom (Specziár & Vida, 1995; Kottelat & Freyhof, 2007). Mrest je najintenzivniji od sredine aprila do kraja maja, a može da traje do početka juna. Van sezone mresta nalazi se u delu toka u kojem postoji strujanje vode. Tokom sezone parenja pokazuje teritorijalno ponašanje koje je u ostatku godine slabo uočljivo. U svim uzrasnim kategorijama mužjaci su malo krupniji od ženki. Uglavnom se hrani sitnim beskičmenjacima, kao što su larve insekata, rakovi, pijavice i mekušci. Na proleće se u ishrani mogu naći i jaja ribe, a ponekad i juvenilne ribe (Specziár & Vida, 1995). Hrani se noću (Kottelat & Freyhof, 2007). Balonov balavac je solitarna životinja i formira jata samo u nepovoljnim uslovima (Speczíar & Vida, 1995).

Stanište

Naseljava litoralnu zonu velikih nizijskih reka sa umerenim strujanjem vode (Specziár & Vida, 1995; Kottelat & Freyhof, 2007). Juvenilne jedinke se nalaze na peskovitom i šljunkovitom dnu, dok odrasle jedinke mogu da naseljavaju i muljevito dno. Preferira staništa sa velikim brojem zaklona (Specziár & Vida, 1995).

the upper and lower reaches of the Danube, the relative abundance of populations in relation to the total abundance of fish fauna is extremely low (0.01-0.02%), while in the middle reaches an increase in relative abundance is recorded (0.42%) (Kováč, 2015). In Serbia, the population characteristics of this species are not known.

Ecology of the species

Males become sexually mature between the first and second year of life, females one year later. During spawning, it migrates from the main course of the river to the banks and floodplains, mainly to places with calm water (Specziár & Vida, 1995; Kottelat & Freyhof, 2007). Spawning is most intense from mid-April to late May and may continue until early June. Outside the spawning season it stays in the part of the stream where water flows. During the spawning season it displays territorial behaviour that is hardly noticeable during the rest of the year. In all age classes, the males are slightly larger than the females. It feeds mainly on small invertebrates such as insect larvae, crustaceans, leeches, and molluscs. In spring, fish eggs and sometimes juveniles may also be preyed upon (Specziár & Vida, 1995). It feeds at night (Kottelat & Freyhof, 2007). The Balon's ruffe is a solitary species and aggregates only under unfavourable conditions (Speczíar & Vida, 1995).

Habitat

It inhabits the littoral zone of large lowland rivers with moderate water flow (Specziár & Vida, 1995; Kottelat & Freyhof, 2007). Juveniles live on sandy and gravelly substrates, while adults can also inhabit muddy bottoms. It prefers habitats with a large number of hiding places (Specziár & Vida, 1995).

Ribolovni značaj

Balonov balavac nema nikakav značaj ni u rekreativnom ni u komercijalnom ribolovu.

Faktori ugrožavanja

Za sada nema ozbiljnijih faktora koji bi doveli do ugrožavanja ove vrste (Freyhof, 2011d). Međutim, zbog izbora staništa, Balonov balavac ne toleriše zagađenje i veće modifikacije vodotoka koje mogu dovesti do nestajanja vrste u glavnom toku i premeštanje jedinki u rukavce i plavna područja (Telcean & Cupşa, 2009b). Na Balonovog balavca uticaj imaju i invazivne vrste glavoča (*Neogobius melanostomus* i *Ponticola kessleri*) usled slične ishrane (Copp *et al*., 2008).

Importance in fisheries

The Balon's ruffe is of no fishery importance, neither in recreational nor in commercial fishing.

Threats

There are currently no serious factors that would cause this species to be threatened (Freyhof, 2011d). However, due to its habitat preferences, the Balon's ruffe does not tolerate pollution and major alterations to watercourses, which may lead to the disappearance of the species in the main course and the relocation of individuals to tributaries and floodplains (Telcean & Cupşa, 2009b). Invasive goby species (*Neogobius melanostomus* and *Ponticola kessleri*) also impact Balon's ruffe due to their similar diet (Copp *et al*., 2008).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2, 8.1.2, 9.1, 9.3

Postojeće mere zaštite

Balonov balavac se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Conservation actions in place

The Balon's ruffe is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Predložene mere zaštite

Kako za sada nema ozbiljnijih faktora koji bi doveli do ugrožavanja ove vrste, potrebno je planirati konzervacione mere koje se odnose na zaštitu resursa i staništa i upravljanje i kontrolu procesa koji se u njima odvijaju.

Conservation actions needed

As there are currently no serious factors that could threaten this species, conservation measures need to be planned to protect the resources and habitats and to manage and control the processes taking place within them.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2

Usled nedostatka podataka neophodna su intenzivnija naučna istraživanja. Potrebno je utvrditi veličinu populacija i populacione trendove. Trebalo bi ustanoviti uticaj koji modifikacije glavnog toka reke imaju na brojnost i ekologiju ove vrste. Neophodna je i veća biološka kontrola invazivnih vrsta, pošto su one kompetitori za hranu sa Balonovim balavcem.

Because of the lack of data, more intensive scientific research is needed. Population sizes and trends need to be determined. The impact of changes in the main course of the river on the abundance and ecology of this species should be determined. Greater biological control of invasive species is also needed as they compete with the Balon's ruffe for food.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 2.2, 3.1, 3.4

AUTOR / AUTHOR: Srđan Subotić

ŠARADAN, BRCAK, MORANEC
Pachychilon pictum (Heckel & Kner, 1858)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Pachychilon pictum* (Heckel & Kner, 1858)

Sinonimi

Squalius pictus Heckel & Kner, 1858; *Rutilus pictus* (Heckel & Kner, 1858); *Pachychilon pictus* (Heckel & Kner, 1858); *Pachylion pictum* (Heckel & Kner, 1858)

Narodno ime: Šaradan, brcak, moranec
Englesko ime: Albanian roach
Francusko ime: Cyprin lippu tacheté, Épirine lippue
Nemačko ime: Albanische Plötze

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, šaradan se ne smatra ugroženom vrstom (Freyhof, 2011f). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 1.819 km², dok je površina naseljavanja (AOO) 48 km². Šaradan u Srbiji ima status gotovo ugrožene vrste (NT) jer, osim male površine naseljavanja, trenutno ne ispunjava druge kriterijume ugroženosti.

Rasprostranjenje

Šaradan je endemična vrsta jugoistočnog dela jadranskog sliva koja naseljava vode u Srbiji, Crnoj Gori, Albaniji, Severnoj Makedoniji i Grčkoj, u slivu Drima, uključujući i Skadarsko i Ohridsko jezero, i Vojuše (Marić & Kažić, 1990; Marić, 1995; Freyhof & Kottelat, 2007). Introdukovana je u neke vode u Italiji i Francuskoj (Freyhof & Kottelat, 2007). U Srbiji naseljava sliv reke Beli Drim (Slika 144).

Opis vrste

Telo šaradana je izduženo (Slika 145). Usne su debele, a donja usna je sastavljena iz tri režnja, pri čemu je srednji režanj dugačak i dobro razvijen. Prednji deo gornje usne pokriva mesnata rostralna kapica, razvijenija kod odraslih. Leđa su plavo-siva do crna, bokovi su svetliji, a trbuh beo. Po telu postoje karakteristične tamnosmeđe šare različitog oblika i veličine koje nastaju zbog tamnije pigmentacije pojedinačnih krljušti ili grupa krljušti. Kod juvenilnih jedinki postoji i tamna pruga koja se gubi sa starošću. Prva negranata žbica leđnog peraja upadljivo je kraća od ostalih žbica. Peraja: D III + 7–9; A III + 8–10; P I + 11–16; V II + 7–8. Broj krljušti u bočnoj liniji iznosi 40–49, a broj kičmenih pršljenova 34–38. Broj branhiospina je 9–14. Ždrelni zubi su jednoredni, DF 5(4)–(5)6 (Šorić, 1983). Naraste do 20 cm i dostigne masu tela do 70 g (Kottelat & Freyhof, 2007).

ALBANIAN ROACH
Pachychilon pictum (Heckel & Kner, 1858)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Pachychilon pictum* (Heckel & Kner, 1858)

Synonyms

Squalius pictus Heckel & Kner, 1858; *Rutilus pictus* (Heckel & Kner, 1858); *Pachychilon pictus* (Heckel & Kner, 1858); *Pachylion pictum* (Heckel & Kner, 1858)

Vernacular name: Šaradan, brcak, moranec
English name: Albanian roach
French name: Cyprin lippu tacheté, Épirine lippue
German name: Albanische Plötze

National threat category assessed according to IUCN criteria

At the global level, the Albanian roach is not classified as a threatened species (Freyhof, 2011f) and has the status of Least Concern. In Serbia, the extent of occurrence (EOO) is 1,819 km², while the area of occupancy (AOO) is 48 km². The Albanian roach is classified as Near Threatened (NT) in Serbia, as it does not currently meet any other threat criteria apart from the small area of occupancy.

Distribution

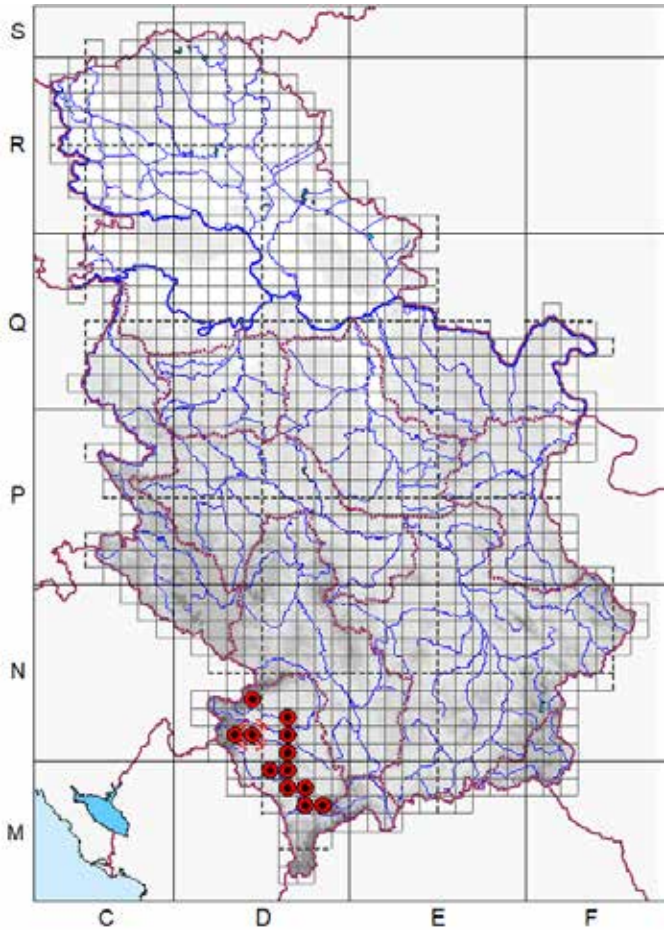
The Albanian roach is endemic to the southeastern part of the Adriatic basin and lives in the Drim basin in Serbia, Montenegro, Albania, Northern Macedonia and Greece, including Lakes Skadar and Ohrid, as well as in Aoös/Vjosa (Marić & Kažić, 1990; Marić, 1995; Freyhof & Kottelat, 2007). It has been introduced into some waters in Italy and France (Freyhof & Kottelat, 2007). In Serbia, it inhabits the White Drim watershed (Figure 144).

Description of the species

The body of the Albanian roach is elongated (Figure 145). The lips are thick and the lower lip consists of three lobes with a long and well-developed median lobe. The anterior part of the upper lip is covered by the fleshy, overhanging rostral cap, which is more developed in adults. The back is blue-grey to black, the flanks are lighter and the belly is white. There are characteristic dark brown marks of various shapes and sizes on the body, caused by darker pigmentation of individual scales or groups of scales. Juveniles also have a dark stripe that disappears with age. The first spine of the dorsal fin is noticeably shorter than the other spines. Fins: D III + 7–9; A III + 8–10; P I + 11–16; V II + 7–8. The number of scales in the lateral line is 40–49 and the number of vertebrae is 34–38. The number of gill rakers is 9–14. The pharyngeal teeth are in a single row, DF 5(4)–(5)6 (Šorić, 1983). It grows up to 20 cm and reaches a body mass of up to 70 g (Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Šaradan, brcak, moranec / Albanian roach – *Pachychilon pictum*		Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive	-
	Bernska konvencija / Bern Convention	**Dodatak / Appendix III**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	**VU**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Zaštićena vrsta / Protected species**



Slika 144. **Rasprostranjenje *Pachychilon pictum* u Srbiji.**

Figure 144. **Distribution of *Pachychilon pictum* in Serbia.**

Slika 145. Šaradan *Pachychilon pictum* (foto: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141029_6.jpg).

