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Article

Towards the Creation of Coastal Marine Protected Areas in the Russian Part of the Caspian Sea: Fish Species in Need of Special Conservation Status


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Abstract

The Special Protected Natural Areas currently existing within the Russian waters of the Caspian Sea are not able to adequately protect the aquatic flora and fauna (especially endemic, rare and endangered species) from the increasing anthropogenic impacts (poaching, river flow regulation, pollution, habitat degradation, mining, etc.). In this context, the creation of additional conservation measures becomes particularly relevant, one of which could be the development of Ecologically and Biologically Significant Marine Protected Areas (EBSMPAs) in the Russian part of the Caspian Sea with a complete ban on economic activity except for scientific research. To this end, the first step was to attempt to compile a list of fish species living in the area under consideration that require additional protection measures. The analysis is based on information on endemism, range size, current population levels, anthropogenic threats and existing conservation measures. The proposed list includes 1 species of cyclostomes and 13 species of bony fishes, which are currently experiencing the most significant anthropogenic impacts.

Key words Red Data Book, endemic, rare species, threatened species, range, conservation status, Ecologically and Biologically Significant Marine Protected Areas (EBSMPAs), Russian Federation, Caspian Sea.

Introduction

The Caspian Sea is the largest salt reservoir of a closed type, not connected to the world ocean (Kosarev, 2005). Throughout the history of its formation, the Caspian Sea has undergone significant changes, in

particular fluctuations in water level and salinity in the Tertiary and Late Tertiary, which contributed to the penetration here of freshwater fauna, which later adapted to the subsequent changes. During these transgressions, representatives of the fauna of the Arctic Ocean and the Mediterranean Sea entered the Caspian Sea along with the salty waters, which, after adapting to the changed conditions, formed new taxa (Zenkevich, 1963; Makhrov et al., 2021). Thus, in terms of origin, the ichthyofauna of the Caspian Sea is represented by several species complexes: (1) autochthonous fishes (members of families Gobiidae and Clupeidae), (2) freshwater fishes, (3) Mediterranean fishes, and (4) Arctic fishes (Zenkevich, 1963; Yablonskaya, 2007).

The Caspian Sea (Figure 1) consists of three parts and on the basis of their physical and geographical parameters can be divided into the northern (relatively shallow and slightly saline), the central (middle) and the southern deep-water ones with a salinity above 13 psu (Leroy et al., 2020). In terms of the number of species, the Caspian ichthyofauna is significantly inferior to other southern seas of the Northern Hemisphere, but is characterised by a large number of endemic species due to the long existence of the Caspian Sea in isolation (Zenkevich, 1963; Kazanchev, 1981; Leroy et al., 2020).

Some representatives of the Caspian ichthyofauna are valuable commercial species (in particular some herring Clupeidae and sturgeon Acipenseridae), which significantly affects the state of their populations. Illegal, unreported and unregulated (IUU) fishing, construction of hydroelectric power plants (HPPs) on the migration routes of anadromous species, pollution, mining and other factors lead to the need to protect and conserve endemic, rare, endangered, and commercially valuable species (Matishov, 2010; Rabazanov et al., 2019; Leontiev et al., 2023). The main measures taken to protect such valuable fishes as sturgeon were the moratorium on commercial fishing by the Caspian coastal states (Russia, Azerbaijan, Kazakhstan, Turkmenistan and Iran) (Fazli et al., 2023), regulation of their trade by Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and their inclusion in national and local Red Data Books (RDBs). Some herring species, as well as Caspian endemics such as the Caspian inconnu *Stenodus leucichthys* and the Caspian lamprey *Caspiomyzon wagneri*, are listed in the RDBs of the Russian Federation (Pavlov, 2021) and some Russian regions (Magomedov, 2009; Ochirov, 2011; Pilipenko et al., 2014).

In addition to general measures to protect unique natural resources, in 1919 the Astrakhan Nature Reserve was established in the Astrakhan region with a total area of 67,917 ha (11,289 ha of which is the Caspian Sea), and in 1987 the Dagestan Nature Reserve was established in the Republic of Dagestan with a total area of 19,061 ha, of which 18,485 ha is the sea (Krever et al., 2009). However, as practice shows, the existence of the current Special Protected Natural Areas in the Russian part of the Caspian Sea does not ensure adequate protection of endemic, rare and endangered species of aquatic flora and fauna, which requires the development of additional measures for their protection and conservation (e.g. Matishov, 2010; Orlov et al., 2022a, 2022b, 2022c). One such measure could be the creation of Ecologically and Biologically Significant Marine Protected Areas (EBSMPAs) (Ashtab et al., 2024; Ginzburg et al., 2024) with a ban on all human activities except scientific research (e.g. Shestakov, Bekyashev, 2014).

The proposed review will attempt to compile a list and to assess the current conservation status of rare, endangered and endemic cyclostomes and bony fish species found in the Russian part of the Caspian Sea that are in need of additional conservation measures and protected areas ("dormant" zones).

Materials and Methods

The research will be carried out in three stages. In the first stage, endemic, rare and endangered fish species were selected for the entire Caspian Sea (Table 1). Species with wide distribution, stable or increasing abundance, absence of anthropogenic threats to their populations or low conservation status were excluded from this list. In the second stage, it is planned to describe the patterns of the spatial distribution of the species in need of additional protection and to prepare appropriate maps, taking into account seasonal and long-term changes as well as migration cycles. In the final stage, it is planned to identify coastal areas of the Russian part of the Caspian Sea where species in need of additional conservation measures regularly occur, and to develop proposals for the establishment of Ecologically and Biologically Significant Marine Protected Areas in the area under consideration.



Figure 1. Map of the Caspian Sea with its surrounding countries, cities, rivers, bays, islands, etc.: 1 - Kenderly Bay, 2 - Dead Kultuk Bay, 3 - Agrakhan Bay, 4 - Chilov Island, 5 - Gulf of Gorgan, 6 - Anzali Lagoon, 7 - Maly Zhemchuzhny Island, 8 - Volga-Caspian Sea Shipping Canal, 9 - Cape Turaly, 10 - Chechen Island, 11 - Bakhtemir Furrow, 12 - Peshnoy Island, 13 - Ogurchinskiy Island (Ogurja Ada), 14 - Durnev Island, 15 - Zyuydostoviy Kultuk, 16 - Kenderly Spit, 17 - Kulaly Island, 18 - Mingachevir, 19 - Lakes of the Lower Terek, 20 - Yasga Lake, 21 - Mingachevir water reservoir, 22 - Varvara water reservoir, 23 - Cape Karasingir. Purple dashed lines show division between the Northern, Middle, and Southern Caspian Sea.

The scientific (Latin) names in Table 1 and the text are accompanied by the author(s) and the year of the original description and follow Fricke et al. (2025). Common names follow Parin et al. (2014) and Froese and Pauly (2024).

A particular fish species was classified as Caspian endemic based on published data (Kazancheev, 1981; Belyaeva et al., 1989; Reshetnikov, 1998; Bogutskaya and Naseka, 2004; Bogutskaya et al., 2013; Parin et al., 2014; Dyldin et al., 2022, 2023, 2024). For the description of the international conservation status, data from CITES (CITES, 2023) and IUCN RLTS (International Union for Conservation of Nature Red List of Threatened Species) (IUCN, 2024) were used. CITES Appendix II includes all species of Caspian sturgeon. This Appendix lists species that are not currently threatened with extinction but may become so, if trade is not controlled. It also includes species that are similar to other listed species and need to be regulated in order to effectively control trade in those other listed species (CITES, 2023). The IUCN RLTS categories are as follows: EX - Extinct, EW - Extinct in the Wild, NT - Near Threatened, EN - Endangered, LC - Least Concern; DD - Data Deficient, NE - Not Evaluated (IUCN, 2024). Data on the conservation status of species in the Russian Federation and its regions are taken from the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan Region (Pilipenko et al., 2014), the Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009). The following categories have been adopted to indicate the conservation status of species within the Russian Federation: 0 - probably extinct, 1 - endangered, 2 - declining in number and/or distribution, 3 - rare, 4 - uncertain status, 5 - recoverable and recovering (Pavlov, 2021).

Furthermore, from the general list of endemic, rare and endangered fish species obtained in this way (41 species in total), species that are widespread, abundant, absent in Russian waters, species for which anthropogenic threats are minimal or have not been identified, and species whose conservation status is LC or DD were excluded. A brief description of the species excluded from Table 1 (28 species in total) and the reasons for their exclusion are given below. All geographical locations are shown in Figure 1.

Table 1. List of endemic, rare, and endangered fish species of the Caspian Sea, including those occurred within the Russian waters (sources of information and explanations of conservation status are provided in Materials and Methods Section; species excluded from further consideration are shaded grey)

No.	Species	Endemic	CITES Appendix II	IUCN Red List category	Russian Federation RDB category	Astrakhan Oblast RDB category	Republic of Kalmykia RDB category	Republic of Dagestan RDB category
PETROMYZONTIDAE								
1.	<i>Caspiomyzon wagneri</i> (Kessler, 1870)	+	-	LC	2	3	2	2
ACIPENSERIDAE								
2.	<i>Acipenser persicus</i> Borodin, 1897	+	2	CR	-	-	-	-
3.	<i>Acipenser gueldenstaedtii</i> Brandt et Ratzeburg, 1833	-	2	CR	-	-	-	-
4.	<i>Acipenser nudiventris</i> Lovetsky, 1828	-	2	CR	1	1	1	1
5.	<i>Acipenser stellatus</i> Pallas, 1771	-	2	CR	-	-	-	-
6.	<i>Huso huso</i> (Linnaeus, 1758)	-	2	CR	-	-	-	-

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Table 1.

CLUPEIDAE								
7.	<i>Alosa sphaerocephala</i> (Berg, 1913)	+	-	LC	-	-	-	-
8.	<i>Alosa braschnikowi</i> (Borodin, 1904)	+	-	DD	-	-	-	-
9.	<i>Alosa caspia</i> (Eichwald, 1838)	+	-	LC	-	-	-	-
10.	<i>Alosa kessleri</i> (Grimm, 1887)	+	-	LC	-	-	-	-
11.	<i>Alosa volgensis</i> (Berg, 1913)	+	-	EX	2	0	2	1
12.	<i>Clupeonella cultiventris</i> (Nordmann, 1840)	-	-	LC	-	-	-	-
13.	<i>Clupeonella grimmi</i> Kessler, 1877	+	-	EN	-	-	-	-
14.	<i>Clupeonella engrauliformis</i> (Borodin, 1904)	+	-	EN	-	-	-	-
CYPRINIDAE								
15.	<i>Luciobarbus caspius</i> (Berg, 1914)	+	-	LC	-	-	3	-
16.	<i>Luciobarbus brachycephalus</i> (Kessler, 1872)	+	-	VU	-	-	-	-
17.	<i>Luciobarbus capito</i> (Güldenstädt, 1773)	+	-	VU	2	-	-	2
18.	<i>Vimba persa</i> (Pallas, 1814)	+	-	LC	2	3	3	-
COREGONIDAE								
19.	<i>Stenodus leucichthys</i> (Güldenstädt, 1772)	+	-	NT	1	1	2	0
SALMONIDAE								
20.	<i>Salmo caspius</i> Kessler, 1877	+	-	NE	2	2	2	2
GOBIIDAE								
21.	<i>Babka macrophthalma</i> (Kessler, 1877)	+	-	LC	-	-	-	-
22.	<i>Benthophilus abdurahmanovi</i> Ragimov, 1978	+	-	LC	-	-	-	-

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Table 1.

