



# FISH OF THE ZETA RIVER

*"Look deep, deep into nature, and then  
you'll understand everything better."*

**Albert Einstein**



**Montenegrin Ecologists Society**

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# About the project

The project has contributed to assessing the diversity of fish species in Zeta River. It involved enhancing the data on fish species distribution in the river's upper stretches and reviewing the conservation status of these species on the Red List of Threatened Species of the International Union for Conservation of Nature (IUCN). Furthermore, the project identified the primary pressures and challenges the studied freshwater habitats face, proposing potential solutions. It also fostered an improved collaboration with local communities and decision-makers in the region.

All the outcomes presented in this publication are the direct results of the project titled „*Contribution to the future protection and management of priority areas for the protection of the CZM catchment surrounding Nikšić.*“ This project was supported by the Critical Ecosystem Partnership Fund (CEPF) and Birdlife.

This publication has been created to efficiently inform, manage, and promote the value of our natural treasure and heritage, specifically the Zeta River. Its primary purpose is to educate young people about the fish population in the Zeta River and the significance of fish diversity and abundance for the local community. The publication provides descriptions of species inhabiting Zeta River, as observed during field research conducted by the Montenegrin Ecologists Society in 2021, as well as species confirmed in earlier studies. For many of the species listed in this publication, their exact distribution has still not been determined, which is why additional research will be carried out in the near future.

Project's contribution also extends to identifying potential endemic species as a result of the exploration of springs and subterranean swallow holes and caves. Additional water sources, such as pits and caves, have also been identified as part of the project. Future research on fish and other species, including amphibians and invertebrates inhabiting these unique habitats, will focus on exploring these areas.

<sup>1</sup> Refers to the species inhabiting one geographic location, such as an island, country, region, or other defined zone.



# About MES

**Montenegrin Ecologists Society (MES)** is an independent and non-profit nongovernmental organisation founded on the 10<sup>th</sup> of August 2012 in Danilovgrad.

## *Mission:*

Promoting a sense of shared responsibility among all community stakeholders to minimise detrimental environmental impacts and establish eco-programs that advance all facets of sustainable development—including social, economic, and ecological dimensions.

## *Vision:*

An environmentally conscious society that can harness natural resources while adhering to and implementing the principles of sustainable development.

## *Openness:*

The organisation welcomes participation from anyone eager to contribute to nature conservation and environmental preservation. This includes researchers from various disciplines: natural sciences, engineering, social sciences, and the humanities, who have an interest in applying ecological principles within their respective fields.

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# Introduction

With all the services they provide, freshwater ecosystems affect the quality of our lives and our well-being. Whether as individuals or as a community, we can make a substantial contribution to their preservation through simple acts of care. By respecting the rights, fundamental needs, and requirements of all living beings and by taking individual or collective actions aimed at conserving the biodiversity of freshwater habitats, we can help safeguard the invaluable benefits provided by these ecosystems.

Rivers can nourish, revitalise, rejuvenate, and inspire us, supplying humans with drinking water and nutritious food. They serve as habitats for an incredible diversity of life, regulate floodwaters, and purify water resources. This is why we have been dependent on them throughout the course of human civilisation. However, in modern times, we often manage freshwater ecosystems without the due respect they deserve, forgetting that all the advantages we enjoy are contingent upon the health of these waters. Also, one of the most profound benefits we derive from untamed and conserved rivers is intangible: in their pristine state, they are a link to health, equilibrium, and stability.

Rivers offer a valuable natural resource in the form of diverse fish species. These fish serve as a source of food and recreation through fishing and play a vital role as indicators of ecosystem health. They are a crucial link in the food chains within aquatic ecosystems and are also interconnected with terrestrial food chains. Furthermore, fish hold significant economic importance for many countries and are subject to numerous international agreements and legal cases (Duplić, 2008). Fish also serve as a primary source of protein for people worldwide (Holmlund & Hammer, 1999). These are just a few compelling reasons why managing freshwater ecosystems and their associated services should be an integral part of regional development planning, with international cooperation being a necessary component. Consequently, more significant investments are being made in preserving rivers to support local communities, ensure a secure food supply, and promote local development.

The extensive diversity of freshwater fish comprises over 10,000 species (Jelić et al., 2008). What's remarkable is that even though freshwater makes up just 0.01 percent of the total water surface, freshwater ecosystems are exceptionally rich and diverse. Current data indicate that freshwater ecosystems and their fish species belong to one of the most threatened groups of habitats and organisms. Broadly speaking, freshwater fish species can be categorised into those that thrive in fast-flowing, cold waters with ample oxygen (e.g., brown trout) and those that prefer slower, warmer water bodies with higher organic matter content (e.g., cod).

Freshwater ecosystems, including deep river canyons and riverbeds like the Zeta River, harbour many endemic and rare fish species. A significant reason behind the high number of endemic species is that these areas have not been gravely affected by the Ice Age, making them important refuges. In conjunction with mountainous terrain, underground pits, and islands, the karst rivers of the Adriatic region stand out as primary centres of endemic flora and fauna (Radović, 1999).

Mediterranean freshwater fish fauna consists of a number of endemic species with a limited area of distribution (Crivelli & Maitland 1995). One of these unique areas is the Zeta River water system, which, along with Lake Skadar, is a vital component of the broader Lake Ohrid-Drim River-Lake Skadar basin. This region boasts the highest recorded levels of species diversity.

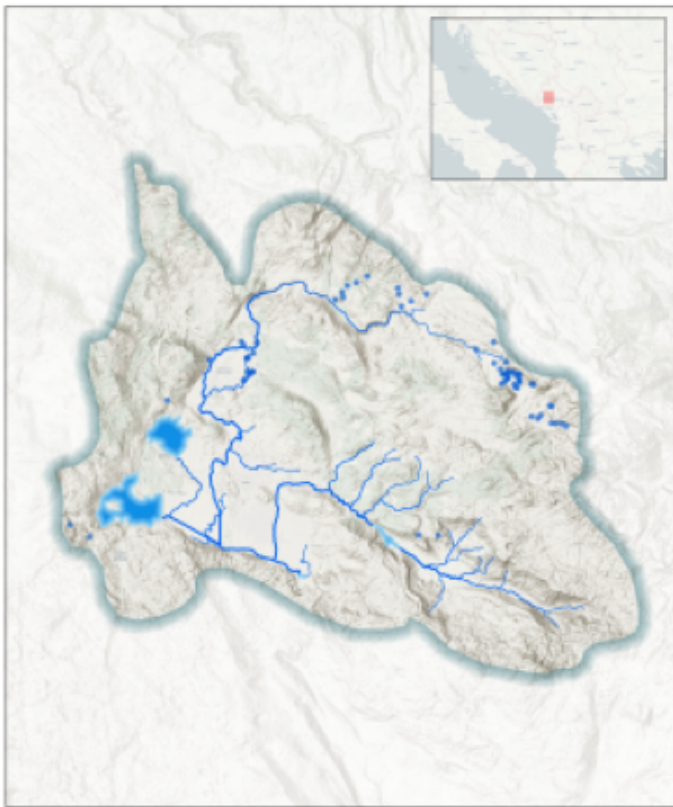
The presence of a wide range of freshwater habitats within a relatively small geographical area, including springs, streams, swallow holes, rivers, pits, lakes, and more, coupled with diverse topography and both groundwater and surface waters, contributes to a rich diversity of fish species, many of which are endemic. Some of these species are unique to a single river stream or this particular Mediterranean region. However, due to limited research on these hydrogeological systems, our knowledge about all the freshwater habitats, their interconnections, and the species inhabiting them still needs to be completed.

This knowledge gap poses challenges when it comes to making informed investments in the management and sustainable utilisation of freshwater ecosystems.

Human activities have introduced various stressors and pressures on river streams, including Zeta River. These refer to the discharge of industrial and sewage wastewater, illegal fishing (poaching), the construction and operation of hydroelectric power plants, sand mining, improper disposal of solid waste, and the introduction of invasive species. These factors collectively pose significant threats to many rivers, including Zeta.

