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Fish diversity in freshwater and brackish water ecosystems of Russia and adjacent waters

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Abstract. In the present paper, the history of fish faunistic and taxonomic knowledge is analyzed, and the freshwater and brackish water fish diversity in the territory of the Russian Federation and adjacent areas is examined. An overview of higher taxa and species is presented (3 classes, 26 orders, 100 families, and 317 genera), including a total of 719 native fish species (plus 36 introduced species, and also 16 species not yet recoded for Russian waters, but expected in the future, and 20 species that were previously removed from the ichthyofauna of Russia due to taxonomic changes; total number in all categories 791 taxa). The Russian water includes freshwater 353, brackish 329, diadromous 82, and amphidromous 27 species. A total of 103 endemic species in the native ichthyofauna adds to an endemism rate of 14,3%. This study significantly increases the total number of fishes ecologically related to fresh and brackish waters of Russia. The native freshwater and brackish water ichthyofauna of the Russian Federation consists of approximately 4% of the global fish species. The fish diversity in selected river systems and lakes is also discussed, with respect to ecoregions, latitude and longitude, and compared with the fish faunas of Europe and North America (north of 50° N).

Keywords: Fish species Diversity, Native species, Non-native species, Endangered and protected species, Endemic species, Russia, Eurasia

Table of contents

1. Introduction

The Russian Federation is the largest country in the world, covering one-eighth of the earth´s terrestrial surface, i.e. more than 17 million km^2, approximately equalling the size of South America. Located in Eurasia, it also includes numerous islands and archipelagos; among those, Sakhalin is the largest single island (more than 77,000 km^2), while Novaya Zemlya (more than 83,000 km^2), Severny (approx. 37,000 km^2) and Franz Josef Land (16,300 km^2) are the largest archipelagos. The freshwater drainage systems comprise more than 3 million rivers and the same number of various lakes across the country. Specific climatic conditions (often severe, because 65% of the country´s territory is subjected to permafrost, having 5–6 snow months, but in some regions, there also are 10–11 winter months), inaccessibility, low population density (e.g. in Siberia or the Russian Far East), extremely long sea coasts and other important factors have significantly influenced the fish species richness and diversity. The Ural Mountain Range is part of the conventional boundary between the continents of Europe and Asia.

Aquatic ecosystems are among the most important components of the Earth's biosphere, and fish populations among their most significant biocenotic elements. Fishes are the largest and oldest (400 million years old) group of vertebrates (Sokolov, 1994). Currently, more than 35,423 valid species are recognized (Fricke et al., 2020a), although twenty years ago the global ichthyofauna was estimated to comprise a little more than 20,000 species (Sokolov, 1994), and 300-500 new fish species are added every year (Fricke et al., 2020b).

The first comprehensive systematic data on the Russian fish fauna in the former Russian Empire, both from fresh and marine waters, were provided by the excellent natural scientist Peter Simon Pallas (Pallas, 1814; biography see Svetovidov, 1981), in the third volume of his three-volume publication, generally entitled Zoographia Rosso-Asiatica. Previously, just a few Russian freshwater fish species, mostly salmonids, had been described by the German apothecary Johann Julius Walbaum (Walbaum, 1792; biography see Müller, 1973), based on the Arctic research of Pennant (1784–1785) [including *Cyprinus carpio caspicus* Walbaum, 1792, *Salmo gorbuscha* Walbaum, 1792, *S. kayko* Walbaum, 1792, *S. keta* Walbaum, 1792, *S. kisatch* Walbaum, 1792, *S. malma* Walbaum, 1792, *S. milktschutsch* Walbaum, 1792, *S. muikisi* Walbaum, 1792, *S. mykiss* Walbaum, 1792, *S. nerka* Walbaum, 1792, *S. palja* Walbaum, 1792, *S. tshawytscha* Walbaum, 1792]. Pallas's comprehensive study formed a robust background for further research on fishes in the Russian Empire. Only a century later, the efforts were continued by Gratzianov (Gratzianov, 1907) in his publication "Versuch einer Übersicht der Fische des Russischen Reiches".

Among recent studies, the monography "Place of Ichthyofauna of Russia in the System of World Fish Fauna" by Romanov (2015) presenting knowledge of marine and fresh water fishes of the Russian Federation and providing short information on 1,450 fish species should be mentioned. The first individual monographs for the Russian Empire and the former Soviet Union were publications by L. S. Berg in the early 20th century, entitled "Fauna of Russia and Adjacent Countries" [Faune de la Russie & des pays limitrophes. Poissons (Marsipobranchii & Pisces)], (e.g. Berg, 1911, 1912, 1914). In 1916, Berg provided generalized information on the entire freshwater ichthyofauna for the first time, and presented it in a separate monograph "Les Poissons des eaux douces de la Russie", which was the second, revised edition of this monograph "Freshwater fishes of Russia. A second edition" appeared in 1923, where the author included 283 species and 95 subspecies. The same author later significantly amended and summarized the knowledge of the fundamental review "Freshwater fishes of the U.S.S.R. and adjacent countries" (Berg, 1948, 1949a, 1949b). For Russia in its current boundaries, monographs were published by a team of authors and edited by Reshetnikov (Reshetnikov, 1998, 2003): "Annotated check-list of Cyclostomata and fishes of the continental waters of Russia" and "Atlas of Russian freshwater fishes", and by Bogutskaya and Naseka "Catalogue of agnathans and fishes of fresh and brackish waters of Russia with comments on nomenclature and taxonomy" (Bogutskaya and Naseka, 2004). Some information on fresh, brackish and migratory fishes was also presented by N.V. Parin and his colleagues (Parin, 2001, 2003; Parin et al., 2002; Evseenko, 2003; Vasil'eva, 2003b; Fedorov, 2004), including the recent monograph "Fishes of Russian Seas: annotated catalogue" (Parin et al., 2014).

For a country as extensive as Russia, the number of such comprehensive treatments of the fish fauna seems fairly low. This low number may be partly due to the fact that in the so-called Russian ichthyological scientific schools, traditionally either marine or freshwater fish groups were studied exclusively. This restricted approach limits the possibilities of research of the general ichthyofauna.

The fundamental works of Berg (1948, 1949a, 1949b) on the freshwater ichthyofauna of the U.S.S.R. provides information on 375 species and 153 subspecies (together 528 taxonomic units) of fishes and fish-like vertebrates. Reshetnikov (1998) recorded 351 species in 17 orders, 47 families, and 178 genera from the continental waters of Russia (including estuarine and brackish fishes). In the atlas of Reshetnikov (2003) only 293 species are included, representing 13 orders, 33 families, and 138 genera. This decrease in the number of species, compared to Reshetnikov (1998), is connected to the fact that the atlas only included species that exclusively live and reproduce in freshwater. According to the latest revision of Bogutskaya and Naseka (2004), the freshwater and brackish water ichthyofauna of Russia includes 486 species arranged in 18 orders, 43 families, and 175 genera (Fig. 1).

The study of taxonomic material accumulated over more than 200 years and our data collected for many years allows us for the first time to analyze and provide generalized data for the entire territory of Russia and adjacent waters in various aspects, such as conservation status, introductions, anadromous species, freshwater and brackish species, the degree of endemicity, and taxonomic status.

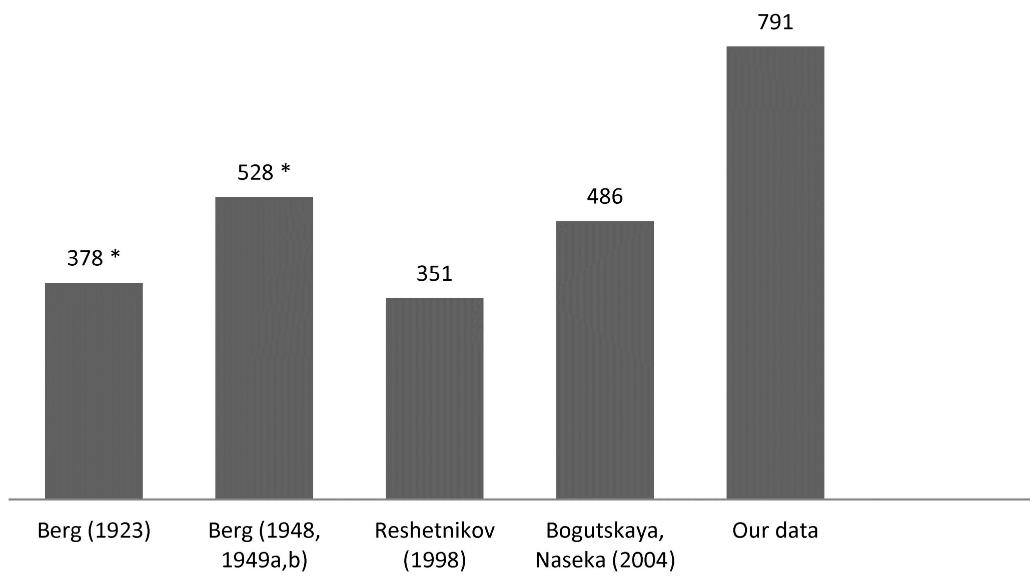

Fig. 1. Total number of freshwater and brackish-water fish species of Russia according to various authors over the past 100 years. * – total number of species with subspecies.

2. Material and Methods

This work is based mainly on critically analyzed sources of literature (books, publications, dissertations, and reports of research institutes), type catalogs and databases, for example, "Eschmeyer's Catalog of Fishes" (Fricke et al., 2020a) or Global Biodiversity Information Facility (GBIF, 2019). Practically for all fish species, sources containing information on the original description were studied and analyzed.

The last lifetime edition of "Fishes of the world" by Nelson is dated 2006. So far, in May 2016, the 5th post-mortem edition of J. Nelson's "Fishes of the world" was published with two co-authors. It should be mentioned that in the last century, Russian systems were used for the classification of fish, such as (Berg, 1955; Lindberg, 1971; Rass and Lindberg, 1971; Rass, 1983, and others). Our classification follows Fricke et al. (2020a) and van der Laan et al. (2014) with some additions.

Depending on the ecological features, each individual valid species was assigned to one of the following ecological groups: brackish water, freshwater, anadromous (where we included anadromous species and one catadromous, including anadromic derivatives – so-called residential forms), and amphidromic. At the same time, working with literary sources (including our data), we found a number of indications for many species, that marine fishes living in sea waters with normal oceanic salinity can be noted both in brackish lagoons and in estuaries and the lower reaches of rivers. We included all such species in this work. Nevertheless, in authoritative large taxonomic databases (such as WoRMS, FishBase and many others) and various published scientific data, some of them are presented only as marine ones, which is erroneous and gives an incorrect judgment about their ecology of habitat.

We studied the conservation status for each species, according to the Red Book of the Russian Federation RDBRF (2000, 2016–2020, in press), and the Red List of the International Union for Conservation of Nature IUCN (2003, 2012, 2015, 2019) and compared them. It should be noted that according to the IUCN criteria, the following categories are distinguished: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient, Not Evaluated. And the following categories are distinguished in the Red Book of the Russian Federation for the mentioned purposes: Category 0 − Probably Extinct, Category 1 − Endangered, Category 2 − Decreasing Number, Category 3 − Rare, Category 4 − Uncertain Status, Category 5 − Rehabilitated and Rehabilitating.

Parabolic relationships between some river basin areas and a number of species were calculated (see Welcomme, 1985). Zoogeographic integrity coefficient (ZIC), i.e. the number of native species divided by the total number of species (Bianco, 1990), was also computed. To compare fish species diversity, the selected standing and running waters located approximately 50° N in Central and North Europe, namely the Rhine (Brenner et al., 2004; Tockner et al., 2009), the Meuse (Descy, 2009), the Elbe (Pusch et al., 2009), the Oder (Rembiszewski and Rolik, 1975; Pusch et al., 2009; Tockner et al., 2009), the Vistula (Rembiszewski and Rolik, 1975; Tockner et al., 2009), and North American rivers (Benke and Cushing, 2006; Scott and Crossman, 1973; Richardson and Milner, 2010; Reynoldson et al., 2010) were used.

3. Results and Discussion

3.1. General characteristic of selected water ecosystems and their fish biodiversity

Russia shares international borders with 18 countries. The total border river length is more than 7,000 km, and for the lakes is approximately 500 km. Most fish are known to perform natural migration during their life cycles (for spawning, feeding, for wintering, due to changes in temperature conditions, etc.) (Lucas and Baras, 2001). Therefore, some of the fishes can be met in neighbouring countries, both in marine and inland fresh waters. Consequently, we cannot take into account all the fish only within the Russian Federation´s borders, except for endemic species (e.g. endemic of lakes to Baikal and El'gygytgyn).

Globally, there are up to 50 seas of various categories, internal, marginal, inter-island, and others (Zaitsev, 2006). Russia shares 13 of those seas: the Baltic, Black, Azov, Barents, White, Kara, Laptev, East Siberian, Chukchi, Bering, Okhotsk, and Japan, including the inner Caspian Sea. These seas belong to the three oceans – the Atlantic, the Arctic, and the Pacific. Russia has an open access to two oceans – Pacific (extremity of Kamchatka Peninsula, eastern coasts of Commander, and the Kuril Islands) and the Arctic (Arctic seas from the Barents east to Chukotka).

According to the Venice System for the Classification of Marine Waters According to Salinity, adopted at the International Limnological Congress in 1959 in Venice, the following categories were adopted: freshwater (salinity to 0,5 ‰), mixogaline or brackish (0,5–30,0 ‰), oligogaline (from 0,51–5,0 ‰), mesohaline (from 5,1 –18,0 ‰), polyhaline (from 18,1–30,0 ‰), eugaline, or marine (from 30,1–40 ‰) and hyperhaline, or oversalted (more than 40 ‰) (Zaitsev, 2006). At the same time, the salinity of the world ocean, depending on latitude and climate, reaches 32 to 36 ‰.

The Baltic, Black, Azov, and Caspian seas have a low salinity from 2‰ to 18‰, where the lowest salinity is observed in the Baltic surface waters from 2‰ in the Gulf of Finland to 9‰ off the coast of Kaliningrad Region; second and third for salinity are the Caspian Sea (from 2‰ in the northern part to 13‰ in the south) and the Sea of Azov (11–13‰), followed by the Black Sea (17–18‰ to 10–12‰ along the coast in places the confluence of large rivers; salinity increases with increasing depth) (Table 1).

Table 1. General characteristics of brackish seas of Russia and adjacent countries with quantitative structure of ichthyofauna.

Seas	**Total area, km^2**	**Maximum depth, m**	**Salinity, ‰.**	**Total fish species**
Caspian Sea	393,000	1025	2,0–13,5	119[1]
Sea of Azov	37,600	14	9,6–13,7	120[2]
Black Sea	423,000	2212	17,5–18,0	180[3]
Baltic Sea	419,000	470	2,0–11,0	239[4,*]

[1]Bogutskaya et al., 2013; [2]Diripasko et al., 2011; [3]Zaitsev, 2006; [4,*]including straits connecting it with the North Sea with normal salinity close to oceanic (Kontula and Haldin, 2012).

Similar natural reservoirs with a salinity not exceeding 30‰ are located east of the White Sea to the East Siberian Sea. Huge masses of freshwater that affect the salinity of the White, Kara, Laptev, and East Siberian seas, originating from the largest rivers of Siberia. In summer, salinity decreases significantly due to melting of ice. Thus, the salinity does not exceed 16–22‰ near the coasts, but is reduced to about 0‰ near the estuaries of Siberian rivers.

Russia is rich in internal fresh waters, such as rivers, lakes, and marshes (the world's largest mire Great Vasyugan, with a total area of more than 50,000 km^2, is located in Western Siberia), including anthropogenic (artificial) water reservoirs such as, reservoirs and ponds.

Ob River with its tributary Irtysh (the total length in Russian territory equals 5,660 km), as well as large rivers as Amur, Lena, Yenisei, Volga, Ural, Severnaya Dvina, and Pechora are among the longest river systems in Russia (Table 2). It is assumed that the total number of rivers of different lengths and classifications on the territory of Russia equals about 3 million, with a total length of more than 8 million km. At the same time, the total length of rivers with economic importance is 523,000 km.

The Russian Lake Baikal is the oldest and deepest freshwater lake in the world, and the 6th largest lake, according to various estimates 25 to 35 million years old. The number of lakes, according to different classifications and origin (according to some estimates, their useful area amounts to 22,5 million hectares) equals more than 3 million (Table 3). For example, in Yakutia alone, lakes with an area of more than 1 hectare amount to more than 700,000 (Kirillov, 1972).

In addition, there are 2,200 artificial reservoirs with a total area of more than 60,000 km². The largest of them include Kuibyshev (6,200 km²), Bratsk (5,500 km²), Rybinsk (4,500 km²), Volgograd (3,100 km²), Tsimlyanskoe (2,700 km²), Nizhnekamsk (2,600 km²), Zeya (2,400 km²), Cheboksary (2,300 km²), Khantai (2,100 km²), and Krasnoyarsk (2,000 km²) (Table 4).

Nevertheless, the construction of a number of reservoirs, in spite of their usefulness (obtaining energy and regulating flood waters), has led to the disappearance of a number of valuable populations of anadromous fish species, such as sturgeons, herrings, salmons and migratory lampreys (both in the European part of Russia and in the Far East Region). This trend is typical for similar structures throughout the world. However, under favorable conditions and proper protection, in the headwaters of the rivers above the dams, populations of graylings, taimen, lenok, and other valuable fish species may be preserved, which do not need extended migrations, albeit with a possible decrease in their total biomass. Another interesting fact is that some migratory species (e.g. *Alburnus leobergi, Rutilus frisii, Stenodus nelma, Parahucho perryi*), after damming the rivers with dams, are able to create reservoir forms (which are not observed in the natural environment in this type of habitat), for example, in some reservoirs of the European part of Russia, Siberia, and the Far East of Russia (see below).

It should also be noted that in the Russian North Pacific, there are a large number of brackish lagoons, which are the most numerous along the coast of Sakhalin Island, where over 170 species are noted (Dyldin and Orlov, 2016a). Lagoons are unique ecosystems, which are of great importance for the reproduction and feeding of fishes (Mariani, 2001; Perez-Ruzafa et al., 2004) because of a high production rate of organic substances. In addition, lagoons facilitate the process of salinity adaptation, including the development of new ecological niches. For predominantly freshwater species, they mainly provide an additional food source, while for marine species they offer more favorable and protected reproduction sites. Lagoons are considered as areas of extremely important economic importance for commercial fishery and mariculture (Dyldin and Orlov, 2016a).

Russia is located in four climatic zones – Arctic, subarctic, temperate, and subtropical. Most important is a temperate climatic belt in the main area of Russia, followed by a large area occupied by Arctic and subarctic regions, but the latter are characterized by an extremely low fish diversity, both in coastal areas and in rivers. For example, in the basins of the East Siberian Sea and the Laptev Sea, the number of species does not exceed 59 (Kirillov et al., 2014), and in the Khantai and Taimyr lakes, respectively, approximately 20 species (Mikhin, 1955; Romanov and Tyulpanov, 1985; Romanov, 2004). The Khantai Lake is characterized by a high diversity of the genus *Salvelinus*, including several sympatrically occurring species: *Thymallus arcticus* (Pallas, 1776) and *Th. baicalensis* Dybowski, 1874 and, possibly, *Th. brevipinnis* Svetovidov 1931, as well as two species of vendace – *Coregonus albula* (Linnaeus, 1758) and *C. sardinella* Valenciennes, 1848.

Several different lakes, including the so-called "ancient" lakes, are characterized by endemic fish species, such as Lake Baikal, Siberia (at least 36 endemic species) and Lake El'gygytgyn (two endemic species *Salvelinus elgyticus* Viktorovsky & Glubokovsky, 1981 and *Salvethymus svetovidovi* Chereshnev & Skopets, 1990) in the upper reaches of the Anadyr River, in the central part of Chukotka.

Table 2. The largest rivers of Russia and adjacent countries and their quantitative structure of ichthyofauna.