23.	<i>Benthophilus baeri</i> Kessler, 1877	+	-	LC	-	-	-	-
24.	<i>Benthophilus casachicus</i> Ragimov, 1978	+	-	LC	-	-	-	-
25.	<i>Benthophilus granulosus</i> Kessler, 1877	+	-	LC	-	-	-	-
26.	<i>Benthophilus grimmi</i> Kessler, 1877	+	-	DD	-	-	-	-
27.	<i>Benthophilus leobergius</i> Berg, 1949	+	-	LC	-	-	-	-
28.	<i>Benthophilus leptcephalus</i> Kessler, 1877	+	-	LC	-	-	-	-
29.	<i>Benthophilus leptorhynchus</i> Kessler, 1877	+	-	LC	-	-	-	-
30.	<i>Benthophilus macrocephalus</i> (Pallas, 1787)	+	-	LC	-	-	-	-
31.	<i>Benthophilus mahmudbejovi</i> Ragimov, 1976	+	-	DD	-	-	-	-
32.	<i>Benthophilus spinosus</i> (Kessler, 1877)	+	-	LC	-	-	-	-
33.	<i>Benthophilus ragimovi</i> Boldyrev et Bogutskaya, 2004	+	-	LC	-	-	-	-
34.	<i>Neogobius caspius</i> (Eichwald, 1831)	+	-	LC	-	-	-	-
35.	<i>Neogobius melanostomus</i> (Pallas, 1814)	+	-	LC	-	-	-	-
36.	<i>Neogobius fluviatilis</i> (Pallas, 1814)	+	-	LC	-	-	-	-
37.	<i>Ponticola goebelii</i> (Kessler, 1874)	+	-	DD	-	-	-	-
38.	<i>Ponticola gorlap</i> (Iljin, 1949)	+	-	LC	-	-	-	-
39.	<i>Proterorhinus nasalis</i> (De Filippi, 1863)	+	-	LC	-	-	-	-

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Table 1.

OXUDERCIDAE								
40.	<i>Hyracanogobius bergi</i> Iljin, 1928	+	-	LC	-	-	-	-
41.	<i>Knipowitschia iljini</i> Berg, 1931	+	-	DD	-	-	-	-

Species that do not need additional protection

Family CLUPEIDAE

Genus *Alosa* Linck, 1790

1. Agrakhan shad *Alosa sphaerocephala* (Berg, 1913)

It is endemic to the Caspian Sea basin and commercially important species. It is found throughout the Northern Caspian Sea; in spring it is most abundant along the eastern shores, and in summer along the northern shores. It is rarely found off the western coast of the Middle Caspian Sea, in Kenderly Bay and Dead Kultuk Bay (Bogutskaya et al., 2013). The type locality is off Tyuleny Island, north of Agrakhan Bay (Esmacili et al., 2018). Additional conservation measures are not required due to its widespread distribution and lack of serious anthropogenic impacts (IUCN, 2024).

2. Caspian marine shad or Brazhnikov's shad *Alosa braschnikowi* (Borodin, 1904)

This is an endemic to the Caspian Sea, an abundant (Sattari, 2021) and commercially important species (Rustamov and Shakirova, 2013). Never enters rivers, spends its entire life cycle at sea. Most of the population is concentrated in the Southern and Middle Caspian Sea, but during the spawning season it migrates to the Northern Caspian Sea along the western and eastern coasts (Kazanchev, 1981, Sattari, 2021). Despite the widespread distribution of this species in the Caspian Sea, genetic data are lacking. An appropriate revision should be carried out to characterise the population and to determine its conservation status (Jafari et al., 2019). Due to its wide distribution and current high abundance, it does not require additional protection.

3. Caspian shad *Alosa caspia* (Eichwald, 1838)

This is an endemic to the Caspian Sea and commercially important species (Rustamov and Shakirova, 2013). The main wintering areas are off the western coast, from Chilov Island to Astara (the border between the Middle and Southern Caspian Sea). In the Southern Caspian Sea, they occur in the southeast, in the area of the Gulf of Gorgan, and also in the western part of the Anzali Lagoon (Holčik and Olah, 1992; Abbasi et al., 1999). Spawning migrations to the Northern Caspian Sea take place along the western coast (Kazanchev, 1981). Dense concentrations are observed in the area of Maly Zhemchuzhny Island and opposite the outlet of the Volga-Caspian Sea Shipping Canal (Zubkova and Kanatyev, 2016). Due to its wide distribution and high abundance, it does not require additional conservation measures.

4. Caspian anadromous shad or blackback *Alosa kessleri* (Grimm, 1887)

It is endemic to the Caspian Sea and commercially important species. It spends the winter in the Southern Caspian Sea off the coast of Iran, while spawning migrations to the Northern Caspian Sea take place along the western coast. It enters the Volga and, to a much lesser extent, the Ural to spawn (Kazanchev, 1981). From 2007 to the present, despite periods of low and medium water levels, there has been a stabilisation and increase in the abundance of the spawning stock of *A. kessleri*, mainly due to restrictions on catch size (Lepilina et al., 2016) and high fecundity of the species (Pyatikopova et al., 2014). Additional conservation measures are not required due to the high abundance of this shad.

Genus *Clupeonella* Kessler, 1877

5. Black Sea sprat *Clupeonella cultiventris* (Nordman, 1840)

This is an endemic to the Ponto-Caspian basin and a fairly widespread species in the Caspian Sea (Kazanchev, 1981). It is widespread throughout the sea, but mainly inhabits the shallow waters not deeper than 100 m. This euryhaline species occurring both in completely desalinated areas of the sea

and in areas with high salinity (Kaydak Inlet). It winters in the Middle and Southern Caspian Sea, mainly south of the latitude of the Kara-Bogaz-Gol Bay (at depths of 20-100 m), as well as in the Northern Caspian Sea (juveniles). Spawning in the Northern Caspian Sea occurs almost everywhere, as well as at shallow depths off the coast of the central and southern parts of the sea (Bogutskaya et al., 2013). It is excluded from the list of the species needing protection due to its high abundance and wide distribution.

6. Bigeye kilka *Clupeonella grimmi* Kessler, 1877

This species is endemic to the Caspian Sea and commercially important species. It occurs in the Middle and Southern Caspian Sea. The bigeye kilka is more abundant in the western half of the sea than in the eastern half (Kazancheev, 1981). Spawning occurs from November to April in the southern Caspian Sea (Aliasghari, 2017). This species does not occur in the Northern Caspian Sea and has not been recorded in Russian waters (Sedov and Paritsky, 2001). It is therefore excluded from the list of the species needing protection in Russian waters.

7. Anchovy tyulka *Clupeonella engrauliformis* (Borodin, 1904)

It is endemic to the Caspian Sea, a commercially important marine fish and a relatively widespread species. It is widely distributed in the Southern and Middle Caspian Sea (Kazancheev, 1981). It spends the winter mainly in the southern and southeastern parts of the Middle Caspian Sea. In summer and autumn, it is also distributed in the deep waters of the Northern Caspian Sea on the border with the Middle Caspian Sea (Bogutskaya et al., 2013). This species does not require additional conservation measures due to its high abundance and wide distribution.

Family GOBIIDAE

Genus *Babka* Iljin, 1927

8. Bigeye racer goby (new English common name) *Babka macrophthalma* (Kessler, 1877)

This is a non-commercial but abundant fish species that is endemic to the Caspian Sea (Bogutskaya et al., 2013). It inhabits the oligohaline and mesohaline areas of the sea and was not previously known from rivers. This species is mainly distributed in the eastern part of the Northern Caspian Sea (Kazancheev, 1981), while it is more common off the western coast of the Middle Caspian Sea near the mouth of the Sulak River (Ivanov and Komarova, 2008). It is excluded from the list due to its high abundance and widespread distribution.

Genus *Benthophilus* Eichwald, 1831

9. Abdurakhmanov's tadpole goby *Benthophilus abdurahmanovi* Ragimov, 1978

It is endemic to the Caspian Sea, a non-commercial species with unknown abundance. This species is widespread in the Northern Caspian Sea, especially in its western part and near the Delta of the Volga River (Kazancheev, 1981). It is also reported from the mouth of the Terek River (Vasil'eva, 1983). In the western part of the Middle Caspian Sea, this goby is known as far south as Makhachkala and Cape Turaly (Ragimov, 1978, 1981, 1985). It has been recorded in the Mangistau Region (northeastern and Middle Caspian Sea) (Chernova and Orlova, 2012). This species was originally described from the east coast of Tyuleny Island in the Northern Caspian Sea. According to Naseka and Bogutskaya (2009) and Bogutskaya et al. (2013), this goby occurs in the Middle and Southern Caspian Sea, but these records have not been confirmed for Iran (Jouladeh-Roudbar et al., 2015). Due to its widespread distribution and unclear level of its abundance, it was excluded from the list.

10. Baer pugolovka *Benthophilus baeri* Kessler, 1877

It is a non-commercial and poorly studied fish, an endemic to the Caspian Sea. In the Middle and Southern Caspian Sea, this species is found mainly along the eastern coast from Cape Peschaniy to Esenguly, while along the western coast, it is distributed southwards to Lankaran, with increased abundance in the southern areas. In the Northern Caspian Sea, this species occurs near Tyuleny and Chechen Islands, in the Bakhtemir Furrow, and southwards to Peshnoy Island and the Mangyshlak Peninsula (Ragimov, 1965, 1977, 1981, 1985; Vasil'eva, 2000; Boldyrev and Bogutskaya, 2007). There is no reliable information on the distribution of *B. baeri* in Russian waters (Bogutskaya et al., 2013). This species has been excluded from the list due to its widespread distribution and the lack of threats to this species (IUCN, 2024).

11. *Benthophilus casachicus* Ragimov, 1978

This is a marine, non-commercial, poorly studied species, endemic to the Caspian Sea. The majority of reliable records of this species are reported for the eastern Caspian Sea from Cape Peschaniy to Ogurchinskiy Island (Ogurja Ada) at depths of 15-75 m (Ragimov, 1977, 1978). There is no information on its distribution in Russian waters (Bogutskaya et al., 2013). Data on the distribution of this species in the waters of the Middle and Southern Caspian Sea (Naseka and Bogutskaya, 2009; Bogutskaya et al., 2013) have not been confirmed by samples from Iran (Esmaeili et al., 2018). Recent data (IUCN, 2024) confirm that *B. casachicus* is restricted to the eastern coast of the Caspian Sea. It is therefore excluded from the list of the species needing protected in Russian waters.

