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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
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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 km², 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 km²), while Novaya Zemlya (more than 83,000 km²), Severny (approx. 37,000 km²) and Franz Josef Land (16,300 km²) 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 Rossico-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 gorbusha Walbaum, 1792, S. kayko Walbaum, 1792, S. keta Walbaum, 1792, S. kisatch Walbaum, 1792, S. malm Walbaum, 1792, S. miltschutsch Walbaum, 1792, S. miukisi Walbaum, 1792, S. mykiss Walbaum, 1792, S. nekta Walbaum, 1792, S. palja Walbaum, 1792, S. tshawyttscha 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 Gratziánov (Gratziánov, 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.](image)
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; Reynolds and 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 ‰), eugenic, or marine (from 30,1–40 ‰) and hyperhaline, or over-salted (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, km² | Maximum depth, m | Salinity, ‰. | Total fish species |
|-------------|-----------------|------------------|--------------|--------------------|
| Caspian Sea | 393,000         | 1025             | 2,0–13,5     | 119¹               |
| Sea of Azov | 37,600          | 14               | 9,6–13,7     | 120²               |
| Black Sea   | 423,000         | 2212             | 17,5–18,0    | 180³               |
| Baltic Sea  | 419,000         | 470              | 2,0–11,0     | 239⁴,*             |

¹Bogutskaya et al., 2013; ²Diripasko et al., 2011; ³Zaitsev, 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 km², 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* Dybowskii, 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 km² | Total species by Berg\(^a\) | 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\(^10\)              |
| Indigirka River / 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\(^14\)            |
| Yasina 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\(^20\)              |

\(^a\)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 km² / the entire basin area, in km² // 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 km² / Region and river where these reservoirs are located | Total area, in thousands of km² | 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 |
| Tsimlyanskoie / Volgograd and Rostov regions, Don River                                          | 2,6                             | 49 / Vekhov et al., 2014      |
| Nizhneamskims / 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’-Illimsk / Irkutsk Region, Angara River, Yenisei basin                                       | 1,9                             | 23 / Kupchinskii 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 hohena*ckeri 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 chinesis*, *Atherina pontica*, *Syngnathus caspius*, *S. nigrolineatus*, *Megalocottus taeniopterus*, *Myxocepalus quadricornis*, *M. stelleri*, *Porocottus japonicus*, *P. tentaculatus*, *Lateolabrax japonicus*, *Sander lucioperca*, *Chelon labrosus*, *Planiliza haematocheilus*, *Clupanodon thrissa*, *Scatophagus argus*, *Liposetta 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 mohigarei*.

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. kessleri*, *B. leptocephalus*, *B. leptorhynchus*, *B. pinchuki*, *B. ragimovi*, *B. spinosus*, *B. svetovidovi*, *Knipowitschia iljini*, *Mesogobius nonulimus*, *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 bruneus*), due to taxonomic changes, are now not considered as members of the Russian ichthyofauna: *Clupeonella caspia*, *C. cultriventris*, *Pelecus cultratus*, *Cottus amphibostomopsis*, *C. czerskii*, *C. hangiongensis*, *Acanthogobius flavimanus*, *A. lactipes*, *Gymnogobius breunigii*, *G. castaneus*, *G. macrognathos*, *G. opperiens*, *G. petschiliensis*, *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 anu* and *arini*, *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-Rossiyskoj-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/?spphrase_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
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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 Scorpaeoiformes (42 species). Three scorpaeiform 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 numerous brackish 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 km², 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 km², average 6,995 km², 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 km², average 40,469 km²) 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 = fA³ (where N = number of species and A = basin area in km²) was calculated. Welcomme (1985) found this
A relationship for the north-flowing Siberian rivers and those in the European part in the former Soviet Union to be \( N = 2.76A^{0.19} \) \((n = 6, r = 0.91, n – \text{number of rivers used for calculation of equation, } r – \text{correlation coefficient})\).

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\(^\circ\)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’s 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; Lévequé 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.](image-url)
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* (Dybowskii, 1872); *Gobio sibiricus* Nikolskii, 1936; *Rhynchoecypris oxyrhynchus* (Mori, 1930); *Romanogobio belingi* (Stastenenko, 1934); *Cobitis lutheri* Rendahl, 1935; *Misgurnus mohoiy* (Dybowskii, 1869); *Lefua pleskei* (Herzenstein, 1888); *Hypomesus japonicus* (Brevoort, 1856); *Thymallus nikolskyi* Kaschenko, 1899; *Pungitius bussei* (Warapachowski, 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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Literature cited

Abell, R., Thieme, M.L., Revenga, C., Bryer, M., Kottelat, M., Bogutskaya, N., Coad, B., Mandrak, N., Balderas, S.C., Bussing, W., Stiassny, M.L.J., Skelton, P., Allen, G.R., Unmack, P., Naseka, A., Ng, R., Sindorf, N., Robertson, J., Armijo, E., Higgins, J.V., Heibel, T.J., Wikramanayake, E., Olson, D., López, H.L., Reis, R.E., Lundberg, J.G., Sabaj Pérez, M.H. and Petry, P. 2008. Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation. BioScience, 58, 5, 403–414.

Alimov, A.F. and Bogutskaya, N.G. (eds). 2004. Biological invasions in aquatic and terrestrial ecosystems. KMK Scientific Press Ltd., Moscow, 436 pp.

Antonov, A.L. and Knizhin, I.B. 2011. Distribution, ecology and range formation of grayling (Thymallidae) in the Amur drainage. Vestnik DVO RAN 2011, 41–48.

Antonov, A.L. 2004. A new species of grayling Thymallus burejensis sp. nova (Thymallidae) from the Amur basin. Voprosy Ikhtiologii, 44, 441–451.

Antonov, A.L. 2012. Diversity of fishes and structure of ichthyocenoses in mountain catchment areas of the Amur basin. Journal of Ichthyology, 52, 149–159. https://doi.org/10.1134/S0032945212020014

Balushkin, A.V. and Chereshev, I.A. 1982. Systematics of the genus Dallia (Umbridae, Esociformes). Trudy Zoologicheskogo Instituta, Akademii Nauk SSSR, 114, 36–56.

Balykin, P.A. and Tokranov, A.M. 2010. Ichthyofauna and fishery in the north-western Bering Sea. Studies of Aquatic Biological Resources of Kamchatka and the Northwestern Part of the Pacific Ocean, 17, 48–65.

Bănărescu, P.M. and Nalbant, T.T. 1973. Pisces, Teleostei. Cyprinidae (Gobioninae). Das Tierreich 93, 1–304.

Berg, L.S. 1911. Faune de la Russie et des pays limitrophes. Poissons (Marsipobranchii et Pisces). Vol. 1. Marsipobranchii, Selachii et Chondrostei. Emperor Academy of Sciences, St. Petersburg, 337 pp.

Berg, L.S. 1912. Faune de la Russie et des pays limitrophes. Poissons (Marsipobranchii et Pisces). Vol. III. Ostariophysi. Part 1. Emperor Academy of Sciences, St. Petersburg, 336 pp.

Berg, L.S. 1914. Les Poissons des eaux douces de la Russie. Riabushinskikh, Moscow, 563 pp.

Berg, L.S. 1948. Freshwater fishes of Soviet Union and adjacent countries. 4th ed. Vol. 1. Guide to the fauna of the U.S.S.R., 27, 1–466.

Berg, L.S. 1949a. Freshwater fishes of the U.S.S.R. and adjacent countries. 4th. ed. Vol. 2. Guide to the Fauna of the U.S.S.R., 29, 467–925.

Berg, L.S. 1949b. Freshwater fishes of the U.S.S.R. and adjacent countries. 4th ed. Vol. 3. Guide to the Fauna of the U.S.S.R., 30, 927–1382.

Berg, L.S. 1955. System of living and fossil fishes and fishlike. Proceedings of the Zoological Institute of the USSR Academy of Sciences, 20, 1–286.

Bianco, P.G. 1990. Proposta di impiego di indici e coefficienti per la valutazione dello stato di degrado dell’ittiofauna autoctona delle acque dolci (Proposed appropriation of indexes and coefficients for the evaluation of deterioration of native fish fauna of freshwaters). Rivista di Idrobiologia, 29, 130–149.

Bogutskaya, N.G. and Coad, B.W. 2009. A review of vertebral and fin-ray counts in the genus Alburnoides (Teleostei: Cyprinidae) with a description of six new species. Zoosystematica Rossica, 18, 126–173.

Bogutskaya, N.G. and Naseka, A.M. 1996. Cyclostomata and fishes of Khanka Lake drainage area (Amur River basin) an annotated check-list with comments on taxonomy and zoogeography of the region. GosNIORKH
and ZIN RAN, St. Petersburg, 89 pp.

Bogutskaya, N.G. and Naseka, A.M. 2004. Catalogue of agnathans and fishes of fresh and brackish waters of Russia with comments on nomenclature and taxonomy. KMK Scientific Press Ltd., Moscow, 389 pp.

Bogutskaya, N.G. and Naseka, A.M. 2006. List of agnathans and fishes of the Caspian Sea and rivers of its basin. Caspian Sea Biodiversity Project under umbrella of Caspian Sea Environment Program. Available from http://www.zin.ru/projects/caspdiv/caspian_fishes.html (accessed 10 January 2019)

Bogutskaya, N.G., Kijashko, P.V., Naseka, A.M. and Orlova, M.I. 2013. Identification keys for fish and invertebrates of Caspian Sea. Volume 1. Fish and molluscs. Scientific Press Ltd. KMK, St. Petersburg–Moscow, 543 pp.

Bogutskaya, N.G., Naseka, A.M., Shedko, S.V., Vasil'eva, E.D. and Chereshnev, I.A. 2008. The fishes of the Amur River: updated check-list and zoogeography. Ichthyological Exploration of Freshwaters, 19, 301–366.

Boltachev, A.R. and Karpova, E.P. 2012. Marine fishes of the Crimean Peninsula. Publishing house «Business-Inform», Simferopol, 224 pp.