Rivers of Russia and adjacent countries / confluence of the sea	Total length, in thousands of km / Total area, in thousands of km^2	Total species by Berg*	Total species by others
Sakhalin Island / Russian Far East			
Poronai River / Sea of Okhotsk	0,35 / 7,990	-	35[1]
Tym' River / Sea of Okhotsk	0,33 / 7,850	-	35[1]
Lyutoga River / Sea of Okhotsk	0,13 / 1,530	-	36[2]
Primorsky Krai / Russian Far East			
Tumen River / Sea of Japan	0,55 / 32,200	-	54[3]
Samarga River / Sea of Japan	0,22 / 7,760	-	21[4]
Russian Far East			
Amur River / Sea of Okhotsk	4,3–4,5 / 2,050,000	85	123[5]
Kamchatka Peninsula / Russian Far East			
Penzhina River / Sea of Okhotsk	0,71 / 73,500	-	21[6]
Talovka (Kuyul) River / Sea of Okhotsk	0,46 / 24,100	-	21[6]
Kamchatka River / Pacific Ocean	0,76 / 55,900	-	24–26[7]
Russian Far East			
Anadyr River / Bering Sea	1,15 / 191,000	29	31[8]
Russian Arctic region			
Kolyma River / East Siberian Sea	2,1 / 643,000	32	33[9]
Alazeya River / East Siberian Sea	1,6 / 65,000	-	24[10]
IndigirkaRiver / East Siberian Sea	1,7 / 360,000	-	32[11]
Lena River / Laptev Sea	4,3 / 2,490,000	45	46[12]
Yana River / Laptev Sea	0,9 / 238,000	-	36[10]
Yenisei River / Kara Sea	3,5 / 2,580,000	45	50[13]
Ob River with its tributary Irtysh / Kara Sea	5,6 / 4,633,000	46	> 70[14]
Pyasina River / Kara Sea	0,8 / 182,000	-	38[21]
Khatanga River / Laptev Sea	1,6 / 364,000	-	28[15]
Pechora River / Barents Sea	1,8 / 322,000	32	36[16]
Northern Dvina River / White Sea	0,7 / 357,000	36	39[16]; 48[17]
European part of Russia			
Neva River / Baltic Sea	0,07 / 5,000	44	-
Western Dvina River / Baltic Sea	1,0 / 88,000	43	< 50[22]
Neman River / Baltic Sea	0,9 / 98,200	-	36[23]
Volga River / Caspian Sea	3,5 / 1,360,000	62	96[18]
Ural River / Caspian Sea	2,4 / 237,000	55	58
Don River / Sea of Azov	1,9 / 422,000	62	77[19]; 78[20]
Kuban River / Sea of Azov	0,9 / 57,900	57	95[20]
Dnieper River / Black Sea	2,2 / 504,000	73	93[20]

*Berg, 1949b; [1]Nikiforov, 2001; [2]Nikitin et al., 2013; [3]Sokolovsky and Epur, 2008; [4]Semenchenko, 2003; [5]Bogutskaya et al., 2008; [6]Koval et al., 2015; [7]Bugaev, 2007; [8]Chereshnev et al., 2001; [9]Chereshnev, 2008; [10]Kirillov, 1972; [11]Kirillov and al., 2008; [12]Kirillov and Knizhin, 2014; [13]Vyshegorodtsev and Zadelenov, 2013; [14]V.I. Romanov, unpubl. data; [15]Kirillov et al., 2014; [16]Sidorov and Reshetnikov, 2014; [17]Novoselov et al., 2015; [18]Slyn'ko et al., 2000; [19]Ivanchev et al., 2013; [20]Vasil'eva, 2003a; [21]Zadelenov, et al. 2019; [22]Kalinin and Pakhomov, 2008; [23]Shibaev et al., 2016.

Table 3. Largest freshwater lakes of Russia and adjacent countries and their quantitative characteristic of ichthyofauna

Lakes	Total area, in km^2 / the entire basin area, in km^2 // Maximum depth, in m	Total species / Sources
European part of Russia		
Ladoga	17,872 / 258,600 // 230,0	43 / Kudersky, 2007
Onega	9,720 / 62,800 // 127,0	36 / Kudersky, 2007
Ilmen	1,090–1,200 / 67,200 // 4,0	25 / Kudersky, 2007
Sjamozero	0,276 / 1,609 // 24,5	21 / Kudersky, 2007
Peipus	3,555 / 47,800 // 15,0	32 / Kudersky, 2007
Siberia		
Taimyr	4,560 / 104,300 // 26,0	17 / Romanov and Tyulpanov, 1985
Khantai	0,822 / 11,900 // 475,0	> 26 / Romanov, 2004
Teletskoye	0,230 / 20,800 // 325,0	12 / Zhuravlev, 2003
Baikal	31,720 / 570,000// 1637,0	61 / Sideleva, 2004
Russian Far East		
Khanka	4,190 / 17,500 //10,0	100 / Bogutskaya et al., 2008

Table 4. Large reservoirs of Russia with a characterisation of their ichthyofauna.

Reservoirs with a total area up to 1,0 thousand km^2/ Region and river where these reservoirs are located	Total area, in thousands of km^2	Total species / Source
Kuibyshev / Volga River, Samara Region	6,2	58 / Shakirova and Severov, 2014
Bratsk / Irkutsk Region, Angara River, Yenisei basin	5,5	49 / Ponkratov, 2014
Rybinsk / Yaroslavl Region, Volga River and its tributaries	4,5	54 / Gerasimov, 2015
Volgograd / Volgograd and Saratov regions, Volga River	3,1	61 / Shashulovsky and Ermolin, 2005
Tsimlyanskoe / Volgograd and Rostov regions, Don River	2,6	49 / Vekhov et al., 2014
Nizhnekamsk / Subjects of the Russian Federation: Tatarstan, Bashkortostan, Udmurtia, Kama River, Volga basin	2,6	42 / Shakirova *et al.*, 2013
Zeya / Amur Region, Zeya River, Amur basin	2,4	26 / Kotsyuk, 2009
Cheboksary / Chuvash, Mari El republics and the Nizhny Novgorod Region, Volga River	2,3	54 / Gerasimov, 2015
Khantai / Krasnoyarsk Krai, Khantai River	2,1	18 / Karmanova, 2004
Krasnoyarsk / Krasnoyarsk Krai, Yenisei River	2,0	26 / Chugunova and Vyshegorodtsev, 2012
Kama / Perm Krai, Kama River, Volga basin	1,9	40 / Zinov'ev, 2014
Ust'-Ilimsk / Irkutsk Region, Angara River, Yenisei basin	1,9	23 / Kupchinskiy and Kupchinskaya, 2006
Saratov / Saratov, Samara and Ulyanovsk regions, Volga River	1,8	52 / Ermolin, 2010
Sheksna / Vologda Region, Sheksna River, Volga basin	1,7	54 / Gerasimov, 2015
Gorky / Yaroslavl, Kostroma, Ivanovo and Nizhny Novgorod regions, Volga River	1,6	54 / Gerasimov, 2015
Votkinsk / Perm Krai and the Udmurt Republic, Kama River, Volga basin	1,1	40 / Zinov'ev, 2014
Novosibirsk / Novosibirsk Region, Ob River	1,0	27 / Popov et al., 2000

3.2. Structure of the Russian ichthyofauna

3.2.1. Freshwater fishes

In this category, we include two groups of fishes. The first group includes species exclusively living in freshwater (282 species), such as the cyprinid species *Abbottina rivularis* (Basilewsky, 1855) and *Acheilognathus asmussii* (Dybowski, 1872) which are associated with freshwater during their entire life cycle.

In the second group we include freshwater species reproducing in freshwater, which are mostly associated with freshwater habitats, but express tolerance to a weak salinity and may be found in estuaries of rivers, which are used as feeding grounds (e.g., *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus hohenackeri* Kessler, 1877, and *Leuciscus aspius* (Linnaeus, 1758). This group includes 71 species.

3.2.2. Brackish water fishes

This category includes marine, brackish and freshwater species, which are divided into four groups with 329 species.

The first group (259 species) includes species which are not found in freshwater and which are, depending on their life strategy, either permanent residents of brackish waters (e. g. *Belone belone* or several species of the tetraodontid *Takifugu* genus), or temporary residents of brackish-water habitats (e. g. *Occella dodecaedron, Liparis dubius*, or, several cartilaginous fishes).

In the second group (27 species), we include species that occur in marine and brackish water as well as freshwater habitats, such as the lower reaches of rivers, or is capable of forming freshwater residential forms: *Protosalanx chinensis, Atherina pontica, Syngnathus caspius, S. nigrolineatus, Megalocottus taeniopterus, Myoxocephalus quadricornis, M. stelleri, Porocottus japonicus, P. tentaculatus, Lateolabrax japonicus, Sander lucioperca, Chelon labrosus, Planiliza haematocheilus, Clupanodon thrissa, Scatophagus argus, Liopsetta glacialis, L. pinnifasciata, Myzopsetta punctatissima, Platichthys bicoloratus*, *P. flesus, P. luscus, P. stellatus* and *Pleuronectes platessa*. Four species are capable of forming freshwater residential forms: *Clupea harengus, Morone saxatilis, Liza ramada* and *Lepidopsetta mochigarei*.

In the third group (26 species), we include species that occur only in brackish water: *Alosa braschnikowi, A. curensis, A. saposchnikowii, A. sphaerocephala, A. suworowi, Clupeonella engrauliformis, C. grimmi, Anatirostrum profundorum, Benthophilus abdurahmanovi, B. baeri, B. casachicus, B. ctenolepidus, B. grimmi, B. kessleri, B. leptocephalus, B. leptorhynchus, B. pinchuki, B. ragimovi, B. spinosus, B. svetovidovi, Knipowitschia iljini, Mesogobius nonultimus, Neogobius caspius, Ponticola bathybius, P. goebelii* and *Proterorhinus nasalis*.

In the fourth group (17 species), we include species that occur only in brackish and fresh water: *Atherina caspia, Percarina demidoffii, P. maeotica, Babka gymnotrachelus, B. macrophthalmus, Benthophilus leobergius, B. macrocephalus, B. magistri, B. mahmudbejovi, B. nudus, B. stellatus, Caspiosoma caspium, Hyrcanogobius bergi, Knipowitschia longecaudata, Ponticola eurycephalus, P. gorlap* and *P. syrman*.

3.2.3. Diadromous fishes

This group includes migratory species performing either catadromous or anadromous migrations. On the territory of Russia, there is just a single catadromous species (*Anguilla anguilla*), but 74 species (plus 2 species *Acipenser colchicus* and *Salmo caspius* recorded in adjacent waters and which can be noted in the waters of Russia and one successfully naturalized species *Alosa sapidissima*) with anadromous migrations (including representatives of Salmonidae, Cyprinidae, Acipenseridae, Clupeidae, and other families) (Appendix Table 1). This group also includes residential forms (54 species) that are derived from anadromous species.

3.2.4. Amphidromous fishes

In the amphidromous category, we refer to fish species that have adapted to reproducing in freshwater and brackish and marine, and whose life cycle is equally related to both marine and fresh water. There are 27 such species, however, two of them (*Gymnogobius cylindricus* and *Rhinogobius brunneus*), due to taxonomic changes, are now not considered as members of the Russian ichthyofauna: *Clupeonella caspia*, *C. cultriventris*, *Pelecus cultratus*, *Cottus amblystomopsis*, *C. czerskii*, *C. hangiongensis*, *Acanthogobius flavimanus*, *A. lactipes*, *Gymnogobius breunigii*, *G. castaneus*, *G. macrognathos*, *G. opperiens*, *G. petschiliensis*, *G. taranetzi*, *G. urotaenia*, *Luciogobius guttatus*, *Tridentiger bifasciatus*, *T. brevispinis*, *Benthophilus granulosus*, *Knipowitschia caucasica*, *Mesogobius batrachocephalus*, *Neogobius fluviatilis*, *N. melanostomus*, *N. pallasi*, *Ponticola ratan*.

3.2.5. Species with disputable taxonomic status

This category comprises two groups. In the first group, we include 34 species whose taxonomic status are in question, often according to molecular data, with species that are invalid or include a complex of synonyms or undescribed species, which in the future may receive the status of valid species (Appendix Table 2).

The second group included 20 species, which due to taxonomic changes were eliminated from the Russian fish fauna, mainly due to the revision of the synonyms (Appendix Table 3).

3.2.6. Species that are not found in the waters of Russia but are expected in the future

In this section, we included 16 species that have been recorded from adjacent waters; it is highly likely that they will be reported from Russian waters in the future:

Lampetra lanceolata, *Acipenser colchicus*, *Gobio acutipinnatus*, *Hemiculter varpachovskii*, *Microphysogobio anudarini*, *Cobitis amphilekta*, *Barbatula sawadai*, *Thymallus nigrescens*, *Salmo caspius*, *Cottus microstomus*, *Oblada melanura*, *Argyrosomus regius*, *Callionymus fasciatus*, *Anatirostrum profundorum*, *Benthophilus pinchuki* and *B. svetovidovi*.

3.2.7. Introduced species

We use the term introduced species to indicate species that have intentionally or accidentally been introduced into Russian water ecosystems where they did not previously exist without human interference. These introduced species introduced into Russian waters originate from North and South America, Asia, Europe, or Africa. In this group we consider only those introduced species that have never been native to any part of Russia and that are presently used, or have been used in the past, mainly in aquaculture, or where naturalization is fixed, only in limited areas in the warmest part of artificially warm water bodies, for example, at a thermal power station. These species usually originate from warmer countries and are not adapted to life in the colder waters of Russia, and naturalization does not occur under natural conditions. Here we report 36 introduced species (Appendix Table 4).

3.2.8. Endangered and protected species

An updated list of species for inclusion in the new edition of the Red Data Book of the Russian Federation (RDBRF) was recently presented (as of September 19, 2016) on the state website of the Ministry of Natural Resources and Ecology of the Russian Federation,

(http://oopt.aari.ru/sites/default/files/documents/ministerstvo-prirodnyh-resursov-i-ekologii-Rossiyskoy-Federacii/N_01-09-2016.pdf). It should be noted that the previous edition of the RDBRF, which by the rules of the Russian Federation in addition to the official printed version, is located at free access as an electronic resource

(http://www.mnr.gov.ru/docs/strategii_i_doktriny/strategiya_sokhraneniya_redkikh_vidov_zhivotnykh/128273/?sphrase_id=44323).

Below we provide a list of RDBRF in 2000, fish species that are planned to be included in the new version of RDBRF in 2019, as well as Russian species listed in the IUCN Red List of Threatened Species up to the end of 2019 (Appendix Table 5). In addition, we provide a taxonomic comparison of the status for each fish species listed in RDBRF (2000, 2020 in press). However, in the RDBRF data for 2016, a number of taxonomic changes of fish species have not been analyzed and taken into account, which in the future may create a taxonomic confusion. The data we present here are aiming to avoid unnecessary future taxonomic problems when assigning a conservation status for individual taxa.

Analyzing the information provided in Appendix Table 5, we can say that in central Russian waters of central Russia (the Azov, Black, and Baltic seas), only the sturgeon species *Acipenser sturio* has completely disappeared in the wild.

However, the situation of Siberian sturgeon populations is still less critical. Although due to the damming on large Siberian rivers (Yenisei and Ob) and other anthropogenic activities since the second World War, when specialized target catches of sturgeon were carried out with food to supplement the front, one can also note the disappearance of a number of natural Siberian populations of sturgeon united under the same name *Acipenser baerii* Brandt, 1869. These issues require a separate taxonomic revision of this species throughout Siberia, so in this paper, we will not dwell on this topic. But we emphasize that this topic is important, requires special attention and separate discussions, and must not be forgotten.

In Russian waters, the situation is critical only for a few species (populations) of sturgeons and herrings, mainly in the European part, including neighboring countries. In other boreal regions like North America, the situation is more alarming. During the past 100 years, at least 57 fish species have disappeared from nature (Burkhead, 2012). Nevertheless, it must be acknowledged that throughout Siberia and much part of the Far East, including Sakhalin and the Kuril Islands, there is not a single record of disappearance of either freshwater or brackish fish species. In terms of preserving the natural (wild) biological wealth of ichthyofauna, Russia can be considered as a worldwide leading nation.

By 2019, 20 species of fishes have been classified as category 1 (Endangered) in the RDBRF, which include very valuable species which were intensively harvested in the past, including an industrial fishery for these species in the beginning of the 20th century (mainly for sturgeon and salmon). Category 2 (Decreasing Number) comprises 18 species, which were also subject of commercial fisheries in the past.

In total, from all freshwater and brackish species found in Russian waters, 425 species are subject of IUCN criteria (Appendix Table 6). This corresponds to more than 53% of the whole freshwater and brackish water ichthyofauna of Russia, while in the RDBRF only 5% of these species belong to this category. In addition, according to IUCN, *Stenodus leucichthys* (Güldenstädt, 1772) which is native to the Caspian Sea basin is considered as extinct in the wild.

3.2.9. Newly discovered species in Russian waters

In this part, we provide information on the species that were newly discovered in fresh and brackish waters of Russia during the period 2004-2018 (Appendix Table 7), after the publication of the monograph of Bogutskaya and Naseka (2004).

Appendix Table 7 comprises a total of 18 additional species and 1 additional subspecies from Russia and 4 additional species described from adjacent territories (also recorded from Russia). A total of 6,353 species (Fricke et al., 2020a) were described worldwide during this period, which results in an extremely insignificant proportion of 0,36% of the new species described from Russia compared with total new species description. However, the distribution of the newly described species is quite impressive and covers both the European part of Russia, Siberia, and the Far East from the basins of the Baltic, White, Black and Azov Seas to the southern part of the Sea of Okhotsk; Sakhalin and Primorsky Krai inclusive. The majority (7 species) is classified in the order Salmoniformes.

3.2.10. Endemic species

Only the ichthyofauna of Lake Baikal 36 endemic species and El’gygytgyn Lake (2 endemic species) can be attributed to exclusively endemic species of Russia. The remaining 65 species have not yet been recorded from adjacent waters. This allows us to consider them as endemic to Russia, so the total number adds to 103 endemic species (Appendix Table 8). In relation to the total number of occurring species 719 (excluding introduced species (36 species) and controversial species (36 species)), this amounts to 14,33%.

The number of endemic species (at least in the Altai Republic, Siberia, and Sakhalin Island) is expected increase in the near future, both due to additional new species as well as species raised from synonymy or subspecies level to species level; examples: *Alburnoides kubanicus* Bănărescu, 1964, *Alburnoides maculatus* (Kessler, 1859), *Barbus kubanicus* Berg, 1912, *Gobio tungussicus* Borisov, 1928, *Phoxinus ujmonensis* Kashchenko, 1899.

The majority of endemic species belong to the three orders Cypriniformes (16 species), Salmoniformes (40 species), and Scorpaeniformes (42 species). Three scorpaeniform families, Cottocomephoridae, Comephoridae, and Abyssocottidae, are endemic to Lake Baikal and its basin.

3.3. The fish diversity of the Russian regions

In various ecoregions in the Russian Federation (Abell et al., 2008), the fish species diversity differs considerably.

In Russia, the largest number of peripheral species is found east of the Ural Mountains - where the Asian part of Russia begins, and there mainly in the southern part of the Far Eastern Region (or Northeast Asia) – Primorsky Krai, Amur basin, and Sakhalin. Within the Russian Far East, the highest species richness was found on the Sakhalin Island (175 species, Dyldin and Orlov, 2016a, 2016b, 2017a, 2017b) affected by a numerousbrackish water lagoons, in the Amur River basin as a whole (123 species, Bogutskaya et al., 2008). A lower number of species was reported from the Primorsky Krai / Far Eastern Federal District (79 species, Shedko, 2001) and north-eastern Russia (65 species, Chereshnev, 1996). In between the Russian Far East and the Russian part of Europe is covered by Siberia, a total of 96 fish species occur (Popov, 2009). In total 53 species of freshwater fishes were found in the Chukotka Autonomous Okrug (Chereshnev, 2008), and the same number in Yakutia (Kirillov, 1972). The freshwater and brackish water fish fauna of the basins of the East Siberian and Laptev Seas consists of 48 species (Chereshnev and Kirillov, 2007). Along the whole Arctic coast of Russia a total of 39 fish species have been recorded (Popov, 2015). Only 29 species were reported from the Altai Region (Golubtsov and Malkov, 2007). The lowest number of fish species is found in the Kuril Islands (28 species, Gritsenko, 2012), and in rivers in the Kamchatka Peninsula (21 native species, Bugaev, 2007).