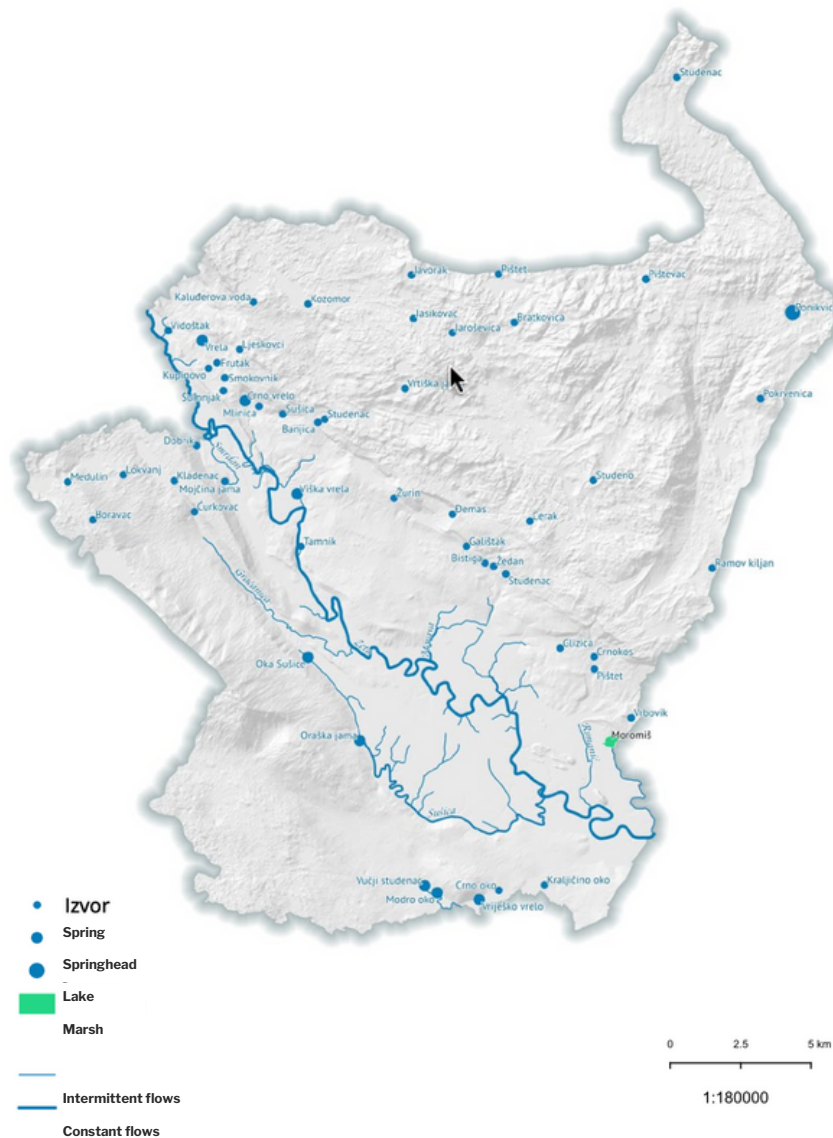
# IV Zeta river as a fish habitat

Zeta River originates under the Vojnik karst mountain as a small stream - Surdub. After covering a few kilometres, this stream transforms into Sušica River. It then merges with Moštanica, becoming Zeta River. Zeta is shaped by several permanent and intermittent watercourses situated in the Gornje Polje area of Nikšić. The most significant ones among these are the Rastovac, Vidrovan, and Gornjepoljski vir (see Map 1).



Map 1. CMZ - Catchment Management Zone surrounding Nikšić (M. Jovičević, EnvPro, 2019.)





Map 2. A basin in the lower course of the Zeta River (Source: Local Biodiversity Action Plan of the Municipality of Danilovgrad 2020-2024. Municipality of Danilovgrad, April 2020).

Slivlje River flows naturally for approximately 28 km until it reaches its underground abyss. It then travels as groundwater for about 5 kilometres before resurfacing as the Perućica spring at an elevation of 348 meters above sea level (masl). At this point, it converges with Glava Zete (74.8 masl) and Oboštičko oko, giving rise to the Donja Zeta. Then Donja Zeta flows through Bjelopavlička plain and extends to its confluence with Morača River in the Morača plain, covering a distance of about 51 kilometres. The riverbed of Zeta River has an average width of around 45 meters, with the widest section being at Slap, measuring approximately 90 meters<sup>2</sup>. In its lower course, Zeta maintains a consistent and slow flow throughout the year. Its bed is relatively deep, featuring a limited number of rapids and several pools, typically around 4-5 meters deep (Marić, 1995). Despite being a tributary of the Morača, Zeta contributes a larger volume of water (Mrdak, 2009). Together, they form a portion of the Lake Skadar basin, which is part of the broader Adriatic basin (Pešić et al., 2019).

2 Study of the Protection of the Natural Assets of the Zeta River Valley, 2019, Environmental Protection Agency

Nikšičko field, with a well-developed network of surface water and groundwater bodies (including the Zeta River) stands as the sole karst field in Montenegro. Despite the vast expanse of the Nikšić field basin, which covers around 1,000 square kilometres, the area occupied by watercourses is relatively limited and encircles the most urbanised section of Nikšić. Gornja Zeta basin sustains approximately 70,000 individuals, both directly and indirectly, for their livelihoods. Additionally, over 20,000 people rely on the Donja Zeta basin as a source of their livelihoods.

Skadar Lake basin is renowned for its remarkable biodiversity, hosting distinctive species of both invertebrates and vertebrates. Within this basin, scientists have recorded a total of 59 freshwater fish species. Among these, 15 are species not native to the area, while 45 are indigenous to the region. Seven of these species are classified as endemic (Pešić et al., 2019).

Donja Zeta River boasts a unique natural phenomenon: it is home to three distinct trout species. The Adriatic trout (*Salmo obtusirostris*) is the most notable among them. This species is exceptionally rare and is only found in the Adriatic basin. It has been classified as Endangered (EN) by the IUCN<sup>3</sup>. The Adriatic trout thrives in the deeper parts of the riverbed and eddies, often proving elusive to observers. Unlike other salmonid species, this trout species exhibits a schooling behaviour. Despite ongoing debates about its taxonomic status, the Adriatic trout deserves total protection and attention, especially considering that it represents one of the last five remaining populations. Aside from the Zeta and Morača rivers, these populations have also managed to survive in the Jadra, Vrljika, Neretva, and Krka.

Another endemic species of the Adriatic basin is the marble trout. This trout can grow to impressive weights of up to 24 kg, making it highly prized in sport fishing. Unfortunately, the marble trout population has significantly declined due to poaching in the Lake Skadar basin, which encompasses the Zeta, Morača, and Cijevna rivers. The introduction of non-native trout species (*Salmo trutta*) has exacerbated the problem by leading to hybridisation. Although the status of the marble trout is far from ideal, it is more commonly encountered than the critically endangered Adriatic trout, which is on the brink of extinction.

Zeta River and its numerous permanent and intermittent tributaries provide an ideal habitat for the European eel (*Anguilla anguilla*). During periods of heavy rainfall, the reduced water flow in these secondary water bodies (compared to the main Zeta River) allows us to spot eels earlier in Sušica, Gračanica, Rimanić, Vranjak, or Morave. Therefore, these secondary water bodies are equally important for the survival of the species. According to the IUCN, the eel is defined as a Critically Endangered species (CR). In contrast, just thirty years ago, both trout and eel were vital food resources for the local population.

<sup>3</sup> The IUCN Red List of Threatened Species is a global threat status representation of plant and animal species.

#### 4.1. Threat factors

Zeta River faces three major detrimental factors: wastewater pollution, poaching, and the presence of hydropower facilities. These pressures result in various challenges, including reducing the availability of clean drinking water, declining fish populations, and altering the river's water flow patterns due to fragmentation and human activity. Collectively, the factors have led to a decrease in the overall fish population, a deterioration in environmental quality, and adverse health impacts on the local population residing in the area.



Figure 1. Illegal fishing traps in Zeta River. July 2022 (source: Portal Volim Danilovgrad)





Figure 2. Discharge of untreated wastewater from the local pig farm and slaughterhouse in Spuz, 2021 (source: Portal Volim Danilovgrad)



Figure 3. Dead fish, a fish die-off in Bogičevići, Danilovgrad, September 2021.





