LAMPREYS (PETROMYZONTI) AND RAY-FINNED FISHES (ACTINOPTERYGII) IN THE EDITIONS OF THE RED DATA BOOK OF RUSSIA OF 1983–2021

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The sections on lampreys and fishes in three editions of the Red Data Book of Russia (1983, 2001, and 2021) have been analyzed. Changes in species composition and the reasons that caused them are considered. The history of the formation of categories of rarity and endangerment statuses in the Russian Red Data Books and their close connection with the Red Data Book and the International Union for Conservation of Nature Red List is shown. The need for categories of conservation status (I, II, and III priorities of conservation measures) is considered. Changes in approaches to listing species in different editions are analyzed. A number of problematic issues in maintaining the Red Data Book of Russia are noted. Proposals are put forward for the formation of a list of lamprey and fish taxa to be listed in the next edition of the Red Data Book of Russian Federation and the selection of status categories for them.

Keywords: Red Data Book of Russia, lampreys, Petromyzonti, ray-finned fish, Actinopterygii, threatened species, species conservation, status categories.

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INTRODUCTION

The main purpose of establishing Red Data Books is to preserve endangered taxa and populations of animals, plants, and fungi. This fully applies to such groups as lampreys and fish, which are traditionally studied by the same specialists. In our country, three editions of the Red

Data Book of Russia have been published - in 1983, 2001, and 2021. In the first edition (Red Data

Book..., 1983), the term "Fish" was used in the section title, and there were no lampreys in this

edition. In the second edition (Red Data Book..., 2001), the term "Bony Fishes" (Osteichthyes) was used for the fish section, and the term "Cyclostomes" (Cyclostomata) for the lamprey section. Most specialists now consider these names outdated. In the editions of the Red Data Book of Russia, the sections on vertebrate animals are presented at the class level. The term cyclostomes (or jawless - Agnatha) is not a taxonomic rank; it conditionally combines into one group the class of Lampreys (Petromyzonti) and the class of Hagfishes (Myxini). Fish (Pisces) are also a composite group including at least three classes. In the Red Data Book of Russia, cyclostomes are represented only by the class Lampreys, and fish - so far only by the class Ray-finned fishes (Actinopterygii). Therefore, changes were made to the section titles in the third edition: "Cyclostomes - Cyclostomata" was replaced by "Lampreys - Petromyzontes", and "Bony Fishes - Osteichthyes" by "Ray-finned Fishes - Actinopterygii" (Red Data Book..., 2021). It should be noted that regarding the systematics of several fish and lamprey taxa, the compilers of the Red Data Book of Russia are guided by the opinion of the majority of researchers at the time of preparation of each edition. The modern Latin name of the lamprey class, which we used above, particularly in the article title, differs from that given in the third edition of the book, but further in our publication, the nomenclature names of taxa are given in accordance with those used in the considered editions of the Red Data Book.

The Red Books of the International Union for Conservation of Nature (IUCN) appeared first. They were published in the 1960-1970s as separate volumes dedicated to specific taxonomic groups: mammals (Mammalia), birds (Aves), amphibians (Amphibia) and reptiles (Reptilia) together, and fish. For fish, the first edition was published in 1969, and the second in 1977 (Miller, 1969, 1977). An overview of fish species included in the first edition of the IUCN Red Book is provided in the work of Pavlov et al. (1994). Since 1986, the IUCN Red Book was reformed into the IUCN Red Lists, which were initially published in paper form, and since 2000 - in electronic

form. Unlike our red books, which have the status of official documents, the IUCN Red Book and Red Lists are only advisory in nature. The legitimacy of the Red Book of Russia as an official document is based on the RSFSR Law "On the Protection and Use of Wildlife" dated July 14, 1982, and the federal laws "On Wildlife" dated April 24, 1995, No. 52 and "On Environmental Protection" dated January 10, 2002, No. 7 with subsequent revisions. Another important difference is that the IUCN only assesses the probability of species extinction without addressing protection issues, while Russian red books determine not only the risk of extinction but also propose necessary protection measures.

In the first edition of the USSR Red Book (1978), lampreys and fish were absent. It was presented as a single volume that included animals and plants. The second edition of 1984 included nine fish taxa, of which three (Atlantic *Acipenser sturio* and Sakhalin *A. mikadoi* sturgeons, Volkhov whitefish - the Volkhov population of common whitefish *Coregonus lavaretus*) are found, in particular, in the waters of modern Russia. This edition was presented in two volumes: Vol. 1 "Animals" and Vol. 2 "Plants" (USSR Red Book, 1984a, 1984b). It should be noted that for the next edition of the USSR Red Book, it was proposed to include from 26 to 31 taxa of lampreys and fish (Pavlov et al., 1985; Shilin, 1985), of which 16 were also found in the waters of modern Russia. However, the dissolution of the USSR prevented the implementation of these plans.

Simultaneously with the Red Book of the USSR (1984a, 1984b), but at a faster pace, the first edition of the Red Book of the RSFSR (Animals) was being prepared. As a result, it was published earlier - in 1983, and in 1985 an additional print run was produced. The Red Book of the RSFSR (1983) included nine fish taxa (Sakhalin and Baikal *A. baeri baicalensis* sturgeons, the anadromous form of mikizha *Salmo mykiss* (Kamchatka salmon), davatchan *Salvelinus alpinus erythinus* , Volkhov whitefish, white Baikal grayling *Thymallus arcticus baicalensis infrasubspecies brevipinnis* , black carp *Mylopharyngodon piceus* , auha *Siniperca chuatsi* and

common sculpin *Cottus gobio*). The Red Book of the RSFSR was presented in two volumes, but the "Animals" volume was published in 1983, and the "Plants" volume in 1988. Thus, during the Soviet period, there were two editions of the Red Book of the USSR and one edition of the Red Book of the RSFSR.