Within the European part of Russia, the entire basin and the coast of the Black Sea including a part of the Sea of Azov comprises 185 species (here marine species are included) (Emtyl’ and Ivanenko, 2002). The Caspian Sea and its entire basin comprise 162 freshwater and brackish-water species (Bogutskaya et al., 2013). The Crimean Peninsula has 88 species, including introduced species (Karpova and Boltachev, 2012), Bryansk Region (refers to the Dnieper basin) comprises 51 species (Kruglikov, 2009), and Kaliningrad Region, the Baltic Sea basin 32 species (Novozhilov, 2012).

In comparison to regions at a similar latitude in other parts of the world, the data on the Russian Federation´s fish species richness are remarkable. From Canada (9,985,000 km^2, i.e. 58% of the Russian Federation´s territory), 24 families and 177 species of freshwater fishes and lampreys have been reported, 181 with introduced species (Scott and Crossman, 1973), which equals 57% of the Russian fish species. While in the 10 largest freshwater lakes in the Russian Federation (surface 0.213–31,720 km^2, average 6,995 km^2, see Table 3) the fish species richness varies from 12 to 100 species (average 37 species), in the 7 lakes on the U. S. – Canadian border (the Nipigon, Superior, Michigan, Huron, St. Clair, Erie, and Ontario Lakes, surface 1,113-95,600 km^2, average 40,469 km^2) it ranges between 40–155 (average 96 species).

Some authors studied the general relationship between fish species richness and various water stream characteristics (e.g. Oberdorff et al., 1995). Welcomme (1985) found considerable differences in the numbers of species inhabiting the various river systems are largely attributable to the size of the river as represented by its basin area or some correlate of it such as the length of the main channel or stream order. The value $N = fA^b$ (where N = number of species and A = basin area in km^2) was calculated. Welcomme (1985) found this relationship for to the north-flowing Siberian rivers and those in the European part in the former Sovet Union to be $N = 2{,}76A^{0.19}$ (n = 6, r = 0,91, n – number of rivers used for calculation of equation, r – correlation coefficient).

Our results show the clear positive correlation between basins of the Siberian rivers flowing to the north (into the Bering, Kara, Laptev and the East Siberian Seas) and fish species richness at $N = 2{,}90A^{0.19}$ (n = 9, r = 0,95). If the Amur river is rich in fish species and flowing rather in the southern part of the country into the Sea of Okhotsk is added, the equation is as follows: $N = 0.81A^{0.30}$ (n = 10, r = 0,54). The same computation for rivers in the European part of Russia is $N = 19{,}27A^{0.10}$ (n = 9, r = 0,52). However, the samples are too small for more detailed statistical analysis: thus, other factors (drivers) influencing fish species richness and diversity can be expressed there. In addition, the results were obtained during various time periods, based on various research intensity and consequently on the gathered data which differ from each other in their completeness and comprehensiveness. Therefore, the results display some uncertainty. Because the fish species diversity changes along the river continuum (Pivnička, 2000; Humpl, 2004), the data on fish communities/assemblages should be gathered from various parts of the individual river basins. Data on the river basin coverage also differ from each other.

Iwasaki et al. (2012) confirmed a positive correlation between basin-fish richness and three river characteristics (mean river discharge, basin area and the maximum proportion of the non-flooding period) and three negative correlations between fish richness and the following river parameters: latitude, coefficients of variation in the frequency of low flow, and the Julian date of annual minimum flow).

Our data were compared with those from other parts of the world located north of the 50° N, i.e. central and northern Europe, Canada, and Alaska, respectively. The rivers of Canada and Alaska with a basin area up to 100,000 km^2 (n = 18) comprised 13–23 fish species (average 23), up to 1,000,000 km^2 (n = 8) 20–67 (average 39) species, while there were 52–106 (average 79) species in rivers having drainage size over 1,000,000 km^2 (n = 2) (Wallace and McCart, 1984; McPhail and Carveth, 1994; Benke and Cushing, 2006).

The species richness across Europe (10,180,000 km^2, including European part of Russian Federation territory) amounts to 525 native freshwater fish and lamprey species. The highest species richness in this territory is found in the main channel and delta of the Danube river, lower stretches and deltas of the Dniestr, Dniepr, and Don and in the Volga delta. The aquatic habitats of the Iberian and northern Europe have the lowest species richness. On the other hand, when the endemicity rate (ratio of endemic/total number of species) in each European drainage is considered, most of the fauna of the species-poor area is largely comprising endemic species. A total of 28 established introduced species were found throughout Europe´ freshwater systems (Kottelat and Freyhof, 2007). Hanel et al. (2011) summarized published data on alien and invasive fishes (Actinopterygii) of Europe from the 18th century to the present. At least 109 exotic freshwater fish species belonging to 29 families are documented. Successful introductions (established or acclimatized species at least in some parts of Europe) of non – native freshwater fishes include at least 38 species (the most of them originate from Asia and North America, some from Central America, South America or Africa). Within European waters, some alien fishes can be considered as invasive. A total of 160 marine alien (invasive) fish species have been reported from the Black Sea – Mediterranean Basin; most of those are so-called Lessepsian migrants which entered from the Red Sea through the Suez Canal.

The zoogeographic integrity coefficient (ZIC) for the whole Russian Federation fish fauna (namely freshwater and brackish water species) was calculated at 0,938. Again, this value should be considered as a rough estimation.

4. Conclusions

The characteristics of the freshwater and brackish water ichthyofauna in Russia presented in this paper gives a very general overview of the taxonomic composition of the fish species and their ecological characteristics.

Meanwhile, issues related to the phylogeography, endemism, and evolution of the Russian freshwater and brackishwater ichthyofauna remain poorly understood. For comparison, we used a number of studies from other regions, including Japan (Watanabe, 1998), Canada (Taylor, 2004), North America (Mayden, 1988), South America (Hubert and Renno, 2006), Australia (Unmack, 2001). Despite some published criticism of Parsimony Analysis for analyzing the composition of various ichthyofaunas (Brooks and van Veller, 2003; Santos, 2005), its use in combination with modern methods of molecular genetic research (Miya and Nishida, 2000; Simmons and Miya, 2004) is here considered to provide the most promising results for assessing the phylogeographic history and evolution of local ichthyofaunas. Thus, future research on the freshwater and brackish water ichthyofauna of Russia should focus on determining its place in the world's ichthyofauna (Abell et al., 2008; Lévequè et al., 2008), identifying relationships with the ichthyofaunas of neighboring regions, and analyzing the degree of its endemism, phylogeographic history and evolution, similar to the publications mentioned above.

Summing up the above findings, the waters of Russia are inhabited by 719 native species of freshwater and brackish water fishes; when questionable and introduced species are taken into account, it comprises at least 791 species (Fig. 2).

The increase in the number of species compared to the data published by Reshetnikov (1998, 351 species) and Bogutskaya and Naseka (2004, 486 species) is not accidental, and to a large extent neither related to so-called "crushing" in taxonomy, in the sense of Reshetnikov (2013). This increase is partly due to the brackish water occurrence of a number of Far Eastern fish species, which are usually referred to exclusively as marine species, and are missing in the reports mentioned above.

Several so-called "marine" fish species are found in the mouths and lower reaches of rivers, brackish lagoons, and lakes adjacent to the sea. Examples include sharks such as *Lamna ditropis* Hubbs and Follett, 1947 and pufferfishes of the genus *Takifugu* (Dyldin and Orlov, 2016a; Dyldin et al., 2016, 2018a).

An example of under-accounting of brackish species found in the mouths of rivers and brackish lagoons can serve as a series of our revision works devoted to the freshwater and brackish-water ichthyofauna of Sakhalin Island (Dyldin and Orlov, 2016a, 2016b, 2017a, 2017b, 2018; Dyldin et al., 2018a, 2018b). Not more than 89 species were known to inhabit this island (Pietsch et al., 2012). Our current study raises this number at least to 175 species (and this number is just based on the first generalized data).

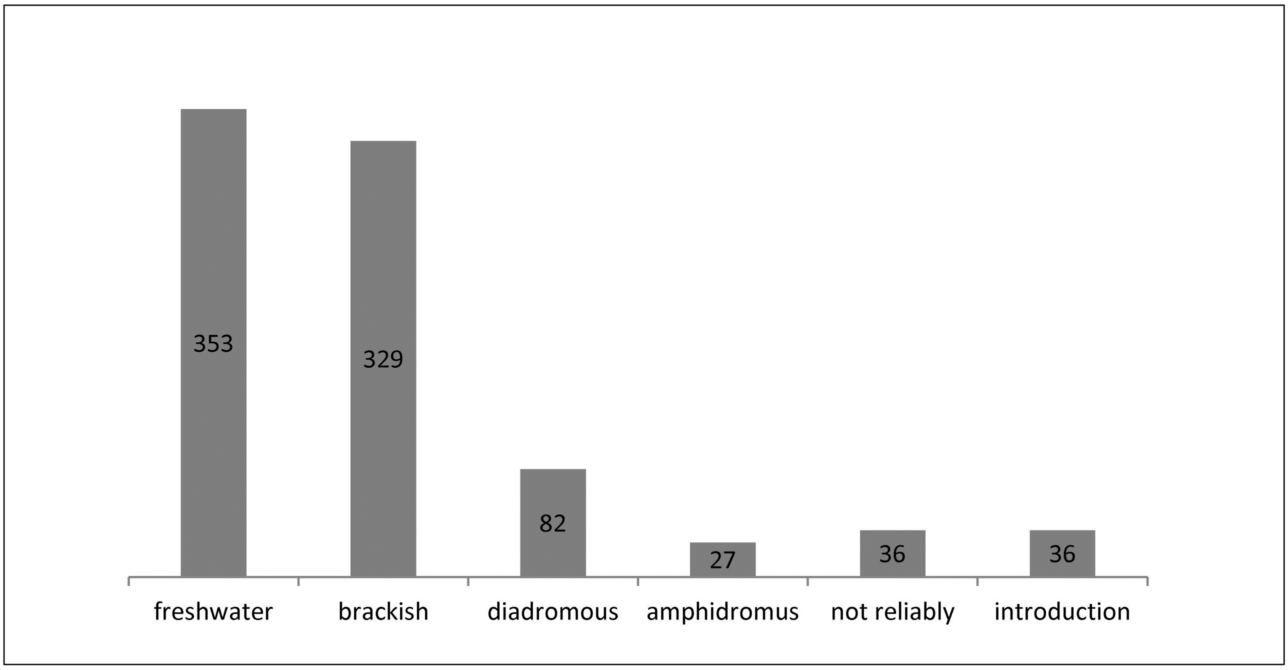

Fig. 2. The total number of ichthyofauna species of Russia without marine species.

The number of Russian freshwater and brackish fishes has almost been doubled compared to earlier works, partly due to changes in the systematics of fish that have occurred over the past several decades, based on the results of morphological and genetic studies or nomenclature changes (Kottelat, 2006, 2012; Kottelat et al., 2005; Kottelat and Freyhof, 2007; Mendel et al., 2008; Bogutskaya and Coad, 2009; Kalous et al., 2012; Bogutskaya et al., 2013, Orr et al., 2015). An example are the graylings of Siberia: it was believed (Svetovidov, 1936, Reshetnikov, 1998, 2003) that just the single subspecies *Thymallus arcticus arcticus* (Pallas, 1776) was present in the basins of the Ob and Yenisei rivers, but recent studies have shown that at least five species and several subspecies inhabit the basins of those rivers (Romanov, 2004, 2007, 2008; Knizhin, 2011; Romanov et al., 2017; Dyldin et al., 2017).

Underestimation of species can be associated with the inadequate taxonomic coverage of separate taxonomic groups, which includes the lack of reliable identification keys. In addition, a poor knowledge of the ichthyofauna of individual areas may be the result of the absence of acceptable regional determinants that allow reliable identification of fish to the species level in the field or laboratory conditions. A particular case of such a situation is the existence of species complexes that means when a single species includes a number of new or difficult to identify, including their subspecies.

In addition, he mentioned various forms that do not currently have any taxonomic status. However, Berg himself often wrote that he lacked sufficient data in order to clarify the taxonomic status of individual subspecies or forms. Therefore, infra-subspecific names were replaced by valid species-group names, or his subspecies were raised to species level. Berg indicated a number of synonyms, a number of which are now treated as valid species, e.g. *Alburnoides maculatus* (Kessler, 1859); *Acipenser mikadoi* Hilgendorf, 1892; *Chanodichthys abramoides* (Dybowski, 1872); *Gobio sibiricus* Nikolskii, 1936; *Rhynchocypris oxyrhynchus* (Mori, 1930); *Romanogobio belingi* (Stastenenko, 1934); *Cobitis lutheri* Rendahl, 1935; *Misgurnus mohoity* (Dybowski, 1869); *Lefua pleskei* (Herzenstein, 1888); *Hypomesus japonicus* (Brevoort, 1856); *Thymallus nikolskyi* Kaschenko, 1899; *Pungitius bussei* (Warpachowski, 1887); *Cottus microstomus* Heckel, 1837; *Cottus nozawae* Snyder, 1911. This also contributed to a considerable increase in the number of species for the Russian and adjacent waters.

According to our data, the native freshwater and brackish-water ichthyofauna of Russia is arranged in 3 classes, 26 orders, 100 families, 317 genera, and 719 species; an additional 36 species have a disputable taxonomic status or are likely present in Russian waters. The number of introduced species both naturalized and for some reason not done this (for example, some aquaculture facilities) reaches 36. The total number of species in all categories amounts to 791.

Fricke et al. (2020a) provide a worldwide total of 35,315 valid recent fish species, including 17,777 freshwater fish species. The total number of all fish species (all categories, marine, freshwater and brackish water) of the Russian ichthyofauna (more than 2000 species, our unpublished data) is about 6% of the number of fish known to date in the world. The Russian native ichthyofauna of fresh and brackish waters (719 species) accounts a little higher 4%.

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Appendix Table 1. List of anadromous fish and lamprey species of Russia and their commercial value. Abbreviations: * – the genus *Tribolodon* has synonymized with the senior genus *Pseudaspius* by Sakai et al. (2020); ? – data verification is needed; - residential form was not observed; + residential form was observed; Nm. – numerous, Cm. – common, R. – rare, Vr. – very rare; Cf. – commercial species in fishing

Anadromous fish	Total area	Distribution within Russia	Residential form	Abundance
1. *Caspiomyzon wagneri* (Kessler, 1870) – Caspian lamprey	Endemic to Caspian Sea basin	Caspian Sea and Volga River north to Volgograd dam	-	R. (in the past, before the construction of the Volgograd dam, has been commercial species, Gratzianov, 1907; Berg, 1948)
2. *Entosphenus tridentatus* (Richardson, 1837) – Pacific lamprey	North Pacific and adjacent Arctic Ocean	Okhotsk and Bering seas, Kuril Islands	+ (only in Canada and U.S.A.)	Cm. (common in the Bering Sea, Orlov et al., 2008, Murauskas et al., 2013, Orlov and Baitaliuk, 2016)
3. *Lampetra fluviatilis* (Linnaeus, 1758) – European river lamprey	Northeastern Atlantic	Basin of the Baltic Sea; Volga River basin	+ (e.g., Scotland, Finland, Sweden and Russia)	Cm. (in the past, for example in the Neva River, basin of Gulf of Finland, was fishing, Berg et al., 1949)
4. *Lethenteron camtschaticum* (Tilesius, 1811) – Arctic lamprey	Arctic Ocean, North Pacific and adjacent Northeastern Atlantic	Barents and White seas to Yenisei, and from Anadyr River to Kamchatka, southern Primorsky Krai, Sakhalin and southern Kuril Islands	+	Cm., Nm. (in Russian Far East, there is a small fishing, Orlov et al., 2014, Dyldin and Orlov, 2016; Orlov and Baitaliuk, 2016)
5. *Petromyzon marinus* Linnaeus, 1758 – Sea lamprey	North Atlantic and adjacent Arctic Ocean	Baltic and Barents seas	+ (only in North America)	R.
6. *Acipenser baerii* Brandt, 1869 – Siberian sturgeon	Siberia	Siberian rivers and adjacent brackish parts of the Arctic Ocean	+ (e.g. upper Ob River)	Cm., R. (fishing is prohibited according to RDBRF)
7. *Acipenser colchicus* Marti, 1940 – Colchian sturgeon	Southeastern Black Sea	It can be noted in the Russian Black Sea coast of Krasnodar Krai (S.B. Podushka, pers.comm.).	-	-
8. *Acipenser gueldenstaedtii* Brandt & Ratzeburg, 1833 – Russian sturgeon	Caspian, Azov and Black seas and their basins.	Caspian, Azov and Black seas basin.	- in the past, it is known from Volga and Ural rivers, as is also in north-western part of the Black Sea basin (Marti, 1940; Nikolskii, 1950; Movchan, 1967)	R. (fishing is prohibited according to RDBRF)

9. *Acipenser medirostris* Ayres, 1854 – Green sturgeon	Pacific coast of North America from Alaska to Mexico	Eastern Kamchatka	-	Vr.
10. *Acipenser mikadoi* Hilgendorf, 1892 – Sakhalin sturgeon	Northwestern Pacific	Okhotsk and Japan seas and their basins	-	R. (fishing is prohibited according RDBRF)
11. *Acipenser nudiventris* Lovetsky, 1828 –Ship	Caspian and Black Sea basins	Only small population remaining in Caspian Sea basin with the spawning rivers Ural and Kura	-	R. (fishing is prohibited according to RDBRF)
12. *Acipenser persicus* Borodin, 1897 – Persian sturgeon	Caspian Sea basin	Caspian Sea and its basin, spawning migrations are known to the rivers Volga and Ural	-	R. (fishing is prohibited according to RDBRF)
13. *Acipenser schrenckii* Brandt, 1869 – Amur sturgeon	Russia, Mongolia, Japan (Hokkaido Isl.) and China	Northwestern Sakhalin and Amur River basin	+ (Amur River basin)	R. (fishing is prohibited according to RDBRF)
14. *Acipenser stellatus* Pallas, 1771 – Starry sturgeon	Basins of the Aegean, Marmara, Adriatic, northern Caspian, Black and Azov seas	Caspian, Black and Azov seas	-	R. (fishing is prohibited according to RDBRF)
15. *Acipenser sturio* Linnaeus, 1758 – European Atlantic sturgeon	Northeastern Atlantic. Currently it is found only in the Gironde estuary in France	Last capture in the eastern Russian part of Baltic Sea is dated 1984 in Ladoga Lake	+ (residential form was known in Lake Ladoga, Berg, 1948)	Regionally extinct (last capture in the eastern Russian part of Baltic Sea is dated 1984 in the Ladoga Lake, Podushka, 1999)
16. *Huso dauricus* (Georgi, 1775) – Kaluga	Northwestern Pacific	Okhotsk Sea and Sea of Japan basins	+	R., Cm. (fishing is prohibited according to RDBRF)
17. *Huso huso* (Linnaeus, 1758) – Beluga	Basins of the Aegean, Marmara, Adriatic, eastern Mediterranean, Caspian, Azov and Black seas	Currently reproduced in Don and Kuban plants; population exclusively consisting of artificially reproduced specimens (Zamotajlov, 2007)	-	Wild forms are no longer found (Zamotajlov, 2007). Fishing is prohibited according to RDBRF)
18. *Alosa alosa* (Linnaeus, 1758) – Allis shad	Northeastern Atlantic	Kaliningrad Oblast, Baltic Sea	-	Vr.
19. *Alosa caspia* (Eichward, 1838) – Caspian shad	Caspian Sea endemic	Caspian Sea	-	Cm., Cf. (at now now caught in bycatch, however, in the past, was one of the most important commercial species in the Caspian Sea, Berg et al., 1949)