Figure 145. Albanian roach *Pachychilon pictum* (photo: Y. Kapakos, https://www.naturagraeca.com/ws/upload/gallery/63/gld63_dt20200418_141029_6.jpg).

Populacione karakteristike

Populacioni trendovi nisu poznati, iako je vrsta prilično brojna, zbog čega se ne očekuje značajniji pad brojnosti populacija (Freyhof, 2011).

Ekologija vrste

Šaradan se mresti od kraja marta do juna. Mrestilišta su obale jezera i reka sa šljunkovitim dnom ili dnom koje je obraslo makrofitskom vegetacijom. Jaja su lepljiva fitofilnog i litofilnog tipa (Kottelat & Freyhof, 2007). Ishrana uključuje larve insekata i druge beskičmenjake, kao i perifiton i mlađ riba (Šorić, 1982; Crivelli, 1996). Živi u jatima (Kottelat & Freyhof, 2007).

Stanište

Naseljava priobalni pojas u jezerima, sporotekuće delove reka, kao i plavna područja (Kottelat & Freyhof, 2007).

Ribolovni značaj

U Srbiji šaradan nema ribolovni značaj, dok u Skadarskom jezeru čini značajan deo komercijalnog ulova (Marić, 1995).

Faktori ugrožavanja

Osnovni faktori ugrožavanja jesu zagađenje vode, izgradnja brana i negativni efekti klimatskih promena.

Population trends

The population trends are not known, although the species is quite numerous, which is why no significant decline in population numbers is to be expected (Freyhof, 2011f).

Ecology of the species

The Albanian roach spawns from late March through June. Spawning sites are the shores of lakes and rivers with gravelly or macrophyte-covered bottoms. The eggs are sticky, phytophilous or lithophilous (Kottelat & Freyhof, 2007). It feeds on insect larvae and other invertebrates, but also on periphyton and juvenile fish (Šorić, 1982; Crivelli, 1996). It is a gregarious species (Kottelat & Freyhof, 2007).

Habitat

It inhabits the coastal zone in lakes, slow-flowing stretches of rivers and floodplains (Kottelat & Freyhof, 2007).

Importance in fisheries

In Serbia, the Albanian roach is of no fishery importance, while in Lake Skadar it accounts for a significant part of the commercial catch (Marić, 1995).

Threats

The greatest threats are water pollution, the construction of dams and the negative effects of climate change.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 7.2.11, 9.1.3, 9.2.3, 9.3.4, 11.2

Postojeće mere zaštite

Šaradan se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Potrebno je poboljšati opšte mere koje se tiču zaštite ihtiofaune i zaštite voda od zagađenja i hidroloških izmena vodenih staništa.

Conservation actions in place

The Albanian roach is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

It is necessary to improve the general measures for the protection of fish fauna and the protection of waters from pollution and hydrological changes in aquatic habitats.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1, 2.1, 2.3, 3.1.1

Neophodna su istraživanja i praćenja stanja veličine i trendova populacija, kao i faktora ugrožavanja, uz razvijanje odgovarajućih programa monitoringa.

Research and monitoring of population size, trends and threats is necessary, as is the development of appropriate monitoring programmes.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.1, 1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Marija Smederevac-Lalić

TANKOREPA KRKUŠA
Romanogobio uranoscopus (Agassiz, 1828)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Gobionidae
Vrsta: *Romanogobio uranoscopus* (Agassiz, 1828)

Sinonimi

Cyprinus uranoscopus Agassiz, 1828; *Gobio uranoscopus* (Agassiz, 1828); *Gobio uranoscopus* (Agassiz, 1828); *Gobio frici* Vladykov,1925; *Gobio uranoscopus frici* Vladykov,1925

Narodno ime: Tankorepa krkuša
Englesko ime: Danubian longbarbel gudgeon
Francusko ime: Goujon du Danube
Nemačko ime: Steingressling
Rusko ime: Дунайский пескарь

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, tankorepa krkuša ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008p). Obim rasprostranjenja vrste (EOO) u Srbiji iznosi 30.254 km², dok je površina naseljavanja (AOO) 60 km². Tankorepa krkuša u Srbiji ima status gotovo ugrožene vrste (NT) jer, osim male površine naseljavanja, trenutno ne ispunjava druge kriterijume ugroženosti.

Rasprostranjenje

Tankorepa krkuša je endemit dunavskog sliva, ali izostaje iz samog glavnog toka Dunava, osim u delovima sa brzom vodenom strujom (Kottelat & Freyhof, 2007). U Srbiji naseljava vode crnomorskog sliva i za sada je nađena u Dunavu, Južnoj Moravi, Zapadnoj Moravi, Toplici, Nišavi, Jermi, Neri i Jovačkim jezerima (Slika 146).

Opis vrste

Tankorepa krkuša ima izduženo telo i dugo repno stablo (Slika 147). Leđa su sivo-smeđa do tamnosmeđa, sa 5 krupnih tamnih mrlja. Na bokovima ima 7–10 krupnih, okruglastih tačaka (Bănărescu & Bănăduc, 2007). Usta su poludonja. Brkovi su dugi i premašuju zadnju ivicu oka (Maitland, 2000). Zona između grudnih peraja nije pokrivena krljuštima. Leđno i repno peraje imaju smeđe mrlje. Peraja: D II–III + 7–9; A II–III + 5–7; P I + 13; V I + 6. Broj krljušti u bočnoj liniji iznosi 41–44. Ždrelni zubi su dvoredni, DF 4(5).3(2)-(2)3.5. Naraste obično do 10–12 cm, a maksimalno do 15 cm (Maitland, 2000). Životni vek je do 6 godina (Kottelat & Freyhof, 2007).

DANUBIAN LONGBARBEL GUDGEON
Romanogobio uranoscopus (Agassiz, 1828)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Gobionidae
Species: *Romanogobio uranoscopus* (Agassiz, 1828)

Synonyms

Cyprinus uranoscopus Agassiz, 1828; *Gobio uranoscopus* (Agassiz, 1828); *Gobio uranoscopus* (Agassiz, 1828); *Gobio frici* Vladykov,1925; *Gobio uranoscopus frici* Vladykov,1925

Vernacular name: Tankorepa krkuša
English name: Danubian longbarbel gudgeon
French name: Goujon du Danube
German name: Steingressling
Russian name: Дунайский пескарь

National threat category assessed according to IUCN criteria

At the global level, the Danubian longbarbel gudgeon is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008p). In Serbia, the extent of occurrence (EOO) is 30,254 km², while the area of occupancy (AOO) is 60 km². The Danubian longbarbel gudgeon is classified as Near Threatened (NT) in Serbia, as it does not currently meet any other threat criteria apart from the small area of occupancy.

Distribution

The Danubian longbarbel gudgeon is endemic to the Danube basin, but it is absent from the main course of the Danube itself, except in parts with fast current (Kottelat & Freyhof, 2007). In Serbia, it inhabits the Black Sea basin and has so far been found in the Danube, South Morava, West Morava, Toplica, Nišava, Jerma and Nera rivers and Jovačka Lakes (Figure 146).

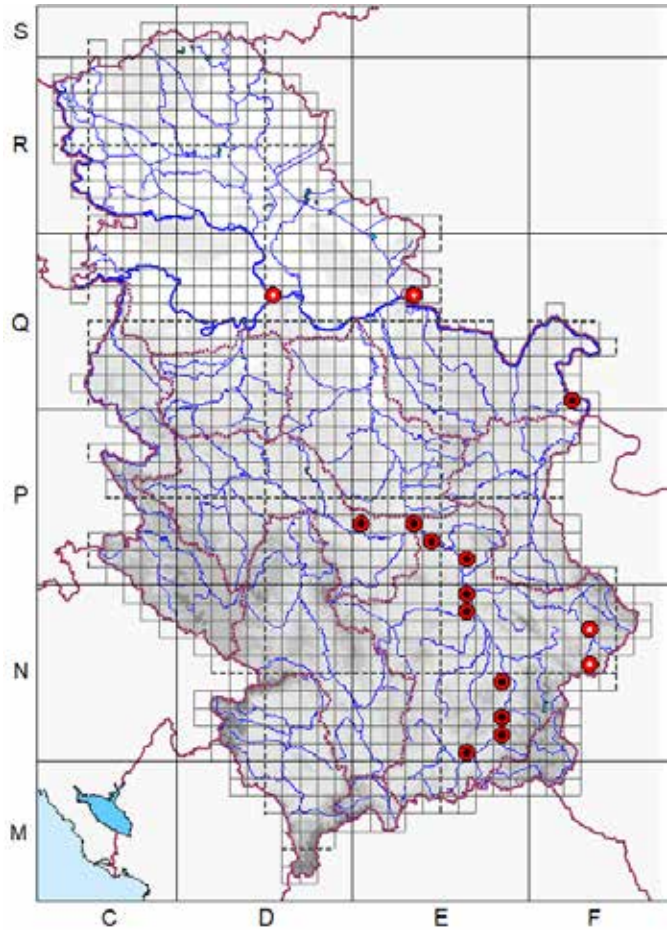
Description of the species

The Danubian longbarbel gudgeon has an elongated body and a long caudal peduncle (Figure 147). The back is grey-brown to dark brown, with 5 large dark spots. There are 7–10 large round spots on the flanks (Bănărescu & Bănăduc, 2007). The mouth is subterminal. The barbels are long and extend beyond the posterior margin of the eye (Maitland, 2000). The area between the pectoral fins is scaleless. The dorsal and caudal fins have brown spots. Fins: D II–III + 7–9; A II–III + 5–7; P I + 13; V I + 6. The number of scales in the lateral line is 41–44. The pharyngeal teeth are in two rows, DF 4(5).3(2)–(2)3.5. It usually grows up to 10–12 cm and reaches a maximum size of 15 cm (Maitland, 2000). Life expectancy is up to 6 years (Kottelat & Freyhof, 2007).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Tankorepa krkuša / Danubian longbarbel gudgeon – *Romanogobio uranoscopus*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Gobio uranoscopus*)	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Gobio uranoscopus*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Gobio* spp.)	**MLM, ODU***
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Gobio uranoscopus*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**NT Strogo zaštićena vrsta / Strictly protected species**

*MLM – minimalna lovna mera 10 cm, ODU – ograničenje dnevnog ulova na 5 kg (mera koja važi za sve autohtone vrste) /
MLM – minimum landing size at 10 cm standard length, ODU – daily catch limit of 5 kg (measure applies to all native species)



Slika 146. **Rasprostranjenje *Romanogobio uranoscopus* u Srbiji.**

Figure 146. **Distribution of *Romanogobio uranoscopus* in Serbia.**

Slika 147. Tankorepa krkuša *Romanogobio uranoscopus* (foto: A. Bajić).

Figure 147. Danubian longbarbel gudgeon *Romanogobio uranoscopus* (photo: A. Bajić).

Populacione karakteristike

Populacioni trendovi nisu poznati, mada je vrsta široko rasprostranjena i još uvek česta u brzotekućim vodama. Međutim, s obzirom da je veoma osetljiva na zagađenje i pregrađivanje vodotoka, lokalno je ugrožena. Sumnja se da brojnost populacija opada i da će se taj trend nastaviti ukoliko se nastavi sa izgradnjom brana na malim rekama (Freyhof & Kottelat, 2008p).

Ekologija vrste

Malo se zna o životnom ciklusu ove vrste. Polnu zrelost stiče u drugoj ili trećoj godini (Mrakovčić *et al*., 2006). Mresti se u maju i junu, u plićacima sa jakom vodenom strujom, na kamenitoj ili šljunkovitoj podlozi (Akimov, 2009). U eksperimentalnim uslovima, mresti se u više navrata u periodu od maja do septembra kada temperatura vode pređe 11 °C (Kottelat & Freyhof, 2007). Hrani se faunom dna. Odrasle jedinke su aktivne noću i vode solitarni način života, osim u periodu mresta kada se okupljaju u jata. Juvenilne jedinke su aktivne danju (Kottelat & Freyhof, 2007).

Stanište

Tankorepa krkuša je tipična reofilna vrsta koja živi u brzim, čistim vodotocima mrenskog regiona bogatim kiseonikom, sa brzinom toka većom od 0,7 m/s. Preferira vodotoke čije je dno prekriveno kamenjem ili krupnijim šljunkom. Juvenilne jedinke naseljavaju pliće delove vodotoka sa slabijom vodenom strujom i peskovitim dnom (Kottelat & Freyhof, 2007).

