Food and Agriculture Organization of the United Nations

FAO FISHERIES AND AQUACULTURE TECHNICAL PAPER

701

ISSN 2070-7010

The inland fisheries of the Russian Federation: their current status for food provision and employment

RUSSIAN FEDERAL RESEARCH INSTITUTE OF FISHERIES AND OCEANOGRAPHY · 1881 · VNIRO

The inland fisheries of the Russian Federation: their current status for food provision and employment

FAO
FISHERIES AND
AQUACULTURE
TECHNICAL
PAPER

701

Edited by
K. Kolonchin
N. V. Kulik
V. A. Belyaev
A. B. Bobyljov
N. V. Yanovskaya
J. Valbo-Jørgensen
S. Funge-Smith

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2024

Required citation:
Kolonchin, K., Kulik, N.V., Belyaev, V.A., Bobyljov, A.B., Yanovskaya, N.V., Valbo-Jørgensen, J. & Funge-Smith, S., eds. 2024. *The inland fisheries of the Russian Federation: their current status for food provision and employment*. FAO Fisheries and Aquaculture Technical Paper, No. 701. Rome, FAO. https://doi.org/10.4060/cc9895en

ISSN 2070-7010 [Print]
ISSN 2664-5408 [Online]

ISBN 978-92-5-138617-0

Preparation of this document

FAO periodically reviews the world's inland fisheries as part of its efforts to understand and appreciate the contribution of these fisheries to food security and human nutrition, ecosystems services and biodiversity resources and livelihoods as well as the constraints involved with their sustainable development, and management and institutional aspects in the national context. In this context it was relevant to examine the inland fisheries of the Russian Federation since the country is among the 10 largest producers of fish from inland fisheries and FAO has not undertaken a through review of the sector since the breakup of the Soviet Union. FAO prepared the overall framework of the review. The information which is presented is of importance not only to the Russian Federation, but also for neighbouring countries that share some of the basins and waterbodies or have waters with similar conditions.

The data and information compiled in this document is based on the published scientific and applied research by leading Russian organizations dealing with issues related to fisheries in Russian inland waters. The research centres that have prepared the materials used in this document comprise the State Research and Production Center of Fisheries (Gosrybcenter) (now the Tyumen branch of VNIRO), the Saint-Petersburgh Branch of VNIRO (GosNIORKH), the Northern Fisheries Research Institute (SevNIIRKH), Astrakhan State Technical University (ASTU), the Rostovrybkom Association, the Ministry of Natural Resources of the Russian Federation, the autonomous non-profit organization 'National Information Agency for Natural Resources' (NIA-Nature), Federal State Budget Institute (FSBI), the Institute of Global Climate and Ecology, the Institute of Water Problems of the Russian Academy of Sciences, the Institute of Biology of Inland Waters of the Russian Academy of Sciences, the VNIRO branch of Freshwater Fisheries (VNIIPRH) and a number of other organizations.

The Review was prepared under the overall direction of Kirill Kolonchin and the editorial board under his leadership (Kulik, N.V., Belyaev, V.A., Bobyljov, A.B., and Yanovskaya, N.V.).

Main authors (all affiliated with FSBSI "VNIRO" unless otherwise stated) were:

Preface, Chapter I – The importance of inland fisheries in the Russian Federation: Yadykina, E.A (lead author), Yanovskaya, N.V., Samoylenko, V.V., and Seromakha, E.N.;

Chapter 2 – Characteristics and ecology of inland waters in the Russian Federation – Yanovskaya, N.V. (lead author);

Chapter 3 – Structure and organization of the inland fisheries of the Russian Federation – Samoylenko, V.V. (lead author), Pavlova, A.O., Kononova, L.A., and Ryzhkov, Y.L.;

Chapter 4, Time series of inland fish catches by region. Pavlova, A.O. (lead author), Bondarenko, G.A., Grigoryeva, E.G., Samoylenko, and V.V., Ivanov, D.S.

Chapter 5 - inland fishery catch by main species. Pavlova, A.O. (lead author), Bondarenko, G.A., Grigoryeva, E.G., Samoylenko, V.V., and Ivanov, D.S.

Chapter 6 – Inland Fishery catch data by Type of waterbody – Pavlova, A.O. (lead author), Bondarenko, G.A., Grigoryeva, E.G., Samoylenko, V.V., and Ivanov, D.S.;

Chapter 7 – Industrial policy and management structure for the exploitation and conservation of stocks of lars in inland waters– Kolonchin, K.V. (lead author), Yanovskaya, N.V., Bekyashev, D.K., Bekyashev, and K.A., Galstyan, G.G.;

Chapter 8 – Fisheries development and management – Brazhnik, S.Yu. (lead author), Skakun, V.A., and Bykov, A.D.

The main abbreviations, terms and definitions, Statistical data tables in the Annex, List of aquatic fishery objects in Russian, English and Latin languages, Translation of the Review into English, and the selection of illustrations were done by Yanovskaya, N.V., Yadykina, E.A., Kononova, L.A., Seromakha, E.N., Tishkova, T.E., Ivanov, D.S., and Pavlova, A.O.

Technical editing of the final report was done by FAO. Copy editing by Robin Leslie and layout and graphic design by Ilvana Hamalukic.

Every attempt was made to provide acknowledgements for the numerous photographs in this publication. However sometimes this was not possible due to the vintage of the figures. All illustrations of fishing gear and vessels were provided courtesy of Tyumen branch of the VNIRO ("Gosrybcenter") 2003a, Handbook, Volume 2.

Abstract

The Russian Federation is the largest country in the world occupying one-third of Eurasia and has enormous water resources including more than 2.5 million rivers, more than 400 000 km² lakes, hundreds of thousands of swamps and other wetlands, thousands of reservoirs, and a share of the world's largest inland sea the Caspian Sea. Fish from inland waters has always been a central part of the Russian diet and been a major contributor to national food security. Inland fisheries provide employment to 40 500 fishers in industrial fisheries, but in addition there are an estimated 2.4 million people categorized as amateur and recreational fishers and around 150 000 Indigenous Peoples who mostly fish for subsistence.

Inland fisheries in In the Russian Federation is highly diversified applying gears that range from hook and line and traps to big trawlers and purse seiners. Around 150 species of finfish and invertebrates are exploited in the fisheries including organisms ranging from gammarid crustaceans to anadromous sturgeons, the largest fish species occurring in inland waters.

Historic production figures surpassed 500 000 tonnes of fish from Russian inland fisheries, and as recently as the late 1980s well over 400 000 tonnes were caught. There has however been a steady decline over the last 40 years and currently around 270 000 tonnes are caught annually according to the official records. However, unrecorded catches by recreational/amateur fishers add up to an estimated 100 000 tonnes annually, subsistence catches by Indigenous Peoples probably add another 67 000 tonnes; and finally, there are significant illegal catches that in some waterbodies are higher than the legal constituting perhaps another 50 000 tonnes. Suggesting that total landings are not far from what was caught in the past.

For decades the Russian Federation has invested significant resources and efforts into developing and managing inland fisheries and aquaculture taking advantage of the the available water resources including both natural systems and the artificial waterbodies that were created to meet the needs for hydropower and irrigation. The review presents the current management structure and summarises the comprehensive legislation governing inland fisheries, including also the agreements with the neighbouring countries sharing some of the major waterbodies or rivers.

The country is divided into eight fishery basins that are managed independently. Strict regulations are in place to ensure sustainable fisheries, and total allowable catches are developed for a range of commercial species in the main waterbodies, for other species recommended annual catches are established. Other management measures include stocking of native and non-native species and the transfer of species between basins, and some environmental engineering to recreate degraded habitats.

Contents

Acknowledgements

FAO would like to extend its appreciation to VNIRO and director Kirill Kolonchin and the editorial board for organizing, editing, and translating the review of the inland fisheries of the Russian Federation, which is presented in this Fisheries and Aquaculture Technical Paper.

We wish to thank all of the authors for sharing their knowledge of and experiences working with the fisheries sector. We would like to thank Robin Leslie for editing the document, Ilvana Hamalukic for the document layout and Varun Tandon for verifying and correcting numbering of tables and figures. We acknowledge the contribution of the FAO liaison office in Moscow in facilitating communication and follow up.

Abbreviations

AOR	Association of Rosokhotrybolovsoyuz – The National Association of Hunting and Fishing
EHP	extremely high pollution of surface waters
FAF	Federal Agency of Fisheries
HP	high pollution of surface waters
IUU	illegal, unreported and unregulated (fishing)
LAR	living aquatic resource
MAC	maximum allowable concentration
NASCO	North Atlantic Salmon Conservation Organization
SPNA	specially protected natural areas
PH	petroleum hydrocarbons
RAC	recommended annual catch
RAS	Russian Academy of Sciences
SGM	sand and gravel mixture
SH	salmon hatcheries
SNF	spawning and nursery farms
SS	synthetic surfactants
TAC	total allowable catch

Terms and definitions

Acclimatization of living aquatic resources: Introduction of valuable species and forming of their stable populations into waterbodies of fishery importance which they did not inhabit earlier or where they have lost their significance.

Biogenic elements: Chemical elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur) that are necessary for living organisms to ensure normal life.

Bottom longline: Hook tackle for catching bottom fish species. It is anchored and marked with buoys.

Casket scow: A non-self-propelled cargo ship with a shallow water draught.

Circles: Floating fishing tackle for catching predatory fish. Live bait of low-value fish species (such as Amur sleeper) is used as bait. The circles consist of discs with a diameter of 120 mm to 200 mm and a thickness of 20 mm to 30 mm with a line groove. They can be rectangular or square.

Conical pots: Stationary fishing gear primarily used for crabs, gastropods and shrimp. The basis is a metal frame, consisting of two or three transverse rings, fastened with rods.

Dragnet: Similar to a seine but operated without a boat, it issometimes provide with a purse, and is usually used in shallow areas of reservoirs.

Dredge: A device for excavating and scraping the sea bed.

Dredge biological (commercial): A filtering gear made of metal mesh or rings, towed along the bottom by small vessels with a tow line. Used for catching bottom orientated non-fin fish target species (for example, mollusks or plants) .

Drift net: This is a single wall or double wall net with a rezhak (Russian), set across the river and floating with the current towards the fish; used for fishing in seas and rivers.

Eutrophic waterbody: A waterbody characterized by high productivity and increased nutrient content.

Fish gig: Fishing gear in the form of a long pole, at the end of which a metal trident (sometimes with six or more serrated teeth).

Fish weir: An obstacle made of stakes driven into the bottom of the river. It serves to trap fish during their migration.

Fishery basin: The fishery basin is the main territorial unit for management and accounting for the economic use and protection of living aquatic resources in the Russian Federation. It is fundamental for assessing the environmental status of fishery waterbodies (seas, rivers, lakes, reservoirs, etc.) as well as hydrobiological, natural and climatic conditions, the species composition of ichthyofauna and the fishery value of the basin in the development of the raw material base.

Fishing brigade: Two or more individuals working for the leaseholder (user) of fishing grounds on a contract. The team ensures the implementation of the work cycle of the labour involved.

Floats: Hollow balls, made of glass or other material that keep the fishing gear in a working position on the surface.

Freshwater dragnet (mutnik): A tissue seine or small-meshed dragnet for catching small fish (mainly in the northwestern lakes and the Volga River).

Freshwater wetlands: Areas with low acidity and excess wet soil, where water stagnates most of the year. They are usually formed in lake areas and have dense vegetation.

Fyke net: This is a stationary covered trap. The net consists of a barrel (bell), neck and frame. It is installed with stakes in shallow areas. Typically, fyke nets are used in the winter season to catch bream, carp, catfish, pike-perch, etc.

Ganging: End of a rope for attaching the hook to the main fishing line.

Gillnet: A net which is suspended in the water column which is used to enmesh and entangle fish in net threads.

Hook fishing gear: Hook gear equipped with one to three hooks are called handlines or pole-and lines; those equipped with many hooks are called tackle (self-fishing and bait). The gear is designed for the fish to swallow the hook with the bait. Self-fishing tackle is hook tackle; it consists of a rope to which thinner ropes are tied at a distance of about 27 cm from each other with extremely sharp hooks and floats attached to them, set in one line.

IUU fishing: Illegal, Unreported and Unregulated fishing, landing, processing and trading of living aquatic resources.

Jig: A jig is a small sinker made of tin or lead with a small hook. The technique imitates the movement of small fish or crustaceans.

Kolkhoz: A cooperative organization of fishers with voluntary membership for the joint management of large-scale fisheries based on social means of production and collective labour.

Kotczi: Open-top maze-type trap made of reeds. Traps are established during floods near the shores of a reservoir in several rows over a considerable length.

Living aquatic resources (LARs): Wild fish, aquatic invertebrates, marine mammals, algae, other aquatic animals and plants.

Lure (spoon): Artificial bait that imitates the movements of fish in water. Usually it is a shiny metal plate or a triangular piece of tin. Several types of lures are known: oscillating, rotating, combined, etc.

Mainline: The main rope (base) of the bottom, demersal, pelagic or vertical longlines in the form of a nylon or hemp rope, to which ganging with hooks is attached.

Merezha (fyke hoop net): A net stretched on hoops of somewhat decreasing diameter, with an entrance to which a long netting web of the same height as the entrance extends.

Near-bottom longline: Hook paternoster line, set up above the ground in a hanging position, by giving additional overlap. This hanging position of the line significantly increases the visibility of the baited hooks to the fish and improves fishing efficiency compared to an ordinary bottom hook line.

Non-self-propelled vessels: Towed vessels with propulsive thrust carried out in various ways (by vessels, tractors, winches, etc.). These vessels include barges, scows and lighters of various purposes and types.

Ordinary fish: Chastic, the commercial name used for groups of fish mainly in inland fishing areas, divided into large ordinary fish (pike, pike-perch, common carp, catfish and ide) and small ordinary fish (rudd, zope, roach, sichel).

Periphyton: Periphyton is a complex mixture of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged surfaces in most aquatic ecosystems.

Phytoplankton: The smallest single-celled plants (algae) that live in suspension in the sea or freshwater column (a layer of water about 200 m from the surface) and receive solar energy.

Receiving and transporting ship: A fishing vessel designed to receive fishing products from catching vessels and deliver them to the port of destination.

Recommended Annual Catch (RAC): Catch of LARs, for which TAC is not established.

Rybvod: Regional Departments for Fisheries and Conservation of Aquatic Biological Resources included in the structure of the Federal Agency for Fisheries.

Scraper: A small seine (dragnet) with very fine mesh.

Seine net: A filtering fishing gear for bottom and pelagic fish deployed mainly from small fishing vessels. It consists of mesh netting set on top, bottom and side wing lines. Seines are used in lake, river and coastal fishing. A small seine net for fishing in shallow water is called a dragnet, and a seine net without a net bag is called a tuck seine.

Set gillnet (anchored): All types of fixed entangling nets installed in reservoirs using stakes, ballast, etc.

Sinkers: Clay, lead, stone and other weights attached to fishing gear for immersion purposes.

Small fyke small net (sekretik): A type of small fyke net with one wing. The tackle is set at a shallow depth near the banks of a river under the shade of trees (e.g. in the Caspian Sea, the Volga and Ural rivers).

Sor: Shallow bay of Lake Baikal.

Stationary gear: Fishing gear that remains in the same place (for example, fixed nets and fyke nets, as well as fyke net varieties –small fyke nets or sekretiki, shrouds, fish traps and fish pots).
Stocking: The regular release of artificially reared organisms to complement natural stocks.
Total Allowable Catch (TAC): The scientifically grounded value of the annual catch of a specific type of LARs in certain areas that takes into account the characteristics of the species.
Trawl: Strainer fishing gear in the form of a cone-shaped net bag with a rigging system, towed behind a vessel.
Water security: Activities of citizens, legal entities and executive authorities related to the rational and environmentally safe use, restoration and protection of waterbodies.
Zherlitsa: Live bait tackle (strong fishing line, wound on a rack, permanently installed on the shore or on the ice to catch predatory fish such as pike, pike-perch, catfish, burbot, perch). Fishing with zherlitsa is mainly done in winter.

1 The importance of inland fisheries in the Russian Federation

**Yadykina, E.A.,
Yanovskaya, N.V.,
Samoylenko, V.V., and
Seromakha, E.N.**

1.1. INLAND FISHERIES' ROLE IN EMPLOYMENT AND FOOD SECURITY IN THE RUSSIAN FEDERATION

According to FAO (2010), "Inland fisheries is an activity carried out in order to catch fish and other aquatic organisms from inland waters".

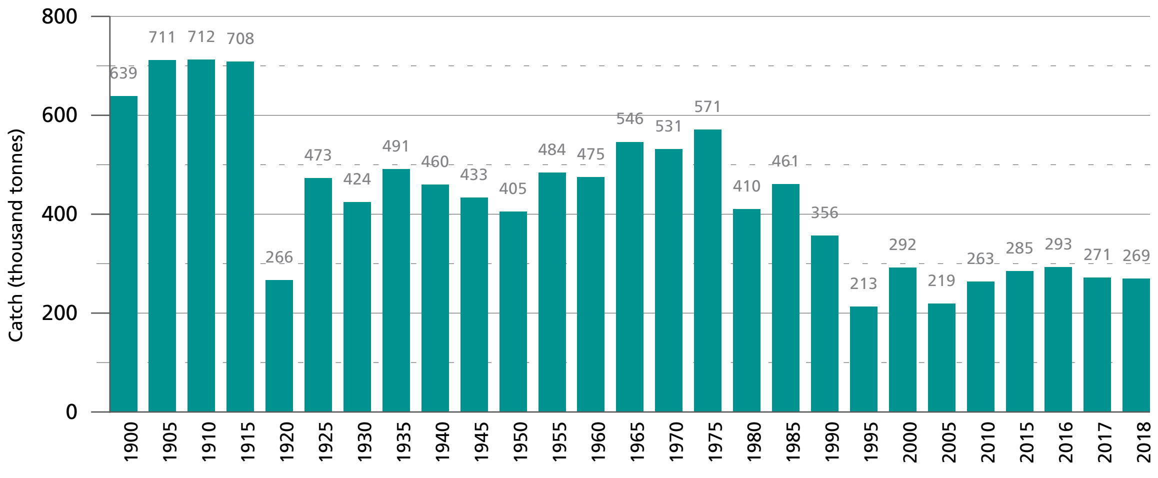
Inland fisheries in Russia[2] have always been an important source of food and employment for the country's population, but over the past 100 years its value in the overall economy has significantly declined. The main reason for the change in the status of fisheries in the inland waters of the Russian Federation, as well as throughout the world, has been multipurpose anthropogenic activities that affect aquatic ecosystems, e.g. the construction of hydraulic structures, land reclamation for agricultural purposes, water intake, pollution from industrial and domestic sewage and waste.

The inland waters of the Russian Federation include 22.5 million ha of lakes, 4.3 million ha of reservoirs, 960 000 ha of reservoirs for complex use and 523 000 km of rivers and other water areas of the Caspian Sea according to the Convention on the legal status of the Caspian Sea (FCRF, 2019).

The catch of living aquatic resources (LARs) is carried out in inland waters of 42 entities of the Russian Federation; no commercial fishing is carried out in the inland waters of 16 entities (19 percent). The main inland waters where industrial fishing was carried out in 2018 are in the West Siberian and Volga–Caspian Fishery basins with production volumes of 68 500 tonnes and 101 900 tonnes, respectively (Ber and Danilevsky, 1860–1875; USSR Ministry of Fisheries, 1980).

The fish catch dynamics for Russian inland waters from 1900 to 2018 are shown in Figure 1.1.

Figure 1.1. Fish catch dynamics in Russian inland waters from 1900 to 2018 ('000 tonnes)



Source: Authors' elaborations.

[2] The term "Russian Federation" denotes the country after the dissolution of the Soviet Union in 1991. While "Russia" is used for periods preceding 1991 as well as any combination of periods, where at least one part falls before 1991.

Inland fisheries in the Russian Federation have a very important role both in terms of employment and food security, both aspects being highly correlated.

The employment of coastal settlement residents in agricultural activities has significantly declined in recent years. Until the beginning of the 1990s, a significant portion was focused on the fishing industry. Men engaged in fishing, while women addressed fish processing. Enterprises had small-tonnage fleets, motor boats and coastal processing infrastructure that was constructed as close as possible to the fishing grounds.

Fishing activities were carried out almost year round. In the Far East, salmon fishing was conducted by teams of local residents. Each team was assigned salmon rivers or sections of rivers. Fishing provided good stable earnings and was considered a much-respected occupation.

The fishery sector, including inland fisheries, no longer creates the number of jobs for the local population it did in the past because it is no longer a requirement to create sustainable work for the local population in order to obtain a fishing concession. Fishing brigades for salmon fishing season are now composed of randomly selected people, some of whom come from far away. Even where new processing plants are constructed there is little impact on employment because most workers are only hired for a few months a year (i.e. during the salmon fishing season that lasts for two to four months). For the rest of the year there are no landings and thus no processing work; this destroys traditional lifestyles in fishing villages. In the interfishing season period, many of the men opt for poaching. At the same time, owners of legal enterprises buy and process poached fish. Thus, catch statistics have become greatly distorted. The owners of the largest fishing companies distribute the fish to other parts of the Russian Federation. For example, chum salmon (*Oncorhynchus keta*) from the Far Eastern rivers is transported over long distances to the central regions of the Russian Federation (including the Moscow region) where fish products are produced from frozen raw material at factories (Dvoryankov, 2000).

However, since the second half of the 1990s, domestic market needs have changed dramatically. In particular, the demand for salted products fell as consumers gave preference to chilled and frozen products. But the existing storage and transportation system is equipped for transporting salted products, requiring minus 4 °C to minus 6 °C , while fresh products (in particular from salmon) require a temperature of minus 18 °C when transported over long distances (GOST 7448-2021 (ГОСТ 7448-2021 Рыба соленая. Технические условия (с Поправкой) - Оглавление - docs.cntd.ru)). This inevitably leads to spoilage of the products while in transit.

Consumers in the Russian Federation do not want to buy low-quality products brought from distant regions and that is why most of the fish caught in the Far East no longer reaches the main domestic markets in the central and western parts of the country. In these markets the fish could be replaced by products from inland waters closer to the places of consumption, taking into account the food habits and tastes of regional populations (Makoedov, 2015).

Since antiquity, problems related to providing stable food supply for the population have been and continue to be issues for the government. Currently, different approaches to achieving food security have emerged. Experts in Western Europe and Japan, whose approach is largely shared by scientists of the Russian Federation, consider that it is necessary to maintain a certain level of food independence using state programmes to support domestic producers. Such measures ensure a continuous supply of food even in situations where imports are affected by civil unrest or other crises. In general, the population should be guaranteed sufficient food supply to warrant sustainable economic development and sociopolitical stability.

Currently, food security is affected by factors such as:

- different climatic conditions having an impact on agricultural and fishery sector production;
- irregularity in territories' economic development; and
- differences in consumption structure, owing to, *inter alia*, the national, cultural and historical traditions of the people living in the country and its regions.

National food security is an integral part of the international (global) food security system. At the same time, it is expected that food-secure countries, including the Russian Federation, due to natural and geographical conditions, are stabilizers of the world food market and help to increase the food security in countries with less favourable conditions for agriculture and fisheries production.

According to the Rome Declaration on World Food Security (1996), it is necessary to follow sustainable food production practices, including those conducted by fisheries, in areas with both high and low potential, i.e. maximal use of each region's potential, which ultimately leads to an increase in both national and global food resources.

An important aspect of food security is food independence, i.e. sustainable production in the Russian Federation of domestic food products in volumes not less than the established threshold for the specific needs of the domestic market. But from a social point of view, another aspect is important, i.e. the physical and economic capacity for each citizen of the country to access safe fish products, regardless of his or her income. Food security at any level (federal and regional) is inextricably linked to transport and demographic security that ensures the population's employment in all activities.

An extensive network of freshwater reservoirs in the Russian Federation plays an important role in providing fish products both in peacetime and in emergency situations. Historically, freshwater fishery production has played various roles in providing national food security. In times of crisis, when transportation links broke down and people's lives were disrupted by war, the role of inland fisheries increased, as it often became the only source of high-quality protein and nutrition for people in vast territories cut off from centralized supply. People had to fish by themselves in nearby waterbodies for their own food and survival.

In peacetime, and under modern conditions, inland waters continue to provide valuable fish products both for consumption by the population of the region and for exchange with other regions of the country, thereby contributing to diversity in people's nutrition even in areas with less access to fish due to geographical conditions (Research Institute of Labour, 2019).

Fisheries continue to play an important role in the country's food sector. In the overall nutritional balance of the country's population fish proteins make up about 10 percent of animal proteins (including meat, dairy products and eggs). When only meat and fish are considered, fish constitutes at least 25 percent. The consumption of fish products is largely a result of food traditions that vary between different regions. As a rule, these traditions have their root in whether any waters suitable for fishing are available in the area (GosNIORH, 2002).

Official fisheries statistics rarely take fish caught for own food into account. Moreover, in many coastal settlements, the quantities of such products used by the population significantly exceed the volumes that pass through retail trade. The actual volumes of fish products consumed by the average resident are therefore significantly higher than the reported data.

According to the Food Security Doctrine of the Russian Federation, the share of domestic fish products in the total volume of marketable fish resources should be at least 85 percent (GRF, 2020). Inland fisheries contribute to this indicator. However, from a social point of view the physical and economic capacity of each citizen of the country to buy safe fish products, regardless of the level of income is important. In this regard, an extensive network of freshwaters in the Russian Federation plays an important role in providing fish products to the population.

1.2. HISTORY OF THE DEVELOPMENT OF INLAND FISHERIES (1900 TO 2018)

Historically, fisheries developed much earlier than other types of trade. In Russia, fisheries began to develop most rapidly after the reform of 1861 (St. Petersburg University, 2011). This was facilitated by market creation, fleet development and railway construction. A very important issue was the removal of the excise duty on salt, which was the main preservative for perishable fish in the era before refrigeration emerged.

Even before the revolution in 1917, there had been various attempts to assess the dynamics of fish catches both in separate fishing basins and in the whole country. Unfortunately, due to differences in the calculation methodology and the inaccuracy of the initial information, these estimates were contradictory (Kuznetsov, 1902).

Strictly speaking, in prerevolutionary Russia (1863 to 1917), official state fisheries statistics, designed to reflect the status and development of industrial fishing in the country, did not exist. There is some information available for this period that can give at least the most general idea of the fish amount caught at different times, in different fishing areas, different species composition, different fishing methods and so forth. The available data in Russia that give some picture of fish catches in this context belong to domestic fisheries science, for which provision of statistical information was mandatory, and allow us to understand how fisheries and the fishing industry developed.

The key researchers and representatives of domestic fisheries science were N.Ya. Danilevsky, A.O. Grimm, I.D., Kuznetsova, V.I. Veshnyakova, V.V. Kevdin among others. They obtained information from two sources: (1) accounting records of the main water owners, such as Cossack fishing troops located in the Don, Kuban, Urals and partly in the Volga and other basins, taking into account the rental income for their fishing land or duties; (2) information regarding fish cargo transportation by rail and waterways that became available in later years.

Both the collection and the processing of the sourced information was extremely challenging. For example, catches were sometimes recorded by weight (pounds) but sometimes by value (roubles); catches were either estimated as the weight of the raw materials or the weight of the processed product; in some types of fishing (e.g. sturgeon) the whole fish was weighed, in others (e.g. herring or roach) the fish was cut into chunks. In some cases the catch was assessed for each individual species, in others, species were grouped; for example, 'large ordinary fish' (the commercial name of the group of fish, adopted mainly in the southern fishing regions of Tsarist Russia adjacent to the Caspian, the Aral, the Azov and Black seas. Ordinary fish were divided into large ordinary fish – wels catfish (*Silurus glanis*), common carp (*Cyprinus carpi*o), northern pike (*Esox lucius*), pike-perch (*Sander lucioperca*) and others and small ordinary fish – sichel (*Pelecus cultratus*), *Carassius* spp. etc. Caspian Sea sprat (*Clupeonella cultriventris*), the main species in the Caspian Sea is not considered an ordinary fish.

Special gear types were used to catch certain fish species depending on their size, e.g. small-meshed nets or large-meshed nets.

Another challenge was the direct interest of water owners[3] and fish processors who distorted data accuracy on the size of the catch or its value for their own advantage.

The final complication in establishing reliable estimates of the size of the fishery was the nature of the catch, for example subsistence catches by the population living in the immediate vicinity of waterbodies which was impossible to monitor. In many cases subsistence catches served as the main source of food (e.g. Arkhangelsk Province, Western and Eastern Siberia, the Far Eastern Krai and other regions).

Data on the development of fisheries in the old fishing areas of the country (the Lower Volga, the Caspian Sea) are generally more reliable. As for the Far East and the Murmansk Peninsula, data are more or less reliable only for the last 25 to 30 years before the revolution in 1917.

The total Russian annual fish catch, including inland waters and the Caspian Sea in the second half of the nineteenth century and early twentieth century, is given in Table 1.

Before 1917, Russia was one of the primary countries in the world in terms of total recorded marine and inland fish catches. However, the average catch per person in Russia was 6.6 kg but was higher in some other countries – 11.7 kg (Japan), 15.5 kg (Denmark), 27.6 kg (the United Kingdom of Great Britain and Northern Ireland) and 29.4 kg (Norway [1913]) (Ber and Danilevsky 1860–1875; Grimm, 1893; Mikhailov, 1962).

Russia lagged behind foreign countries in terms of catch growth. From 1896 to 1913 fish catches in Norway rose by 50.5 percent or on average by 3.3 percent per year and Bristish fish catches doubled. From 1898 to 1913 significant success was achieved by Japan where catches of fish and other aquatic animals almost quadrupled.

[3] People who had waterbodies on private property, though partly limited by other owners or the state.