For the next edition of the Red Book of Russia, it was proposed to include 30 fish species and two lamprey species (Sokolov, Shilin, 1989). These proposals were implemented in 1997 in the new List of animal species included in the Red Book of the Russian Federation and excluded from the Red Book of the Russian Federation (hereinafter - the List) (Order..., 1997 [1]), and in 2001, the "Animals" volume (2nd edition) was published (Red Book..., 2001). It should be noted that the rules for the protection and use of species listed in the Red Book come into effect not from the moment the book is published, but from the date the List is approved. The next approval of the List by the Ministry of Natural Resources and Ecology of the Russian Federation (Ministry of Natural Resources of Russia) took place in 2020, and in 2021, the "Animals" volume (3rd edition) was published (Red Book..., 2021). The second edition of the "Animals" volume included three species of lampreys and 39 species of fish. The third edition also contained three species of lampreys and 39 species of fish (Table 1), but the species composition of fish was partially changed - some species were excluded, but the list was supplemented with new species in a threatened state (Table 2). It should be noted that many species were not included in their entirety, but only as separate populations or groups of populations.

[1] Order of the State Committee of the Russian Federation for Environmental Protection dated 19.12.1997 No. 569 "On approval of lists of wildlife objects included in the Red Book of the Russian Federation and excluded from the Red Book of the Russian Federation" (https://docs.cntd.ru/document/901702704. Version 05/2024).

Table 1. Change in the Number of Lamprey and Fish Species in the Red Data Book of Russia Editions

Publication Year	Number of Species (Lampreys + Fish)		
	Total Listed	Excluded	Newly Included
1983	0 + 9	0 + 1	0
2001	3 + 39	0 + 11	3 + 31
2021	3 + 39	0	0 + 11

Table 2. Red Data Book of Russia (2021), Excluded and Newly Included Fish Species

Excluded	Included
Atlantic Twaite Shad	Baltic Sturgeon
Russian Riffle Minnow	Sharp-snouted Lenok (populations of the Angara River and Lake Baikal basin)
Ciscaucasian Spined Loach	Bauntovsky Whitefish
Yellowcheek	Muksun (Yamal Peninsula populations)
Black Amur	Bulat-Mai Barbel
Black Amur Bream	Colchian Bitterling
Small-scaled Yellowfin	Crimean Short-barbeled Gudgeon
Mandarin Fish (Chinese Perch)	Crimean Loach
Volga Zander (Ural River basin population)	Vimba (populations of the Kuban River basin and rivers of the Black Sea coast of Krasnodar Territory)
Soldatov's Catfish	European Eel (basins of the Barents, White, Black, and Azov Seas)
European Bullhead	Short-snouted Seahorse

Note. For Latin names, see Table 3.

The aim of our work is to analyze changes in the species composition of lampreys and fish in the editions of the Red Data Book of Russia, review the systems of status categories in the Red Data Book of Russia and their connection with the IUCN Red List categories, highlight some problematic issues in maintaining the Red Data Book of Russia, and provide suggestions on approaches to forming the list of taxa of lampreys and fish to be included and selecting status categories for its next edition.

Comparison and Analysis of Lamprey and Fish Species Composition in the Red Book of Russia Editions

The presence of only nine fish taxa (Table 3) and the absence of lampreys in the Red Book of the RSFSR (1983) certainly did not reflect the actual situation at that time and can only be considered as the first experience in this direction. In the next edition of 2001, there were already three species of lampreys and 39 fish taxa. Only the white Baikal grayling did not make it into the subsequent edition, possibly due to difficulties in its identification and practical protection, since

other forms of grayling also inhabit the Lake Baikal basin. This grayling was not included in the last three editions of the Red Book of the Republic of Buryatia (2005, 2013, 2023).

Table 3. Comparison of species composition and categories of lampreys and ray-finned fishes in the editions of the Red Book of Russia

Species, subspecies, populations	Year of publication		
	1983	2001	2021
Class Lampreys – Petromyzont~~es~~			
Order Petromyzontiformes			
Sea lamprey *Petromyzon marinus*		1	4, ND, III
Caspian lamprey *Caspiomyzon wagneri*		2	2, V, III
Ukrainian lamprey *Eudontomyzon mariae*		2	2, V, III (only populations of the Black Sea coast rivers of Krasnodar Territory)
Class Ray-finned fishes – Actinopterygii			
Order Acipenseriformes			
Sakhalin sturgeon *Acipenser mikadoi*	4 (listed as *A. medirostris*)	1 (listed as *A. medirostris*)	1, CE, I
Ship sturgeon *Acipenser nudiventris*		1	1, CE, I
Amur sturgeon *Acipenser schrenckii* (Zeya-Bureya population)		2	2, D, II
Siberian sturgeon *Acipenser baerii*	2 (only Baikal populations)	2 (only West Siberian and Baikal populations)	2, D, II (all populations except those of the Lena River basin)
Baltic sturgeon *Acipenser oxyrinchus* (native population)		0 (listed as *A. sturio*)	0, EW, I
European sturgeon *Acipenser sturio*		0 (previously called Atlantic)	0, EW, I
Sterlet *Acipenser ruthenus* , populations of the basins:			
– Dnieper River		1	1, CE, II
– Don River		1	2, D, II
– upper and middle Kama (Perm Territory, Kirov Region)		1	5, NT, II
– Sura River		1	2, D, II
– Ural River		1	2, D, II