12. Granular tadpole goby or granular pugolovka *Benthophilus granulatus* Kessler, 1877

This species is a non-commercial abundant species, endemic to the Caspian Sea. It is widely distributed, including the southeastern part of the Northern Caspian Sea, off the coast of Dagestan and Azerbaijan, off the mouths of the Volga and Ural rivers, and in the lower reaches of the Volga Delta to Astrakhan (Kazanchev, 1981). Some publications (Reshetnikov, 2002; Miller, 2004) indicate that the range of this species also includes the coastal areas of all parts of the sea, including Iranian waters. However, an analysis of reliable literature data and collections of ZIN RAS (Zoological Institute of the Russian Academy of Sciences, Sankt-Peterburg, Russia) shows that *B. granulatus* does not occur along the coasts of the Southern Caspian Sea (Boldyrev and Bogutskaya, 2007). Before the lowering of the sea level, this species was found along the northern coast of the Buzachi Peninsula from Durnev Island eastwards to the northern part of the Dead Kultuk Bay (Bogutskaya et al., 2013). It is excluded from the list of species in need of protection due to its wide distribution and high abundance.

13. Grimm tadpole goby *Benthophilus grimmi* Kessler, 1877

This species is endemic to the Caspian Sea, a deep-sea marine fish inhabiting depths below 100 m, whose range is limited to the western part of the Middle Caspian Sea and the northernmost part of the Southern Caspian Sea from Chechen Island to the Absheron Peninsula (Boldyrev and Bogutskaya, 2007). This goby is not reported from the Northern Caspian Sea, while it is absent from the coastal waters of Russia in the Middle Caspian Sea (IUCN, 2024). This species has also been reported from the waters of Kazakhstan in the Mangystau Region (Chernova and Orlova 2012), while data on its records in the Middle and Southern Caspian Sea are not supported by samples from Iran (Esmaeili et al., 2018). The species does not require additional conservation measures due to its habitat at depths where human activity is minimised.

14. Caspian stellate tadpole goby *Benthophilus leobergius* Berg, 1949

This is a marine, widespread but not abundant species, endemic to the Caspian Sea. This goby is thought to be widespread throughout the Caspian Sea (IUCN, 2024). However, it is known (Boldyrev and Bogutskaya, 2007; Bogutskaya et al., 2013) that this species does not occur off the eastern coast of the Middle Caspian Sea. In its southeastern part, *B. leobergius* is known from the waters of Ogurchinskiy Island (Ogurja Ada) and the Gulf of Gorgan (Esmaeili et al., 2018; Jouladeh-Roudbar et al., 2015). It is also reported from the Safid Rud River (Abbasi et al., 1999), the southern and southwestern parts of the Iranian coast and as far north as Zyuydostoviy Kultuk in Azerbaijan (Ragimov, 1965, 1966; Kiabi et al., 1999). The species does not require additional conservation measures due to its widespread distribution, lack of information on current abundance and existing threats to its populations (IUCN, 2024).

15. Flat-head tadpole goby *Benthophilus leptcephalus* Kessler, 1877

This species is a deep-sea marine fish found at depths of 30-300 m and is an endemic to the Caspian Sea (IUCN, 2024). It is mainly found in the Middle and Southern Caspian Sea. In the western part of the Middle Caspian Sea, it is known from the mouth of the Samur River, while in the eastern part of the Southern Caspian, this goby occurs between Turkmenbashi and Esenguli (Kessler, 1877; Ragimov, 1965, 1977, 1982; Boldyrev and Bogutskaya, 2007). *B. leptcephalus* has not been observed in the shallow coastal waters of Russia (IUCN, 2024). This species does not require additional conservation measures due to its habitat at great depths, where human activity is virtually non-existent.

16. Short-snout tadpole goby or short-snout pugolovka *Benthophilus leptorhynchus* Kessler, 1877

This is a deep-sea marine species found at depths of 40-150 m and is endemic to the Caspian Sea (IUCN, 2024). It is reliably reported only from the waters off the western coast of the Middle Caspian Sea from the mouth of the Sulak River to the northern part of the Southern Caspian Sea south of the Absheron Peninsula, where it has been rarely observed (Kessler, 1877; Berg, 1927; Boldyrev and Bogutskaya, 2007). According to Naseka and Bogutskaya (2009) and Bogutskaya et al. (2013), this species occurs in the waters of the Middle and Southern Caspian Sea, but no records of this species have been documented in Iranian waters (Esmaeili et al., 2018). In the Northern Caspian Sea, this species has not been observed in the shallow coastal waters of Russia (IUCN, 2024). The species is not currently in need of protection as it inhabits depths where anthropogenic impacts are negligible.

17. Caspian tadpole goby *Benthophilus macrocephalus* (Pallas, 1787)

This species is a marine, coastal and estuarine, non-commercial, abundant fish, endemic to the Caspian Sea (IUCN, 2024). It inhabits the entire Northern Caspian Sea, while off the western coast of the Middle Caspian Sea, it is mainly found in the area from Chechen Island to the mouth of the Sulak River and south to the Absheron Peninsula. In the Southern Caspian Sea, this species is known from the Gulf of Gorgan (Ragimov, 1965; Bogutskaya et al., 2013). It is also reported from the Volga Delta and the mouth of the Ural River (Kazancheev, 1981). It is one of the most widespread gobies in the Northern Caspian Sea (Berg, 1949; Ragimov, 1966, 1981; Vasil'eva, 1983, 2000). Prior to sea-level lowering, *B. macrocephalus* was also recorded in Dead Kultuk Bay (Svetovidov, 1937). The current level of anthropogenic impact on populations of this species is unclear (IUCN, 2024). Due to its high abundance, wide distribution and lack of known threats, it does not require additional protection.

18. Small-spine tadpole goby *Benthophilus mahmudbejovi* Ragimov, 1976

This is a non-commercial marine species, endemic to the Caspian Sea. It is distributed in almost the entire Northern Caspian Sea, while along the eastern coast of the Middle and Southern Caspian Sea, this species is recorded near Cape Peschaniy, Cape Rakushechniy, Cape Kara-Singir, Kenderly Spit, Cheleken Peninsula and Ogurchinskiy Island (Ogurja Ada) (Reshetnikov et al., 2002; Bogutskaya et al., 2013). It is not abundant in the Northern Caspian Sea as a whole. There were no catches in the eastern part of the Northern Caspian Sea in 2000-2003, during the period of sea desalination (Stepanova et al., 2004). Boldyrev and Bogutskaya (2007), Naseka and Bogutskaya (2009), Bogutskaya et al. (2013) also reported this species from the waters of the Middle and Southern Caspian Sea, but these data are not confirmed by samples from Iran (Esmaeili et al., 2015, 2018). This species is thought to be widespread in the Caspian Sea, but current abundance and the extent of anthropogenic impacts are unknown (IUCN, 2024). This species has been excluded from the list of species in need of additional protection due to its wide distribution, uncertain abundance and unknown threats to its populations.

19. Spiny tadpole goby or spiny pugolovka *Benthophilus spinosus* (Kessler, 1877)

This is non-commercial, poorly studied marine species, endemic to the Caspian Sea. It is distributed along the eastern and western coasts of the Middle Caspian Sea and in the southeastern part of the Northern Caspian Sea (from Kulaly Island to the Mangyshlak Peninsula), as well as in the southeastern corner of the sea (Bogutskaya et al., 2013). This species is quite rare along the western coasts of the Middle and Southern Caspian Sea, and is not recorded in the western part of the Northern Caspian Sea (Kazancheev, 1981; IUCN, 2024). It is excluded from the list of species needing conservation in Russian waters as it occurs only in the southernmost part of this area, while current threats to populations of this species are unknown (IUCN, 2024).

20. Ragimov's tadpole goby *Benthophilus ragimovi* Boldyrev et Bogutskaya, 2004

This is a deep-sea marine fish, endemic to the Caspian Sea that inhabits depths of 30-200 m (IUCN, 2024). This species is known from the western coast of the Middle Caspian Sea (Esmaeili et al., 2015, 2018) and the Southern Caspian Sea from Chechen Island to Astara (Boldyrev and Bogutskaya, 2007). *B. ragimovi* has not been recorded in the Northern Caspian Sea, while it has not been observed in shallow coastal areas in Russian waters of the Middle Caspian Sea (Bogutskaya et al., 2013; IUCN,

2024). Therefore, additional conservation measures are not required for this fish, as it inhabits depths where the impact of human activities is minimal.

Genus *Neogobius* Iljin, 1927

21. Caspian goby *Neogobius caspius* (Eichwald, 1831)

This species is a rare marine species, endemic to the Caspian Sea, occurring throughout the Caspian Sea with the exception of the deep waters of the central and southern parts (IUCN, 2024). It is a target of recreational fishing (Rustamov and Shakirova, 2013). *N. caspius* avoids fresh waters and does not enter estuaries (Ragimov, 1965; Kazanchev, 1981; Abdoli and Naderi, 2009). It is not abundant in the Northern Caspian Sea, but is regularly recorded in this area. An increase in abundance was observed in the western part of the sea in 2003 (Stepanova et al., 2004; Bogutskaya et al., 2013). The species does not require additional protection due to its widespread distribution, stable abundance and lack of known threats (IUCN, 2024).

22. Monkey goby *Neogobius fluviatilis* (Pallas, 1814)

This species inhabits fresh and brackish waters. The native range includes the basins of the Marmara, Black and Azov seas, including tributaries of the Don and Kuban rivers (Berg, 1949; Svetovidov, 1964; Naseka et al., 2012; Artaev et al., 2021; Moskul, 2021). It has recently invaded the Volga and Oka rivers (Ivanchev and Ivancheva, 2010; Slynko and Tereshchenko, 2014; Kvach et al., 2021). Since 2012, *N. fluviatilis* has been recorded in the Baltic Sea basin, including the Pregolya and Neman rivers (Novozhilov and Gulina, 2023; Shibaev et al., 2024). Due to its widespread distribution, expanding range, increasing abundance and unknown threats to populations (IUCN, 2024), no additional conservation measures are required for this species.

23. Round goby *Neogobius melanostomus* (Pallas, 1814)

It is a brackish and freshwater species. Its native range includes the basins of the Marmara, Caspian (whole), Black and Azov seas (Berg, 1949; Svetovidov, 1964; Vasil'eva, 2007; Bogutskaya et al., 2013; Slynko and Tereshchenko, 2014; Zarei et al., 2022). It has been introduced into the Aral Sea (Vasil'eva, 2007), but has probably not acclimatised due to the high salinity (Vassilev et al., 2012). *N. melanostomus* was introduced into the Baltic Sea (Kaliningrad Region and Gulf of Finland), where it invaded the lower reaches of some rivers (Vasil'eva, 2007; Novozhilov, 2012; Karaseva, 2022; Yurtseva and Uspenskiy, 2022; Shibaev et al., 2024). It has also been accidentally introduced into some lakes and rivers of the North America (e.g., Ontario and Illinois) (Kottelat and Freyhof, 2007; Vasil'eva, 2007; Gutowsky and Fox, 2011; Vassilev et al., 2012). Due to its widespread distribution, range expansion, increasing abundance and lack of known threats to its populations (IUCN, 2024), the introduction of additional conservation measures is not required.