20. *Alosa fallax* (Lacepéde, 1803) – Twaite shad 20.1 *Alosa fallax baltica* Kukuev & Orlov, 2018 – Baltic shad	Northeastern Atlantic	Black Sea, including Kerch Strait; Baltic Sea (Gulf of Finland and coast of Kaliningrad Oblast) – *A. fallax baltica*	-	Vr. (in the Black Sea); R. for the Baltic (Kukuev and Orlov, 2018), but in the past in Curonian and Vistula bays, it was a commercial species, Winkler et al., 2000; Tylik and Svirina, 2011.
21. *Alosa immaculata* Bennett, 1835 – Pontic shad	Black and Azov seas	Black and Azov seas	+ (Don River Basin)	Cm. (at now is as bycatch, but in the past it has been a valuable commercial species, Berg et al., 1949)
22. *Alosa kessleri* (Grimm, 1887) – Caspian anadromous shad	Caspian Sea and its basin	Caspian Sea and its basin	-	Cm. (at now caught in bycatch, in the past it has been a valuable commercial species (Berg et al., 1949)
23. *Alosa sapidissima* (Wilson, 1811)	Native area is the Atlantic coast of Northern America	Eastern Kamchatka, northwestern Bering Sea and Anadyr River	-	Vr.
24. *Alosa tanaica* (Grimm, 1901) – Azov shad	Mediterranean, Black and Azov seas	Black and Azov seas	-	Cm., Cf. (local fishery)
25. *Alosa volgensis* (Berg, 1913) – Volga shad	Caspian Sea	Caspian Sea	-	R. (it was commercial species (Berg et al., 1949)
26. *Alburnus chalcoides* (Güldenstädt, 1772) – Caspian bleak	Caspian Sea	Caspian Sea including Volga drainages	+ it formed residential forms in a number of reservoirs (Bogutskaya et al., 2013)	R.
27. *Alburnus leobergi* Freyhof & Kottelat, 2007 – Azov shemaya	Sea of Azov	Sea of Azov, enters in the Don, Kuban, Severskiy Donets and others rivers of Russia	+ (in Tsimlyansk and Krasnodar reservoirs, formed a residential form, Emtyl‘ and Ivanenko, 2002, Polumordvinov et al., 2012)	Cm., R. (it was a valuable commercial species, Diripasko et al., 2011)
28. *Luciobarbus brachycephalus* (Kessler, 1872) – Shorthead barbel	Aral Sea basin (Chu River, Kazakhstan); western and Southern parts of Caspian Sea	Caspian Sea basin.	+	R., Cm. (caught in bycatch)

29. *Luciobarbus capito* (Güldenstädt, 1773) – Bulatmai barbel	Caspian and Aral seas basin	Casipan Sea basin including lower Volga River	+	R. (in the past it has been a common, Berg, 1949a)
30. *Rutilus caspicus* (Yakovlev, 1870) – Vobla	Caspian Sea basin	Caspian Sea basin	-	Cm., Cf.
31. *Rutilus frisii* (Nordmann, 1840) – Vyrezub	Black and Azov seas	Black and Azov sea basins	+ (in River Don of Tsimlyansk reservoir to the upper reaches (Ivanchev et al., 2013)	Cm., R. (it was a valuable commercial species, Berg, 1949a)
32. *Rutilus heckelii* (Nordmann, 1840) – Taran'	Black and Azov seas	Black and Azov seas, entering Don, Kuban rivers and etc.	-	Nm., Cf.
33. *Rutilus kutum* (Kamensky, 1901) – Caspian kutum	Caspian Sea basin	Caspian Sea basin	-	Cm. Cf. (valuable commercial species in the past. Currently, this species has a limited commercial value, Rabazanov et al., 2017, 2019)
34. * *Pseudaspius brandtii* (Dybowski, 1872) – Pacific redfin	Northwestern Pacific	Okhotsk and Japan seas	+ («lake» form)	Nm., Cm., Cf.
35.*Pseudaspius sachalinensis* (Nikolskii, 1889) – Sakhalin redfin	Northwestern Pacific	Okhotsk and Japan seas	+	Nm., Cf.
36. *Pseudaspius hakonensis* (Günther, 1877) – Big-scaled redfin	Northwestern Pacific	Okhotsk and Japan seas, including southern Kurils	+ («lake» form)	Nm., Cf.
37. *Vimba persa* (Pallas, 1814) – Caspian vimba	Caspian Sea	Caspian Sea and its basin	?-	R. (caught in bycatch)
38. *Vimba vimba* (Linnaeus, 1758) – Vimba	Basins of North, Baltic, Marmara (Asian territory of Turkey), Black and Azov seas	Basins of Baltic, Black and Azov seas	+ (e.g., Krasnodar reservoir in Kuban River, Tsimlyansk reservoir in Don River, Emtyl' and Ivanenko, 2002, Ivanchev and Ivancheva, 2010)	Nm., Cm., Cf.
39. *Hypomesus nipponensis* McAllister, 1963 – Japanese smelt	Northwestern Pacific	Okhotsk and Japan seas, including southern Kurils	+	Nm., Cf.
40. *Hypomesus olidus* (Pallas, 1814) – Pond smelt	Arctic and North Pacific	Arctic seas (from Kara Sea and eastwards); Bering, Okhotsk and Japan seas	+	Nm., Cf.

41.*Osmerus dentex* Steindachner & Kner, 1870 – Arctic (Asian) rainbow smelt	North Atlantic, North Pacific and Arctic Ocean	Arctic Ocean; Bering, Okhotsk and Japan seas	+	Nm., Cf.
42. *Osmerus eperlanus* (Linnaeus, 1758) – European smelt	North Atlantic and adjacent Arctic	Baltic, Barents and White seas	+	Nm., Cf.
43. *Coregonus albula* (Linnaeus, 1758) – Vendace	In lakes of White, Barents, Baltic and North seas basins	White, Barents, Baltic seas; upper Volga; southern Taimyr Peninsula including lower part the Yenisei River basin, basin of Chatanga River, as well and Lake Taimyr	+ (anadromous species in Gulf of Finland, but primarily it freshwater lacustrine fish)	Nm., Cm., Cf.
44. *Coregonus autumnalis* (Pallas, 1776) – Arctic cisco	Arctic	Arctic coast from Chaun Bay (East Siberian Sea) to Pechora Sea (southeastern Barents Sea)	+ («lake» form)	Cm., Cf.
45. *Coregonus laurettae* Bean, 1881 – Bering cisco	North America and Russia	Limited to some rivers of Bering Strait, Chukotka	+	?Cm.
46. *Coregonus maraena* (Bloch, 1779) – Maraena whitefish	Basins of the Baltic and southern North seas	Basin of the Baltic Sea, including Lake Ladoga	+ («lake» forms)	?Cm.
47. *Coregonus muksun* (Pallas, 1814) – Muksun	Arctic	From Kara River eastwards to Kolyma River	+ («lake» forms)	Cm., Cf.
48. *Coregonus pallasii* Valenciennes, 1848 – Aspsik	Baltic Sea	Baltic Sea, including Gulf of Finland and Neva River	-	R.
49. *Stenodus leucichthys* (Güldenstädt, 1772) – Inconnu	Endemic species of Caspian Sea	Caspian Sea, single specimen enter Volga, Ural and Terek rivers (Bogutskaya et al., 2013)	-	R. (it was a valuable commercial species)
50. *Stenodus nelma* (Pallas, 1773) – Siberian inconnu	Basins of Arctic and Pacific oceans	From Kola Peninsula and Pechora Bay in the Barents Sea to Anadyr River and Kamchatka	+ (rarely creates residential forms e.g., in the Novosibirsk Reservoir, as well as in lakes and Zaisan Kubenskoe (Sidorov and Reshetnikov, 2014)	Cm., R., Cf.
51. *Oncorhynchus gorbuscha* (Walbaum, 1792) – Pink salmon	North Pacific and adjacent Arctic	Arctic (known from Lena River estuary (Laptev Sea) and Chaun Bay (East Siberian Sea); Pacific coast Kurils, Bering, Okhotsk and Japan seas	-	Nm., Cf.

52. *Oncorhynchus keta* (Walbaum, 1792) – Chum salmon	North Pacific and adjacent Arctic	The same distribution as *O. gorbuscha*	-	Nm., Cf.
53. *Oncorhynchus kisutch* (Walbaum, 1792) – Coho salmon	North Pacific and adjacent Arctic	From Chukotka to coast of Primorsky Krai, including Pacific coast of Kurils	+ (in some lakes in North America and Kamchatka)	Nm., Cm., Cf.
54. *Oncorhynchus masou* (Brevoort, 1856) – Cherry salmon	Northwestern Pacific	From Kamchatka (Kamchatka River) to southern part of Primorsky Krai	+ (often creates freshwater forms considered as separate species or subspecies e.g, Japan)	Cm., Cf.
55. *Oncorhynchus nerka* (Walbaum, 1792) – Sockeye salmon	North Pacific and adjacent Arctic	From eastern Chukotka to the Sakhalin Island, including Kurils	+ («lake» forms)	Nm., Cm., Cf.
56. *Oncorhynchus tshawytscha* (Walbaum, 1792) – Chinook salmon	North Pacific and adjacent Arctic	From Chaun Bay (Arctic bay in the East Siberian Sea) and Bering Strait along Asia coast to rivers of the Primorsky Krai, including Kurils	-	Cm., Cf.
57. *Parahucho perryi* (Brevoort, 1856) – Japanese huchen	Northwestern Pacific	Endemic for Russia's Far East, Japan and Okhotsk seas	+ (some populations spend all their lives in freshwater while others are anadromous (freshwater form can create by barriers in rivers not allowing anadromic migration), Dyldin et al., 2018)	R., Cm. (fishing is prohibited according to RDBRF)
58. *Parasalmo clarkii* (Richardson, 1836) – Cutthroat trout	North Pacific	Northwestern Kamchatka	+	R.
59. *Parasalmo mykiss* (Walbaum, 1792) – Rainbow trout	North Pacific	Shantar Islands and Kamchatka	+ (Shantar Islands)	R., Cm. (fishing is prohibited according to RDBRF)
60. *Parasalmo penshinensis* (Pallas, 1814) – Kamchatka steelhead	Kamchatka Peninsula	Kamchatka Peninsula and the Pacific coast of adjacent Kurils	?-	Cm.
61. *Salmo caspius* Kessler, 1877 – Caspian trout	Southern Caspian basin	There is no reliable information about the capture in Russia	+	

62. *Salmo ciscaucasicus* Dorofeeva 1967 – Ciscaucasia trout	Western Caspian Sea	Caspian Sea	+ (basins of Volga and Ural rivers)	Vr.
63. *Salmo labrax* Pallas, 1814 – Black Sea salmon	Black and Azov seas	Black and Azov seas and their basin	+ (e.g., some lakes of Austria in Danube basin and Crimean Peninsula)	R.
64. *Salmo salar* Linnaeus, 1758 – Atlantic salmon	North Atlantic and adjacent Arctic	Rivers of the Baltic, Barents and White seas, eastward to Kara River	+ (e.g., Karelian lakes)	?Cm.
65. *Salmo trutta* Linnaeus, 1758 – Sea trout	Northeastern Atlantic and adjacent Arctic	Basins of the Barents, White and Baltic seas	+ (creates of lake and river forms)	?Cm. (fishing is prohibited according to RDBRF)
66. *Salvelinus albus* Glubokovsky, 1977 – White charr	Endemic species of Kamchatka	Endemic species to Kamchatka in the basin of the Kamchatka River, including Lake Kronotskoye	+ (Lake Kronotskoye)	Cm. (object of amateur fishing)
67. *Salvelinus alpinus* (Linnaeus, 1758) – Arctic charr	Arctic (?circumpolar) and North Atlantic	In all the Russian Arctic seas and rivers of its basin	+ («lake» form)	Cm., R. Cf.
68. *Salvelinus curilus* (Pallas, 1814) – Kuril charr	Northwestern Pacific	Okhotsk and Japan seas including Kurils	+ («lake» form, e.g., Sakhalin and Kuril islands)	Cm., Nm., Cf.
69. *Salvelinus leucomaenis* (Pallas, 1814) – Whitespotted charr	Northwestern Pacific	Japan, Okhotsk and western Bering seas (to Bering Strait), including all Kuril Islands	+ («lake» form)	Cm., Nm., Cf.
70. *Salvelinus levanidovi* Chereshnev, Skopetz & Gudkov, 1989 – Levanidov's charr	Northwestern Pacific	Rivers of northern part of the Sea of Okhotsk, including Yama and Penzhina rivers	?+	Cm. Cf. (caught in by-catch)
71. *Salvelinus malma* (Walbaum, 1792) – Dolly varden	North Pacific and adjacent Arctic	Chukotka, Kamchatka and northern part of the Sea of Okhotsk, including the Pacific coast of Kurils	+ «lake» forms	Cm. Cf. (little importance in sport fishing)
72. *Salvelinus taranetzi* Kaganovsky, 1955 – Taranetz's charr	Russia and Arctic coast of Alaska, U.S.A. and Canada	From Chaun Bay (East Siberian Sea) to Chukchi Sea, Bering Strait and Cape Olyutorsky, Kamchatka	+ «lake» forms	Cm.
73. *Salvelinus vasiljevae* Safronov & Zvezdov, 2005 – Sakhalinian charr	Northwestern Pacific	Endemic species to the Sakhalin Island	+	Cm., Cf.

74. *Gasterosteus aculeatus* Linnaeus, 1758 – Three-spined stickleback	North Atlantic, North Pacific and adjacent Arctic	From Azov and Black seas to White Sea and Novaya Zemlya, as well as Baltic Sea; from Chukotka to Primorsky Krai	+	Nm.
75. *Gasterosteus nipponicus* Higuchi, Sakai & Goto, 2014	Northwestern Pacific	Okhotsk and Japan seas	+ (estuary-resident form)	Cm.
76. *Pungitius pungitius* (Linnaeus, 1758) – Ninespine stickleback	Circumpolar	Artic seas to Kamchatka	+	Cm.
77. *Pungitius sinensis* (Guichenot, 1869) – Chinese ninespine stickleback	Eastern Asia	From Kamchatka to Amur River and Tumannaya River (Tumen), including Kurils	?-	Cm.

Appendix Table 2. Species with a controversial taxonomic position.
Fr. – freshwater, Br. – brackish, Mr. – marine.

Taxon	Taxonomic remarks
1. *Carcharhinus plumbeus* (Nardo, 1827) – Sandbar shark	According to recent molecular studies, Western Atlantic populations (*C. plumbeus*) are distinct from the Indo-Pacific ones, and the name *Carcharhinus japonicus* (Temminck & Schlegel, 1850) should be restored for the latter (Ebert et al., 2013)
2. *Alosa suworowi* (Berg, 1913) – Suworow's shad	According to the opinions by Svetovidov (1952) and Reshetnikov (1998) the taxonomic status of *A. suworowi* is questionable, because it may be a hybrid between different species of herrings. Also, in a recent important monograph on the fishes the Caspian Sea (Bogutska et al., 2013), this taxon is listed as with an unclear taxonomic status.
3. *Clupeonella caspia* Svetovidov, 1941 – Caspian sprat	According to data by Bogutskaya and Naseka (2006) and Bogutskaya et al. (2013), this taxon is allocated to a separate species. However, the genetic-population data show that the population of *C. caspia* is one of the forms of the widespread species *Clupeonella cultriventris* (see Karabanov, 2013).
4. *Clupeonella tscharchalensis* (Borodin, 1896) – Lake Charkhal sprat	This taxon is usually classified as a subspecies *Clupeonella cultriventris tscharchalensis* or placed in the synonymy of *Clupeonella cultriventris* (Nordmann, 1840), e.g. by Berg (1948), Reshetnikov (1998). Subsequently, Bogutskaya and Naseka (2006), Kottelat and Freyhof (2007), Hanel et al. (2009), and Naseka (2010) treated it as a separate species *C. tscharchalensis*, but the genetic-population data demonstrate that *C. tscharchalensis* is only one of the forms of the widespread species *Clupeonella cultriventris*, e.g. Karabanov (2013).
5. *Acheilognathus amurensis* (Holčík, 1962) – Amur River bitterling	Naseka and Bogutskaya (2004), without having seen the type material, placed *Acanthorhodeus asmussii amurensis* Holčík, 1962 in the synonymy of *Acheilognathus asmussii* (Dybowski, 1872); this synonymy was accepted by Kottelat (2006). However, after examining the type material of *Acanthorhodeus asmussii amurensis*, we consider this taxon as a valid and probably distinct species *Acheilognathus amurensis* (Holčík, 1962). Specimens reported from the Amur River drainage at Khabarovsk by Novomodny (2002) as *Acheilognathus macropterus* (Bleeker, 1871) from Amur River drainage at Khabarovsk, as well as *Acheilognathus* sp. by Bogutskaya et al. (2008), are probably based on *A. amurensis*.
6. *Gobio delyamurei* Freyhof & Naseka, 2005 – Delyamure's gudgeon	The classification of *G. delyamurei* as a distinct species of gudgeon from the River Chornaya is probably premature, and requires further comparative molecular studies. According to the Crimean researchers, this species has not been observed in the past (Karpova and Boltachev, 2012), and therefore the gudgeon from the River Chornaya should be considered as an invasive species; it is here preliminarily identified as *Gobio krymensis* Bănărescu & Nalbant, 1973.
7. *Gobio kubanicus* Vasil'eva, 2004 – Kuban gudgeon	Probably, the taxa *Gobio kubanicus* and *G. delyamurei* are junior synonyms of *G. krymensis* Bănărescu & Nalbant, 1973. A final decision on the taxonomic position of Crimean gudgeons requires additional genetic studies.

8. *Opsariichthys bidens* Günther, 1873 – Chinese hook snout carp	In the past, this taxon was placed in the synonymy of *Opsariichthys uncirostris* (Temminck & Schlegel, 1846), or was treated as a subspecies *Opsariichthys uncirostris bidens*. Following Kottelat (2001), Bogutskaya and Naseka (2004) and Bogutskaya et al. (2008) it is here treated as a valid species *O. bidens*.
9. *Rutilus caspicus* (Yakovlev, 1870) – Vobla	Berg (1949a), Reshetnikov (1998, 2003) and others classified this taxon as a subspecies *Rutilus rutilus caspicus*. Subsequently, based on morphological and biological differences and the fact of sympatry, it was treated as a distinct species (Bogutskaya and Naseka, 2004; Bogutskaya et al., 2013). According to the results of the mtDNA study, we here treat it as a junior synonym of *Rutilus lacustris* (Pallas, 1814) (Levin et al., 2016).
10. *Rutilus heckelii* (Nordmann, 1840) – Taran’	Berg (1949a), Bulakhov et al. (2008), Diripasko et al. (2011, 2015) and others, have classified this taxon as a subspecies. According to Fricke et al. (2007), Kottelat and Freyhof (2007), Hanel et al. (2009), it should be treated as a valid species. According to the results of the mtDNA study, we here treat it as a junior synonym of *Rutilus lacustris* (Pallas, 1814) (Levin et al., 2016).
11. *Sarcocheilichthys lacustris* (Dybowski, 1872) – Lacustrine gudgeon	Berg (1914, 1949a), Nikolskii (1956) and other authors classified this taxon as a subspecies *Sarcocheilichthys sinensis lacustris*. According to Bănărescu and Nalbant (1973), Bogutskaya and Naseka (1996), Reshetnikov (1998 2003), Naseka and Gershtein (2006), and Novomodny (2014) the taxon is a junior synonym of *Sarcocheilichthys sinensis* Bleeker, 1871. We here follow Bogutskaya et al. (2008) who treated it as a distinct species *Sarcocheilichthys lacustris*; therefore, *Sarcocheilichthys sinensis* is not member of the Russian ichthyofauna.
12. *Vimba tenella* (Nordmann, 1840) – Crimea vimba	Emtyl’ and Ivanenko (2002), Zamotajlov (2007), Boltachev et al. (2015) and others, classified this taxon as a subspecies *Vimba vimba tenella*, while Parin et al. (2014) treated it as a junior synonym of *Vimba vimba* (Linnaeus, 1758). Following Movchan (2016) we classify it as a valid species, *V. tenella*.
13. *Cobitis gladkovi* Vasil'ev & Vasil'eva, 2008 – Gladkov’s spiny loach	In the original description this taxon was treated as a subspecies *Cobitis melanoleuca gladkovi*. Kottelat (2012) raised it as *Cobitis gladkovi* to species level.
14. *Barbatula cobdonensis* (Gundriser, 1973) – Kobdo River loach	According to Kottelat (2006), this taxon was questionably placed in the synonymy of *B. compressirostris*. Kottelat (2012) treated it, also questionably, as a valid species, and provided some taxonomical notes. Prokofiev (2015, 2016 – as *Nemacheilus cobdonensis*) believed that the description was based on mixed material, and treated the name as a nomen dubium.
15. *Barbatula toni* (Dybowski, 1869) – Amur loach	Currently, according to Kottelat's revision (Kottelat, 2012), all of the previously in its composition synonyms are derived from *B. toni*, while *B. compressirostris*, *B. tomiana*, *B. oreas*, *B. nuda* and *B. markakulensis* are given the status of valid species. Considering all the above-mentioned and prevailing traditional views of Russian scientists on the nomenclature and limits of distribution of the Amur loach, it is necessary to conduct further research (revisions) with the inclusion of both comparative and molecular data. Considering the remote synonymy from *B. toni*, the limits of

distribution of this species is previously limited to the upper course of the Amur.