Figure 4. Waste in the river bed of Gračanica, a tributary of Gornja Zeta



Figure 5. Part of the upper course of the Zeta River canalized for hydropower needs

Zeta River's fish fauna faces its most significant challenges from poaching and the introduction of pollutants through wastewater. Additionally, considerable environmental pressures stemming from utilising Gornja Zeta's water resources for electricity generation, the increasing frequency of droughts and sudden rainfalls, inadequate management of coastal vegetation, improper disposal of solid waste, and the emergence of invasive species have led to a substantial decline in fish populations within this river over the past two decades. This is to the extent that two of the once most abundant trout species, the Adriatic trout, and the marble trout, are now on the verge of extinction.



## 5. FISH SPECIES OF THE ZETA RIVER

As previously mentioned in Chapter 4, the Zeta River comprises two distinct sections, each characterised by a unique fish fauna composition. The upper course, defined by Rastovac, Vidrovan, and Gornjepoljski vir, pertains to the river's segment from its source to the Slivlje swallow hole. Meanwhile, the lower course refers to the river's stretch from its resurgence following the swallow hole from Glava Zete to where it meets the Morača River (as depicted on Maps 1 and 2).

By reviewing available literature and research conducted as part of this project, a total of 32 fish species have been documented in the Zeta River and its tributaries (see Table 1). These species constitute approximately 42% of the freshwater ichthyofauna in Montenegro. As a whole, Montenegro's freshwater ecosystems host 75 freshwater fish species (Pešić et al., 2019). Among these 75 species, 28 are native to the region, five are invasive, and 14 hold endemic status in Montenegro (as detailed in Table 1).

Salmonid species are known to prefer streams with swifter currents, lower water temperatures, and higher dissolved oxygen levels, while in the lower reaches of rivers, characterised by slower flows and somewhat higher water temperatures, cyprinid<sup>4</sup> species are typically found (Marić, 2018). Among the most significant species listed in Table 1 are *Salmo obtusirostris zetensis* and *Salmo marmoratus*. *S. obtusirostris zetensis* is an endemic species of the Zeta River, occasionally venturing into the Morača River and Lake Skadar (Ivanović, 1973). However, its population has significantly declined over the past two decades, with Mrdak et al. (2012) reporting its presence only in the vicinity of Glava Zete. According to the IUCN Red List, this species is classified as Endangered (IUCN 2022). The lower course of the Zeta River is one of the primary habitats for the marble trout (*S. marmoratus*) (Marić, 2019).

Table 1. Fish of the Zeta River

Species	Common name	Endemic species	IUCN status	Literature data	Research in 2021
<i>Acipenser sturio</i> Linnaeus, 1758	Atlanska jesetra, /ˈæt.læns.kə dʒəˈseɪ.trə/, the European sea sturgeon	/	CR	+	/
<i>Alburnoides ohridanus</i> (Karaman, S., 1928)	Ohridska ukljeva, /ˈɒh.rɪdskə ˈu:k.ljɛ.və/, the Ohrid spirlin	Yes	VU	+	/

<sup>4</sup> Fish of the carp family \*Jelić et al., 2021, Updating the conservation status of important fish species and raising awareness within the local community about the values of the unique karst field freshwater ecosystem CMZ in the vicinity of Nikšić, MES, and BIOTA. Podgorica, Zagreb.

<i>Alburnus scoranza</i> Heckel & Kner, 1857	ukljeva, /'ʊk.ljɛ.və/	Yes	LC	+	/
<i>Alosa falax</i> (Lacepède, 1803)	čepa, /'tʃɛ.pə/, the twait shad	/	/	+	/
<i>Anguilla anguilla</i> (Linnaeus, 1758)	jegulja, /'jɛ.gul.ja/, the European eel	No	CR	+	+
<i>Barbatula zetensis</i> (Soric, 2000)	Zetska brkica, /'zɛts.kə 'brkɪ.tsə/, Zeta stone loach	Yes	LC	+	+
<i>Barbus rebeli</i> Koller, 1926	mrena, /'mrɛ.na/, the western Balkan barbel	Yes	LC	+	/
<i>Carassius auratus</i> (Linnaeus, 1758)	zlatna ribica, /'zlat.na ri 'bi.tsə/, the Goldfish	Invasive	I	+	/
<i>Carassius gibelio</i> (Bloch, 1782)	babuška, /ba'buʃka/, Prussian carp	Invasive	/	/	+
<i>Chondrostoma ohridanum</i> (Linnaeus, 1758) (sinonim za <i>C. nasus</i> prema Ketmeier)	skobalj, /'sko.baʃ/, the European potamodromous cyprinid fish	Yes	VU	+	/
<i>Cyprinus carpio</i> Linnaeus, 1758	šaran, /'ʃa.ran/, the European carp	Invasive	VU	+	/
<i>Cobitis ohridana</i> Karaman, 1928	vijun, /'vi.jun/	Yes	LC	+	/



<i>Gambusia holbrooki</i> (Girard, 1859)	gambuzija, /gam'bu.zija/, eastern mosquitofish	Invasive	LC	+	+
<i>Gasterosteus gymnurus</i> (Cuvier, 1829)	bodonja, /bo'doɲa/, the three-spined stickleback	No	LC	+	+
<i>Gobio skadarensis</i> Karaman, 1937	Skadarska mrenica, /ska'darska 'mrɛ.ni.tsə/, the Skadar gudgeon	Yes	EN	+	+
<i>Lampetra soljani</i> Tutman, Freyhof, Dulčić, Glamuzina & Geiger, 2017	mala paklara, /'ma.la pa'kla.ra/	/	/	+	/
<i>Oncorhynchus mykiss</i> (Walbaum, 1792)	Kalifornijska pastrmka, /kæl.ə 'fɔr.ni.əs.kə 'pæs.trm.kə/, rainbow trout	Invasive	/	+	+
<i>Pachychilon pictum</i> (Heckel & Kner, 1858)	saradan, /sə'ræ.dən/, Albanian roach	Yes	LC	+	/
<i>Phoxinus apollonicus</i> Bianco & De Bonis, 2015	gaovica, /'ga.o.vi.tsa/	*	/	+	+
<i>Phoxinus karsticus</i> Binco and De Bonis, 2015	gaovica, /'ga.o.vi.tsa/	Yes	/	+	/
<i>Petromyzon marinus</i> Linnaeus, 1758	morska paklara, /'mɔr.ska pa 'kla.ra/, sea lamprey	No	LC	+	/

<i>Pomatoschistus montenegrensis</i> Miller & Šanda, 2008	glavočić crnotrus, /'gla.vo.tʃits 'tsr.no.trus/	*	LC	+	/
<i>Pomatoschistus canestrinii</i> (Ninni, 1883)	glavočić crnotrus, /'gla.vo.tʃits 'tsr.no.trus/	/	LC	+	/
<i>Pseudorasbora parva</i> (Schlegel, 1842)	bezribica, /,bez'ri.bi.tsa/, topmouth gudgeon	Invasive	LC	+	/
<i>Rhodeus amarus</i> (Bloch, 1782)	gavčica, /'gav.tʃi.tsa/, the European bitterling	No	LC	+	/
<i>Rutilus ohridanum</i> Karaman, 1924	brcak, /'brtsak/, Leucos basak	Yes	LC	+	/
<i>Salaria fluviatilis</i> (Asso, 1801)	babica, /'ba.bi.tsa/, the freshwater blenny	/	LC	+	/
<i>Salmo farioides</i> Karaman, 1938	potočna pastrmka, /po'toʃ.na 'pæs.trm.ka/, the west Balkan trout,	/	/	+	+
<i>Salmo obtusirostris</i> (Heckel, 1851)	mekousna pastrmka, /,meiku:snə 'pæstrm.kə/, the Adriatic trout	Yes	EN	+	/
<i>Salmo marmoratus</i> Cuvier, 1829	glavatica, /,glævə'tikə/, the marble trout	/	LC	+	/

<i>Squalius platyceps</i> Župančič, Marić, Naseka and Bogutskaya, 2010	klijen, /'kli.jen/	/	LC	+	+
<i>Telestes montenigrinus</i> (Vukovic, 1963)	mekiš, /'mɛ.kiʃ/	Yes	LC	+	+

Of the mentioned 32 species, only *Salmothymus obtustirostris zetensis* (the Adriatic trout) is legally protected in Montenegro. The European sea sturgeon (*Acipenser sturio*) used to be present in the Bojana River and Lake Skadar, but its presence has not been confirmed in recent years. Therefore, it is necessary to reassess or revise its presence in the Adriatic basin of Montenegro. DNA testing of the waters is required to determine whether it has disappeared. This sturgeon species is classified as Critically Endangered (CR) on the IUCN Red List at the global level.