Genus *Ponticola* Iljin, 1927

24. Caspian ratan or rotan goby *Ponticola goebelii* (Kessler, 1874)

This is an extremely rare marine species, endemic to the Caspian Sea, known mainly from a small number of type specimens (Kessler, 1874; Pinchuk, 1976; Kazanchev, 1981). Its range mainly covers the western part of the Middle Caspian Sea from Chechen Island in the north to the Absheron Peninsula in the south, but it is also known from the Southern Caspian Sea (Bogutskaya et al., 2013; Zarei et al., 2022), where it has been recorded near the mouth of the Kura River and in the Turkmenbashi area (Ragimov, 1977; Naseka et al., 2012; Bogutskaya et al., 2013). No records of this species were observed in the Northern Caspian Sea from 1974 to 2003 (Stepanova et al., 2004). The species does not currently require any additional conservation measures, as threats to its populations are unknown (IUCN, 2024).

25. Caspian bighead goby *Ponticola gorlap* (Iljin, 1949)

This species is a riverine, estuarine and marine fish inhabiting both the Caspian and Azov seas basins. This species is a target of recreational fishing (Rustamov and Shakirova, 2013). It is mainly found in the sea, especially in coastal waters (Kazanchev, 1981). *P. gorlap* is widespread throughout the Caspian Sea and its basin, including the lower reaches of the Volga River to Astrakhan, small rivers of Dagestan, Azerbaijan and northern Iran, the Kura River to Mingachevir, lakes of the Lower Terek,

Yasga Lake, and lower reaches of the Ural River (IUCN, 2024). This species is relatively rare in the Northern Caspian Sea, as well as near the western and eastern shores of the Middle and Southern Caspian Sea, where it is relatively rare, except off the Absheron Peninsula (Bogutskaya et al., 2013). Its abundance in the Middle Caspian Sea has increased slightly following the desalination of the sea due to an increase in river discharge (Stepanova et al., 2004; Bogutskaya et al., 2013). Currently, this species does not require additional conservation measures due to its increasing abundance and lack of threats to its populations (IUCN, 2024).

Genus *Proterorhinus* Smitt, 1900

26. Tubenose goby *Proterorhinus nasalis* (De Filippi, 1863)

This non-commercial species is distributed in the Caspian and Azov seas and their basins, including the Volga and Don Rivers (IUCN, 2024). In the Caspian Sea, it is ubiquitous, with a preference for kelp forests in the Northern Caspian Sea (Kazanchev 1981; Bogutskaya et al., 2013). The species does not require additional protection due to its stable abundance, widespread distribution and lack of threats to its populations (IUCN, 2024).

Family OXYDURCIDAE

Genus *Hyrcanogobius* Iljin, 1928

27. Volga dwarf goby *Hyrcanogobius bergi* Iljin, 1928

This is a non-commercial species, endemic to the Caspian Sea. It is known from the northern and western parts of the Caspian Sea. This species is widespread in the Northern Caspian Sea basin, along the western coast to Cape Turaly, including the lakes of the lower reaches of the Terek River (Berg, 1931; Iljin, 1956; Ragimov, 1965). Ragimov (1986) reported this species from the eastern coast of the Southern Caspian Sea. According to the most recent data (IUCN, 2024), this species is widespread in the western Caspian Sea along the Russian and Azerbaijani coasts, and in the Southern Caspian Sea in the waters of Iran and Turkmenistan. As its population is estimated to be stable and no threats to the population have been identified (IUCN, 2024), we consider that additional conservation measures are not currently appropriate.

Genus *Knipowitschia* Iljin, 1927

28. Iljin's dwarf goby *Knipowitschia iljini* Berg, 1931

This is a brackish water, neritic, non-commercial species, endemic to the Caspian Sea (IUCN, 2024). Ragimov (1965) indicated its range between Kultuk and Astara off the coast of Azerbaijan. In general, this species is mostly found in the Southern Caspian Sea (waters of Iran and Turkmenistan) and partly in the Middle Caspian Sea (waters of Kazakhstan and Azerbaijan) (Naseka and Bogutskaya 2009, Özcan, 2009, Freyhof, 2011, Esmaeili et al., 2015; Jouladeh-Roudbar et al., 2015). It is not found in the Northern Caspian Sea, including Russian waters (Bogutskaya et al., 2013; IUCN, 2024). Therefore, it is not included in the list of species of conservation concern in Russian waters.

Species in need of additional conservation measures

Family PETROMYZONTIDAE

Genus *Caspiomyzon* Berg 1906

1. Caspian lamprey *Caspiomyzon wagneri* (Kessler, 1870).

This is an anadromous, historically valuable commercially important species, endemic to the Caspian Sea basin. It is found throughout the sea, but there are no precise data on its distribution by depth and feeding grounds (Orlov et al., 2022a, 2022b). It enters the Volga, Ural, Kura, Terek, Aras and Iranian rivers to spawn, forming independent populations (Nikitin, 2016). Before the construction of hydroelectric dams, this lamprey migrated into the Volga as far as Tver, the Kama as far as Chusovaya, the Oka as far as the Moscow, the Terek as far as the mouth of the Baksan, the Kura as far as Mtskheta, and the Ural as far as Orenburg (Bogutskaya et al., 2013). Fishing for Caspian lamprey has been banned since 1997. Currently, this species is listed in the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan Region (Pilipenko et al, 2014), the Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009), as well as Turkmenistan (Annabayramov, 2011) (category IV with undetermined

status) and Kazakhstan (Meldebekov, 2010) (category II as a species declining rapidly within its range), but has an inappropriate IUCN Least Concern conservation status (IUCN, 2024). Conservation measures aimed at maintaining the Caspian lamprey population are currently not effective (Orlov et al., 2022a, 2022b). The reasons for the decline in Caspian lamprey abundance observed in recent decades include overregulation of the Volga River flow (Nikitina, 1998), IUU fishing (Nikitin, 2016), water pollution, dredging and many other factors (Nazari et al., 2017; Orlov et al., 2022a, 2022b). The impact of these factors dictates the creation of additional conservation measures.

Family ACIPENSERIDAE

Genus *Acipenser* Linnaeus 1758

2. Persian sturgeon *Acipenser persicus* Borodin, 1897

This is an anadromous, valuable commercial species, endemic to the Caspian Sea basin. The Persian sturgeon is distributed throughout most of the Caspian Sea (IUCN, 2024), including the shallow waters of the Northern Caspian Sea (Khodorevskaya et al., 2007). It spawns mainly in the Kura River and rivers along the Iranian coast. The species enters the Volga River in much smaller numbers and is the least abundant species among the sturgeons of the Volga-Caspian basin (Guteneva and Ivanova, 2015). The main habitat in winter is the continental slope of the Northern Caspian Sea and the eastern shelf of the Middle Caspian Sea (Khodorevskaya et al., 2007). The main reason for the decline of Persian sturgeon stocks is IUU fishing on migration routes, within feeding and spawning grounds (Guteneva and Ivanova, 2015), as well as the regulation of the Volga River flow by the Volzhskaya HPP, located on migration routes. The main current conservation measures aimed at the recovery of the population are the prohibition of commercial fishing (with the exception of fishing for research purposes), as well as the listing of this species in various RDBs and CITES Appendix II. However, the existence of these measures has not contributed to an increase in the population and it continues to decline (Rustamov and Shakirova, 2013; Guteneva and Ivanov, 2015), which requires the development of additional conservation measures.

3. Ship or fringebarbel sturgeon *Acipenser nudiventris* Lovetsky, 1828

This species is an anadromous fish and one of the least abundant sturgeons in the Caspian Sea with limited commercial value (Chebanov et al., 2018; Orlov et al., 2022d). It is mainly found in the Middle and Southern Caspian Sea and is rare in the Northern Caspian Sea. This sturgeon spawns mainly in the Kura and the Ural rivers, rarely in the rivers of the Iranian coast and in the Volga River (Bogutskaya et al., 2013). This species is listed in the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan Region (Pilipenko et al., 2014), the Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009), as well as Tajikistan (Rustamov and Shakirova, 2013; Artaev et al., 2025) (category I as vulnerable species), Azerbaijan (Habibbayli and Babayev, 2023) (category II as not abundant, declining species) and Kazakhstan (Meldebekov, 2010) (Aral Sea population, category I as vulnerable). Along with other sturgeons, international trade is regulated by CITES (CITES, 2023) and fishing is prohibited everywhere. Despite substantial artificial propagation, the population remains very low due to loss of natural spawning grounds, intensive IUU fishing, pollution of habitats with industrial wastes, and disruption of natural spawning migration routes (Ponomarev and Ponomareva, 2009; Orlov et al., 2022d). Therefore, additional conservation measures need to be developed for this species.

4. Stellate sturgeon *Acipenser stellatus* Pallas, 1771

This species is distributed throughout the Caspian Sea and occurs in the Middle and Southern Caspian Sea to depths of 75-100 m (Kazanchev, 1981). Recently, in the northern part of the sea, there has been a shift in feeding aggregations from the western coast to the eastern shallow areas with warmer and saltier waters (Zykova and Konopleva, 2011, Ruban et al., 2022). It enters rivers from the Ural to the Sulak to spawn (Bogutskaya et al., 2013). Since the 1990s, there has been a steady decline in the abundance of *A. stellatus* due to both anthropogenic impacts and climatic changes. Its abundance is extremely low in the modern period and this species is considered to be threatened with extinction (Khodorevskaya and Kalmykov, 2014; Fazli et al., 2021). Therefore, additional conservation measures need to be developed for the stellate sturgeon.

5. Russian sturgeon *Acipenser gueldenstaedtii* Brandt et Ratzeburg, 1833

The population of the Russian sturgeon is more stable compared to the stocks of beluga and stellate sturgeon, but the tendency to reduce its commercial stocks remains as a result of insufficient recruitment (Khodorevskaya and Kalmykov, 2014). In the sea, it occurs everywhere at depths down to 40-50 m. The densest feeding aggregations are formed in the western and central parts of the Northern Caspian Sea (Ruban et al., 2019). It spawns mainly in the Volga and Ural rivers, and to a lesser extent in the Terek River (Bogutskaya et al., 2013). In the late 1950s, after the construction of the Volga hydroelectric cascade, a significant part of the spawning grounds in the upper and middle reaches of the Volga River were lost (Zykov et al., 2013). In this context, measures have been taken to artificially propagate Caspian sturgeon stocks. For this purpose, sturgeon hatcheries have been built in the lower reaches of the Volga, Kura and Ural rivers, which ensure the breeding and annual release of juveniles into the sea (Zykov et al., 2013). In addition to artificial propagation, CITES has imposed a moratorium on fishing for sturgeon, while the Russian sturgeon has been listed with other Caspian sturgeon in various RDBs. However, this species continues to decline due to IUU fishing and other anthropogenic impacts (Ivanov et al., 2020), and therefore additional conservation measures required to save and restore this valuable species.