16. *Tachysurus brashnikowi* (Berg, 1907) – Brazhnikov's catfish

According to Novomodny (2004, 2014), this taxon is a synonym of *Tachysurus nitidus* (Sauvage & Dabry de Thiersant, 1874).

17. *Tachysurus sinensis* Lacepéde, 1803 – Chinese catfish

According to the neotype designated by Ng and Kottelat (2007), this species is distributed in the basin of the Yongding River in northern China. However, its distribution range is probably wider, including northeastern Asia. Further detailed faunistic studies are necessary. Bogutskaya et al. (2008) gave a distribution area for *Tachysurus sinensis* that was previously confused by Russian authors with *Tachysurus fulvidraco* (Richardson, 1846).

18. *Dallia admirabilis* Chereshnev, 1980 – Wonderful blackfish

According to Mecklenburg et al. (2002) and Campbell et al. (2015), this species is a synonym of *Dallia pectoralis* Bean, 1880; which agreed to the work of Campbell et al. (2015), the latter authors stress the similarity of the morphology of this species with some specimens from Alaska identified as *D. pectoralis*. Nevertheless, prior to relevant studies with a large number of samples throughout the known area for all members of the *Dallia* genus, the status of these populations remains questionable. What the above authors themselves wrote about. However, if this information could be confirmed, *D. admirabilis* should be considered as a junior synonym of *D. pectoralis*.

19. *Dallia delicatissima* Smitt, 1881 – Splendid blackfish

This taxon was restored as a valid species by the lectotype designation (NRM 9577) of Balushkin and Chereshnev (1982). According to Mecklenburg et al. (2002) and Kuehne and Olden (2014), this species is a synonym of *Dallia pectoralis* Bean, 1880; some other authors placed it in the genus *Umbra*.

20. *Coregonus baicalensis* Dybowski, 1874 – Baikal whitefish

According to Berg (1948) this taxon was treated as a subspecies *Coregonus lavaretus baicalensis*; some other authors classified it as a junior synonym of *Coregonus pidschian* (Gmelin, 1789), or *Coregonus lavaretus* (Linnaeus, 1758) (Reshetnikov, 1998; Kottelat, 2006). Bogutskaya and Naseka (2004), Matveev et al. (2009), treated it as a valid species *C. baicalensis*.

21. *Coregonus vessicus* Drjagin, 1932 – Beloye cisco

Kottelat and Freyhof (2007) treated this taxon as a valid species. According to Berg (1948) it was classified as a subspecies *Coregonus sardinella vessicus*. Recently (Gerasimov, 2015), it was classified as a junior synonym of *Coregonus albula*.

22. *Parasalmo clarkii* (Richardson, 1836) – Cutthroat trout

The taxonomic status of *Parasalmo clarkii* from western Kamchatka is uncertain, and requires more detailed study (Tokranov and Sheiko, 2006; Parin et al., 2014).

23. *Parasalmo penshinensis* (Pallas, 1814) – Kamchatka steelhead

According to Savvaitova and Lebedev (1966), Pavlov et al. (2001), Mal'tsev (2007), Kuzishchin (2010) and others, the only species of the genus in Kamchatka is *Parasalmo mykiss*, and *P. penshinensis* is just as one of the various life-history forms of *P. mykiss*.

24. *Salmo ezenami* Berg, 1948 – Ezenam trout

According to Berg (1948) and Reshetnikov (1998, 2003), this taxon was treated as a subspecies *Salmo trutta ezenami*. Bogutskaya and Naseka (2004) and Kottelat and Freyhof (2007) raised it to species level, as *S. ezenami*. To clarify the taxonomic status of the *S. ezenami*, further genetic studies are required (Ninua et al., 2018).

25. *Salmo labrax* Pallas, 1814 – Black Sea salmon	According to Berg (1948), Reshetnikov (1998, 2003), Vassilev and Pehlivanov (2005), and Boltachev and Karpova (2012), this taxon is treated as a subspecies *Salmo trutta labrax*. Others authors (Kottelat, 1997; Holčík, 2002; Fricke et al., 2007; Kottelat and Freyhof, 2007; Diripasko et al., 2011, 2015) classified it as valid species.
26. *Salvelinus albus* Glubokovsky, 1977 – White charr	According to Bugaev (2007), this taxon is part of the *Salvelinus alpinus* (Linnaeus, 1758) species complex. According to Reshetnikov (1998), Leman and Esin (2008), and Oleinik and Skurikhina (2010) it belongs to the *Salvelinus malma* (Walbaum, 1792) species complex. Several other authors treated it as a valid species (Sheiko and Fedorov, 2000; Bogutskaya and Naseka, 2004; Tokranov and Sheiko, 2006). Recently, Omelchenko (2005) and Salmenkova (2016) demonstrated that *S. albus* is not a valid species, based on a comparative genetic analysis. Genetic results of Oleinik et al. (2019) show that *S. kuznetzovi*, *S. albus*, and *S. malma malma* represent a monophyletic group that originated from a common ancestor.
27. *Salvelinus andriashevi* Berg, 1948 – Chukchi charr	Reshetnikov (1998, 2003) classified this taxon in the *Salvelinus alpinus* species complex. On the basis of a comparative population genetic analysis, Omelchenko (2005) considered it to be a subspecies of *S. alpinus*. Oleinik et al. (2017) and Esin and Markevich (2017) treated it as a synonym of *Salvelinus taranetzi* Kaganovsky, 1955. Based on morphological and craniological differences, some other authors (Berg, 1948; Chereshnev, 2008) classified *S. andriashevi* as a valid species.
28. *Salvelinus gritzenkoi* Vasil'eva & Stygar, 2000 – Gritsenko's charr	A comparative analysis suggests that the population of Gritsenko's charr of Chernoe Lake is not different from the anadromous charr *Salvelinus malm*a (Walbaum, 1792); therefore, *S. gritzenkoi* cannot be considered as a valid species (Gritsenko, 2012).
29. *Salvelinus kronocius* Viktorovsky, 1978 – Kronotsky charr	Genetic data demonstrate that this species is close to *Salvelinus malma* (Walbaum, 1792) (Oleinik and Skurikhina, 2010; Esin and Markevich, 2017).
30. *Salvelinus kuznetzovi* Taranetz, 1933 – Ushki lake charr	This taxon was first described as a subspecies *Salvelinus malma kuznetzovi*. According to recent genetic revision (Oleinik et al., 2019), this taxon is not valid and should be considered as part of *Salvelinus malma*; see also the remarks under *Salvelinus albus*, above.
31. *Aspidophoroides bartoni* Gilbert, 1896 – Aleutian alligatorfish	According to several authors (Mecklenburg et al., 2002 2018), *A. bartoni* is a junior synonym of *A. monopterygius* (Bloch, 1786), which means that the species would be widespread in the North Pacific. Other authors (Tokranov and Orlov, 2005; Balykin and Tokranov, 2010; Sokolovsky et al., 2011; Dyldin et al., 2018a) reported *A. bartoni* from Far Eastern waters of Russia. It should be noted that if *A. bartoni* is treated as a valid species, *A. monopterygius* would not be part of the ichthyofauna of the Russian sector of the North Pacific.
32. *Percarina maeotica* Kuznetsov, 1888 – Azov percarina	According to Berg (1949b), Collette and Bănărescu (1977), Reshetnikov (1998), Bogutskaya and Naseka (2004), Kottelat and Freyhof (2007) and others, this taxon is either treated as a valid species, or as a subspecies of *Percarina demidoffii* Nordmann, 1840.

33. *Rhinogobius cliffordpopei* (Nichols, 1925) – Pope's goby	This taxon was originally described from southern China. According to Novomodny (2014), it occurs in the Russian waters of Amur River, where another species of *Rh. lindbergi* is probably also present.
34. *Proterorhinus semipellucidus* (Kessler, 1877) – Freshwater Caspian tubenose goby	Probably this taxon is only a freshwater form of the coastal marine and brackish water species *P. nasalis*.

Appendix Table 3. Species excluded from the ichthyofauna of Russia. Fr. – freshwater, Br. – brackish, Mr. - marine.

Species	Taxonomic position in the past	Current taxonomic status
(Fr.) *Alburnus mento* (Heckel, 1836)	In the past, some authors Kottelat (1997), Reshetnikov (1998) and others, have listed it as a subspecies *Alburnus chalcoides mento,* or it was placed in the synonymy of *Alburnus chalcoides*.	Now, according to Bogutskaya and Naseka (2004), Kottelat and Freyhof (2007) it is classified as a valid species *A. mento*. The range of *A. mento* is limited to subalpine lakes in Germany and Austria in the Danube drainage (Kottelat and Freyhof, 2007)
(Fr.) *Barbus escherichii* Steindacher, 1897 – Sakarya barbel	Berg (1949a), Reshetnikov (1998, 2003) and others, have classified this taxon as a subspecies *Barbus tauricus escherichii*, or *Barbus plebejus escherichii*	According to the new morphological and genetic data (Bogutskaya and Naseka, 2004; Gandlin and Levin, 2016; Levin et al., 2019), this taxon is raised to species level. *Barbus tauricus rionica* Kamensky, 1899, that formally occured in rivers along Black sea coast in Krasnodarsk region and western part of Transcaucasia, is now treated as a valid species. *B.escherichii* is no member of the Russian ichthyofauna.
(Fr.) *Chanodichthys dabryi* (Bleeker, 1871) – Humpback	-	Formerly (Bogutskaya and Naseka, 1996; Reshetnikov, 1998, 2003) recorded *Ch. dabryi* for waters of Russia, but only by including the taxon *Chanodichthys abramoides*, which is now treated as a valid species.
(Fr.) *Microphysogobio tungtingensis* (Nichols, 1926) – Longnose gudgeon	This species comprised several subspecies: *Microphysogobio tungtingensis anudarini* from Bujr Nur Lake, Mongolia, *Microphysogobio tungtingensis amurensis* from basin of Amur River, *M. tungtingensi suifuensis* described from China (Suifu, province Szechwan), *M. tungtingensi uchidai* described from Pusan, South Korea.	As *M. tungtingensi amurensis* is now treated as a valid species, *M. tungtingensis* is not member of the Russian ichthyofauna.
(Fr.) *Oreoleuciscus dsapchynensis* Warpachowski, 1889 – Dsapchyn River osman	In the past this species was recorded by Berg (1949a) for the waters of Russia in the Teletskoye Lake basin, Altai region (Russia); Berg treated *Oreoleuciscus ignatowi* Nikolskii 1902 as a junior synonym. Bogutskaya and Naseka (2004) placed *Oreoleuciscus dsapchynensis* in the synonymy of *Oreoleuciscus potanini* (Kessler, 1879).	Kottelat (2006) restored it as a valid species. Kottelat (2006) treated *Oreoleuciscus ignatowi* as a junior synonym of *Oreoleuciscus potanini* (Kessler, 1879), which action excludes *Oreoleuciscus dsapchynensis* from the Russian ichthyofauna.
(Fr.) *Sarcocheilichthys nigripinnis* (Günther, 1873) – Rainbow gudgeon	Some authors (e.g., Novomodny et al., 2004; Novomodny 2014; etc.) have treated *Sarcocheilichthys czerskii* as a junior synonym of this species.	According to Reshetnikov (2003), Naseka and Gershtein (2006), Bogutskaya et al. (2008), *Sarcocheilichthys czerskii* is a valid species. It was originally described from Shanghai, China. Not considered as a

		member of the Russian ichthyofauna, because here *Sarcocheilichthys soldatovi* and *Sarcocheilichthys czerskii* are treated as valid species.
(Fr., Br.) *Squalidus argentatus* (Sauvage & Dabry de Thiersant, 1874) – Silver gudgeon	-	Originally described from Yangtze River, China; distributed in China and Taiwan. This species is not considered as a member of Russian ichthyofauna
(Fr.) *Cobitis choii* Kim & Son, 1984 – Choi's spiny loach	This taxon has been treated as a junior synonym of *Cobitis lebedevi* Vasil'eva & Vasil'ev, 1985; its distribution area includes the Amur River basin (Russia, China and Mongolia) and the southern part of Primorsky Krai.	*C. lebedevi* is here considered as valid (following Kim et al., 1999; Kottelat, 2006, 2012). It is endemic to the Kum River drainage, southern part of Korean Peninsula (Kim and Son, 1984; Kottelat, 2006).
(Fr.) *Cobitis sinensis* Sauvage & Dabry de Thiersant, 1874 – Chinese spiny loach	Former records of this taxon from the Korean Peninsula are now attributed to *Cobitis hankugensis* Kim, Park, Son & Nalbant, 2003; *C. sinensis* is no longer considered as a member of the Korean ichthyofauna (Kim et al., 2003).	Russian distribution area of this species (either native or introduced): border waters of Amur drainage near Khabarovsk (Novomodny, 2004; Novomodny et al., 2004), where it is probably replaced by *Cobitis melanoleuca* Nichols, 1925, see Bogutskaya et al. (2008) or other species that were recently described from Korea and China. So according to «Eschmeyer's catalog of Fishes», not less than 15 species of this genus were described from Korea and China from 1990 to 2015, including *Cobitis hankugensis*. Identification requires a comparison with Russian spiny loaches from the border of the Far Eastern waters.
(Fr.) *Misgurnus buphoensis* Kim & Park, 1995 – Korean weatherfish	According to Shedko and Shedko (2003), Bogutskaya and Naseka (2004) and Naseka and Gershtein (2006), the taxon *Misgurnus nikolskyi* Vasil'eva, 2001, is a junior synonym of *M. buphoensis;* in this case *M. buphoensis* would be a member of the Russian ichthyofauna.	According to Bogutskaya et al. (2008) and Kottelat (2012), *M. nikolskyi* is treated as a valid species.
(Fr.) *Sabanejewia aurata* (De Filippi, 1863) – Goldside spined loach	Several subspecies were previously recognized: *Sabanejewia aurata kubanica* Vasil'eva & Vasil'ev, 1988 – Kuban River spined loach, Kuban River basin; *S. a. baltica* Witkowsky, 1994 – Baltic spined loach, Baltic Sea basin; *S. a. balcanica* (Karaman, 1922) – Balkan spined loach, from basin of Aegean and Black seas; *S. a. bulgarica* (Drensky, 1928) – Danube (Bulgarian) spined loach, from Danube River basin, Bulgaria.	*S. aurata* is not considered to be a member of the Russian ichthyofauna, because the previous subspecies that were found in Russian waters, were either synonymized with other species or raised to species level, see Kottelat and Freyhof (2007), Kottelat (2012) and Fricke et al. (2020a). However, it might have been introduced.
(Fr.) *Tachysurus fulvidraco* (Richardson, 1846) – Yellow catfish	Formerly known from China, Korea, northern Vietnam, Amur River basin (including Khanka Lake and Ussuri and Sungari rivers), and northwestern Sakhalin Island (Berg, 1949a; Reshetnikov, 1998).	Not occurring in Russian water (Ng and Kottelat, 2007).

(Fr.) *Tachysurus nitidus* Sauvage & Dabry de Thiersant, 1874 – Shiny catfish	According to Novomodny (2004, 2014), *Tachysurus brashnikowi* (Berg, 1907) is a junior synonym of *T. nitidus*.	*T. nitidus* may be the so-called "southern population", and *T. brashnikowi* (Berg, 1907) the "northern population", i.e., two valid species; in that case *T. nitidus* is not part of the Russian ichthyofauna (Bogutskaya and Naseka, 2004; Bogutskaya et al., 2008).
(Fr.) *Coregonus lavaretus* (Linnaeus, 1758) – Lavaret	In a broad sense, *C. lavaretus* is widespread from central and northwest Europe to Siberia. Sometimes is called the *C. lavaretus* complex and considered as a superspecies (Reshetnikov, 1998, 2003).	The type of locality of *C. lavaretus* is Lake Bourget, France (Bogutskaya and Naseka, 2004; Kottelat and Freyhof, 2007). At present a number of forms that were previously was listed as part of *C. lavaretus* have been raised to species level (see Bogutskaya and Naseka, 2004; Kottelat and Freyhof, 2007; Fricke et al., 2020a).
(Mr., Br.) *Atherina boyeri* Risso, 1810 – Big-scale silverside	-	With the establishment of the valid species *Atherina pontica* from the Black and Azov seas and *Atherina caspia* from the Caspian Sea, *A. boyeri* is no longer a member of Russian ichthyofauna.
(Mr., Br.) *Spicara smaris* (Linnaeus, 1758) – Picarel	-	The Sea of Azov and Black Sea were formerly included in its distribution range, due to its synonymy [*Sciaena gymnodon* Pallas, 1814; *Smaris vulgaris* Valenciennes, 1830; *Spicara flexuosa* Rafinesque, 1810, and others].
(Am.) *Gymnogobius cylindricus* Tomiyama, 1936 – Cylindrical goby	According to Lindberg and Krasyukova (1975) this taxon is placed in the synonymy of *Gymnogobius raninus* Taranetz, 1934, the latter was described from Peter the Great, Sea of Japan, Russia.	We now treat *G. cylindricus* as a valid species (e.g., Stevenson, 2002; Parin et al., 2014), while *G. raninus* is usually treated as a synonym of *Gymnogobius macrognathos* (Bleeker, 1860). Therefore, *G. cylindricus* is currently not treated as a member of the Russian ichthyofauna.
(Mr., Br.) *Luciogobius elongatus* Regan, 1905 – Elongate goby	According to Berg (1949b) this taxon was placed in the synonymy of *Luciogobius guttatus* Gill, 1859.	Since the beginning of the 1930s, this species has not been recorded from Russian waters; most likely, it was previously misidentified.
(Am.) *Rhinogobius brunneus* (Temminck & Schlegel, 1845) – Brown goby	Gobies from Sakhalin and Amur basin southward to Taiwan and Hainan and the Philippines, as well as from the waters of Japan, Korean Peninsula, China and Vietnam, were historically identified as *R. brunneus* (Pinchuk, 1978, 1992; Dyldin and Orlov, 2017b).	*Rh. brunneus* was originally described from the Nagasaki, southern Japan, and not yet found in Russian waters (coast of Primorsky Krai and Sakhalin Island). Russian findings are now attributed to *Rh. sowerbyi* Ginsburg, 1917 and *Rh. lindbergi* Berg, 1933 (Bogutskaya et al., 2008; Dyldin and Orlov, 2017b).
(Fr.) *Rhinogobius similis* Gill, 1859 – Similar goby	Berg (1949b) and Lindberg and Krasyukova (1975) have synonymized *Rhinogobius bergi* Lindberg, 1936 with *Rh. similis*, the former	Currently, *Rh. bergi* is treated as a junior synonym of *Rhinogobius sowerbyi*, so that *Rh. similis* is no longer a member of the Russian ichthyofauna.