*Salmothymus obtustirostris zetensis* and *Gobio skadarensis* are species categorised as Endangered (EN) on the IUCN Red List.

*Anguila anguilla* is classified as Critically Endangered (CR) on the IUCN Red List.

Regarding the European Habitats Directive<sup>5</sup>, the following species are listed in Annex II: *Petromyzon marinus*, *Lampetra zananđreaei*, *Salmo marmoratus*, and *Telestes montenigrinus*.

<sup>5</sup> Directive that consists of articles regulating human activities for the conservation of wild species and habitats of European significance.

## 1. *Rutilus ohridanus* - Dalmatian roach



Figure 6. Dalmatian roach (© Jörg Freyhof)

Genus *Rutilus* derives its name from the Latin word for 'red,' signifying the reddish coloration of the eyes and fins in this species.

**Distribution:** This species is endemic to Lake Prespa, Lake Ohrid, Lake Skadar, and their tributaries, including Zeta River. It has also been introduced into Mavrovo Lake (Drim River basin) and Vlasina Lake in the Danube basin.

**Biology:** Dalmatian roaches thrive in calmer waters, such as freshwater lakes and slow-moving, vegetated rivers. They typically form smaller flocks but gather in larger groups during winter. Individuals can reach lengths of up to 30 cm

**Characteristics:** They have a terminal mouth, short pointed snout, and convex dorsal and ventral fins. Notably, all fins exhibit red or orange coloration, particularly during the spawning period.

Studies have revealed morphological variations among populations from Lake Prespa, Lake Ohrid, and Lake Skadar. Some authors previously classified these populations as three subspecies. If accepted, these subspecies include

- *Rutilus ohridanus ohridanus* (Karaman, 1924) from Lake Ohrid
- *Rutilus ohridanus prespensis* (Karaman, 1924) from Lake Prespa
- *Rutilus ohridanus vukovici* Marić, 1989. from Lake Skadar basin

*Rutilus ohridanus vukovici* is found in the Zeta River. Future research will determine population levels in these lakes (Marić, 1995).

**Endangerment:** Dalmatian roach faces a threat due to habitat loss resulting from increasing pollution in the Zeta River and the entire Lake Skadar basin. It is currently classified as a Least-Concern species (LC) on the IUCN Red List of Threatened Species.

## 2. *Pachychilon pictum* - Albanian roach



Figure 7. Albanian roach (© Jörg Freyhof)

**Distribution:** Albanian roach is an endemic fish species found in the freshwater systems of Skadar and Ohrid Lakes. Its natural habitat includes slow-flowing rivers, streams, and shallow freshwater lakes. Available data suggests that approximately half of the total population of this species resides in Lake Skadar.

**Biology:** This species typically spawns on sandy beds or among aquatic vegetation when water temperatures exceed 12°C. Its diet consists of fish, invertebrates, insect larvae, and periphyton<sup>6</sup>. The Albanian roach can reach a maximum length of 18 cm and weigh up to about 70 grams.

**Characteristics:** Known for its social behaviour, Albanian roach prefers habitats near coastal lakes, slow streams, and backwaters of streams and rivers.

**Endangerment:** Primary threat to this species is habitat loss. Currently, it is classified as a species of Least Concern (LC) on the IUCN Red List of Threatened Species.

<sup>6</sup> A mixture of small plant and animal organisms that are adhered to larger organisms and objects immersed in water.



### 3. *Salmo marmoratus* - marble trout



Figure 8. Marble trout (© Jörg Freyhof)

**Distribution:** Marble trout is primarily found in the Adriatic basin, specifically in the Neretva, Soča, and Po river in Italy. It also inhabits both fast-flowing and deep, slower branches of the Zeta, Morača, and Cijevna rivers, ultimately ending up in Lake Skadar.

**Biology:** Marble trout thrives in various aquatic environments, including running or standing waters with sandy or gravelly bottoms. It is also known to inhabit the cold waters of alpine rivers and glacial lakes. Its diet primarily consists of other fish species. Spawning occurs in rivers, on gravel bottoms, typically from early December to late January.

**Characteristics:** Distinguishing features of the marble trout include a pronounced head relative to the body, a broader and more cylindrical body compared to river trout, shorter and rounded fins, a larger number of vertebrae, and extended neural spines but fewer upper and lower caudal fins. Notably, it is the largest species within the trout family.

**Endangerment:** Marble trout populations are facing a decline in the Morača, Zeta, and Cijevna rivers. Although this species was relatively common in Lake Skadar during the 1970s and 1980s, there is a lack of recent data on its presence. The marble trout is listed in Annex II of the EU Habitats Directive and is classified as a Least-Concern species (LC) on the global IUCN Red List.

It's important to note that marble trout populations are under threat due to hybridization with other strains of river trout (*S. trutta*), resulting in fertile hybrids that now dominate most rivers where marble trout once thrived.

#### 4. *Salmo farioides* - River trout

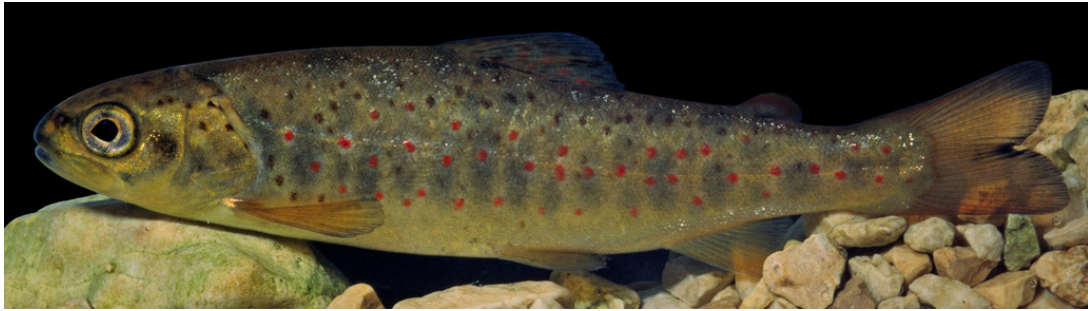


Figure 9. River trout (© Jörg Freyhof)

**Distribution:** Known as the West Balkan trout, Adriatic brown trout, or Balkan brook trout, this species of fish is native to the Balkan region, including Albania, Croatia, North Macedonia, and Montenegro.

**Biology:** It thrives in freshwater environments characterized by fast-flowing, clear, and cold water, often found in rapids and small waterfalls. This trout prefers river and stream habitats with ample oxygen and maintains a preference for water temperatures below 25°C throughout the year. Its primary diet consists of invertebrates that inhabit the riverbed.

**Characteristics:** The west Balkan trout is recognized by its distinctive large red spots, sometimes encircled by a whitish border. Faint vertical lines may also be visible along its flank. Mature individuals, including both males and females, typically reach an average length of about 30 cm. Measurements taken from the Morača River population in Montenegro indicate an average length of 36 cm and an approximate weight of 458 grams for this species.