– Angara River			1, D, II
– Kuban River		1	
Kaluga sturgeon *Huso dauricus* (Zeya-Bureya population)		1	1, D, II
Azov beluga *Huso huso maeoticus*		1	1, CE, I
Order Clupeiformes			
Volga shad *Alosa volgensis*		2	2, D, III
Abrau sprat *Clupeonella abrau*		1	3, V, III
Twaite shad *Alosa fallax fallax* (Baltic Sea basin)		4 (excluded in 2011)	
Order Salmoniformes			
Blunt-snouted lenok *Brachymystax tumensis* (populations of the Ob River basin)		1 (listed as *B. lenok*)	1, CE, II
Sharp-snouted lenok *Brachymystax lenok* (populations of the Angara River channel and Lake Baikal basin)			2, V, III
Siberian taimen *Hucho taimen* (populations of the European part of Russia; Western Siberia (except for the Altai Republic and Tomsk River within the Kemerovo Region); Angara River basin, including Lake Baikal basin; Sakhalin Island)		1 (only populations of the European part of Russia, Polar and Middle Urals)	1, D, II
Sakhalin taimen *Parahucho perryi* (populations of Primorsky Territory and Sakhalin Region)		2 (only populations of Sakhalin Island)	1, D, I
Rainbow trout *Parasalmo mykiss* :			
– anadromous form = Kamchatka salmon	3 (listed as *Salmo mykiss*)	3	2, V, II
– population of the Shantar Islands		3	3, D, II
Atlantic salmon *Salmo salar* (freshwater form = lake salmon)		2 (excluding the population of the Shuya River in the Lake Onega basin)	2, D. II
Brown trout *Salmo trutta* :			
– common (Baltic) trout *S. t. trutta*		2 (all populations and forms of the Baltic Sea basin)	2, V, II (only basins of Lakes Ladoga and Onega)
– Caspian trout *S. t. caspius* :			
– anadromous form of the Caspian Sea basin		1	2, D, II

– stream trout of the Volga and Ural River basins		4	1, D, II
– Black Sea trout *S. t. labrax*		1 (only anadromous form)	1, D, II (anadromous form of the Black Sea basin, lake and stream forms of the Crimean Peninsula)
– Eizenam trout *S. t. ezenami*		2	1, CE, I
Arctic char *Salvelinus alpinus* :			
– populations of the Polar Urals			3, V, III (population of Lake Bolshoe Shchuchye)
– populations of Transbaikalia (= Davatchan)	2	2	2, D, III (only populations of Lakes Frolikha, Bolshoe and Maloe Leprindo, Leprindokan, Davatchan, Irbo, Tokko, Usu, Kamkanda, Ogiendo)
Small-mouthed char *Salvelinus elgyticus*		3	3, NT, III
Long-finned char of Svetovidov *Salvethymus svetovidovi*		3	3, NT, III
Common whitefish *Coregonus lavaretus* :			
– Volkhov population = Volkhov whitefish	1 (listed as *C. l. baeri*)	2 (listed as *C. l. baeri*)	1, D, II
– Svir population			1, D, II
Baunt whitefish *Coregonus baunti* (populations of many-rakered whitefish in Lakes Bolshoe and Maloe Kapylyushi)		3 (listed as *C. l. baunti*)	3, NT, III
Muksun *Coregonus muksun* (populations of the Yamal Peninsula)			2, D, III
European cisco *Coregonus albula* (population of Lake Pleshcheyevo = Pereslavl cisco)		2 (listed as *C. albula pereslavicus*)	2, V, III
Pygmy whitefish *Prosopium coulteri*		3	3, NT, III
Nelma *Stenodus leucichthys* :			
– belorybitsa *S. l. leucichthys*		1 (only population of the Ural River basin)	1, CE, I

– nelma *S. l. nelma*		1 (populations of the European part of Russia)	2, V, II (populations of the European part of Russia, excluding the population of the Pechora River basin)
White Baikal grayling *Thymallus arcticus baicalensis infrasubspecies brevipinnis*	2		
European grayling *Thymallus thymallus*		2 (populations of the upper Volga and Ural River basins)	2, V, III (populations of the Ural River basin)
Order Cypriniformes			
Azov-Black Sea shemaya *Alburnus mento*		2 (listed as *Chalcalburnus chalcoides mento*)	2, V, III (excluding the anadromous form of the Don River basin)
Russian riffle minnow *Alburnoides bipunctatus rossicus*		2	
Common barbel *Barbus barbus* :			
– populations of rivers of the Baltic Sea basin			2, V, III
– populations of the Dnieper River basin = Dnieper barbel		1	1, D, II
Bulatmai barbel *Luciobarbus capito*			2, V, II
Crimean short-barbeled gudgeon *Gobio tauricus*			2, CE, III
Colchic bitterling *Rhodeus colchicus*			1, D, III
Vyrezub *Rutilus frisii* :			
– nominative subspecies *R. f. frisii*		4	2, V, II
– kutum *R. f. kutum*		2 (excluded in 2004)	
Vimba *Vimba vimba* (populations of the Kuban River basin and Black Sea coast rivers of Krasnodar Territory)			2, D, II
Black carp *Mylopharyngodon piceus* (native population)	1	1	
Yellowcheek *Elopichthys bambusa*		1	
Black Amur bream *Megalobrama terminalis*		1	
Small-scaled yellowfin *Plagiognathops microlepis*		1	
Crimean spined loach *Cobitis taurica*			2, CE, III
Caucasian spined loach *Sabanejewia caucasica*		3	
Order Siluriformes			
Soldatov's catfish *Silurus soldatovi*		2	