	originally described from Maihe River, Peter the Great Bay basin, Primorye, Russia.	
(Fr.) *Alburnus mento* (Heckel, 1836)	In the past, some authors Kottelat (1997), Reshetnikov (1998) and others, have listed it as a subspecies *Alburnus chalcoides mento,* or it was placed in the synonymy of *Alburnus chalcoides*.	Now, according to Bogutskaya and Naseka (2004), Kottelat and Freyhof (2007) it is classified as a valid species *A. mento*. The range of *A. mento* is limited to subalpine lakes in Germany and Austria in the Danube drainage (Kottelat and Freyhof, 2007)
(Fr.) *Barbus escherichii* Steindacher, 1897 – Sakarya barbel	Berg (1949a), Reshetnikov (1998, 2003) and others, have classified this taxon as a subspecies *Barbus tauricus escherichii*, or *Barbus plebejus escherichii*	According to the new morphological and genetic data (Bogutskaya and Naseka, 2004; Gandlin and Levin, 2016; Levin et al., 2019), this taxon is raised to species level. *Barbus tauricus rionica* Kamensky, 1899, that formally occured in rivers along Black sea coast in Krasnodarsk region and western part of Transcaucasia, is now treated as a valid species. *B.escherichii* is no member of the Russian ichthyofauna.
(Fr.) *Chanodichthys dabryi* (Bleeker, 1871) – Humpback	-	Formerly (Bogutskaya and Naseka, 1996; Reshetnikov, 1998, 2003) recorded *Ch. dabryi* for waters of Russia, but only by including the taxon *Chanodichthys abramoides*, which is now treated as a valid species.
(Fr.) *Microphysogobio tungtingensis* (Nichols, 1926) – Longnose gudgeon	This species comprised several subspecies: *Microphysogobio tungtingensis anudarini* from Bujr Nur Lake, Mongolia, *Microphysogobio tungtingensis amurensis* from basin of Amur River, *M. tungtingensis suifuensis* described from China (Suifu, province Szechwan), *M. tungtingensis uchidai* described from Pusan, South Korea.	As *M. tungtingensisamurensis* is now treated as a valid species, *M. tungtingensis* is not member of the Russian ichthyofauna.
(Fr.) *Oreoleuciscus dsapchynensis* Warpachowski, 1889 – Dsapchyn River osman	In the past this species was recorded by Berg (1949a) for the waters of Russia in the Teletskoye Lake basin, Altai region (Russia); Berg treated *Oreoleuciscus ignatowi* Nikolskii 1902 as a junior synonym. Bogutskaya and Naseka (2004) placed *Oreoleuciscus dsapchynensis* in the synonymy of *Oreoleuciscus potanini* (Kessler, 1879).	Kottelat (2006) restored it as a valid species. Kottelat (2006) treated *Oreoleuciscus ignatowi* as a junior synonym of *Oreoleuciscus potanini* (Kessler, 1879), which action excludes *Oreoleuciscus dsapchynensis* from the Russian ichthyofauna.
(Fr.) *Sarcocheilichthys nigripinnis* (Günther, 1873) – Rainbow gudgeon	Some authors (e.g., Novomodny et al., 2004; Novomodny 2014; etc.) have treated *Sarcocheilichthys czerskii* as a junior synonym of this species.	According to Reshetnikov (2003), Naseka and Gershtein (2006), Bogutskaya et al. (2008), *Sarcocheilichthys czerskii* is a valid species. It was originally described from Shanghai, China. Not considered as a member of the Russian ichthyofauna, because here *Sarcocheilichthys soldatovi* and *Sarcocheilichthys czerskii* are treated as valid species.

(Fr., Br.) *Squalidus argentatus* (Sauvage & Dabry de Thiersant, 1874) – Silver gudgeon	-	Originally described from Yangtze River, China; distributed in China and Taiwan. This species is not considered as a member of Russian ichthyofauna
(Fr.) *Cobitis choii* Kim & Son, 1984 – Choi's spiny loach	This taxon has been treated as a junior synonym of *Cobitis lebedevi* Vasil'eva & Vasil'ev, 1985; its distribution area includes the Amur River basin (Russia, China and Mongolia) and the southern part of Primorsky Krai.	*C. lebedevi* is here considered as valid (following Kim et al., 1999; Kottelat, 2006, 2012). It is endemic to the Kum River drainage, southern part of Korean Peninsula (Kim and Son, 1984; Kottelat, 2006).
(Fr.) *Cobitis sinensis* Sauvage & Dabry de Thiersant, 1874 – Chinese spiny loach	Former records of this taxon from the Korean Peninsula are now attributed to *Cobitis hankugensis* Kim, Park, Son & Nalbant, 2003; *C. sinensis* is no longer considered as a member of the Korean ichthyofauna (Kim et al., 2003).	Russian distribution area of this species (either native or introduced): border waters of Amur drainage near Khabarovsk (Novomodny, 2004; Novomodny et al., 2004), where it is probably replaced by *Cobitis melanoleuca* Nichols, 1925, see Bogutskaya et al. (2008) or other species that were recently described from Korea and China. So according to «Eschmeyer's catalog of Fishes», not less than 15 species of this genus were described from Korea and China from 1990 to 2015, including *Cobitis hankugensis*. Identification requires a comparison with Russian spiny loaches from the border of the Far Eastern waters.
(Fr.) *Misgurnus buphoensis* Kim & Park, 1995 – Korean weatherfish	According to Shedko and Shedko (2003), Bogutskaya and Naseka (2004) and Naseka and Gershtein (2006), the taxon *Misgurnus nikolskyi* Vasil'eva, 2001, is a junior synonym of *M. buphoensis;* in this case *M. buphoensis* would be a member of the Russian ichthyofauna.	According to Bogutskaya et al. (2008) and Kottelat (2012), *M. nikolskyi* is treated as a valid species.
(Fr.) *Sabanejewia aurata* (De Filippi, 1863) – Goldside spined loach	Several subspecies were previously recognized: *Sabanejewia aurata kubanica* Vasil'eva & Vasil'ev, 1988 – Kuban River spined loach, Kuban River basin; *S. a. baltica* Witkowsky, 1994 – Baltic spined loach, Baltic Sea basin; *S. a. balcanica* (Karaman, 1922) – Balkan spined loach, from basin of Aegean and Black seas; *S. a. bulgarica* (Drensky, 1928) – Danube (Bulgarian) spined loach, from Danube River basin, Bulgaria.	*S. aurata* is not considered to be a member of the Russian ichthyofauna, because the previous subspecies that were found in Russian waters, were either synonymized with other species or raised to species level, see Kottelat and Freyhof (2007), Kottelat (2012) and Fricke et al. (2020a). However, it might have been introduced.
(Fr.) *Tachysurus fulvidraco* (Richardson, 1846) – Yellow catfish	Formerly known from China, Korea, northern Vietnam, Amur River basin (including Khanka Lake and Ussuri and Sungari rivers), and northwestern Sakhalin Island (Berg, 1949a; Reshetnikov, 1998).	Not occurring in Russian water (Ng and Kottelat, 2007).

(Fr.) *Tachysurus nitidus* Sauvage & Dabry de Thiersant, 1874 – Shiny catfish	According to Novomodny (2004, 2014), *Tachysurus brashnikowi* (Berg, 1907) is a junior synonym of *T. nitidus*.	*T. nitidus* may be the so-called "southern population", and *T. brashnikowi* (Berg, 1907) the "northern population", i.e., two valid species; in that case *T. nitidus* is not part of the Russian ichthyofauna (Bogutskaya and Naseka, 2004; Bogutskaya et al., 2008).
(Fr.) *Coregonus lavaretus* (Linnaeus, 1758) – Lavaret	In a broad sense, *C. lavaretus* is widespread from central and northwest Europe to Siberia. Sometimes is called the *C. lavaretus* complex and considered as a superspecies (Reshetnikov, 1998, 2003).	The type of locality of *C. lavaretus* is Lake Bourget, France (Bogutskaya and Naseka, 2004; Kottelat and Freyhof, 2007). At present a number of forms that were previously was listed as part of *C. lavaretus* have been raised to species level (see Bogutskaya and Naseka, 2004; Kottelat and Freyhof, 2007; Fricke et al., 2020a).
(Mr., Br.) *Atherina boyeri* Risso, 1810 – Big-scale silverside	-	With the establishment of the valid species *Atherina pontica* from the Black and Azov seas and *Atherina caspia* from the Caspian Sea, *A. boyeri* is no longer a member of Russian ichthyofauna.
(Mr., Br.) *Spicara smaris* (Linnaeus, 1758) – Picarel	-	The Sea of Azov and Black Sea were formerly included in its distribution range, due to its synonymy [*Sciaena gymnodon* Pallas, 1814; *Smaris vulgaris* Valenciennes, 1830; *Spicara flexuosa* Rafinesque, 1810, and others].
(Am.) *Gymnogobius cylindricus* Tomiyama, 1936 – Cylindrical goby	According to Lindberg and Krasyukova (1975) this taxon is placed in the synonymy of *Gymnogobius raninus* Taranetz, 1934, the latter was described from Peter the Great, Sea of Japan, Russia.	We now treat *G. cylindricus* as a valid species (e.g., Stevenson, 2002; Parin et al., 2014), while *G. raninus* is usually treated as a synonym of *Gymnogobius macrognathos* (Bleeker, 1860). Therefore, *G. cylindricus* is currently not treated as a member of the Russian ichthyofauna.
(Mr., Br.) *Luciogobius elongatus* Regan, 1905 – Elongate goby	According to Berg (1949b) this taxon was placed in the synonymy of *Luciogobius guttatus* Gill, 1859.	Since the beginning of the 1930s, this species has not been recorded from Russian waters; most likely, it was previously misidentified.
(Am.) *Rhinogobius brunneus* (Temminck & Schlegel, 1845) – Brown goby	Gobies from Sakhalin and Amur basin southward to Taiwan and Hainan and the Philippines, as well as from the waters of Japan, Korean Peninsula, China and Vietnam, were historically identified as *R. brunneus* (Pinchuk, 1978, 1992; Dyldin and Orlov, 2017b).	*Rh. brunneus* was originally described from the Nagasaki, southern Japan, and not yet found in Russian waters (coast of Primorsky Krai and Sakhalin Island). Russian findings are now attributed to *Rh. sowerbyi* Ginsburg, 1917 and *Rh. lindbergi* Berg, 1933 (Bogutskaya et al., 2008; Dyldin and Orlov, 2017b).

Appendix Table 4. Introduced fish species and its current status in the Russian waters.
Accepted designations: - currently not farmed in aquaculture; + used in aquaculture, farmed; ? + introduced into the border waters with Russia, so far there is no information about the captures in the waters of Russia, but it is possible; (n) in natural conditions naturalization took place (it should be noted that we do not consider naturalization as natural if it occurred in artificially warm water bodies, as for example at Heat Power Plants); (?n) there may have been naturalization, but this requires documentary evidence.

Introduced species	Native area	Place of introduction in Russia	Modern state
1. *Acipenser fulvescens* Rafinesque, 1817 – lake sturgeon	North America, U.S.A. and Canada	In the past, there was an attempt of breeding at the Aksai-Don plant in the Rostov Oblast (S.B. Podushka, pers. comm.)	-
2. *Acipenser naccarii* Bonaparte, 1836 – Adriatic sturgeon	Northern and southern parts of the Adriatic Sea	Used for breeding since 1997 at Aleksin chemical plant (Podushka et al., 2006)	+
3. *Acipenser oxyrinchus* Mitchill, 1815 – American Atlantic sturgeon	Northwestern part of Atlantic Ocean, the coasts of U.S.A. and Canada	Several years ago, fertilized eggs and larvae have been imported from Canada to the Baltic region (basins of the Odra and the Vistula). Later, in these rivers, individuals of this species were recorded, including the Russian part of the Gdansk Bay in Kaliningrad region (Kolman et al., 2011a, 2011b).	?+
4. *Polyodon spathula* (Walbaum, 1792) – Mississippi paddlefish	Northern America, in Mississippi and its tributaries, flowing into the Gulf of Mexico	This species is cultivated in aquaculture both in the European part and in the Far East of Russia. Reported from Krasnodar Krai (Pashkov et al., 2004); also in Russian Siberia and Far Eastern waters in the Sea of Japan including Khanka Lake in the Amur River basin (Kharin and Cheblukov, 2009; Kharin and Vinnikov, 2011); Crimean Peninsula (Karpova and Boltachev, 2012; Karpova, 2016).	+
5. *Alosa sapidissima* (Wilson, 1811) – American shad	Atlantic coast of Northern America	Eastern Kamchatka (Korfa, Karaginski and Kamchatka bays), northwestern Bering Sea and Anadyr River (Berg, 1948; Tokranov and Sheiko, 2006; Chereshnev, 2008). Within the Russian waters, naturalization likely has not occurred. The occasional modern records of this species most probably come from the North American waters, where this species naturalized (Tokranov, 2015; Tokranov and Orlov, 2015).	-
6. *Barbodes semifasciolatus* (Günther, 1868) – Chinese barb	China	Introduced to Khanka Lake, Amur River basin (observed in 1987) (Manilo and Pan'kov, 2004; Svirskiy and Barabanshchikov, 2010)	?+
7. *Hypophthalmichthys nobilis* (Richardson, 1845) – Bighead carp	Southern and central China	Introduced to the European part of Russia. Used for aquaculture across Russia including basin of Azov (Kuban), Black and Caspian seas (Moskul, 1994, 1998; Pashkov et al., 2004; Ivanchev and Ivancheva, 2010); Siberia (Interesova, 2016); Sungari and Amur rivers, including Khanka Lake	+ (n)

		since 1952-1960. Later entered the Amur River basin (Naseka and Gershtein, 2006; Novomodny, 2014); also Tumannaya River (Tumen) (Sokolovsky and Epur, 2008).	
8. *Megalobrama amblycephala* Yih, 1955 – Wuchang bream	China in the middle reaches of the Yangtze River.	Introduced to Sungari River and Khanka Lake (Novomodny et al., 2004; Novomodny and Belyaev, 2004), however, no reliable information on capture in the Russian part of the Amur basin (Novomodny, 2014)	?+
9. *Ochetobius elongatus* (Kner, 1867) – Chinese elongate minnow	China, Korea and Vietnam, from Yangtze River southward to northern Vietnam	Khanka Lake, Amur River basin (Bogutskaya and Naseka, 2004; Novomodny and Belyaev, 2004; Svirskiy and Barabanshchikov, 2010)	+ (?n)
10.?*Rhodeus fangi* (Miao, 1934) – Fang's bitterling	China	Probably entered the Chinese side of Amur River basin in the decade 1930-40 (Novomodny, 2002; Novomodny and Belyaev, 2004), where, possibly by mistake, described as a new species *Rhodeus amurensis* (Vronsky, 1967). Currently present in the Amur basin, including the Sungari and Ussuri basins, as well as in the Lake Khanka (Novomodny, 2002, 2014; Novomodny and Belyaev, 2004)	+ (n)
11. *Rhodeus ocellatus* (Kner, 1866) – Rosy bitterling	Eastern Asia, is not native for Russian water	First reported in 2001 from Kiya River, Amur basin (Novomodny, 2014)	+ (?n)
12. *Misgurnus anguillicaudatus* (Cantor, 1842) – Oriental weatherfish	Zhoushan Island, China	Originally introduced on the Chinese side (Sungari River basin), reported from the Russian part of Amur River basin (Novomodny and Belyaev, 2004)	+ (n)
13. *Paramisgurnus dabryanus* Dabry de Thiersant, 1872 – Dabry's weatherfish	Southern China, including Hainan and probably Taiwan	Originally introduced on the Chinese side, it is now naturalized in the Russian part of the Amur basin (Novomodny and Belyaev, 2004; Novomodny, 2014)	+ (n)
14. *Ictiobus bubalus* (Rafinesque, 1818) – Smallmouth buffalo	Northern America	Used in fish farms in the Krasnodar Territory since 1971; later reported from the Volga basin at Samara and Tver. Used in fish farms and in other regions of Russia (Moskul, 1998; Emtyl' and Ivanenko, 2002; Pashkov et al., 2004)	+
15. *Ictiobus cyprinellus* (Valenciennes, 1844) – Bigmouth buffalo	Northern America	In Siberia (e.g., Ob and Yenisei rivers, also Novosibirsk and Belovskoye reservoirs and etc.), Kalmykia, Krasnodar Krai (since 1971), Volga drainage of the coast of Samara, Tver etc. (Moskul, 1998; Emtyl' and Ivanenko, 2002; Pashkov et al., 2004; Interesova, 2016); Crimean Peninsula (Karpova, 2016)	+
16. *Ictiobus niger* (Rafinesque, 1819) – Black buffalo	Northern America	Along with other representatives of this genus, it is used in fish farming in the European part of Russia and Siberia (Moskul, 1998; Emtyl' and	+

		Ivanenko, 2002; Pashkov et al., 2004; Interesova, 2016)	
17. *Ameiurus nebulosus* (LeSueur, 1819) – Brown catfish	North America	Appeared after 1935 as an object of pond farming in water bodies of Ukraine and Belarus, first in the Pripyat River basin where entered other river systems of Belarus and Western Ukraine (Bulakhov et al., 2008). In Russia probably in border waters near Belorussia and Ukraine (Reshetnikov, 1998)	-
18. *Ictalurus punctatus* (Rafinesque, 1818) – Channel catfish	North America, mainly in the Missouri and Mississippi rivers basins	First imported from the USA in 1972. In the Kuban basin, Sea of Azov, introduced in 1974; later observed in the lower and middle reaches of this river. Naturalization occurs only in waters with artificially high temperatures, such as at some thermal power plants, in the Tula region, Krasnodar, the Moscow region, Siberia and other regions of Russia (Emtyl' and Ivanenko, 2002; Alimov and Bogutskaya, 2004; Pashkov et al., 2004; Bulakhov et al., 2008; Interesova, 2016); Crimean Peninsula (Karpova, 2016).	+
19. *Clarias gariepinus* (Burchell, 1822) – North African catfish	Africa and Asia Minor, Turkey	Used in aquaculture in Lipetsk, Kursk, Ryazan and Krasnodar region (Levina et al., 2015)	+
20. *Plecoglossus altivelis* (Temminck & Schlegel, 1846) – Ayu	Japan, also all rivers of Korean Peninsula, China, Taiwan and northern Vietnam to Kalong and Tien Yen rivers	Introduced but not naturalized (Bogutskaya and Naseka, 2004)	-
21. *Protosalanx chinensis* (Basilewsky, 1855) – Chinese noodlefish	Eastern Asia	Introduced several decades ago in the Chinese part of Sungari River. Currently found in the Russian part of the Amur basin to the city of Khabarovsk. Introduced since 2006 in Lake Khanka (Svirskiy and Barabanshchikov, 2010; Butova and Novomodny, 2014; Novomodny, 2014; Tang et al., 2015)	+ (n)
22. *Salmo ischchan* Kessler, 1877 – Sevan trout	Endemic species of the Sevan Lake (Armenia) and its drainage	Introduced in 1960 to Onega and Ladoga lakes, but naturalization did not occur (Bogutskaya and Naseka, 2004); Crimean Peninsula (Karpova, 2016)	-
23. *Salvelinus fontinalis* (Mitchill, 1814) – Brook trout	Eastern part of North America	Naturalized in the eastern part of Gulf of Finland (Bogutskaya and Naseka, 2004)	+ (?n)
24.*Gambusia holbrooki* Girard, 1859 – Eastern mosquitofish	Eastern part of North America	First imported from Italy in 1925, to the southern part of the former USSR to Abkhazia in the north-eastern part of the Black Sea, as a biological remedy, against the malaria mosquitoes. Specially bred since 1940, they were specially bred each year in Ukraine and the Crimean Peninsula. However, in winter, most of	+ (?n)

		the individuals died and their numbers were maintained, mainly due to breeding each year (Emtyl' and Ivanenko, 2002; Bulakhov et al., 2008). This species was probably naturalized on the Crimean Peninsula (Karpova, 2016), this fact requires verification.	
25. *Poecilia reticulata* Peters, 1859 – Guppy	South America (Venezuela, Barbados, Trinidad, northern Brazil and the Guyanas)	One of the most well-known and popular aquarium fish in the world, in Russia, too. Aquarists often release this species to Russian rivers, although in winter all individuals die, and only in warm water bodies at a thermal power station does naturalization occur, such as at the Krasnodar Thermal Power Plant (Emtyl' and Ivanenko, 2002)	+ (n)
26. *Oryzias sinensis* Chen, Uwa & Chu, 1989 – Chinese medaka	China	Basin of Amur River, basin of Sungari River, including near Khabarovsk area (Novomodny and Belyaev, 2004; Novomodny, 2014); Ob River basin, Western Siberia (Popov 2009) also Kuban River and other rivers of Caucasus' coast of the Black Sea of the Krasnodar Krai (Emtyl' and Ivanenko, 2002; Naseka and Diripasko, 2005)	+ (n)
27. *Morone saxatilis* (Walbaum, 1792) – Striped bass	Atlantic coast of North America	Kuban River, basins of the Azov and Black seas (Bogutskaya and Naseka, 2004; Vasil'eva, 2007)	+
28. *Lepomis gibbosus* (Linnaeus, 1758) – Pumpkinseed	Atlantic coast of the North America from Washington and Oregon, U.S.A to New Brunswick, Canada	Widely introduced to temperate waters, now it is widespread throughout Europe, from Portugal to Crimean Peninsula, eastward to Dniepr (Hanel and Lusk, 2005; Kottelat and Freyhof, 2007; Bulakhov et al., 2008; Lusk et al., 2011; Fedonenko and Marenkov, 2013; Karpova, 2016)	+ (n)
29. *Micropterus salmoides* (Lacepéde, 1802) – Largemouth black bass	Eastern half of the North America to Quebec and Ontario in the Canada (to the year 1800)	District of Novorossiysk, Basin of Black Sea (successively naturalized in Abrau and Limantschik lakes, but its present occurence is questionable, see Berg (1949b), Bogutskaya and Naseka (2004)	+ (?n)
30. *Gymnocephalus baloni* Holcik & Hensel, 1974 – Danube ruffe or Balon's ruffe	Danube (from delta to Germany) and Dniepr (from delta to Kiev, middle reaches of Pripyat River)	Only known from a single capture in 2010 from the Crimean Peninsula (Karpova and Boltachev, 2012; Karpova, 2016)	(?n)
31. *Oreochromis aureus* (Steindachner, 1864) – Blue tilapia	Eurasia and Africa	In the basin of the Kuban River in the warm Staraya Kuban Lake, apparently naturalization occurred in warm waters, because females with eggs was found there (Pashkov et al., 2004)	+ (n)
32. *Oreochromis mossambicus* (Peters, 1852) – Mozambique tilapia	South Africa	Introduced to warm water, in aquaculture in some reservoirs, e.g., Kuban River basin and coast of the Black Sea, see Pashkov et al. (2004)	-