Table 1. Russian total fish catch (inland and marine) in the second half of the nineteenth century and early twentieth century

Fishing waters	Catch ('000 tonnes)		
	1863*	1893**	1913***
Caspian Sea	200	510	678 (-)
Azov and Black seas	70	140	71 (58)
Baltic Sea	x	30	43 (16)
White and Barents seas	20	20	32 (7)
Far East	x	30	100 (57)
Aral Sea and Lake Balkhash	x	5	39 (-)
Inland waters (rivers and lakes)	70	420	88 (88)
Total	360	1 155	1 051 (226)

Note: Catch in 1913: The numbers given are the total catch in seas and freshwaters, (in parentheses only freshwaters – rivers and lakes).

* The numbers given only reflect registered fish catches. Actual catches, especially in inland waters, were much more in 1913, this difference was 30 percent to 35 percent of the total Ber, K. & Danilevsky, N. 1860–1875. Research on the state of fisheries in Russia. I–IX..

** Grimm, O. 1893. Fisheries and capture of sea animals. In Agriculture and forestry in Russia. SPB.

*** USSR Ministry of Fisheries. 1950–1989. Data from the Central Statistical Bureau of the USSR, 1950-1989.

Catches also increased in other European countries such as Denmark, France, Germany, Kingdom of the Netherlands (the), Sweden, as well as in the United States of America. The low volume of fish products in Tsarist Russia was compensated mainly by imports from United Kingdom of Great Britain and Northern Ireland (herring) and Norway (cod [*Gadus morhua*]). From 1902 to 1913, the import of fish products increased from 180 000 tonnes to 370 000 tonnes.

In 1913 Russia imported 480 000 tonnes of fish products, which was more than 45 percent of the domestic catch by weight (USSR Ministry of Fisheries 1950–1989, Murin 1978). At the same time, Russia exported some fish products, mainly of high value, such as sturgeons and their caviar. But both volume and value of imported fish products were much higher than exports.

The rapid development of water transport contributed to the promotion of fish consumption in all areas of the Volga region and the transport time was reduced from two months (by barges) to two weeks (by steamers). The state owned most of the river and lake fishing areas. However, significant lands were owned by Cossack military communities, rural communities, monasteries as well as private individuals. LARs in waterbodies were exploited by purchase, lease, unlicensed fishing and even partial nationalization. At that time, fishing was mainly concentrated in inland waters (see Table 2). In 1913, inland waters accounted for 86 percent of the Russian catch, of which the bulk (75 percent) came from the Caspian Basin, which included the Volga region (VNIRO, 1998; PCA, 1930; USSR Ministry of Fisheries, 1974).

Table 2. Catch ('000 tonnes) in inland waters of Russia, 1900 to 1917 (excluding the Azov and the Black seas, aquaculture and sea mammals)

Years	Total catch in inland waters	Source	
		Caspian Basin	Freshwater (lakes, rivers)
1900	639	305	334
1905	711	405	306
1910	712	444	268
1913	904	678	226
1915	708	616	92
1916	543	467	76
1917	721	604	117

Source: USSR Ministry of Fisheries. Central Research Institute of Information and Technical and Economic Research of Fisheries of the USSR. (CRIITERF) 1905–1989. Statistical information on catching fish, seafood and aquatic mammals in Russia for 1900-1917. Moscow, 1974..

The Tsarist Russian state paid special attention to fisheries and published the results of a fundamental study of fisheries in a nine-volume monograph *Research on the state of fisheries in Russia (1860–1875)*. The Russian Government's policy on inland fisheries was based on this information.

Technical fishing equipment at the end of the nineteenth century until the beginning of the twentieth century was rather unsophisticated; in total there were only about 100 motor vessels for several tens of thousands of fishing boats (VNIRO, 1998). The intensive use of fish resources of inland waters was, as a rule, virtually unregulated.

In the immediate postrevolutionary period (post 1917), inland fisheries largely collapsed. In 1920, inland fish production in Russia decreased to about one-third of the level of 1913 (904 000 tonnes). However, by 1918 at the end of the civil war, the creation of the Main Directorate for Fisheries and Fish Industry (Glavryba), the adoption of legislative acts in the field of fisheries and state investments allowed inland fishing to recover. By 1929, Russia was able to reach 70 percent of the 1915 catch from inland waters and by 1940 inland fish catches had reached 460 000 tonnes (see Table 3).

Table 3. Catch ('000 tonnes) in inland waters of Russia, 1920 to 1940 (except the Azov and the Black seas, aquaculture and sea mammals)

Years	Total catch in inland waters	Sources	
		Caspian Basin	Freshwater (lakes, rivers)
1920	266	182	84
1925	473	419	54
1930	424	337	87
1935	491	307	184
1940	460	267	193

Source: USSR Ministry of Fisheries (CRIITERF). 1971. Statistical and economic reference data on the extraction of fish, whales, aquatic mammals and seafood in 1860-1969. Moscow.

During the Great Patriotic War[4] (1941 to 1945), the fishing industry was set with a task of expanding inland waters and marine fisheries. The fishers of the Caspian Sea not only increased fish catch in the first hardest year of the war, but also began to produce special products for supplying the front (e.g. fish concentrate, canned food and so forth). As in other production sectors in this period, male fishers joining the military were replaced with women, teenagers and elderly people.

Table 4. Catch ('000 tonnes) in inland waters of Russia, 1941–1945 (except the Azov and the Black seas, aquaculture and sea mammals)

Years	Total catch in inland waters	Sources	
		Caspian Basin	Freshwater (lakes, rivers)
1941	457	296	161
1942	436	265	171
1943	518	300	218
1944	470	259	211
1945	433	246	187

Source: USSR Ministry of Fisheries (CRIITERF). 1971. Statistical and economic reference data on the extraction of fish, whales, aquatic mammals and seafood in 1860-1969. Moscow.

During the most difficult period of the war, the inland waters of the European part of the USSR were inaccessible to fishing, due to temporary occupation. Inland fish supplies were provided by the fishers of Siberia, where more than 340 fishing collective farms (*kolkhozes*) and 490 aquaculture farms were organized. A new fishing fleet was created (with more than 192 motor vessels and 222

[4] This refers to Russia's involvement in the Second World War (1941 to 1945).

large non-self-propelled vessels) and 50 new fish factories were built. All this allowed the Siberians to increase the catch of fish in inland waters to 120 000 tonnes in 1943, which amounted to more than a quarter of the catch of all inland waters of Russia see Table 4 (VNIRO 1998; USSR Ministry of Fisheries 1964, 1971; Bakhtiyarov and Fedorova 2018; Murin 1979).

In 1950, inland fisheries[5] still provided over 40 percent of the country's total catch. In the 1950s, the process of creating the material and technical base for exploiting the oceans began. At the same time, there was a gradual increase in the scale of fishing in inland waters, however, not at a similar pace.

In the 1970s, anthropogenic impact on the LARs of inland waters became apparent. At that time, more than 500 000 tonnes of fish had been caught annually in freshwater bodies belonging to the territory of Russia as part of the USSR (see Table 5). According to official statistics, the annual catch in inland waters of Russia from 1990 to 2010 ranged from 200 000 tonnes to 350 000 tonnes, averaging 243 000 tonnes.

Table 5. Catch ('000 tonnes) in inland waters of Russia, 1950 to 1990 (except the Azov and the Black seas, aquaculture and sea mammals)

Years	Total catch in inland waters	Sources	
		Caspian Basin	Freshwater (lakes, rivers, reservoirs)
1950	405	222	183
1955	484	322	162
1960	475	251	224
1965	546	294	252
1970	531	332	199
1975	571	287	284
1980	410	271	139
1985	461	207	255
1990	356	209	147

Source: USSR Ministry of Fisheries (VNIERH). 1991. Fisheries of the USSR for 1900-1990 (statistical and economic reference book), Volume 2. Raw material base of the fishing industry. Moscow, USSR Ministry of Fisheries, All-Russian Research and Design Institute of Economics, Information and Automated Fisheries Management Systems (VNIERH). 284 pp.

Since the mid-1990s, the discrepancy between the Total Allowable Catch (TAC) and the official catch in inland fisheries is explained by the collapse of large fishing enterprises and the transition to small-scale fishing, as well as a collapse of the statistical reporting system. All these factors contributed to the growth of catch not accounted for and to a shift towards species with high market value and demand (i.e. sturgeon, whitefish [*Coregonus* spp.], salmon and pike-perch) (Sergeev, 2004; USSR Ministry of Fisheries, 1981; Brazhnik, 2011).

1.3. CULTURAL ASPECTS OF FISHERIES AMONG MINORITY INDIGENOUS GROUPS

The cultural aspects of inland fisheries in the Russian Federation are quite diverse for different territories, and have been undergoing transformation, driven by the sociolegal changes that have taken place in the Russian Federation since the beginning of the 1990s.

In the North, Siberia and the Far East of the Russian Federation, the livelihoods and economic activities of some of the population remain similar to those practised several hundred years ago. In these areas, the basis of human existence, since ancient times, has been reindeer husbandry, hunting, fishing, gathering wild plants and making traditional hunting and fishing tools, clothes and so forth. Various environmental management techniques have evolved according to local conditions and natural resources.

There are different opinions concerning the role of fishing in the life of various Indigenous Peoples and how much historical traditions apply in a modern context.

[5] At that time fish coming from aquaculture was not separated from total fish production, however aquaculture production was low.

In the early years of the USSR, some progressive measures were introduced to develop economies in the North such as assigning fishing grounds to newly created domestic cooperatives and supplying fishing equipment. However, as leaders of small ethnic groups have often noted, the indigenous inhabitants did not have the political or economic means and status to sustain and develop these cooperatives.

Discussions on this issue intensified following the transition to a market economy when fishing had to become an economically viable enterprise. Currently, there is growing competition between indigenous and non-indigenous groups for control and access to fisheries resources, particularly in the case of the most profitable fisheries.

Although there are differences among indigenous groups, fishing has been of almost universal importance in meeting the nutritional needs of the peoples in the northern region. This led to the formation and development of various fishery production enterprises (Smetanin, 2006; Gololobov and Mostovenko, 2016; Klokov, Krasovskaya and Yamskov, 2002; Spodina, 2014; Okhotina, 2008).

Fisheries developed along the seaboard, near fish-rich lakes and rivers in which Pacific salmon spawned. Such enterprises were characteristic of the Nanai, Ulchi, Itelmens, Okhotsk Evens and Eastern Koryak Indigenous Peoples whose main activity was fishing.

The Indigenous Peoples of the North, especially the Ulchi and Nanai, widely used fish skin on a daily basis. Today, samples of such products can be seen in local history museums in the Far East. In addition to making clothes, shoes and various household items, fish skin was used instead of window glass, on the sails of boats, to cover hunting huts and as thread for sewing.

Owing to Russian resettlement programmes in the Far East during the eighteenth and nineteenth centuries and northward penetration of the Manchus and Chinese, traditional and relatively sustainable systems of using natural resources began to collapse and populations of the most valuable animal and fish species started to decline.

According to the 2010 Population Census of the Russian Federation there were 316 011 Indigenous Peoples. Their share in the total population was small at 0.22 percent. The largest group was the Nenets (44 640 people) and the smallest was the Kereks (four people).

Indigenous Peoples differed in the ratio of urban and rural populations. In 2010, most of the Indigenous Peoples lived in rural areas, with the exception of the Vepsians, Vods, Mansi, Ulta (Orok people) and Shors. All Kereks were city dwellers.

Since 2002, there has been a decrease in the mortality rate of Indigenous Peoples, including infant mortality (Averin, 2015). Indigenous Peoples speak Russian as well as their native languages and some of their representatives speak other languages.

The share of economically active and employed Indigenous Peoples aged 15 to 72 in private households varies from 38.9 percent to 76.1 percent. Indigenous Peoples have various sources of livelihood. Income dependency has the largest share per 1 000 people for Telengits (517), Tozhu Tuvans (513), Mansi (453), Soyots (448), Khanty (448), Nenets (444), Evenks (431), Chukchi (428), Evens (428), Yukaghirs (422), Nivkhs (412), Koryaks (404), Tubalars (400), Dolgans (395), Kets (385), Nanai (378), Udege (372), Selkups (364) and Ulch (352). Pensions prevail among the Vepsians (554). Dolgans have a significant share of the population living on benefits (386). Private subsidiary farming as a source of livelihood is not significant among Indigenous Peoples, although its share is higher than state social security, scholarships and savings (Averin, 2015).

2 Characteristics and ecology of inland waters in the Russian Federation

Yanovskaya, N.V.

2.1. PHYSICAL AND GEOGRAPHICAL DESCRIPTION OF FRESHWATER BODIES AND INLAND SEAS

Water resources are one of the fundamental and dynamic elements of the Russian Federation's national wealth. The water–economic complex formed on their basis largely determines the socio-economic sustainability, scale and direction of the country's development.

Water and environmental security are the most important components of national state security. In the near and distant future, preservation of these resources will depend on the uninterrupted supply of water to economic sectors and the condition of water resources. Such state security will be largely determined by supplying the population with potable water, reliable forecasting of floods or droughts, their timely prevention and/or mitigation of damage and the effectiveness of state support for water management and protection. Transparent information dissemination is equally important in these contexts.

The Russian Federation occupies 16.6 percent of global land territory and has a coastline of 60 000 km in 12 seas belonging to the Arctic, Pacific and Atlantic oceans, as well as the Caspian Sea. The country is characterized by abundant natural waterbodies, including a well-developed river network and lakes' system (NIA–Priroda, 2019).

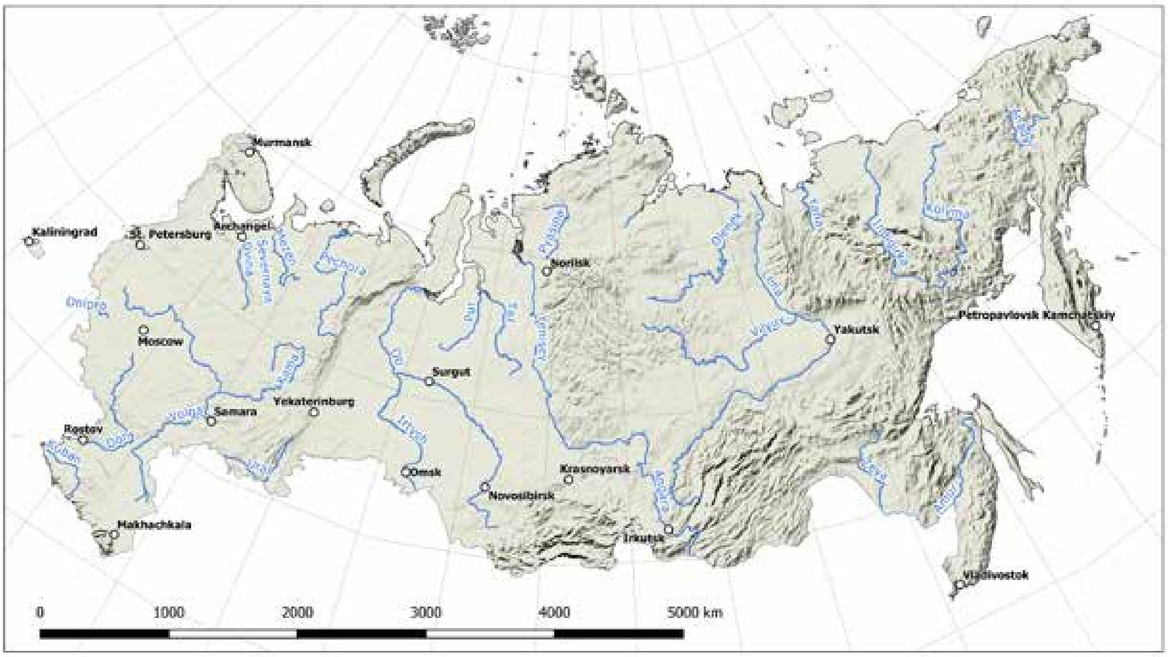
2.1.1. Descriptions of the major regions with inland fisheries

The fishing regions of the Russian Federation in this review are divided into eight economic fishery regions (basins) for administrative purposes, including the Caspian Sea and other inland waterbodies (Figure 2.1).

1. Northern fishery basin;
2. Far Eastern fishery basin;
3. Western fishery basin;
4. Volga–Caspian fishery basin;
5. Azov–Black Sea fishery basin;
6. West Siberian fishery basin;
7. East Siberian fishery basin;
8. Baikal fishery basin.

The largest rivers, lakes and reservoirs are illustrated in Figures 2.2 and 2.3 and outlined in Table 6.

Figure 2.1. The largest rivers in the Russian Federation

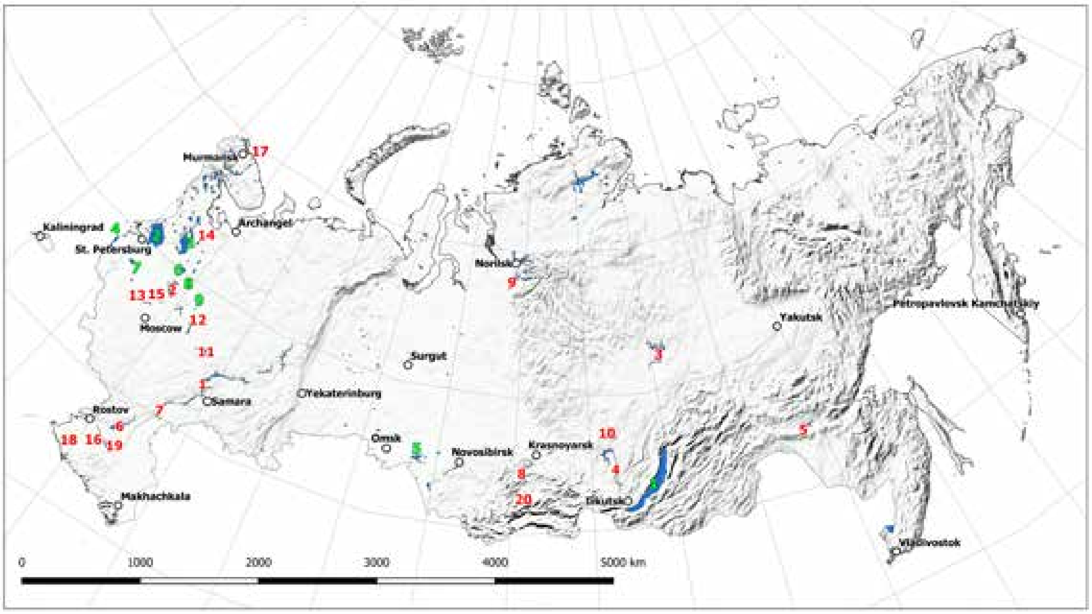


Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

Figure 2.2. The eight fishery basins in inland waters of the Russian Federation

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

Figure 2.3. The largest lakes (green numbers) and reservoirs (red numbers) in the Russian Federation.



Lakes: 1: Baikal, 2: Ladoga, 3: Onega, 4: Peipus, 5: Chany, 6: Beloye/White, 7: Il'Men', 8: Kubenskoye, 9: Galich
Reservoirs: 1: Kuibyshev, 2: Rybinsk, 3: Vilyuy, 4: Bratsk, 5: Zeya, 6: Tsimlyansk, 7: Volgograd, 8: Krasnoyarsk, 9: Khantayskoye, 10: Ust-Ilim, 11: Cheboksary, 12: Gorky, 13: Ivankovo, 14: Vodlozersky, 15: Uglich, 16: Veselovsky, 17: Verkhneteriberskoye, 18: Krasnodar, 19: Proletarskoe, 20: Sayano-Shushenskoye

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

Table 6. The major inland fishery statistical regions of the Russian Federation and their associated river basins and major surface waterbodies

Basin/region	Major rivers	Natural lakes	Reservoirs	Other waterbodies/ wetlands	Catch 2018, tonnes
Northern fishery basin	North Divina, Pechora, Mezen, Tuloma, Paz	Onega, lakes of the Arkhangelsk region	Verkhneteriberskoye and others		5 295
Far Eastern fishery basin	Anadyr, Amur, Kolyma, Zeya		Zeya		52 297
Western fishery basin	Neva	Ladoga, Ilmen, Pskovo-Chudskoye (Peipus), Lake White, Galich, Kubenskoe	Vodlozersky		16 269
Volga–Caspian fishery basin	Volga (northern), Volga (southern), Kama, Sulak, Dnieper, Terek, Ural		Uglich (Uglichskoe), Ivankovo (Ivan'kovskoe), Cheboksary (Cheboksarskoe), Rybinsk (Rybinskoe), Volgograd, Saratov, Gorky (Gorkovskoe), Kuibyshev (Kuibyshevskoe)		101 887
Azov–Black Sea fishery basin	Don River, Kuban, Protoka, Manych cascade		Tsimlyansk, Veselovsky, Krasnodar (Krasnodarskoe), Proletarskoe, Veselovskoe, Us't-Manychskoe		13 157
West Siberian fishery basin	Ob–Irtysh, Yenisei, Khatanga, Pur, Taz, Pyasina, Khantayka	Chany	Krasnoyarsk (Krasnoyarskoe), Sayano-Shushenskoe Mainskoe, Ust'-Khantayskoe		68 466
East Siberian fishery basin	Lena, Vilyui, Yana, Indigirka, Olenyok		Vilyui		6 678
Baikal fishery basin	Angara, Selenga	Baikal	Bratsk, Ust–Ilim		4 945
Total	**115 585**	**35 597**	**33 574**	**50 347**	**269 084**

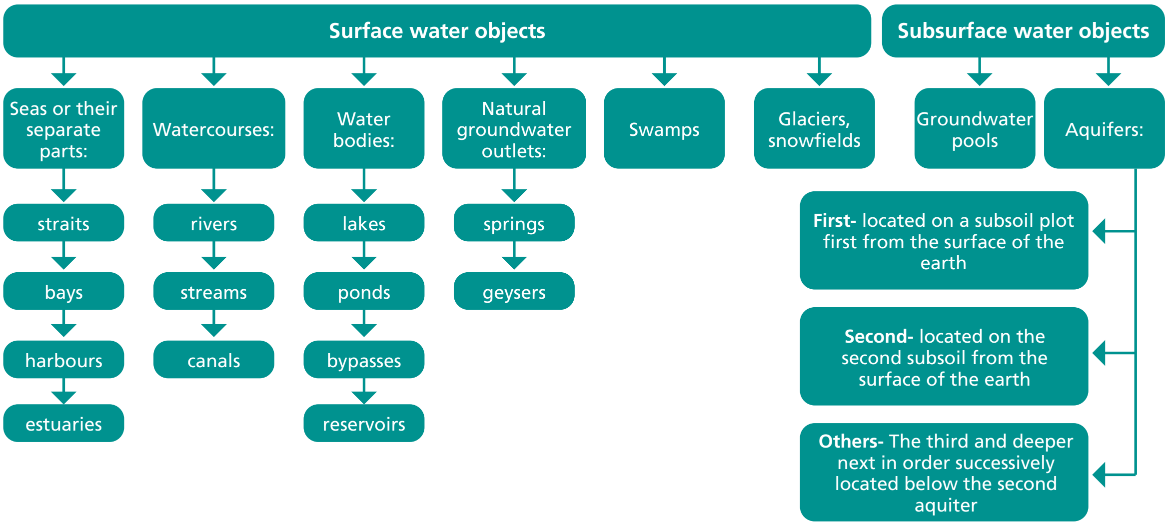
Source: Ministry of Agriculture (MoA). 2013. On approval of the list of types of aquatic living resources, for which the total allowable catch is established. Order of the Ministry of Agriculture of the Russian Federation of 1 October 1, 2013, No. 365.

2.1.2. Legal definition of waterbodies

According to paragraph 6 of Article 1 of the Water Code of the Russian Federation, ‘water resources’ mean all of the waterbodies within the territory of the Russian Federation.

Waterbodies (‘objects’) according to the Water Code of the Russian Federation are divided into several types depending on physical–geographic, hydroregime and other characteristics (Articles 5 to 19 of the Water Code of the Russian Federation) (Figure 2.4).

Figure 2.4. Classification of the water resources of the Russian Federation



Source: Government of the Russian Federation. 2006. Water codex of the Russian Federation. Dated 6 June 2006 N 74-ФЗ. As amended on 8 February 2019) (as amended and supplemented, entered into force on 1 January 2020) (online). Available at http://www.consultant.ru/document/cons_doc_LAW_60683/

2.2. SURFACE WATERS

In the Russian Federation, there are over 2.5 million rivers, more than 2.7 million lakes, hundreds of thousands of swamps and other water resources (see Table 7).

Table 7. Water resources by the federal districts of the Russian Federation

Federal district	River network ('000 km)	Lakes and artificial waterbodies ('000 ha)	Swamps and wetlands ('000 ha)	Groundwater stocks ('000 m^3/day)
Northwestern	1 000	84	25 682	4 939
Central	200	900	1 238	27 851
Volga	400	2 000	899	17 226
Southern	91	1 144	518	8 735
North Caucasian	47	120	55	7 342
Ural	5	7 000	40 194	5 696
Northern	2 000	12 000	41 821	13 708
Far Eastern	4 000	11 200	42 375	5 926

Source: National Information Agency “Natural Resources” (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

2.2.1. Rivers

A peculiarity of most rivers in the Russian Federation is that they generally have meridional flow discharging into the Arctic (64 percent) and Pacific (27 percent) oceans (Table 8). In the Azov–Black Sea (1 percent) and Caspian (7 percent) basins, where approximately 67 percent of the Russian Federation's population lives, there are totally 193 942 rivers (170 188 rivers in the Caspian basin). The Baltic Sea Basin accounts for less than 2 percent of the total number of rivers in the Russian Federation.

Eight of the 50 largest river basins in the world are located wholly or partly in the Russian Federation. The Russian Federation's state water register records 142 300 rivers of which 139 251 are small rivers less than 100 km long; 2 835 are medium-sized rivers with lengths ranging between 101 km and 500 km; and 214 are large rivers over 500 km long.

The vast majority of watercourses flowing through the Russian Federation are less than 10 km long and these are estimated to number about 2.1 million units (which is 95% of the rivers less than 100 km long). Small rivers and streams are the main element of the channel network of catchment areas. Up to 44 percent of the population of the Russian Federation and almost 90 percent of the rural population live in their basins.

Table 8. The number and length of the rivers of the Russian Federation (excl. Azov and Black Sea basins) by the sea and ocean drainage

Sea and ocean drainage	Number of rivers	Length of rivers, km
The Arctic Ocean	1 629 121	5 715 476
The White Sea	109 534	373 898
The Barents Sea	61 348	240 103
The Kara Sea	475 187	2 278 219
The Laptev Sea	421 786	16 411 381
The East Siberian Sea	483 672	997 980
The Chukchi Sea	41 830	84 215
Arctic Ocean islands	35 764	99 680
The Pacific Ocean	685 841	1 729 435
The Bering Sea	172 140	400 939
The Sea of Okhotsk	437 541	1 151 781
The Sea of Japan	55 024	110 009
The Pacific islands	21 136	66 706
Caspian Sea	170 188	675 536
The Baltic Sea	53 585	140 171
Others	1 657	5 996

Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

Water quality of major rivers

The discharge of untreated or insufficiently treated wastewater is the main reason for environmental disasters caused by the periodic accumulation in a single environment of a large amount of pollutants. In terms of discharges of pollutants, in their quantity and component composition in each hydrographic region, different types of industry prevail, for example, those concerned with metal-mining, metallurgical, metal-working, pulp and paper, chemical, chemical–biological, pharmaceutical, defence, energy generation, housing and communal services as well as drainage of agricultural enterprises and so forth.

The present level of wastewater treatment is insufficient and the entry into the waterbodies of wastewater from most types of industrial and communal services is one of the reasons for their pollution by mineral, biogenic and organic substances, many of which are toxic, as well as eutrophication of individual waterbodies, primarily reservoirs. Runoff from agricultural lands, pastureland and livestock farms results in pollution via nutrients, organic substances and pesticides.

2.2.2. Lakes

Water resources of lakes

Water in lakes is classified as a static reserve due to slower water exchange, although a small proportion of the reserves is renewed annually. In the Russian Federation, according to rough estimates, there are more than 2.7 million lakes with a total water surface area of almost 409 000 km^2 (Table 9).

Ninety-eight percent of the lakes are small (less than 1 km^2) and shallow (1.0 m to 1.5 m deep); 19 lakes (of which seven are in the European part of the Russian Federation) have a mirror area exceeding 1 000 km^2.

Table 9. Lake distribution by geographical area of the Russian Federation

Area	Number	Surface area (km²)
European territory		
Kola Peninsula	107 146	8 195
Karelia and the northwest	82 503	50 107
North	232 419	13 756
Central region	35 836	17 329
Middle and Southern Urals	6 778	4 182
Southern region	26 459	20 947
Caspian lowlands	11 305	3 864
Asian territory		
West Siberian lowland	788 042	87 754
Altai and Kuznetsk basins	17 151	8 743
Western and Eastern Sayan	14 307	7 227
Transbaikalia	47 135	35 647
Central Siberia	319 872	28 108
North Siberian lowlands	318 849	38 487
Northeastern Siberia	595 118	67 863
Far East	63 088	9 758
Kamchatka	40 857	2 772
Ocean islands	41 132	3 517
Total	**2 747 997**	**408 256**

Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

Specially protected lakes

Lakes Baikal and Teletskoe as well as the water basin of Lake Ubsu-Nur are included in the UNESCO World Heritage List.

Lake Baikal is the deepest lake in the world with a maximum depth of 1 642 m. With a total volume of 23 000 km^3, it contains about 90 percent of the Russian Federation's surface water reserves. The total annual flow of the largest rivers in the Russian Federation is about 10 percent of the volume of the lake. The water has unusual purity – water transparency reaching a depth of 40 m. The lake is 636 km long, with the largest and smallest widths being 79.5 km and 25 km, respectively. The coastline is more than 2 000 km long and the surface area 31 500 km^2. The catchment area is about 571 000 km^2. More than 300 rivers and streams flow into the lake. Over half of the inflowing water comes from the Selenga River. Only one river, the Angara, flows from the lake.