**Endangerment:** This species faces significant threats, including climate change, rising water temperatures, pollution, the construction of hydroelectric power plants, and overfishing. Consequently, overfishing has led to a substantial decline in the populations of this species in Montenegro

#### 5. *Salmothymus obtusirostris* spp. *zetensis* - Adriatic trout



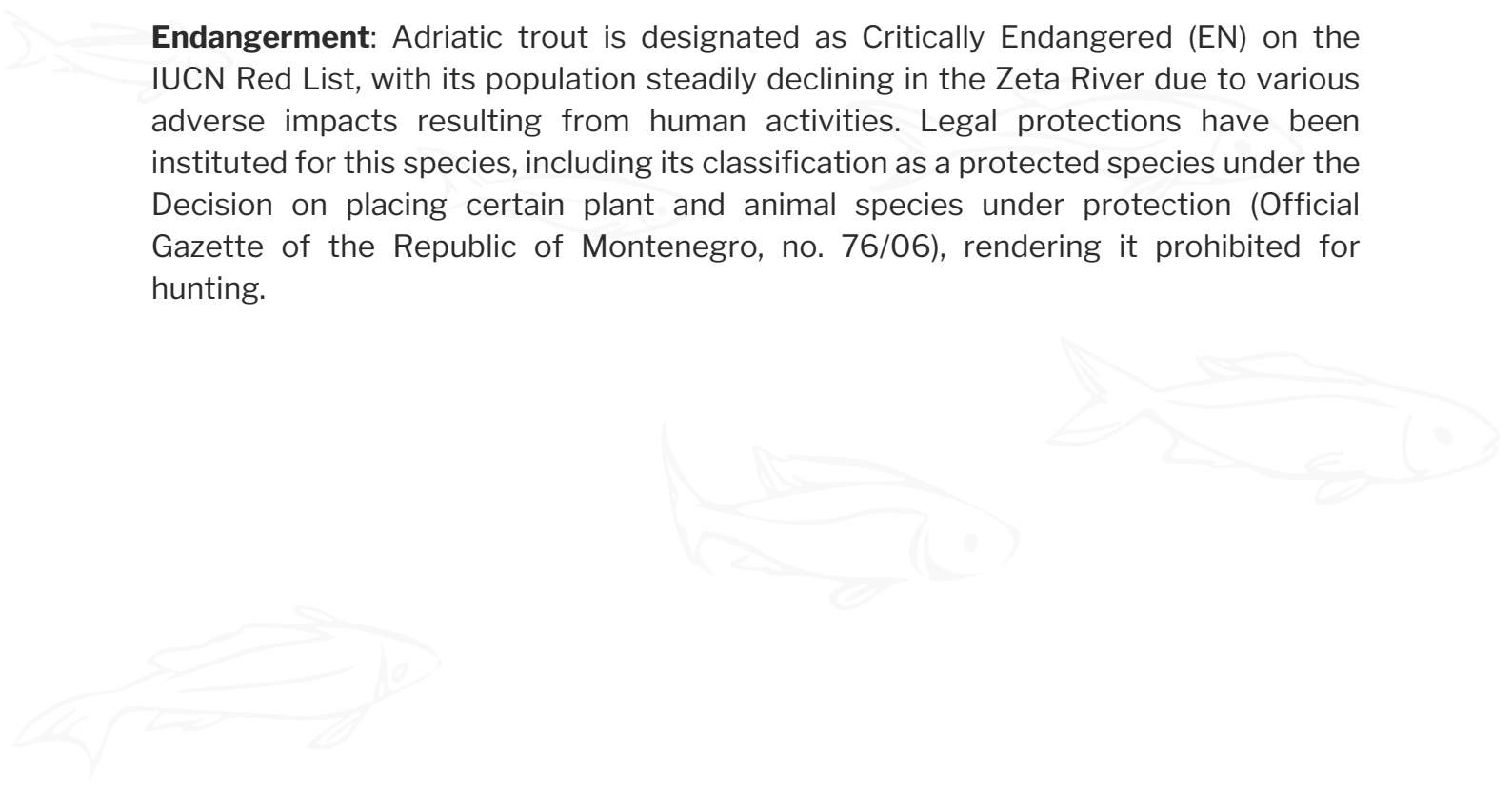
Figure 10. Adriatic trout (© Aleš Snoj)

**Distribution:** Adriatic trout, a member of the Salmonidae family, is an endemic species found within the Adriatic basin on the Balkan Peninsula. Its natural range is confined to several Adriatic rivers in Croatia, Bosnia and Herzegovina, and Montenegro. Notably, five natural populations of this subspecies exist in the Neretva, Vrljica, Jadra, Krka, and Zeta rivers (Ćaleta et al., 2015). The upper course of the Zeta River, particularly the Tunjevo and Slap areas, holds significant importance as a spawning ground for the Adriatic trout.

**Biology:** This species thrives in pristine, cold, karst waters that are rich in oxygen, often residing in their deeper and more tranquil sections. Throughout the day, it tends to seek refuge among aquatic vegetation and shaded areas, becoming more active at night in search of food. Unfortunately, the population of this species is extremely limited, found only in a few locations, and is currently in decline. Spawning typically occurs at temperatures above 10°C and extends from February to March, sometimes even as late as May.

**Characteristics:** Adriatic trout exhibits physical similarities to both grayling and river trout. Its scientific genus name, *Salmothimus obtusirostris*, originates from *obtusus* meaning *blunt*, and *rostris* referring to *snout*. Among the trout species in the Adriatic basin, it ranks as one of the largest and can reach lengths exceeding 70 cm, although such specimens are rare. Its physique is elongated, featuring a short head and a relatively small mouth with semi-lower to lower positioning and notably fleshy lips. Teeth are often small and may even be absent. The body is covered with relatively small scales, ranging from 100 to 120 along the lateral line. Coloration varies among populations, spanning from gray to gold, with a typically white underside. Dark spots are commonly found on the gill cover, and numerous spots can appear on the front portion of the body's sides. Additionally, red-orange spots may extend along the flank, reaching as far as the caudal fin shaft.

**Endangerment:** Adriatic trout is designated as Critically Endangered (EN) on the IUCN Red List, with its population steadily declining in the Zeta River due to various adverse impacts resulting from human activities. Legal protections have been instituted for this species, including its classification as a protected species under the Decision on placing certain plant and animal species under protection (Official Gazette of the Republic of Montenegro, no. 76/06), rendering it prohibited for hunting.



## 6. *Acipenser sturio* - European sea sturgeon (regionally extinct)



Figure 11. European sea sturgeon (© Jörg Freyhof)

**Distribution:** This particular fish species, originating from the Adriatic Sea, enters Lake Skadar through the Bojana River for the purpose of spawning. Historically, it was abundant in Lake Skadar and played a significant role in the local fishing industry. Regrettably, the population of this fish has seen a drastic reduction within the rivers of the Adriatic basin. Over the last 10 to 20 years, there have been no recorded catches of this fish in Lake Skadar, and it is now considered extinct in this region.

**Biology:** The fish follows a migratory pattern, spending most of its life in the sea and only a brief period in rivers. Prior to spawning, it migrates to rivers for rest, typically selecting the river mouth as its spawning location. Similar to other sturgeon species, its diet consists primarily of shellfish and crustaceans.

**Characteristics:** Distinguished by its wedge-shaped head that tapers to a prolonged point, the sturgeon possesses a mouth area adorned with several sensitive-cell-rich whiskers. Its dorsal fins are notably distant from its body. Along the body of this fish, five longitudinal lines of large bony plates can be observed. The underside displays a yellow hue, while the back exhibits a brownish-gray coloration. While sturgeons have the potential to reach lengths of up to 6 meters and weigh as much as 400 kilograms, more typical specimens measure around 1.25 meters in length. They boast impressive longevity, with potential lifespans of up to 100 years, reaching maturity relatively late at 12 to 14 years for males and 16 to 18 years for females.



**Endangerment:** Sturgeons (Teleostei; Acipenseridae) are among the most critically endangered fish species, facing threats from water pollution, habitat degradation, and overfishing. The Atlantic sturgeon (*Acipenser sturio*), for example, has virtually vanished from the Danube River basin. Additionally, the construction of dams poses a newer and significant threat to sturgeons, with approximately 50% of all dams in the Eurasian region being constructed between 1960 and 1980 (Williot et al. 2002). These dams obstruct free access to many sturgeon spawning grounds, serving as a primary factor contributing to the decline in their populations (Lenhardt et al. 2004).

The European sea sturgeon is classified as Critically Endangered (CR) on the global IUCN Red List and is listed in Annex II of the EU Habitats Directive and Annex II of the Berne Convention<sup>7</sup>.

## 7. *Squalius platyceps*



Figure 12. *Squalius platyceps* (© Jörg Freyhof)

The name of the genus *Squalius* originates from the Latin words *squaleo* and *squalidus*, which mean rough-skinned.

**Distribution:** This species is primarily found in watercourses that flow into the Ligurian and Tyrrhenian seas in Italy, as well as rivers within the Adriatic basin in Italy, Switzerland, Slovenia, Croatia, Bosnia and Herzegovina, and Montenegro, extending up to Lake Skadar. It is notably common in the Zeta River and the lower course of the Morača River.