Boltachev, A.R. and Karpova, E.P. 2017. Marine fishes of the Crimean Peninsula. Publishing house «Business-Inform», Simferopol, 376 pp.

Boltachev, A.R., Karpova, E.P. and Miroshnichenko, A.I. 2015. Fishes. In, Ivanov, S.P. and Fateryga, A.V. (eds.) Red book of the Republic of Crimea. Animals. PP «ARIAL» LLC., Simferopol, pp. 268–285.

Brenner, T., Buise, A.D., Lauff, M., Luquet, J.F. and Staub, E. 2004. The present status of river Rhine with special emphasis on fisheries development. In, Welcomme, R.L. and Petr, T. (eds.) Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries. Sustaining Livelihoods and Biodiversity in the New Millennium. Volume 1. Phnom Penh, Kingdom of Cambodia, pp. 121–146.

Brooks, D.R. and Van Veller, M.G.P. 2003. Critique of parsimony analysis of endemicity as a method of historical biogeography. Journal of Biogeography, 30, 819–825.

Bugaev, V.F. 2007. Fish of the Kamchatka River watershed (abundance, utilization, issues). Izdatel'stvo "Kamchatpres", Petropavlovsk-Kamchatsky, 192 pp.

Bulakhov, V.L., Novitsky, R.O., Pakhomov, O. E. and Khristov O.O. 2008. Biological diversity of Ukraine.Dnipropetrovsk region. Cyclostomes (Cyclostomata). Fishes (Pisces). Dnipropetr. Univ. Press, Ukraine, 304 pp.

Burkhead, N.M. 2012. Extinction rates in North American freshwater fishes 1900–2010. BioScience, 62, 798–808. https://doi.org/10.1525/bio.2012.62.9.5

Butova, E.V. and Novomodny, G.V. 2014. Fresh water clearhead icefish Protosalanx hyalogranius (Abbott, 1901) from the Amur River. Vladimir Ya. Levanidov’s Biennial Memorial Meetings, 6, 124–133.

Campbell, M.A., Takebayashi, N. and López, J.A. 2015. Beringian sub-refugia revealed in blackfish (Dallia): implications for understanding the effects of Pleistocene glaciations on Beringian taxa and other Arctic aquatic fauna. BMC Evolutionary Biology, 15, 144. https://doi.org/10.1186/s12862-015-0413-2

Collette, B.B. and Bănărescu, P. 1977. Systematics and zoogeography of the fishes of the family Percidae. Journal of the Fisheries Research Board of Canada, 34, 1450–1463.

Descy J.-P. 2009. Continental Atlantic Rivers. In, Tochner, K., Robinson, Ch.T. and Uehlinger, U. (eds.) Rivers of Europe. Chapter 5. Elsevier Academic Press, Amsterdam & al., 728 pp.

Diripasko, O.A., Bogutskaya, N.G., Dem’yanyenko, K.V. and Izergin, L.V. 2015. Sea of Azov: a brief review of the environment and fishery. Aquatic Ecosystem Health & Management, 18, 184–194. + Supplementary Materials: «Fishes of the Sea of Azov: an updated check-list».

Diripasko, O.A., Izergin, L.V. and Demyanenko, K.V. 2011. Fishes of the Azov Sea. Printed by "NPK Inter-M, Zaporozhye", Berdyansk, Ukraine, 288 pp.

Dyldin, Yu.V. and Orlov, A.M. 2017a. Ichthyofauna of fresh and brackish waters of Sakhalin Island: an annotated list with taxonomic comments. 3. Gadidae–Cryptacanthodidae families. Journal of Ichthyology, 57, 48–83. https://doi.org/10.1134/S0032945217010039
Dyldin, Yu.V. and Orlov, A.M. 2017b. Ichthyofauna of fresh and brackish waters of Sakhalin Island: an annotated list with taxonomic comments. 4. Pholidae-Tetraodontidae families. Journal of Ichthyology, 57, 183–218. https://doi.org/10.1134/S0032945217020072

Dyldin, Yu.V. and Orlov, A.M. 2016a. Ichthyofauna of fresh and brackish waters of Sakhalin Island: an annotated list with taxonomic comments. 1. Petromyzontidae–Clupeidae families. Journal of Ichthyology, 56, 534–555. https://doi.org/10.1134/S0032945216040032

Dyldin, Yu.V. and Orlov, A.M. 2016b. Ichthyofauna of fresh and brackish waters of Sakhalin Island: an annotated list with taxonomic comments. 2. Cyprinidae–Salmonidae families. Journal of Ichthyology, 56, 656–693. https://doi.org/10.1134/S0032945216050040

Dyldin, Yu.V. Hanel, L., Romanov, V.I., and Plesník, J. 2017. A review of the genus Thymallus (Pisces: Salmoniformes, Salmonidae, Thymallinae) with taxonomic notes. Bulletin Lampetra, 8, 103–126.

Dyldin, Yu.V., Matsuura, K. and Makeev, S.S. 2016. Comments on puffers of the genus Takifugu from Russian waters with the first record of yellowfin puffer, Takifugu xanthopterus (Tetraodontiformes: Tetraodontidae) from Sakhalin Island. Bulletin of the National Museum of Nature and Science, Tokyo. Ser. A, 42, 133–141.

Dyldin, Yu.V., Orlov, A.M., Velikanov, A.Ya., Makeev, S.S., Romanov, V.I. and Hanel, L. 2018a. An annotated list of the marine and brackish-water ichthyofauna of Aniva Bay (Sea of Okhotsk, Sakhalin Island): 1. Petromyzontidae—Agonidae Families. Journal of Ichthyology, 58, 473–501. https://doi.org/10.1134/S0032945218040033

Dyldin, Yu.V., Orlov, A.M., Velikanov, A.Ya., Makeev, S.S., Romanov, V.I. and Hanel L. 2018b. An annotated list of the marine and brackish waters ichthyofauna of Aniva Bay (Sea of Okhotsk, Sakhalin Island). Part 2: Cyclopteridae–Molidae families. Journal of Ichthyology, 58, 633–661. https://doi.org/10.1134/S0032945218050053

Ebert, D.A., White, W.T., Ho, H.-C., Last, P.R., Nakaya, K., Séret B., Straube, N., Naylor, G.J. and de Carvalho, M.R. 2013. An annotated checklist of the chondrichthyans of Taiwan. Zootaxa, 3752, 279–386.

Emtyl’, M.H. and Ivanenko, A.M. 2002. Fishes of the south-western Russia: study guide. Kuban State University, Krasnodar, 340 pp.

Ermolin, V.P. 2010. Composition of the ichthyofauna of the Saratov Reservoir. Journal of Ichthyology, 50, 211–215. https://doi.org/10.1134/S0032945210020098

Esin, E.V. and Markevich, G.N. 2017. Charrs of genus Salvelinus of Asian North Pacific: origin, evolution and modern diversity. Kamchatpress, Petropavlovsk-Kamchatsky, 188 pp.

Evseenko, S.A. 2003. An annotated catalogue of pleuronectiform fishes (order Pleuronectiformes) of the seas of Russia and adjacent countries. Journal of Ichthyology, 43, (suppl. 1), 57–74.

Fedonenko, E.V. and Marenkov, O.N. 2013. The resettlement, spatial distribution and morphometric characteristics of the pumpkinseed sunfish Lepomis gibbosus (Centrarchidae, Perciformes) in the Zaporozhian Reservoir. Russian Journal of Biological Invasions, 2, 51–59. https://doi.org/10.1134/S207511171303003X

Fedorov, V.V. 2004. An Annotated catalog of fishlike vertebrates and fishes of the seas of Russia and adjacent countries. Part. 6. Suborder Zoarcoidei. Journal of Ichthyology, 44 (suppl. 1), 73–128.

Freyhof, J. and Kottelat, M. 2007. Review of the Alburnus mento species group with description of two new species (Teleostei: Cyrinidae). Ichthyological Exploration of Freshwaters, 18, 213–225.

Fricke, R., Bilecenoglu, M. and Sari, H.M. 2007. Annotated checklist of fish and lamprey species (Gnathostomata and Petromyzontomorphi) of Turkey, including a Red List of threatened and declining species. Stuttgarter Beiträge zur Naturkunde. Serie A (Biologie), 706, 1–174.

Fricke, R., Eschmeyer, W.N. and Fong, J.D. 2020b Species by family/subfamily in Eschmeyer's Catalog of Fishes. Available from http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (accessed 15 February 2020)
Fricke, R., Eschmeyer, W.N. and van der Laan, R. 2020a. Eschmeyer’s Catalog of Fishes: Genera, species, references. Available from http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (accessed 15 February 2020)

Froese, R. and Pauly, D. 2019. FishBase. Available from http://www.fishbase.org version (accessed 08 November 2019).

Gandlin, A.A. and Levin, B.A. 2016. Phylogeny of the Caucasian barbel of the genus Barbus (Cyprinidae) according to mtDNA. In, Actual issues of modern zoology and ecology. Penza, November 15–18, 2016. Publishing house of PSU, Penza, p. 30.

GBIF. 2019. The Global Biodiversity Information Facility. Available from http://www.gbif.org/ (accessed 08 November 2019)

Gerasimov, Yu.V. 2015. Fishes of the Rybinsk reservoir: population dynamics and ecology. Filigran, Yaroslavl, 418 pp.

Golubtsov, A.S. and Malkov, N.P. 2007. Essay on the fish fauna of the Altai Republic: systematic diversity, distribution and conservation. Scientific Press KMK, Moscow, 164 pp.

Gratzianov, V.I. 1907. Versuch einer Übersicht der Fische des Russischen Reiches in systematischer und geographischer Hinsicht. Tipogr. Vil’d, Moscow, 567 pp.

Gritsenko, O.F (ed.). 2012. Fishes of the Kuril Islands. VNIRO Publishing, Moscow, 978 pp.

Hanel, L. and Lusk, S. 2011. Alien fishes in European waters. Bulletin Lampetra, 7, 148–185.

Hanel, L., Plesník, J., Andreska, J., Novák, J. and Plíštil, J. 2011. Alien fishes in European waters. Bulletin Lampetra, 7, 148–185.