Species diversity has no equal among the ancient and great lakes of the world, 2 630 species and subspecies of animals and plants are found in the lake, of which more than 2 000 are endemic; more than 20 new species of invertebrate animals are discovered and described annually.

Preserving Lake Baikal's unique landscape, fauna and flora is the main environmental task for the sustainable development of the Baikal region.

Lake Teletskoe is also known as Altyn-Kolyem (the Golden Lake) and is the pearl of Gorny Altai. In 1998, Lake Teletskoe along with the Altai and Katunsky state nature reserves, Belukha Mountain and the Ukok National Park became UNESCO's Altai Golden Mountains World Heritage Site. Although the surface area of 223 km^2 is relatively small, Lake Teletskoye, with a maximum depth of 325 m, is the deepest reservoir in the Russian Federation and the second deepest waterbody in the country. The reservoir holds up to 40 km^3 of clean freshwater with transparency of up to 12 -15 m. Seventy-one permanent rivers (of which the Chulyshman River has the highest discharge) and 150 temporary streams flow into it, and only one river, the Biya, flows out. Lake Teletskoye and the headwaters of the Biya River are inhabited by two rare species of whitefish – Teletskoye whitefish (*Coregonus lavaretus pidschian* n. *smitti*) and Pravdin's whitefish (*Coregonus pravdinellus*).

2.2.3. Reservoirs

Water resources of reservoirs

There are 2 650 reservoirs in the Russian Federation with a capacity of over 1 million m^3 in operation and their total usable volume is 342 km^3; more than 90 percent of that volume is stored in the reservoirs with capacity of over 10 million m^3. The total reservoir coastline is 75 400 km. About 230 reservoirs are used in a complex (for more than one purpose); 30 for energy needs; 1 760 for agriculture; 297 for water supply; and 586 for other needs (including fisheries and aquaculture). By surface area Kuybyshevskoe (6 150 km^2), Bratskoe (5 500 km^2), Rybinskoe (4 500 km^2), Volgogradskoe (3 100 km^2) and Krasnoyarskoe (2 000 km^2) reservoirs are among the top ten largest in the world (Table 10).

The rivers of the European territory, where water consumers and water users experience a shortage of water resources in certain periods and years, are characterized by a high degree of regulated flow. For example, for the Volga, the Don and the Ural respectively 40 percent, 50 percent and 68 percent of the water is stored during the flood and released later in the year according to the demand.

The regulation of the flow of northern rivers is carried out mainly for the purposes of energy generation, water transport and timber rafting. In the northwest region, the main water sources are rivers and lakes of the Neva River Basin; 32 reservoirs with a total usable volume of 1.1 km^3 are used to regulate the flow, which is used for energy, industrial and municipal water supply, water transport, irrigation, fisheries and recreation.

Table 10. Characteristics of the main reservoirs in the Russian Federation

Reservoir	Characteristics
Cheboksarskoe	294 km long and important in the contexts of water management, fishery and social significance.
Kuibyshevskoe	The largest reservoir of the Volga–Kama cascade; it is the main regulator of runoff from the Volga River. Its main role is to ensure a special spring release regime in the lower Volga annually to feed agriculture and fisheries of the Volgograd and Astrakhan regions.
Ivan'kovskoe, Uglichskoe, Rybinskoe and Gorkovskoe	These form a continuous cascade on the Upper Volga (the fifth is the Upper Volga Reservoir located in the upper river isolated from the cascade). These reservoirs along with the Oka River form 45 percent of the annual flow of the Volga.
Volgogradskoe	540 km long and the closing gate of the Volga–Kama cascade through which a special spring release to the Lower Volga is carried out.

Reservoir	Characteristics
Krasnodarskoe	Has the primary purposes of irrigating more than 200 000 ha of agricultural land, protecting about 600 000 ha of farmland in the lower reaches of the Kuban River against flooding, and providing fish spawning sites and transport passage to the estuaries of the Kuban and Protoka Rivers.
Sayano-Shushenskoe Mainskoe, Krasnoyarskoe	The reservoirs of the Angara–Yenisei cascade complex located on the Yenisei River are used for energy generation, shipping, irrigation and water supply purposes.
Ust'-Khantayskoe	On the Khantayka River and part of the aforementioned complex of reservoirs.
The Manych cascade	Including the Proletarskoe (useful capacity 0.08 km^3), Veselovskoe (1.06 km^3) and Us't-Manychskoe (0.07 km^3) reservoirs; used for shipping, energy generation, fishing and irrigation.
Stavropol region	The region has about 100 reservoirs, mainly for irrigation; the largest are also used for water supply, fish farming and energy generation.

Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

2.2.4. The Caspian Sea

The Caspian Sea is an inland waterbody that has no connection with any of the world's oceans (Figure 2.5). This formally allows it to be considered an inland waterbody or great lake even though its waters are brackish in some parts.

Salinity is one of the most important factors affecting the biological productivity of the Caspian Sea. In the northern part, the salinity level increases from 0.1 percent to 0.2 percent near the estuaries of the Volga and the Ural rivers, and up to 10 - 12 percent in zones bordering the Middle Caspian.

In terms of the volume, the Caspian Sea is the largest enclosed body of water in the world. Its total area is 378 400 km^2, equivalent to 18 percent of the total area of all lakes in the world. The total coastline of the Caspian Sea is about 7 000 km. The coastline that lies within the Russian Federation stretches for 695 km.

The fishery of the Caspian Sea is one of the most important for the Russian Federation. The unique physical and geographical characteristics of the sea are closely associated with the high diversity of autochthonous (513 species) and endemic fish species. Some species live only in the Caspian Sea (Caspian Sea sprats, sturgeons, among others). The development of fishing facilities by the Russian Federation in the Caspian Sea is associated with the coast of Dagestan and the open sea in the northern and middle parts of the Caspian Sea (Mirzoyan *et al.*, 2018).

One hundred and thirty rivers flow into the Caspian Sea, almost all of them located in the north and west (the eastern coast does not have a single river reaching the sea). The largest river in the Caspian Basin is the Volga River, which provides 78 percent of the river water entering the sea; other rivers flowing into the Caspian Sea include the Kura, Ural, Terek and others.

The northern part of the sea is shallow, with maximum depths of 15 m to 20 m on the rim of the central part of the sea.

The shores of the northern section are heavily indented with many coves and bays. There are many islands and channels in the deltas of the Volga and Ural rivers.

Figure 2.5. The coastlines of Caspian Sea countries

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

Seawater quality in the Caspian Sea

In 2018, the salinity of the waters of the North Caspian at secular Sections[6] III and IIIa varied between 5.52 ‰ and 18.15 ‰ and 1.89 ‰ and 8.18 ‰, averaging 13.05 ‰ and 4.42 ‰, respectively. A significant difference in the average salinity is due to the influence of runoff from the Volga River. Water transparency ranged from 1.5 m to 6.0 m.

Pollution in the Caspian has resulted in an oil film covering the water surface, which disrupts gas exchange processes and may cause the death of fish and other aquatic organisms. The main sources of pollution include oil products, discharge of industrial and domestic wastewater transported with river flows into the Caspian Sea, shipping, exploration and exploitation of oil and gas fields, including on the Dagestan site of the Shelf of the Russian Federation.

The level of water pollution with petroleum hydrocarbons (PH) in both sections was about 1.3 MAC with a maximum value of 2.0 MAC in Section IIIa, which was significantly lower than the indicators of 2017. Concentrations of phenols and synthetic surfactants (SS) remained at the levels of 2013 - 2017 and averaged 1.6 - 4 MAC and 0.28 MAC, respectively.

The content of the most toxic metals – mercury and cadmium – remained significantly below the permissible limit. The interannual changes in the average water content in shallow water of cobalt, nickel, zinc, lead and copper in absolute value varied by 2 or more percent. In 2018, in Section IIIa, an excess of the established standards for the concentration of metals was recorded. The maximum values of mercury, manganese, lead, cadmium, cobalt and zinc were 0.1, 0.8, 0.08, 0.14, 0.8 and 0.9 MAC, respectively.

The long-term dynamics of the content of the abovementioned metals in water of Section IIIa generally coincided with the section located to the east. No noticeable temporary trends in the metal content in waters of the Northern Caspian have been observed in the last six years. The exception was zinc, concentration of which in the second half of 2018 was 4 - 5 folds higher. Significant differences in the metal content between the sections were not observed, except for cobalt.

In 2018, the oxygen regime remained within the established standard. For 2016 to 2018 the average annual concentration of oxygen in waters in Sections III and IV increased by 10 - 15 percent.

In 2018, the waters of the Dagestani seaboard were characterized as 'moderately polluted' (littorals of the Sulak, Makhachkala, Izberbash Rivers) and 'polluted' with the highest pollution levels at the villages of Lopatin and Kaspiysk. The oxygen regime was within normal limits. Over the past three years, the average annual concentration of oxygen dissolved in water has increased generally.

2.2.5. Wetlands

General characteristics

Freshwater wetlands play an important role in the formation of hydrological regimes of rivers. They regulate floods and high waters and contribute to the natural self-purification of river waters from many atmospheric and anthropogenic pollutants.

According to the Federal Service for State Registration, Cadastre and Cartography (Rosreestr), freshwater wetlands in the Russian Federation account for about 153 million ha (NIA-Priroda 2019). Most of the freshwater wetlands are in the category of forest land (101.9 million ha); there are also many freshwater wetlands in the categories of agricultural land (25.6 million ha) and stock land (13.8 million ha). Freshwater wetlands are unevenly distributed over the territory and are characterized by significant fluctuations. As a result of climatic, geomorphological and other natural factors, most freshwater wetlands are concentrated in the northwestern regions of the European zone and in the central regions of the West Siberian Plain. To the south of this zone, the formation of freshwater wetlands weakens and almost stops.

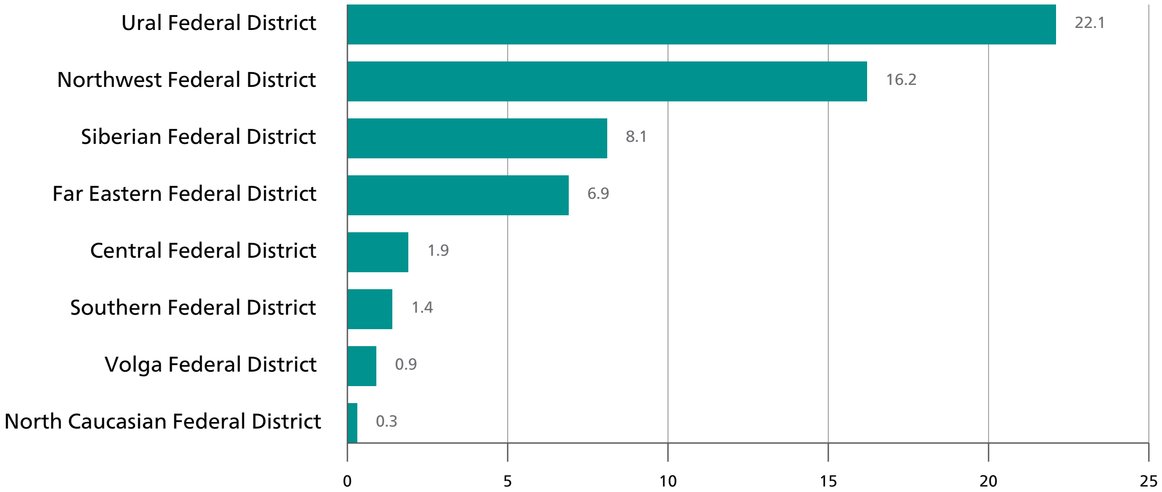
The area of freshwater wetlands ranges from several hectares to many square kilometres. According to the species composition of plants and the conditions of water and mineral nutrition,

[6] The "centenary" network of reference points for measuring water level was established in 1960, and included offshore coastal and estuarine water level stations, hydraulic gates at river reservoirs and other points.

bottom, transitional and upland freshwater wetlands are distinguished. It is estimated that about 3 000 km^3 of static natural water reserves are concentrated in freshwater wetlands.

In the context of federal districts, the Ural Federal District clearly dominates in terms of the share of freshwater wetlands in the total area of the district (Figure 2.6). It accounts for 22.1 percent of the freshwater wetlands. The share in the Southern Federal District (1.4 percent) significantly exceeds the share of the Volga Region (0.9 percent).

Figure 2.6. The share of freshwater wetlands in the total area of federal districts (percent)



Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

2.3. MONITORING OF WATERBODIES

State monitoring of waterbodies comprises observation, assessment and forecast of changes in the state of waterbodies that are either under federal ownership or the property of constituent entities of the Russian Federation, municipalities, individuals or legal entities.

In accordance with the 'Regulation on the Implementation of State Monitoring of Water Bodies', the organization and implementation of state monitoring of waterbodies is carried out by the government agencies listed in Table 11.

Table 11. Federal agencies with monitoring responsibilities for waterbodies

Federal agency	English name	Function relevant to waterbodies
Rosvodresursy	Federal Agency of Water Resources	The federal executive bodies listed in the table provide for the collection, processing, storage and submission of data in the established manner to Rosvodresursy; the information is necessary for conducting state monitoring of waterbodies.
Rosnedra	Federal Agency for for Mineral Resources	Rosnedra monitors groundwater and exogenous geological processes.
Roshydromet	Federal Service for Hydrometeorology and Environmental Monitoring	Roshydromet in cooperation with Rostekhnadzor monitors the safety of hydraulic structures (GTS).
Rostekhnadzor	Federal Environmental, Industrial and Nuclear Supervision Service	
Rostransnadzor	The Federal Authority for Transport Oversight	Rostransnadzor monitors the safety of shipping hydraulic structures.
Rospotrebnadzor	Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing	Rospotrebnadzor conducts social and hygienic monitoring in terms of assessing the quality of water from drinking and domestic water supply sources; it also assesses the status of waterbodies containing natural healing water resources used for spa therapy.
Rosrybolovstvo	Federal Agency for Fisheries	Rosrybolovstvo monitors waterbodies for fishery purposes.

Source: GRF. 2007. On approval of the Regulations on the implementation of state monitoring of water bodies. Decree of the Government of the Russian Federation, No. 219 of 10 April 2007.

2.3.1. Hydrobiological assessments of freshwater bodies

The state of freshwater ecosystems is monitored according to the main hydrobiological indicators: phytoplankton, zooplankton, periphyton and zoobenthos (Table 12).

In 2018, an assessment of the status of freshwater ecosystems by hydrobiological indicators was carried out on 121 waterbodies at 175 hydrobiological points and 274 gauges. The condition of surface waters by hydrobiological indicators was assessed in 18 constituent entities of the Russian Federation, including ten regions (Amur, Astrakhan, Irkutsk, Leningrad, Pskov, Murmansk, Nizhny Novgorod, Rostov, Samara and Jewish Autonomous Oblast), in the republics of Buryatia, Karelia, Tatarstan, Sakha (Yakutia), in the Zabaykalsky, Krasnoyarsk and Khabarovsk Territories (Krais), as well as in Saint-Petersburgh.

The main waterbodies for observation were: cascades of reservoirs on the rivers Volga, Lena, Yenisei, Angara, Amur, Don and Selenga; waterbodies of the cities of Saint-Petersburgh, Kazan, Astrakhan, Tolyatti, Murmansk, Krasnoyarsk, Chita, Samara, Nizhny Novgorod and Petrozavodsk, as well as transboundary waterbodies – Pskovskoye and Chudskoye lakes, Paz and Amur rivers.

Table 12. Status of freshwater pollution in different hydrographic regions

Hydrographic area	Pollution status based on measurements	Pollution status
The Barents *(Northern fishery basin)*	Water quality	2007–2018: Water quality in most waterbodies in the region remained unchanged and varied from 'conditionally clean' to 'slightly polluted' with interannual fluctuations within the quality class.
	Phyto- and zooplankton indicators	2018: According to phyto- and zooplankton indicators, the waters of the Imandra and the Chunozero lakes, the Patso–Yoki, Lotta and Akkim rivers were still 'slightly polluted', and according to macrozoobenthos indicators, 'dirty'.
The Baltic *(Western fishery basin)*	Zoobenthos indices	2018: The most polluted waterbody of the region is Petrozavodsk Bay of Lake Onega, the water of the bottom layer of which in 2018 was 'polluted' (in 2017, 'dirty'). However, this does not reflect the actual state of the ecosystems of this reservoir because Lake Onega belongs to the xenotrophic group of waterbodies in which there is virtually no sedimentary organic matter, which does not allow the full development of macrozoobenthos fauna.
	Phyto- and zooplankton	2015–2018: The quality of waters of the Chudskoe, Pskovskoe and Onega lakes remained unchanged. The waters of the Onega, Chudskoe and Pskovskoe lakes were still referred to as 'slightly polluted'.
The Caspian *(Volgo–Caspian fishery basin)*	Phytoplankton	2016–2018: Observations were carried out on the cascade of the Volga River reservoirs and its large tributaries. The waters of the Gorkovskoe and Cheboksarskoe reservoirs in 2016 to 2018 were 'slightly contaminated'.
Kara *(West Siberian fishery basin)*	Zooplankton, zoobenthos and periphyton	2015–2018: The water conditions of the Yenisei River (near the city of Krasnoyarsk) and the Berezovka River were 'slightly polluted'.
East Siberia *(East Siberian fishery basin)*	Zoobenthos	2016–2018: Neelova Bay was still the most polluted waterbody in the region. The quality of its waters was 'polluted'. 2018: The positive dynamics of water quality in the lower reaches of the Lena River remained at the Khabarov station and Kyusyur village; according to the zoobenthos state, the water was rated as 'conditionally clean'.
	Phytoplankton	2016–2018: Neelova Bay remained unchanged and 'slightly polluted'.
The Pacific *(Far Eastern fishery basin)*	Zooplankton	2018: The water quality of the Amur River from the city of Blagoveshchensk to the city of Nikolaevsk-on-Amur had not changed. The water was estimated as 'slightly polluted' in sections located downstream of cities and 'conditionally clean' upstream of these cities.

Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

2.3.2. Waterbodies that have high and extremely high pollution levels

In 2018, extremely high pollution levels (EHP)[7] of surface freshwater in the Russian Federation were observed in 631 cases in 133 waterbodies and in 2017 in 624 cases in 128 waterbodies. In 2018, High Pollution levels (HP)[8] were observed in 2 112 cases in 312 waterbodies; in 2017 HP was observed in 330 waterbodies in 2 121[9] cases.

In 2018, 2 743 cases of EHP and HP were recorded for 35 major pollutants. It should be noted that over the past five years, the number of cases of EHP has not changed; HP is decreasing slightly.

Table 13 shows the number of cases of HP and EHP recorded in 2018 in the river basins of the Russian Federation.

Table 13. High and extremely high pollution of waterbodies by administrative unit of the Russian Federation

Rivers basins	Number of cases			The regions (oblast), okrugs, krais and republics of the Russian Federation
	HP	EHP	Sum	
Ob	654	311	965	Kemerovo, Kurgan, Novosibirsk, Omsk, Sverdlovsk, Tyumen, Chelyabinsk regions; Khanty–Mansiysk and Yamalo–Nenets Autonomous Okrug
Volga	847	58	905	Astrakhan, Kirov, Moscow (including the city of Moscow), Nizhny Novgorod, Ryazan, Samara, Sverdlovsk, Tver, Tula, Chelyabinsk regions; Perm region; Udmurt Republic
Amur	237	42	279	Amur region, Zabaykalsky krai, Primorsky krai and Khabarovsky krai
Dnieper	12	118	130	Smolensk region
Yenisei	51	7	58	Irkutsk region
Ural	30	13	43	Orenburg and Chelyabinsk regions
Don	34	1	35	Belgorod region
Terek	30	0	30	Republic of North Ossetia – Alania
North Dvina	16	1	17	Vologda region
Kolyma	8	3	11	Magadan region
Others	193	77	270	Leningradskaya (including Saint-Petersburgh), Murmansk, Novosibirsk, Sakhalin regions, Primorsky krai
Total	**2 112**	**631**	**2 743**	

Source: National Information Agency "Natural Resources" (NIA-Priroda). 2019. On the state and use of water resources of the Russian Federation in 2016, 2017, 2018. State Report. NIA-Priroda.

In 2018, the HP and EHP of surface freshwaters were recorded in 51 constituent entities of the Russian Federation. Fifty-seven percent of all cases of HP and EHP occurred in waterbodies of Sverdlovsk (15.5 percent), Moscow (10.4 percent), Nizhny Novgorod (7.7 percent), Chelyabinsk (4.9 percent), Murmansk (4.8 percent), Kurgan (4.0 percent) and Novosibirsk (3.9 percent) regions and Khabarovsky krai (6.2 percent). Over the past ten years, Sverdlovsk region has accounted for the largest number of cases of HP and EHP among the constituent entities of the Russian Federation, however, compared to previous years, this indicator has significantly decreased (by 17 percent) and reached a minimum for the period 2009 to 2018 (Nikonorov, 1996).

2.3.3. Freshwater biodiversity of inland waters

In the Russian Federation, biodiversity was spotlighted in the early 1990s with the adoption of the 'National Program of the Russian Federation for the Conservation of Biological Diversity' (Sokolov, Chernov and Reshetnikov, 1994).

[7] EHP of surface water – the level of pollution that exceeds the Maximum Allowable Concentration (MAC) by 5 or more percent for substances of hazard classes 1 and 2 and 50 or more percent for substances of classes 3 and 4.

[8] HP of surface waters – the level of pollution exceeding the MAC by 3 to 5 percent for substances of hazard classes 1 and 2, 10 to 50 percent for substances of classes 3 and 4, 30 to 50 percent for oil products, phenols, manganese ions, copper and iron.

[9] The data were adjusted in September 2017, taking into account cases of EHP by smell.

The role of the Russian Federation in preserving global biodiversity and maintaining biosphere functions is obvious, due to the large range of ecosystems that exists on its territory and the species diversity in the country. At the same time, the development of various sectors of the domestic economy means that there is a real increase in the threats to biodiversity, including LARs (Voronkov and Belousov, 2015).

Data published in the Fifth National Report of the Ministry of Natural Resources and Ecology of the Russian Federation (MNRE, 2015) indicated:

- there are 343 species of freshwater fish and nine species of Petromyzontiformes (including diadromous species) in inland waters of the Russian Federation;
- the number of fish species varies from 28 in the Kolyma River to 128 in the Amur River Basin (Reshetnikova, 2002); and
- about 60 percent of the Russian Federation's freshwater fish species are of commercial interest and almost all of them are targeted by recreational fisheries.

Almost no ecosystem remains unaffected by anthropogenic activities that have led to significant changes in the composition of their biological communities. Some faunal species are being lost and new species and forms with high ecological plasticity and resilience are emerging, leading to local and regional changes in their biodiversity. These processes can be observed most clearly in industrially developed areas (Sokolov, Chernov and Reshetnikov, 1994). The main anthropogenic factors determining the biodiversity of aquatic ecosystems are:

- flow regulation (dams, water fences);
- chemical, radioactive and thermal pollution;
- introduction of alien species;
- eutrophication; and
- catching of aquatic resources.

2.3.4. The effects of damming rivers on fish biodiversity

In the Russian Federation, the most significant impact on the change in the biodiversity of various rivers has been caused by large-scale hydropower dam construction since the mid-1930s.

The construction of the Volga–Kama cascade dams as well as the hydraulic structures on the Terek, Sulak and other rivers of the basin have had a devastating effect on the natural reproduction and recruitment of aquatic resources. A number of species, such as Volga shad (*Alosa volgensis*), were cut off from spawning sites and became extinct; other species have decreased significantly in numbers, including populations of several commercial species including lamprey (*Lampetra fluviatills*), beluga (*Huso huso),* sheefish (*Stenodus leucichthys*) and Caspian salmon (*Salmo caspius*) that now only survive thanks to artificial propagation and state-funded stocking programmes.

With the commissioning of dams of the lower part of the Volga–Kama cascade in 1958, a new stage in the development of sturgeon populations of the Caspian Basin began, characterized by a sharp deterioration in their natural reproduction. Regulation of the Volga discharge, especially the construction of the Volgograd hydroelectric complex in 1959, led to the disruption of the hydrological regime in the lower reaches of the river, i.e. a decrease in the flow of freshwater runoff, a decrease in the removal of biogenic elements and suspended solids, the loss of the bulk of the natural spawning grounds of beluga (98 percent), starry sturgeon (*Acipenser stellatus*) (40 percent) and a sharp reduction in the spawning areas of other sturgeons (80 percent). Out of 3 600 ha of sturgeon spawning grounds in the lower reaches of the Volga, only 430 ha have been preserved (Khoroshko, Vlasenko and Novikova, 1971).

Regulation of river flow has led to the transformation of river systems into lake systems, with completely different hydrological, hydrochemical and hydrobiological characteristics, which, in turn, have created different conditions for the life of hydrobiota, their composition and structure.

In the Volga River section, which is currently occupied by the Kuibyshevskoe Reservoir, the composition of the ichthyofauna has undergone significant changes, although the number of fish species (Reshetnikova, 2002) is practically the same as before the creation of the reservoir (Kuznetsov, 1978; USSR Ministry of Fisheries, 1971), however, the migratory and rheophilic species have become 'rare' or 'endangered', while the limnophilic species have increased in numbers. At the same time, a number of exotic species have appeared, e.g. silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*), grass carp (*Ctenopharyngodon idella*) and peled (*Coregonus peled*) among others; these species were introduced on purpose or accidentally during acclimatization works (Sharonov, 1972). Similar changes have occurred in all the Volga reservoirs.

2.3.5. Other environmental impacts on fish biodiversity

In addition to regulating river flow, other types of economic activities, mining in particular, have had significant impact on biodiversity including ichthyofauna. This is especially pronounced for the rivers of the Republic of Sakha (Yakutia).

The exploitation of mineral deposits in the upper part of the Chroma River (the basin of the East Siberian Sea) led to an increase in the runoff of solids more than 500 km downstream from the development sites. The spawning areas of vendace (*Coregonus albula*), broad whitefish (*Coregonus nasus*) and European whitefish (*Coregonus lavaretus*) decreased due to the siltation, which threatened their populations with extinction. Siberian brook lamprey (*Lethenteron kessleri*), Arctic grayling (*Thymallus arcticus*) and northern pike generally disappeared (Tyaptiryanov, 1988).

Significant changes in the composition of ichthyofauna and conditions for the reproduction of semi-migratory fish occurred in the basin of the Tom' River – one of the largest tributaries of the Ob' River. Until the 1930s, this river was a salmon-type watercourse (Ruzsky, 1920).

However, recently, an increase in turbidity of the water has contributed to the formation of fishless zones in the Chroma River. As a result, the Eurasian minnow (*Phoxinus phoxinus*) and the Siberian brook lamprey have disappeared from this river.

In waterbodies of the Altai Republic, despite the relatively favourable ecological situation in the region, human activities have led to the disappearance of 25 percent of the species of the native ichthyofauna (8 out of 29 species have disappeared or are on the verge of extinction). Such species include the Pacific lamprey (*Entosphenus tridentatus*), Siberian brook lamprey and Siberian sturgeon (*Acipenser baerii*) (Golubtsov and Malkov, 2006). Formerly, 29 species of fish lived in the Tom' River Basin including taimen (*Hucho taimen*), lenok (*Brachymystax lenok*), Arctic grayling, tugun (*Coregonus tugun*) and humpback whitefish (*Coregonus pidschian*). As a result of chemical pollution, semi-diadromous[10] fishes and sterlet sturgeon (*Acipenser ruthenus*) disappeared in the river, taimen, lenok, Arctic grayling became rare and local stocks of tugun and humpback whitefish disappeared. At the same time, lake and river species such as northern pike, common dace (*Leuciscus leuciscus*), and roach have become more prevalent in the lower Tom' (Gundrizer, 1992).

[10] Semi-diadromous fish refer to species that live in river mouths and enter them for short distances for spawning.

3 Structure and organization of the inland fisheries of the Russian Federation

Samoylenko, V.V.,
Pavlova, A.O.,
Kononova, L.A., and
Ryzhkov, Y.L

3.1. THE TYPES OF INLAND FISHERIES

Inland fisheries may be characterized by one or more types of fishing.[11] The generally accepted term ‘type’ of fisheries is referred to in the legislation of the Russian Federation as ‘category’. In accordance with the Russian Federation’s law, citizens and legal entities can carry out the following types of fishing:

3.1.1. Industrial fishing

Industrial fishing[12] (see example in Figure 3.1) in the inland waters of the Russian Federation is carried out by legal entities and individual entrepreneurs with or without the use of fishing vessels, as well as with or without the use of fishing areas. This sort of fishing is carried out in accordance with the TAC corresponding to the types of LARs being targeted. These TACs are established based on the contract that assigns the shares of quotas for the extraction (catch) of LARs. In this contract the following information is required: parties, the subject of the contract, the name and size of the share of the quotas for the extraction (catch) of LARs, its duration, type(s) of fishing, rights, obligations and responsibilities of the parties.

In relation to types of LARs, for which the TAC is not established, fishing is carried out on the basis of agreements on the use of LARs, where one side (the state authority) agrees to provide the other side (a legal entity or an individual entrepreneur) the right to harvest LARs. An agreement on the use of LARs may be reached via an auction.

The preparation procedure, the form of the contract and the conclusion of the contract for the use of LARs are established by the Government of the Russian Federation.

[11] Inland fishery is not considered a special category of fishing under the Russian Federation’s legislation.
[12] Industrial fishing is the only type of commercial fisheries recognized in inland waters.

Figure 3.1. Industrial fishing in Volga–Caspian fishery basin.

3.1.2. Fishing for scientific research and control purposes

Fishing for research and control purposes is conducted to study and conserve LARs, as well as their habitats and to establish TACs and recommended catches.

This type of fishing is carried out by scientific organizations on the basis of annual plans for resource research on LARs. It is necessary to obtain the following permissions:

- for the provision of LARs for use;
- for catch;[13] and
- for aquatic resources research.