Ribolovni značaj

Tankorepa krkuša nema ribolovni značaj.

Faktori ugrožavanja

Najveću pretnju njenim populacijama predstavljaju zagađenje vodotoka, regulacija tokova i izgradnja brana.

Population trends

The population trends are not known, although the species is widespread and still common in fast-flowing waters. However, as it is very sensitive to pollution and damming of watercourses, it is locally threatened. Populations are thought to be declining and this trend will continue if dam construction on small streams continues (Freyhof & Kottelat, 2008p).

Ecology of the species

Little is known about the life cycle of this species. It reaches sexual maturity in the second or third year (Mrakovčić *et al*., 2006). It spawns in May and June in shallow water with strong current on rocky or gravelly substrate (Akimov, 2009). Under experimental conditions, it spawns repeatedly from May to September, when the water temperature exceeds 11 °C (Kottelat & Freyhof, 2007). It feeds on bottom fauna. Adults are nocturnal and solitary, except during the spawning season when they aggregate. Juveniles are active during the day (Kottelat & Freyhof, 2007).

Habitat

The Danubian longbarbel gudgeon is a typical rheophilic species that lives in fast, clean, oxygen-rich waters in the barbel zone with a flow velocity of more than 0.7 m/s. It prefers watercourses whose bottom is covered with stones or coarse gravel. Juveniles stay in shallower parts with slow currents and sandy bottoms (Kottelat & Freyhof, 2007).

Importance in fisheries

The Danubian longbarbel gudgeon is of no fishery importance.

Threats

The greatest threats to its populations are the pollution and regulation of watercourses and the construction of dams.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.11, 9.1.3, 9.2.3, 9.3.4

Postojeće mere zaštite

Tankorepa krkuša se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu, navedenu kao *Gobio* spp., propisana je minimalna lovna mera od 10 cm standardne dužine tela (SL) i ograničenje dnevnog ulova do 5 kg.

Predložene mere zaštite

Potrebno je sprečiti degradaciju staništa, zagađivanje vode i pregrađivanje vodotoka.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 2.3

Neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije ove vrste, kao i faktora ugrožavanja, uz razvoj odgovarajućih programa monitoringa.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

Conservation actions in place

The Danubian longbarbel gudgeon is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a minimum landing size at 10 cm standard length and a daily catch limit of up to 5 kg are set for this species (listed as *Gobio* spp.).

Conservation actions needed

It is necessary to prevent the destruction of habitats, the pollution of waters and the blockage of watercourses.

Research is needed on the size, distribution and trends of populations, the life history and ecology of this species and threats it faces, and appropriate monitoring programmes must be developed.

AUTOR / AUTHOR: Stefan Skorić

8.6.

Vrste sa nedovoljno podataka o ugroženosti (DD)

Data deficient species (DD)

AZOVSKA HARINGA
Alosa tanaica (Grimm, 1901)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Clupeiformes
Porodica: Clupeidae
Vrsta: *Alosa tanaica* (Grimm, 1901)

Sinonimi

Clupea tanaica Grimm, 1901; *Alosa caspia tanaica* (Grimm, 1901); *Caspialosa caspia tanaica* (Grimm, 1901); *Alosa nordmanni* Antipa, 1904; *Alosa caspia nordmanni* Antipa, 1904; *Alosa bulgarica* Drensky, 1934; *Caspialosa tanaica palaeostomi* Sadowsky, 1934; *Caspialosa caspia palaeostomi* Sadowsky, 1934

Narodno ime: Azovska haringa
Englesko ime: Azov shad, Black Sea shad
Rusko ime: Азовский пузанок

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, azovska haringa ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008d). Obim rasprostranjenja (EOO) i površina naseljavanja (AOO) u Srbiji nisu procenjeni jer je vrsta nađena na samo jednom lokalitetu. S obzirom da ne postoje neophodni podaci za direktnu ili indirektnu procenu ugroženosti na osnovu stanja populacije, azovska haringa za sada ima status vrste sa nedovoljno podataka o ugroženosti (DD).

Rasprostranjenje

Odrasle jedinke azovske haringe žive u Crnom i Azovskom moru, odakle ulaze u pritoke radi mresta (Freyhof & Kottelat, 2008d). U Srbiji je poslednjih godina nađeno svega nekoliko primeraka ove vrste u akumulaciji „Đerdap II". Nekada je beležena duž celog rečnog toka Dunava kroz Srbiju, kao i u nekim pritokama (Simonović, 2001; Višnjić-Jeftić, 2012). (Slika 148).

Opis vrste

Telo azovske haringe je umereno visoko, sa izraženim trbušnim grebenom pokrivenim krljuštima (Slika 149). Često ima tamne tačke duž bokova. Boja tela na leđnoj strani je plavkasto-zelena, bokovi su srebrnasto-beli, obično sa tamnom tačkom iza operkuluma, a povremeno je prisutna i čitava serija tamnih tačaka na bokovima. Gornja vilica ima izraženo središnje udubljenje. Na nepčanoj i ralastoj kosti zubi su slabo razvijeni. Branhiospine su duge (duže od škržnih filamenata), tanke, mnogobrojne, na prvom škržnom luku obično ih ima 66–96 (Kottelat & Freyhof, 2007). Maksimalna dužina tela iznosi 24 cm, u proseku 14–16 cm, a maksimalna masa tela 60 g (Navodaru & Waldman, 2003; Tiganov *et al*., 2016).

AZOV SHAD, BLACK SEA SHAD
Alosa tanaica (Grimm, 1901)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Clupeiformes
Family: Clupeidae
Species: *Alosa tanaica* (Grimm, 1901)

Synonyms

Clupea tanaica Grimm, 1901; *Alosa caspia tanaica* (Grimm, 1901); *Caspialosa caspia tanaica* (Grimm, 1901); *Alosa nordmanni* Antipa, 1904; *Alosa caspia nordmanni* Antipa, 1904; *Alosa bulgarica* Drensky, 1934; *Caspialosa tanaica palaeostomi* Sadowsky, 1934; *Caspialosa caspia palaeostomi* Sadowsky, 1934

Vernacular name: Azovska haringa
English name: Azov shad, Black Sea shad
Russian name: Азовский пузанок

National threat category assessed according to IUCN criteria

At the global level, the Azov shad is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008d). The extent of occurrence (EOO) and the area of occupancy (AOO) in Serbia have not been estimated, as the species has been found in only one location. In the absence of the necessary data for a direct or indirect threat assessment based on the status of its population, the Azov shad is currently classified as Data Deficient (DD).

Distribution

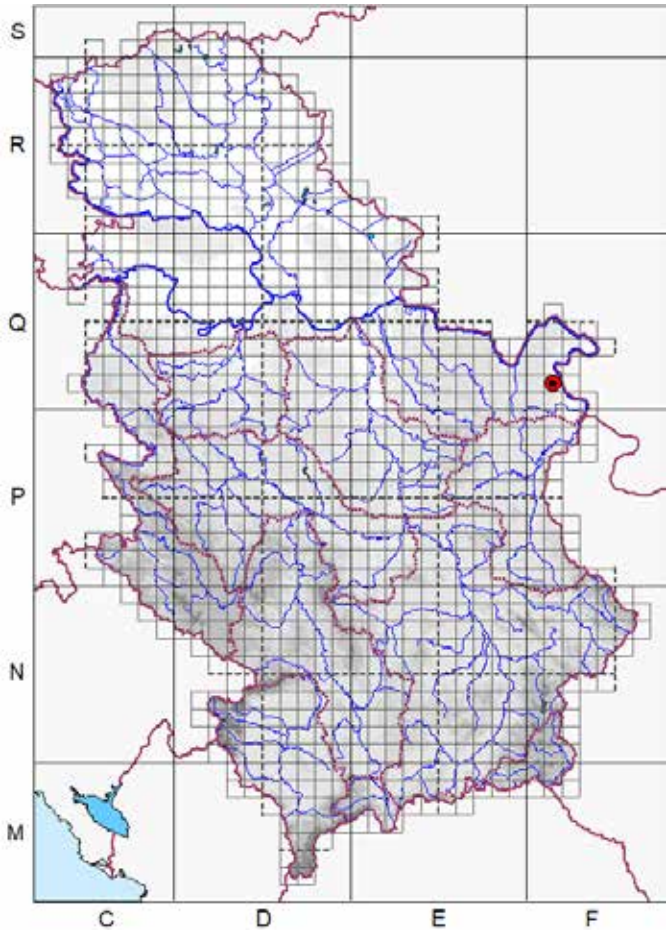
Adult specimens of the Azov shad live in the Black and Azov Seas, from where they enter tributaries to spawn (Freyhof & Kottelat, 2008d). In recent years, only a few specimens of this species have been found in the reservoir "Đerdap II" in Serbia. Previously, it was recorded along the entire section of the Danube in Serbia, as well as in some tributaries (Simonović, 2001; Višnjić-Jeftić, 2012). (Figure 148).

Description of the species

The body of the Azov shad is moderately high and has a prominent ventral keel covered with scales (Figure 149). It often has dark spots along its flanks. The dorsum is bluish-green, the flanks are silvery-white, usually with a dark spot behind the operculum, and occasionally there is a whole row of dark spots on the flanks. The upper jaw has a distinct median notch. The teeth are poorly developed on the palatine bones and vomer. The gill rakers are long (longer than the gill filaments), thin and numerous, and there are usually 66–96 on the first gill arch (Kottelat & Freyhof, 2007). Maximum body length is 24 cm, with an average of 14–16 cm, and maximum body mass is 60 g (Navodaru & Waldman, 2003; Tiganov *et al*., 2016).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Azovska haringa / Azov shad, Black Sea shad – *Alosa tanaica*		**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Alosa* spp.)	**Prilog / Annex II, V**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Alosa* spp.)	**Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks (navedena kao / listed as *Alosa caspia*)	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) /Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Alosa caspia*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**DD Strogo zaštićena vrsta / Strictly protected species**



Slika 148. **Rasprostranjenje *Alosa tanaica* u Srbiji.**

Figure 148. **Distribution of *Alosa tanaica* in Serbia.**

Slika 149. Azovska haringa *Alosa tanaica* (foto: K. Tošić).

Figure 149. Azov shad *Alosa tanaica* (photo: K. Tošić).

Populacione karakteristike

Brojnost populacija azovske haringe drastično je smanjena početkom XX veka zbog zagađenja vode. Smatra se da se populacije danas nalaze u stabilnom stanju, sa umerenom brojnošću (Kolarov, 1991; Tiganov *et al.*, 2016). Očekuje se mogući pad brojnosti u Crnom moru kao posledica pada kvaliteta staništa u estuarskim ekosistemima usled povećanja saliniteta zbog vodozahvata i suše (Freyhof & Kottelat, 2008d). S druge strane, vrsta je još uvek brojna u basenu Azovskog mora. O brojnosti i populacionim karakteristikama azovske haringe u Srbiji nema podataka.

Ekologija vrste

Azovska haringa je anadromna vrsta i migrira iz mora u donje tokove velikih reka radi mresta. Polnu zrelost dostiže sa 1–2 godine. Mresti se u slatkoj ili blago bočatoj vodi, najčešće u mirnijim delovima toka reke i plavnim područjima. Većina jedinki mresti se 2–4 puta u životu. Zrele jedinke se pojavljuju blizu obale od kraja januara do marta i ulaze u reke kada temperatura dosegne oko 10 °C (april/maj), a mrest počinje pri temperaturi od 15 °C (maj/jun) (Kotelat & Freyhof, 2007). Jaja su batipelagična. Nakon mresta adulti migriraju u priobalne lagune ili u more u blizini rečnih ušća kako bi se hranili. Mlađ tokom prvog leta migrira u more ili estuare gde ostaju do zrelosti. U moru se hrani zooplanktonom, larvama insekata i sitnim ribama.

Stanište

Azovska haringa je eurihalina, pelagična vrsta koja naseljava brakičnu i morsku vodu, a mresti se u slatkoj vodi. U moru živi u dubljim slojevima priobalnih voda na 50–70 m dubine, dok se mrest u rekama odvija blizu obale u mirnim delovima i plavnim područjima, na dubini od 2–4 m (Freyhof & Kottelat, 2008d).

Ribolovni značaj

Ribolovni značaj azovske haringe u Srbiji izgubljen je nakon stavljanja vrste pod trajni lovostaj. U državama basena Crnog mora predstavlja umereno ekonomski značajnu vrstu (Tiganov *et al.*, 2016).