Hubert, N., Renno, J.F. 2006. Historical biogeography of South America in freshwater fishes. Journal of Biogeography, 33, 1414–1436.

Humpl, M. 2004. Stream fish communities evaluation in the Labe River basin using cluster analysis. Biodiversity of fishes of the Czech Republic, 5, 99–106.

Chereshnev, I.A. and Kirillov, A.F. 2007. Fishlike vertebrates and fishes from the Laptev Sea and the East-Siberian Sea and their related freshwater areas. Bulletin of the North-East Scientific Center, Russian Academy of Sciences Far East Branch, 2, 95–106.

Chereshnev, I.A. 2008. Freshwater fishes of Chukotka. NESC FEB RAS, Magadan, 324 pp.

Chereshnev, I.A. 1996. Biological diversity of freshwater fish fauna in Russian North-East. Dal’nauka, Vladivostok, 198 pp.

Chugunova, Yu.K. and Vyshgorodtsev, A.A. 2012. Current status of fish diversity and parasites of fish in Krasnoyarsk Reservoir. Tomsk State University Journal, 365, 218–222.

Interesova, E.A. 2016. Alien fish species in the Ob River basin. Russian Journal of Biological Invasions 7, 156–167. https://doi.org/10.1134/S207511716020089

IUCN. 2003. Guidelines for application of IUCN criteria at regional levels. Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK, 26 pp.
IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. Available from http://www.iucnredlist.org/technical-documents/categories-and-criteria (accessed 10 December 2019)

IUCN. 2019. The IUCN Red List of Threatened Species. Version 2019-2. Available from http://www.iucnredlist.org (accessed 10 December 2019)

Ivanchev, V.P., Sarychev, V.S. and Ivancheva, E.Y. 2013. Lamprey and a fish of the Upper Don Basin. Proceedings of the Oka State Biosphere Reserve. Issue 28. NP «Golos gubernii», Ryazan, 275 pp.

Ivanchev, V.P. and Ivancheva, E.Y. 2010. Cyclostomata and fishes of the Ryazan region and adjacent areas. NP «Golos gubernii», Ryazan, 292 pp.

Iwasaki, Y., Ryo, M., Sui, P. and Yoshimura, Ch. 2012. Evaluating the relationship between basin-scale fish species richness and ecologically relevant flow characteristics in rivers worldwide. Freshwater Biology, 57, 2173–2180. https://doi.org/10.1111/j.1365-2427.2012.02861.x

Kalinin, M.Yu., and Pakhomov, A.V. 2008. Assessment of the state of water resources of the Western Dvina and Neman river basins in the Republic of Belarus. Belsens, Minsk, 60 pp.

Kalous, L., Bohlen, J., Rylková, K. and Petrtýl, M. 2012. Hidden diversity within the Prussian carp and designation of a neotype for Carassius gibelio (Teleostei: Cyprinidae). Ichthyological Exploration of Freshwaters, 23, 11–18.

Karabanov, D.P. 2013. Genetic adaptation of the Black-Caspian sprat Clupeonella cultriventris (Nordmann, 1840) (Actinopterygii: Clupeidae). Publishing house "Science Book", Voronezh, 179 pp.

Karmanova, O.G. 2004. Common fish species of the Khantai Reservoir ( Morphology, Ecology). Ph.D. Thesis. Tomsk, Russia, 12 pp.

Karpova, E.P. 2016. Alien species of fish in freshwater ichthyofauna of the Crimea. Russian Journal of Biological Invasions, 7, 340–350. https://doi.org/10.1134/S1063074009070104

Kharin, V.E. and Cheblukov, V.P. 2009. The first finding of the American paddlefish Polyodon spathula (Polyodontidae) in waters of the Russian Far East. Russian Journal of Marine Biology, 35, 611–613. https://doi.org/10.1134/S1063074009070104

Kharin, V.E. and Vinnikov, K.A. 2011. The first finding of the American paddlefish Polyodon spathula (Polyodontidae) in the Amur Bay, Sea of Japan. Izvestiya TINRO, 164, 180–184.

Kim, I.-S. and Son, Y.-M. 1984. Cobitis choii, a new cobitid fish from Korea. Korean Journal of Ichthyology, 15, 1–12.

Kirillov, F.N. 1972. Fishes of Yakutia. Nauka, Moscow, 359 pp.
Knizhin, I.B. and Weiss, S.J. 2009. A new species of grayling *Thymallus svetovidovi* sp. nova (Thymallidae) from the Yenisey basin and its position in the genus *Thymallus*. Journal of Ichthyology, 49, 1–9. https://doi.org/10.1134/S0032945209010019

Knizhin, I.B. 2011. Diversity and taxonomic identification of graylings (*Thymallus*) in the Yenisey River basin. Journal of Siberian Federal University. Biology, 3, 293–300.

Knizhin, I.B., Antonov, A.L. and Weiss, S.J. 2006. A new subspecies of the Amur grayling *Thymallus grubii flavomaculatus* ssp. nova (Thymallidae). Journal of Ichthyology, 46, 555–562. https://doi.org/10.1134/S0032945206080017.

Knizhin, I.B., Antonov, A.L., Safronov, S.N. and Weiss, S.J. 2007. New species of grayling *Thymallus tugarinae* sp. nova (Thymallidae) from the Amur River Basin. Journal of Ichthyology, 47, 123–139. https://doi.org/10.1134/S0032945207020014

Kolman, R., Kapusta, A., Duda, A. and Wiszniewski, G. 2011b. Review of the current status of the Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus* Mitchill 1815, in Poland: principles, previous experience, and results. Journal of Applied Ichthyology, 27, 186–191. https://doi.org/10.1111/j.1439-0426.2011.01680.x

Kolman, R.B., Kapusta, A., Schepkovski, M., Duda, A., Bogacka-Kapusta, E., Wiszniewski, G. and Prusinska, M. 2011a. Re-establishing the Baltic sturgeon *Acipenser oxyrinchus oxyrinchus* Mitchill - basis and the first results. In, International Conference "Sturgeon fishes and their future" 7-10 June, 2011. Berdyansk, Ukraine, pp. 138–143.

Kontula, T. and Haldin, J. 2012. HELCOM Checklist of Baltic Sea macro-species. Baltic Sea Environment Proceedings, 130, 1–203.

Kottelat, M. and Freyhof, J. 2007. Handbook of European freshwater fishes. Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany, 646 pp.

Kottelat M. 1997. European freshwater fishes. A heuristic checklist of the freshwater fishes of Europe (exclusive of former USSR), with an introduction for non-systematists and comments on nomenclature and conservation. Biologia (Bratislava), 52 (Suppl. 5), 1–271.

Kottelat, M. 2001. Freshwater fishes of northern Vietnam. A preliminary check-list of the fishes known or expected to occur in northern Vietnam with comments on systematics and nomenclature. Environment and Social Development Unit, East Asia and Pacific Region, The World Bank, Washington, 123 pp.

Kottelat, M. 2006. Fishes of Mongolia. A check-list of the fishes known to occur in Mongolia with comments on systematics and nomenclature. The World Bank, Washington, 103 pp.

Kottelat, M. 2012. Conspectus Cobitinum: an inventory of the loaches of the world (Teleostei: Cypriniformes: Cobitoidei). The Raffles Bulletin of Zoology, Suppl. 26, 1–199.

Kottelat, M. 2013. The fishes of the inland waters of Southeast Asia: a catalogue and core biography of the fishes known to occur in freshwaters, mangroves and estuaries. The Raffles Bulletin of Zoology, Suppl. 27, 1–663.

Kottelat, M., Bogutskaya, N.G. and Freyhof, J. 2005. On the migratory Black Sea lamprey and the nomenclature of the ludoga, Peipsi and ripus whitefishes (Agnatha: Petromyzontidae; Teleostei: Coregonidae). Zoosystematica Rossica, 14, 181–186.

Koval, M.V., Esin, E.V. and Bugaev, A.V. 2015. Freshwater ichthyofauna of the Penzhina and Talovka rivers (north-west Kamchatka). Issledovaniya V odnykh Biologicheskikh Resursov Kamchatki i Severo-Zapadnoy Chasti Tikhogo Okeana, 37, 53–145.

Kruglikov, S.A. 2009. Ichthyofauna of the Bryansk Oblast. Gosudarstvennyy prirodnyy biosfernyy zapovednik «Bryanskiy les», Bryansk, 87 pp.

Kudersky, L.A. 2007. Ways of formation of ichthyofauna of Lake Ladoga. Obshchestvo. Sreda. Razvitiye, 3, 102–110.