Order Perciformes			
Volga zander *Stizostedion volgensis* (Ural River basin)		3	
Chinese perch, auha *Siniperca chuatsi*	1	2	
Order Scorpaeniformes			
Common sculpin *Cottus gobio*	2	2	
Order Anguilliformes			
European eel *Anguilla anguilla* (basins of the Barents, White, Black and Azov seas)			1, D, III
Order Gadiformes			
Kildin cod *Gadus morhua kildinensis*		1	1, CE, II
Order Gasterosteiformes			
Short-snouted seahorse *Hippocampus hippocampus*			2, V, III

Note. Nomenclature names of taxa are given in accordance with those used in the Red Books under consideration. Categories of species rarity status: 0 – probably extinct, 1 – endangered, 2 – declining in numbers and/or distribution, 3 – rare, 4 – undefined status, 5 – restored and recovering. Categories of species extinction threat status: IR – extinct in the Russian Federation, KR – critically endangered, I – endangered, U – vulnerable, BU – near threatened, ND – data deficient. Categories of degree and priority of conservation measures taken and planned (priorities): I – immediate comprehensive measures are required, including the development and implementation of a conservation strategy and/or recovery (reintroduction) program for the object and action plans; II – implementation of one or several special measures for the conservation of the object is necessary, III – general measures provided for by the regulatory legal acts of the Russian Federation in the field of environmental protection are sufficient.

It is considered that in Russian waters there are from seven to nine species of lampreys (Bogutskaya, Naseka, 2004; Fish..., 2010; Parin et al., 2014). The inclusion of three lamprey species in the second edition of the Red Book of Russia was an important step in conserving representatives of this insufficiently studied class. Individual populations of other lamprey species have been included in the red books of several constituent entities of the Russian Federation. Analysis and synthesis of these data will help in the future to identify new representatives of this class for inclusion in the Red Book of Russia. Among fish in the second edition, the order Acipenseriformes is most represented with eight species, based on their proportion to the total number in Russia (12 species). Sturgeons (Acipenseridae) are the most vulnerable group - six species are included in the category "endangered," and the Atlantic sturgeon has probably already disappeared. Only one species - the Siberian sturgeon *A. baerii* was in the category with a less threatened status "declining in numbers." In fact, there were nine species of sturgeons in the second edition, as it is now established that under the name "Atlantic sturgeon" there were two species - the Baltic *A. oxyrinchus* and European *A. sturio* sturgeons, which will be discussed in more detail below. It should be noted that five sturgeon species are not included in their entirety, but only as subspecies or individual populations, the remaining three - at the species level (Table 3). The order Clupeiformes was initially represented by three taxa, but later for the Atlantic twaite shad *Alosa fallax fallax* data appeared that due to natural reasons it began to quickly recover its numbers, and in 2011 the subspecies was excluded from the Red Book of Russia. The order Salmoniformes is most represented by the number of species. It includes nine representatives of the Salmonidae family, four of the Coregonidae family, and one of the Thymallidae family. For the lake salmon (in the next edition it is named "Atlantic salmon *Salmo salar* (freshwater form = lake salmon)"), based on the results of effective artificial reproduction in 2004, the Shuya population of the Onega Lake basin was excluded. Of the Salmoniformes, five species are included as separate subspecies, seven species as separate populations, and only three species in their entirety (Table 3). The order Cypriniformes is represented by two families: Cyprinidae - eight species and Cobitidae -

one species. Of the cyprinids, five species are included in their entirety and three species at the subspecies level; of the loaches, the Caucasian spined loach *Sabanejewia caucasica* is included at the species level. If we analyze the representatives of this order by category, five species are included in the category "endangered," two in the category "declining," one in the category "rare," and one in the category "uncertain status." In 2004, the kutum *Rutilus frisii kutum* was excluded from the 2001 edition. The basis for this was data on the upward trend in its numbers due to large-scale artificial reproduction. Currently, despite the release of a large number of juveniles of this subspecies (in 2022, 11 million specimens were released), a decrease in its numbers is observed. If this decline cannot be stopped, it would be appropriate to consider including it in the Red Book of the Republic of Dagestan, as the main stocks of this subspecies are concentrated in the Dagestani waters of the Caspian Sea basin. From the order Perciformes, two species are included: the Volga zander *Stizostedion volgensis* at the population level and the aucha at the species level. The remaining three orders - Siluriformes, Scorpaeniformes, and Gadiformes - have one species each: Soldatov's catfish *Silurus soldatovi* and the common bullhead at the species level, and the Kildin cod *Gadus morhua kildinensis* at the subspecies level (Table 3). Due to taxonomic changes, it should be noted that in Russian waters it is not the common bullhead but the Russian bullhead *C. koshewnikowi* (Sideleva et al., 2015) that inhabits. This needs to be taken into account in new editions of the red books of the Russian Federation's constituent entities.