Population trends

The populations of Azov shad were drastically reduced in the early 20th century due to water pollution. Today, populations are considered stable, with moderate density (Kolarov, 1991; Tiganov *et al.*, 2016). A possible decline in abundance is expected in the Black Sea as a result of the decline in habitat quality in estuarine ecosystems due to increased salinity from water withdrawal and drought (Freyhof & Kottelat, 2008d). On the other hand, the species is still common in the basin of the Sea of Azov. There are no data available on the abundance and population trends of Azov shad in Serbia.

Ecology of the species

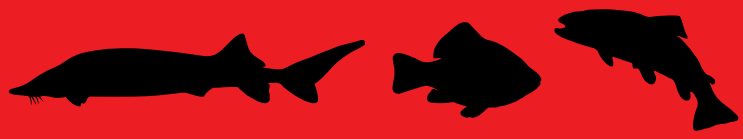
The Azov shad is an anadromous species and migrates from the sea to the lower reaches of large rivers to spawn. It reaches sexual maturity at the age of 1–2 years. It spawns in fresh or slightly brackish waters, usually in calmer parts of the river and in floodplains. Most individuals spawn 2–4 times in their lifetime. Mature individuals emerge near shore from late January to March and enter rivers when temperatures reach about 10 °C (April/May), and spawning begins at 15 °C (May/June) (Kotelat & Freyhof, 2007). The eggs are bathypelagic. After spawning, adults migrate to coastal lagoons or the sea near river mouths to feed. Juveniles migrate to the sea or estuaries during their first summer, where they remain until sexual maturity. At sea, it feeds on zooplankton, insect larvae and small fishes.

Habitat

The Azov shad is a euryhaline, pelagic species that inhabits brackish and marine waters and spawns in freshwater. In the sea, it lives in the deeper layers of coastal waters at a depth of 50–70 m, while in rivers spawning occurs near the shore in calm areas and floodplains at a depth of 2–4 m (Freyhof & Kottelat, 2008d).

Importance in fisheries

The fishery importance of the Azov shad in Serbia was lost after a permanent ban on fishing was imposed on this species. In the countries of the Black Sea basin it has a moderate commercial importance (Tiganov *et al.*, 2016).



Faktori ugrožavanja

Vrstu ugrožavaju izgradnja brana, industrijski i vojni otpad, zagađenje vode, kao i globalna promena klime (Freyhof & Kottelat, 2008d).

Threats

The species is threatened by the construction of dams, industrial and military waste, water pollution and global climate change (Freyhof & Kottelat, 2008d).

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.8, 7.2.10, 9.2.3, 11.2

Postojeće mere zaštite

Azovska haringa se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu (navedenu kao *Alosa caspia*) propisan je trajni lovostaj.

Conservation actions in place

The Azov shad is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a permanent ban on fishing is imposed on this species (listed as *Alosa caspia*).

Predložene mere zaštite

Imajući u vidu činjenicu da su brane jedan od dominantnih faktora ugrožavanja, neophodno bi bilo postavljenje ribljih staza i liftova na branama.

Conservation actions needed

Since dams are one of the biggest threats, fish ladders would have to be installed at the dams.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.1, 2.1, 5.4.2

S obzirom da su za ovu vrstu u Srbiji podaci oskudni, neophodna su opsežna istraživanja veličine, distribucije i trendova populacije, životne istorije, ekologije, kao i faktora ugrožavanja.

As there is little data on this species in Serbia, extensive research is needed on population size, distribution and trends, life history, ecology and threats.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 1.6, 3.1

AUTOR / AUTHOR: Željka Višnjić-Jeftić

BUGARSKA BRKICA
Sabanejewia bulgarica (Drensky, 1928)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Cobitidae
Vrsta: *Sabanejewia bulgarica* (Drensky, 1928)

Sinonimi

Cobitis bulgarica Drensky, 1928; *Sabanejewia aurata bulgarica* (Drensky, 1928); *Cobitis taenia tesselatus* Pietschmann, 1937

Narodno ime: Bugarska brkica
Englesko ime: Bulgarian golden loach
Nemačko ime: Bulgarischer-Goldsteinbeißer
Rusko ime: Болгарская щиповка

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, bugarska brkica ne smatra se ugroženom vrstom (Freyhof & Kottelat, 2008s). Mali obim rasprostranjenja vrste u Srbiji (EOO iznosi 100 km²) i veoma mala površina naseljavanja (AOO iznosi svega 1 km²) ukazuju na pretpostavku da je vrsta ugroženija nego što to definišu formalni IUCN kriterijumi. S obzirom na to da u Srbiji trenutno postoji samo jedan nalaz ove vrste, kao i da nema dovoljno kvantitativnih pokazatelja o stanju njenih populacija, bugarska brkica za sada ima status vrste sa nedovoljno podataka o ugroženosti (DD).

Rasprostranjenje

Bugarska brkica je endemit dunavskog sliva. Naseljava donji i srednji tok Dunava uzvodno do Bratislave. Ulazi samo u donje delove pritoka Dunava. Naseljava i sliv Tise u Mađarskoj i Slovačkoj. U Srbiji za sada postoji jedan nalaz u Savi kod Šapca (Slika 150).

Opis vrste

Telo bugarske brkice je izduženo i bočno spljošteno (Slika 151). Zadnja ivica repa je zaobljena. Glava je bočno spljoštena, usta su donja, sa 3 para brkova. Postoji bočni niz od 4–9 tamnih mrlja, dok je na leđima 5–8 mrlja. Izostaje red malih tačaka ispod bočnih mrlja. Baza leđnog peraja nalazi se iznad baze trbušnih peraja. Ventralni masni greben na repnom stablu odsustvuje ili je znatno slabije razvijen od dorzalnog. Peraja: D II–III + 7, P II + 7–8, V II + 5. Naraste do 12 cm (Baensch & Riehl, 1995). Životni vek ove vrste iznosi oko 4–5 godina (Harka *et al*., 2002).

BULGARIAN GOLDEN LOACH
Sabanejewia bulgarica (Drensky, 1928)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Cobitidae
Species: *Sabanejewia bulgarica* (Drensky, 1928)

Synonyms

Cobitis bulgarica Drensky, 1928; *Sabanejewia aurata bulgarica* (Drensky, 1928); *Cobitis taenia tesselatus* Pietschmann, 1937

Vernacular name: Bugarska brkica
English name: Bulgarian golden loach
German name: Bulgarischer-Goldsteinbeißer
Russian name: Болгарская щиповка

National threat category assessed according to IUCN criteria

At the global level, the Bulgarian golden loach is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008s). The small extent of occurrence in Serbia (EOO is 100 km²) and the very small area of occupancy (AOO is only 1 km²) suggest that the species is more threatened than defined by the formal IUCN criteria. Considering the fact that there is currently only one record of this species in Serbia, as well as the fact that there are not enough quantitative indicators on the status of its populations, the Bulgarian golden loach is currently classified as Data Deficient (DD).

Distribution

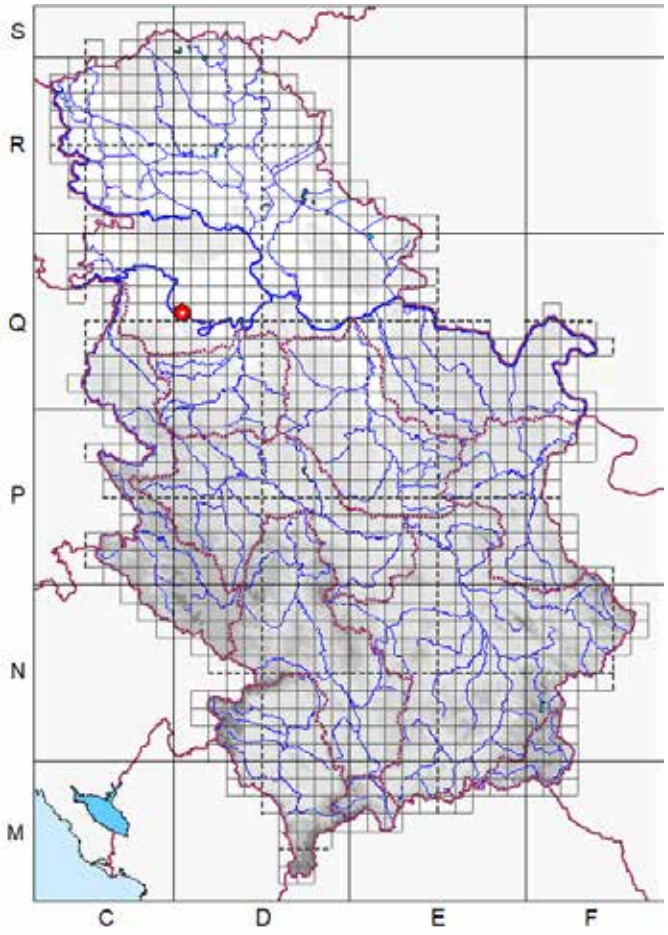
The Bulgarian golden loach is endemic to the Danube basin. It inhabits the lower and middle reaches of the Danube upstream to Bratislava. It occurs only in the lowermost parts of the Danube tributaries. It also inhabits the Tisza basin in Hungary and Slovakia. In Serbia, there is so far only one record in the Sava River near Šabac (Figure 150).

Description of the species

The body of the Bulgarian golden loach is elongated and laterally flattened (Figure 151). The posterior edge of the tail is rounded. The head is laterally flattened, the mouth is inferior, with three pairs of barbels. There is a mid-lateral row of 4–9 dark blotches along flanks and 5-8 blotches on the back. The row of small spots below the mid-lateral blotches is lacking. The base of the dorsal fin is above the base of the ventral fins. The ventral adipose crest on the caudal peduncle is absent or much less pronounced than the dorsal one. Fins: D II–III + 7, P II + 7–8, V II + 5. Grows up to 12 cm (Baensch & Riehl, 1995). Life span of this species is about 4–5 years (Harka *et al*., 2002).

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

	Bugarska brkica / Bulgarian golden loach – *Sabanejewia bulgarica*	**Status**
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Sabanejewia aurata*)	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Sabanejewia aurata*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001)	-
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**DD Zaštićena vrsta / Protected species**



Slika 150. **Rasprostranjenje *Sabanejewia bulgarica* u Srbiji.**

Figure 150. **Distribution of *Sabanejewia bulgarica* in Serbia.**

Slika 151. Bugarska brkica *Sabanejewia bulgarica* (foto: N. Sekulić).

Figure 151. Bulgarian golden loach *Sabanejewia bulgarica* (photo: N. Sekulić).

Populacione karakteristike

U Srbiji, za ovu vrstu nema dovoljno podataka o populacionim karakteristikama.

Ekologija vrste

Bugarska brkica polno sazreva sa 2–3 godine života, kada dostigne dužinu od 6 cm (Froese & Pauly, 2022). Mrest je porcioni, u periodu između aprila i jula. Hrani se sitnim larvama insekata, planktonskim račićima i detritusom. Uglavnom je stacionarna vrsta, a najveća zabeležena distanca koju može da pređe iznosi oko 600 m, za šta joj treba oko dva meseca (Szepesi & Harka, 2011).

Stanište

Bugarska brkica je slatkovodna i pridnena vrsta koja naseljava veće nizijske reke, obično u dubljoj vodi i u delovima sa čistom vodom (Kottelat & Freyhof, 2007). Preferira peščani supstrat ili mešani peščano-šljunkoviti, sa umerenim protokom vode (Curtean-Bănaduc *et al*., 2015).

Ribolovni značaj

Bugarska brkica nema ribolovni značaj.

Faktori ugrožavanja

Zagađenje različitog porekla (urbano, industrijsko i poljoprivredno) predstavlja glavni faktor ugrožavanja. Tome treba dodati još i eroziju i spiranje priobalnog zemljišta, kao posledice poljoprivrednih aktivnosti, kao i uništavanje riparijalne vegetacije.

Population trends

In Serbia, there is not enough data on the population characteristics of this species.

Ecology of the species

The Bulgarian golden loach becomes sexually mature at the age of 2-3 years, when it reaches a length of 6 cm (Froese & Pauly, 2022). Spawning takes place in portions between April and July. It feeds on small insect larvae, planktonic crustaceans and detritus. It is mostly a stationary species and the greatest recorded distance it can travel is about 600 m, which takes it about two months to travel (Szepesi & Harka, 2011).