Kuehne, L.M. and Olden, J.D. 2014. Ecology and conservation of mudminnow species worldwide. Fisheries, 39, 341–351. https://doi.org/10.1080/03632415.2014.933318
(Salmoniformes, Thymallidae). Vestnik Buryatskogo Universiteta, Seriya 2, Biologiya, 7, 69–82.
Mayden, R.L. 1988. Vicariance biogeography, parsimony, and evolution in North American freshwater fishes. Systematic Zoology, 37, 329–355.
McPhail, J.D. and Carveth, R. 1994. Field key to the freshwater fishes of British Columbia. Draft for 1994 field testing. Discussion document. Resources Inventory Committee, Victoria (British Columbia, Canada), 233 pp.
Mecklenburg, C.W., Lynghammar, A., Johansen, E., Byrkjedal, I., Dolgov, A.V., Karamushko, O.V., Mecklenburg, T.A., Møller, P. R., Steinke, D., Wienerroither, R.M. and Christiansen, J.S. 2018. Marine fishes of the Arctic Region. Volume 1. CAFF Monitoring Series Report, 28, 1–454.
Mecklenburg, C.W., Mecklenburg, T.A. and Thorsteinson, L.K. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland, 1037 pp.
Mendel, J., Lusk, S., Vasil'eva, E.D., Vasil'ev, V.P., Lusková, V., Ekmekci, F.G., Erk’akand, F., Ruchin, A., Koščo, J., Vetešník, L., Halačka, K., Šanda, R., Pushkov, A.N. and Reshetnikov, S.I. 2008. Molecular phylogeny of the genus Gobio Cuvier, 1816 (Teleostei: Cyprinidae) and its contribution to taxonomy. Molecular Phylogenetic and Evolution, 47, 1061–1075. https://doi.org/10.1016/j.mpev.2008.03.005
Mikhin, V.S. 1955. Fishes of the Taimyr lakes and Taymyrskoy guby. Izvestia VNIORKh, 35, 5–43.
Miya, M. and Nishida, M. 2000. Use of mitogenomic information in teleostean molecular phylogenetics: a tree-based exploration under the maximum-parsimony optimality criterion. Molecular Phylogenetic and Evolution, 17, 437–455.
Moskul, G.A. 1994. Fisheries exploration of Krasnodar reservoir. GosNIORKh, St. Petersburg, 136 pp.
Moskul, G.A. 1998. Fishes of the reservoirs of Kuban basin. Krasnodar Book Publishers, Krasnodar, 177 pp.
Movchan, Yu.V. 1967. Acipenser gueldenstaedti Brandt of the north-west part of the Black Sea and the Kuban River. Vestnik Zoologii, 6, 26–32.
Movchan, Yu.V. 2016. Vimba tenella (Nordmann, 1840). The Red Book of Ukraine. Avilable from http://redbook-ua.org/ru/item/vimba-tenella-nordmann/ (accessed 19 April 2019)
Müller, H.-P. 1973. Der Ichthyologe und Schildkrötenforscher Johann Julius Walbaum. Die Heimat, Neumünster, 80, 195–197.
Murauskas, J.G., Orlov, A.M. and Siwicke, K.A. 2013. Relationships between the abundance of Pacific lamprey in the Columbia River and their common hosts in marine environment. Transactions of the American Fisheries Society, 142, 143–155. https://doi.org/10.1080/00028487.2012.730113
Naseka, A.M. and Bogutskaya, N.G. 2004. Contribution to taxonomy and nomenclature of freshwater fishes of the Amur drainage area and the Far East (Pisces, Osteichthyes). Zoosystematica Rossica, 12, 279–290.
Naseka, A.M. and Diripasko, O.A. 2005. New invasive fish species in freshwater fish fauna in the northern coastal region of the Sea of Azov. Vestnik Zoologii, 39, 89–94.
Naseka, A.M. and Freyhof, J. 2004. Romanogobio parvus, a new gudgeon from River Kuban, southern Russia (Cyprinidae, Gobioninae). Ichthyological Exploration of Freshwaters, 15, 17–23.
Naseka, A.M. and Gershtein, V.V. 2006. Cyclostomata and fishes. In, Nazarenko, A.A (ed.) Vertebrates of zapovednik "Khankaisky" and PriKHankayskaya lowland. Printing house OOO RITS "Idea", Vladivostok, pp. 16–67.
Naseka, A.M. 2010. Zoogeographical freshwater divisions of the Caucasus as a part of the West Asian Transitional Region. Proceedings of the Zoological Institute RAS, 314, 469–492.
Naseka, A.M., Spodareva, V.V., Freyhof, J., Bogutskaya, N.G. and Poznjak, V.G. 2005. New data to species composition and distribution of gudgeons (Gobioninae, Cyprinidae) in the Kuban River. Folia Zoologica, 54 (Suppl.1), 50–55.
Naseka, A.M., Tuniyev, S.B. and Renaud, C.B. 2009. Lethenteron ninai, a new nonparasitic lamprey species from the north-eastern Black Sea basin (Petromyzontiformes: Petromyzontidae). Zootaxa, 2198, 16–26.
Nelson, J.S. 2006. Fishes of the world. Fourth edition. John Wiley & Sons, Inc., New Jersey, 601 pp.
Nelson, J.S., Grande, T.C. and Wilson, M.V.H. 2016. Fishes of the World. Fifth edition. John Wiley & Sons, Inc., Hoboken, New Jersey, 752 pp.

Ng, H.H. and Kottelat, M. 2007. The identity of Tachysurus sinensis La Cepède, 1803, with the designation of a neotype (Teleostei: Bagridae) and notes on the identity of T. fulvidraco (Richardson, 1845). Electronic Journal of Ichthyology, 2, 35–45.

Nikiforov, S.N. 2001. Freshwater ichthyofauna of the Sakhalin and its development. Ph.D. Thesis, Inst. Biol. Morya, Dal’nevost. Otd., Ross. Akad. Nauk., Vladivostok, 22 p.

Nikitin, V.D., Metlenkov, A.V., Prokhorov, A.P., Safronenko, V.A., Lukyanova, N.S. and Galenko, K.G. 2013. Species composition and seasonal distribution of fishes in the Lyutoga River (2011–2012). Transactions of the Sakhalin Research Institute of Fisheries and Oceanography, 14, 55–95

Nikolskii, G.V. 1950. Special ichthyology. Sovetskaja Nauka, Moscow, 436 pp.

Nikolskii, G.V. 1956. Fishes of Amur Basin. Academy of Sciences of the USSR, Moscow, 551 pp.

Ninua, L., Tarkhnishvili, D. and Gvazava, E. 2018. Phylogeography and taxonomic status of trout and salmon from the Ponto-Caspian drainages, with inferences on European brown trout evolution and taxonomy. Ecology and Evolution, 8, 2645–2658. https://doi.org/10.1002/ece3.3884

Novomodny, G., Sharov, P. and Zolotukhin, S. 2004. Amur fish: wealth and crisis. WWF RFE, Russia, Printed by Apelsin Co., Ltd., Vladivostok, 51 pp.

Novomodny, G.V. and Belyaev, V.A. 2004. Short review of data on introduced fish species in the Amur River basin. In, Khovansky, I.E. and Ostrovsky, V.I. (eds.) Methodic and applied aspects of fisheries researches on the Far East. Collected Scientific Works. Khabarovsk publishing house, Khabarovsk, pp. 3–26.

Novomodny, G.V. 2002. Seven species of bitterlings (Cyprinidae, Acheilognathinae) in the Amur River basin. In, First International Symposium “Fish productivity of the Amur River fresh waters and adjacent rivers”. 29 October – 1 November 2002. Khabarovsk, Russia, p.31.

Novomodny, G.V. 2004. Brief survey of modern data on fish of the Amur basin. In, The Fourth Grodekov Lectures. Proceedings of the Regional Scientific and Practical Conference in Primorye in the Historical-Cultural and Natural-Science Context of Russia. Part 2. KhKKM, Khabarovsk, pp. 310–316.

Novomodny, G.V. 2014. Fishes of the Amur near Khabarovsk (a short illustrated guide). Publishing house OOO "Light", Voronezh, 92 pp.

Novoselov, A.P., Studenov, I.I. and Lukin, A.A. 2015. Current state of water biological resources of the Northern Dvina River. Northern (Arctic) Federal University Bulletin: Natural Sciences, 4, 90–99.

Novozhilov, O.A. 2012 Characteristics species structure of young fish in rivers of the Kaliningrad region. Scientific Journal of Kaliningrad State Technical University "KSTU NEWS", 24, 69–76.

Oberdorff, T., Guégan, J. -F. and Hugueny, B. 1995. Global scale patterns of fish species richness in rivers. Ecography, 18, 345–352.

Oleinik, A.G. and Skurikhina, L.A. 2010. Mitochondrial DNA diversity and relationships of endemic charrs of the genus Salvelinus from Lake Kronotskoye (Kamchatka Peninsula). Hydrobiologia, 650, 145–159. https://doi.org/10.1007/s10750-009-0004-6

Oleinik, A.G., Skurikhina, L.A., Kukhlevsky, A.D. and Bondar, E.I. 2017. Genetic relationships of Chukchi charr Salvelinus andriashevi and Taranetz charr, Salvelinus taranetzi. Russian Journal of Genetics, 53, 1137–1145. https://doi.org/10.1134/S1022795417100076

Oleinik, A.G., Skurikhina, L.A., Kukhlevsky, A.D. and Bondar, E.I. 2019. On the origin of endemic stone charr in the Kamchatka River basin. Hydrobiologia, 1–13. https://doi.org/10.1007/s10750-018-3867-6

Omelchenko, V.T. 2005. Charrs of genus Salvelinus Richardson (Salmoniformes, Salmonidae): genetic divergence of populations of Russian North East and Far East. Vladimir Ya. Levanidov’s Biennial Memorial Meetings, 3, 492–509.

Orlov, A. and Baitalyuk, A. 2016. Distribution of Arctic and Pacific lampreys in the North Pacific. In, Orlov, A. and Beamish, R. (eds.) Jawless fishes of the world. Volume 2. Cambridge Scholars Publishing, Newcastle upon Tyne, pp. 32–56.
Orlov, A.M., Baitalyuk, A.A. and Pelenev, D.V. 2014. Distribution and size composition of the Arctic lamprey *Lethenteron camtschaticum* in the North Pacific. Oceanology, 54, 180–194. https://doi.org/10.1134/S0001437014020192

Orlov, A.M., Savinykh, V.F. and Pelenev, D.V. 2008. Features of the spatial distribution and size structure of the Pacific lamprey *Lampetra tridentata* in the North Pacific. Russian Journal of Marine Biology, 34, 276–285. https://doi.org/10.1134/S1063074008050039

Orr, J.W., Wildes, S., Kai, Y., Raring, N., Nakabo, T., Katugin, O. and Guyon, J. 2015. Systematics of North Pacific sand lances of the genus *Ammodytes* based on molecular and morphological evidence, with the description of a new species from Japan. Fishery Bulletin, 113, 129–156. https://doi.org/10.7755/FB.113.2.3

Pallas, P.S. 1814. Zoographia Rosso-Asiatica, sistens omnium animalium in extenso Imperio Rossico & adjacentibus maribus observatorum recensionem, domicilia, mores & descriptiones anatomen atque icones plurimorum. Vol. 3. Ex Officina Caes Academiae Scientarium, Petropoli, i–vii + 1−428 + index (I–CXXV), Pls. 1, 13, 14, 15 20 and 21.