<sup>7</sup> Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979)



**Biology:** *Squalius platyceps* inhabits karst water bodies characterised by fast-flowing streams and lakes with crystal-clear waters and temperatures ranging from 5-25°C. However, it can also be encountered in calmer, ponded areas of lowland rivers. This species is frequently found in smaller rivers and shallow sections of swiftly flowing streams, even surviving dry periods by restricting themselves to very shallow habitats. Juvenile individuals often form groups in shallow coastal habitats, while adults tend to be more solitary, spending the majority of their time independently. Spawning for *Squalius platyceps* typically occurs in shallow sections of fast-flowing streams or along the banks of slower lowland rivers, as well as in smaller mountain streams. This breeding period takes place from April to July when the water temperature surpasses 14°C. During this time, individuals gather in groups to increase the success of spawning. Sexually mature individuals often spawn multiple times during the season, with one female spawning with several different males.

**Characteristics:** As with other *Squalius* species, *Squalius platyceps* is covered in prominent large scales. Its body is spindle-shaped with a slight lateral flattening and features a lateral stripe. The head is narrow, with a relatively small and fleshy mouth, which can be terminal or semi-lower, and pharyngeal teeth arranged in two rows. Dorsal area tends to be darker, while the flank exhibits a metallic silver hue, and the underside ranges from silver to white. These fish can attain lengths of up to 60 cm, although the average size typically reaches around 35 cm.

**Endangerment:** *Squalius platyceps* is classified as the Least-Concern species on the IUCN Red List, indicating that it is not currently facing significant threats to its survival.



## 8. *Telestes montenigrinus*



Figure 13. *Telestes montenigrinus* (© Jörg Freyhof)

**Distribution:** This species inhabits the upper and middle reaches of Morača, Zeta and Cijevna rivers, where it is quite commonly found.

**Biology:** Inhabits a wide range of habitats from small mountain streams to lake shores. It breeds from March to May when the watercourses swell and the water temperature becomes favorable for fertilized eggs. It spawns in calmer, open waters, gathering in small groups and lays eggs on rocky surfaces. *Telestes montenigrinus* feeds on plankton and benthic fauna.

**Characteristics:** all species of this genus are characterised by a terminal or lower terminal mouth and a pronounced dark stripe along the flank, from the eye to the tip of the tail. The dark stripe along the flank is more pronounced in adults than in young fish and is especially visible during spawning. The body is elegantly elongated and slightly laterally flattened. The head is relatively small. The entire body, except for the head, is covered with overlapping scales. The fins are yellowish to slightly orange at the base. The dorsal fins begin a little after the middle of the body, in line with or a little behind the beginning of the ventral fins. The dorsal part of the body is olive to dark brown, while the flank below the stripe and the underside is grey-white. It can grow up to 16 cm.

**Endangerment:** It is recognised as a Least-Concern (LC) species on the IUCN Red List; *Telestes montenigrinus* is listed in Annex II of the Habitats Directive of the European Union.

## 9. *Cobitis ohridana*



Figure 14. *Cobitis ohridana* (© Jörg Freyhof)

The name of the genus comes from the Greek word *kobitis* meaning "a small fish".

**Distribution:** This species is found in waters spanning from the Drina to Aos rivers, encompassing regions in Albania, Macedonia, Serbia, and Greece. It is also present in Lake Ohrid and Lake Skadar. In Montenegro, it primarily inhabits the lower sections of the Zeta and Morača rivers.

**Biology:** *Cobitis ohridana* can be located in both rivers and lakes, adapting to substrates ranging from fine sand to mud with aquatic algae. This fish tends to be solitary and secretive, often concealing itself during the day with only its eyes and mouth visible. Its active foraging occurs at night, guided by its whiskers and acute sense of smell. Due to limited mobility, it maintains a relatively small living area. Typically, its lifespan does not exceed five years. Spawning takes place in spring and summer within dense aquatic vegetation or on rocks. An intriguing spawning behaviour involves the male wrapping its snake-like body around the female, ensuring secure reproduction. *Cobitis ohridana* primarily feeds on smaller bottom-dwelling organisms, including shrimp, insect larvae, and small molluscs.

**Characteristics:** These unusual, lesser-known fish species exhibit an elongated, snake-like body with lateral flattening and small scales. Their small mouth, located on the underside of the head, is inconspicuous at first glance and is accompanied by three pairs of short, fleshy whiskers. *Cobitis ohridana* displays a distinctive coloration, featuring a pale yellow body adorned with brown-black spots on the flank and back. While capable of reaching a maximum size of 7 cm, individuals are typically smaller, contributing to the scarcity of data available.

**Endangerment:** *Cobitis ohridana* is relatively common in the Zeta River and the lower reaches of the Morača River. It holds the status of a Least-Concern species (LC) on the IUCN Red List.

## 10. *Pomatoschistus montenegrensis* (sin. *Ninnigobius montenigrensis*)



Figure 15. *Pomatoschistus montenegrensis* (© Jörg Freyhof)

The genus name *Pomatoschistus* is derived from the Greek words *poma* and *athos*, which refer to a cover, specifically the gill cover, and the word *schistos*, signifying *split*.

**Distribution:** *Pomatoschistus* species are predominantly found in the lower sections of watercourses within the Adriatic basin. They inhabit regions such as the Morača River and its tributary, Zeta, as well as Lake Skadar. In Lake Skadar, these species have been observed in a sizeable natural channel connecting Lake Malo Blato with the primary body of Lake Skadar.

**Biology:** This fish is typically found in freshwater environments, particularly in slow-moving shallows or pools formed after river floods. It exhibits a preference for substrates consisting of fine sand and muddy bottoms, often with limited vegetation or with algae and other macrophytes. *Pomatoschistus montenegrensis* primarily feeds on small invertebrates residing on the river or lake bottom, including crustaceans and certain types of worms. During the night, it actively scours the river or lake bottom in search of prey.

**Characteristics:** *Pomatoschistus montenegrensis* is characterized by its elongated, spindle-shaped body, blunt head, and rounded tail fin. This is a relatively small fish, with males reaching sizes of up to 2.8 cm and females growing to about 2.3 cm. They exhibit an ashen coloration, featuring numerous small yet distinct black spots. These spots are particularly conspicuous on the head and body, with a more pronounced presence on the heads of males.

**Endangerment:** On the IUCN Red List, it is recognized as a species of Least Concern (LC).



## 11. *Cyprinus carpio* - European carp



Figure 16. The European carp (© Jörg Freyhof)

**Distribution:** Eurasian or European carp, formerly known as common carp, is a widespread freshwater fish of eutrophic waters in lakes and large rivers in Europe and Asia.

**Biology:** Carp are highly adaptable and can tolerate a wide range of environmental conditions. They exhibit a preference for large bodies of slow-moving or stagnant water, particularly those with soft sediments of plant origin. These fish tend to be gregarious and often form groups of five or more individuals. Eurasian carp are naturally found in temperate climates, residing in fresh to slightly brackish water. They thrive in water temperatures ranging from 23 to 30°C. The European carp engage in spawning activities on the bottom, typically in areas with overgrown macrophytic vegetation or freshly flooded grassy zones. During winter, they retreat to deeper layers of water and congregate in groups. The European usually spawns in the spring but can have multiple spawning events within a season, triggered by rising water temperatures and increased rainfall. They are well adapted to surviving in frozen waters during winter, as long as there is some free water beneath the ice. Carp are highly tolerant of low oxygen levels and can even gulp air from the water's surface. Their omnivorous diet includes aquatic plants, insects, crustaceans (such as zooplankton), worms, and occasionally small fish. Carp are known for their feeding activity, which is most intense during the night and around sunrise.

**Characteristics:** European carp is characterised by a robust body with a prominent dark golden sheen, especially on the head. Its body is adorned with large, shiny scales. It possesses sizeable pectoral fins and a dorsal fin that tapers down the last two-thirds of its body, gradually increasing in size toward the head. The caudal and anal fins can vary in colour, appearing as dark bronze or pale orange. European carp has a downward-turned mouth and is equipped with two pairs of whiskers, with the lower pair being larger. Wild carp are generally slimmer than their farmed counterparts, featuring a body length approximately four times their body height.



It typically has red flesh and a forward-protruding mouth. When provided with sufficient space and food, the European carp can attain substantial sizes, with an average length in natural conditions ranging from 25 to 75 cm and a maximum length of up to 100 cm. They can weigh up to 30 kg. Carp is used as food in many areas but is also considered a pest in several regions due to its ability to outcompete native fish species.