Habitat

The Bulgarian golden loach is a freshwater and demersal species that lives in larger lowland rivers, usually in deep and clear water (Kottelat & Freyhof, 2007). It prefers sandy substrate or mixed sand-gravel with moderate water flow (Curtean-Bănaduc *et al*., 2015).

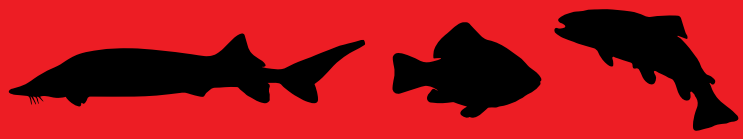
Importance in fisheries

The Bulgarian golden loach is of no fishery importance.

Threats

Pollution from various sources (urban, industrial and agricultural) is the major risk factor. Other threats include erosion and runoff from the surrounding landscape due to agricultural activities and destruction of riparian vegetation.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	7.2.4, 7.3, 9.1.3, 9.2.3, 9.3.1, 9.3.2, 9.3.3



Postojeće mere zaštite

Bugarska brkica se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Neophodno je sprečiti unošenje bilo kakve vrste otpada, kao i hidrološke izmene vodotoka i modifikacije obala, čime bi se omogućila prirodna obnova staništa.

Conservation actions in place

The Bulgarian golden loach is listed in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stock*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

The introduction of waste of any kind, as well as hydrological changes in watercourses and alterations to the banks, must be prevented in order to allow the restoration of natural habitats.

Predložene mere zaštite prema IUCN klasifikacionoj šemi / Conservation actions needed following the IUCN classification scheme	1.2, 2.3

Neophodna su istraživanja veličine, distribucije i trendova populacija, životnog ciklusa i ekologije vrste, kao i faktora ugrožavanja. Takođe, neophodno je uvesti i kvalitetan monitoring stanja populacija ove vrste.

Research needs to be conducted on the size, distribution and trends of populations, the life cycle and ecology of the species, and threats. High-quality monitoring of the status of the populations of this species must also be introduced.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi / Research needed following the IUCN classification scheme	1.2, 1.3, 1.5, 3.1, 3.4

AUTOR / AUTHOR: Gorčin Cvijanović

SVETLICA
Telestes souffia (Risso, 1827)

Taksonomski status

Razdeo: Chordata
Klasa: Actinopteri
Nadred: Teleostei
Red: Cypriniformes
Porodica: Leuciscidae
Vrsta: *Telestes souffia* (Risso, 1827)

Sinonimi

Leuciscus souffia souffia Risso, 1826; *Leuciscus souffia* Risso, 1827; *Chondrostoma rysela* Agassiz, 1835; *Leuciscus agassii* Valenciennes, 1844; *Telestes rysela* Heckel, 1851

Narodno ime: Svetlica
Englesko ime: Vairone
Francusko ime: Blageon
Nemačko ime: Strömer
Rusko ime: Елец-андруга

Nacionalna kategorija ugroženosti prema IUCN kriterijumima

Na globalnom nivou, svetlica se ne smatra ugroženom vrstom (Freyhof & Kottelat, 2008v). Mali obim rasprostranjenja vrste u Srbiji (EOO iznosi 100 km²) i mala površina naseljavanja (AOO iznosi 4 km²) ukazuju na pretpostavku da je vrsta ugroženija nego što to definišu formalni IUCN kriterijumi. S obzirom na to da u Srbiji trenutno postoje samo dva nalaza ove vrste, kao i da nema dovoljno kvantitativnih pokazatelja o stanju njenih populacija, svetlica za sada ima status vrste sa nedovoljno podataka o ugroženosti (DD).

Rasprostranjenje

Svetlica naseljava mediteranski basen, od sliva reke Od do reke Var (Francuska, Švajcarska), slivove reka Soče (Italija, Slovenija) i Cetine (Hrvatska), najveći deo sliva Rajne (Nemačka i Švajcarska), kao i sliv Dunava, i to zapadne pritoke u Nemačkoj, Austriji, Sloveniji, Hrvatskoj i delu Bosne i Hercegovine (Veličković *et al*., 2020). Takođe naseljava i gornji tok reke Tise (Rumunija, Ukrajina) (Telcean & Cupşa, 2009a). Novija istraživanja pokazuju da postoje tri podvrste ove vrste iz južne Francuske i sliva Dunava, *T. s. souffia*, *T. s. agassii* i *T. s. rysela*, tako da se sugeriše da bi korektni naziv za sliv Dunava i Rajne bio *T. s. rysela*, ili čak na nivou vrste, *T. rysela* umesto *T. souffia* (Gilles *et al*., 2010). U Srbiji je zabeležena u Limu i Gračanici (dva vrlo bliska lokaliteta koji su obuhvaćeni istim UTM kvadratom) (Slika 152). Postoji i jedan stari nalaz Josifa Pančića iz 1860. godine za Crni Timok, ali kako svetlica tamo nije više nalažena, smatra se da je vrsta iščezla sa tog lokaliteta.

Opis vrste

Telo svetlice je izduženo i vretenasto (Slika 153). Leđa su tamna, plavičastog odsjaja, dok su bokovi i trbuh svetliji, srebrnasti. Duž

VAIRONE
Telestes souffia (Risso, 1827)

Taxonomic status

Phylum: Chordata
Class: Actinopteri
Superorder: Teleostei
Order: Cypriniformes
Family: Leuciscidae
Species: *Telestes souffia* (Risso, 1827)

Synonyms

Leuciscus souffia souffia Risso, 1826; *Leuciscus souffia* Risso, 1827; *Chondrostoma rysela* Agassiz, 1835; *Leuciscus agassii* Valenciennes, 1844; *Telestes rysela* Heckel, 1851

Vernacular name: Svetlica
English name: Vairone
French name: Blageon
German name: Strömer
Russian name: Елец-андруга

National threat category assessed according to IUCN criteria

At the global level, the vairone is not classified as a threatened species and has the status of Least Concern (LC) (Freyhof & Kottelat, 2008v). The small extent of occurrence in Serbia (EOO is 100 km²) and the small area of occupancy (AOO is 4 km²) suggest that the species is more threatened than defined by the formal IUCN criteria. As there are currently only two records of this species in Serbia and there are no sufficient quantitative indicators of the status of its populations, the vairone is currently classified as Data Deficient (DD).

Distribution

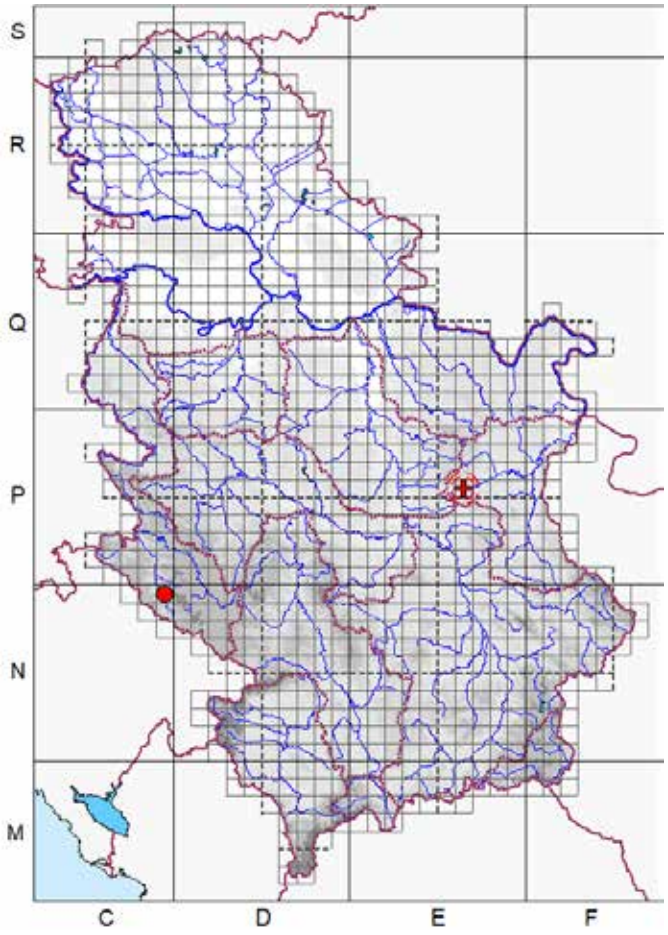
The vairone inhabits the Mediterranean Sea basin from the Aude to the Var drainage (France, Switzerland), the watersheds of the Soča (Italy, Slovenia) and the Cetina (Croatia), the uppermost part of the Rhine basin (Germany and Switzerland) and the Danube basin in the western tributaries in Germany, Austria, Slovenia, Croatia and part of Bosnia and Herzegovina (Veličković *et al*., 2020). It also inhabits the upper reaches of the Tisza River (Romania, Ukraine) (Telcean & Cupşa, 2009a). Recent studies show that there are three subspecies of this species from southern France and the Danube basin, *T. s. souffia*, *T. s. agassii* and *T. s. rysela*, so it is suggested that the correct name for the Danube and Rhine basins is *T. s. rysela* or even at species level *T. rysela* instead of *T. souffia* (Gilles *et al*., 2010). In Serbia, it was recorded in the Lim and Gračanica (two very close locations covered by the same UTM square) (Figure 152). There is also an old finding by Josif Pančić from 1860 in the Crni Timok, but as the vairone no longer occurs there, it is assumed that the species has disappeared from this location.

Description of the species

The body of the vairone is elongated and spindle-shaped (Figure 153). The back is dark with a blue tinge, while the flanks and belly are lighter and

Status vrste u međunarodnim konvencijama i nacionalnoj legislativi **Species status in international conventions and national legislation**

Svetlica / Vairone – *Telestes souffia*		Status
Međunarodna zaštita / International protection	IUCN Red List	**LC**
	CITES konvencija	-
	Evropska direktiva o staništima / European Habitats Directive (navedena kao / listed as *Leuciscus souffia*)	**Prilog / Annex II**
	Bernska konvencija / Bern Convention (navedena kao / listed as *Leuciscus souffia*)	**Dodatak / Appendix III, Rezolucija / Resolution 6**
	Bonska konvencija / Bonn Convention	-
Zaštita u Srbiji / Protection in Serbia	Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva / Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi	**Prilog / Annex I**
	Naredba o merama za očuvanje i zaštitu ribljeg fonda / Regulation on Measures for the Conservation and Protection of Fish Stocks	**Trajni lovostaj / Permanent ban on fishing**
	Prethodni status ugroženosti (prema Simonović, 2001) / Previous threat category (according to Simonović, 2001) (navedena kao / listed as *Leuciscus souffia*)	**DD**
	Aktuelni IUCN status ugroženosti i zaštite u Srbiji / Current IUCN threat category and conservation status in Serbia	**DD Strogo zaštićena vrsta / Strictly protected species**



Slika 152. **Rasprostranjenje *Telestes souffia* u Srbiji.**

Figure 152. **Distribution of *Telestes souffia* in Serbia.**

Slika 153. Svetlica *Telestes souffia* (foto: L. Blazek, https://www.dreamstime.com/souffia-floating-water-image106582862).

Figure 153. Vairone *Telestes souffia* (photo: L. Blazek, https://www.dreamstime.com/souffia-floating-water-image106582862).

bokova postoji široka, tamna, plavo-siva pruga. Bočna linija i osnove grudnih i trbušnih peraja obojene su žućkasto-narandžasto. Usta su subterminalna, dok se zaobljena njuška prostire preko vrha gornje usne. Peraja: D II–III + 7–9; A II–III + 9–10; P 14–15; V 10. U bočnoj liniji ima 45–61 krljušti. Naraste do 25 cm, obično 12–17 cm. Dostiže starost od 10–15 godina (Muus & Dahlström, 1968).

Populacione karakteristike

Iako ova vrsta nije ekonomski interesantna, populacije su pod negativnim ljudskim uticajem širom areala. Podaci u Francuskoj pokazuju da je četvrtina ispitivanih populacija u opadanju, dok je oko 20% kritično ugroženo, na šta ukazuje mala gustina populacija kao i nizak genetički polimorfizam (Muenzel *et al.*, 2010). Populacije u slivu Dunava izolovane su i genetički različite, bez razmene genetičkog materijala (Veličković *et al.*, 2020). Noviji podaci pokazuju da je stanište svetlice u Hrvatskoj smanjeno na 10% nekadašnje distribucije, tako da se sada nalazi na svega par lokaliteta u reci Bregani i nekim delovima Save (Vucić *et al.*, 2017). S druge strane, distribucija ove vrste u gornjem delu sliva Tise veća je nego što se prvobitno smatralo (Telcean & Cupşa, 2009a). U Srbiji, za ovu vrstu nema dovoljno podataka o populacionim karakteristikama.