Parin, N.V. 2001. An annotated catalog of fishlike, vertebrates and fishes of the seas of Russia and adjacent countries. Part 1. Order Myxiniformes-Gasterosteiformes. Journal of Ichthyology, 41 (Suppl. 1), 51–131.

Parin, N.V. 2003. An annotated catalogue of fish-like vertebrates and fishes of the seas of Russia and adjacent countries: Part 3. Orders Perciformes (excluding suborders Gobioidei, Zoarcoidei and Stichaeoidei) and Tetraodontiformes. Journal of Ichthyology, 43 (suppl. 1), 1–40.

Parin, N.V. Evsenko, S.A. and Vasil’eva, E.D. 2014. Fishes of Russian Seas: annotated catalogue. Publishing house KMK, Moscow, 733 pp.

Parin, N.V., Fedorov, V.V. and Sheiko, B.A. 2002. An annotated catalogue of fish-like vertebrates and fishes of the seas of Russia and adjacent countries. Part 1. Order Scorpaeniformes. Journal of Ichthyology, 42 (Suppl. 1), 60–135.

Pashkov, A.N., Plotnikov, G.K. and Shutov I.V. 2004. New data on the composition and distribution of acclimatizer species in the ichthyocenoses of continental water bodies in the Northwest Caucasus. Izvestiya VUZov. Severo-Kavkazskiy region. Yestestvennyye nauki, Suppl. 1, 46–52.

Pavlov, D.S., Savvaitova, K.A., Kuzishchin, K.V., Gruzdev, M.A., Pavlov, S.D., Mednikov, B.M. and Maksimov, S.V. 2001. The Pacific noble salmon and trouts of Asia. Scientific World, Moscow, 200 pp.

Pennant, T. 1784-1785. Arctic zoology. Henry Hughs, London. Vol. 1: [10] + I-CC + [5] + 1–185, Pls. 1–8; Vol. 2: 187-586 + [13], Pls. 9–23.

Perez-Ruzafa, A., Quispe-Becerra, J.I., Garcia-Charton, J.A. and Marcos, C. 2004. Composition, structure and distribution of the ichthyoplankton in a Mediterranean coastal lagoon. Journal of Fish Biology, 64, 202–218. https://doi.org/10.1111/j.1095-8649.2004.00301.x

Pietsch, T.W., Bogatov, V.V., Storozhenko, S.Yu., Lelej, A.S., Barkalov, V.Yu., Takahashi, H., Joneson, S.L., Kholin, S.K., Glew, K.A., Harpel, J.A., Krestov, P.V., Makarchenko, E.A., Minakawa, N., Ohara, M., Bennett, D.J., Anderson, T.R., Crawford, R.L., Prozorova, L.A., Kuwahara, Y., Shedko, S.V., Yabe, M., Woods, P.J. and Stevenson, D.E. 2012. Biodiversity and biogeography of Sakhalin Island. In, Storozhenko, S.Yu. (ed.) Flora and fauna of North-West Pacific islands (Materials of International Kuril Island and International Sakhalin Island Projects). Dalnauka, Vladivostok, pp. 11–79.

Pivnička, K. 2000. Fish species diversity in the longitudinal profile of a large river (Elbe). Biodiversity of fishes of the Czech Republic, 3, 119–126.

Podushka, S.B. 1999. Finding of Atlantic sturgeon *Acipenser sturio* in Ladoga Lake. Scientific Bulletin of Laboratory of Ichthyology of INENKO RAS, 1, 5–10.

Podushka, S.B., Shebanin, V.M. and Pilaauri, A.N. 2006. First experience of Italian sturgeon rearing in Russia. In, Proceedings of the 4th International scientific and practical conference, March 13-15, 2006, Astrakhan. VNIIRO Publishing, Moscow, pp. 161–163.
Reshetnikov, Yu.S. (ed.). 1998. Annotated check-list of Cyclostomata and fishes of the continental waters of Russia. Nauka Publishers, Moscow, 220 pp.

Reynoldson, T.B., Culp, J., Lowell, R. and Richardson, J.S. 2005. Fraser River basin. In, Benke, A.C. and Cushing, C.E. (eds.) Rivers of North America. Elsevier, Amsterdam, pp. 696–732.

Richardson, J.S. and Milner, A.S. 2005. Pacific coast rivers of Canada and Alaska. In, Benke, A.C. and Cushing, C.E. (eds.) Rivers of North America. Elsevier, Amsterdam, pp. 734–773.

Romanov, N.S. and Tyulpov, M.A. 1985. The ichthyofauna of lakes of the Taimyr Peninsula. In, Geography of Taimyr lakes. Nauka, Leningrad, pp. 139–183.

Romanov, V.I. 2004. Ichthyofauna of the Putorana plateau. In, Romanov, A.A. (ed.) Vertebrate fauna of the Putorana plateau. Rosselkhozakademia, Moscow, pp. 29–89.

Romanov, V.I. 2007. On the status of the Western Siberian subspecies of Arctic grayling (Thymallus arcticus arcticus): analysis of some meristic characters. In, Researches on ichthyology and related disciplines in inland waters in the early XXI century (the 80th anniversary of professor L.A. Kudersky). FGNU "GosNIORKh" and "KMK", St. Petersburg, pp. 436–452.

Romanov, V.I. 2008. Features of distribution and structure of fish fauna of graylings (Thymallidae) from Yenisei River basin and Baikal Lake. In, Problem and prospects for the use of water resources of Siberia in the XXI century. Mater. vseross. conf. with int. participation. Krasnoyarsk, pp. 52–58.

Romanov, V.I. 2015. Place of ichthyofauna of Russia in the system of world fish fauna. Tomsk State University, Tomsk, 410 pp.

Romanov, V.I., Interesova, E.A., Dyldin, Yu.V., Babkina, I.B., Karmanova, O.G. and Vorobiev, D.S. 2017. An annotated list and current state of ichthyofauna of the Middle Ob River basin. International Journal of Environmental Studies, 74, 818–830. https://doi.org/10.1080/00207233.2017.1288547

Safronov, S.N. and Zvezdov, T.V. 2005. Salvelinus vasilievae sp. nova. – a new species of freshwater chars (Salmonidae, Salmoniformes) from northwestern Sakhalin. Journal of Ichthyology, 45, 700–711.

Safronov, S.N. 2009. Species diversity, knowledge and monitoring of rare and endangered Salmoniformes fish of Sakhalin Island. Journal "News of Irkutsk State University". Series «Biology, Ecology», 2, 51–54.

Salkenkov, E.A. 2016. Genetic connectivity between sympatric populations of closely related char species, Dolly Varden Salvelinus malma and white char Salvelinus albus. Russian Journal of Genetics, 52, 74–78. https://doi.org/10.1134/S1022795416010129

Sakai, H., Watanabe, K. and Goto, A. 2020. A revised generic taxonomy for Far East Asian minnow Rhynchocypris and dace Pseudaspius. Ichthyological Research, 67, 330–334. https://doi.org/10.1007/s10228-019-00726-5

Santos, C.M.D. 2005. Parsimony analysis of endemicity: time for an epitaph? Journal of Biogeography, 32, 1281–1286.

Savvaiova, K.A. and Lebedev, V.D. 1966. On the systematic position of Kamchatka trout (Salmo penshinensis) and mykiss (Salmo mykiss Walbaum) and their relationships with American representatives of the genus Salmo. Voprosy Ikhtiologii, 6, 593–608.

Scott, W.B. and Crossman, J.E. 1973. Freshwater fishes of Canada. Bulletin of the Fisheries Research Board of Canada, 184, 1–966.

Semenchenko, A.Yu. 2003. Fishes of Samarga River (Primorye Territory). Vladimir Ya. Levanidov's Biennial Memorial Meetings, 2, 337–354.

Semenov, D.Yu. and Ruchin, A.B. 2008. Cobitis melanoleuca gladkovi Vasil'ev et Vasil'eva, 2008 – a new subspecies in the ichthyofauna of the Ulyanovsk Oblast. In, Ecology of small rivers: biodiversity, ecology, protection. Borok, pp. 263–265.

Shakirova, F.M. and Severov, Yu.A. 2014. Species composition of ichthyofauna of the Kuibyshev Reservoir. Journal of Ichthyology, 54, 513–525. https://doi.org/10.1134/S0032945214050099
Shakirova, F.M., Govorkova, L.K. and Anokhina, O.K. 2013. Modern state of Nizhnekamsk Reservoir and possibility rational development of its fishery resources. Izvestia of Samara Scientific Center of the Russian Academy of Sciences, 15, 518–527.

Shashulovsky, V.A. and Ermolin, V.P. 2005. The composition of the ichthyofauna of the Volgograd Reservoir. Voprosy Ikhtiologii, 45, 324–330.

Shedko, S.V. 2001. The list of cyclostomes and fresh water fishes of the Primor’e coast. Vladimir Ya. Levanidov's Biennial Memorial Meetings, 1, 229–249.

Shedko, S.V. and Shedko, M.B. 2003. A new data on freshwater ichthyofauna of the south of the Russian Far East. Vladimir Ya. Levanidov's Biennial Memorial Meetings, 2, 319–336.

Shedko, S.V., Shedko, M.B. and Pietsch, T.W. 2005. Pungitius polyakovi sp. n., a new species of ninespine stickleback (Gasterosteiformes, Gasterosteidae) from southern Sakhalin Island. In, Flora and fauna of Sakhalin Island (Materials of International Sakhalin Island Project). Part 2. Dalnauka, Vladivostok, pp. 223–233.

Sheiko, B.A. and Fedorov, V.V. 2000. Chapter 1. Class Cephalaspidomorphi – Lampreys. Class Chondrichthyes–Cartilaginous fishes. Class Holocephali – Chimaeras. Class Osteichthyes – Bony fishes. In, Catalog of vertebrates of Kamchatka and adjacent waters. Kamchatsky Pechatny Dvor, Petropavlovsk-Kamchatsky, pp. 7–69.