**Endangerment:** It is recognised as a Vulnerable Species (VU) on the global IUCN Red List.

## 12. *Chondrostoma ohridanum* - Common nase



Figure 17. Common nase (© Jörg Freyhof)

**Distribution:** Common nase is an endemic fish species of the Ohrid-Lake Skadar system, but half of the entire population lives in Lake Skadar. Unfortunately, this fish population has drastically decreased in the entire Lake Skadar system in the last 20 years. In the Zeta River, these fish populations have also decreased significantly, unlike in the 1980s when they were a fairly common catch.

**Biology:** They inhabit moderate to fast and large to medium rivers with rocky or gravel bottoms. Adults are often found in fairly shallow, fast-flowing waters, often adjacent to eddies created by piled rocks. Juvenile common nase tend to dwell on the riverbed in shallow coastal environments and seek refuge in backwaters or depressions during the winter months. As they mature, they transition from the shoreline to swifter flowing waters. During winter, adult common nase aggregate in dense groups in the lower regions of rivers. Larvae and juveniles primarily feed on small invertebrates, while adults have a diet consisting of detritus, decomposing organic matter, and silicate algae that inhabit the riverbed. This species exhibits social behaviour.

**Characteristics:** Common nase can reach a maximum length of 50 cm, with a typical length of around 25 cm. The maximum recorded weight is 1.5 kg, and they can live up to 15 years.

**Endangerment:** It is recognized as a Vulnerable Species (VU) on the global IUCN Red List.

### 13. *Alburnus scoranza*



Figure 18. *Alburnus scoranza* (© Jörg Freyhof)

**Distribution:** *Alburnus scoranza* is a species of cyprinid fish found exclusively in the basins of Skadar and Ohrid Lakes. In Montenegro, the Skadar Lake population of this species holds significant economic importance in freshwater fishing.

**Biology:** These fish exhibit social behaviour and form large schools, congregating at specific locations known as "oka" in Lake Skadar during the winter. These locations are characterised by underground springs that provide the lake with fresh, clean water at a consistent temperature throughout the year. *Alburnus scoranza* spawns on the shores of the lake or migrates to tributaries to spawn in shallow rivers. Their eggs are laid on sandy, gravelly, and rocky substrates at a depth of approximately 0.3 meters. Their primary diet consists of smaller crayfish and other arthropods, and they serve as a vital food source for predatory fish. *Alburnus scoranza* is more sensitive to pollution compared to other cyprinids, which may explain the decline in its populations in northwestern Europe.

**Characteristics:** This small fish is often likened to a freshwater sardine. It has an elongated, straight body with a pointed head and a relatively small, upward-facing mouth. The body is characterised by its shiny silvery colour, and its fins are pointed and colourless. They can reach a maximum length of 17.9 cm, with a maximum recorded weight of 47.40 g and a maximum recorded age of 5 years.

**Endangerment:** *Alburnus scoranza* is listed on the IUCN Red List as a species of Least-Concern (LC).

## 14. *Anguilla anguilla* - European Eel



Figure 19. European eel (© Jörg Freyhof)

**Distribution:** European eel is a widely distributed species found in most European watercourses that flow into the Atlantic Ocean, the North Sea, the Baltic Sea, and the Mediterranean Sea. It migrates to spawn in the Sargasso Sea in the western Atlantic. In Montenegro, this species inhabits watercourses in the Adriatic and Black Sea basins. It is considered a native species in the Adriatic basin and a non-native species in the Black Sea basin.

**Biology:** European eel has a diverse diet, consuming marine, estuarine, and freshwater fauna. Adult eels primarily feed on invertebrates, with a preference for mollusks and crustaceans, as well as smaller fish. Young eels, known as small eels or glass eels, feed on insect larvae, mollusks, worms, and crustaceans. During the cold months, European eels do not feed (Reshetnikov, 2003). They exhibit a catadromous life cycle, spending their adult lives in freshwater or estuarine habitats and undertaking long migrations to the ocean, specifically the Sargasso Sea, for spawning. After spawning, adult eels die.

Larval stage of eels, known as *leptocephalus*, is characterised by a leaf-shaped body and is well-suited for long-distance migration. These larvae drift in plankton for an average of 7-11 months, with some individuals having a larval phase lasting up to three years. Prior to reaching coastal waters, *leptocephalus* undergoes metamorphosis, becoming the "glass eel" stage, which involves body shortening and adopting a more cylindrical shape. At this stage, glass eels do not resemble adult eels, leading scientists to consider them a different species for a long time.

Glass eels acquire pigmentation, transform into adults, and migrate to freshwater habitats, where they are referred to as "yellow eels." The yellow coloration is believed to act as a form of protection against predators. The mucus coating on eels is thought to protect them from changes in water salinity.

**Characteristics:** European eels have an elongated, snake-like, cylindrical body with small, slit-shaped gill openings. Their bodies are covered in very small scales. Pectoral fins are located behind the elongated head, and there is a single fin formed by the merging of the dorsal and caudal fins with the tail fin. European eels are coated in a thick layer of mucus, which enables them to crawl across wet grass from one water body to another. Their lower jaw is slightly longer than the upper jaw. While exceptionally large individuals can reach lengths of up to 1.5 meters, they are typically much smaller, around 60–80 cm, and rarely exceed 1 meter in length. European eels are consumed as food in various regions around the world. Their blood contains toxins, but these toxins are broken down during cooking (Coad, 2005).

**Endangerment:** European eel is a Critically Endangered species (CR) according to the IUCN Red List. Since the 1970s, the number of eels migrating to Europe has declined by around 90% (possibly as much as 98%). Potential causes include overfishing, parasites such as *Anguillicola crassus*, river barriers such as hydroelectric dams, and natural changes in the North Atlantic Oscillation i.e. the Gulf Stream and the North Atlantic Drift. Recent research suggests that PCB (a type of toxic chemical) pollution may be a major factor in the decline.

#### 15. *Gasterosteus gymnnurus* (sin. *G. aculeatus*) - Three-spined stickleback



Figure 20. Three-spined stickleback (© Jörg Freyhof)

**Distribution:** Three-spined stickleback is a widely distributed species found in both arctic and temperate regions. Its range extends southward to regions including the Black Sea, southern Italy, the Iberian Peninsula, North Africa, East Asia north of Japan, North America, and even Greenland. This adaptable fish can inhabit a wide range of aquatic environments, from marine coastal areas to rivers and lakes of various types. During the winter, three-spined sticklebacks typically reside in deeper water. Adult individuals are commonly found in freshwater environments, estuaries, and coastal seas. In freshwater habitats, they can be found in various settings, including small streams, lakes, and large rivers.



**Characteristics:** Three-spined stickleback is characterised by the presence of pelvic fins in the form of spines. Its body is relatively tall and laterally flattened. Unlike most fish, its body is not covered in scales; instead, it is protected by a varying number of bony plates. A distinctive ridge forms at the base of the tail. The mouth of this species can be extended forward in a trumpet-like shape, and it possesses teeth on its jaws and pharyngeal bones. The coloration of the three-spined stickleback varies throughout different seasons and is especially pronounced during the spawning season. Males develop a bright red throat and a green body during spawning, with their eyes taking on a red-grey hue. Females develop dark ribbed spots on their backs. The maximum recorded length for this species is 11.0 cm, with the typical length averaging around 5.1 cm. The highest recorded age for this species is 8 years.

**Biology:** Juvenile three-spined sticklebacks undertake migrations to the sea (in the case of anadromous populations) or to larger bodies of freshwater (in the case of freshwater populations) in the months of July and August, forming large schools during this period. During the spawning season, male sticklebacks display vibrant coloration, with their undersides turning bright orange to red, while their flanks and eyes become blue-green. Eggs hatch in approximately 7-8 days. Anadromous forms of this species typically experience exhaustion and mortality after completing their spawning cycle. In contrast, freshwater individuals have the ability to complete several reproductive cycles within a year or over multiple years. Their diet consists of a variety of prey, including worms, crustaceans, aquatic insect larvae, adult aquatic insects, small fish, and they have even been observed feeding on their own fry and eggs.