Ekologija vrste

Svetlica polno sazreva sa 3 godine. Mresti se od kraja marta do maja, pri temperaturi vode iznad 12 °C (Mrakovčić *et al.*, 2006; Kottelat & Freyhof, 2007). Polaže 6.000–8.000 jaja na šljunkovitoj podlozi (Mrakovčić *et al.*, 2006). Netolerantna je prema niskim koncentracijama kiseonika i zahteva šljunkovitu podlogu za mrest. Hrani se larvama insekata, račićima i algama. Svetlica je jatna vrsta.

Stanište

Naseljava srednje tokove bržih i umereno brzih potoka i reka sa čistom vodom i šljunkovitim dnom (Wocher & Rösch, 2006; Telce-

silvery. There is a broad, dark, blue-grey mid-lateral stripe on the flanks. The lateral line and the bases of the pectoral and ventral fins are yellowish-orange. The mouth is subterminal, while the rounded snout extends above the tip of the upper lip. Fins: D II–III + 7–9; A II–III + 9–10; Q 14–15; V 10. There are 45–61 scales in the lateral line. Grows up to 25 cm, usually 12–17 cm. It reaches an age of 10–15 years (Muus & Dahlstroem, 1968).

Population trends

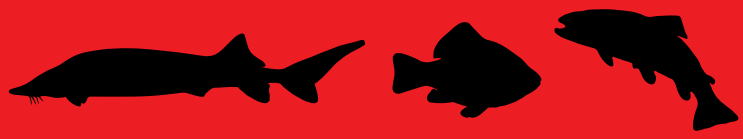
Although this species is economically uninteresting, populations throughout the region are under negative human influence. Data from France show that a quarter of the populations studied are in decline, while about 20% are threatened with extinction, indicating low population density and genetic polymorphism (Muenzel *et al.*, 2010). The populations in the Danube basin are isolated and genetically distinct, with no exchange of genetic material (Veličković *et al.*, 2020). Recent data show that the habitat of the vairone in Croatia has been reduced to 10% of its former range, so that it only occurs in a few places in the Bregana River and in some parts of the Sava River (Vucić *et al.*, 2017). On the other hand, the distribution of this species in the upper part of the Tisza basin is larger than originally assumed (Telcean & Cupşa, 2009a). In Serbia, there is insufficient data on the population characteristics of this species.

Ecology of the species

The vairone becomes sexually mature at the age of 3 years. It spawns from the end of March to May at a water temperature above 12 °C (Mrakovčić *et al.*, 2006; Kottelat & Freyhof, 2007). It lays 6,000-8,000 eggs on a gravelly substrate (Mrakovčić *et al.*, 2006). It is intolerant of low oxygen concentrations and requires a gravel substrate to spawn. It feeds on insect larvae, crustaceans and algae. The vairone occurs in groups.

Habitat

It inhabits the middle reaches of fast and moderately fast streams and rivers with clear water and gravelly bottoms (Wocher & Roesch,



an & Cupşa, 2009a). Preferira temperaturu vode od 10 °C do 20 °C (Baensch & Riehl, 1991). Nalazi utočište među korenjem, kamenjem, granjem ili panjevima u vodi (Wocher & Rösch, 2006). Tokom leta ova mesta često nisu dostupna zbog niskog vodostaja, pa migrira u delove u kojima zaklon prave krošnje žbunja ili drveća.

Ribolovni značaj

Svetlica nema ribolovni značaj.

Faktori ugrožavanja

Osim ugrožavanja usled izgradnje brana, koje sprečavaju migracije i pristup ključnim staništima i tako smanjuju brojnost jedinki, u lokalnim sredinama mogu se pojaviti i druge pretnje. Iako nije predmet ilegalnog ribolova, zbog neselektivnosti i korišćenja nedozvoljenih alata (elektroribolov), može biti ugrožena (Curtean-Bănăduc *et al*., 2017). Eksploatacija šljunka, uništavanje obalske vegetacije, kao i organsko zagađenje iz otpadnih voda, mogu negativno uticati na populacije svetlice.

Faktori ugrožavanja prema IUCN klasifikacionoj šemi / Threats following the IUCN classification scheme	3.2, 7.2.11, 9.1.3, 9.3.4

Postojeće mere zaštite

Svetlica se nalazi u Prilogu I *Pravilnika o proglašenju i zaštiti strogo zaštićenih i zaštićenih vrsta biljaka, životinja i gljiva* i ima status strogo zaštićene vrste. U okviru *Naredbe o merama za očuvanje i zaštitu ribljeg fonda* za ovu vrstu propisan je trajni lovostaj.

Predložene mere zaštite

Potrebno je zaštititi staništa, bilo da je reč o smanjenju zagađenja ili uklanjanju posledica regulacije toka. Takođe je značajno očuvanje obalske vegetacije i sprečavanje eksploatacije šljunka.

Predložene mere zaštite prema IUCN klasifikacionoj šemi	1.2, 2.3

Neophodna su istraživanja veličine, distribucije i trendova populacija, životne istorije i ekologije vrste, uz razvoj programa monitoringa, pošto su noviji podaci o stanju i distribuciji populacija u regionu pokazali značajna odstupanja od prethodnog stanja. Ovakvi podaci bi obezbedili dovoljno informacija kako bi se utvrdilo koje aktivnosti treba preduzeti i koje mere zaštite doneti.

Predložena naučna istraživanja prema IUCN klasifikacionoj šemi	1.2, 1.3, 3.1

2006; Telcean & Cupşa, 2009a). It prefers a water temperature of 10 °C to 20 °C (Baensch & Riehl, 1991). It seeks shelter between roots, stones, branches or tree stumps in the water (Wocher & Roesch, 2006). In summer, these places are often inaccessible because of the low water level, so it migrates to areas where the canopy of bushes or trees provides shelter.

Importance in fisheries

The vairone is of no fishery importance.

Threats

In addition to the threat posed by the construction of dams, which prevent migration and access to important habitats and thus reduce the number of individuals, other threats may also occur in the local environment. Although not subject to illegal fishing, it may be threatened by non-selective fishing and the use of illegal tools (electrofishing) (Curtean-Bănăduc *et al*., 2017). The exploitation of gravel, the destruction of coastal vegetation and organic pollution from sewage can have a negative impact on its populations.

Conservation actions in place

The vairone is included in Annex I of the *Rulebook on Proclamation and Protection of Strictly Protected and Protected Wild Species of Plants, Animals and Fungi* and has the status of a strictly protected species. Under the *Regulation on Measures for the Conservation and Protection of Fish Stocks*, a permanent ban on fishing is imposed on this species.

Conservation actions needed

Habitats need to be protected, whether by reducing pollution or eliminating the effects of river regulation. It is also important to preserve coastal vegetation and prevent the exploitation of gravel.

Research is needed on the size, distribution and trends of populations, the life history and ecology of the species, and the development of a monitoring programme, as recent data on the status and distribution of populations in the region have shown significant deviations from past status. These data would provide sufficient information to decide what activities and conservation measures should be taken.

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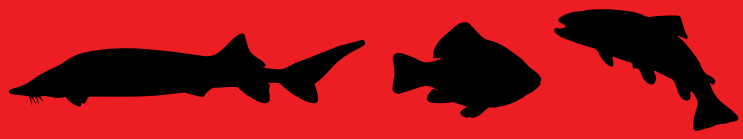

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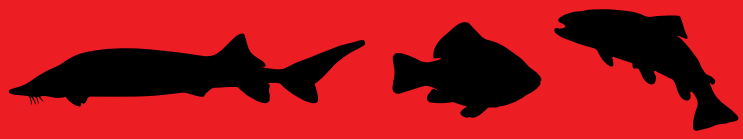

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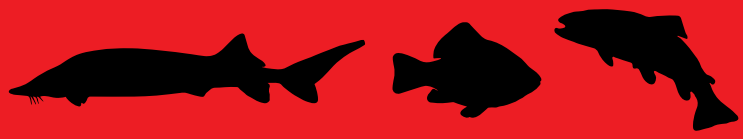

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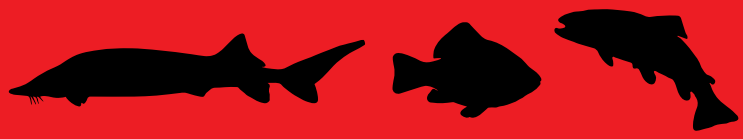

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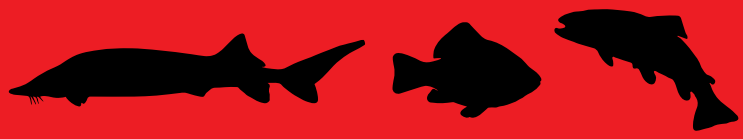

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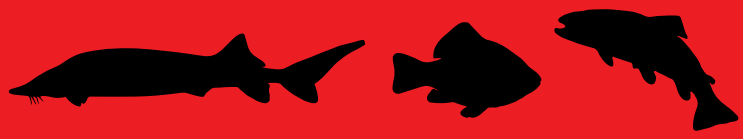

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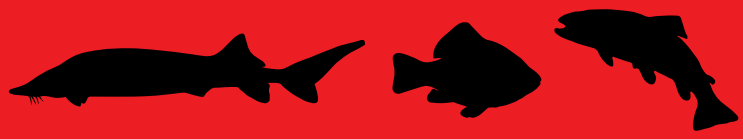

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PRILOZI

APPENDICES

PRILOG 1

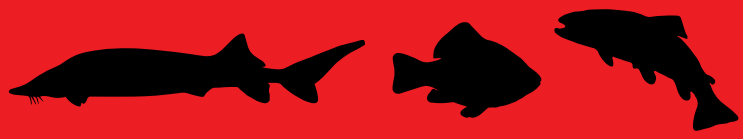
Klasifikaciona šema faktora ugrožavanja prema IUCN (verzija 3.3)

1. Stambeni i komercijalni kompleksi
1.1. Stambena i urbana područja
1.2. Komercijalna i industrijska područja
1.3. Područja za turizam i rekreaciju
2. Poljoprivreda i akvakultura
2.4. Morska i slatkovodna akvakultura
2.4.1. Samostalna/zanatska akvakultura
2.4.2. Industrijska akvakultura
2.4.3. Skala nepoznata/nezabeležena
3. Energetika i rudarstvo
3.1. Eksploatacija nafte i gasa
3.2. Rudarstvo i otvoreni kopovi
3.3. Obnovljivi izvori energije
4. Komunikaciona i saobraćajna infrastruktura
4.1. Putevi i pruge
4.2. Linearna transportna infrastruktura (dalekovodi, akvadukti, naftovodi, gasovodi, cevovodi itd.)
4.3. Brodski koridori
4.4. Avionski koridori
5. Eksploatacija bioloških resursa
5.4. Ribolov & eksploatacija akvatičnih resursa
5.4.1. Planirana eksploatacija: malih razmera (vrsta koja se procenjuje jeste ciljna vrsta)
5.4.2. Planirana eksploatacija: velikih razmera (vrsta koja se procenjuje jeste ciljna vrsta)
5.4.3. Neplanirani efekti: malih razmera (vrsta koja se procenjuje nije ciljna vrsta)
5.4.4. Neplanirani efekti: velikih razmera (vrsta koja se procenjuje nije ciljna vrsta)
5.4.5. Gonjenje/kontrola (npr. vrste koje se ubijaju zbog toga što se hrane komercijalnim vrstama)
5.4.6. Motivacija nepoznata/nezabeležena
6. Antropogeni pritisci i smetnje
6.1. Rekreativne aktivnosti
6.2. Ratovi, građanski nemiri i vojne vežbe
6.3. Rad i druge aktivnosti
7. Modifikacije prirodnih sistema
7.2. Brane i korišćenje vodnih resursa
7.2.1. Crpljenje površinskih voda (za domaćinstva)
7.2.2. Crpljenje površinskih voda (komercijalno)
7.2.3. Crpljenje površinskih voda (u poljoprivredi)
7.2.4. Crpljenje površinskih voda (nepoznata svrha)
7.2.5. Crpljenje podzemnih voda (za domaćinstva)
7.2.6. Crpljenje podzemnih voda (komercijalno)
7.2.7. Crpljenje podzemnih voda (u poljoprivredi)
7.2.8. Crpljenje podzemnih voda (nepoznata svrha)
7.2.9. Male brane
7.2.10. Velike brane
7.2.11. Brane (nepoznate veličine)
7.3. Ostale modifikacije ekosistema