During fishing for scientific research and control purposes only the amount of LARs necessary to meet the objectives of the research is extracted, and the LARs caught for research are used only for the indicated purposes. After carrying out these activities, the extracted LARs must be returned to their habitat. If the physical state of such LARs does not allow them to return to their habitats, they must be destroyed. The production of fish and other products from LARs for commercialization or consumption on vessels used for fishing for scientific research and control purposes is prohibited. The procedure for this type of fishing is established by the Government of the Russian Federation. An example of a research vessel is shown on Figure 3.2.

Figure 3.2. The research vessel Caspian Explorer.

[13] The Federal Agency for Fisheries can decide on the provision of LARs for research purposes, after which users may obtain permission to catch these LARs. So, without the first it is not possible to get the second.

3.1.3. Fishing for educational, cultural and instructional purposes

The purpose is to meet the needs of educational institutions and scientific organizations as well as zoos, oceanariums, museums, circuses and other mediums for education, cultural and entertainment events. The procedure for obtaining permission for fishing for educational, cultural and instructional purposes is established by the federal executive body for fisheries.

Figure 3.3 illustrates how fish biological data is collected in the field.

Figure 3.3. Collection of biological data on fish specimens the field.

3.1.4. Recreational (amateur) fishing

In December 2018, the Federal Law on Recreational Fishing, which regulates relations for recreational fishingin inland and marine waters of the Russian Federation was adopted.

Citizens who engage in recreational fishing have ownership of the caught LARs and have the right to freely use general-purpose waterbodies. In waterbodies owned by citizens or legal entities, recreational fishing is carried out in accordance with civil and land laws. This type of fishing may be prohibited or restricted on waterbodies located in specially protected natural territories and other lands, where the access of citizens is prohibited or restricted in accordance with federal laws.

Recreational fishing is prohibited in waterbodies reserved for commercial fish farming, including pond aquaculture, as well as in ponds that are used for amelioration purposes, including irrigation systems.

To protect the environment, preserve LARs and their habitats, the following restrictions on recreational fishing are stipulated:

- periods of extraction of LARs using nets in the regions of the North, Siberia and the Far East for personal consumption;
- ban on the use of explosives and chemicals, as well as electricity; and

- ban on underwater extraction of LARs, i.e. spearfishing in holiday resorts. When spearfishing, it is forbidden to use individual electronic means for detecting LARs under water, as well as scuba gear and other autonomous breathing apparatus.

Figure 3.4 shows recreational ice fishing in Chivyrkuisky Bay.

Figure 3.4. Amateurs ice fishing. Chivyrkuisky Bay, April 2009.

3.1.5. Fishing to ensure traditional ways of life and traditional economic activities of Indigenous Peoples in the North, Siberia and the Far East

Indigenous Peoples include people living in the traditional settlements of their ancestors who preserve their traditional way of life, which is a historically developed means of subsistence, based on ancestral environmental management, social living conventions, culture, and the preservation of customs and beliefs.

When carrying out traditional fishing, individuals belonging to small nations and their communities have the right to apply traditional methods of extraction (catch) of LARs, if such methods do not directly or indirectly reduce biological diversity, and do not reduce the number of and the sustainable reproduction of wild organisms, or violate their habitat, and do not pose a danger to humans.

Traditional fishing is carried out in accordance with the fishing rules for individual basins[14] within the established quotas for the extraction of LARs allocated to the selected constituent entities of the Russian Federation for traditional fishing of small nations; they are distributed among the users by the executive authorities of the selected subjects[15] of the Russian Federation.

[14] The Ministry of Agriculture establishes the fishing rules for the individual basins with the involvement of the users.

[15] The federal subjects are the constituent entities of the Russian Federation, its top-level political divisions according to the Constitution.

Traditional fishing is carried out by persons belonging to small nations, with or without a fishing area. Fishery areas[16] are allocated to the Indigenous Peoples of the North, Siberia and the Far East in order to ensure that they can continue their traditional ways of life and traditional economic activities. Fishery areas are provided via a contract under which the state authority agrees to provide the legal entity or individual entrepreneurs with the right to harvest LARs in the fishing area in the manner established by the Government of the Russian Federation.

Traditional fishing without providing a fishing area is carried out without permission to harvest LARs, except when harvesting rare and endangered species (i.e. species listed in the Red Book of the Russian Federation). Figures 3.5-3.7 show some examples of traditional ways to preserve and prepare fish by Indigenous Peoples.

Figure 3.5. Traditional drying of Pacific salmon (Yukola). Karaginsky District, 2006.

[16] The fishery area may correspond to an entire waterbody or a part of it.

Figure 3.6. An Indigenous Peoples leader of Etneut drying fish. Karaginsky District, 2006.

Figure 3.7. A woman prepares fish for the Festival of the First Fish. Karaginsky District, 2006.

3.2. PARTICIPATION AND EMPLOYMENT IN DIFFERENT PARTS OF THE INLAND FISHERY SECTOR

Table 14. Participation in different types of inland fisheries in the Russian Federation

Type of fishing	No of people participating	Comments
Industrial	40 500	50: 50 (men: women).
Recreational (amateur)	2 422 000	Licensed. Other estimates place this between 10 million and 30 million.
Sport fishing (catch–release)	55 000	
Subsistence fishing	150 000	Estimated number based on the number of able-bodied people.

Source: Rosstat. Regions of the Russian Federation (RoR). 2019. Socio-economic indicators. 2019. Stat. compt/Rosstat. 1204 pp.

Parliamentary Newspaper. 2020. With Free Fishing You Have to Wait a Bit. Parliamentary newspaper, January 2020 [online]. Available at https://www.pnp.ru/social/s-besplatnoy-rybalkoy-pridyotsyanemnogo-povremenit.html

Barabanov, V.V. 2017. Assessment of the impact of recreational fishing on aquatic biological resources and development of measures for its regulation in the conditions of the Volga-Caspian basin (Astrakhan region). Novosibirsk. (PhD synopsis).

Leonov, S.N. & Shevaryova, Ya.S. 2017. Problems and perspectives for the development of traditional types of economic activity of Indigenous Peoples of the North and Far East. Regionalistica, 4(2):26–45.

Association of Rosokhotrybolovsoyuz (AOR). Rosokhotrybolovsoyuz [online]. Available at http://rors.ru/fishing/

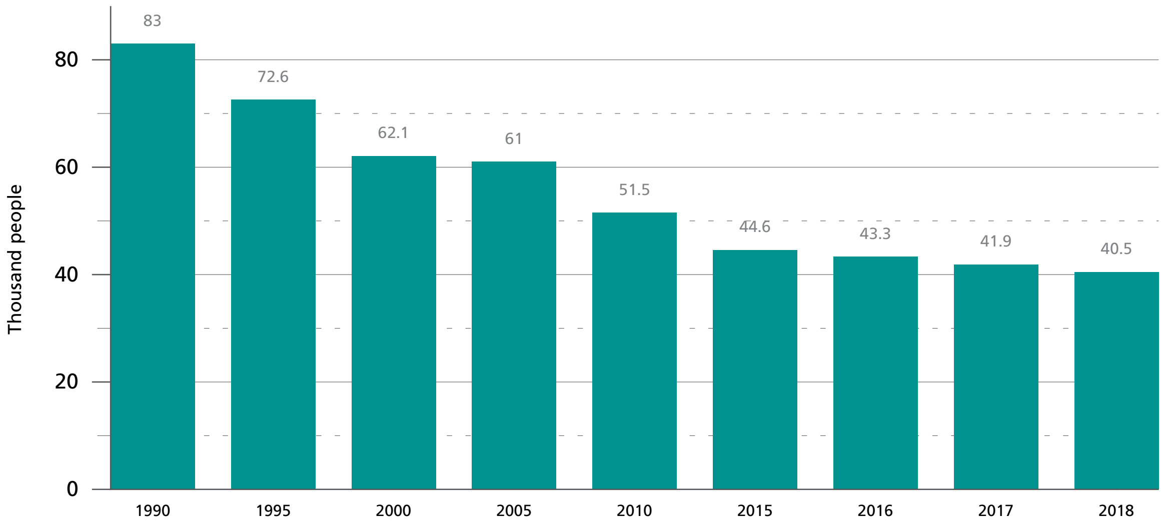
3.2.1. Industrial fishing

Official information on the number of people employed in industrial fishing in the inland waters of the Russian Federation indicates not only serious structural changes in the fisheries economy from 1990 to 2018, but also systemic problems in statistical accounting. Accounting for the number of workers in fisheries reflects all the problems that accompanied the processes that took place in fisheries during this period (the destruction of the old economic system, privatization, monetization of relations, bursts of unemployment and so forth). As a result, the system of federal statistics initiated from 1991 to 1996 discovered significant gaps in quantifying various aspects of fisheries. Only in the first decade of the twenty-first century did the situation begin to stabilize.

Figure 3.8 provides updated data on the number of employed personnel in industrial fisheries in the inland waters of the Russian Federation based on information from industry sources (Sechin, 2014; Rosstat 2019, 2020; Rosstat, 2010; VNIRO, 2001–2003, 2005).

It is easy to see that the total number of industrial fisheries progressively decreases over time.

Figure 3.8. The total number of fishers engaged in industrial fishing in the inland waters of the Russian Federation (1990 to 2018)



Source: Authors' elaborations.

Nevertheless, the structure of employment in industrial fisheries in the inland waters of the Russian Federation remained quite stable – 13 percent of the total number is full-time staff of fishery enterprises, while 87 percent is part-time (seasonal) staff. This ratio is typical for a long-term range (1995 to 2017).

Regarding gender composition of workers in fisheries, the ratio of men and women is approximately the same 50: 50 (Table 14). Moreover, fluctuations in this ratio over the years are very insignificant over the entire period of 1990 to 2018.

According to VNIIERH (2006) in global terms, the catch/fisher/year is:

- set seines, fishing lines with hooks and nets from motorless boats: 1 tonne;
- coastal longlines, gillnets and trawl nets from small boats: 10 tonnes; and
- fishing with nets and longlines from medium-sized boats: 24 tonnes.

The shown catch indicators (1 ton to 10 tonnes/fisher) are sufficiently close to the fisheries in inland waters of the Russian Federation. Estimates show that from 1990 to 2005, the average relative catch (tonnes/capita/year) in industrial fisheries ranged from 2.92 tonnes to 4.79 tonnes of fish. The maximum values are correlated with the Southern, Ural and Siberian federal districts. Further, the average relative catch began to increase slowly, and by 2018 had reached 6.64 tonnes of fish per year.

3.2.2. Recreational (amateur) fishing

According to an estimate made by the Association of Rosokhotrybolovsoyuz[17] – hereafter referred to as the AOR – there are 10 million recreational fishers in the Russian Federation. Other sources provide even more impressive data of up to 30 million people (Parliamentary Newspaper, 2020). Obviously, both organized amateurs, who fished under nominal one-time permits (licences) and unorganized amateurs who caught LARs in public waterbodies without appropriate licences were taken into account.

Studies conducted on the basis of 24 regional Departments for Fisheries and Conservation of Aquatic Biological Resources included in the structure of the Federal Agency for Fisheries (*rybvods*) showed that the total number of amateur fishers considered by *rybvod* specialists for the period 2007 to 2008 was about 2.42 million people (Table 15).

Missing information from some *rybvods* had to be supplemented with an expert estimate of the number of recreational fishers based on the fish catch rates indicated by the *rybvods*, as well as taking into account the number of men living in specific areas of the Russian Federation (Barabanov, 2017).

Table 15. Distribution of the number of amateur fishers in the *rybvod* zones of jurisdiction

Name of territorial rybvod	Number of amateur fishers		Total estimated number
	Rybvod[18] data	Expert estimate	
Azcherrybvod	70 985		70 985
Amurrybvod	12 002		12 002
Baikalrybvod		3 319	3 319
Verhneobrybvod	299 770		299 770
Yeniseirybvod	13 474		13 474
Zapbaltrybvod	60 000		60 000
Kamuralrybvod	0	191 367	191 367
Kamchatrybvod	0	70 990	70 990
Karelrybvod	1 637		1 637

[17] All-Russian Association of Public Associations of Hunters and Fishers – 'Association of Rosokhotrybolovsoyuz'.

[18] Registered/licensed fishers.

Name of territorial rybvod	Number of amateur fishers		Total estimated number
	Rybvod[18] data	Expert estimate	
Komirybvod	1 604		1 604
Mosrybvod		244 800	244 800
Murmanrybvod	3 734		3 734
Nizhnevolzhrybvod	135 383		135 383
Nizhneobrybvod	2 524		2 524
Ohotskrybvod	106 173		106 173
Primorrybvod	90 000		90 000
Sahalinrybvod	90 000		90 000
Sevzaprybvod	900 000		900 000
Sevkasprybvod		17 220	17 220
Sevrybvod		2 765	2 765
Srednevolzhrybvod	9 727		9 727
Hakasrybvod	1 342		1 342
Centrrybvod		73 141	73 141
Yakutrybvod		20 317	20 317
TOTAL			**2 422 275**

Source: Barabanov, V.V. 2017. Assessment of the impact of recreational fishing on aquatic biological resources and development of measures for its regulation in the conditions of the Volga-Caspian basin (Astrakhan region). Novosibirsk. (PhD synopsis). Information from reports of 24 regional Departments for the conservation, reproduction of aquatic biological resources that were not officially published.

3.2.3. Sport fishing (catch–release fishing tourism)

This involves sport fishing and fishing tourism. The first category is focused on official sporting events (personal and team), which are clearly regulated in all aspects (place of fishing, safety, requirements for gear and equipment, competition regulations and so forth) (Ministry of Sports of Russia, 2014). As a rule, sport fishing is organized on the principle of catch and release,[19] therefore, regardless of the number of sport fishers, the effect on the total catch is close to zero. According to the AOR, about 300 competitions of various levels are organized annually, in which more than 55 000 fishers take part (AOR, online) (Table 14).

Inland fishing tourism is growing. Fishing tourism in the Russian Federation is gradually becoming a popular pastime and is in demand. The development of fishing tourism began to gain momentum after 2000. Demand for fishing tours is growing, and the industry and the level of service being offered continues to develop and improve.

There are no statistical data on the number of tourist fishers in the inland waters of the Russian Federation. Preliminary expert assessment shows that their total number does not exceed 2 400 to 3 600 people. According to the Kamchatrybvod *rybvod*, which is one of the richest in terms of fish stocks among the regions of the Russian Federation, tourist fishers in the inland waters of Kamchatka have very little impact on the total catch.

One of the main factors for fisher tourists is the cost of the tour and the time of flight which explains the relatively low numbers, and their distribution and development nationally.

3.2.4. Fishing to ensure traditional ways of life and traditional economic activities of Indigenous Peoples in the North, Siberia and the Far East

The main group of people engaged in inland fisheries for subsistence is Indigenous Peoples of the North, Siberia and the Far East. The statistics on this group are more reliable compared to other groups, such as occasional or unorganized amateur fishers, for whom fishing is a recreation and obtaining food is only a secondary objective.

[19] The target species are mainly cyprinids, but this varies among regions.

Over the past decades, there have been major changes in the employment structure of Indigenous Peoples. About half of the employable native population does not have permanent work (Leonov and Shevaryova, 2017). In recent years, fish catches in areas of Indigenous Peoples have almost halved, which mainly has to do with non-compliance with fishing requirements, lack of market opportunities and pollution of waterbodies by industrial effluents. The small fishing fleet is in a very unsatisfactory condition (Yamal, 2020–2021). Fisheries in areas where Indigenous Peoples live almost halved in volume during the period of market reforms due to the condition of biological resources, the environmental status and the loss of markets. Significant losses of valuable fish species caught were attributable to the lack of freezing and processing tecnologies (Leonov and Shevaryova, 2017).

A survey of people engaged in inland fisheries for subsistence purposes was carried out in the 2010 population census[20] (Table 14) to clarify the numbers of Indigenous Peoples involved (Leonov and Shevaryova, 2017; Yamal, 2020–2021; Bogoyavlensky, 2012; Pacific State University, undated; Averin, 2015).

3.3. MAIN CHARACTERISTICS OF FISHING IN INLAND WATERBODIES OF THE RUSSIAN FEDERATION

3.3.1. Industrial fishing

The need for rational use of fish stocks and the presence of hard regimes of industrial fishing on waterbodies require the use of various types of fishing gear for optimal selectivity of certain species of fish and size groups (Melnikov, 1991). The industrial fishing gears used on various waterbodies and their target species are presented in Table 16.

Table 16. The use of industrial fishing gear for the catch of LARs in various waterbodies of the Russian Federation

Waterbodies	Species	Fishing gear
West Siberian fishery basin		
The Ob and the Irtysh rivers with tributaries	Sturgeon, nelma *(Coregonus nelma)*, muksun *(Coregonus muksun)*, broad whitefish, peled, humpback whitefish, northern pike, ruffe *(Gymnocephalus cernuaus)*, burbot *(Lota lota)*.	Seine nets, set gillnets and drift nets, *kotczi* and traps (Gosrybcenter, 2003a).
Lake systems of the Ob River Basin	Roach, *Carassius* spp., common dace, European perch *(Perca fluviatilis)*; by-catch – northern pike, ide *(Leuciscus idus)*, tench *(Tinca tinca)*.	Set seines and seine nets – in summer, and in winter seine nets and freshwater dragnet *(mutnik)*.
The Yenisei River	Sterlet sturgeon, other sturgeon species, Arctic char *(Salvelinus alpinus)*, lake char *(Salvelinus lepechini)*, taimen, lenok, nelma, vendace, tugun, Arctic cisco *(Coregonus autumnalis)*, peled, broad whitefish, European whitefish, round whitefish *(Prosopium cylindraceum)*, muksun, roach, grayling *(Thymallus thymallus)*, Arctic rainbow smelt *(Osmerus mordax dentex)*, northern pike, Siberian dace *(Leuciscus baicalensis)*, ide, tench, *Carassius* spp., burbot, European perch, ruffe, roach.	Lake and river set gillnets, seine nets (Gosrybcenter, 2003a).
Lakes of the Yenisei River Basin	Burbot, peled, European whitefish, sea trout *(Salmo trutta)*, European perch.	Set and lake seines, set gillnets (Gosrybcenter, 2003a).
Baikal fishery basin		
Lake Baikal	Baikal omul *(Coregonus migratorius)*, European whitefish, grayling. Roach, European perch, common dace, common carp, northern pike.	Set gillnets, seine nets and set seines. Set gillnets and drift nets, seine nets, fyke nets (Gosrybcenter, 2003a).
Bratsk and Ust'-Ilim reservoirs, the Angara River	Lamprey, taimen, lenok, tugun, European whitefish, Arctic cisco, grayling, northern pike, roach, common dace, ide, Eurasian minnow, goldfish *(Carassius auratus)*, European perch, ruffe, burbot, Arctic char.	Set gillnets, seine nets, fyke nets (Gosrybcenter, 2003a).

[20] Given the crucial role of fisheries to these populations it is assumed that all of them are somehow involved in fishing.

Waterbodies	Species	Fishing gear
East Siberian fishery basin		
The Lena, the Yana, the Indigirka, the Kolyma, the Olenek rivers, etc.	Siberian sturgeon (only in the Lena River), nelma, muksun, vendace, Arctic cisco, European whitefish, broad whitefish, northern pike, ide, European perch, roach, tugun, etc.	Seine nets (length 300 m to 400 m), drift nets and set gillnets.
Lakes of the Sakha (Yakutia) Republic	Broad whitefish, peled, humpback whitefish, northern pike, *Carassius* spp.	Set gillnets (Gosrybcenter, 2003a).
The Volga–Caspian fishery basin		
The Volga and the Akhtuba rivers within boundaries of the Astrakhan region and northern part of the Caspian Sea	Sheefish, shads (*Alosa* spp.), pike-perch, freshwater bream *(Abramis brama)*, common carp, sichel, roach, asp *(Leuciscus aspius)*, mullets *(Mugilidae)*, shads, sea sprats *(Sprattus)*, gobies *(Gobiidae)*, crayfishes *(Cambaridae)*.	Seine nets, drift nets and set gillnets, traps, crayfish catchers (Gosrybcenter, 2003b).
Western part of the Caspian Sea, the Terek and the Sulak rivers, etc. (FSUE, 2003b)	Sterlet sturgeon, sheefish, shads, pike-perch, freshwater bream, common carp, sichel, roach, asp, mullets, Caspian Sea sprats, gobies.	Seine nets, sea scrapers, drift nets and set gillnets, traps, crayfish catchers (Gosrybcenter, 2003b).
Volgograd and Saratov reservoirs with the rivers flowing into them	Northern pike, ide, asp, freshwater bream, *Carassius* spp., common carp, pike-perch, burbot, wels catfish, zope *(Ballerus ballerus)*, sterlet sturgeon, European perch, bleak *(Alburnus alburnus)*, sichel.	Seine nets, set gillnets and drift nets, traps (Gosrybcenter, 2003b).
Kuibyshev and Nizhnekamsk reservoirs	Freshwater bream, pike-perch, common carp, zope, roach, sichel, white bream *(Blicca bjoerkna)*, Volga pikeperch *(Sander volgensis)*, northern pike, sterlet sturgeon, wels catfish, *Carassius* spp., European perch.	Seine nets, set gillnets, traps (Gosrybcenter, 2003c).
Gorky and Cheboksary reservoirs; the Volga, Vetluga, Oka and Sura rivers	Freshwater bream, pike-perch, northern pike, roach, sichel, asp, burbot, white bream, European perch.	Nets, seine nets and traps (Gosrybcenter, 2003c).
Rybinsk and Uglich reservoirs	Freshwater bream, pike-perch, northern pike, zope, sichel, burbot, vendace, wels catfish, common dace, roach, white bream, *Carassius* spp., ide, European perch, ruffe.	Nets, seine nets and traps (Gosrybcenter, 2003c).
Western fishery basin		
Ladoga Lake, Narva and Verkhne-Svir reservoirs	Whitefishes, European smelt *(Osmerus eperlanus)*, vendace, pike-perch, European perch, roach, freshwater bream, northern pike, burbot, ruffe, white bream.	Seine nets, traps and set gillnets (Gosrybcenter, 2003c).
Peipsi and Teploe lakes	Freshwater bream, pike-perch, northern pike, vendace, European whitefish, rainbow smelt *(Osmerus mordax)*, burbot, ide, *Carassius* spp., roach, European perch.	Seine nets, mutnik, fish weirs, set gillnets and drift nets, traps (Gosrybcenter, 2003c).
Ilmen Lake, small lakes and rivers	Freshwater bream, pike-perch, roach, bleak, zope, sichel, white bream and European perch.	Seine nets, mutnik, nets and traps (Gosrybcenter, 2003c).
Northern fishery basin		
Vozhe, Kuben and Beloe Lakes; Sheksna Reservoir	Freshwater bream, roach, European whitefish, pike-perch, northern pike, burbot, ide, *Carassius* spp., European perch, ruffe, etc.	Seine nets, set gillnets and drift nets, traps (Gosrybcenter, 2003c).
The Pechora, Vychegda and Mezen rivers with tributaries	Sea trout, Arctic char, grayling, European whitefish, vendace, peled, Arctic cisco, northern pike, freshwater bream, burbot, roach, ide, common dace, *Carassius* spp., European perch, ruffe.	Seine nets, set gillnets and drift nets, traps (Gosrybcenter, 2003c).
The Northern Dvina and Onega rivers; Lacha Lake	Atlantic salmon *(Salmo salar)*, nelma, northern pike, roach, ide, freshwater bream, *Carassius* spp., burbot, European perch.	Seine nets and set seines, set gillnets and drift nets, traps (Gosrybcenter, 2003c).
Onega and Syamozero lakes; Vygozero, Segozero and Vodlozero reservoirs	Sea trout, lake char, whitefishes, vendace, grayling, smelts *(Osmerus spp.)*, northern pike, burbot, freshwater bream, pike-perch, ide, roach, European perch and ruffe.	Seine nets, set gillnets, traps and set seines (Gosrybcenter, 2003c).
The Azov–Black Sea fishery basin		
Tsymlyansk Reservoir	Freshwater bream, zope, pike-perch, wels catfish, common carp, Volga pikeperch, white bream, sichel, vimba bream *(Vimba vimba)*, etc.	Set gillnets, seine nets and traps (fyke nets) (Gosrybcenter, 2003b).
Proletar, Veselovo, Krasnodar, Chograi, Novotroitsk and Otkazninsk reservoirs	Freshwater bream, common carp, roach, *Carassius* spp., Volga pikeperch, pike-perch, silver carp, crayfishes, etc.	Set gillnets and drift nets, seine nets and traps (fyke nets) (Gosrybcenter, 2003b).

Waterbodies	Species	Fishing gear
The Far East fishery basin		
The Amur River	Chum salmon, pond smelt *(Hypomesus olidus)*, Arctic rainbow smelt, burbot, Carassius spp., asp, predatory carp *(Chanodichthys erythropterus)*, spotted steed *(Hemibarbus maculatus)*, barbel steed *(Hemibarbus labeo)*, naked catfishes *(Bagridae)*, etc.	Set gillnets and drift nets, seine nets and set seines, traps (Gosrybcenter, 2003b).
Khanka Lake	Sharpbelly *(Hemiculter leucisculus)*, humpback whitefish, common carp, predatory carp, northern pike, barbel and spotted steed, wels catfish, pike-perch, Mongolian redfin *(Chanodichthys mongolicus)*, etc.	Set gillnets, seine nets, traps (Gosrybcenter, 2003b).

Source: MoA. 2021. On approval of fishing rules for the Northern fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 13 May 2021, No. 292 [online]. Available at https://docs.cntd.ru/document/603702170?marker=64U0IK

MoA. 2022. On approval of fishing rules for the Far-Eastern fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 6 May 2022, No. 285 [online]. Available at https://docs.cntd.ru/document/350550495

MoA. 2020. On approval of fishing rules for the Western fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 21 October 2020, No. 620 [online]. Available at https://docs.cntd.ru/document/573191354

MoA. 2022. On approval of fishing rules for the Volga-Caspian fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 13 October 2022, No. 695 [online]. Available at https://docs.cntd.ru/document/352246469

MoA. 2020. On approval of fishing rules for the Azov-Black Sea fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 9 January 2020, No. 1 [online]. Available at https://docs.cntd.ru/document/564189244

MoA. 2020. On approval of fishing rules for the West-Siberian fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 30 October 2020, No. 646 [online]. Available at https://docs.cntd.ru/document/573191329

MoA. 2020. On approval of fishing rules for the East-Siberian fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 26 June 2020, No. 347 [online]. Available at https://docs.cntd.ru/document/565309776

MoA. 2014. On approval of fishing rules for the Baikal fishery basin. Order of the Ministry of Agriculture of the Russian Federation of 7 November 2014, No. 435 [online]. Available at http://docs.cntd.ru/document/420233780

The traditional fishing gear in freshwater bodies comprises set gillnets and drift nets, seine nets, traps (fyke nets, *sekretik*, *merezha*, etc.), pair seines and trawls (for fishing vessels).

Trawl fishing in inland waters is not widespread, despite high levels of mechanization and effectiveness. Midwater trawls are used in the deepwater areas of Lake Onega to catch vendace (Babiy, 2008). Until recently, trawl fishing was carried out on the reservoirs of the Volga River cascade.

In some internal waters both bottom and semi-pelagic pair trawl fishing is used. The most significant development of this kind of fishing was on the Chano–Barabinsky system of lakes and the Novosibirsk Reservoir. Fishing is carried out by continuous trawling with periodic emptying of the trawl on an auxiliary vessel. Different types of vessels are used as tugboats (Mamontov *et al.*, 2005).

Seine net fishing is common. Both the design and size of seine nets and the fishing technology differ basin-wise, e.g. equally winged and non-equally winged seine nets, seine nets with a valance and other variations on lakes. *Mutniki* became widespread on the waterbodies of the northwest. Pair seines are used on the lakes of the Novosibirsk region, the Tsimlyansky Reservoir and some other reservoirs. Seine net fishing is carried out on stationary fishing places, usually in major rivers, and on round (flip-flop) fishing places of major rivers, braided reaches, shallow bays and so forth (Mamontov *et al.*, 2005).

The most widespread passive gears are set gillnets, drift nets and fishing with traps. Set gillnets are used in practically all basins and they are the main fishing gear on reservoirs.

Drift net fishing is mainly used on major rivers, as well as on some reservoirs. It is most common in Western Siberia, where the target species are mostly species of whitefish.

Fishing with traps is quite common. The bulkiness of the individual types of traps, the intensive labour needed and the limited areas and short period where they can be used are the main constraints preventing their wider use in open water. On the other hand, the expansion of trap use is very reasonable, taking into account the positive qualities of this type of fishing: high labour productivity, low energy demands and operating costs, high quality of caught fish and fair selectivity (Mamontov *et al.*, 2005).

3.3.2. Research and control fisheries

The most proven and reliable method for assessing fish stocks in freshwater bodies has been and still remains direct quantification of the catch using filtering fishing gear (trawls and seine nets). The reliability of this method has been validated over many years of research practice in the Russian Federation.

Fishery independent assessment of the stock is still the main choice in waterbodies where scientific organizations have their own trawl vessels (Rybinsk, Nizhnekamsk, Kuibyshev, Saratov, Volgograd, Tsymlyansk and Novosibirsk reservoirs; Ladoga, Onega, Beloe and Chany lakes). Moreover, the use of trawls makes it possible to obtain objective data on the state of LARs annually, evaluate changes in fish populations and take operational measures to regulate fishing for example.

Dragnets, scrapers and seine nets are widespread in ichthyological research. The yields of larvae, fingerlings and yearlings are estimated according to the catches of small-mesh dragnets and scrapers. The number of older age groups of fish is estimated according to the catches by commercial seine nets. As a rule, crews of fishers are involved when conducting seine surveys in waterbodies.

Set gillnets and drift nets are most often used in the study of species and length composition as well as age-length characteristics of fish.