Genus *Huso* Brandt et Ratzeburg 1833

6. Beluga or giant sturgeon *Huso huso* (Linnaeus, 1758)

This is an anadromous fish. It is found everywhere in the Caspian Sea, where it inhabits a depths of 40-60 m from the surface most of the year and migrates down to 180 m for the wintering. This sturgeon does not usually form shoals. Beluga of Volga origin migrates south to the waters of Turkmenistan, Iran and Azerbaijan for feeding. It used to spawn in all rivers from the Ural to the Gorgan, but the Volga was the main spawning river (Bogutskaya et al., 2013). After the regulation of the flow of the Volga River, a significant part of the species' spawning grounds was lost, and since the mid-1950s its reproduction has been mainly artificially supported (Zykov, 2011). Despite intensive artificial reproduction, beluga stocks have been declining steadily in recent decades mostly due to IUU fishing (Ivanov et al., 2020) that require development of additional conservation measures.

Family CLUPEIDAE

Genus *Alosa* Linck, 1790

7. Volga shad *Alosa volgensis* (Berg, 1913)

This is an anadromous shad, endemic to the Caspian Sea basin. This species spends the winter in the Southern Caspian Sea, while during migrations it is found throughout the sea. It spawns in the Volga, much less in the Ural, and occasionally in the lower reaches of the Terek River. This shad is found in the waters of the Republic of Kalmykia, Astrakhan and Volgograd regions (before the construction of the Volgograd hydroelectric dam) (Pavlov, 2021). Currently, the species has lost its commercial importance (Voinova, 2013). The main reasons for the decline in the abundance of the Volga shad were the regulation of river flow and competition for spawning grounds with the blackback *Alosa kessleri*. The main conservation measure for this species is its inclusion in the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan Region (Pilipenko et al, 2014), Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009), as well as Turkmenistan (Annabayramov, 2011) (category II as a not abundant, declining species) and Kazakhstan (Meldebekov, 2010) (category II as a not abundant, declining species). Reducing stocks of this species to critical levels will require the introduction of additional conservation measures.

Family CYPRINIDAE

Genus *Luciobarbus* Heckel 1843

8. Caspian barbel *Luciobarbus caspius* (Berg, 1914)

This species is an anadromous fish, endemic to the Caspian Sea basin. It is distributed in the western part of the sea (from the northern coast of Kazakhstan to eastern Iran) (IUCN, 2024). It spawns mainly in the Terek, Kura, Lankaran, Sefid Rud, and Gorgan rivers. Before the construction of the Mingachevir HPP, this species migrated in the Kura River up to the lower reaches of the Alazani River. Individual records of this barbel are known from the Volga, Terek and Samur rivers (Bogutskaya et al., 2013). The IUCN classifies its conservation status as LC (IUCN, 2024). Since this species is endemic to the Caspian Sea, is declining in abundance, is listed in the RDB of Kalmykia (Ochirov, 2014), and

faces many threats, especially to its migration routes and habitat quality (IUCN, 2024), there is an urgent need to protect its spawning grounds, completely ban commercial and recreational fishing, and reduce pollution levels.

9. Bulatmai barbel *Luciobarbus capito* (Güldenstädt, 1773)

This is a commercially important species, endemic to the Caspian Sea basin. This barbel is mainly found in the western part of the Caspian Sea from the Volga River to the Atrak River (IUCN, 2024). In this area, this species prefers shallow desalinated coastal waters with depths to 20-25 m. In freshwater, this species is reported from all rivers of the western coast from the Terek to the Kura and Lankaran, and from the Iranian coast to the Atrak River (Bogutskaya et al., 2013). This species is listed in the RDBs of the Russian Federation (Pavlov, 2021), Republic of Dagestan (Magomedov, 2009) and Azerbaijan (Habibbayli and Babyev, 2023) (category II as a not abundant, declining species), as well as in the IUCN RLTS as VU (IUCN, 2024). Despite this, the species continues to decline, mainly due to over-regulation of river flows on spawning migration routes, water pollution, destruction of spawning grounds and IUU fishing (Pavlov, 2021; IUCN, 2024). This demonstrates the low effectiveness of existing conservation measures for this species and the need for additional protection.

10. Aral barbel *Luciobarbus brachycephalus* (Kessler, 1872)

This species is an endemic to the Caspian and Aral seas basins, including their tributaries. In the Caspian region, this barbel occurs in both the western and southern parts of the basin (Geng et al., 2022). In southwestern Russia, it still occurs in the lower reaches of the Terek River, where it used to spawn in the past (Bogutskaya et al., 2013). This barbel has disappeared from most of the lower reaches of the Kura River in Azerbaijan, although a landlocked population exists in the Mingachevir reservoir and the Alazani River tributary. It continues to occur in some other locations in Azerbaijan (Kuljanishvili et al., 2020; IUCN, 2024). The Aral barbel was a valuable commercial species in the past, but its natural populations are currently declining due to over-regulation of river flows, anthropogenic impacts on its habitat and IUU fishing (IUCN, 2024). The main conservation measures in Kazakhstan are listing in the RDB in category II (Meldybekov, 2010), prohibition of fishing, and artificial propagation (Adyrbekova et al., 2023). The IUCN has classified this species as VU (IUCN, 2024). Due to the ongoing population decline in the Caspian Sea basin, this species is in need of additional protection.

Genus *Vimba* Fitzinger, 1873

11. Caspian vimba *Vimba persa* (Pallas, 1814)

This species is an endemic to the Caspian Sea basin and has a fairly wide distribution. It spawns in the rivers of Dagestan, Azerbaijan and Iran from the Kuma and Terek to the Gulf of Gorgan. In the Volga River, where its spawning migrations are limited to the Delta, this species migrates in very small numbers (Berg, 1949, Boldyrev et al., 2023). The Caspian vimba is listed in the RDBs of the Astrakhan Region (Pilipenko et al., 2014) and the Republic of Kalmykia (Ochirov, 2014). Although the IUCN assesses its status as LC (IUCN, 2024), there is a continuous decline in abundance in the modern period, caused by changes in the hydrological regime of rivers due to their flow regulation, water pollution and IUU fishing. There is therefore a need to develop additional conservation measures for this species.

Family COREGONIDAE

Genus *Stenodus* Richardson, 1836

12. Caspian Inconnu or sheefish *Stenodus leucichthys* (Guldenstadt, 1772)

It is an endemic to the Caspian Sea basin. In summer, sheefish inhabits the Middle and Southern Caspian Sea at depths to 50 m, while in autumn and winter they feed in the Northern Caspian Sea (Vasilchenko, 2002). Before the regulation of the flow of the Volga River, this species migrated to spawn in its tributaries. Previously, sheefish had entered the Terek River, while some individuals went to spawn in the Ural River (Letichevsky, 1963, 1972, 1975). It was a valuable commercial species, whose abundance has declined sharply. The main conservation measures for the preservation and recovery of its stocks are artificial propagation in fish hatcheries and a ban on fishing (Matishov, 2010), as well as the inclusion of this species in the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan region (Pilipenko et al., 2014), the Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009), as well as Kazakhstan (Meldebekov, 2010) (category IV as a poorly studied

species) and Turkmenistan (Annabayramov, 2011) (category III as a rare, declining species). The IUCN has classified the status of the sheefish as NT (IUCN, 2024) due to the continued decline of this species' population as a result of river flow regulation, pollution, habitat destruction and IUU fishing (Matishov, 2010). As existing conservation measures, including artificial propagation, have not had the desired effect, this species requires additional protection.

Family SALMONIDAE

Genus *Salmo* Linnaeus, 1758

13. Caspian trout *Salmo caspius* Kessler 1877

This is an anadromous species, endemic to the Caspian Sea basin. It feeds in the sea and spawns in the rivers of the Southern Caspian Sea, mainly in the Kura River. In the past, it was reported from many rivers along the Iranian coast as far as Gorgan (Armantrout, 1980; Holčík and Oláh, 1992; Kiabi et al., 1999; Abdoli and Naderi, 2009). With the construction of the Mingachevir and Varvara HPPs (1954-1955), all natural spawning grounds in the Kura River (about 1,000 km from the mouth) were lost. In the sea, it occurs mainly off the western and southern coasts at depths of 40-50 m, but performs rather long horizontal migrations (Askerov et al., 2001; Bogutskaya et al., 2013). The main limiting factors that have influenced the sharp decline in the abundance of the Caspian trout have been overfishing and overregulation of river flows. Dams on the Terek and Sulak rivers have become the main factor in the population decline (Pavlov, 2021). The main measures to restore the abundance of this species are artificial reproduction in fish hatcheries (Matishov, 2010), as well as listing in the RDBs of the Russian Federation (Pavlov, 2021), the Astrakhan Region (Pilipenko et al., 2014), the Republics of Kalmykia (Ochirov, 2014) and Dagestan (Magomedov, 2009), as well as in the RDB of Tatarstan in category III (rare, declining species) (Nazirov, 2016), Azerbaijan in category II (rare, declining species) (Habibbayli and Babayev, 2023) and Kazakhstan in category I (endangered species) (Meldebekov, 2010). There is no information that existing conservation measures for the Caspian trout have resulted in stabilisation or increase of its abundance, which requires the development of additional protection.

Conclusions

In the course of our study, data on about 90 marine fish species occurring throughout the Caspian Sea were analysed. Firstly, species occurring in Russian waters and endemic species, mainly representatives of the families Gobiidae and Clupeidae (36 species in total), as well as endangered species (5 species) were selected for further analysis. In total, 40 fish species and single cyclostome species were selected. The results of the analysis made it possible to divide the species under consideration into two categories, i.e. species requiring additional conservation measures (13 species) and species not requiring such measures (28 species). It was found that the species most in need of additional protection were generally those with a high commercial value (sturgeon, some herring, Caspian inconnu, etc.). Their abundance has declined for a number of reasons, including climatic changes. Both legal and poaching (IUU fishing) have the greatest negative impact on populations. It has a particularly severe impact on the most valuable commercial targets, such as sturgeon and Caspian inconnu. The regulation of river flows (construction of a network of HPPs) has led to a sharp decline in the abundance of many anadromous species (Caspian lamprey, sturgeon, Caspian inconnu, Caspian trout, etc.). Habitat degradation (dredging, excavation, various land reclamation measures, etc.) also has a negative impact on the populations of the above species, as well as on members of the family Cyprinidae. Unfortunately, at the present time, many of the measures taken to protect these species are ineffective or do not have a sufficient impact to change the situation for the better.

The key issue is the need to comprehensively address the causes that are negatively impacting populations of valuable commercial species, as well as species that require additional conservation measures. We believe that the most effective approach to this problem is the creation of EBSMPAs, i.e. the designation of marine areas (MPAs) for the conservation of vulnerable marine and coastal ecosystems. The main functions of such areas are to maintain and increase biodiversity and to conserve marine ecosystems, i.e. their ability to recover or maintain their natural state (Kachur, 2020). This strategy of establishing MPAs has already shown positive results in different regions of the world's oceans. Marine protected areas exist in the Indian Ocean (e.g. in the waters of the Seychelles with an

area of 210 thousand km²), a network of MPAs (covering 5% of marine waters) has been established within the economic zone of South Africa, MPAs exist in the North Atlantic, the Mediterranean and the Baltic seas, large MPAs have been created in the waters of the Southern, Pacific and Atlantic Oceans, in the EEZ of Australia, around the overseas territories of France, Great Britain and the USA (Ivanov et al., 2022). Protected areas currently cover less than 3% of the territorial waters and EEZ of the Russian Federation, while the vast majority of planned MPAs in Russian waters are concentrated in the Arctic and Far East (Ivanov et al., 2022). The establishment of EBSMPAs in the Caspian Sea will contribute to improving the conservation situation not only of particularly valuable species, but also of the overall biodiversity of the Caspian Sea flora and fauna.