APPENDIX 1

IUCN Threats Classification Scheme (Version 3.3)

1. Residential & commercial development
1.1. Housing & urban areas
1.2. Commercial & industrial areas
1.3. Tourism & recreation areas
2. Agriculture & aquaculture
2.4. Marine & freshwater aquaculture
2.4.1. Subsistence/artisanal aquaculture
2.4.2. Industrial aquaculture
2.4.3. Scale unknown/unrecorded
3. Energy production & mining
3.1. Oil & gas drilling
3.2. Mining & quarrying
3.3. Renewable energy
4. Transportation & service corridors
4.1. Roads & railroads
4.2. Utility & service lines
4.3. Shipping lanes
4.4. Flight paths
5. Biological resource use
5.4. Fishing & harvesting aquatic resources
5.4.1. Intentional use: subsistence/small scale (species being assessed is the target)[harvest]
5.4.2. Intentional use: large scale (species being assessed is the target)[harvest]
5.4.3. Unintentional effects: subsistence/small scale (species being assessed is not the target)[harvest]
5.4.4. Unintentional effects: large scale (species being assessed is not the target)[harvest]
5.4.5. Persecution/control
5.4.6. Motivation unknown/unrecorded
6. Human intrusions & disturbance
6.1. Recreational activities
6.2. War, civil unrest & military exercises
6.3. Work & other activities
7. Natural system modifications
7.2. Dams & water management/use
7.2.1. Abstraction of surface water (domestic use)
7.2.2. Abstraction of surface water (commercial use)
7.2.3. Abstraction of surface water (agricultural use)
7.2.4. Abstraction of surface water (unknown use)
7.2.5. Abstraction of ground water (domestic use)
7.2.6. Abstraction of ground water (commercial use)
7.2.7. Abstraction of ground water (agricultural use)
7.2.8. Abstraction of ground water (unknown use)
7.2.9. Small dams
7.2.10. Large dams
7.2.11. Dams (size unknown)
7.3. Other ecosystem modifications



8. Invazivne i druge problematične vrste, geni i zaraze
- 8.1. Invazivne alohtone/strane vrste/zaraze
  - 8.1.1. Nedefinisane vrste
  - 8.1.2. Imenovane vrste
- 8.2. Problematične autohtone vrste/zaraze
  - 8.2.1. Nedefinisane vrste
  - 8.2.2. Imenovane vrste
- 8.3. Introdukovani genetički materijal
- 8.4. Problematične vrste/zaraze nepoznatog porekla
  - 8.4.1. Nedefinisane vrste
  - 8.4.2. Imenovane vrste

9. Zagađenje
- 9.1. Komunalne i urbane otpadne vode
  - 9.1.1. Kanalizacija
  - 9.1.2. Oticanje
  - 9.1.3. Tip nepoznat/nezabeležen
- 9.2. Industrijske i vojne otpadne vode
  - 9.2.1. Izlivanje nafte
  - 9.2.2. Procedne vode iz rudnika
  - 9.2.3. Tip nepoznat/nezabeležen
- 9.3. Otpadne vode iz poljoprivrede i šumarstva
  - 9.3.1. Opterećenje nutrijentima
  - 9.3.2. Erozija zemljišta, sedimentacija
  - 9.3.3. Herbicidi & pesticidi
  - 9.3.4. Tip nepoznat/nezabeležen
- 9.4. Komunalni i čvrsti otpad
- 9.5. Aerozagađivači
  - 9.5.1. Kisele kiše
  - 9.5.2. Smog
  - 9.5.3. Ozon
  - 9.5.4. Tip nepoznat/nezabeležen
- 9.6. Višak energije
  - 9.6.1. Svetlosno zagađenje
  - 9.6.2. Termalno zagađenje
  - 9.6.3. Zagađenje bukom
  - 9.6.4. Tip nepoznat/nezabeležen

11. Klimatske promene i ekstremni vremenski uslovi
- 11.1. Izmene i izmeštanje staništa
- 11.2. Suše
- 11.3. Ekstremne temperature
- 11.4. Oluje i poplave
- 11.5. Drugi uticaji

12. Ostale mogućnosti
- 12.1. Ostale pretnje

8. Invasive & other problematic species, genes & diseases
- 8.1. Invasive non-native/alien species/diseases
  - 8.1.1. Unspecified species
  - 8.1.2. Named species
- 8.2. Problematic native species/diseases
  - 8.2.1. Unspecified species
  - 8.2.2. Named species
- 8.3. Introduced genetic material
- 8.4. Problematic species/diseases of unknown origin
  - 8.4.1. Unspecified species
  - 8.4.2. Named species

9. Pollution
- 9.1. Domestic & urban waste water
  - 9.1.1. Sewerage
  - 9.1.2. Run-off
  - 9.1.3. Type unknown/unrecorded
- 9.2. Industrial and military wastewater
  - 9.2.1. Oil spills
  - 9.2.2. Seepage from mining
  - 9.2.3. Type unknown/unrecorded
- 9.3. Agricultural & forestry effluents
  - 9.3.1. Nutrient loads
  - 9.3.2. Soil erosion, sedimentation
  - 9.3.3. Herbicides & pesticides
  - 9.3.4. Type unknown/unrecorded
- 9.4. Garbage & solid waste
- 9.5. Air-borne pollutants
  - 9.5.1. Acid rain
  - 9.5.2. Smog
  - 9.5.3. Ozone
  - 9.5.4. Type unknown/unrecorded
- 9.6. Excess energy
  - 9.6.1. Light pollution
  - 9.6.2. Thermal pollution
  - 9.6.3. Noise pollution
  - 9.6.4. Type unknown/unrecorded

11. Climate change & severe weather
- 11.1. Habitat shifting & alteration
- 11.2. Droughts
- 11.3. Temperature extremes
- 11.4. Storms & flooding
- 11.5. Other impacts

12. Other options
- 12.1. Other threat

PRILOG 2

Klasifikaciona šema mera zaštite koje se sprovode prema IUCN (verzija 2.0)

Monitoring i planiranje

1. Da li postoji akcioni plan za oporavak vrsta?
2. Da li postoji sistematski plan monitoringa?

APPENDIX 2

IUCN Conservation Actions in Place Classification Scheme (Version 2.0)

Monitoring & planning

1. Is there an Action Recovery Plan?
2. Is there a systematic monitoring scheme?

Zaštita i upravljanje vodenim/kopnenim staništima

3. Da li su identifikovana područja za zaštitu?
4. Da li je takson prisutan na bar jednom zaštićenom području?
   4.1. Ukoliko je odgovor „da", navesti koji se procenat populacije nalazi unutar zaštićenih područja (1–100%)
5. Da li postoji plan upravljanja područjem sa obuhvatom areala vrste i izvan zaštićenog područja?
6. Da li se sprovodi kontrola prisustva ili prevencija širenja invazivnih vrsta?

Upravljanje vrstama

7. Da li postoji plan dozvoljenog izlova po vrstama i količinama?
8. Da li je takson uspešno reintrodukovan ili je u cilju zaštite vrste planski introdukovan izvan granica zabeležene distribucije, ali u odgovarajuća staništa i ekogeografsko područje?
9. Da li je takson predmet *ex situ* zaštite?

Obrazovanje i legislativa

10. Da li je takson obuhvaćen programima obrazovanja ili jačanja svesti koji su sprovedeni u skorije vreme?
11. Da li je takson predmet međunarodnih programa?
12. Da li se za takson sprovodi međunarodna kontrola prometa?

Land/water protection & management

3. Have conservation sites been identified?
4. Does the taxon occur in at least one Protected Area?
   4.1. If yes, indicate what proportion of the population is within Protected Areas (1-100%)
5. Is there an area based regional management plan?
6. Is there invasive species control or prevention?

Species management

7. Is there a harvest management plan?
8. Has the taxon been successfully reintroduced or introduced benignly?
9. Is the taxon subject to *ex situ* conservation?

Education & legislation

10. Is the taxon the subject of any recent education or awareness programmes?
11. Is the taxon Included in international legislation?
12. Is the taxon subject to any international management/trade controls?

PRILOG 3

Klasifikaciona šema predloženih mera zaštite prema IUCN (verzija 2.0)

1. Zaštita kopnenih/vodenih staništa
- 1.1. Zaštita lokaliteta/područja
- 1.2. Zaštita resursa i staništa

2. Upravljanje kopnenim/vodenim staništima
- 2.1. Upravljanje lokalitetima/područjima
- 2.2. Kontrola invazivnih/problematičnih vrsta
- 2.3. Obnavljanje staništa i prirodnih procesa

3. Upravljanje vrstama
- 3.1. Upravljanje vrstama
  - 3.1.1. Upravljanje eksploatacijom
  - 3.1.2. Upravljanje trgovinom
  - 3.1.3. Ograničavanje populacionog rasta
- 3.2. Oporavak vrsta
- 3.3. Reintrodukcija vrsta
  - 3.3.1. Reintrodukcija
  - 3.3.2. Introdukcija u odgovarajuća staništa izvan istorijskog areala vrste u svrhu zaštite
- 3.4. *Ex situ* očuvanje
  - 3.4.1. Uzgoj u zatočeništvu/veštačko razmnožavanje
  - 3.4.2. Očuvanje genetičkih resursa

4. Obrazovanje i podizanje svesti
- 4.1. Formalno obrazovanje
- 4.2. Obuka
- 4.3. Podizanje svesti i komunikacija

5. Zakon i politika
- 5.1. Zakonodavstvo

APPENDIX 3

IUCN Conservation Actions Classification Scheme (Version 2.0)

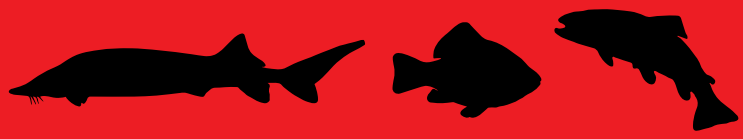
1. Land/water protection
- 1.1. Site/area protection
- 1.2. Resource & habitat protection

2. Land/water management
- 2.1. Site/area management
- 2.2. Invasive/problematic species control
- 2.3. Habitat & natural process restoration

3. Species management
- 3.1. Species management
  - 3.1.1. Harvest management
  - 3.1.2. Trade management
  - 3.1.3. Limiting population growth
- 3.2. Species recovery
- 3.3. Species re-introduction
  - 3.3.1. Reintroduction
  - 3.3.2. Benign introduction
- 3.4. *Ex situ* conservation
  - 3.4.1. Captive breeding/artificial propagation
  - 3.4.2. Genome resource bank

4. Education & awareness
- 4.1. Formal education
- 4.2. Training
- 4.3. Awareness & communication

5. Law & policy
- 5.1. Legislation



5.1.1. Međunarodni nivo
5.1.2. Nacionalni nivo
5.1.3. Podnacionalni nivo
5.1.4. Neodređeni nivo
5.2. Pravila i propisi
5.3. Standardi i kodeksi privatnog sektora
5.4. Usklađenost i sprovođenje
5.4.1. Međunarodni nivo
5.4.2. Nacionalni nivo
5.4.3. Podnacionalni nivo
5.4.4. Neodređeni nivo
6. Sredstva za život, ekonomski i drugi podsticaji
6.1. Povezivanje delatnosti i alternativnih izvora prihoda
6.2. Promena delatnosti
6.3. Tržišni potencijali
6.4. Naknade za sprovođenje zaštite
6.5. Nemonetarne vrednosti

5.1.1. International level
5.1.2. National level
5.1.3. Sub-national level
5.1.4. Scale unspecified
5.2. Policies and regulations
5.3. Private sector standards & codes
5.4. Compliance and enforcement
5.4.1. International level
5.4.2. National level
5.4.3. Sub-national level
5.4.4. Scale unspecified
6. Livelihood, economic & other incentives
6.1. Linked enterprises & livelihood alternatives
6.2. Substitution
6.3. Market forces
6.4. Conservation payments
6.5. Non-monetary values

PRILOG 4

Klasifikaciona šema predloženih naučnih istraživanja prema IUCN (verzija 2.0)

1. Istraživanja
1.1. Taksonomija
1.2. Veličina populacije, rasprostranjenje i trendovi
1.3. Životna istorija i ekologija
1.4. Eksploatacija, korišćenje i izvori prihoda
1.5. Pretnje
1.6. Akcije vezane za očuvanje
2. Planiranje očuvanja i zaštite
2.1. Akcioni plan zaštite/oporavka vrsta
2.2. Plan upravljanja područjem
2.3. Plan eksploatacije i trgovine
3. Monitoring
3.1. Populacioni trendovi
3.2. Trendovi nivoa eksploatacije
3.3. Trendovi trgovine
3.4. Trendovi staništa
4. Ostalo