When transitioning from the second to the third edition, the number of species remained unchanged (Table 1), but the species composition of fish was renewed by 25% (Table 2). Species were excluded for various reasons. The Russian riffle minnow *Alburnoides bipunctatus rossicus* , Volga zander, and bullhead are widespread species whose status varies in different parts of their range and is not threatened everywhere. In such cases, it is advisable to include species in the Red Books of those constituent entities of the Russian Federation that consider it necessary. The Ciscaucasian spined loach was recognized as insufficiently studied to be considered a threatened species at the federal

level. The Twaite shad experienced a rapid increase in numbers due to natural causes. When coordinating the draft List with the Ministry of Agriculture of the Russian Federation, regarding the complex of Amur fish (yellowcheek *Elopichthys bambusa* , black Amur bream *Megalobrama terminalis* , black Amur carp, small-scale yellowfin *Plagiognathops microlepis* , Soldatov's catfish, Amur sleeper), the Federal Agency for Fishery presented data on the growth in numbers of these species due to the favorable hydrological regime of the Amur River in the current period, so it was decided to exclude them. In our opinion, regarding the small-scale yellowfin and Soldatov's catfish, this decision was most likely hasty.

The inclusion of 11 new species was carried out primarily based on the steady decline in their numbers. This was the main reason for the populations of muksun *C. muksun* , vimba bream *Vimba vimba* , Bulatmai barbel *Luciobarbus capito* , Colchian bitterling *Rhodeus colchicus* , Crimean short-barbeled gudgeon *Gobio tauricus* , Crimean spined loach *Cobitis taurica* , European eel *Anguilla anguilla* , and short-snouted seahorse *Hippocampus hippocampus* . Changes in taxonomy were also reasons for including new species. The taxonomy of the sturgeon inhabiting the Baltic Sea, as well as the lenok *Brachymystax lenok* and Baunt whitefish *C. baunti* has been revised. Previously, it was believed that only one species of sturgeon - *A. sturio* , which had the Russian name "Atlantic sturgeon," inhabited the basins of the Baltic and Black Seas. Modern research has shown that a closely related species - *A. oxyrinchus* , which is now commonly called Atlantic sturgeon (called Baltic sturgeon in the third edition), has inhabited the Baltic Sea for the last few centuries, while *A. sturio* is called European sturgeon. Lenok was previously considered one species represented by two forms: sharp-snouted and blunt-snouted. Currently, each form is considered an independent species - respectively *B. lenok* and *B. tumensis* . In the 2001 edition, lenok was listed as a single species and represented only by the blunt-snouted form (Alekseev, 2001). In the 2021 edition, lenok is included as two species; the sharp-snouted lenok is listed for the first time (Table 2). Baunt whitefish is also now considered an independent species (Pronin et al., 2011). In the 2001 edition, it was listed as a

subspecies of the common whitefish, while in the 2021 edition it is listed as an independent species (Table 3).

In addition to the changes discussed above, the composition of populations of several species previously included in the publication has also been affected (Table 3). For the Ukrainian lamprey *Eudontomyzon mariae* , only populations from rivers of the Black Sea coast of Krasnodar Territory were retained. Currently, there is no consensus among specialists regarding the species identity of these populations. Some specialists believe they belong to the Turkish lamprey (*E. lanceolate*), while others consider them a new species – Nina's lamprey (*Lampetra ninae* = *Lethenteron ninae*). Regardless of their taxonomic affiliation, these populations are in a threatened state and require urgent conservation measures. For the Siberian sturgeon, almost all populations that were not included in the previous edition have been added, with the exception of the relatively stable populations in the Lena River basin. For the sterlet *A. ruthenus* , the extinct native population of the Kuban River basin was excluded, and the severely reduced population of the Angara River basin was added. Due to excessive exploitation as a popular object of paid licensed fishing, the Shuya population of Atlantic salmon has again sharply declined in numbers and was re-included in the third edition. Now the freshwater form of Atlantic salmon is completely listed in the Red Book of Russia. The distribution area of the listed populations of common (Baltic) brown trout *S. trutta trutta* was reduced to the basins of Lakes Ladoga and Onega. For the Black Sea trout *S. t. labrax* , the lacustrine and stream forms of the Crimean Peninsula were added to the anadromous form. For the Arctic char *S. alpinus* , the number of Transbaikal populations included in the publication was reduced to 10, keeping only those in the most threatened state; the population of Lake Bolshoye Shchuchye in the Polar Urals was also added. This lake is very popular with tourists and, despite being located in a specially protected natural area, constant fishing of char occurs there. For the common taimen *Hucho taimen* , several Western Siberian populations were added, as well as populations from the Angara River basin, Lake Baikal, and Sakhalin Island. For the Sakhalin taimen *Parahucho perryi* , populations from Primorsky Territory

that were already in the regional red book were added. The beloribitsa *Stenodus leucichthys leucichthys* , as a subspecies, is now completely listed. For the nelma *S. l. nelma* , based on data from the All-Russian Research Institute of Fisheries and Oceanography (VNIRO), the population of the Pechora River basin was excluded. For the European grayling, based on new data on abundance and distribution, populations of the upper Volga basin were excluded. For the Azov-Black Sea shemaya *Alburnus mento* , due to its population growth through effective artificial reproduction, the anadromous form of the Don River basin was excluded. For the common barbel *Barbus barbus* , populations of the Baltic Sea basin were added, and now the species is completely listed.