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References

- Abbasi, K., Valipour, A., Talebi Haghighi, D., Sarpanah, A., Nezami, S. (1999) *Atlas of Iranian Fishes. Gilan Inland Waters*. Gilan Fisheries Research Centre, Rasht.
- Abdoli, A. & Naderi, M. (2009) *Biodiversity of Fishes of the Southern Basin of the Caspian Sea*. Abzian Scientific Publication, Tehran.
- Adyrbekova, K., Isbekov, K.B., Barakbayev, T.T. & Iskhakhov, G.Z. (2023) Current state of rare and endangered barbels of the genus *Luciobarbus* Heckel, 1843 in the Aral–Syrdarya Basin (Kazakhstan) and prospects for their conservation (A review). *Biology*, 12, 489. <https://doi.org/10.3390/biology12040489>
- Aliasghari, M., AnvariFar, H., & Mir, J.I. (2017) Effects of fishing and natural parameters on big eye kilka *Clupeonella grimmi* (Clupeiformes: Clupeidae) population in southern waters of the Caspian Sea. *UNED Research Journal*, 9, 185–191.
- Annabayramov, B., ed. (2011) *The Red Data Book of Turkmenistan. Volume 2: Invertebrates and Vertebrates. Animals. 3rd edition, revised and updated*. Ashgabat, Ylym.
- Armantrout, N.B. (1980) *The freshwater fishes of Iran*. Ph.D. Thesis. Oregon State University, Corvallis.
- Artaev, O., Pashkov, A., Vekhov, D., Saprykin, M., Shapovalov, M., Levina, M. & Levin, B. (2021) Fish occurrence in the Kuban River Basin (Russia). *Biodiversity Data Journal*, 9, e76701. <https://doi.org/10.3897/BDJ.9.e76701>
- Artaev, O., Thoni, R., Mirzoev, N., & Levin, B. (2025) Ichthyofauna of Tajikistan: diversity and changes over the past century. *American Museum Novitates*, 4032, 1–55. <https://doi.org/10.1206/4032.1>
- Ashtab, D., Gholamalifard, M., Jokar, P., Kostianoy, A.G. & Semenov, A.V. (2024) Spatial Planning of Marine Protected Areas (MPAs) in the Southern Caspian Sea: Comparison of Multi-Criteria Evaluation (MCE) and Simulated Annealing Algorithm. *Journal of Marine Science and Engineering*, 12, 123. <https://doi.org/10.3390/jmse12010123>
- Askerov, F.S., Zaitsev, Yu.Yu., Kasimov, R.Yu. & Kuliev, Z.M. (2001) *Biodiversity: Wonderful Fishes of the Caspian*. Print Studio, Baku.
- Belyaeva, V.N., Vlasenko, A.D. & Ivanov, V.P., eds. (1989) *The Caspian Sea: Ichthyofauna and Commercial Resources*. Moscow, Nauka.

- Berg, L.S. (1927) Notes on the Caspian *Benthophilus* (Gobiidae). In *Sbornik v Chest' Professora Nikolaia Mikhailovicha Knipovicha, 1885-1925*. Russian S.F.S.R. Narodnyi Komissariat Zemledeliya, Moscow, pp. 331–344.
- Berg, L.S. (1931). Description of a new gobioid fish, *Knipowitschia iljini*, from the Caspian Sea. *Bulletin de l'Académie des Sciences de l'Union des Républiques Soviétiques Socialistes, VII Série, Classe des Sciences Mathématiques et Naturelles*, 1931, 1271–1273.
- Berg, L.S. (1949). Freshwater fishes of the U.S.S.R. and adjacent countries. 4th edition, Vol. 3. *Opredeliteli po Faune SSSR* 30, 927–1382.
- Bogutskaya, N.G., Kijashko, P.V., Naseka, A.M. & Orlova, M.I. (2013). *Identification Keys for Fish and Invertebrates of the Caspian Sea. Vol. 1. Fish and Molluscs*. Moscow, KMK Press.
- Bogutskaya, N.G. & Naseka, A.M. (2004) *Catalogue of Agnathans and Fishes of Fresh and Brackish Waters of Russia with Comments on Nomenclature and Taxonomy*. Moscow, KMK Press.
- Boldyrev, V.S. & Bogutskaya, N.G. (2007). Revision of the tadpole-gobies of the genus *Benthophilus* (Teleostei: Gobiidae). *Ichthyological Exploration of Freshwaters*, 18, 31–96.
- Boldyrev, V.S., Yakovlev, S.V. & Viphlo, E.V. (2023) Alien Vimba bream *Vimba vimba* (Cyprinidae) in the Ural River Basin. *Russian Journal of Biological Invasions*, 14, 279–284. <https://doi.org/10.1134/S2075111723030037>
- Chebanov, M.S., Galich, E.V., Merkulov, Ya.G. & Bekbergenova, V. (2018) Biotechnology and fish-breeding and biological indexes of ship sturgeon breeding and rearing (*Acipenser nudiventris*, Lovetsky, 1828) under the conditions of Krasnodar Region. In *Actual Issues of Fishing, Fish Farming (Aquaculture) and Ecological Monitoring of Aquatic Ecosystems*. AzNIIRKh, Rostov-na-Donu.
- Chernova, N.V., Orlova, I.V. (2012) The species composition of the fish fauna of the Caspian Sea within the Mangistau region of the Republic of Kazakhstan. *Bulletin of the KazNU. Environmental Series* 1, 139–144.
- CITES. (2023) *Convention on International Trade in Endangered Species of Wild Fauna and Flora. Appendices I, II and III*. Geneva, CITES Secretariat.
- Dyldin, Y.V., Orlov, A.M., Hanel, L., Romanov, V.I., Fricke, R. & Vasil'eva, E.D. (2022) Ichthyofauna of the fresh and brackish waters of Russia and adjacent areas: Annotated list with taxonomic comments. 1. Families Petromyzontidae–Pristigasteridae. *Journal of Ichthyology*, 62, 385–414. <https://doi.org/10.1134/S0032945222030031>
- Dyldin, Y.V., Orlov, A.M., Hanel, L., Romanov, V.I., Fricke, R. & Vasil'eva, E.D. (2023) Ichthyofauna of the fresh and brackish waters of Russia and adjacent areas: Annotated list with taxonomic comments. 2. Order Cypriniformes, suborders Catostomoidei, Cobitoidei and Cyprinoidei. *Journal of Ichthyology*, 63, 636–686. <https://doi.org/10.1134/S0032945223040045>
- Dyldin, Y.V., Orlov, A.M., Hanel, L., Romanov, V.I., Fricke, R., Bochkarev, N.A. & Vasil'eva, E.D. (2024) Ichthyofauna of the Fresh and Brackish Waters of Russia and Adjacent Areas: Annotated List with Taxonomic Comments. 3. Orders Siluriformes–Syngnathiformes. *Journal of Ichthyology*, 64, 903–961. <https://doi.org/10.1134/S0032945224700772>
- Esmaili, H. R., Coad, B.W., Mehraban, H.R., Masoudi, M., Khaefi, R., Abbasi, K., Mostafavi, H. & Vatandoust, S. (2015) An updated checklist of fishes of the Caspian Sea basin of Iran with a note on their zoogeography. *Iranian Journal of Ichthyology*, 1, 152–184. <https://doi.org/10.22034/iji.v1i3.18>
- Esmaili, H.R., Sayyadzadeh, G., Eagderi, S. & Abbasi, K. (2018) Checklist of freshwater fishes of Iran. *FishTaxa* 3, 1–95.
- Fazli, H., Abdolmaleki, S., Kaymaram, F. & Khoshghalb, M.R.B. (2024) Spatial and temporal trends in the relative abundance of Caspian sturgeon during 2006–2022. *Fisheries Management and Ecology*, 31, e12668. <https://doi.org/10.1111/fme.12668>
- Fazli, H., Tavakoli, M., Behrouz Khoshghalb, M.R., & Moghim, M. (2021). Population dynamics of stellate sturgeon *Acipenser stellatus* Pallas, 1771 in the southern Caspian Sea. *Iranian Journal of Fisheries Sciences*, 20, 45–61. <https://doi.org/10.22092/IJFS.2021.123469>
- Freyhof, J. (2011) Chapter 2.6. Diversity and distribution of freshwater gobies from the Mediterranean, the Black and Caspian seas. In *The Biology of Gobies*. CRC Press & Science Publishers, Boca Raton et al., pp. 279–288.