To study fish stocks, both commercial and specially designed traps for research are used. The use of traps is most effective in studying feeding and spawning fish migrations (Sechin, 2010).

3.3.3. Recreational and sport fishing

Recreational (amateur) fisheries feature significantly in catches of LARs. *All About Fishing* (available at http://ribalka-vsem.ru/index/sposoby_lovli_ryby/0-669) provides useful information on the main methods which are briefly outlined below.

Fly hook fishing (dapping) is used to catch trout, salmon, chub (*Squalius cephalus*), ide, asp, roach, northern pike, pike-perch, European perch, common carp and many other species. It is considered to be the oldest method of fishing on freshwater bodies. It is carried out on the surface of the water, without a float and weight lead. The larvae of various insects serve as bait.

Angling, or rod fishing is the most common and popular fishing method for catching almost all species of fish. Most often non-predatory fish, such as common carp, *Carassius* spp., freshwater bream, roach, white bream, tench and many other species.

Legering is angling with static bait on the bottom of a lake or river bed without the use of a float. The main target species are common carp, freshwater bream, roach, white bream, *Carassius* spp., tench and wels catfish.

Jigging employs a lure called a jig. This is a lead sinker with a hook moulded into it and usually covered by a soft body to attract fish. Jigs create jerky, vertical motion, as opposed to spinnerbaits which move through the water horizontally.

Among the methods for catching predatory fish, the most common are *zherlitsa*, circles, spinning, and spoon lures.

Zherlitsa uses a line on which live bait is hooked. *Zherlitsa* is attached to a long pole or branches hanging over the surface of water. Such tackle targets northern pike and sometimes pike-perch or wels catfish in backwaters or reed/grass beds.

Circles fishing is a variation of *zherlitsa*.

Spinning refers to rod fishing with artificial bait, such as a spoon lure, for northern pike, European perch, pike-perch, Volga pikeperch, wels catfish and predatory fish species.

For more information visit <http://ribalka-vsem.ru/index/sposoby_lovli_ryby/0-669>.

3.3.4 Traditional methods of fishing used by Indigenous Peoples

In the North, Siberia and Far East of the Russian Federation, Indigenous Peoples still subsist as they did many hundreds of years ago via reindeer husbandry, hunting and fishing.

Prior to contact with Europeans, many Indigenous Peoples of the Russian Federation used relatively primitive fishing gear. For example, the Evens used the so-called 'Elga', similar to a fish-gig. The inhabitants of Primorye caught salmon with the help of screens, fish traps and bow and arrow (with wide arrowheads). They also used various modifications of the fish-gig. Harpoons allowed them to hunt pinniped marine mammals as well.

Fish were caught with nets woven from fibres of nettle, hemp, deer tendons and whalebone fibres; wing nets made of willow rods; landing nets; and on bone hooks. Fish were also lured with light from a boat at night and hit with a gig. So-called ‘mordy’ (snouts) were installed on small rivers for fishing.

The abundance of fish provided food supplies for a whole year as well as for their sled dogs. It is interesting to note that before the advent of civilization, small local populations used very limited natural resources avoiding interuption of natural processes. Now, Indigenous Peoples use both traditional and modern commercial and recreational fishing gear. Set gillnets and drift nets with different meshes are the main gears used. On Lake Baikal, despite a ban on commercial catch of Baikal omul (*Coregonus migratorius*), a limited amount of fishing using set gillnets was still allowed to maintain traditional lifestyles from October 2017 to December 2019. However, since 2020 Indigenous Peoples are only allowed to catch Baikal omul on Lake Baikal using angling gear (Ministry of Agriculture, 2014).

3.4. MAIN FISHING GEAR AND METHODS

The main methods for industrial fishing in inland waters are:

- seining, using seine nets, cross-over and set seines;
- netting, with set gillnets and drift nets;
- trawling; and
- trap setting.

On open water, drift nets and set gillnets account for approximately 34 percent of caught fish; other methods account for 33 percent (seine nets), 27 percent (traps) and 4 percent (trawls). Other fishing gear accounts for 2 percent of the catch.

Net fishing is the most common, simple and least costly method and is carried out using gillnets. One of the main advantages of net fishing is a high degree of selectivity of fishing gear, which in many ways becomes a decisive factor in choosing the best fishing gear. Another factor is the possibility of fishing in degraded sections of waterbodies, where fishing by other means is impossible. The widespread use of net fishing has been facilitated by the introduction of synthetic materials for the manufacture of nets and large floats.

Net fishing is the most energy-efficient and therefore the simplest method, because even small boats can be used. The main disadvantages are fish spoiling, if they have died in the nets due to being entangled for a long time, and the gill covers damaged.

Trawl fishing is limited in inland waters but in some regions it has been used for a long time.

In total, 3 763 registered and authorized fishing gears of various types and sizes are used in inland waters of the Russian Federation. According to accepted international and domestic classifications, fishing gear is divided into five categories in line with the classification of the International Standard Statistical Classification of Fishing Gear (ISSCFG):

1. filtering-type fishing gear;
2. gillnets and entangling nets;
3. traps;
4. grappling and wounding fishing gear; and
5. miscellaneous gear.

3.4.1. Filtering-type fishing gear

Seine nets

Fishing with seine nets[21] is common in lake, river and coastal fisheries. A seine net is a filtering-type fishing gear, which can fish the entire water column of a fishing reservoir.

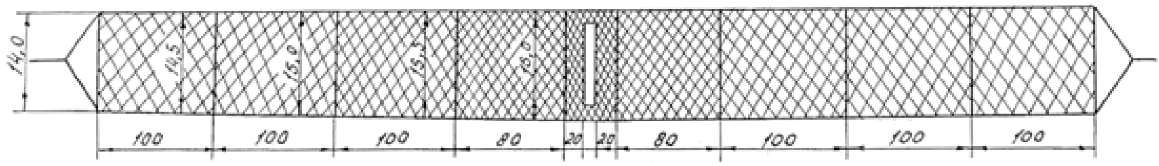
The seine net is a long net 'purse' fixed on upper, lower and side guard ropes. It is set from the shore or from a vessel. The upper net guard rope is equipped with a float and the lower one with a weight. The net wall consists of two wings. Ropes attached to the wings of the seine are used to pull the net ashore or towards a vessel thereby trapping the fish.

Non-equally winged seines are often used in river fishing when fish are moving upstream. Depending on the local fisheries regulations, usually two-thirds of the width of the river is covered by the net, and one-third remains open for the passage of fish. On large rivers, sometimes a smaller part of the river is covered.

Equally winged seines are more often used in lakes when fish are moving downstream to the sea after spawning (e.g. Lower Volga, Ural River), when it is especially important to cover a large area with fishing gear. Equally winged seines are usually 20 percent to 25 percent higher than the depth at the place of fishing and thus cover the water column from the bottom to the surface.

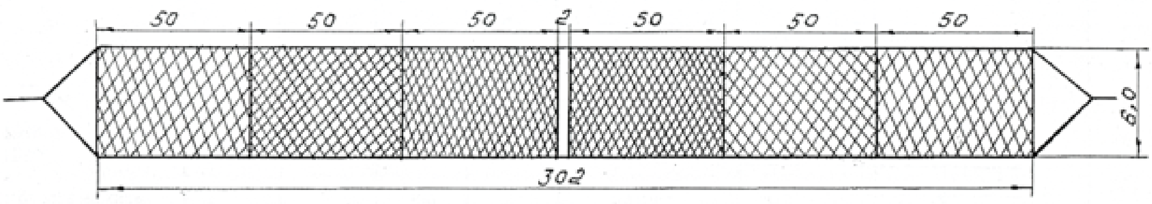
Some examples of seine nets are shown in Figures 3.9 to 3.13.

Figure 3.9. Seine net for Arctic cisco



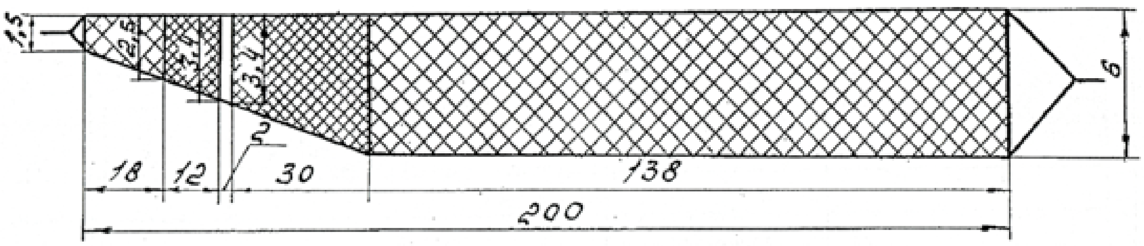
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.10. Seine net for ordinary species



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

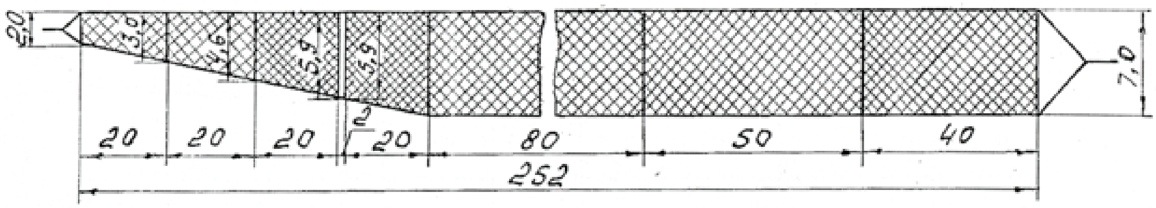
Figure 3.11. River seine net



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

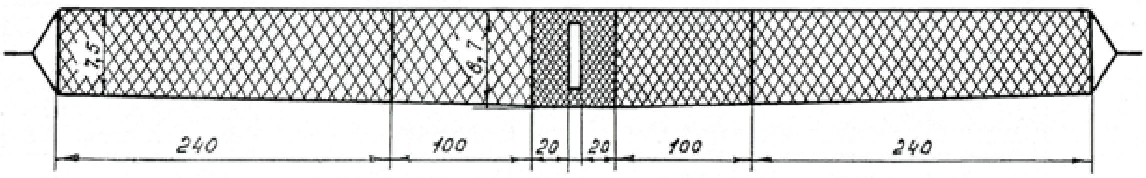
[21] Seine nets are not allowed for amateur and sport fishing in the Russian Federation. They are permitted for research institutes, fish farms and for regions of the Russian Federation where they are not banned.

Figure 3.12. Seine net for vendace



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.13. Winter Baikal seine net



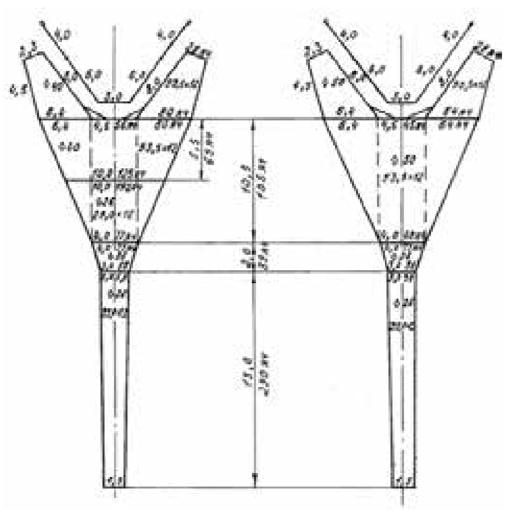
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Trawls

The trawl is a filtering fishing gear in the form of a cone-shaped net bag with a rigging system towed by a fishing vessel along the bottom or in the water column. The trawl filters the water through the net trapping the fish that accumulates in the bag.

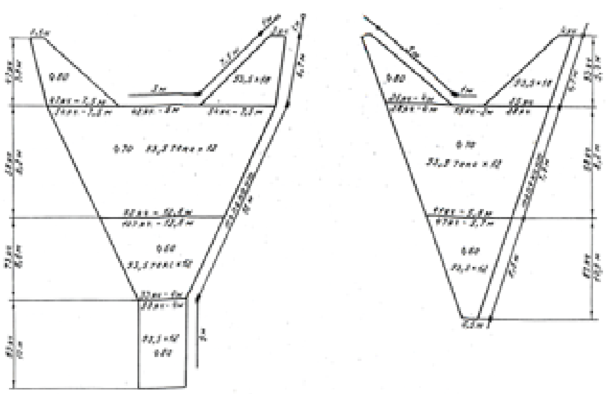
Method-wise, trawls can be for bottom or midwater use. Bottom trawls target aquatic organisms that live on or near the bed of a waterbody or midwater. Some examples of trawl structures are shown in Figures 3.14 and 3.15.

Figure 3.14. Midwater semi-pelagic trawl (Tsimlyansk Reservoir)



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003b. Commercial fishing gear for inland waters of Russia. Handbook, Volume 3. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 248 pp.

Figure 3.15. Midwater trawl

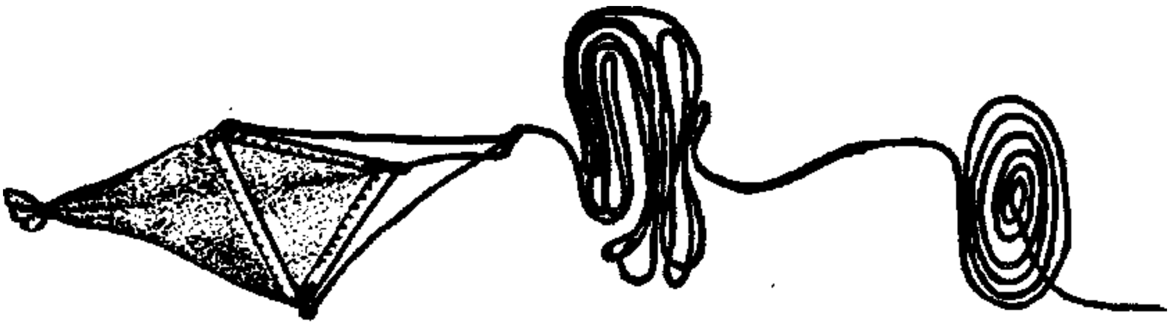


Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003b. Commercial fishing gear for inland waters of Russia. Handbook, Volume 3. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 248 pp.

Dredges

Dredges are filtering fishing gear (Figure 3.16) designed to collect LARs on the waterbody bed, including those that bury into the bottom. The effectiveness of dredges, unlike trawls, does not depend on the reaction of LARs to the movement of the gear along the bed. Manual dredges are used in the inland waters of the Russian Federation (mainly for catching crayfish).

Figure 3.16. Dredge for catching crayfish



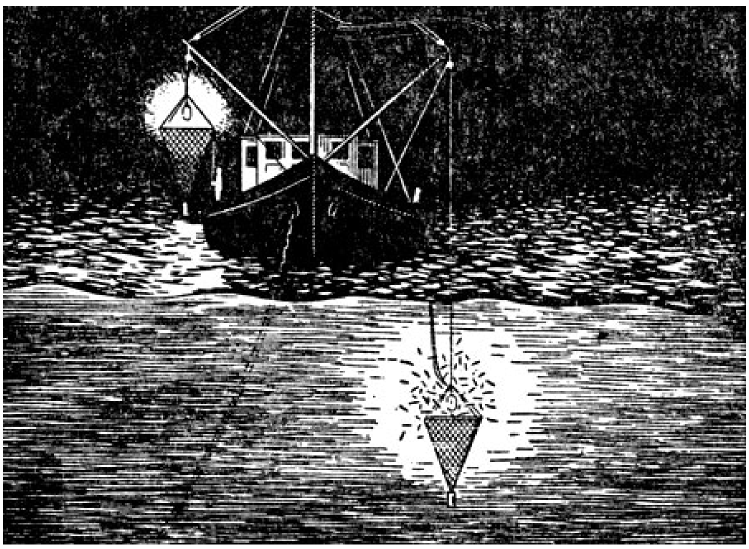
Source: Handbook of pond fish farming / Ed. collegium: A. I. Isaev (ed.) [and others]; All-Russian scientific research institute of pond fisheries. - Moscow: Pishchepromizdat, 1959. - 375 p.

Dredges have a net or a metal basket mounted on a framework, the lower part of which may feature a chain or a similar device for raising bottom species so they get caught in the net as it is pulled through the water.

Lift nets

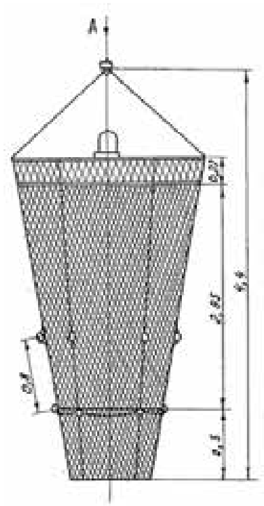
Ship lifting nets are filtering gear equipped with artificial lights (Figure 3.17). The lifting nets are used at night when the fish are attracted to the artificial lights and trapped by quickly raising the net. Fine meshed cone pots are used for catching sprat (*Clupeonella* spp.) in the Caspian Sea. The cone is attached to a metal hoop 2 m to 3 m in diameter with an electric lamp above the opening.

Figure 3.17. Fishing boat using cone pots (with lights)



Source: Agricultural Encyclopedia / Ed. collegium: I. A. Benediktov... P. P. Lobanov (editor-in-chief) [and others]. - 3rd ed., revised. - Moscow: Selkhozgiz, T. 4. - 1955, 670 p.

Figure 3.18. Conical pot



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003b. Commercial fishing gear for inland waters of Russia. Handbook, Volume 3. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 248 pp.

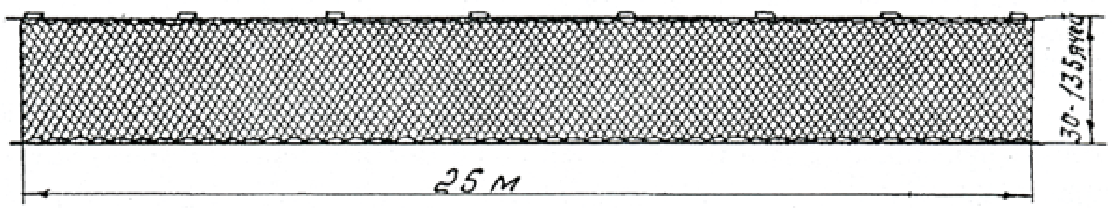
The sprat fishing vessel is normally equipped with two cone pots respectively port and starboard (Figure 3.17). The pots are deployed with outriggers and plunged separately. During lowering, the light is turned on and the sprat concentrate around the lamp. After three to five minutes, without turning off the light, the pot is raised capturing the sprat above it. Then the second pot is deployed. Some vessels have only one pot but use a hoop with a larger diameter. Figure 3.18 illustrates the cone pot and its configuration.

3.4.2. Gillnets and entangling nets

Set gillnets (anchored and on stakes)

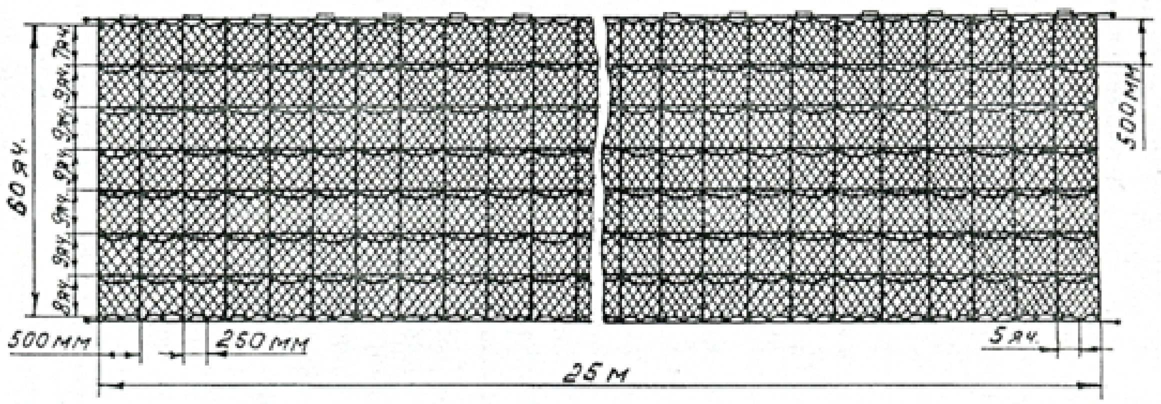
Set gillnets are the most popular fishing gear in the inland waters of the Russian Federation due to the simplicity of the device and use. The set gillnet consists of one or several net panels fixed on upper and lower guard ropes running along the length of the net. The upper guard rope is equipped with a float and the bottom with sinkers. Set gillnets on stakes differ from the anchored set gillnets only in the setting method, therefore the same structures can be installed either by anchoring or staking. Set gillnets have single-panel (Figure 3.19), double-panel and frame versions.

Figure 3.19. Single-panel set gillnet



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

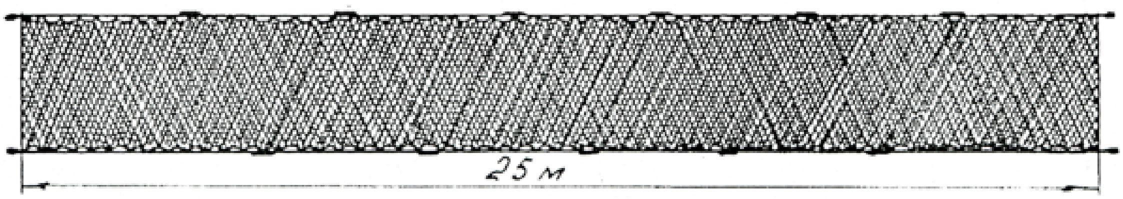
Figure 3.20. Set frame gillnet



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

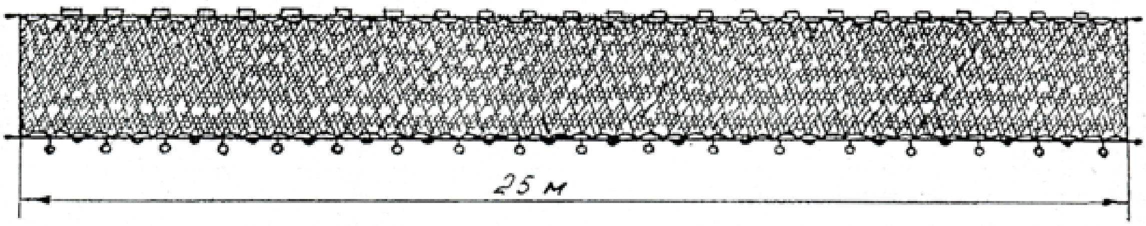
The set frame gillnet (Figure 3.20) has additional square mesh walls on both sides with larger mesh and thread than a regular net. Fish not only become entangled but larger individuals become snagged in the stow net bag. The latter is very important because these nets are primarily used for catching large fish. Catches with the set frame gillnet are significantly higher than catches with the single-panel set gillnet.

Figure 3.21. Double-panel set gillnet



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.22. Trammel set gillnet



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Double-panel set gillnets (Figure 3.21) or trammel set gillnets (Figure 3.22) have two or three net canvases, pulled on top by a cord with floats, and from below by a cord with sinkers.

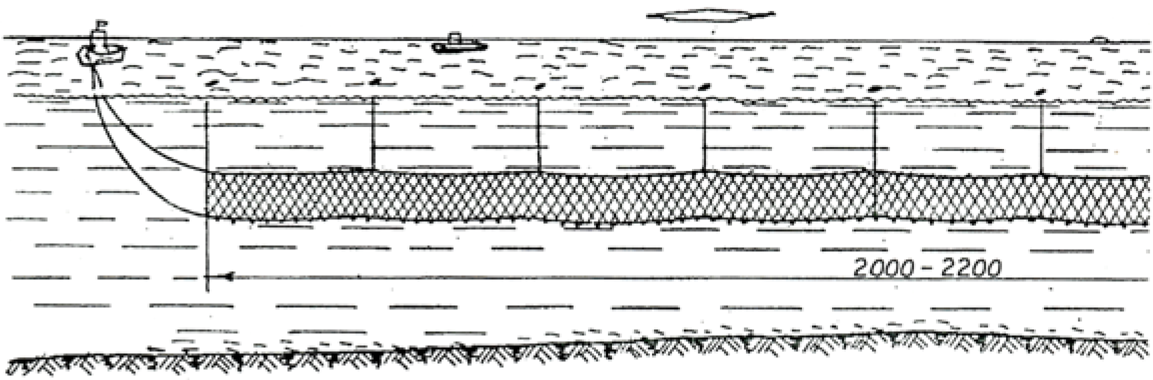
Drift nets

Drift nets are almost identical in design to set gillnets and are used on rivers and lakes. During fishing, they move with the current towards swimming fish for capture.

Drifter fishing (Figure 3.23) differs from fishing with drift net fishing owing to the significantly lower momentum of the nets that intercept approaching fish that swim into the net and get caught. For drifter fishing, dozens of nets are commonly connected in a drifter order.

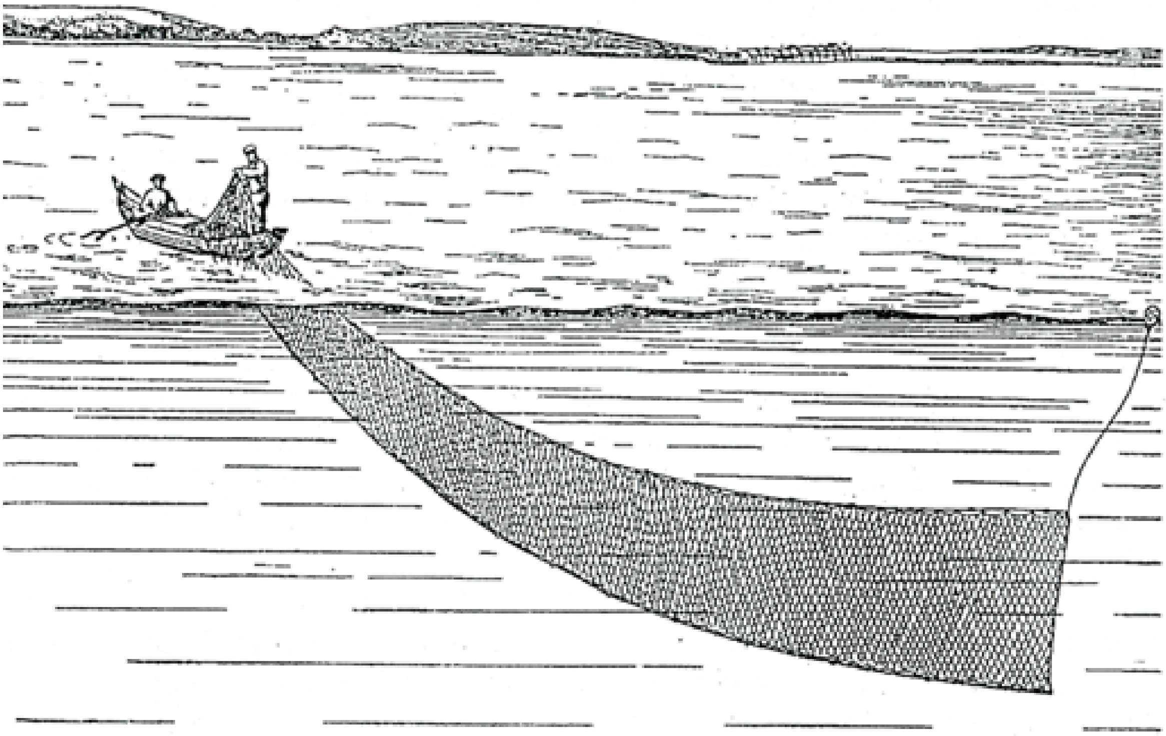
River drift nets (Figure 3.24) have one or more rectangular net panels fixed on guard ropes. Like set gillnets, drift nets have single-panel, double-panel, trammel and frame variations.

Figure 3.23. Drifter fishing



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.24. Fishing with drift nets



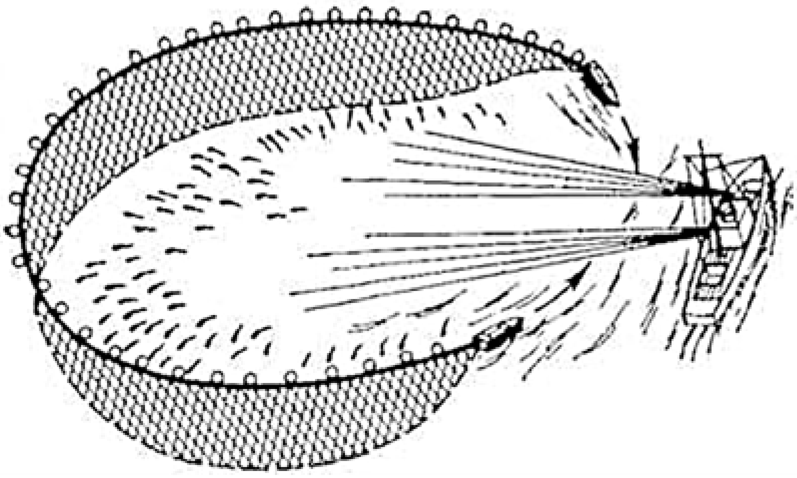
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Encircling gillnets

The encircling gillnet (Figure 3.25) is entangling gear used actively to capture fish in habitats where they are concentrating. Encircling gillnets are single-panel and differ only marginally from single-panel set and drift nets.

In inland waterbodies, encircling gillnets are mainly used in overgrown or snagged sections for catching a wide variety of fish. In the Caspian Sea, encircling gillnets are used to catch mullet. Artificial lights and noise are often used to chase fish into the net.

Figure 3.25. Encircling gillnet



Source: Melnikov, V.N. 1991. Fishing gears configuration and technology of fish catching. Moscow, Agropromizdat. 1991. 384 pp.

According to fishing regulations, fixing encircling gillnets in position is not allowed due to the risk of the gear becoming entangled.