**Endangerment:** It is recognised as a Least-Concern (LC) on the global IUCN Red List.





## 16. *Lampetra soljani*



Figure 21. *Lampetra soljani* (© Jörg Freyhof)

Although until recently this species of freshwater lamprey in the Lake Skadar basin has been considered to be *Lampetra zanandreae*, Tutman et al., 2017, describe *Lampetra soljani* as a new species. This species is also present in the Zeta River. *Lampetra zanandreae* and *L. soljani* differ by genetic divergence of 2.5%. *Lampetra soljani* is further distinguished from *L. zanandreae* by the lack of posterior teeth within the oral disc (lampreys do not have jaws like fish do). *Lampetra zanandreae* has a single row of posteriors with up to 20 teeth, but there are also individuals without posterior teeth (Hubbs and Potter 1971).

**Distribution:** Inhabits Europe: It can be found only in the Neretva basin in Croatia and Bosnia and Herzegovina. In Montenegro, it was recorded in the Morača River basin, including the Zeta River.

**Biology:** In terms of characteristics, lampreys are not classified as fish but represent a separate evolutionary line of organisms characterised by the lack of a solid jaw. But historically, they were always considered together with fish in literature reviews. Larvae are found in silt or fine sand-silt sediments in slow-flowing or no-current river sections, in shallows on banks or backwaters at a water depth of about 10–50 cm. Adults and *ammocoetes* are usually caught together. It is not a migratory species; however, passive transport and brief upstream and downstream migrations may take place. Adults do not feed, while their larvae (*ammocoetes*) filter food from the bottom. The diet of this species has not been studied to a large extent.

**Characteristics:** This freshwater species of lamprey has a snake-like, silvery body. At the time of spawning, it changes colour, turning darker. Its head has 4 more distinctly coloured regions, important for its recognition. The growth of *Lampetra soljani* is conditioned by the habitat. Individuals reach a greater length in streams with a relatively large annual variation in water temperature and abundance of food. *Ammocoetes* (larvae) grow faster on a muddy bottom than on a sandy one. Also, individuals over 12 cm have been recorded.

**Endangerment:** Status of this species on the global IUCN Red List has not yet been assessed.

## 17. *Petromyzon marinus* - sea lamprey



Figure 22. Sea lamprey (© Jörg Freyhof)

Sea lamprey is a parasitic species that inhabits the northern hemisphere. It is sometimes referred to as "vampire fish."

**Distribution:** Sea lamprey is found in various coastal regions, including the coasts of North America from Labrador to the Gulf of Mexico. In addition to North America, it inhabits the northeastern coast of the Atlantic Ocean, ranging from areas such as Norway, Iceland, and the Barents Sea, down to North Africa and the Mediterranean Sea. It is noteworthy that at the beginning of the 21<sup>st</sup> century, the sea lamprey was recorded in the Zeta River for the first time.

**Biology:** Sea lampreys are anadromous, meaning they undertake migrations between freshwater and saltwater environments. They migrate to rivers from their lake or sea habitats for the purpose of spawning. During this process, females lay numerous eggs in nests constructed by males on the substrate of the stream. Spawning is followed by the death of adult lampreys. The larvae of sea lampreys burrow into the sandy and muddy substrate in calmer waters downstream from the spawning area. Here, they feed by filtering plankton and detritus from the water.

After spending a few years in freshwater habitats, the lamprey larvae undergo metamorphosis, allowing the juveniles to migrate to seas or lakes, where they begin their hematophagous (blood-feeding) diet, characteristic of adult lampreys. They parasitize other fish by using their suction cup-like mouth to attach themselves to the host's skin, and they remove tissue with a sharp tongue and keratinised teeth. To facilitate their feeding, sea lampreys produce a blood anticoagulant known as *lamphredin*. Typically, the victims of these lampreys die from excessive blood loss or infection. After a year of hematophagous feeding, the lampreys return to the river to spawn and subsequently die, completing their life cycle approximately a year and a half after the end of metamorphosis.

**Characteristics:** Sea lamprey has a snake-like body resembling an eel without paired fins. Its mouth is jawless, round, and sucker-like. It is as wide or wider than her head; sharp teeth are arranged in many consecutive circular rows. There are seven gill openings behind the eye.

Sea lamprey's back and flank are olive or brown-yellow, with a few black marble spots and a brighter coloured underside. Adults can reach a length of over 10 cm and a body weight of up to 2.3 kg.

**Endangerment:** This species is listed as Least-Concern (LC) on the global IUCN Red List.

### 18. *Phoxinus apollonicus*



Figure 23. *Phoxinus apollonicus* (© Jörg Freyhof)

**Distribution:** *Phoxinus apollonicus* inhabits Morača and its tributary Zeta River (Lake Skadar basin). *P. apollonicus* is considered a possible endemic species of the Albanian ichthyogeographic region (Bianco and Filippo, 2015).

**Biology:** Ecology of the species is mostly unknown and, as a rule, very similar to the species *P. lumaireul*. It inhabits the upper parts of rivers and their tributaries from the headstream to the barbel zone. It also enters groundwater, where it can survive dry periods. During mating, males take on a more intense color with a predominance of red, green, and black tones. Very small pearly organs (spawning lumps) then also appear on their heads.

**Characteristics:** This species is unequivocally different from all other species of the Cyprinidae family by the reduced number of teeth on the pharyngeal bones. The species usually has four teeth in the outer row, but also 3 or 2 and 1 or 0 in the inner row. The underside and the lower part of the head are shiny-silver in collar, while the fins have a golden-yellow hue. The dorsal part is dotted with a large number of dark spots neatly arranged in a row. The lateral line extends along nearly the entire body length. These fish are typically small, averaging about 4.5 cm in size.

**Endangerment:** Status of this species on the global IUCN Red List has not yet been assessed.



## 19. *Gobio skadarensis* - Skadar gudgeon



Figure 24. Skadar gudgeon (© Jörg Freyhof)

**Distribution:** Skadar gudgeon inhabits only the basin of Lake Skadar in Montenegro and Albania, Europe. It can be found in Lake Skadar and the lower parts of its tributaries in Montenegro. It was also recorded in the lower course of the Zeta River. The important spawning habitat of this species is Vranjske Njive.

**Biology:** Lives exclusively in fresh waters. Generally, it inhabits fast-flowing clear and cold rivers, with a sandy or gravelly bottom, preferably with underwater plants. But, it can also inhabit still waters. As a benthic species, the Skadar gudgeon feeds at the bottom of rivers and still waters. It feeds on insect larvae, molluscs, and crustaceans.

**Characteristics:** Based on its relatives in the Adriatic and Aegean basins, it can be determined by the following characteristics: the absence of scales between the pectoral fins and scales that do not extend over the pectoral region. The Skadar gudgeon can reach a size of about 9 cm.

**Endangerment:** This species is listed as Endangered (EN) on the IUCN Red List.

## 20. *Barbatula zetensis* - Zeta stone loach



Figure 25. The Zeta stone loach (© Jörg Freyhof)

**Distribution:** This is an endemic species that inhabits the Lake Skadar basin and Morača basin (including the Zeta River) in Montenegro. It shares the habitat with *Cobitis ohridana*.

**Biology:** This freshwater fish inhabits streams and rivers with rocky and gravel bottoms. It prefers mossy stones. All species from this family prefer lowland streams.

**Characteristics:** Maximum recorded length of this species is 6.6 cm, and they can live for a maximum of 2 years.

**Endangerment:** Zeta stone loach is an indicator of a preserved ecosystem. This species is very sensitive to habitat changes, promptly leaving degraded habitat under pressure.

It is listed as Least-Concern (LC) on the global IUCN Red List.





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## GLOSSARY

### ***European Habitats Directive***

*Annex II* - animal and plant species of community interest whose conservation requires the designation of special areas of conservation

*Annex IV* - animal and plant species of community interest in need of strict protection

### ***Bern Convention***

*Appendix II* - strictly protected fauna species

*Appendix III* - protected fauna species

### ***IUCN Red List***

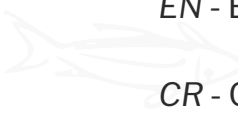
LC - Least Concern

NT - Near threatened

VU - Vulnerable

EN - Endangered

CR - Critically Endangered







MONTENEGRIN ECOLOGISTS  
**SOCIETY**