33. *Rocio octofasciata* (Regan, 1903) – Blue jack Dempsey	North and Central America	One specimen captured near the mouth of Moskva River (Ivanchev and Ivancheva, 2010). In Staraya Kuban Lake at a thermal power plant in the Krasnodar Territory, naturalization occurred (Zworykin and Pashkov, 2010)	+ (n)
34. *Sarotherodon melanotheron* Rüppell, 1852 – Blackchin tilapia	Western Africa	In the past, aquaculture object in warm waters of the European part of Russia (Bogutskaya and Naseka, 2004)	-
35. *Millerigobius macrocephalus* (Kolomba tovic, 1891) – Large-headed goby	Native area is Mediterranean Sea	Since 2009, reported from the Black Sea in Sevastopol Bay (Crimean Peninsula), where it was possibly introduced through ballast water and etc. (Boltachev and Karpova, 2012, 2017)	+ (n)
36. *Pomatoschistus bathi* Miller, 1982 – Bath's goby	Black, Mediterranean, Adriatic, Aegean and Marmara seas	First reported in 2000 from Ukrainian and Russian waters of the Black Sea (Boltachev and Karpova, 2012)	+ (n)

Appendix Table 5. List of lampreys and fish species listed in the RDBRF (2000, 2016, 2020 in press) and IUCN (2019) categories. Note: in parentheses "()" we marked the accepted security category according to the RDBRF. Several categories are provided with a slash, such as (1/2), then it means that within Russia, within a single species there are several populations (but one species) classified in different categories.

RDBRF 2000	**RDBRF 2016, 2020 (in press)**	**Actual taxonomic status according to our data**	**IUCN 2019**
Petromyzon marinus (1)	*Petromyzon marinus* (4)	*P. marinus* Linnaeus, 1758	LC
Petromyzon wagneri (2)	*Caspiomyzon wagneri* (2)	*C. wagneri* (Kessler, 1870)	NT
Petromyzon mariae (2)	*Eudontomyzon mariae* (2), the population of the Black Sea coast of the river Krasnodar Territory	*E. mariae* (Berg, 1931)	LC
Huso dauricus (1)	*Huso dauricus* (1), the Zeya-Bureya population	*H. dauricus* (Georgi, 1775)	CR
Huso huso ponticus Sal'nikov & Malyatskii, 1934 (1)	*Huso huso maeoticus* Sal'nikov & Malyatskii, 1934 (1)	*H. huso* (Linnaeus, 1758)	CR
Acipenser sturio (0)	*Acipenser sturio* (0), the population of the Black Sea basin	*A. sturio* Linnaeus, 1758	CR
_	*Acipenser oxyrinchus* (0), the aboriginal population	*A. oxyrinchus* Mitchill, 1815 - this species is not native to the waters of Russia and should be excluded from the RDBRF	NT
Acipenser medirostris (1)	*Acipenser mikadoi* (1)	*A. mikadoi* Hilgendorf, 1892	CR
Acipenser schrenckii (1)	*Acipenser schrenckii* (1)	*A. schrenckii* Brandt, 1869	CR
Acipenser baerii baerii (2)	*Acipenser baerii* (2), with the exception of the Lena River basin populations	*A. baerii* Brandt, 1869	EN
A. baerii baicalensis (2)	_	*A. baerii* Brandt, 1869	EN
Acipenser nudiventris (1)	*Acipenser nudiventris* (1)	*A. nudiventris* Lovetsky, 1828	CR
_	*Acipenser gueldenstaedtii* (1)	? *A. gueldenstaedtii* Brandt & Ratzeburg, 1833	CR
Acipenser ruthenus (1)	*Acipenser ruthenus*, the populations of the Dnepr	*A. ruthenus* Linnaeus, 1758	VU

	River basin and the Angara River basin (1), populations of the Sura, Ural, Don, Upper Oka and Klyazma river basins (2), the population of the Upper and Middle Kama basin (5)		
_	*Acipenser stellatus* (1), the population of the Azov-Black Sea basin	*A. stellatus* Pallas, 1771	CR
Alosa kessleri volgensis (2)	*Alosa volgensis* (2)	*A. volgensis* (Berg, 1913)	EN
Alosa fallax fallax (4)	_	*A. fallax* (Lacepéde, 1803)	LC
Clupeonella abrau (4)	*Clupeonella abrau* (3)	*C. abrau* (Maliatsky, 1930)	CR
Salmo salar *Salmo salar* m. *sebago* (2)	*Salmo salar* (2), the residential form	*S. salar* Linnaeus, 1758	LC
Salmo trutta trutta *Salmo trutta trutta* m. *lacustris* (2) *Salmo trutta trutta* m. *fario* (2)	*Salmo trutta trutta* (2), the lake forms of the Baltic Sea basin in the basin of Ladoga and Onega lakes	*S. trutta* Linnaeus, 1758	LC
Salmo trutta caspius (1)	*Salmo trutta caspius*, for the anadromous form of the Caspian Sea basin (2), the residential (stream) form of the Volga and Ural river basin (1)	*S. ciscaucasicus* Dorofeeva, 1967	_
Salmo trutta labrax (1)	*Salmo trutta labrax* (1), for the anadromous form of the Black Sea basin, and for the lake and brook forms of the Crimean Peninsula	*S. labrax* Pallas, 1814	LC
Salmo trutta ezenami (2)	*Salmo trutta ezenami* (1)	*S. ezenami* Berg, 1948	CR
Parasalmo mykiss (3)	*Parasalmo mykiss*, for the anadromous form of the Kamchatka (2), for the Shantar Islands population (3)	*P. mykiss* (Walbaum, 1792)	_
Salvelinus alpinus (2)	*Salvelinus alpinus*, the populations of the Frolikha, Big and Small Leprindo, Leprindokan, Davatchan, Irbo, Tokko, Usu, Kamkanda, Ogiendo lakes (Transbaikalia) (2), the population of the Lake Shchuchye (Polar Urals) (3)	*S. alpinus* (Linnaeus, 1758)	LC

Salvelinus elgyticus (3)	*Salvelinus elgyticus* (3)	*S. elgyticus* Viktorovsky & Glubokovsky, 1981	_
Salvelinus svetovidovi (3)	*Salvethymus svetovidovi* (3)	*Salvethymus svetovidovi* Chereshnev & Skopets, 1990	VU
Hucho taimen (1)	*Hucho taimen* (1), the populations of the European part of Russia, the Western Siberia (with the exception of the Altai Republic and and the Tom River within the boundaries of the Kemerovo region), the basin of Lake Baikal, including the basin of the Angara River, the Sakhalin Island	*H. taimen* (Pallas, 1773)	VU
Hucho perryi (2)	*Parahucho perryi* (1), the populations of Primorsky Krai and Sakhalin Region.	*P. perryi* (Brevoort, 1856)	CR
Brachymystax lenok (1)	*Brachymystax tumensis* (1), the population of the Ob River basin	*B. tumensis* Mori, 1930	_
-	*Brachymystax lenok* (2), the populations of the Baikal Basin and the Angara River basin	*B. lenok* (Pallas, 1773)	_
Stenodus leucichthys leucichthys (1)	*Stenodus leucichthys leucichthys* (1)	*S. leucichthys* (Güldenstädt, 1772)	EW
Stenodus leucichthys nelma (1)	*Stenodus leucichthys nelma* (2), the populations of the European part of Russia, with the exception of the Pechora River Basin population	*S. nelma* (Pallas, 1773)	LC
Coregonus lavaretus baeri (2)	*Coregonus lavaretus* (1), populations of the Volkhov and Svir, Ladoga Lake basin	*C. baerii* Kessler, 1864	DD
Coregonus lavaretus baunti (3)	*Coregonus baunti* (3), the populations of the Big and Small Kapylyushi lakes	*C. baunti* Mukhomediyarov, 1948	DD
Coregonus albula pereslavicus (2)	*C. albula* (2), the population of the Lake Plescheevo	*C. albula* (Linnaeus, 1758)	LC
	Coregonus muksun (2), the populations of the Yamal Peninsula	*Coregonus muksun* (Pallas, 1814)	LC

Prosopium coulteri (3)	*Prosopium coulteri* (3)	*P. coulterii* (Eigenmann & Eigenmann, 1892)	_
Thymallus thymallus (2)	*Thymallus thymallus* (2), the populations of the Ural river basin	*Th. thymallus* (Linnaeus, 1758)	LC
Rutilus frisii frisii (4)	*Rutilus frisii frisii* (1)	*R. frisii* (Nordmann, 1840)	LC
Rutilus frisii kutum (2)	_	*R. kutum* (Kamensky 1901)	_
_	*Vimba vimba* (2), the populations of the Kuban River basin and the rivers of the Black Sea coast of the Krasnodar Territory	*V. tenella* (Nordmann, 1840)	_
	Cobitis taurica (2)	*C. taurica* Vasil'eva, Vasil'ev, Janko, Ráb & Rábová, 2005	CR
Barbus barbus borysthenicus (1)	*Barbus barbus*, the population of the Baltic Sea basin (2), the population of the Dnieper basin (1)	*Barbus barbus* (Linnaeus, 1758), for the	LC
		Baltic Sea basin	
		B. borysthenicus Dybowski, 1862, for the upper reaches of Dniepr drainage	_
_	*Luciobarbus capito* (2)	*L. capito* (Güldenstädt, 1773)	VU
_	*Gobio tauricus* Vasil'eva, 2005 (2)	*Gobio krymensis* Bănărescu & Nalbant, 1973	VU
Chalcalburnus chalcoides mento (2)	*Alburnus mento* (2)	*Alburnus leobergi* Freyhof & Kottelat, 2007, for the rivers of the Sea of Azov *Alburnus mentoides* Kessler, 1859, for the rivers of Crimean Peninsula	LC EN
_	*Alburnus chalcoides* (2)	*A. chalcoides* (Güldenstädt, 1772)	LC
Alburnoides bipunctatus rossicus (2)	_	*A. rossicus* Berg, 1924	LC
Elopichthys bambusa (1)	*Elopichthys bambusa* (5)	*E. bambusa* (Richardson, 1845)	DD
Mylopharyngodon piceus (1)	*Mylopharyngodon piceus* (1), the aboriginal population	*M. piceus* (Richardson, 1846)	DD
Megalobrama terminalis (1)	*Megalobrama mantschuricus* (3)	*M. mantschuricus* (Basilewsky, 1855)	_
Plagiognathops microlepis (1)	*Plagiognathops microlepis* (1)	*P. microlepis* (Bleeker, 1871)	LC
_	*Rhodeus colchicus* (1)	*Rhodeus colchicus* Bogutskaya & Komlev, 2001	LC

Sabanejewia caucasica (3)	_	*S. caucasica* (Berg, 1906)	LC
Silurus soldatovi (2)	*Silurus soldatovi* (3)	*S. soldatovi* Nikolskii & Soin, 1948	_
Stizostedion volgensis (3)	_	*Sander volgensis* (Gmelin, 1789)	LC
Siniperca chuatsi (2)	*Siniperca chuatsi* (5)	*S. chuatsi* (Basilewsky, 1855)	_
Cottus gobio (2)	_	*C. gobio* Linnaeus, 1758	LC
Gadus morhua kildinensis (1)	*Gadus morhua kildinensis* (1)	*Gadus morhua* Linnaeus, 1758	VU
_	*Anguilla anguilla* (1), the basins of the Barents, White, Black and Azov seas	*A. anguilla* (Linnaeus, 1758)	CR
_	*Hippocampus hippocampus* (2)	*H. guttulatus* Cuvier, 1829	DD

Appendix Table 6. Number of Russian freshwater and brackish water fish and lamprey species according to IUCN categories.

EX	EW	CR	EN	VU	NT	LC	DD
-	1	17	8	27	17	318	37

Appendix Table 7. List of brackish and freshwater fishes newly described from Russia and adjacent areas during 2004-2018. * the species was described from adjacent waters.

New taxa	Distribution in Russian waters	Note
2004		
Gobio kubanicus Vasil'eva, 2004 – Kuban gudgeon	Kuban River basin (Vasil'eva et al., 2004)	
Romanogobio parvus Naseka & Freyhof, 2004 – small Kuban gudgeon	Black Sea basin in the middle and lower reaches of the Kuban, also is marked for the basin of Don where penetrated from Nevinnomyssky channel (Naseka and Freyhof, 2004; Naseka et al., 2005)	
Thymallus burejensis Antonov, 2004 – Bureye River grayling	In the original description from the Levaya River in the Middle Amur River basin (Antonov, 2004)	
2005		
Coregonus lutokka Kottelat, Bogutskaya & Freyhof, 2005 – Lake Ladoga whitefish	Ladoga and Onega lakes (Kottelat et al., 2005; Kottelat and Freyhof, 2007)	According to ICZN this is a replacement name for *Coregonus widegreeni ludoga* Berg, 1916, which was previously treated by another author as *Coregonus ludoga* Polyakov, 1874
Pungitius polyakovi Shedko, Shedko & Pietsch, 2005 –Polyakov's ninespine stickleback	South-eastern Sakhalin Island (Shedko et al., 2005)	
Salvelinus vasiljevae Safronov & Zvezdov, 2005 – Sakhalin or Vasil'eva's charr	Rivers of the north-western Sakhalin Island (Safronov and Zvezdov, 2005; Safronov, 2009)	
Thymallus baicalolenensis Matveev, Samusenok, Pronin & Tel'pukhovsky, 2005 – Barguzin River grayling	The upper reaches of Barguzin River, as well as rivers and lakes of Baikal Lake basin, including Lena River basin (Matveev et al., 2005; Matveev and Samusenok, 2009; Matveev et al., 2009; Antonov, 2012)	First described as a subspecies, *Thymallus arcticus baicalolenensis*
2006		
Thymallus flavomaculatus Knizhin, Antonov & Weiss, 2006 – Yellow-spotted grayling	Upper largest tributaries of the Amur River basin, as well as the upper reaches of the rivers belonging to the basins of Japan and Okhotsk seas, including the Tatar Strait basin, except Sakhalin Is. (Knizhin et al., 2006; Bogutskaya et al., 2008; Antonov and Knizhin, 2011)	First described as a subspecies, *Thymallus grubii flavomaculatus*
2007		
Alburnus leobergi Freyhof & Kottelat, 2007 – Azov shemaya	Azov Sea, whence comes into the Don, Kuban, Seversky Donets and other rivers (Freyhof and Kottelat, 2007; Kottelat and Freyhof, 2007)	Formerly treated as a part of *Chalcalburnus chalcoides mento* (Heckel, 1836) or *Alburnus mento*. Freyhof and Kottelat (2007) described this as a new species, while according to

		their data the distribution *A. mento* is limited to its type locality.
* *Barbatula sawadai* (Prokofiev, 2007) – Sawada's loach	Ero River basin, tributary of Selenga River system in Mongolia (Prokofiev, 2007, 2015, 2016). The finding of this species within the waters of Russia is very high.	Originally classified in the genus *Orthrias*.
Thymallus tugarinae Knizhin, Antonov, Safronov & Weiss, 2007 – Lower Amur grayling	Currently, range of this species includes northern Sakhalin Is., Amur estuary, lower reaches of Amur and partly in the central and upper Amur basin, including Tatar Strait, rivers of Primorsky Krai and Uda and Tugur rivers of the continental part of Sea of Okhotsk (Knizhin et al., 2007; Antonov and Knizhin, 2011; Antonov, 2012; Dyldin et al., 2017)	
2008		
? *Cobitis gladkovi* Vasil'ev & Vasil'eva, 2008 – Gladkov's spiny loach	The range of this species includes basins of the Volga, Don, Kuban, Eja and Maly and Bolshoi Uzen, as well as the northern Caspian Sea (Vasil'ev and Vasil'eva, 2008); indicated for the Kuibyshev reservoir in Ulyanovsk region (Semenov and Ruchin, 2008)	First treated as a subspecies, *Cobitis melanoleuca gladkovi* from Seversky Donets, Don River basin (Vasil'ev and Vasil'-*eva, 2008). Kottelat (2012) raised it to species level. Accor-ding to the authors of the original des--*cription (see Parin et al., 2014), we treat this taxon as a junior synonym of *Cobitis melanoleuca* Nichols, 1925.
Gobio volgensis Vasil'eva, Mendel, Vasil'ev, Lusk & Lusková, 2008 – Volga gudgeon	Volga River basin, including deltas of the Volga and Ural (Mendel et al., 2008; Bogutskaya et al., 2013)	
2009		
Alburnoides gmelini Bogutskaya & Coad, 2009 –Dagestan spirlin or Gmelin's sprilin	Western Caspian Sea from the Sulak River to the rivers near Derbent (Bogutskaya and Coad, 2009)	
Lethenteron ninae Naseka, Tuniyev & Renaud, 2009 – Western transcaucasian brook lamprey	The western part of the Caucasus, Russia and Abkhazia (Naseka et al., 2009; Renaud, 2011)	
Thymallus svetovidovi Knizhin & Weiss, 2009 – Svetovidov's grayling or Upper Yenisei grayling	The upper flow of all the rivers belonging to the Yenisey River basin, Mongolia and Russia (Knizhin and Weiss, 2009; Knizhin, 2011)	
2012		
Cottus kolymensis Sideleva & Goto, 2012 – Kolyma River sculpin	Kolyma River and its basin (Sideleva and Goto, 2012)	

2014	
* *Gasterosteus nipponicus* Higuchi, Sakai & Goto, 2014 – Japanese three-spined stickleback	The Sea of Japan of Primorsky Krai and Sakhalin Island (Higuchi et al., 2014)
2015	
* *Ammodytes heian* Orr, Wildes & Kai, 2015 – Peaceful sand lance	From the southern part of the Sea of Okhotsk to the Pacific side of northern Japan (Orr et al., 2015)
Barbatula restricta Prokofiev, 2015 – Restricted loach	Saldan-Kol Lakein the upper Ob River basin, Altai Mountains (Prokofiev, 2015)
Cottus gratzianowi Sideleva, Naseka & Zhidkov, 2015 – Gratzianow's sculpin	Onega river system, White Sea basin (Sideleva et al., 2015)
2017	
* *Takifugu flavipterus* Matsuura, 2017 – Eellowfin puffer	Far East of Russia, the coast of Primorsky Krai (Matsuura, 2017)
2018	
Alosa fallax baltica Kukuev & Orlov, 2018 – Baltic shad	Coasts and rivers of Russian Baltic Sea in the Gulf of Finland and Kaliningrad Region (Kukuev and Orlov, 2018)

Appendix Table 8. Endemic fish species for the Russian waters and the Crimean Peninsula. Note: ? – taxonomic status is questionable, or endemicity requires additional research. Fr. – freshwater, Br. – brackish, Mr. – marine.