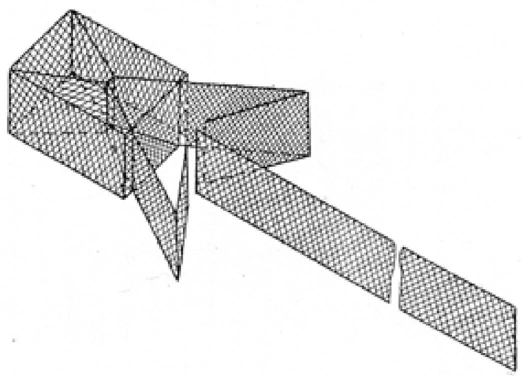
3.4.3. Traps

Stationary uncovered pound nets

Set seines (Figures 3.26 to 3.29) are stationary uncovered traps. Usually they are used in large inland waterbodies where fishing with other gear is less effective or difficult. The set seine can be installed both from the shore and at a distance from it.

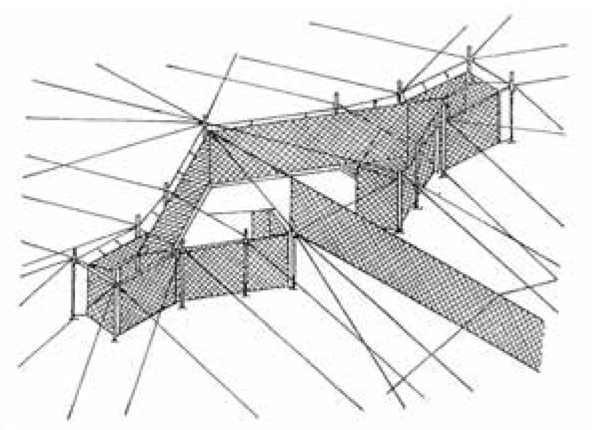
The principle of set seines is blocking the expected path of moving fish. The fish are guided into a system of net barriers and guiding devices where they are trapped and cannot escape.

Figure 3.26. Lake set seine



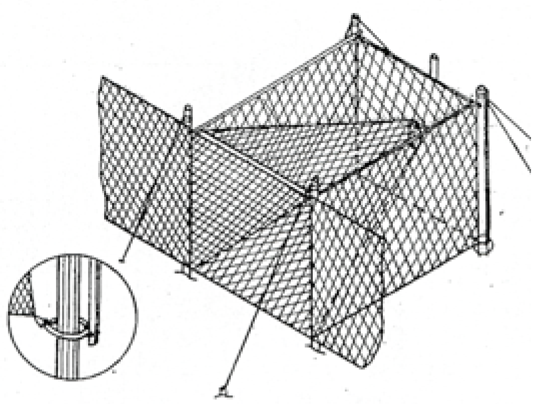
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.27. Set seine for whitefish



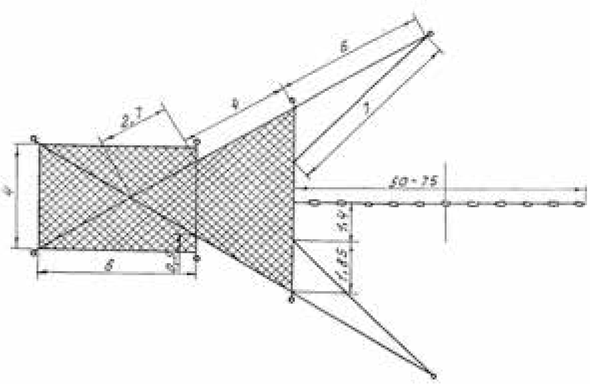
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.28. *Sors*[22] set seine



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.29. Set seine for ordinary species



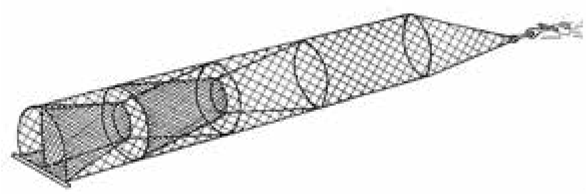
Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

[22] *Sors* is the local name for the shallow bays of Lake Baikal, separated by islands or promontories.

Fyke nets

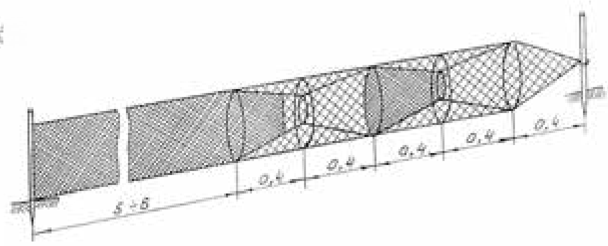
The fyke net (Figures 3.30 and 3.31) is a stationary covered trap. Fyke nets are used in inland waters for catching fish that move against the river current towards spawning grounds, as well as spent fish, moving downstream with the river flow into the sea after spawning. Fyke nets can be used in shallow water, under ice and in locations where bottom conditions prevent other gear from being used.

Figure 3.30. Winter fyke net



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Figure 3.31. Lake fyke net

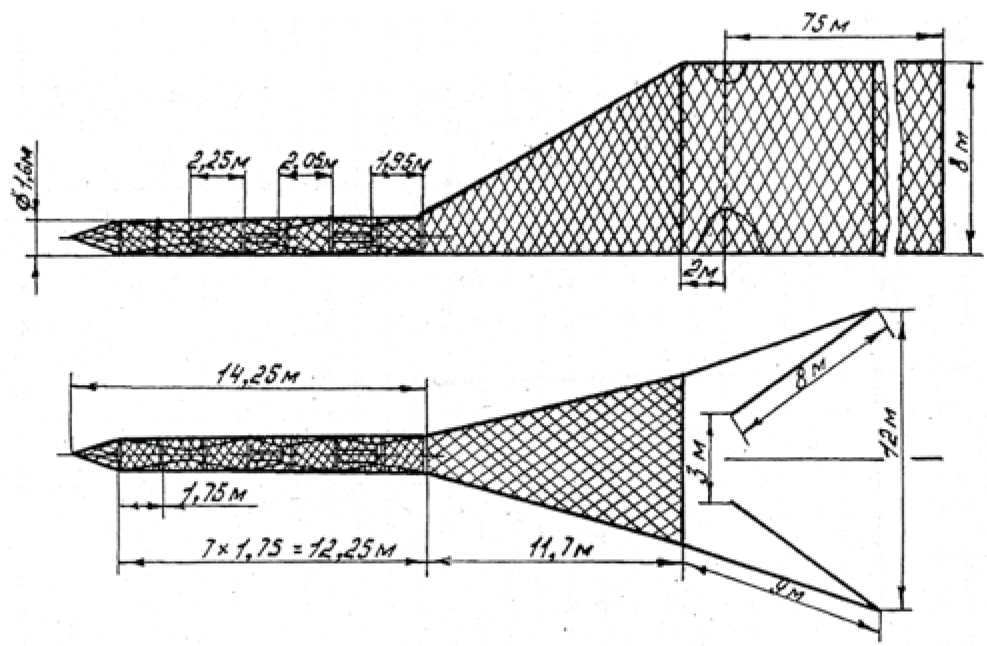


Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Fyke nets have three structural elements: a guiding device, a trap and a cod end. The trap is a large net construction, containing a truncated cone entrance. The cod end serves to concentrate the catch and is a cylindrical or conical net bag. Fyke nets are fixed with stakes and anchors.

The *merezha* (Figure 3.32) is a type of fyke net, that is, a stationary covered trap. It is mainly used in river fisheries, but less often in lakes.

Figure 3.32. *Merezha* for catching European smelt (*Osmerus eperlanus*)

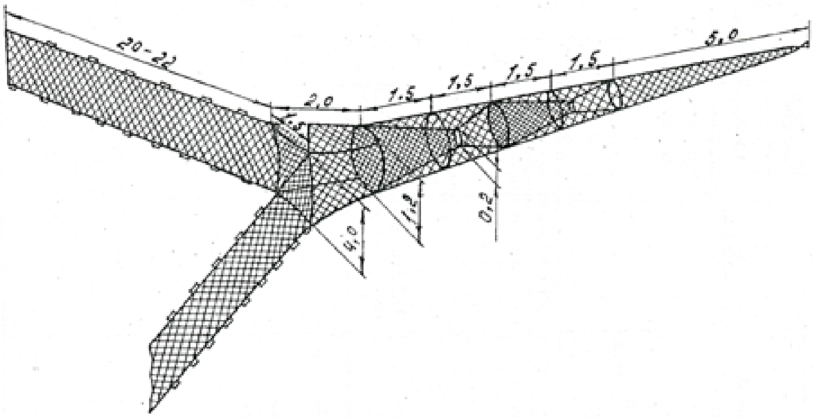


Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

The principle is that when fish meet the stretched wings, they will immediately enter a holding device, from which they cannot escape.

The *ryuza (*Figure 3.33) has the same function as the fyke net and *merezha*.

Figure 3.33. Ryuza for catching ruffe *(Gymnocephalus cernua)*



Source: Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. Commercial fishing gear for inland waters of Russia. Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

3.4.4. Grappling and wounding

Rods and hand-operated pole-and-lines

Many species of fish are caught using rod and reel. There are many varieties of rod and reel designed for different seasons and different species of fish, e.g. those equipped with a float, designed for seasonal fishing in open water, those for spinning, designed to throw tackle with bait[23] over long distances and those for winter fishing.

Each type of handline has varieties, for example, spinning handlines for trolling fish from a motor boat in motion are very durable and can withstand heavy loads.

Longlines

Set (horizontal) longlines (Figures 3.34, 3.35) are hook fishing gear[24] targeting bottom-oriented and bottom-dwelling fish, often on rocky beds, slopes and at great depths. The principle of fishing with set longlines is to attract the fish with a baited hook[25] for it to swallow, become hooked and held by the mouth.

Figure 3.34. Bottom longline

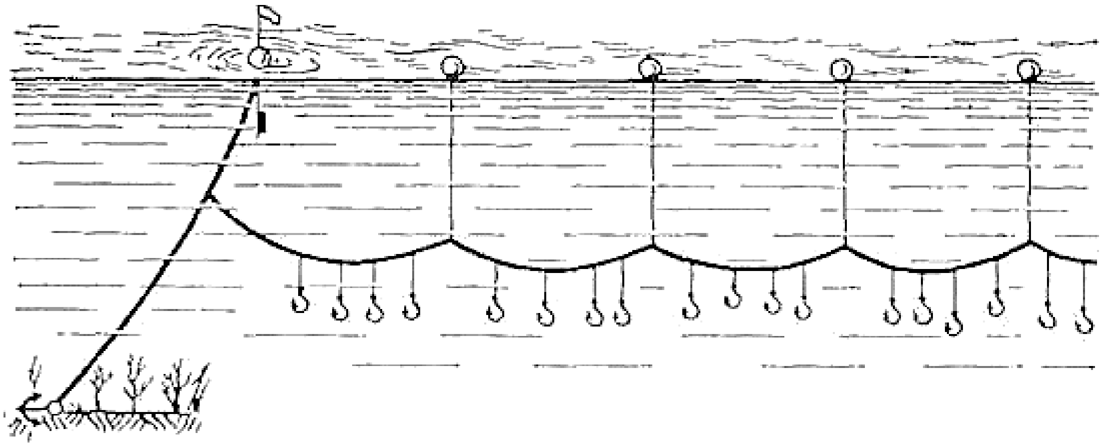
Source: Melnikov, V.N. 1991. Fishing gears configuration and technology of fish catching. Moscow, Agropromizdat. 1991. 384 pp.

[23] Bait can be natural (dead or alive) or artificial (spinners, spoons, jigs, wobblers, flies, lures).

[24] The lengths of the sections of the longline are 200 m to 400 m, the distance between the leads in them is 40 m to 60 m and the lengths of the leads are up to 20 m to 30 m. There can be 2 000 to 3 000 hooks.

[25] The use of longlines with unbaited ripping hooks targeting migratory fish is illegal.

Figure 3.35. Near-bottom longline



Source: Melnikov, V.N. 1991. Fishing gears configuration and technology of fish catching. Moscow, Agropromizdat. 1991. 384 pp.

The set longline usually consists of sections with three main elements: a hook designed to capture and hold the fish; a mainline with ganging, that is, the bearing part of the longline; and floats and sinkers, providing the placement of the tackle in the water. Depending on the conditions and the target species, hooks of various shapes and sizes are used. Longline fishing has three main processes: placing, passive fishing and fetching the longline to collect the catch.

3.4.5. Miscellaneous gear

In industrial fishing in the Russian Federation, fish pumps are used for catching miscellaneous species in inland waters. The fish pump is installed near a waterbody (pool) or on a ship. Caught fish pass through the pipe and are separated from the water that is immediately returned to the waterbody.

In the Caspian Sea, fish pumps have replaced conical pots for catching sprat. The hose of the fish pump is lowered into the water from the side of the vessel. A light source is placed nearby to attract fish. Lured by light, the fish are vacuumed onto the vessel.

3.5. VESSELS OF THE INLAND FISHING FLEET

The fishing fleet of the inland waters of the Russian Federation is quite large (as of 2018 there were thousands of ships and boats). Until the beginning of the nineteenth century, the traditional vessels of the inland fishing fleet were idiosyncratic to the area in which they were used. Traditional fishing vessels in inland fisheries and coastal waters have a long history dating back to the sixteenth century and earlier (Table 17).

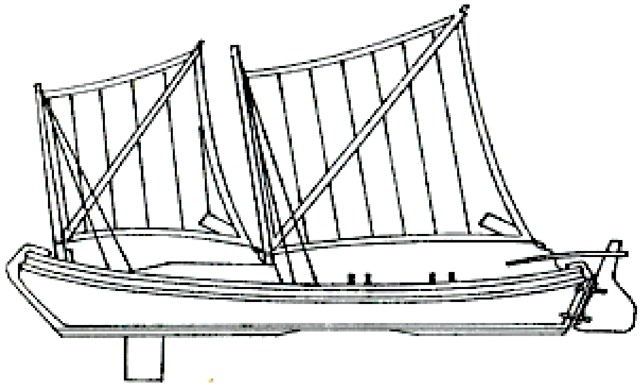
Table 17. Historical the Russian Federation fishing fleet vessels

Region	Vessel type
Pomeranian North	*Karbasses: schneks, elas, karbasses, 'T type'*
Northwest	*Soymas (Figure 3.36), gdovkas;*
South	*Caïques, baydas*
Volga region	*Rybnizci, reyuschki, budarki*

Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

Some vessels evolved from designs used by neighbouring cultures and reflect the specifics of fishing in a particular region and the influence of local natural factors.

Figure 3.36. Soyma



Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

A radical change in the appearance of the fleet occurred from 1940s to 1960s when new types and classes of vessels were created due to the introduction of welded steel hulls, internal combustion engines and mechanical drives for fishing devices.

An essential feature of the inland water fleet is that it consists mainly of small vessels adapted to the diversity of inland water environments. Some vessels must be able to negotiate 1 m- to 3 m-high swells; others must be capable of navigating in shallow water and have the capacity to pass through narrow channels. Another important factor is the need to ensure that the vessels can be transported by rail and road which obviously imposes certain restrictions on their dimensions. In addition, ships and engines must be easy to maintain and service particularly in small enterprises with poor technical equipment (Trifonov, 2010) (Table 18).

Table 18. The main groups of ships and boats used for industrial fishing in the Russian Federation

Fishing method	Types of vessel
Seine fishing	▪ Longboat-taps ▪ Tone boats ▪ Self-shooting seine boats ▪ Oak seine boats ▪ Moto seine boats.
Net fishing	▪ Net lifting boats ▪ Net boats
Trawl fishing	▪ Trawl boats
Processing	▪ Fish pick-up posts ▪ Casket scows
Receiving and transporting	▪ Receiving and transporting refrigerators ▪ Casket boats ▪ Live fishing vessels ▪ Live fishing well smacks

Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

The fishing fleet is extremely diverse (Mamontov *et al.*, 2003). In a relatively small range of mechanization (up to 300 horsepower), there are 128 different types or variations of similar types of vessels. The fleet mainly consists of vessels that have been in operation for 30 to 50 years which do not meet modern safety and operational efficiency requirements; at least 75 percent of the vessels are motorized.

The inland fisheries fleet has about 6 500 extracting, receiving, transporting and auxiliary vessels with total capacity of 145 000 horsepower.

Most fishing vessels have a low degree of mechanized fishing processes (especially net fishing) and poor sonar and radio communication facilities.

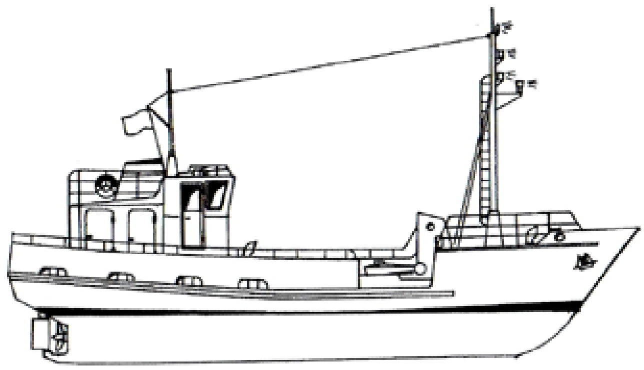
A significant part of the receiving and transporting fleet does not have refrigerated holds and is not capable of fully ensuring the required quality of the transported fresh fish. The fleet has practically no processing vessels for freezing, fish salting and producing fat-flour, etc.) (Mamontov *et al.*, 2003).

Expansion and renewal of the fleet is episodic in nature due to lack of funds among operators; new vessels are often acquired through leasing.

At least 60 percent to 70 percent of the fish landed by industrial fisheries is caught from vessels and 30 percent by ice fishing in winter.

Net lifters and net boats are the main vessels in this class. Model 111 and 211 ships are the most common vessels in inland waters of the Russian Federation (Figure 3.37). These vessels have sufficient seaworthiness to work in waterbodies belonging to category 'M'[26] of the River Register classification; they can operate up to 10 miles offshore and withstand Beaufort wind force of up to 4 (11 to 16 knots).

Figure 3.37. Net lifting boat, model 211

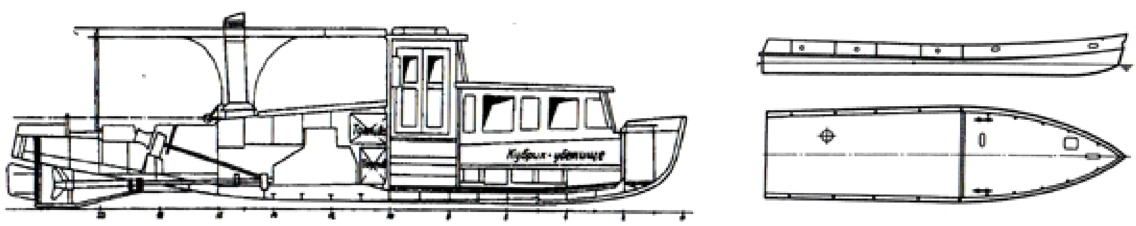


Vessel characteristics	Size
Maximum length	14.9 m
Width	3.7 m
Board height	1.5 m
Draught with cargo	1.12 m
Displacement with cargo	24.2 tonnes
Fish-carrying capacity	4.5 tonnes
Speed	6.5 knots
Main engine power	29.3 kW
Autonomy	8 days
Crew	5 persons

Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

Seine fishing vessels are more likely to be mechanized and the fish hauls are of higher quality than those of gillnet fishing. There are various classes of ships designed to work with seines. Deploying a seine from a self-shooting seine boat, towed by a longboat tap is a common practice (Figure 3.38).

Figure 3.38. Self-shooting seine boat (left) and longboat tap (right) (Trifonov, 2010)



Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

[26] Category M: Waves with a height of 3 m have a total repeatability of not more than 4 percent of navigation time.

Motor seine boats can be divided into large (lake) and small (river) types. A specific feature of many motor seine boats is the presence of a stab barbell because at shallow depths, the use of a conventional anchor device does not hold the vessel properly in place. For example, on model 6007B of the motor seine boat there are three stab barbells: one on the bow and two on the stern, along the sides.

All motor seine boats are notable for their fitness in towing non-self-propelled vessels. This allows them to be used as tugboats during transportation in the interfishing season period as well as for self-shooting seine boats, casket scows, live fishing well smacks, floating fish pick-up posts and guardships during fishing.

The number of specially designed vessels for trawl fishing is limited. Most have multipurpose functions although only one is usually needed owing to specific fishing practices in particular waterbodies.

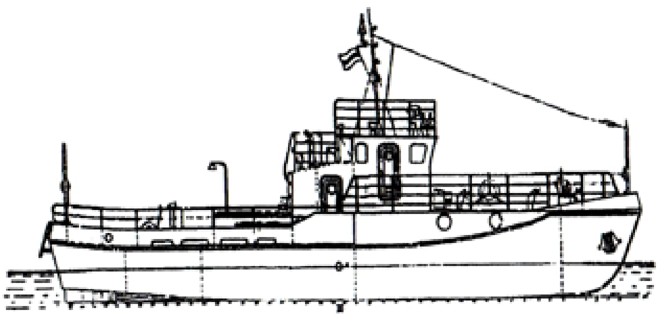
In twin trawl fishing, various types of towing boats (BMK-90, KS-100) are widely used. For stern patter trawling, model 716 boats designed for marine trawling have been used for a long time. To upgrade the technology, the Siberian Fish Research Institute Project designed model 20790T with a stern portal (Figure 3.39).

The main purposes of processing vessels are storing and conducting primary processing of fish for transfer to receiving and transport vessels.

In the past, the bulk of the processing fleet was built for Western Siberia, the South Volga and the Caspian Basin.

Figures 3.39 and 3.40 illustrate and provide details on a trawl boat and a casket scow (a processing vessel). Among the self-propelled processing vessels (PTR pr. 6001, PTR-150), a freezing reception floating base pr. 891/3 can be noted. However, the most common types of processing vessels are casket scows. These are vessels of the LPS-12, 6090, 6090-K, 70170 models (Figure 40).

Figure 3.39. Trawl boat, model 20790T (Trifonov, 2010)

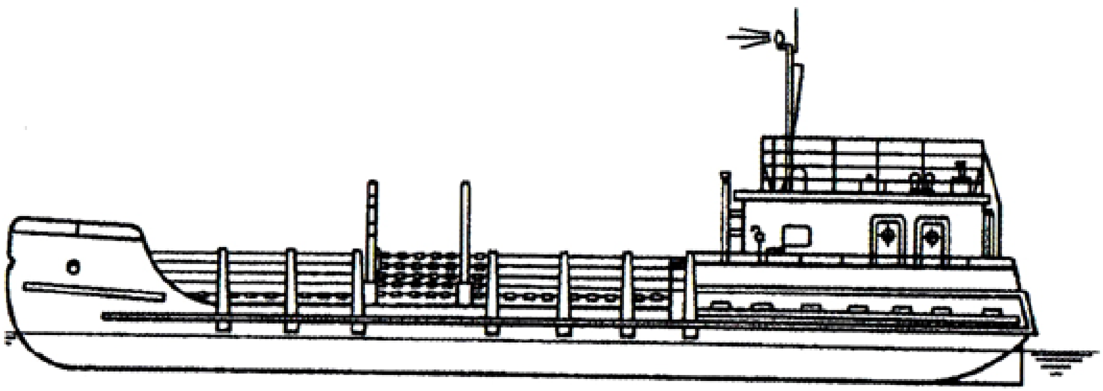


Vessel characteristics	Size
Maximum length	21.3 m
Width	3.95 m
Board height	1.7 m
Draught with cargo	1.1 m
Displacement with cargo	41 tonnes
Fish carrying capacity	4.5 tonnes
Speed	16.5 knots
Main engine power	110 kW
Autonomy	5 days
Crew	4 persons

Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

Fish storage on these vessels is carried out with an ice and salt mixture and on model 70170 (Figure 3.40) also in a liquid environment, in a cold weak NaCl solution. This model only requires a crew of two. The main advantage is the low cost of construction. The main disadvantages include the lack of an ice maker on board. For this reason, casket scows use crushed ice delivered by receiving and transporting ships. Refrigeration units are equipped on fish pick-up posts of the pr. 6006 and pr. 1345 'Beaver' models.

Figure 3.40. Casket scow, model 70170 (Trifonov, 2010)



Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

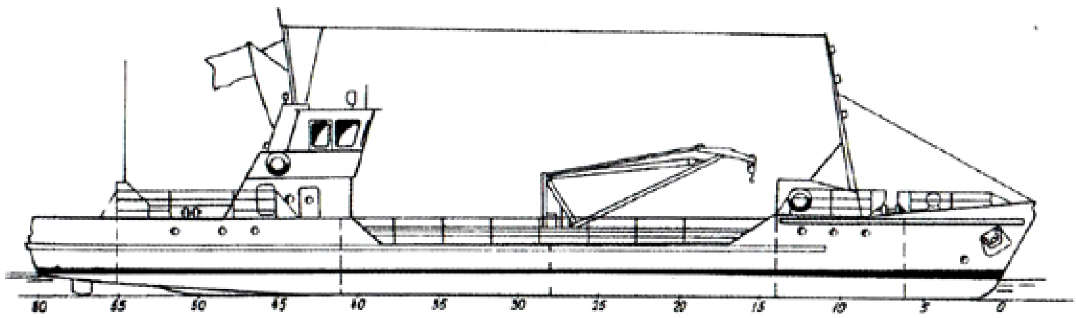
As a rule, fish pick-up posts have a pontoon-type hull providing sufficient storage space for fish.

Receiving and transporting vessels are most widespread in Siberia and the Volga region. These are mainly vessels with refrigerated holds, although from 1980 to 1990 in Western Siberia casket scows were used for transporting fish in an ice and salt mixture.

One of the most successful of these vessels was the refrigerated 'Kolonok' model (Figure 3.41).

The largest of the receiving and transporting vessels of inland waterbodies was model 6009, built in Tobolsk, which could maintain temperatures in the holds of up to -18 °C. Two MAK-30/1 compressor and condensing units with capacity of 1 500 kcal/h were installed on this vessel.

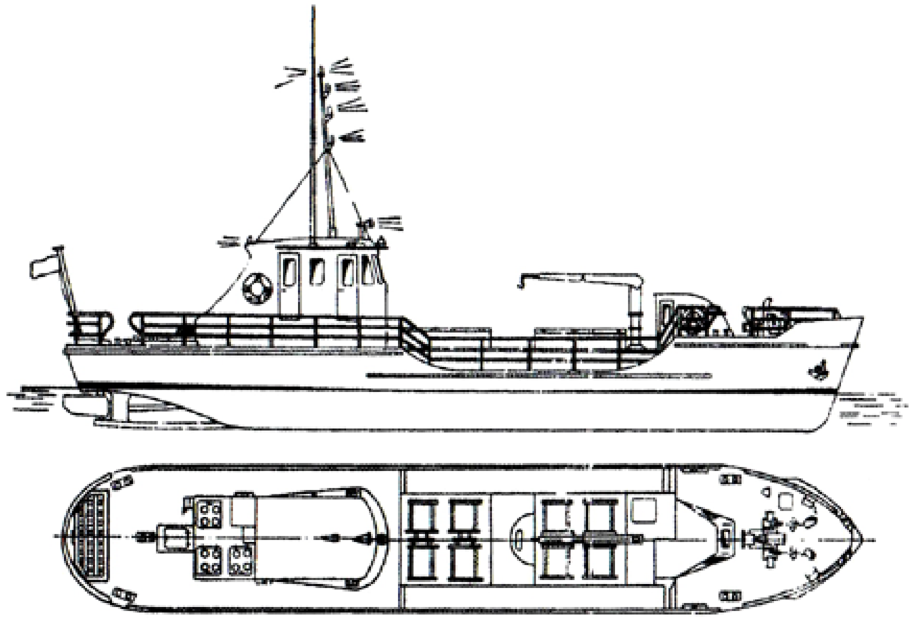
Figure 3.41. Model 1344 Kolonok receiving and transporting vessel (Trifonov, 2010)



Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

In addition to vessels with refrigerated holds, ships for the transportation of live fish (motorized and unmotorized) were designed and built (Figure 3.42). In particular, model 6175 was equipped with two flowing tank holds. The production of live fishing well smacks at the Primorsko–Akhtyrskaya shipyard continued into the 1990s.

Figure 3.42. Live fishing boat model 926 (Trifonov, 2010)



Source: Trifonov, A.V. 2010. River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives. Publishing House TransLit. 144 pp.

4 Time series of inland fish catches by region

**Pavlova, A.O.,
Bondarenko, G.A.,
Grigoryeva, E.G.,
Samoylenko, V.V., and
Ivanov, D.S.**

The extraction of LARs in inland waterbodies is carried out within the boundaries of eight basins in the territory of 79 constituent entities of the Russian Federation.

The largest catches occur in the Volga–Caspian and Far Eastern fishery basins, while the Northern fishery basin is the most unproductive. In 2004, three new fishery basins were created out of the Far Eastern fishery basin: the Baikal, East Siberian and West Siberian fishery basins. The West Siberian fishery basin occupies a leading position in the catch of LARs in the country.

The total catch of LARs in inland waters in 2018 amounted to 269 100 tonnes, which was 1 475 tonnes lower than 2017 (Table 19). The Volga–Caspian fishery basin contributes most of these catches (37.9 percent or 101 887 tonnes) supplemented by the West Siberian fishery basin (25.4 percent or 68 466 tonnes). The share of the Far Eastern fishery basin amounted to 19.4 percent (52 297 tonnes) in this period. The remaining basins account for a total of 17.3 percent (Appendix 5, Tables 5.1 to 5.9). As in previous years, the predominant species in the catches are *Carassius* spp., freshwater bream, roach, European perch and northern pike, the total share of which was 47 percent of the total catch (VNIERH, 1991, 1994, 2000, 2003; FAF, 1990-2018; VNIRO, 2016a).