Category Systems in the Editions of the Red Book of Russia and Their Comparison with the Red Book and IUCN Red List Categories

The volumes of the IUCN Red Book used a system for assessing the degree of extinction threat consisting of five categories: E – endangered, V – vulnerable, R – rare, J – indeterminate, O – recovered. This system served as the basis for categories in the USSR Red Book (1984a, 1984b) and three editions of the Red Book of Russia (1983, 2001, 2021). In our red books, this system is commonly called the system of rarity status categories. The uppercase Latin letters E, V, R, J, O, duplicating the names of categories in the IUCN Red List, were replaced with numbers in our editions: in the 1983 edition – Roman numerals (I–V), in the 2001 and 2021 editions – Arabic numerals (0–5). In the 1983 edition, category I (endangered) also included species (subspecies) that may have already disappeared. In the 2001 and 2021 editions, category 0 – probably extinct (taxa that have not been encountered for a long time, but no conclusive research has been conducted to confirm their extinction) was separated from category 1, and the number of rarity status categories in these editions equals six. The category "declining in numbers" (editions of 1983 and 2001) in the third edition is called "declining in numbers and/or distribution." In addition, category V, "recovered" (1983 edition),

in subsequent editions was replaced with the category "recovering and recovered," since recovered species should no longer be in the main list of the Red Book of Russia.

Since 1991, IUCN experts began developing a new system of categories (Mace, Lande, 1991), which was first applied in the IUCN Red List in 1996. The previous category system for determining the degree of extinction threat was based mainly on subjective expert assessment, which often led to different results. The new system (the final version 3.1 was adopted in 2001) was based on the use of quantitative criteria, which allowed for more accurate assessment of species status (IUCN Red List... , 2001, 2012). A Russian translation of this version is available online (Categories and Criteria..., 2001). It should be noted that the main group "threatened species" (Threatened) includes three categories: "Critically Endangered" (CR), "Endangered" (EN), and "Vulnerable" (VU). The remaining categories do not belong to this group. In the IUCN Red List, they provide additional information characterizing the status of all assessed species. These categories are: "Extinct" - Extinct (EX), "Extinct in the Wild" - Extinct in the Wild (EW), "Least Concern" - Least Concern (LC), which in practice includes relatively safe species, and an intermediate category between VU and LC called "Near Threatened" - Near Threatened (NT), as well as the category "Data Deficient" - Data Deficient (DD). For national and regional red books, two more categories are recommended: "Regionally Extinct" - Regionally Extinct (RE) and "Not Applicable" - Not Applicable (NA) (Guidelines..., 2012). The NA category includes species that occasionally appear irregularly in the region ("vagrant taxa"), therefore it is not possible to assess the degree of threat of their extinction in the region. Quantitative criteria have been developed only for the group of threatened species, but the IUCN Red Lists include all species that have been assessed by categories, including LC. This allows the IUCN to keep track of the number of assessed species.

Since initially the new system of categories, particularly quantitative criteria, caused critical reaction among several Russian specialists (Kuzmin et al., 1998), it was not used in the 2001 edition of the Red Book of Russia. The main argument was that the same criteria cannot be applied to all

groups of animals and plants (while the IUCN guidelines stated that this system of quantitative criteria is suitable for all organisms except microorganisms). In fact, upon deeper examination, the criteria system proved to be flexible and could be used to assess extinction threat for a wide range of organisms (Ilyashenko et al., 2018; Ushakov, 2019). Therefore, it was decided to use both the previous and new category systems in the third edition. The first, as mentioned above, was called rarity status categories, the second - extinction threat status categories. However, lawyers from the Russian Ministry of Natural Resources imposed certain restrictions. According to their conclusion, the List approved by the Ministry of Natural Resources of Russia, being an official state document, should contain only Russian symbols, therefore Russian translations of IUCN category names are allowed, but abbreviations in Latin letters are not. The compromise solution was to replace Latin letters in abbreviations with uppercase Russian letters in the List, and it was decided not to indicate quantitative criteria in the List. The abbreviations RE, CR, EN, VU, NT, LC, DD were replaced with IR (extinct in Russia), KR (critically endangered), I (endangered), U (vulnerable), BU (near threatened), NO (least concern), ND (data deficient) (Procedure..., 2016 [2]; Order..., 2020 [3]).

Nevertheless, in the text of the essays under the "Category and Status" heading, the use of IUCN categories with criteria in their true form is additionally allowed, therefore this heading in the third edition has quite a complex appearance: rarity status category + Russian extinction threat status category + (in parentheses) corresponding IUCN extinction threat category with criteria by which it

[2]Procedure for maintaining the Red Book of the Russian Federation. Appendix to the order of the Ministry of Natural Resources of Russia dated 23.05.2016 No. 306. With amendments as of 05.07.2021 (https://docs.cntd.ru/document/420359269?marker=6560IO. Version 05/2024).

[3]Order of the Ministry of Natural Resources of Russia dated 24.03.2020 No. 162 "On approval of the List of wildlife objects included in the Red Book of the Russian Federation" (https://docs.cntd.ru/document/564578614. Version 05/2024).

was determined + category with criteria for this species in the IUCN Red List, if it was assessed there + conservation status category (priority of conservation measures).