Shibaev, S.V., Sokolov, A.V., Shibaeva, M.N., Lineva, E.V., Novozhilov, O.A., Masyutkina, E.A., Makushenko, M.E. and Lange, E.K. 2016. Background conditions of the biota of the River Neman in the area of potential impact of the Baltic NPP (the Kaliningrad Region). Scientific Journal of Kaliningrad State Technical University, 42, 59–86.

Sideleva, V.G. and Goto, A. 2012. A new species of sculpin Cottus kolymensis sp. nova (Scorpaeniformes, Cottidae) from rivers of Kolyma. Journal of Ichthyology, 52, 301–307. https://doi.org/10.1134/S0032945212020130

Sideleva, V.G. 2004. Fishes (Pisces). In, Timoshkin O.A (ed.) Anannotated check-list of the fauna of Lake Baikal and its catchments area. Volume 1. Nauka, Novosibirsk, pp. 1023–1050.

Sideleva, V.G., Naseka, A.M. and Zhidkov, Z.V. 2015. A new species of Cottus from the Onega River drainage, White Sea basin (Actinopterygii: Scorpaeniformes: Cottidae). Zootaxa, 3949 (3), 419–430.

Sidorov, A.S. and Reshetnikov, Yu.S. 2014. Salmoniformes fish of reservoirs of the northeast European part of Russia. Association of scientific editions KMK, Moscow, 346 pp.

Simmons, M.P. and Miya, M. 2004. Efficiently resolving the basal clades of a phylogenetic tree using Bayesian and parsimony approaches: a case study using mitogenomic data from 100 higher teleost fish. Molecular Phylogenetic and Evolution, 31, 351–362.

Slyn'ko, Yu.V., Kiyashko, V.I. and Yakovlev, V.N. 2000. List of species of fish and fish-like of the Volga basin. In, Catalog plant and animal of reservoirs of the Volga basin. Izd. YAGTU, Yaroslavl, pp. 252–277.

Sokolov, L.I. (ed.) 1994. Rare and endangered animals. Fishes: reference manual. Vysshaya Shkola, Moscow, 334 pp.

Sokolovsky, A.S. and Epur, I.V. 2008. The ichthiofauna of the Tumen River lower reaches and its adjacent water bodies.Vladimir Ya. Levanidov's Biennial Memorial Meetings, 4, 364–370.

Sokolovsky, A.S., Sokolovskaya, T.G. and Yakovlev, Yu.M. 2011. Fishes of the Peter the Great Bay. Second edition. Dalnauka, Vladivostok, 431 pp.

Svetovidov, A.N. 1936. European and Asian graylings (Genus Thymallus Cuvier). Proceedings of the Zoological Institute of the Academy of Sciences of the USSR, 3, 183–301.

Svetovidov, A.N. 1952. Fauna SSSR. Fishes. Herrings (Clupeidae). Zoologicheskii Institut Akademi Nauk SSSR. New Series No. 48. V. 2. Izdatel'stvo Akademii Nauk SSSR, Moskov–Leningrad, 331 pp.

Svetovidov, A.N. 1981. The Pallas fish collection and the Zoographia Rosso-Asiatica: an historical account. Archives of Natural History, 10, 45–64.
Svirskiy, V.G. and Barabanshchikov, E.I. 2010. Biological invasions as an element of antropogenic pressure upon the aquatic biotic communities in Lake Khanka. Russian Journal of Biological Invasions, 1, 21–25. https://doi.org/10.1134/S2075111710010054

Tang, F.J., Liu, W., Wang, J. L., Henne, J. and Cui, X.S. 2015. Clearhead icefish, (Protosalanx hyalocranius Abbott, 1901) (Salmoniformes, Salangidae), a new non-native species has established a population in the Amur. Journal of Applied Ichthyology, 31, 177–179. https://doi.org/10.1111/jai.12454

Taylor, E.B. 2004. An analysis of homogenization and differentiation of Canadian freshwater fish faunas with an emphasis on British Columbia. Canadian Journal of Fisheries and Aquatic Sciences, 61, 68–79.

Tockner, K., Robinson, Ch.T., Uehlinger, U., Tonolla, D., Siber, R. and Peter, F.D. 2009. Introduction to European rivers. In, Tockner, K., Robinson, Ch.T. and Uehlinger, U. (eds.) Rivers of Europe. Chapter 1. Academic Press, Elsevier, pp. 1–22.

Tokranov, A.M. and Orlov, A.M. 2005. Spatial-bathymetric distribution and size composition of Aleutian alligator fish Aspidophoroides bartoni (Agonidae) in Pacific waters of the northern Kuril Islands and southeast Kamchatka. Journal of Ichthyology, 45, 380–384.

Tokranov, A.M. and Orlov, A.M. 2015. Termophilic and Eastern Pacific migrants in ichthyofauna in the Pacific waters off the northern Kuril Islands and Kamchatka in the 20th–21st centuries. Russian Journal of Biological Invasions, 6, 260–273. https://doi.org/10.1134/S2075111715040042

Tokranov, A.M. 2015. Migrant fishes in Russian Far East. Trudy VNIRO, 156, 146–159.

Tokranov, A.M. and Sheiko, B.A. 2006. Fishes. In, Red data book of Kamchatka. Animals. V. 1. Kamchatsky Pechatny Dvor, Petropavlovsk-Kamchatsky, pp. 33–89.

Tylik, K.V. and Svirina, L.V. 2011. Biological parametrs of the twaite shad Alosa fallax of Curonian Lagoon of Baltic Sea in modern conditions. Izvestia KGTU, 22,142–149.

Unmack, P.J. 2001. Biogeography of Australian freshwater fishes. Journal of Biogeography, 28, 1053–1089.

van der Laan, R., Eschmeyer, W.N. and Fricke, R. 2014. Family–group names of recent fishes. Zootaxa, 3882 (1), 1–230. https://doi.org/10.11646/zootaxa.3882.1.1

Vasil’ev, V.P. and Vasil’e, E.D. 2008. Comparative karyology of species of the genera Misgurnus and Cobitis (Cobitidae) from the Amur River Basin in connection with their taxonomic relations and the evolution of karyotypes. Journal of Ichthyology, 48, 1–13. https://doi.org/10.1134/S0032945208010013

Vasil’e, E.D. 2003a. Main alterations in ichthyofauna of the largest rivers of the northern coast of the Black Sea in the last 50 years: A review. Folia Zoologica, 52, 337–358.

Vasil’e, E.D. 2003b. An annotated catalogue of fishes and fish-like organisms living in seas of Russia and adjacent countries: Part 4. Gobioidi. Journal of Ichthyology, 43 (suppl. 1), 41–56.

Vasil’e, E.D. 2007. Fish of the Black Sea. Key to marine, brackish-water, euryhaline, and anadromous species with color illustrations, collected by S.V. Bogorodsky. Izdatel’stvo VNIRO, Moscow, 238 pp.

Vasil’e, E.D., Vasil’e, V.P. and Kuga, T.I. 2004. On taxonomy of gudgeons of the genus Gobio (Gobioninae, Cyprinidae) of Europe: a new species of gudgeon Gobio kubanicus sp. nova from the Kuban River basin. Voprosy Ikhtiologii, 44, 766–782.

Vassilev, M.V. and Pehlivanov, L.Z. 2005. Checklist of Bulgarian freshwater fishes. Acta Zoologica Bulgarica, 57, 161–190.

Vekhov, D.A., Naumenko, A.N., Gorelov, V.P., Golokolenova, T.B. and Shevlyakova, T.P. 2014. The current state and use of aquatic biological resources of the Tsimlyansk reservoir (2009-2013). In, Rybokhozyaystvennyye isssledovaniya na vodnykh ob'yektakh Yevropeyskoy chasti Rossii. FGBNU GosNIORKH, St. Petersburg, pp. 116–145.

Vyshegorodtsev, A.A. and Zadelenov, V.A. 2013. Commercial fishes of Yenisei. Siberian Federal University, Krasnoyarsk, 303 pp.
RUSSIAN FRESHWATER AND BRACKISH WATER FISH

Walbaum, J.J. 1792. Petri Artedi sueci genera piscium. In quibus systema totum ichthyologiae proponitur cum classibus, ordinibus, generum characteribus, specierum differentiis, observationibus plurimis. Redactis speciebus 242 ad genera 52. Ichthyologiae pars III. Ant. Ferdin. Rose, Grypeswaldiae [Greifswald]. Part 3: [i-viii] + 1–723, pls. 1–3.

Wallace, R. and McCart, P.J. 1984. The fish and fisheries of the Athabasca River basin: their status and environmental requirements. Prepared for Alberta Environment, Planning Division, 269 pp.

Watanabe, K. 1998. Parsimony analysis of the distribution pattern of Japanese primary freshwater fishes, and its application to the distribution of the bagrid catfishes. Ichthyological Research, 45, 259–270.

Welcomme, R.L. 1985. River Fisheries. FAO Fisheries Technical Paper, 262, 330 pp.

Winkler, H.M., Skora, K., Repecka, R., Ploks, M., Neelov, A., Urho, L., Gushin, A. and Jespersen, H. 2000. Checklist and status of fish species in the Baltic Sea. ICES CM 2000/Mini 11. ICES Headquarters, Copenhagen, 15 pp.

WoRMS. 2019. World Register of Marine Species. Available from http://www.marinespecies.org (accessed 26 January 2020)

Zadelenov, V.A., Zvantsev and V.V., Forina, Yu.Yu. 2019. Fish of the river basin of the Pyasina River. In: Pishchchenko, E.V. and Moruzi, I.V. (eds.) The Current State of Aquatic Bioresources: Materials of the 5th International Conference, Novosibirsk, November 27–29 2019. NSAU, Novosibirsk, pp. 77–80.

Zaitsev, Y.P. 2006. Introduction to the ecology of the Black Sea. Even, Odessa, 224 pp.

Zamotajlov, A.S. (ed.). 2007. Red data book of Krasnodar Territory (animals). Second edition. Center for Development PTR Krasnodar Territory, Krasnodar, 504 pp.

Zhuravlev, V.B. 2003. Fishes of the upper Ob basin. Publishing Altai University, Barnaul, 292 pp.