APPENDIX 4

IUCN Research Needed Classification Scheme (Version 2.0)

1. Research
1.1. Taxonomy
1.2. Population size, distribution & trends
1.3. Life history & ecology
1.4. Harvest, use & livelihoods
1.5. Threats
1.6. Actions
2. Conservation planning
2.1. Species action/recovery plan
2.2. Area-based management plan
2.3. Harvest & trade management plan
3. Monitoring
3.1. Population trends
3.2. Harvest level trends
3.3. Trade trends
3.4. Habitat trends
4. Other

PRILOG 5

SKRAĆENICE

Kategorije ugroženosti:

EX – izumrla vrsta
EW – vrsta iščezla u prirodi
CR – kritično ugrožena vrsta
EN – ugrožena vrsta
VU – ranjiva vrsta
NT – gotovo ugrožena vrsta
LC – najmanje zabrinjavajuća vrsta

APPENDIX 5

ABBREVIATIONS

Threat categories:

EX – Extinct
EW – Extinct in the Wild
CR – Critically Endangered
EN – Endangered
VU – Vulnerable
NT – Near Threatened
LC – Least Concern

DD – vrsta sa nedovoljno podataka o ugroženosti
RE – regionalno iščezla vrsta
NA – vrsta neprikladna za procenu
NE – vrsta nije procenjena
LR/lc – niži stepen ugroženosti/najmanja briga
LR/nt – niži stepen ugroženosti/gotovo ugrožena vrsta

DD – Data Deficient
RE – Regionally Extinct
NA – Not Applicable
NE – Not Evaluated
LR/lc – Low Risk/least concern
LR/nt – Low Risk/nearly threatened

PRILOG 6

SIMBOLI NA KARTAMA RASPROSTRANJENJA

APPENDIX 6

SYMBOLS ON DISTRUBUTION MAPS

	LITERATURNI / LITERATURE	tačan literaturni podatak / accurate literature record
	TERENSKI / FIELD	tačan i proverljiv terenski podatak / accurate and verifiable field record
	LITERATURNI I TERENSKI / LITERATURE AND FIELD	tačan i literaturni i terenski podatak / accurate literature and field record
	TAKSON JE IŠČEZAO / TAXON IS EXTINCT	podatak o nalazu je tačan, ali je vrsta iščezla sa datog lokaliteta / the information about the record is correct, but the species has disappeared from the indicated location
	ADVENTIVAN / ADVENTITIOUS	podatak o nalazu je tačan, ali se odnosi na adventivne (alohotne) populacije, odnosno na populacije koje se nalaze izvan svog prirodnog areala / the information about the record is correct, but they refer to adventitious (allochthonous) populations, i.e. populations outside their natural range
	NEPOUZDAN / UNRELIABLE	nepouzdan (sumnjiv) podatak / unreliable (questionable) record
	NETAČAN / INCORRECT	pogrešan objavljen podatak – "greška" koju je ustanovio neosporni autoritet za grupu / incorrect published record – an "error" identified by an unquestioned authority for the group
	STEPEN PRECIZNOSTI MANJI OD 20×20 KM A VEĆI OD 10×10 KM / DEGREE OF ACCURACY LESS THAN 20×20 KM BUT MORE THAN10×10 KM	podatak za koji nije bilo moguće odrediti preciznost lokacije 10×10 km ili manje / record for which it was not possible to determine the accuracy of the location 10×10 km or less

PRILOG 7

SKRAĆENI NAZIVI MEĐUNARODNIH KONVENCIJA

- CITES konvencija – Konvencija o međunarodnom prometu ugroženih vrsta divlje faune i flore
- Evropska direktiva o staništima – Evropska direktiva o očuvanju prirodnih staništa i divlje faune i flore – Direktiva o staništima
- Bernska konvencija – Konvencija o očuvanju evropske divlje flore i faune i prirodnih staništa
- Bonska konvencija – Konvencija o očuvanju migratornih vrsta divljih životinja

APPENDIX 7

SHORT TITLES OF INTERNATIONAL CONVENTIONS

- CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
- European Habitats Directive – Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora – Habitats Directive
- Bern Convention – Bern Convention on the Conservation of European Wildlife and Natural Habitats
- Bonn Convention – Convention on the Conservation of Migratory Species of Wild Animals

УНИВЕРЗИТЕТ У БЕОГРАДУ -
БИОЛОШКИ ФАКУЛТЕТ
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FACULTY OF BIOLOGY

ЗАВОД ЗА ЗАШТИТУ
ПРИРОДЕ СРБИЈЕ
INSTITUTE FOR NATURE
CONSERVATION OF SERBIA

ИНСТИТУТ ЗА
МУЛТИДИСЦИПЛИНАРНА
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CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

502.211:597.2/.5(497.11)

CRVENA knjiga faune Srbije. 5, Ribe = Red Book of Fauna of Serbia. 5, Fishes / [urednici, editors] Aleksandar Hegediš, Jasmina Krpo-Ćetković ; [izrada i uređivanje karata, map creators and editors Marjan Niketić, Marina Ilić, Dragan Kaličanin] ; [prevod, translation Jasmina Krpo-Ćetković]. - Beograd : Univerzitet, Biološki fakultet : Zavod za zaštitu prirode Srbije : Univerzitet, Institut za multidisciplinarna istraživanja = Belgrade : University, Faculty of Biology : Institute for Nature Conservation of Serbia : University, Institute for Multidisciplinary Research, 2024 (Beograd : Birograf). - 421 str. : ilustr. ; 28 cm

Uporedo srp. tekst i engl. prevod. - Tiraž 500. -
Bibliografija: str. 397-414.

ISBN 978-86-80877-86-0 (ZZPS)

1. Хегедиш, Александар, 1955- [уредник]
а) Рибе -- Угрожене врсте -- Србија

COBISS.SR-ID 152932873

Knjiga predstavlja hvale vredan doprinos naših ihtiologa da se ova grupa vodenih kičmenjaka sagleda ne samo sa faunističkog i bionomskog aspekta, već pre svega, u pogledu stanja i stepena ugroženosti, zbog čega ima poseban značaj i vrednost. Knjiga bi trebalo da alarmira i aktivira širok krug ljudi da se prema ovoj ekonomski važnoj fauni, koja predstavlja obnovljivi biološki resurs, odnose zaštitarski i u pogledu korišćenja, oprezno i održivo, a ne stihijski i bez kontrole, kakav je danas često slučaj. Sve što je u rukopisu nabrojano, od postojećih mera zakonske zaštite do velikog broj faktora ugrožavanja, koji su za svaku vrstu specifični, može pomoći ili dati smernice ponašanja onima koji su ekonomski ili rekreativno upućeni na korišćenje ribljeg fonda kako bi se negativni antropogeni pritisci smanjili ili bar kontrolisali.

Vladimir Stevanović

The book represents a commendable contribution by our ichthyologists to consider this group of aquatic vertebrates not only from a faunistic and bionomic point of view, but above all with regard to the status and degree of endangerment, which is why it is of particular importance and value. This book should alert and mobilise a wide circle of people to treat this economically important fauna, which represents a renewable biological resource, carefully and sustainably in terms of protection and use, rather than spontaneously and uncontrollably, as is often the case today. Everything listed in the manuscript, from the existing legal protection measures to a large number of risk factors specific to each species, can help those involved in the exploitation of fish stocks, whether commercially or recreationally, or provide behavioural guidelines to reduce or at least control the negative anthropogenic pressures.

Vladimir Stevanović

Izrada nacionalnih crvenih knjiga spada u standarde savremene zaštite prirode. Rad na njihovom publikovanju prioritet je za sve istraživače koji se bave očuvanjem biodiverziteta, kako sa profesionalnog (naučnog i obrazovnog), tako i sa društvenog, pa i patriotskog aspekta. Odajem iskreno priznanje urednicima i autorima na ogromnom trudu, vremenu i strpljenju u prikupljanju podataka, analizama i pisanju tekstova. Ovakva monografija, zavidnog kvaliteta i sveobuhvatnog sadržaja, rezultat je višegodišnjih terenskih i dvogodišnjih kabinetskih studija 15 veoma kompetentnih ihtiologa iz nekoliko institucija u Republici Srbiji. Sintetsko delo iz oblasti očuvanja diverziteta faune riba Srbije očekivano je dugi niz godina, a njeno publikovanje pokazuje na kom je nivou savremena ihtiologija u Srbiji. Knjiga predstavlja rezultat velikog napora ihtiologa svih generacija koji su se ujedinili sa ciljem očuvanja raznovrsnosti faune riba, zaštite njihovih staništa, ali i čitave prirode u našoj zemlji. Uverena sam da će "Crvena knjiga faune Srbije V – ribe" predstavljati fundamentalan i često citiran izvor podataka u narednoj deceniji u Srbiji i regionu.

Ljiljana Tomović

The creation of national Red Books is one of the standards of modern nature conservation. Working on their publication is a priority for all researchers involved in biodiversity conservation, both from a professional (scientific and educational) and a social, even patriotic, point of view. I express my sincere gratitude to the editors and authors for their enormous effort, time and patience in collecting data, analysing and writing texts. Such a monograph of enviable quality and comprehensive content is the result of several years of field studies and two years of cabinet studies by 15 highly competent ichthyologists from various institutions in the Republic of Serbia. A synthetic work in the field of conservation of the diversity of fish fauna of Serbia has been awaited for many years, and its publication demonstrates the level of modern ichthyology in Serbia. It is the result of a great effort of ichthyologists of all generations who have joined forces with the aim of preserving the diversity of fish fauna and protecting their habitats, but also the entire nature in our country. I am convinced that the "Red Book of Fauna of Serbia V – Fishes" will be a fundamental and often cited source of data in Serbia and the region in the next decade.

Ljiljana Tomović

"Crvena knjiga faune Srbije V – ribe" je vrlo atraktivna i jako potrebna publikacija, uživao sam u njenom čitanju. Zaštita ugroženih vrsta predstavlja aktuelni problem koji mora biti potkrepljen kvalitetnim podacima koji su u ovu knjigu bogato uključeni. Znanje sistematike riba Evrope jako se promenilo poslednjih godina. Opisano je dosta novih vrsta, a molekularna filogenija je donela ogroman broj informacija o biodiverzitetu i razlikama među vrstama. Nije uopšte jednostavno pratiti sve radove, pa čak ni za specijaliste koje se bave tim predmetom istraživanja. Čestitam svim autorima na neobično dobrom radu.

Radek Šanda

The "Red Book of Fauna of Serbia V – Fishes" is a very attractive and necessary publication, I enjoyed reading it. The protection of endangered species is a current problem that needs to be supported by high-quality data, which is abundant in this book. Knowledge of the systematics of fishes in Europe has changed considerably in recent years. Many new species have been described, and molecular phylogeny has provided a large amount of information on species diversity and the differences between species. Even for specialists dealing with this research topic, it is not easy to follow all this. I congratulate all the authors on their remarkably good work.

Radek Šanda

Knjiga predstavlja značajno delo, bazirano na svim nacionalnim i međunarodnim saznanjima, kao i na relevantnoj i aktuelnoj literaturi. Ona će sigurno biti od koristi ne samo za stručnjake ihtiologe, već i za različite zainteresovane strane čija je oblast delovanja vezana delom i za ugroženost populacija riba u Srbiji, tako da će svi oni u knjizi naći punovažan materijal koji će im pomoći u analizi podataka i donošenju odluka. Nadamo se da će ova knjiga biti i pokretač za izradu akcionih planova za različite vrste riba i njihov monitoring. Uz sve probleme vezane za taksonomski status pojedinih vrsta riba, knjiga daje vredne podatke o rasprostranjenosti slatkovodnih vrsta riba u Srbiji i procenu njihovog statusa koja je bazirana na velikom broju prikupljenih podataka.

Mirjana Lenhardt

The book is an important work based on the entire national and international knowledge as well as on relevant and current literature. It will certainly be useful not only for ichthyologists, but also for various interested parties whose field of activity is partly related to the endangerment of fish populations in Serbia. They will all find in the book valid material that will help them in analysing data and making decisions. We hope that this book will also be an impetus for the creation of action plans for various fish species and their monitoring. In addition to all the problems related to the taxonomic status of certain fish species, the book provides valuable data on the distribution of freshwater fish species in Serbia and an assessment of their status based on a large amount of collected data.

Mirjana Lenhardt