In addition to the categories of rarity status and extinction threat, a new group of categories was added to the third edition - categories of degree and priority of implemented and planned conservation measures (I, II and III priorities of conservation measures). Their necessity is due to the fact that different taxa with the same category of rarity or extinction threat require different degrees and urgency of special protection measures. Additionally, the real possibilities of implementing protective measures are taken into account (GOST R 59783-2021 [4]). Taxa of priority I require immediate implementation of comprehensive measures, including development and implementation of conservation strategy and/or restoration (reintroduction) program with action plans; taxa of priority II require implementation of one or several special measures for their conservation; for taxa of priority III, general measures provided by regulatory and legal acts of the Russian Federation for conservation of flora and fauna objects listed in the Red Book of Russia are sufficient (Order..., 2020 [3]). For lampreys, all species are assigned priority III. Among fish, priority I is assigned to eight taxa (Table 3). This means that conservation strategies or restoration (reintroduction) programs must be prepared and approved by the Ministry of Natural Resources of Russia for all of them. So far, only a draft restoration program for the Ezenami trout *S. t. ezenami* has been prepared. Priorities II and III were assigned to the remaining fish taxa in the ratio of

26:19 respectively.

Some problematic issues in maintaining the Red Book of Russia.

[4]GOST R 59783-2021 "Environmental protection. Biological diversity. Criteria for assessment of rare and endangered species of animals, plants and fungi." Approved and put into effect by Order of the Federal Agency for Technical Regulation and Metrology dated 21.10.2021 No. 1236-st (https://docs.cntd.ru/document/1200181382. Version 05/2024).

The name of the section "Category and Status" is, in our opinion, debatable. Firstly, the third edition presents several categories and statuses, therefore its name in the plural form would be more appropriate. Secondly, in IUCN publications (IUCN Red List ... , 2001, 2012), it is considered that the concept of "category" includes both the abbreviation (in IUCN - letters, in Russia - number and letters) and the category name. It turns out that in the second and third editions, the concepts of "category" and "status" are separated: category refers only to the number, while status refers to the name. It should be taken into account that in the "Procedure for maintaining the Red Book of the Russian Federation" approved by the Ministry of Natural Resources of Russia (Procedure..., 2016 [2]), the expression "status category" is used, i.e., category is included in the concept of "status". Probably, "Categories of Statuses" would be a more correct name for the section.

Let's consider how well the rarity status categories may correspond to extinction threat status categories. It can be immediately stated that they fundamentally correspond to each other, but not completely. Category 1 (threatened with extinction) fully includes the entire CR category (Critically Endangered) and the main part of the EN category (Endangered). Category 2 (declining in numbers and/or distribution) includes a small part of the EN category **)** and the main part of the VU category (Vulnerable). Category 3 (rare) includes the remaining part of the VU category and part of the NT category (Near Threatened). Category 4 (status undetermined) includes the main part of the DD category (Data Deficient). Category 5 (restored and recovering) corresponds to part of the LC category (Least Concern). Category 0 (probably extinct) formally has no correspondence in IUCN categories, as it only suggests the probability of species extinction (rather than definitively established), but in practice, especially in our regional books, it is often considered synonymous with RE (Regionally Extinct). The incomplete correspondence of categories makes their exact comparison difficult and may raise questions when the same rarity status category in one account corresponds to one extinction threat status category, while in another account it corresponds to a different one. A question arises: is the outdated system of rarity status categories really necessary? We suggest that in future editions it

would be advisable to use a single more progressive system of extinction threat status categories. There is also another interesting proposal - to combine both systems into one (Ushakov, 2019).

In the second edition, besides the main official List, there were three Appendices: 1) Annotated list of taxa and animal populations excluded from the Red Book of the Russian Federation (approved by the State Committee of the Russian Federation for Environmental Protection simultaneously with the main List); 2) Annotated list of taxa and populations of world fauna that have become extinct in the Russian Federation; 3) Annotated list of taxa and animal populations requiring special attention to their status in the natural environment. In the third edition, these appendices were abolished, although they contained much useful additional information. Thanks to Appendix 1, it was possible to quickly learn which taxa were excluded and for what reasons; thanks to Appendix 2, we remember the taxa that have completely disappeared, otherwise they might completely disappear from our memory; Appendix 3 included taxa whose status causes concern for various reasons and many of which may be included in the main List in the future. Regarding fish, this appendix played an important additional role. According to legislation, before final approval, the draft List must be coordinated with several ministries and departments, particularly for fish and other types of aquatic biological resources (ABR) - with Rosrybolovstvo, which is part of the Ministry of Agriculture of Russia. Including ABR in the Red Book of Russia means transferring several species from the control of the Ministry of Agriculture of Russia (in practice, from Rosrybolovstvo's control) to the control of the Ministry of Natural Resources of Russia. During coordination, controversial species are identified, some of which have to be excluded from the draft List. In this case, they were included in Appendix 3 and did not fall out of environmentalists' sight. Additionally, several fish species were included in Appendix 3 as potential candidates for the next edition of the Red Book of Russia, for which additional data needs to be collected. This appendix, playing an advisory role, has no legal force, therefore species included in it do not require coordination with Rosrybolovstvo and fully reflect environmentalists' opinion. It is

difficult to agree with the decision of the Ministry of Natural Resources of Russia to abolish all these Appendices.