Zinov’ev, E.A. 2014. About faunistic specificity of fish polytypic reservoirs of basin middle Kama. Izvestia of Samara Scientific Center of the Russian Academy of Sciences, 16, 554–559.

Zworykin, D.D. and Pashkov, A.N. 2010. Eight-striped Cichlasoma—an allochthonous species of cichlid fish (Teleostei: Cichlidae) from Staraya Kuban Lake. Russian Journal of Biological Invasions, 1, 1–6. https://doi.org/10.1134/S207511710010017

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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 baeri* 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) |
### RUSSIAN FRESHWATER AND BRACKISH WATER FISH

| No. | Species Name | Scientific Name | Distribution | Habitat | Status |
|-----|--------------|-----------------|--------------|---------|--------|
| 9.  | Acipenser mediostris | 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 to 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) |
| #  | Species                                      | Native Area                                      | Habitat                          | Remarks                                                                 |
|----|---------------------------------------------|-------------------------------------------------|----------------------------------|-------------------------------------------------------------------------|
| 20 | *Alosa fallax* (Lacepède, 1803) – Twaite 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; Tyl'ik and Svirina, 2011. |
| 20.1 | *Alosa fallax baltica* | Kukuev & Orlov, 2018 – Baltic shad | | |
| 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 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, Severkski 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 | Caspian 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. |
|   | Species                                                                 | Distribution                                                                                   | Notes                                                                                           |
|---|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 41. Osmerus dentex Steindachner & Kner, 1870 – Arctic (Asian) rainbow smelt | North Atlantic, North Pacific and Arctic Ocean                                                | +                                                                                               |Nm., Cf.                                                                                         |
| 42. Osmerus eperlanus (Linnaeus, 1758) – European smelt                   | North Atlantic and adjacent Arctic                                                           | +                                                                                               |Nm., Cf.                                                                                         |
| 43. Coregonus albula (Linnaeus, 1758) – Vendace                           | In lakes of White, Barents, Baltic and North seas basins                                     | + (anadromous species in Gulf of Finland, but primarily it freshwater lacustrine fish)         |Nm., Cm., Cf.                                                                                   |
| 44. Coregonus autumnalis (Pallas, 1776) – Arctic cisco                    | 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                        | Limited to some rivers of Bering Strait, Chukotka                                            | +                                                                                               |?Cm.                                                                                             |
| 46. Coregonus maraena (Bloch, 1779) – Maraena whitefish                  | Basin of the Baltic Sea, including Lake Ladoga                                               | + «lake» forms                                                                                 |?Cm.                                                                                             |
| 47. Coregonus munksun (Pallas, 1814) – Muksun                            | From Kara River eastwards to Kolyma River                                                   | + «lake» forms                                                                                 |Cm., Cf.                                                                                         |
| 48. Coregonus pallasii Valenciennes, 1848 – Aspsik                        | Baltic Sea, including Gulf of Finland and Neva River                                         | -                                                                                               |R.                                                                                               |
| 49. Stenodus leucichthys (Güldenstädt, 1772) – Inconnu                   | 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                                                         | + (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                 | Arctic (known from Lena River estuary (Laptev Sea) and Chaun Bay (East Siberian Sea); Pacific coast Kurils, Bering, Okhotsk and Japan seas | -                                                                                               |Nm., Cf.                                                                                         |
| No. | Species | Distribution | Remarks |
|-----|---------|--------------|---------|
| 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 penshinenesis* (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 + |
| No. | Species | Common Name | Distribution | Remarks |
|-----|---------|-------------|--------------|---------|
| 62. | *Salmo ciscaucasicus* | Ciscaucasia trout | Western Caspian Sea, Caspian Sea + (basins of Volga and Ural rivers) | Vr. |
| 63. | *Salmo labrax* | 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* | 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* | 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* | 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* | 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 cairiulus* | Kuril charr | Northwestern Pacific, Okhotsk and Japan seas including Kurils + («lake» form, e.g., Sakhalin and Kuril islands) | Cm., Nm., Cf. |
| 69. | *Salvelinus leucomaenis* | 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* | 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* | 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 tatarinovii* | 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* | Sakhalinian charr | Northwestern Pacific, Endemic species to the Sakhalin Island + | Cm., Cf. |
| No. | Species Name | Distribution                                                                 | Remarks                                    | Unit |
|-----|--------------|-------------------------------------------------------------------------------|--------------------------------------------|------|
| 74  | *Gasterosteus aculeatus* Linnaeus, 1758 – Thre−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 Arctic 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. (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 Novomody (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 c obdonensis** (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. o reas, B. nuda and B. markakaldensis* 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* Lacepède, 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* Dybowsky, 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 vescicus*. 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 (1999, 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 char

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. koznetzovi, S. albus, and S. malma malma* represent a monophyletic group that originated from a common ancestor.

27. *Salvelinus andriashevi* Berg, 1948 – Chukchi char

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 cranio-morphological differences, some other authors (Berg, 1948; Chereshnev, 2008) classified *S. andriashevi* as a valid species.

28. *Salvelinus gritzenkoi* Vasil’eva & Stygar, 2000 – Gritsenko’s char

A comparative analysis suggests that the population of Gritsenko’s char of Chernoe Lake is not different from the anadromous char *Salvelinus malma* (Walbaum, 1792); therefore, *S. gritzenkoi* cannot be considered as a valid species (Gritsenko, 2012).

29. *Salvelinus kronocius* Viktorovsky, 1978 – Kronotsky char

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 char

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 occurred 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 sufihensis* described from China (Suifu, province Szechwan), *M. tungtingensi uchidai* described from Pusan, South Korea. | As *M. tungtingensis amurensis* is now treated as a valid species, *M. tungtingensis* is not member of the Russian ichthyofauna. |
| (Fr.) *Oreoleuciscus dsapchynensis* Warpachowski, 1889 – Dsaphyn 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 czerkii* as a junior synonym of this species. | According to Reshetnikov (2003), Naseka and Gershtein (2006), Bogutskaya et al. (2008), *Sarcocheilichthys czerkii* is a valid species. It was originally described from Shanghai, China. Not considered as a |
(Fr., Br.) *Squalidus argentatus* (Sauvage & Dabry de Thiersant, 1874) – Silver gudgeon

This taxon has been treated as a junior synonym of *Cobitis lebedevi* Vasilev & Vasilev, 1985; its distribution area includes the Amur River basin (Russia, China and Mongolia) and the southern part of Primorsky Krai.

(Cobitis choii) Kim & Son, 1984 – Choi's 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).

(Misgurnus buphoensis) Kim & Park, 1995 – Korean weatherfish

According to Shedko and Shedko (2003), Bogutsksaya and Naseka (2004) and Naseka and Gershtein (2006), the taxon *Misgurnus nikolskyi* Vasilev, 2001, is a junior synonym of *M. buphoensis*; in this case *M. buphoensis* would be a member of the Russian ichthyofauna. According to Bogutsksaya et al. (2008) and Kottelat (2012), *M. nikolskyi* is treated as a valid species.

(Sabanejewia aurata) (De Filippi, 1863) – Goldside spined loach

Several subspecies were previously recognized: *Sabanejewia aurata kubanica* Vasilev & Vasilev, 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.

(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).
According to Novomodny (2004, 2014), Tachysurus brasnikowi (Berg, 1907) is a junior synonym of T. nitidus.

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).

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.

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].

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.

Since the beginning of the 1930s, this species has not been recorded from Russian waters; most likely, it was previously misidentified.

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.  

(\textit{Fr.}) \textit{Alburnus mento} (Heckel, 1836)  
In the past, some authors Kottelat (1997), Reshetnikov (1998) and others, have listed it as a subspecies \textit{Alburnus chalcoides mento}, or it was placed in the synonymy of \textit{Alburnus chalcoides}.  
Now, according to Bogutskaya and Naseka (2004), Kottelat and Freyhof (2007) it is classified as a valid species \textit{A. mento}. The range of \textit{A. mento} is limited to subalpine lakes in Germany and Austria in the Danube drainage (Kottelat and Freyhof, 2007)

(\textit{Fr.}) \textit{Barbus escherichii} Steindacher, 1897 – Sakarya barbel  
Berg (1949a), Reshetnikov (1998, 2003) and others, have classified this taxon as a subspecies \textit{Barbus tauricus escherichii}, or \textit{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. \textit{Barbus tauricus rionica} Kamensky, 1899, that formally occupied in rivers along Black sea coast in Krasnodarsk region and western part of Transcaucasia, is now treated as a valid species. \textit{B. escherichii} is no member of the Russian ichthyofauna.

(\textit{Fr.}) \textit{Chanodichthys dabryi} (Bleeker, 1871) – Humpback  
Formerly (Bogutskaya and Naseka, 1996; Reshetnikov, 1998, 2003) recorded \textit{Ch. dabryi} for waters of Russia, but only by including the taxon \textit{Chanodichthys abramoides}, which is now treated as a valid species.

(\textit{Fr.}) \textit{Microphysogobio tungtingensis} (Nichols, 1926) – Longnose gudgeon  
This species comprised several subspecies: \textit{Microphysogobio tungtingensis anudarini} from Bujr Nur Lake, Mongolia, \textit{Microphysogobio tungtingensis amurenensis} from basin of Amur River, \textit{M. tungtingensis suifuensis} described from China (Suifu, province Szechwan), \textit{M. tungtingensis uchidai} described from Pusan, South Korea.  
As \textit{M. tungtingensis amurenensis} is now treated as a valid species, \textit{M. tungtingensis} is not member of the Russian ichthyofauna.

(\textit{Fr.}) \textit{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 \textit{Oreoleuciscus ignatowi} Nikolskii 1902 as a junior synonym. Bogutskaya and Naseka (2004) placed \textit{Oreoleuciscus dsapchynensis} in the synonymy of \textit{Oreoleuciscus potanini} (Kessler, 1879).  
Kottelat (2006) restored it as a valid species. Kottelat (2006) treated \textit{Oreoleuciscus ignatowi} as a junior synonym of \textit{Oreoleuciscus potanini} (Kessler, 1879), which action excludes \textit{Oreoleuciscus dsapchynensis} from the Russian ichthyofauna.