Endemic species	Distribution
Clupeiformes Bleeker, 1859 – Herrings	
1. (Fr.) *Clupeonella abrau* (Maliatsky, 1930) – Abrau sprat	Lake Abrau, eastern coast of Black Sea near Novorossiysk
Cypriniformes Bleeker, 1859 – Carps	
2. (Fr.) *Alburnoides kubanicus* Bănărescu, 1964 – Kuban spirlin	left bank tributaries of Kuban drainage, including rivers Laba, Labenok, Belaya and etc.
3. (Fr.) *Alburnoides maculatus* (Kessler, 1859) – Crimean spirlin	Crimean Peninsula in the small rivers, including Chernaya, Al'ma, Bel'bek and Kacha rivers
4. (Fr.) *Alburnus mentoides* Kessler, 1859 – Crimean shemaya	the basins of Black and Azov seas, in the rivers Cacha, Alma, Bel'bek and others of Crimean Peninsula
5. (Fr.) *Barbus kubanicus* Berg, 1912 – Kuban barbel	the upper and middle reaches of the Kuban drainage (including Psekups, Afips and others rivers), Sea of Azov basin
6. (Fr.) *Chondrostoma kubanicum* Berg, 1914 – Kuban nase	throughout the Kuban River basin
7. ? (Fr.) *Gobio delyamurei* Freyhof & Naseka, 2005 – Delyamure's gudgeon	River Chornaya, southwestern Crimean Peninsula
8. (Fr.) *Gobio krymensis* Bănărescu & Nalbant, 1973 – Crimean gudgeon	rivers of Crimean Peninsula, such as Kacha, Salgir etc., including some reservoirs
9. ? (Fr.) *Gobio kubanicus* Vasil'eva, 2004 – Kuban gudgeon	basin of the Kuban River
10. (Fr.) *Gobio soldatovi* Berg, 1914 – Soldatov's gudgeon	lower and middle reaches of Amur River basin, including drainage of Ussuri and near Khabarovsk
11. (Fr.) *Gobio tungussicus* Borisov, 1928 – Lena River gudgeon	mainly in the middle reaches of Lena including some lakes (as the Nidzhili, Nyyraabyt and Mongoi) of the Vilyui River basin
12. (Fr.) *Gobio volgensis* Vasil'eva, Mendel, Vasil'ev, Lusk & Lusková, 2008 – Volga gudgeon	Volga River basin, including delta of Volga and Ural
13. (Fr.) *Squalius aphipsi* (Aleksandrov, 1927) – Aphips chub	Kuban drainage (in its left tributaries from the Laba to Adagum, and mountain streams, as the Afips and Psekups), Sea of Azov
14. (Fr.) *Cobitis taurica* Vasil'eva, Vasil'ev, Janko, Ráb & Rábová, 2005 – Crimean spiny loach	Lower reaches of the Chernaya River, southwestern part of Crimean Peninsula
15. (Fr.) *Sabanejewia kubanica* Vasil'eva & Vasil'ev, 1988 – Kuban spined loach	the basin of Kuban River
16. (Fr.) *Barbatula restricta* Prokofiev, 2015 – Restricted loach	Saldan-Kol Lake, upper Ob River basin, Altai

17. (Fr.) *Catostomus rostratus* (Tilesius, 1813) – Siberian sucker	Arctic basin in the Indigirka, Alazeya, Kolyma and Yana drainages

Esociformes Rafinesque, 1810 – Pikes

18. (Fr.) *Dallia admirabilis* Chereshnev, 1980 – Wonderful blackfish	Lakes of middle and lower reaches of Amguema River basin, Chukotka Peninsula

Salmoniformes Rafinesque, 1810 – Salmons

19. (Fr., Br.) *Coregonus anaulorum* Chereshnev, 1996 – Sharpnose whitefish	in rivers related to the Gulf of Anadyr, such as Anadyr, Kanchalan, Velikaya, Penzhinka etc.
20. (An., Rs.) *Coregonus autumnalis* (Pallas, 1776) – Arctic cisco	along Arctic coast from Cane Bay (East Siberian Sea) to Mezen River (basin of the White Sea) and Pechora (southeastern Barents Sea), including Ob, Yenisei, Lena and Kolyma rivers, Kara and Baydaratskaya bays, Kolguev Island and Novaya Zemlya
21. (Fr.) *Coregonus baerii* Kessler, 1864 – Volkhov whitefish	southern part of Lake Ladoga, lower part of the Volkhov River
22. ? (Fr.) *Coregonus baicalensis* Dybowski, 1874 – Baikal whitefish	northern part of the Lake Baikal, but mainly Barguzin and Chivyrkui bays, Selenga shallow, and Little Sea strait
23. (Fr.) *Coregonus baunti* Mukhomediyarov, 1948 – Lake Baunt whitefish	Tsipo-Tsipikan lakes, Vitim River system in basin of the Lena River, Siberia
24. (Fr.) *Coregonus fluviatilis* Isachenko, 1925 – Yenisei River whitefish	Yenisei River, central part of Siberia
25. (Fr.) *Coregonus kiletz* Michailovsky, 1903 – Kiletz	Lake Onega
26. (Fr.) *Coregonus ladogae* Pravdin, Golubev & Belyaeva, 1938 – Ripus	Lake Ladoga
27. (Fr.) *Coregonus migratorius* (Georgi, 1775) – Baikal omul	Lake Baikal and its drainage including some lakes in the Upper Lena basin
28. (Fr.) *Coregonus pravdinellus* Delkeit, 1950 – Pravdin's whitefish	Lake Teletskoye, Altai
29. (Fr.) *Coregonus smitti* Warpachowski, 1901 – Lake Teletskoe whitefish	Lake Teletskoye and adjacent rivers in the Ob River Basin, Altai
30. (Fr.) *Coregonus subautumnalis* Kaganowsky, 1932 – Penzina cisco	Penjina and Talovka rivers basin, Koryak Autonomous Area
31. (Fr.) *Coregonus tugun* (Pallas, 1814) – Tugun	from Ob River to Yana Rivers, including Yenisei and Lena rivers basin, as is also Khatanga River (southern Taimyr Peninsula)
32. ? (Fr.) *Coregonus vessicus* Drjagin, 1932 – Beloye cisco	Beloe Ozero, Karelia. Currently, this taxon is widely spread over the Volga, it is noted in the Kuibyshev, Saratov, Rybinsk reservoirs and etc

33. (Fr.) *Coregonus widegreni* Malmgren, 1863 – Valaam whitefish	In the Ladoga and Onega lakes
34. (Fr.) *Thymallus baicalensis* Dybowski, 1874 – Baikal black grayling	Lake Baikal and its tributaries, also Yenisei and Angara rivers; Lena River basin; southern part of Taimyr Peninsula
35. (Fr.) *Thymallus baicalolenensis* Matveev, Samusenok, Pronin & Tel'pukhovsky, 2005 – Barguzin River grayling	Barguzin River (it is the third largest tributary of Baikal), also and other rivers and lakes of Baikal basin including Lena River drainage
36. (Fr.) *Thymallus burejensis* Antonov, 2004 – Bureye River grayling	Levaya Bureya River, in the middle part of the Amur River
37. (Fr.) *Thymallus flavomaculatus* Knizhin, Antonov & Weiss, 2006 – Yellow-spotted grayling	upper reaches of bigger tributaries of Amur basin, upper reaches of tributaries of the Japan and Okhotsk seas, including basin of the Tatar Strait
38. (Fr.) *Thymallus nikolskyi* Kaschenko, 1899 – Nikolsky’s grayling	upper Ob river system, including Katun and Ursul rivers, Tcharysh River at the Ust’-Kan and Lake Tel’men’e; Tom River basin
39. (An.) *Parasalmo penshinensis* (Pallas, 1814) – Kamchatka steelhead	mainly in rivers of western Kamchatka, but also found in the eastern part to the Ozernaya River
40. ? (Fr.) *Salmo ezenami* Berg, 1948 – Ezenam trout	endemic species of the Lake Ezenam, Dagestan
41. ? (An., Rs.) *Salvelinus albus* Glubokovsky, 1977 – White charr	Kamchatka in the basin of the Kamchatka River, including Lake Kronotskoye where it is as a resident form
42. ? (Fr.) *Salvelinus andriashevi* Berg, 1948 – Chukchi charr	Lake Estikhet near Providence Bay, Chukotka Peninsula
43. (Fr.) *Salvelinus boganidae* Berg, 1926 – Boganida charr	lakes of the Taimyr Peninsula and probably in Chukotka Peninsula
44. (Fr.) *Salvelinus czerskii* Drjagin, 1932 – Cherski's charr	Lakes of the Lena, Yana, Indigirka, Alazeya, Kolyma and Chukochya river basins
45. (Fr.) *Salvelinus drjagini* Logashev, 1940 – Dryagin's charr	rivers and lakes of the Taimyr Peninsula
46. (Fr.) *Salvelinus elgyticus* Viktorovsky & Glubokovsky, 1981 – Small-mouth charr	El'gygytgyn Lake from basin of the Anadyr River in the central part of the ChukotkaPeninsula
47. ? (Fr.) *Salvelinus gritzenkoi* Vasil’eva & Stygar, 2000 – Gritsenko’s charr	Onekotan Island, northern Kurils
48. (Fr.) *Salvelinus jacuticus* Borisov, 1932 – Yakutian charr	the lakes from lower reaches of the Lena River
49. (Fr.) *Salvelinus krogiusae* Glubokovsky, Frolov, Efremov, Ribnikova & Katugin, 1993 – Lake Dal'nee charr	Lake Dal'nee, southeastern Kamchatka
50. ? (Fr.) *Salvelinus kronocius* Viktorovsky, 1978 – Kronotsky charr	Lake Kronotskoye including Listvennichnaya River, southeastern Kamchatka
51. ? (Fr.) *Salvelinus kuznetzovi* Taranetz, 1933 – Ushki Lake charr	Ushki Lake, basin of the Kamchatka River in the southeastern Kamchatka

52. (An.) *Salvelinus levanidovi* Chereshnev, Skopetz & Gudkov, 1989 – Levanidov's charr	rivers of northern part of the Sea of Okhotsk, from Yama to Penzhina
53. (Fr.) *Salvelinus neiva* Taranetz, 1933 – Neiva	northern part of the Sea of Okhotsk, mountain lakes and rivers in the basin of Okhota River
54. (Fr.) *Salvelinus schmidti* Viktorovsky, 1978 – Schmidt's charr	Lake Kronotskoye, including the rivers and streams running into this lake
55. (Fr.) *Salvelinus taimyricus* Mikhin, 1949 – Taimyr charr	Taimyr Peninsula, including Taimyr, Lama, Khantaika Sobach'ye and Keta lakes
56. (Fr.) *Salvelinus tolmachoffi* Berg, 1926 – Esei Lake charr	some lakes of the Khatanga River and probably Lake Khantayskoye of the Yenisei River basin, Taimyr Peninsula
57. (An., Rs.) *Salvelinus vasiljevae* Safronov & Zvezdov, 2005 – Sakhalinian charr	Amur Liman and rivers in northwestern part of the Sakhalin Island, including Varnak, Ten'gi, Pyrki and Langry
58. (Fr.) *Salvethymus svetovidovi* Chereshnev & Skopets, 1990 – Long-finned charr	Anadyr River basin, Lake El'gygytgyn in central part of Chukotka

Gasterosteiformes Gill, 1872 – Sticklebacks

59. (Fr.) *Pungitius bussei* (Warpachowski, 1887) – Busse's ninespine stickleback	Russian part of Amur River basin
60. (Fr.) *Pungitius polyakovi* Shedko, Shedko & Pietsch, 2005 – Polyakov's ninespine stickleback	southeastern part of Sakhalin Island

Scorpaeniformes Bloch, 1789 – Mail-cheeked fishes

61. (Fr.) *Cottus altaicus* Kaschenko, 1899 – Altaic sculpin	rivers of the Upper and Middle Ob River basin
62. (Fr.) *Cottus gratzianowi* Sideleva, Naseka & Zhidkov, 2015 – Gratzianow's sculpin	Onega River drainage, White Sea basin
63. (Fr.) *Cottus kolymensis* Sideleva & Goto, 2012 – Kolyma River sculpin	Kolyma River and its drainage
64. (Fr.) *Cottus kuznetzovi* Berg, 1903 – Kuznetsov's sculpin	Lena River basin
65. (Mr., Br.) *Myoxocephalus tuberculatus* Soldatov & Pavlenko, 1922 – Shantar sculpin	northern Okhotsk Sea, including Shantar Islands, Taui Bay and western Kamchatka
66. (Mr., Br.) *Porocottus camtschaticus* (Schmidt 1916) – Kamchatka fringed sculpin	northern Kuril Islands and southern Kamchatka
67. (Mr., Br., Fr.) *Porocottus japonicus* Schmidt, 1935 – Japanese fringed sculpin	southern Okhotsk Sea (Aniva Bay) and Russian part of northern Japan Sea
68. (Fr.) *Batrachocottus baicalensis* (Dybowski, 1874) – Bighead Baikal sculpin	around Lake Baikal, with the exception of the Selenginsky and Severobaikalsky shallows

69. (Fr.) *Batrachocottus multiradiatus* Berg, 1907 – Multiradiate Baikal sculpin	throughout Lake Baikal
70. (Fr.) *Batrachocottus nikolskii* (Berg, 1900) – Fat Baikal sculpin	throughout Lake Baikal
71. (Fr.) *Batrachocottus talievi* Sideleva, 1999 – Taliev's Baikal sculpin	Lake Baikal
72. (Fr.) *Cottocomephorus alexandrae* Taliev, 1935 – Northern Baikal sculpin	Lake Baikal, but mainly in the northern part
73. (Fr.) *Cottocomephorus grewingkii* (Dybowski, 1874) – Yellowfin Baikal sculpin	Lake Baikal, mainly in the south and central parts, as well as in the rivers Angara and Irkut, and in the lower Selenga River, also in other rivers flowing into the Baikal
74. (Fr.) *Cottocomephorus inermis* (Yakovlev, 1890) – Longfin Baikal sculpin	throughout Lake Baikal and Angara River
75. *Paracottus knerii* (Dybowski, 1874) – Stone Baikal sculpin	Lake Baikal and all its tributaries, including Yenisei River bassin
76. (Fr.) *Comephorus baikalensis* (Pallas, 1776) – Big Baikal oilfish	around Lake Baikal, but it is found only in open waters
77. (Fr.) *Comephorus dybowskii* Korotneff, 1904 – Little Baikal oilfish	throughout Lake Baikal
78. (Fr.) *Abyssocottus elochini* Taliev, 1955 – Elochin's Baikal sculpin	northern part of the Lake Baikal, Cape of Elochin
79. (Fr.) *Abyssocottus gibbosus* Berg, 1906 – Gibbous Baikal sculpin	throughout Lake Baikal
80. (Fr.) *Abyssocottus korotneffi* Berg, 1906 – Korotneff's Baikal sculpin	throughout Lake Baikal
81. (Fr.) *Asprocottus abyssalis* Taliev, 1955 – Rough Baikal sculpin	southern part of the Lake Baikal
82. (Fr.) *Asprocottus herzensteini* Berg, 1906 – Herzenstein's Baikal sculpin	around Lake Baikal, except for shallow lagoon
83. (Fr.) *Asprocottus intermedius* Taliev, 1955 – Intermediate Baikal sculpin	Lake Baikal, but mainly in the northern part
84. (Fr.) *Asprocottus korjakovi* Sideleva, 2001 – Korjakov's Baikal sculpin	Lake Baikal
85. (Fr.) *Asprocottus parmiferus* Taliev, 1955 – Armored Baikal sculpin	Lake Baikal, but mainly in the middle and northern parts
86. (Fr.) *Asprocottus platycephalus* Taliev, 1955 – Flathead Baikal sculpin	Lake Baikal, mainly in the northern part
87. (Fr.) *Asprocottus pulcher* Taliev, 1955 – Sharpnose Baikal sculpin	northern part of the Lake Baikal

88. (Fr.) *Cottinella boulengeri* (Berg, 1906) – Short-headed Baikal sculpin	in all open waters of the Lake Baikal
89. (Fr.) *Cyphocottus eurystomus* (Taliev, 1955) – Widemouth Baikal sculpin	middle and south parts of the Lake Baikal
90. (Fr.) *Cyphocottus megalops* (Gratzianov, 1902) – Bigeye Baikal sculpin	Lake Baikal, but mainly in the northern part
91. (Fr.) *Limnocottus bergianus* Taliev, 1935 – Berg's Baikal sculpin	in the open parts of middle and southern the Lake Baikal
92. (Fr.) *Limnocottus godlewskii* (Dybowski, 1874) – Godlewsky's Baikal sculpin	in south and central parts of the Lake Baikal
93. (Fr.) *Limnocottus griseus* (Taliev, 1955) – Gray Baikal sculpin	Lake Baikal
94. (Fr.) *Limnocottus pallidus* Taliev, 1948 – Pallid Baikal sculpin	throughout Baikal Lake
95. (Fr.) *Neocottus thermalis* Sideleva, 2002 – Warm-water Baikal sculpin	Lake Baikal, local endemic of Frolikha Bay
96. (Fr.) *Neocottus werestschagini* (Taliev, 1935) – Vereshchagin's Baikal sculpin	southern part of the Lake Baikal
97. (Fr.) *Procottus gotoi* Sideleva, 2001 – Goto's Baikal sculpin	Lake Baikal
98. (Fr.) *Procottus gurwicii* (Taliev, 1946) – Dwarf Baikal sculpins	southern part of the Lake Baikal
99. (Fr.) *Procottus jeittelesii* (Dybowski, 1874) – Red Baikal sculpin	around Lake Baikal, but mainly in the middle and southern parts
100. (Fr.) *Procottus major* Taliev, 1949 – Major Baikal sculpin	throughout Lake Baikal
101. (Mr., Br.) *Liparis dubius* Soldatov, 1930 – Whitespotted snailfish	Japan (the coast of Primorsky Krai, including Peter the Great Bay) and Okhotsk (Aniva Bay, southern Sakhalin Island) seas
102. (Mr., Br.) *Liparis kusnetzovi* Taranetz, 1936 – Kuznetzov's snailfish	Japan Sea (the coast of Primorsky Krai, western Sakhalin Island) and Okhotsk (eastern Sakhalin Island)
Perciformes Rafinesque, 1810 – Perches	
103. (Mr., Br.) *Davidijordania brachyrhyncha* (Schmidt, 1904) – Shortbilled eelpout	northern Japan and Okhotsk seas, including Peter the Great Bay, Tatar Strait, Sakhalin Island, Shantar Islands and Taui Bay