A debatable question is how comprehensively separate threatened populations should be included in the Red Book of Russia. The genetic diversity of each species is determined by the combination of gene pools of its constituent populations. Therefore, ideally, all endangered populations should be preserved. However, it is impossible to register all of them in the federal Red Book. This task is more feasible for the Red Books of the Russian Federation subjects. At the same time, practice has shown that it is advisable to include certain threatened populations or groups of populations, for example, of particularly valuable or endemic species, in the Red Book of Russia, especially in cases when the composition of the entire species cannot be agreed upon with Rosrybolovstvo or when the population inhabits several subjects of the Russian Federation and coordinated actions are needed for its preservation. The question is how to correctly select populations deserving this status, distinguishing them among those that are sufficient to include only in the Red Books of the Russian Federation subjects.

Another unresolved issue is the problem of artificial reproduction of fish species listed in the Red Book of Russia. Historically, this was handled by the Main Basin Directorate for Fisheries and Conservation of Aquatic Biological Resources (Glavrybvod - one of the important subdivisions of Rosrybolovstvo), which has a network of state fish hatcheries. The main task of these hatcheries is the artificial breeding of commercially valuable fish species to replenish their stocks in water bodies. Species listed in the Red Book of Russia fall completely under the jurisdiction (management) of the Ministry of Natural Resources of Russia, which does not have its own fish hatcheries but is responsible for preserving "its" species. Traditionally, Glavrybvod continues artificial breeding of Red Book species, but the issue of funding for these works remains unresolved. Additionally, Glavrybvod's local branches must obtain special permits from the Federal Service for Supervision of Natural Resources (Rosprirodnadzor - an agency of the Ministry of Natural Resources) for maintaining broodstock,

catching spawners in the wild to replenish (update) broodstock, and releasing raised juveniles into natural water bodies. Bureaucratic complications are inevitable here. It happens that Rosprirodnadzor officials repeatedly "return" document packages submitted for obtaining permits. Time delays result in significant costs for fish hatcheries. A clear example of the lack of inter-agency understanding is the fate of the Baltic sturgeon restoration program, developed under VNIRO's leadership by the country's most competent sturgeon specialists. This program was approved by Rosrybolovstvo's management and received funding. The Rosprirodnadzor Commission twice rejected VNIRO's application to catch sturgeon specimens for implementing this program, probably failing to understand it. As a result, the program was not implemented. In our view, the above pushes Glavrybvod and Rosrybolovstvo to abandon the reproduction of Red Book fish species, which in some cases may negatively affect their conservation, as some species are currently completely deprived of natural spawning opportunities.

Conclusion

Maintaining Red Books implies not only their periodic publication (at least once every 10 years) but also allows adding new species or excluding previously included ones when necessary, as well as improving the maintenance procedures and structure of the books themselves. The International Union for Conservation of Nature has accumulated the most extensive experience in maintaining the Red Book and subsequently the Red List. This experience was used in creating and maintaining domestic Red Books. The category system used by IUCN until 1996 formed the basis for the domestic system of rarity status categories, which is presented in all three editions of the Red Book of Russia. Since 1996, IUCN has used a new, more progressive category system with quantitative criteria, which in the 2021 edition of the Red Book of Russia was also used as the foundation for the second Russian category system - extinction threat statuses. Unlike IUCN lists, our Red Books, or

more precisely, the approved Lists, are official documents, and executive bodies are obligated to implement actions for the conservation of listed taxa and populations.

In Russia, there have been three editions of the Red Book (Volume "Animals"). Changes in the considered sections were observed in each edition. The first edition in 1983 included only nine fish taxa, which certainly did not reflect the real situation with threatened species. The release of the second edition in 2001 coincided with a difficult transition period in our country. Nevertheless, the edition was published and, compared to the first one, it included lampreys (three species) and 39 fish species. A positive aspect of the second edition was the appearance of Appendices. Appendices 2 and 3 had no legal force but contained much useful additional information, and Appendix 3, in particular, presented taxa that could not be agreed upon with Rosrybolovstvo (Federal Agency for Fishery), but which, according to IUCN criteria, fell into categories with threatened status. Therefore, being in this Appendix, they did not fall out of the ecologists' field of view. In the third edition, published in 2021, the list of included taxa did not change quantitatively but was updated. Two new category systems were also added: categories of extinction threat and categories of conservation measure priorities, which was an important step toward improving the assessment of taxa status and their protection. Unfortunately, the Appendices that were in the second edition were abolished in the third one.

The next edition is expected to be prepared in 2030 or in the following years. Most likely, it will eliminate the need for a system of rarity status categories, and it will be completely replaced by a more advanced system of extinction threat status categories with a set of quantitative criteria and conservation priority categories. The following approach to preparing the new List seems appropriate. Using the system of quantitative criteria, assess the degree of extinction threat for all fish and lamprey species found in Russian freshwaters, as well as in the Caspian and Azov seas, identify threatened species, assign them categories of extinction threat status and conservation priorities, and include them in the draft new List. Restore the Appendices to the Red Book of Russia, as it was in the second edition, and include those species from the draft List that cannot be agreed upon with Rosrybolovstvo

in Appendix 3, along with some other threatened taxa that for various reasons did not make it into the main list. The heading "Category and Status" should also be corrected to the more accurate "Status Categories." The interdepartmental issue of artificial reproduction of several fish species listed in the Red Book of Russia should, in our opinion, be resolved at the government level through centralized funding from compensation funds.

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COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that this work is a review and was not associated with direct research on fish or other animals, therefore does not require approval from the bioethics committee.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflict of interest.

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