Table 19. Distribution of inland catches by fishery basins, 1990 to 2018 (tonnes)

Inland fishery basin*	1990	1995	2000	2005	2010	2015	2016	2017	2018
Far Eastern fishery basin**	89 519	58 457	76 574	87 465	97 886	136 532	98 813	67 042	52 297
Northern fishery basin	4 945	3 244	5 164	4 094	4 646	4 777	4 344	12 046	5 295
Western fishery basin	12 353	8 939	14 050	12 730	11 107	13 691	12 390	11 809	16 269
Azov–Black Sea fishery basin	20 852	10 947	15 292	7 527	12 547	10 896	8 536	10 757	13 157
Volga–Caspian fishery basin	228 445	131 287	181 288	71 346	90 598	75 938	82 905	80 512	101 887
West Siberian fishery basin	---	---	---	29 193	37 772	33 002	73 712	76 167	68 466
Baikal fishery basin	---	---	---	3 232	4 666	5 582	5 157	5 936	4 945
East Siberian fishery basin	---	---	---	3 650	3 761	4 672	7 033	6 290	6 768
Total	356 114	212 874	292 368	219 237	262 983	285 090	292 890	270 559	269 084

* The division of inland waters into eight fisheries basins was introduced in 2004.

** Until 2004, the West Siberian, Baikal and East Siberian basins were part of the Far Eastern fishery basin.

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П(fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018..

4.1. NORTHERN FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

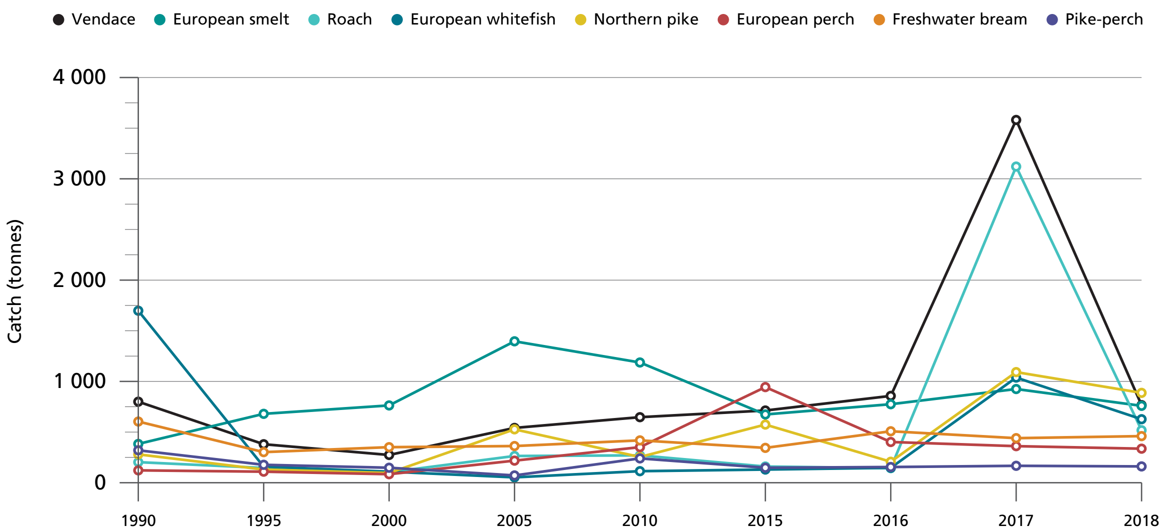
The Northern fishery basin includes areas of the Barents Sea, White Sea and Lake Onega and the associated river basins, as well as waterbodies located in the Republic of Karelia, the Komi Republic, the Nenets Autonomous Okrug, and the Arkhangelsk, Murmansk, Vologda and Kirov regions. It is limited by the basins of the abovementioned rivers. This region has the most significant lake resources. However, as a rule, most of them are of no interest for fishing purposes. The main fishery is concentrated on large rivers (the Tuloma and Paz for example), as well as on medium-size and large lakes (Onega and others) and reservoirs (Verkhneteriberskoye and others).

The reason for the low yield in the lakes is not only their low fish productivity, but also the low population density in the region, as well as poorly developed transport infrastructure. The most significant waterbody in terms of fisheries in the basin is Lake Onega, where almost half of all LARs in the basin are caught (VNIRO, 2016b).

In 2018, 5 295 tonnes of LARs were caught in freshwater bodies of the Northern fishery basin – 6 751 tonnes lower than the record year of 2017. Roach and vendace catches returned to their usual level. The level of development of the resource base in the basin remains one of the lowest in the country and amounts to only 31 percent of possible catches.

The catch of the main species in the Northern fishery basin is presented in Figure 4.1.

Figure 4.1. Catches of the main fish species in the Northern fishery basin, 1990 to 2018



Source: Authors' elaborations.

4.2. FAR EASTERN FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The Far Eastern fishery basin includes the Chukchi, Bering and Okhotsk seas, the Sea of Japan and the basins of the rivers flowing into them, as well as waterbodies located on the land territory of the Russian Federation within the borders of the Chukotka Autonomous Region; Primorsky, Khabarovsk and Kamchatka territories; Jewish Autonomous Region; and the Sakhalin, Magadan and Amur regions. It is limited by the basins of the abovementioned rivers.

The main waterbody in the basin is the Amur River (contributing over 90 percent of the catch in the basin). Compared with the Amur River, the fisheries in other waterbodies of the basin are poorly developed.

The LARs of the basin are represented by more than 130 species; however, the fishery is mainly based on the extraction of Pacific salmon (Table 20), the catch of which can vary significantly for both natural and organizational reasons.

Kamchatka is the only region in Asia where sockeye salmon (*Oncorhynchus nerka*), Chinook salmon (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*) are artificially reproduced and stocked in such quantities that they can be caught in sufficient number to be considered an important and valuable commercial species.

After more than 100 years of intensive exploitation, salmonids remained the main target of the fisheries in the Far East until the middle of the twentieth century. Only with the development of oceanic fisheries, during the 1960s and 1970s, did their share in the total fish catch in the Far Eastern region begin to decline, especially at the time when Pacific salmonid stocks were low.

Nevertheless, since the 1990s, efforts to protect and sustainably exploit these fish, along with favourable climatic conditions for their reproduction led to an increase in the number of the main commercial stocks and populations of the three most important species – pink salmon (*Oncorhynchus gorbuscha*), chum salmon and sockeye salmon. They also allowed healthy stocks of coho salmon and Chinook salmon to be maintained.

From the 1990s to date, and especially in the first decade of the twenty-first century, the salmonid stocks in the Far East have grown (Karpenko 2014, Federal Statistical Observation Undated) (Table 20).

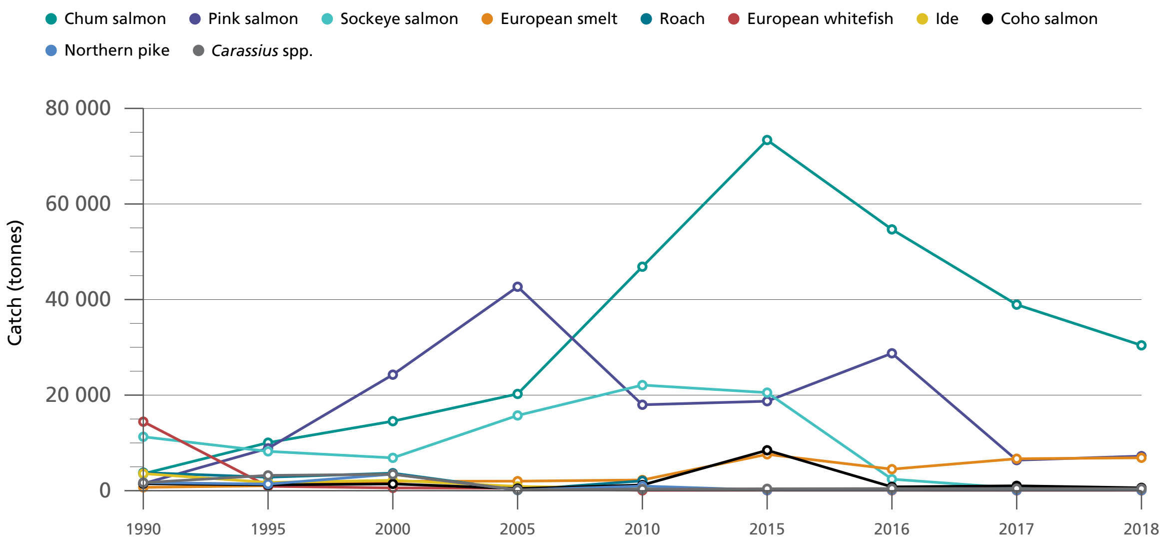
Table 20. Inland catches of Pacific salmon (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Pink salmon	1 476	8 862	24 275	42 680	17 982	18 949	28 763	6 706	7 235
Chum salmon	3 540	10 049	14 546	20 250	46 874	73 387	54 680	38 934	30 419
Coho salmon	1 457	1 213	1 419	442	1 183	8 460	797	1 015	596
Sockeye salmon	11 280	8 229	6 872	15 742	22 100	20 525	2 410	520	381
Masu salmon *(Oncorhynchus masou)*		13	3	9	10	1	1		
Chinook salmon	1 083	738	264	205	99	310	150	3	
Total salmonids	18 836	29 104	47 379	79 328	88 248	121 632	86 801	47 178	38 631

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

The catches of LARs in waterbodies of the Far Eastern fishery basin are subject to significant fluctuations. Over the past five years alone, this value ranged from 136 532 tonnes to 52 297 tonnes. In 2018, 52 297 tonnes of fish were caught in the basin, which was 14 745 tonnes lower than in 2017 (Appendix 5, Tables 5.1 to 5.9). The decrease in total catch volumes is mainly due to the declining catches of chum and pink salmon (Figure 4.2). Among all the commercial species of the Far Eastern fishery basin, the most exploited stocks of LARs are in the Khabarovsky Krai.

Figure 4.2. Catches of the main fish species in the Far Eastern fishery basin, 1990 to 2018



Source: Authors' elaborations

4.3. WESTERN FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The Western fishery basin includes the Baltic Sea and Lake Ladoga with rivers flowing into them and all waterbodies of fisheries significance in the Kaliningrad, Leningrad, Pskov and Novgorod regions as well as Saint-Petersburgh.

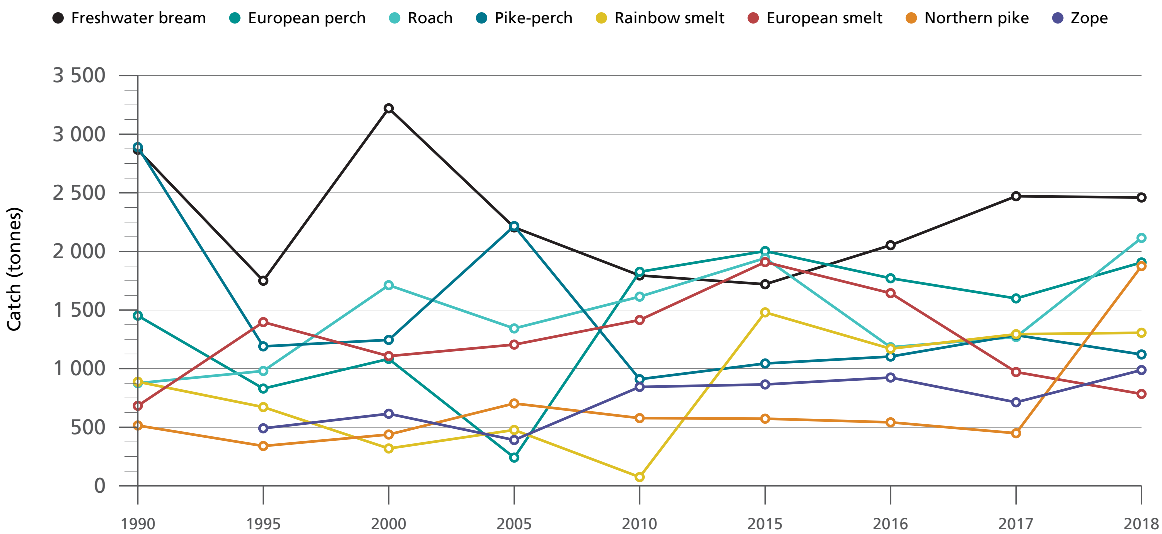
The largest waterbody and the most significant in terms of fisheries in the Western fishery basin is Lake Ladoga. More than 50 percent of the catch of LARs comes from three lakes – Ladoga (12.5 percent), Pskovsko–Chudskoye (24 percent) and Ilmen (13.8 percent).

In the Western fishery basin there is a significant number of small lakes and reservoirs, the fish stocks of which are lightly exploited. Recently, fishers have become more interested in exploiting LARs in small reservoirs because the fish stocks in other reservoirs have become depleted due to over exploitation.

In 2018, 16 269 tonnes of LARs were extracted from freshwater bodies of the Western fishery basin, 4 460 tonnes more than 2017 (Appendix 5 Tables 5.1 to 5.9). The increase in catches was mainly attributable to an increase in the production of northern pike, European perch and roach (Figure 4.3).

The Lake Ladoga fishery produced 2 032 tonnes of fish in 2018 (Appendix 3).

Figure 4.3. Catches of the main fish species in the Western fishery basin, 1990 to 2018



Source: Authors' elaborations.

4.4. VOLGA–CASPIAN FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The Volga–Caspian fishery basin is subdivided into the Northern and Southern fishing regions, delimited by a conventional line at the dam of the Volga Hydroelectric Power Station (Volgograd city).

The southern region of the Volga–Caspian fishery basin includes the Caspian Sea, as well as waterbodies of significance to fisheries in the territories of the Astrakhan region, the Republic of Dagestan, Ingushetia and Kalmykia.

The northern fishing area of the Volga–Caspian fishery basin includes the Volga River from its headwaters to the dam of the Volga Hydroelectric Power Station (the city of Volgograd) with rivers flowing into it, and 14 reservoirs, as well as all waterbodies used for fisheries of the constituent entities of the Russian Federation of the Volga–Caspian fishery basin.

The most significant freshwater body of the Southern fishery region is the Volga River within the Astrakhan region. The largest part of the LARs in the Northern fishery region is concentrated in the reservoirs of the Volga–Kama cascade, of which the Kuibyshev Reservoir plays the most significant role. In 2018, 101 887 tonnes of LARs were extracted from the Volga–Caspian fishery basin, 21 375 tonnes more than 2017 (Appendix 5 Tables 5.1 to 5.9).

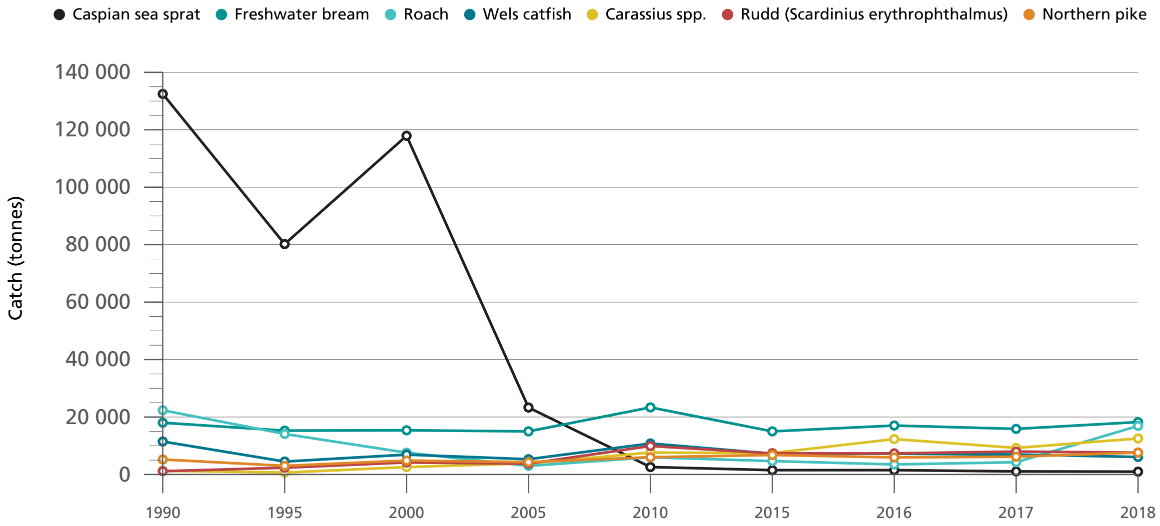
It should be noted that this region has the highest population density in the country. In this regard, it is obvious that the actual catches in the region are significantly different from the official statistics. In particular, in the Southern fishery region, the catch by recreational fishing alone is tens of times higher than the officially declared one. A similar picture is observed in the northern part of this basin, where almost uncontrolled recreational fishing has become widespread during the last decade and has had a significant impact on some fish stocks.

The dominant commercial species in the basin is freshwater bream – the share in catches over the past five years has been around 20 percent, with landings of between 15 001 and 23 350 tonnes (Figure 4.4).

The main fishing areas are concentrated in the Lower Volga within the Astrakhan region and in Kuibyshev Reservoir with 3.7 percent of the landings (3 800 tonnes).

Since 2004, catches have tended to increase in Kuibyshev Reservoir (Appendix 5). The situation in other reservoirs of the cascade is ambiguous. The Ivankovo Reservoir is currently completely closed for fishing apart from recreational and sports fishing. The fish stocks of the Rybinsk, Gorkovsky, Cheboksary and other reservoirs are exploited quite intensively.

Figure 4.4. Catches of the main fish species in Volga–Caspian fishery basin, 1990 to 2018



Source: Authors' elaborations.

4.5. AZOV–BLACK SEA FISHERY BASIN

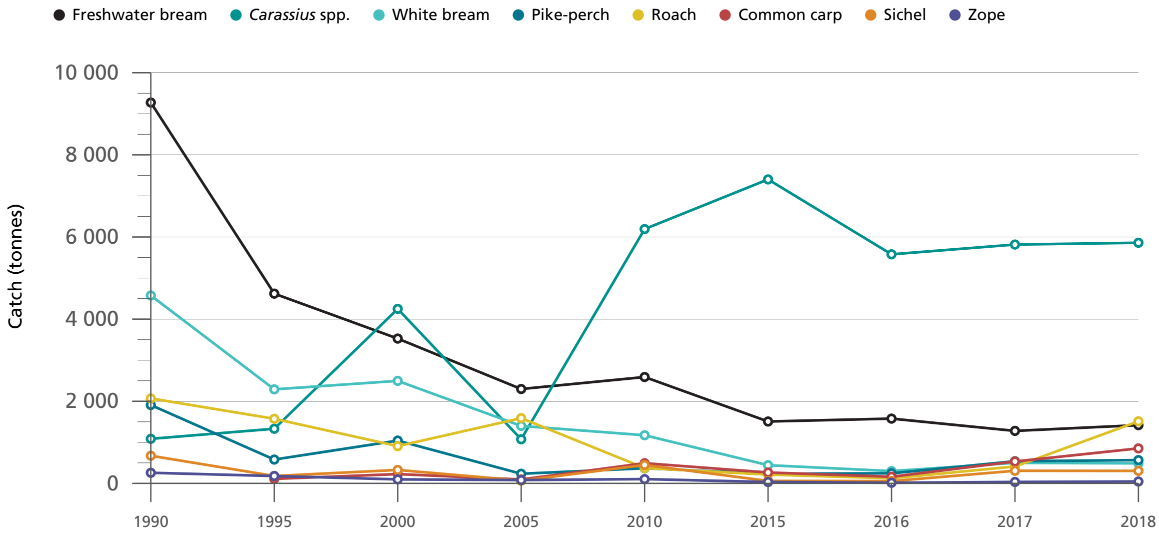
Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The Azov–Black Sea fishery basin includes river basins discharging into the Black and Azov Seas and all waterbodies of the Krasnodar and Stavropol Krai, Volgograd (Don River Basin), Voronezh, Lipetsk, Rostov and other areas of the region.

In 2018, 13 157 tonnes of fish were caught in the inland waters of the basin (Appendix 5, Tables 5.1 to 5.9).

The species composition of the commercial catches of LARs, according to the official statistics, is relatively stable from year to year. As in previous years, in 2018 *Carassius* spp. (44.5 percent) and freshwater bream (10.7 percent) dominated the catches. The share of other fish species was 44.2 percent and crayfish occupied 0.6 percent (Figure 4.5).

Figure 4.5. Catches of the main fish species in the Azov–Black Sea fishery basin, 1990 to 2018



Source: Authors' elaborations.

In recent years, there has been an increase in the catches of LARs from 7 527 tonnes (2005) to 13 157 tonnes (2018). Compared with 2017, there was a slight increase in catches in 2018 due to *Carassius* spp., roach and common carp extraction (see Appendix 5).

The most significant and heavily exploited reservoir in the basin is the Tsimlyansk Reservoir where more than 60 percent of the total catch in the basin is landed.

The catch is dominated by *Carassius* spp., freshwater bream, common carp and European perch, the share of which in 2018 amounted to 87.8 percent of the total catch. In recent years there has been a clear trend towards increased catches of *Carassius* spp.

In other reservoirs in the region, the situation is different. The indigenous fish species are of low value and of no interest to fishers. In addition, suboptimal technical equipment in fishing enterprises, the lack of infrastructure for storing and processing fish, and the high degree of macrophyte overgrowth in individual reservoirs mean that only 50 percent of the available commercial fish stocks is used.

4.6. WEST SIBERIAN FISHERY BASIN

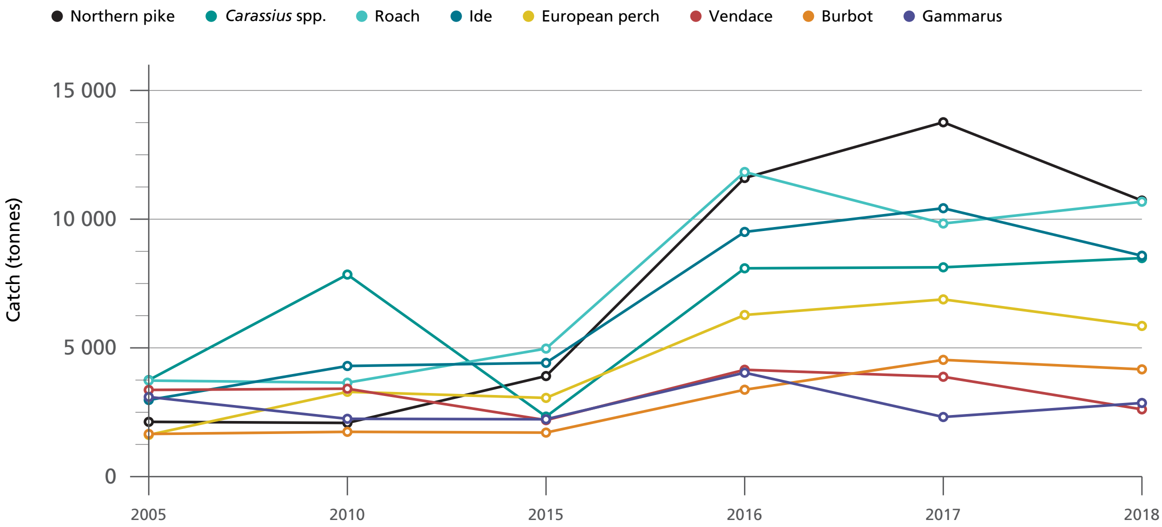
Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The West Siberian fishery basin is divided into the Ob–Irtysh and Yenisei fishery regions and includes the Kara Sea and the Laptev Sea with their rivers, bays, streams, channels, reservoirs, and lakes, as well as other waterbodies.

The total volume of fish catches in the West Siberian fishery basin in 2018 amounted to 68 466 tonnes, 7 701 tonnes lower than 2017 (Appendix 5, Tables 5.1 to 5.9).

Important species are roach (15.6 percent), *Carassius* spp. (12.4 percent), ide (12.5 percent), northern pike (15.7 percent) and European perch (8.5 percent). The invertebrate fishery harvests brine shrimp (*Artemia* spp.) and gammarus (*Gammarus* spp.) (Figure 4.6).

Figure 4.6. Catches of the main fish species in the West Siberian fishery basin, 2005 to 2018



Source: Authors' elaborations.

4.7. EAST SIBERIAN FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

The East Siberian fishery basin includes the East Siberian Sea and the Laptev Sea with basins of rivers flowing into them through the Republic of Sakha (Yakutia) and all waterbodies of significance to fisheries located within the borders of the Republic of Sakha (Yakutia), Chukotka Autonomous Okrug, Magadan Region, Amur region and Khabarovsky Krai. It is limited by the basins of the abovementioned rivers.

However, official statistics only consider the catches of LARs in the Republic of Sakha.

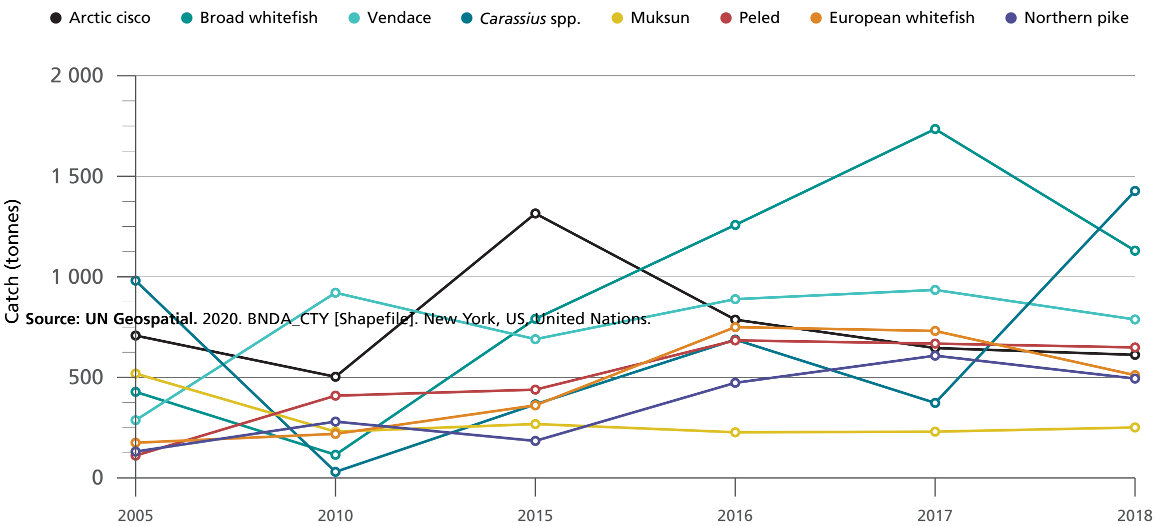
The Republic of Sakha has huge water resources, however, only 28 rivers, 8 000 lakes and the Vilyui Reservoir are managed to some degree.

Fishing in the Republic of Sakha is based on the extraction of semi-diadromous whitefish species (sheefish, muksun and Arctic cisco) during their spawning migrations and on their feeding grounds. The by-catch of immature and first spawning species is very high on the breeding grounds, which has been the main reason for the decline in the populations of these important commercial species.

In 2018, the officially recorded fish catch in the East Siberian fishery basin amounted to 6 768 tonnes, 478 tonnes more than in 2017 (Appendix 5, Tables 5.1 to 5.9). The dominant species in the catch was *Carassius* spp., however, as in previous years whitefish as a group was the most important, i.e. vendace (11.6 percent), Arctic cisco (9 percent), broad whitefish (16.6 percent), European whitefish (7.5 percent), peled (9.6 percent) and muksun (3.7 percent) (Figure 4.7).

The most significant waterbody of the East Siberian fishery basin is the Lena River.

Figure 4.7. Catches of the main fish species in the East Siberian fishery basin, 2005 to 2018



Source: Authors' elaborations.

4.8. BAIKAL FISHERY BASIN

Source: UN Geospatial. 2020. BNDA_CTY [Shapefile]. New York, US, United Nations.

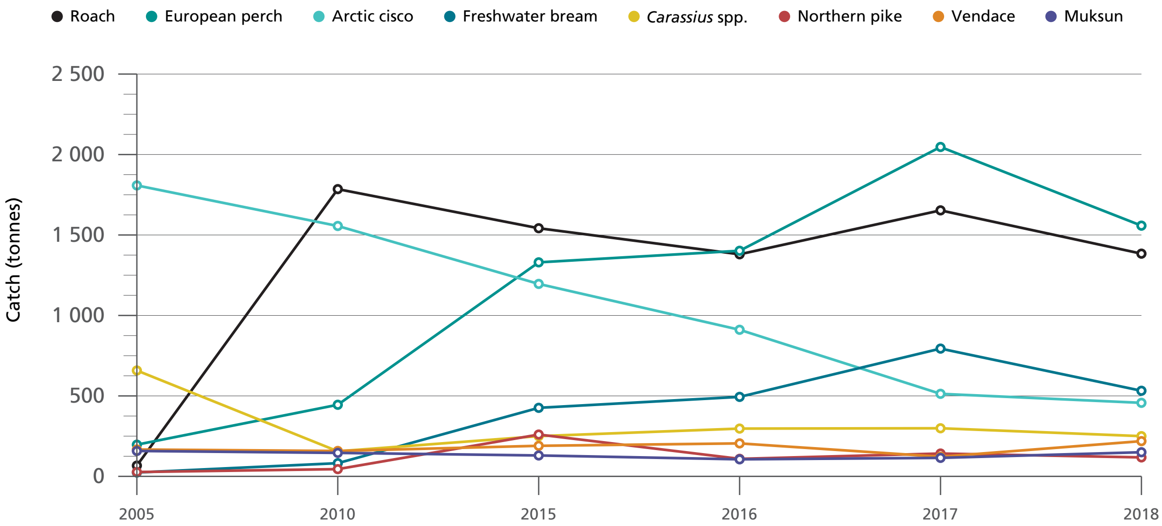
The Baikal fishery basin includes Lake Baikal with basins of the rivers discharging into it, the Angara River with associated reservoirs and other waterbodies of fishery significance located within the borders of the Republic of Buryatia, the Zabaykalsky Krai and the Irkutsk region.