- Fricke, R., Eschmeyer, W.N. & Van der Laan, R., eds. (2025) *Eschmeyer's Catalog of Fishes: Genera, Species, References*. (<http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>). Electronic version accessed 20/02/2025.
- Froese, R. & Pauly, D., eds. (2024) *FishBase*. World Wide Web electronic publication. www.fishbase.org, version (10/2024).
- Geng, L., Meng, M., Xue, S., Lv, X., Zou, M., Jiang, H., Tong, G., Yang, Y. & Han, Y. (2022) Construction of a high density genetic map and QTL analysis of morphological traits in Aral barbel *Luciobarbus brachycephalus* (Teleost: Cyprinidae). *Aquaculture Reports*, 27, 101404. <https://doi.org/10.1016/j.aqrep.2022.101404>
- Ginzburg, A.I., Kostianoy, A.G., Gholamalifard, M., Koibakova, S.E. & Syrlybekkyzy, S. (2024) Ecologically and Biologically Significant Marine Protected Areas in the Caspian Sea: a review. *Ecologica Montenegrina*, 76, 85–115. <https://doi.org/10.37828/em.2024.76.6>
- Guteneva, G.I. & Ivanova, L.A. (2015) Efficiency of natural reproduction and biological characteristics of the spawners of the Persian sturgeon (*Acipenser persicus* Borodin) in the conditions of the regulated runoff of the Volga River. *Vestnik of Astrakhan State Technical University. Series: Fishing Industry*, 4, 15–23.
- Gutowky, L.F.G. & Fox, M.G. (2011) Occupation, body size and sex ratio of round goby (*Neogobius melanostomus*) in established and newly invaded areas of an Ontario River, *Hydrobiologia*, 671, 27–37. <https://doi.org/10.1007/s10750-011-0701-9>
- Habibbayli, I. & Babayev, M., eds. (2023) *The Red Book of the Republic of Azerbaijan. Fauna. Third Edition*. Baku, Imak.
- Holčík, J. & Oláh, J. (1992) *Fish, Fisheries and Water Quality in Anzali Lagoon and Its Watershed. Report Prepared for the Project - Anzali Lagoon Productivity and Fish Stock Investigations*. Food and Agriculture Organization, Rome.
- Iljin, B.S. (1956) Remarks and corrections to the suborder Gobioidae in L.S. Berg's "Freshwater Fishes of the U.S.S.R and Adjacent Countries", Edition 4, 1948-1949, pages 1055–1125. *Voprosy Ikhtiologii*, 7, 185-192.
- IUCN. (2024). *The IUCN Red List of Threatened Species. Version 2024-2*. <https://www.iucnredlist.org>. Accessed on 19/02/2025.
- Ivanchev, V.P. & Ivancheva, E.Y. (2010) *Cyclostomata and Fishes of the Ryazan Region and Adjacent Areas*. Golos Gubernii, Ryazan.
- Ivanov, A.N. & Zabelina, N.M. (2022) Current concept of marine protected areas in Russia and in the world. *Hydrosphere Ecology*, 2, 27–36. [https://doi.org/10.33624/2587-9367-2022-2\(8\)-27-36](https://doi.org/10.33624/2587-9367-2022-2(8)-27-36).
- Ivanov, V.P. & Komarova, G.V. (2008) *Fishes of the Caspian Sea*. Astrakhan State Technical University, Astrakhan.
- Ivanov, V.P., Paltsev, V.N. & Shipulin, S.V. (2020) *Fishery Resources of the Caspian Sea*. VNIRO, Moscow.
- Jafari, O., Fernandes, J.M.D.O., Hedayati, A.A., Shabany, A. & Nasrolahpourmoghadam, M. (2019) Microsatellite analysis of five populations of *Alosa braschnikowi* (Borodin, 1904) across the southern coast of the Caspian Sea. *Frontiers in Genetics*, 10, 760. <https://doi.org/10.3389/fgene.2019.00760>
- Jouladeh-Roudbar, A., Vatandoust, S., Eagderi, S., Jafari-Kenari, S. & Mousavi-Sabet, H. (2015) Freshwater fishes of Iran; an updated checklist. *AAFL Bioflux*, 8, 855-909.
- Kachur, A.N. (2020) Marine protected areas of the North-West Pacific (current status, management plans and development strategies). *Vestnik DVO RAN*, 4, 151–159. <https://doi.org/10.37102/08697698.2020.212.4.024>
- Karaseva, E.M. (2022) Spatiotemporal distribution and size composition of larvae of the invasive round goby *Neogobius melanostomus* and of native sand goby *Pomatoschistus minutus* (Gobiidae) in the ichthyoplankton of the southeastern Baltic Sea. *Journal of Ichthyology*, 62, 428–436. <https://doi.org/10.1134/S0032945222030055>
- Kazancheev, E.N. (1981) *Fishes of the Caspian Sea*. Moscow, Legkaya I Pishchevaya Promyshlennost'.
- Kessler, K.F. (1874). A description of fishes belonging to the families common to both the Black and the Caspian seas. *Travaux de la Société des Naturalistes de St. Pétersbourg*, 5, 191–324.

- Kessler, K.F. (1877) The Aralo-Caspian Expedition. IV. Fishes of the Aralo-Caspio-Pontine ichthyological region. *Trudy Sankt-Petersburgskogo Obshchestva Estestvoispytatelei Supplement*, 1–360.
- Khodorevskaya, R.P. & Kalmykov, V.A. (2014) Formation of populations of Acipenseridae sturgeons in the Volga-Caspian basin. *Journal of Ichthyology*, 54, 576–583.
<https://doi.org/10.1134/S0032945214050051>
- Khodorevskaya, R.P., Ruban, G.I. & Pavlov, D.S. (2007) *Behavior, Migration, Distribution, and Stocks of Sturgeon in The Volga-Caspian Basin*. KMK Press, Moscow.
- Kiabi, B.H., Abdoli, A., & Naderi, M. (1999) Status of the fish fauna in the South Caspian Basin of Iran. *Zoology in the Middle East*, 18, 57–65. <https://doi.org/10.1080/09397140.1999.10637782>
- Kosarev, A.N. (2005) Physico-Geographical Conditions of the Caspian Sea. In *The Caspian Sea Environment. The Handbook of Environmental Chemistry (Kostianoy, A.G. & Kosarev, A.N., eds.)*, Vol 5P. Springer, Berlin, Heidelberg. https://doi.org/10.1007/698_5_002.
- Kottelat, M. & Freyhof, J. (2007) *Handbook of European Freshwater Fishes*. Kottelat and Freyhof, Berlin & Cornol.
- Krever, V.G., Stishov, M.S. & Onufrenya, I.A. (2009) *Specially Protected Natural Territories of Russia: Current State and Development Prospects*. Moscow, WWF-Russia.
- Kuljanishvili, T., Epatashvili, G., Freyhof, J., Japoshvili, B., Kalous, L., Levin, B., Mustafayev, N., Ibrahimov, S., Pipoyan, S. & Mumladze, L. (2020) Checklist of the freshwater fishes of Armenia, Azerbaijan and Georgia. *Journal of Applied Ichthyology*, 36, 501–514.
<https://doi.org/10.1111/jai.14038>
- Kvach, Y., Zamorov, V. & Pupins, M. (2021) *Review of Invasive Ponto-Caspian Gobiids: Current Range and History of Expansion*. Saule, Daugavpils.
- Leontiev, S.Yu., Piyanova, S.V., Ulchenko, V.A. & Kamshukov, S.V. (2023) Methodological aspects of assessing the scale of IUU fishing in inland water bodies by the example of individual regions of Russia. *Trudy VNIRO*, 192, 139–151. <https://doi.org/10.36038/2307-3497-2023-192-139-151>
- Lepilina, I.N., Nikolenkov, A.A., Vojnova, T.V. & Stepanova T.G. (2016) The status of stocks of herring - black-backed shad, biological, physiological and biochemical parameters and nutritional analysis of migrating spawners in the Volga River. *Vestnik of Astrakhan State Technical University. Series: Fishing Industry*, 2, 43–52.
- Leroy, S.A.G., Lahijani, H.A.K., Crétaux, J.F., Aladin, N.V. & Plotnikov, I.S. (2020) Past and Current Changes in the Largest Lake of the World: The Caspian Sea. In *Large Asian Lakes in a Changing World (Mischke, S., ed.)*. Springer, Cham. https://doi.org/10.1007/978-3-030-42254-7_3
- Letichevsky, M.A. (1963) *Reproduction of Inconnu in conditions of regulated runoff of the Volga*. Fisheries, Moscow.
- Letichevsky, M. A. (1972) Commercial stocks of whitefish and their breeding conditions in the pre-dam zone of the Volgograd hydroelectric power station. *Trudy VNIRO*, 39, 92–105.
- Letichevsky, M.A. (1975) The experience of determining the number of spawning populations of Inconnu and the effectiveness of factory breeding in the conditions of the Delta and the Lower Volga. *Voprosy Ikhtiologii*, 15, 630–635.
- Magomedov, B.I., ed. (2009) *The Red Data Book of the Republic of Dagestan*. Makhachkala, Ministry of Natural Resources and Environmental Protection of the Republic of Dagestan.
- Makhrov, A.A., Vinarski, M.V., Gofarov, M.Y., Dvoryankin, G.A., Novoselov, A.P. & Bolotov, I.N. (2021) Faunal exchanges between the basins of the Arctic Ocean and the Caspian Sea: Their history and current processes. *Biology Bulletin*, 48, 892–906.
<https://doi.org/10.1134/S1062359021070190>
- Matishov, G.G., ed. (2010) *Inconnu and Salmon of the Caspian Region*. Southern Scientific Center RAS, Rostov-na-Donu.
- Meldebekov, A.M., ed. (2010) *The Red Data Book of the Republic of Kazakhstan. 4th edition, revised and updated. Volume I: Animals, Part 1: Vertebrates “DPS”*, Almaty.
- Miller, P.J., ed. (2004) *The freshwater fishes of Europe*. Vol. 8/II. Gobiidae. Aula-Verlag, Wiesbaden.
- Moskul, G.A. (2021) *Fishes of the Reservoirs of Kuban Basin: A Guide*. Kuban State University, Krasnodar.
- Naseka, A.M. & Bogutskaya, N.G. (2009) Fishes of the Caspian Sea: zoogeography and updated checklist. *Zoosystematica Rossica*, 18, 295–317.

- Naseka, A.M., Boldyrev, V.S., Spodareva, V.V., Lobanov, A.L. & Bogutskaya, N.G. (2012) Catalogue of specimens in the collection of the Zoological Institute, Russian Academy of Sciences: Gobiidae of the Black Sea and Caspian basins. *Explorations of the Fauna of the Seas*, 73, 1–123.
- Nazari, H., Abdoli, A., Kiabi, B.H. & Renaud, C.B. (2017) Biology and conservation status of the Caspian lamprey in Iran: a review. *Buletin Lampetra*, 8, 6–32.
- Nazirov, A.A., ed. (2016) *The Red Data Book of the Republic of Tatarstan: Animals, Plants, Fungi*. 3rd Edition. Ideal-Press, Kazan.
- Nikitin, E.V. (2016) Structural and functional characteristics of the population of Caspian lamprey *Caspiomyzon wagneri* Kessler, 1870. In *Proceedings of the All-Russian Conference with International Participation "The Current State of Bioresources of Inland Waters and Ways of Their Rational Use"*, GosNIORH, Kazan, pp. 767–773.
- Nikitina, N.G. (1998) Prospects for the conservation of stocks of the Caspian lamprey, In *Abstracts of the 42nd Scientific Conference of the Faculty and the 48th Student Scientific Conference*. Astrakhan State Technical University, Astrakhan, p. 25.
- Novozhilov, O.A. (2012) Characteristic of species structure of fish juveniles in rivers of Kaliningrad oblast. *Izvestiya Kaliningradskogo Gosudarstvennogo Tekhnicheskogo Universiteta*, 24, 69–77.
- Novozhilov, O.A. & Gulina, T.S. (2023) Monkey goby *Neogobius fluviatilis* (Pallas, 1814) as a new species in the ichthyofauna of the Kaliningrad region. In *Aquatic Bioresources, Aquaculture, and Ecology of Water Reservoirs*. Vol. 3. Kaliningrad State Technical University, Kaliningrad, pp. 85–90.
- Ochirov, N.L., ed. (2014) *The Red Data Book of the Republic of Kalmykia*. Vol. 1. Animals. Jangar, Elista.
- Orlov, A.M., Barkhalov, R.M., Rabazanov, N.I., Orlova, S.Y. & Sokol'skii, A.F. (2022a) Caspian lamprey *Caspiomyzon wagneri* (Petromyzontidae): A review of historical and modern data. *Journal of Ichthyology*, 62, 1245–1268. <https://doi.org/10.1134/S0032945222040166>
- Orlov, A.M., Barkhalov, R.M., Rabazanov, N.I. & Orlova, S.Yu. (2022b) The Endangered Caspian lamprey, *Caspiomyzon wagneri*. In *Imperiled: The Encyclopedia of Conservation*. Elsevier, Amsterdam, pp. 616–622. <https://doi.org/10.1016/B978-0-12-821139-7.00117-3>.
- Orlov, A.M., Interesova, E.A., Dyldin, Yu.V. & Romanov, V.I. (2022c) The Endangered Eurasian Freshwater Sturgeons. In *Imperiled: The Encyclopedia of Conservation*. Elsevier, Amsterdam, pp. 541–553. <https://doi.org/10.1016/B978-0-12-821139-7.00135-5>.
- Orlov, A.M., Rabazanov, N.I. & Barkhalov, R.M. (2022d) The Endangered Fringebarbel Sturgeon, *Acipenser nudiventris*. In *Imperiled: The Encyclopedia of Conservation*. Elsevier, Amsterdam, pp. 554–558. <https://doi.org/10.1016/B978-0-12-821139-7.00097-0>.
- Özcan, G. (2009) The status of the Freshwater Gobiid, *Knipowitschia mermere* Ahnelt, 1995: distribution ecology and threats. *Biharean Biologist*, 3, 139–141.
- Parin, N.V., Evseenko, S.A. & Vail'eva, E.D. (2014) *Fishes of Russian Seas: Annotated Catalogue*. KMK Press, Moscow.
- Pavlov, D.S., ed. (2021) *The Red Data Book of the Russian Federation*. Vol. "Animals". 2nd Edition. FGBU "VNII Ecologiya", Moscow.
- Pilipenko, V.N., Lozovskaya, M.V., Zakutnova, V.I., Laktionov, A.P., Chuikov, Yu.S., Pirogovsky, M.I., Fedorovich, V.V., Rusanov, G.M., Bondarev, D.V., Gavrilov, N.N., Reutsky, N.D., Bozhansky, A.T., Kokin, O.A., Afanasiev, V.E. Zimin, A.V., Andreev, V.Yu., Voloboeva, O.V., Meshcheryakova, N.O., Lozovskaya, G.A., Busalova, A.S. & Faizova, M.I. 2014. *The Red Data Book of the Astrakhanskaya Oblast*. Astrakhan State University, Astrakhan.
- Pinchuk, V.I. (1976) Systematics of the goby, genera *Gobius* Linné (native species), *Neogobius* Iljinu [sic] and *Mesogobius* Bleeker. *Journal of Ichthyology*, 16, 543–552.]
- Ponomarev, S.V., Ponomareva, E.N. (2009) Analysis of the main anthropogenic factors affecting the state of the sturgeon population in the Caspian basin. In *Proceedings of the International Scientific and Practical Conference "Problems of Sturgeon Reproduction in the Middle Reaches of the Ural River, and Ways to Solve Them"*. Zhangir Khan West Kazakhstan Agrarian and Technical University, Uralsk.
- Pyatikopova, O.V., Voinova, T.V., & Raspopov, V.M. (2014) Formation of replenishment of black-backed shad population (*Alosa kessleri kessleri* (Grimm, 1887)) in different water years by