(\textit{Fr.}) \textit{Sarcocheilichthys nigrigennis} (Günther, 1873) – Rainbow gudgeon  
Some authors (e.g., Novomodny et al., 2004; Novomodny 2014; etc.) have treated \textit{Sarcocheilichthys czerskii} as a junior synonym of this species.  
According to Reshetnikov (2003), Naseka and Gershtein (2006), Bogutskaya et al. (2008), \textit{Sarcocheilichthys czerskii} is a valid species. It was originally described from Shanghai, China. Not considered as a member of the Russian ichthyofauna, because here \textit{Sarcocheilichthys soldatovi} and \textit{Sarcocheilichthys czerskii} are treated as valid species.
(Fr., Br.) **Squalidus argentatus**
(Sauvage & Daby 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 & Daby 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* Witkowski, 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), *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).

(Mr., Br.) *Atherina boyeri* Risso, 1810 – Big-scale silverside

With the establishment of the valid species *A. pontica* from the Black and Azov seas and *A. 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 *G. 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 *L. 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 bruneus* (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. bruneus* (Pinchuk, 1978, 1992; Dyldin and Orlov, 2017b). *R. bruneus* 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 *R. sowerbyi* Ginsburg, 1917 and *R. 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             | 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.) | -            |
| Rafinesque, 1817 – lake sturgeon    |                                          |                                                                                                  |              |
| 2. Acipenser naccarii               | Northern and southern parts of the Adriatic Sea | Used for breeding since 1997 at Aleksin chemical plant (Podushka et al., 2006)                             | +            |
| Bonaparte, 1836 – Adriatic sturgeon |                                          |                                                                                                  |              |
| 3. Acipenser oxyrinchus             | Northwestern part of Atlantic Ocean, the | 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). | ?+           |
| Mitchell, 1815 – American Atlantic sturgeon | the coasts of U.S.A. and Canada      |                                                                                                  |              |
| 4. Polyodon spathula                | Northern America, in Mississippi and its | 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). | +            |
| (Walbaum, 1792) – Mississippi paddlefish | its tributaries, flowing into the Gulf of Mexico |                                                                                                  |              |
| 5. Alosa sapidissima                | 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). | -            |
| (Wilson, 1811) – American shad       |                                          |                                                                                                  |              |
| 6. Barbodes semifasciolatus         | China                                    | Introduced to Khanka Lake, Amur River basin (observed in 1987) (Manilo and Pan’kov, 2004; Svirskiy and Barabanshchikov, 2010) | ?+           |
| (Günther, 1868) – Chinese barb      |                                          |                                                                                                  |              |
| 7. Hypophthalmichthys nobilis       | 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)        |
| (Richardson, 1845) – Bighead carp    |                                          |                                                                                                  |              |
| No. | Species | Origin | Introduction | Notes |
|-----|---------|--------|--------------|-------|
| 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 Belovskyye 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 | + |
| **Species** | **Origin** | **Notes** |
|------------|------------|-----------|
| **17. Ameiurus nebulosus**<br>(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 Belarus and Ukraine (Reshetnikov, 1998) |
| **18. Ictalurus punctatus**<br>(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**<br>(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**<br>(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**<br>(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) |
| **22. Salmo ischchan**<br>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**<br>(Mitchill, 1814) – Brook trout | Eastern part of North America | Naturalized in the eastern part of Gulf of Finland (Bogutskaya and Naseka, 2004) |
| **24. Gambusia holbrooki**<br>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... |
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| Number | Species Name | Habitat | Remarks |
|--------|--------------|---------|---------|
| 25. | *Poecilia reticulata* | 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* | 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* | Atlantic coast of North America | Kuban River, basins of the Azov and Black seas (Bogutskaya and Naseka, 2004; Vasil’eva, 2007) | + |
| 28. | *Lepomis gibbosus* | Atlantic coast of 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* | 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 occurrence is questionable, see Berg (1949b), Bogutskaya and Naseka (2004)) | + (?n) |
| 30. | *Gymnocephalus bouloni* 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) | - |
| No. | Species Name                                      | Origin                         | Information                                                                 |
|-----|--------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------|
| 33  | *Rocio octofasciata* (Regan, 1903) – Blue jack    | 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) |
| 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* (Kolombatov, 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) |
| 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) |
**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          |                                               |           |
| 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* Mitchell, 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)

| Species                                      | Location                                                                 | Status |
|----------------------------------------------|---------------------------------------------------------------------------|--------|
| _Acipenser stellatus_ (1)                    | the population of the Azov-Black Sea basin                                | CR     |
| _Alosa kessleri volgensis_ (2)               | Alosa volgensis (2)                                                       | EN     |
| _Alosa fallax fallax_ (4)                    | _A. fallax_ (Lacepède, 1803)                                             | LC     |
| _Clupeonella abrau_ (4)                      | _C. abrau_ (Maliatsky, 1930)                                             | CR     |
| _Salmo salar_                               | _Salmo salar_ (2), the residential form                                    | LC     |
| _Salmo trutta_                               | _Salmo trutta_ (2), the lake forms of the Baltic Sea basin in the basin of Ladoga and Onega lakes | 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) | _      |
| _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 | LC     |
| _Salmo trutta ezenami_ (2)                   | _Salmo trutta ezenami_ (1)                                               | CR     |
| _Parasalmo mykiss_ (3)                       | _Parasalmo mykiss_ for the anadromous form of the Kamchatka (2), for the Shantar Islands population (3) | _      |
| _Salvelinus alpinus_ (2)                     | _Salvelinus alpinus_ for the populations of the Frolikha, Big and Small Leprindo, Leprindokan, Davatchan, Irbo, Tokko, Usu, Karnkanda, Ogiendo lakes (Transbaikalia) (2), the population of the Lake Shchuchye (Polar Urals) (3) | LC     |

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Salvelinus elgyticus (3)  Salvelinus elgyticus (3)  S. elgyticus Viktorovsky & Glubokovsky, 1981

Salvelinus svetovidovi (3)  Salvethymus svetovidovi (3)  Salvethymus svetovidovi Chereshnev & Skopets, 1990

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 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

Hucho perryi (2)  Parahucho perryi (1), the populations of Primorsky Krai and Sakhalin Region.

Brachymystax lenok (1)  Brachymystax tumensis (1), the population of the Ob River basin

-  Brachymystax lenok (2), the populations of the Baikal Basin and the Angara River basin

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

Coregonus lavaretus baeri (2)  Coregonus lavaretus (1), populations of the Volkhov and Svir, Ladoga Lake basin

Coregonus lavaretus baunti (3)  Coregonus baunti (3), the populations of the Big and Small Kapylyushi lakes

Coregonus albula pereslavicus (2)  C. albula (2), the population of the Lake Plescheevo

Coregonus muksun (2), the populations of the Yamal Peninsula
| Scientific Name (Common Name) | Scientific Name (Common Name) | Scientific Name (Common Name) | IUCN Status |
|-------------------------------|-------------------------------|-------------------------------|-------------|
| 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 (Kamesky 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) | _           |
| _                             | Cohitis taurica (2)           | C. taurica Vasil'eva, Vasil'ev, Janko, Râb & 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 Baltic Sea basin | LC          |
| _                             | Lociobarbus 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          |
| _                             | Alburnus chalcoides (2)       | A. chalcoides (Güldenstädt, 1772) | LC          |
| _                             | Alburnus 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          |
| Scientific Name                                      | Common Name                        | Status   |
|-----------------------------------------------------|------------------------------------|----------|
| Sabanejewia caucasica (3)                           | _                                  | LC       |
| Silurus soldatovi (2)                               | Silurus soldatovi (3)              | _        |
| Stizostedion volgensis (3)                          | _                                  | LC       |
| Siniperca chuatsi (2)                               | Siniperca chuatsi (5)              | _        |
| Cottus gobio (2)                                    | _                                  | LC       |
| Gadus morhua kildinensis (1)                        | Gadus morhua kildinensis (1)       | VU       |
| _                                                   | Anguilla anguilla (1), the basins of the Barents, White, Black and Azov seas | CR       |
| _                                                   | Hippocampus hippocampus (2)        | DD       |

*Notes:*
- LC: Lower Category
- VU: Vulnerable
- CR: Critically Rare
- DD: Data Deficient
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 |
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*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.

**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’-*, 2008). Kottelat (2012) raised it to species level. According to the authors of the original description (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 spirlin

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).
| Year | Species                          | Location/Description                                                                 |
|------|----------------------------------|--------------------------------------------------------------------------------------|
| 2014 | *Gasterosteus nipponicus* Higuchi, Sakai & Goto, 2014 – Japanese threespined 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 Lake in 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 endemicty 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 |
| 2. (Fr.) *Alburnoides kubanicus* Bănărescu, 1964 – Kuban spirin | left bank tributaries of Kuban drainage, including rivers Laba, Labenok, Belaya and etc. |
| 3. (Fr.) *Alburnoides maculatus* (Kessler, 1859) – Crimean spirin | 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, Nyraabyt 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 tauroca* 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

Siberian sucker in the Indigirka, Alazeya, Kolyma and Yana drainages

**Esociformes Rafinesque, 1810 – Pikes**

18. (Fr.) *Dallia admirabilis* Chershevnev, 1980 – Wonderful blackfish

Lakes of middle and lower reaches of Amguema River basin, Chukotka Peninsula

**Salmoniformes Rafinesque, 1810 – Salmons**

19. (Fr., Br.) *Coregonus anaulorum* Chershevnev, 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* Dybowskij, 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* Kaganovsky, 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.
RUSSIAN FRESHWATER AND BRACKISH WATER FISH

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 dryagin 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 Chukotka Peninsula

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.) *Salvelinus 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 polyakovii* 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.) *Myxocephalus 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 baikalensis* (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 elochni* Taliev, 1955 – Elochini’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 eury stomus* (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 – Warmwater Baikal sculpin Lake Baikal, local endemic of Frolikha Bay

96. (Fr.) *Neocottus vereshchagini* (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