- unilateral (2011, 2013). *Vestnik of Astrakhan State Technical University. Series: Fishing Industry*, 2, 56–61.
- Rabazanov, N.I., Orlov, A.M., Abdusamadov, A.S., Barkhalov, R.M. & Akhemedkhanov, K.M. (2019) Caspian Kutum *Rutilus kutum*: A Long Story of Exploitation, Survival, and Revival. In *From Catastrophe to Recovery: Stories of Fishery Management Success*. American Fisheries Society, Bethesda, pp. 485–508. <https://doi.org/10.47886/9781934874554.ch20>
- Ragimov, D.B. (1965) On the distribution of gobiids at the western coast of the central and southern Caspian. *Doklady Akademii Nauk Azerbajjanskoi SSR*, 21, 47–50.
- Ragimov, D.B. (1966) *Species composition, biology, and stocks of gobiids off the western coast of the Middle and South Caspian Sea*. Ph.D. Thesis. Institute of Zoology of Azerbaijan SSR Academy of Sciences, Baku.
- Ragimov, D.B. (1977) On the distribution and abundance of some goby fishes of the eastern coast of the Middle and Southern Caspian (second report). *Izvesiya Akademii Nauk Azerbajjanskoi SSR. Seriya Biologicheskie Nauki*, 4, 87–91.
- Ragimov, D.B. (1978) On the systematic status of some species of the genus *Benthophilus* (family Gobiidae) from the Caspian Sea and the Sea of Azov. *Voprosy Ikhtiologii* 18, 791–798.
- Ragimov, D.B. (1981) Distribution and abundance of gobies (Gobiidae) in the Northern Caspian. *Voprosy Ikhtiologii*, 21, 223–231.
- Ragimov, D.B. (1985) Some Caspian species of the genus *Benthophilus* (Gobiidae). *Journal of Ichthyology*, 25, 153–161.
- Reshetnikov, Yu.S., ed. (1998) *Annotated Catalog of Cyclostomata and Fish of Continental Waters of Russia*. Nauka, Moscow.
- Reshetnikov, Yu.S., ed. (2002) *Atlas of Freshwater Fishes of Russia*. 2 Vols. Nauka, Moscow.
- Ruban, G.I., Khodorevskaya, R P., & Shatunovskiy, M I. (2019). Long-term dynamics of sturgeon distribution in the northern part of the Caspian Sea. *Inland Water Biology*, 12, 443–451. <https://doi.org/10.1134/S1995082919040126>
- Ruban, G.I., Safaraliev, I.A., Osipov, F.A., Dergunova, N.N. & Petrosyan, V.G. (2022) Dynamics of the stellate sturgeon (*Acipenser stellatus* Pallas, 1771) ecological niche in the northern part of the Caspian Sea modeled on the basis of long-term (1992–2006) summer monitoring data. *Russian Journal of Biological Invasions*, 13, 338–349. <https://doi.org/10.1134/S2075111722030146>
- Rustamov, A.K., & Shakirova, F.M. (2013) Summary of the modern ichthyofauna of Turkmenistan. In *Study of the Biodiversity of Turkmenistan (Vertebrates)*. Menzbirov Ornithological Society, Central Asian Branch, Moscow–Ashgabat, pp. 78–89.
- Sattari, M., Mazareiy, M.H., Khataminejad, S., Bibak, M. & Imanpour Namin, J. (2021) Geometric Morphometric analysis of *Alosa braschnikowi* (Teleostei, Clupeidae) populations in the southern Caspian Sea. *Iranian Journal of Animal Biosystematics*, 17, 1–13. <https://doi.org/10.22067/IJAB.2021.63418.0>
- Sedov, S.I., & Paritsky, Yu.A. (2001) Biology and Fishing of Marine Fishes. In *The State of Stocks of Commercial Objects in the Caspian Sea and Their Use*. KaspNIRKh, Astrakhan, pp. 186–205.
- Shestakov, I.V. & Bekyashev, K.A. (2014) Marine protected areas: the conception and legal regime. *Rybnoe Khozyaistvo*, 3, 42–49.
- Shibaev, S.V., Novozhilov, O.A., Aldushin, A.S., Burbah, A.V., Aldushina, Y.K., Gulina, T.S., Baranovskij, P.N. & Fedorov, L.S. (2024) Research of the species composition of the coastal ichthyocenosis of the Baltic Sea within the Kaliningrad coast. *Voprosy Rybolovstva*, 25, 49–58. <https://doi.org/10.36038/0234-2774-2024-25-1-49-58>
- Slynko, Yu.V. & Tereshchenko, V.G. (2014) *Freshwater Fishes of the Ponto-Caspian Basin (Diversity, Faunogenesis, Population Dynamics, Adaptation Mechanisms)*, Polygraph-Plus, Moscow.
- Stepanova, N.Yu., Latypova, V.Z. & Yakovlev, V.A. (2004) *Ecology of Kuibyshev Reservoir: Bottom Sediments, Benthos, and Benthivorous Fishes*. Academy of Sciences of Tatarstan Republic, Kazan.
- Svetovidov, A.N. (1937) Fishes of the bays of the Caspian Sea Komsomolets (Dead Kultuk) and Kaydak. *Trudy Komissii po Kompleksnomu Izucheniyu Kaspiiskogo Morya*, 1, 183–211.
- Svetovidov, A.N. (1964) *Fishes of the Black Sea*. Nauka, Moscow-Leningrad.
- Vasil'eva, E.D. (1983) Osteological analysis of some Caspian puffballs in connection with the taxonomy of the genus *Benthophilus* (Gobiidae). *Voprosy Ikhtiologii*, 23, 544–556.

- Vasil'eva, E.D. (2000) Craniological analysis of some species of *Benthophilus* (Gobiidae) and problems of taxonomy and phylogenetic relations of this group. *Journal of Ichthyology*, 40, 724–731.
- Vasil'eva, E.D. (2007) *Fishes of the Black Sea. Key to Marine, Brackish-Water, Euryhaline, and Anadromous Species with Color Illustrations, Collected by S. V. Bogorodsky*. VNIRO, Moscow.
- Vasilchenko, O.N. (2002) *Biological Bases of Increasing the Efficiency of Reproduction of Inconnu in the Caspian Basin*. KaspNIRKh, Astrakhan.
- Vassilev, M., Apostolou, A., Velkov, B., Dobrev, D. & Zarev, B. (2012) *Atlas of the Gobies (Gobiidae) in Bulgaria*. IBER, Sofia.
- Voinova, T.V. (2013) Dynamics of catch and biological characteristics of blackback shads in the Volga-Caspian fisheries subarea in modern conditions (the Volga River and its streams). *Vestnik of Astrakhan State Technical University. Series: Fishing Industry*, 3, 25–29.
- Yablonskaya, E.A. (2007) *Biology of the Caspian Sea*. Moscow, VNIRO.
- Yurtseva, A.O. & Uspenskiy, A.A. (2022) Morphological differentiation of the round goby *Neogobius melanostomus* (Pallas, 1814) by north-east border of the invasive distribution range. *Contemporary Problems of Ecology*, 29, 62–75. <https://doi.org/10.15372/SEJ20220106>
- Zarei, F., Al Jufaili, S.M. & Esmaeili, H.R. (2022) *Oxyurichthys omanensis* sp. nov., a new Eyebrow Goby (Teleostei: Gobiidae) from Oman. *Zootaxa*, 5182, 361–376. <https://doi.org/10.11646/zootaxa.5182.4.3>
- Zenkevich, L.A. (1963) *Biology of the Seas of the USSR*. Moscow, USSR Academy of Sciences.
- Zubkova T.S. & Kanatyev S.V. (2016) Caspian herrings as promising objects for fishing. *Rybnoe Khozyaistvo*, 3, 67–71.
- Zykov, L.A. (2011) Evaluation of the commercial return of the Caspian sturgeon *Huso huso* L. from juveniles of artificial reproduction. *Voprosy Rybolovstva*, 12, 349–363.
- Zykov, L.A., Zykova, G.G. & Abramenko, M.I. (2013). Estimation of trade return Russian Caspian sturgeon *Acipenser gueldenstaedtii* from young fish of artificial reproduction. *Voprosy Rybolovstva*, 14, 460–477.
- Zykova, G.F. & Konopleva, I.V. (2011) Present distribution and abundance of stellate sturgeon in the Caspian Sea. *Rybnoe Khozyaistvo*, 2, 48–50.