The total volume of fish catches in the Baikal fishery basin in 2018 amounted to 4 945 tonnes, 991 tonnes lower than 2017 (Appendix 5, Tables 5.1 to 5.9). The largest and most significant waterbody is Lake Baikal and on average almost 50 percent of the catches in the basin comes from this lake.

As in previous years, commercial catches in the waterbodies of the Baikal fishery basin mainly constituted roach (28 percent) and European perch (31.5 percent). The share of freshwater bream, *Carassius* spp. and other fish species was 41.7 percent (Figure 4.8). In October 2017, fishing for Arctic cisco was almost completely banned in Lake Baikal, so catches were significantly reduced.

In the Bratsk and Ust–Ilim reservoirs, the largest reservoirs in the Irkutsk region, fishing is carried out mainly in areas located near access roads; fisheries are not well-developed in the more distant parts of these waterbodies. Small reservoirs and rivers in this region have poor fisheries potential due to low productivity and inaccessibility. In the reservoirs of the Zabaykalsky Krai, fishing now practically does not exist.

Figure 4.8. Catches of the main fish species in the Baikal fishery basin, 2005 to 2018



Source: Authors' elaborations.

4.9. ADDITIONAL CATCH DATA FROM ALTERNATIVE SOURCES

Assessment of catch data for various types of fisheries was carried out using various sources, including official statistics, administrative data from basin departments for fisheries and conservation of LARs (*rybvods*), publications by the Federal Agency for Fisheries (FAF) scientific literature and other sources.

The catches of fish and other LARs for subsistence were calculated on the basis of the number of Indigenous Peoples of the North, Siberia and Far East. In the absence of official data for this group from 2010 to 2018, forecast values were obtained using actual population growth rates estimated from the 2002 and 2010 population censuses.

Additional indicators in the quantitative assessment of the Indigenous Peoples' catch were taken as the average volume of fish consumption by one person in live weight (170 kg of fish/ year)[27] and the share of the total population of Indigenous Peoples of the North, Siberia and Far East (53 percent) (Rosstat, 2006).

The catch of recreational (amateur) fishing was determined using FAF administrative data (Table 21). Other sources considered that the officially registered catch of recreational fishers required an upward adjustment (Karnaukhov, 2019; Kostyurin, Barabanov and Aseinov, 2014; Barabanov, Tkach and Prosvirin, 2016; Asanov, 2016) and this was taken into account. Typically, a factor of 3

[27] Estimated based on unpublished information from indigenous communities and selected regional media reports.

to 4 and sometimes higher, was used as the corrective coefficient. Corresponding revaluation of the catch by recreational fishing was carried out with an average coefficient of 3.5.

Table 21. Catches by types of fishing in inland waters of the Russian Federation (in tonnes)

Types of fishing	1990	1995	2000	2005	2010	2015	2016	2017	2018
Officially registered catch	356 114	212 874	292 368	219 237	262 983	285 090	292 890	270 559	269 084
Catch for subsistence (Indigenous Peoples)	n/d	n/d	59 767	60 689	61 970	63 209	64 473	65 763	67 078
Recreational fishing [1)]	n/d	n/d	n/d	23 140	22 866	25 610	30 424	30 424	28 903
Revaluation of recreational fishing [2)]	n/d	n/d	n/d	80 991	80 030	89 634	106 485	106 485	101 161
Sport fishing [3)]	n/d	n/d	0	0	0	0	0	0	0
Fishing tourism	0	0	7	18	15	14	26	26	32
Total	**356 114**	**212 874**	**352 142**	**384 075**	**427 864**	**463 557**	**494 298**	**473 257**	**466 258**

1) Estimated by FAF specialists.

2) Catch not taken into account by FAF specialists.

3) On a 'catch and release' principle.

Source: Asanov, A.Yu. 2016. Aquatic biological resources of the Penza region, the Sura River. Bulletin of Astrakhan STU. Series: Fisheries, 2: 7–14.

Barabanov, V.V., Tkach, V.N. & Prosvirin, D.N. 2016. A comparative assessment of the size composition of fish from catches of industrial and recreational fishing in the Astrakhan region.

Bulletin of Astrakhan STU. Series: Fisheries, 2: 34–42.

Karnaukhov, G.I. 2019. The use of stock of aquatic biological resources for fishing and recreational fishing in the Chograi reservoir. International Scientific Journal, 10(88), Part 1: 92–94.

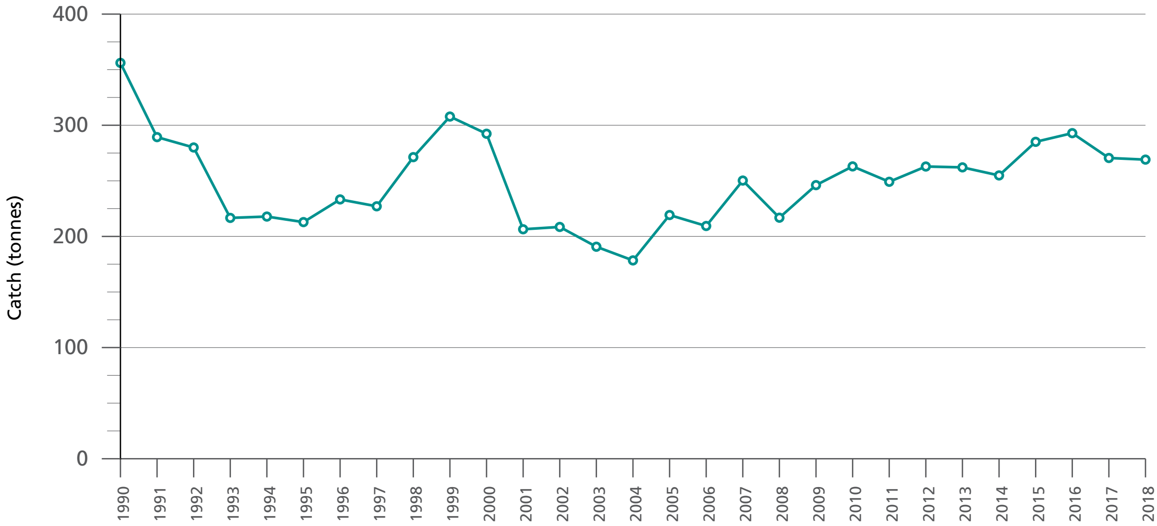
Kostyurin, N.N., Barabanov, V.V. & Aseinov, D.D. 2014. Determination of the impact of recreational fishing on aquatic biological resources of the Volga-Caspian fishing subarea (Astrakhan region) 2012.

Bulletin of the Fisheries Science, 1(1): 16–28..

Estimating the catches for sport fishing, including fishing tourism, required expert knowledge and generally reflected the dynamics of these types of fishing. In this review, it was taken into account that sport fishing does not really affect the indicators of total fish catches in inland waters because it is based on the catch-and-release principle. Until 1990, there was no tangible fishing tourism in the Russian Federation, at least as a type of service, but recently it has been developing at a rather significant rate. However, this type of fishing does not introduce any noticeable changes in the general situation of the catches and the status of the LARs stocks in the inland waters of the Russian Federation.

In accordance with the catch estimates obtained from the various types of fisheries, it was possible to assess the contribution of each fisheries subsector to the overall volume of landed fish (Figure 4.9). The average catches for 2005 to 2018 shown in the figure include recreational fishers' and Indigenous Peoples' catches for subsistence purposes; as a rule, they are included in the total statistically recorded catch. At the same time, according to information of the state bodies of the FAF, the volumes of recreational fishing in relation to industrial production vary widely, from 2 percent (Lower Ob, western region and the Amur River) to 95 percent in central Russian Federation (in the jurisdictional zone of the Central FAF) (FAF, 2006; 2008; 2009).

Figure 4.9. Total inland fish catches in the Russian Federation, 1990 to 2018 according to the official data



Source: Authors's elaborations.

The largest share among all types of fishing (and the greatest threat) is unorganized and unaccounted recreational fishing not included in official data, which, according to expert estimates, reaches up to 41.6 percent of the total statistically recorded catch volume. The danger of this type of fishing lies in the fine line of the transition from recreational fishing to Illegal, Unreported and Unregulated (IUU) fishing.

Fishery for subsistence purposes has a significant weight, which averages 13.4 percent of the total statistically recorded catch of LARs of inland waters. However, indicators of indigenous fish consumption are presented by the first iteration and need additional research.

Sport fishing and fishing tourism have practically no effect on catch volumes and fish stocks (their share does not exceed 0.01 percent of the statistical catch taken).

4.10. ASSESSMENT OF IUU FISHING OF VALUABLE FISH SPECIES

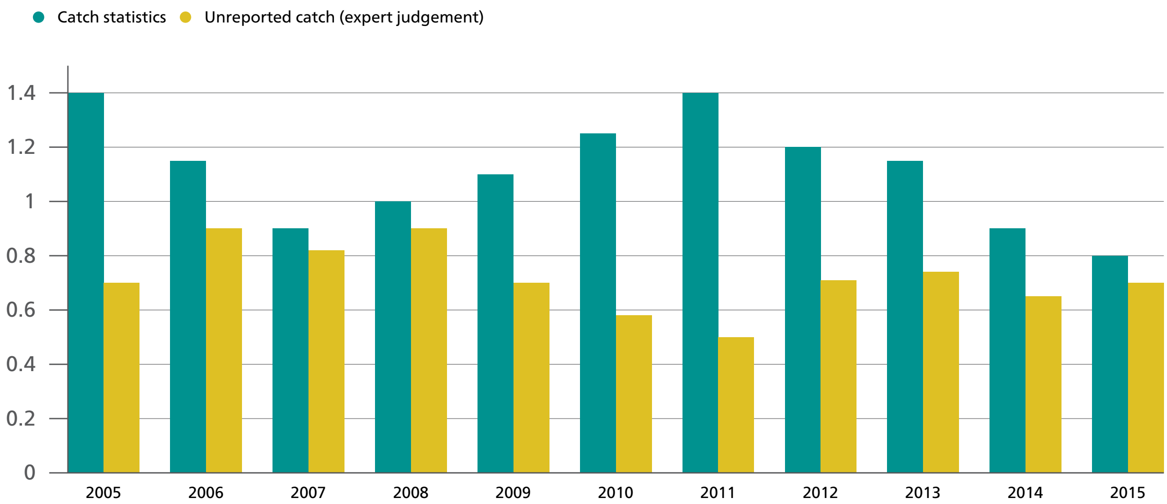
The issues involved with IUU fishing are not so much due to unorganized individuals and/or groups of fishers, but rather licensed users who fail to comply with the management regulations, mostly targeting valuable and especially valuable species of fish (Table 22).

Table 22. Characteristics of different fish species

Characteristics	Species
Especially valuable species	Beluga, kaluga (*Huso dauricus*), Amur sturgeon (*Acipenser schrenckii*), Persian sturgeon (*Acipenser persicus*), Danube sturgeon (*Acipenser gueldenstaedtii*), Siberian sturgeon, starry sturgeon.
Valuable species	Sheefish, coho salmon, sea trout, Caspian kutum (*Rutilus kutum*), Atlantic salmon, lake form of Atlantic salmon (*Salmo salar* morpha *sebago*), rainbow trout (freshwater landlocked form) (*Oncorhynchus mykiss*), muksun, nelma, sockeye salmon, Arctic cisco, Baikal omul, European whitefish, pike-perch, masu salmon, sterlet sturgeon, taimen, European eel (*Anguilla anguilla*), Chinook salmon and broad whitefish.
Large ordinary fish	Northern pike, freshwater bream, burbot, ide, common carp, European perch, wels catfish, pike-perch and others.
Small ordinary fish	Roach, common dace, ruffe, sichel, *Carassius* spp. and others.

Source: Ministry of Agriculture. 2019. Order of Ministry of Agriculture of the Russian Federation of 23 October 2019. No. 596..

Figure 4.10. The ratio of Baikal omul catches according to statistical data and unaccounted catch ('000 tonnes)



Source: Peterfeld, V.A. & Sokolov, A.V. 2016. The current state of cisco stocks (Coregonus migratorius Georgi) in Lake Baikal. Fisheries, 3: 72–75. MNRE. 2018. On the state of Lake Baikal and measures for its protection in 2017. State report. Ministry of Natural Resources and Ecology of the Russian Federation. 223 pp..

The example of the Baikal omul in Figure 4.10 is useful for illustrating the problem (Peterfeld and Sokolov, 2016; MNRE, 2018; VNIRO, 2010). Unsustainable use of stocks of this species led to the establishment of a ban on fishing in 1968, which was lifted in 1987. From 1982 to 2003 catches of Baikal omul were stable, with landings ranging from 1 800 tonnes to 2 700 tonnes and averaging 2 200 tonnes (Peterfeld and Sokolov, 2016). However, since 2004 and to date there has been a significant decrease in Baikal omul stocks and the catches of this species (Figure 4.10).

The scale of unreported fishing is large, mainly due to a decrease in effective protection of fish stocks (Peterfeld and Sokolov, 2016; MNRE, 2018). Unreported catch increased in 2013 to 2015 and almost equalled the decrease in official landings occurring at the same time. According to another source (MNRE, 2018), an expert assessment showed that in 2012, 700 tonnes of Baikal omul were illegally caught; the figures fluctuated subsequently – 730 tonnes in 2013, 690 tonnes in 2014, 710 tonnes in 2015, 510 tonnes in 2016 and 365 tonnes in 2017 (Table 23). IUU fishing from 2012 to 2017 thus grew at a faster pace than the official catches and averaged about 94 percent of the recorded cisco catch (Table 23). Studies suggest that illegal catches ranged from 4 percent to 7 percent of Baikal omul's commercial biomass (or 78 percent in addition to the total legal catch). A similar picture is demonstrated by illegal salmonid fishing in inland waters of the Russian Federation (VNIRO, 2010).

Table 23. Assessment of IUU fishing of Baikal omul (tonnes)

Indicators for Baikal omul	2012	2013	2014	2015	2016	2017
Statistically recorded catch	1 207	1 140	840	793	622	198
Expert assessment of IUU fishing	700	730	690	710	510	365
TAC	1 900	1 800	1 750	1 500	1 100	500
TAC – (fishing + IUU)	-7	-70	220	-3	-32	-63
Ratio of IUU/statistically recorded catch	58%	64%	82%	90%	82%	184%

Source: Peterfeld, V.A. & Sokolov, A.V. 2016. The current state of cisco stocks (Coregonus migratorius Georgi) in Lake Baikal. Fisheries, 3: 72–75. MNRE. 2018. On the state of Lake Baikal and measures for its protection in 2017. State report. Ministry of Natural Resources and Ecology of the Russian Federation. 223 pp.

The expert assessment indicated that approximately 50 000 tonnes to 60 000 tonnes of valuable fish species were landed illegally in inland waterbodies in the Russian Federation from 2016 to 2017. This value could grow to 120 000 tonnes to 150 000 tonnes if IUU fishing of large and small ordinary species is taken into account. However, in this case it is necessary to understand that, probably, a large share of this estimate has already been considered in the catch estimate for unorganized recreational fishing (Table 21).

5 Inland fishery catch by main species

Pavlova A.O.,
Bondarenko, G.A.,
Grigoryeva, E.G.,
Samoylenko, V.V., and
Ivanov, D.S.

Fishery statistics reflect the catch of more than 130 fish species and a small number of crustaceans and invertebrates. The dominant species in freshwater catches is freshwater bream, of which more than 20 000 tonnes are caught annually (Table 24). Cyprinids as a whole account for about 43 percent of the total inland catch, salmonids about 23 percent, whitefishes about 6 percent, smelt about 3 percent and other freshwater fish about 19 percent.

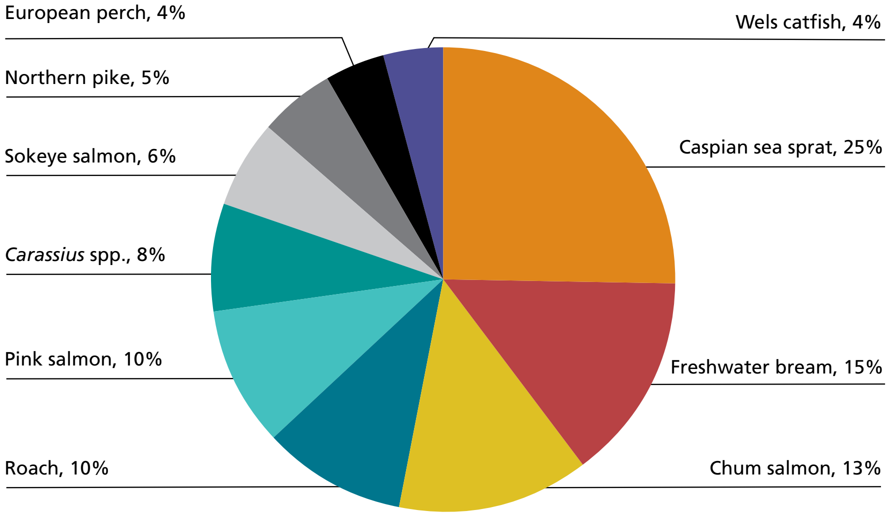
Table 24. Catches of main fish species in inland waters, 1990 to 2018 (in tonnes)

Species/years	1990	1995	2000	2005	2010	2015	2016	2017	2018
Roach	35 274	19 630	13 973	10 122	15 745	13 510	18 190	20 585	33 648
Chum salmon	3 540	10 049	14 546	20 250	46 874	73 387	54 680	38 934	30 419
Freshwater bream	30 755	29 142	23 794	21 937	30 626	20 116	24 364	24 772	26 440
Northern pike	7 802	4 938	8 863	7 978	10 348	12 435	19 077	22 499	21 985
European perch	2 738	2 234	4 026	4 913	11 351	11 045	13 196	14 958	14 136
Ide	4 529	1 977	2 378	4 596	5 143	5 004	10 029	10 902	11 140
European smelt	1 755	3 118	3 825	4 644	4 999	10 315	7 193	8 871	8 836
Rudd	1 147	2 350	4 182	3 785	10 049	7 415	7 371	8 062	7 704
Pink salmon	1 476	8 862	24 277	42 680	17 982	18 949	28 763	6 706	7 235
Wels catfish	11 670	4 590	7 199	5 381	10 980	7 326	7 308	7 057	6 264
Common carp	3 439	752	4 007	2 257	3 430	3 522	3 367	4 821	5 929
Pike-perch	8 654	3 271	3 863	3 121	3 483	3 970	4 838	5 463	5 830
White bream	6 197	3 106	4 123	3 759	5 000	4 786	4 380	4 582	4 594
European whitefish	18 784	1 321	1 200	1 683	1 846	1 636	2 820	3 132	2 166
Caspian Sea sprat	132 477	80 205	117 914	23 310	2 588	1 507	1 509	1 062	983
Sockeye salmon	11 280	8 229	6 872	15 742	22 100	20 525	2 410	520	381
Others	74 597	29 100	47 326	43 079	60 439	69 642	83 395	87 633	81 394
Total	**356 114**	**212 874**	**292 368**	**219 237**	**262 983**	**285 090**	**292 890**	**270 559**	**269 084**

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

In the allocation of the total catch for 29 years (1990 to 2018), the main species were Caspian Sea sprat with 1 336 492 tonnes, freshwater bream with 764 227 tonnes, chum salmon with 708 946 tonnes, roach with 519 215 tonnes and pink salmon with 510 076 tonnes (Figure 5.1).

Figure 5.1. Relative contribution of the major fish species in inland fisheries, 1990 to 2018 (Appendix 1, Tables 1.1 to 1.9)



Source: Authors' elaborations.

However, these data do not provide complete information on the state of fishing during the period. For example, owing to an ecological catastrophe in 2001, almost all the Caspian sprat stocks died, which made fishing unprofitable and caused a severe crisis. Caspian Sea sprat fishing has declined by more than 99 percent since 1990 (from 132 477 tonnes to 983 tonnes).

If the total catch over the past ten years, starting in 2009, is considered, chum salmon (467 008 tonnes), freshwater bream (246 905 tonnes), pink salmon (189 011 tonnes) and roach (182 719 tonnes) remain among the most caught species and *Carassius* spp. has also entered the list (219 819 tonnes) (Appendix 1).

6 Inland fishery catch data by type of waterbody

Pavlova A.O.,
Bondarenko, G.A.,
Grigoryeva, E.G.,
Samoylenko, V.V., and
Ivanov, D.S.

Over the past 30 years, officially registered catches in inland waters have steadily stayed at 255 000 tonnes to 293 000 tonnes, with an average of about 264 000 tonnes (Figure 6.1).

Industrial fishing in most freshwater waterbodies is mainly focused on the withdrawal of species of LARs with a high market value (whitefishes, salmonids, pike-perch), the real catch of which can significantly exceed the amount of the allowable catch established for them. At the same time, the stocks of low-value mass fish species (roach, European perch) are underutilized, which leads to the replacement of the most valuable species in biological systems with species of low value that are unimportant for industrial fishing (Makoedov and Kozhemyako, 2007).

Before the collapse of the Soviet Union, inland waters meant not only rivers, lakes and reservoirs (i.e. mostly freshwater bodies), but also the Black, Azov, Caspian and Aral seas. In some publications, the White Sea, and sometimes the coastal part of the Baltic Sea, were classified as inland waterbodies. In addition, the data on products obtained from commercial farms and the catch of sea mammals were included in the reporting statistics.

In this work, the statistical information on catches and types of inland waterbodies is given in a comparable form to the current accounting structure. So, the Azov, Black and Aral seas, data on aquaculture, as well as catches of aquatic mammals in the Caspian Sea and on Lake Baikal are excluded from catches in inland waters (Table 25).

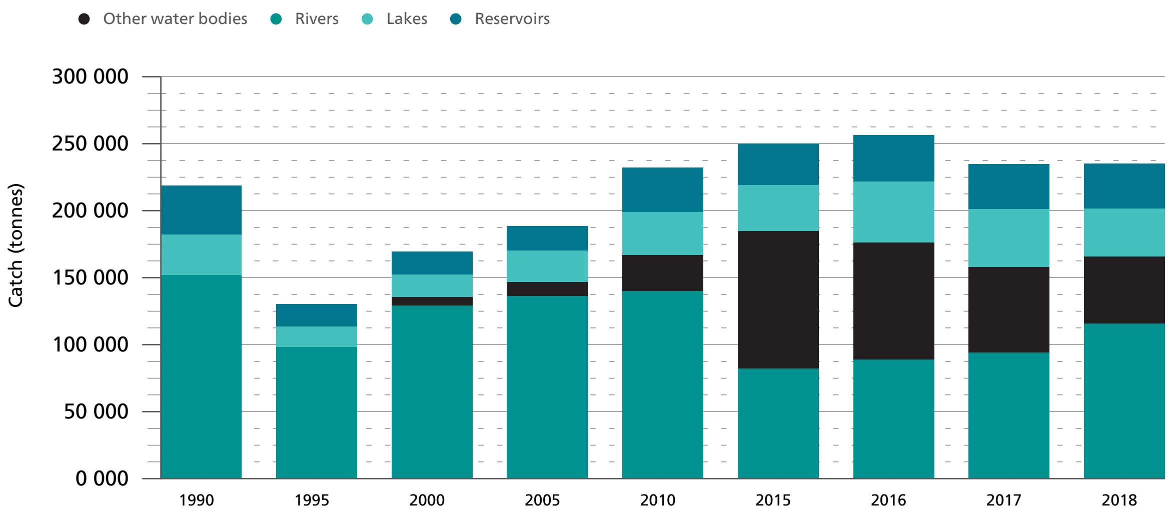
Table 25. Distribution of commercial catches (tonnes) by types of inland waterbodies (1990 to 2018) according to official statistics

Year	TOTAL	Total freshwater waterbodies	Freshwater waterbodies				Caspian Sea
			Rivers	Lakes	Reservoirs	Other waterbodies	
1990	356 114	218 573	151 870	30 223	36 480		137 541
1995	212 874	130 267	98 407	15 273	16 587		82 607
2000	292 368	169 356	129 284	16 731	16 901	6 440	123 012
2005	219 237	188 391	136 401	23 297	18 271	10 422	30 846
2010	262 983	232 182	139 913	32 121	33 069	27 079	30 801
2015	285 090	249 956	82 083	34 619	30 610	102 644	35 134
2016	292 890	256 219	88 937	45 257	34 428	87 597	36 671
2017	270 559	234 619	94 218	42 981	33 384	64 036	35 940
2018	269 084	235 103	115 585	35 597	33 574	50 347	33 981

Source: Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018..

Most of the catch was taken in rivers (≈65 percent of the total catch in freshwater waterbodies over 29 years). Lakes and reservoirs on average contributed 12 percent each, other waterbodies 15 percent (Figure 6.1).

Figure 6.1. Catches in freshwater waterbodies (excluding the Caspian Sea)



Source: Authors' elaborations.

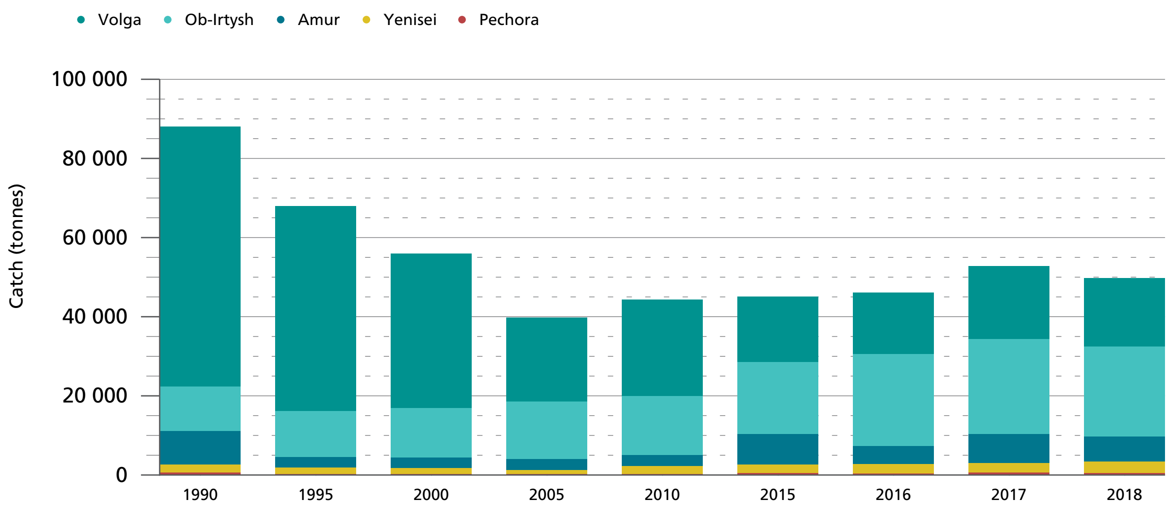
6.1. RIVER FISHERIES

Rivers are the basis of the water resources of the Russian Federation. Over 120 000 rivers with a length of more than 10 km flow through the country, with a total length of over 2.3 million km; the number of small rivers, however, is much larger.

The basins of the Arctic and Pacific oceans contribute about 90 percent of the rivers' discharge, while the basins of the Caspian and Azov seas contribute less than 8 percent.

River fishing of diadromous and semi-diadromous fish is carried out, as a rule, in the estuarine and pre-estuarine areas during their spawning run. In the rivers of the Caspian and Azov basins, the main fishing targets are ordinary species of fish. In the rivers of the North, Siberia and Far East regions, the main target species are various types of whitefishes, European smelt, burbot and salmonids, most of which breed in rivers and fatten in the seas, low salinity bays and inlets or in large lakes. Therefore, rivers and river systems have particular fishery importance as natural spawning grounds for many valuable fish species and feeding grounds for their offspring (Mamontov, Litvinenko and Sklyarov, 2003).

Figure 6.2. Catches in the main rivers of Russia, 1990 to 2018



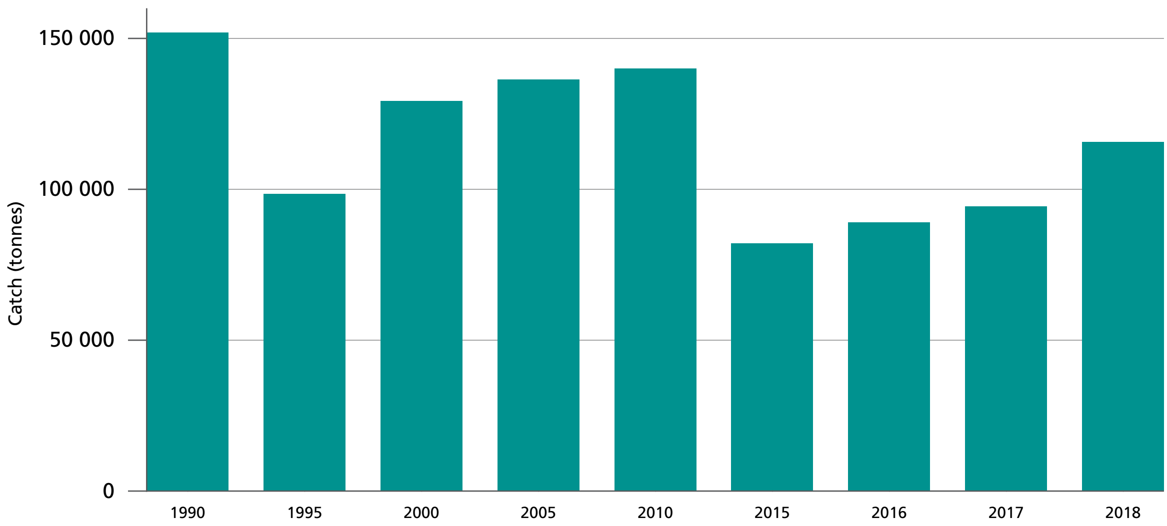
Source: Authors' elaborations.

The rivers of the European part of the Russian Federation have undergone great changes in connection with their regulation and hydropower dam construction. Currently, the Neva, Northern Dvina, Pechora and some other rivers remain unregulated. The regulation of rivers has resulted in many of them losing their roles in the reproduction of fish stocks.

The main volume of fish is caught in the basins of the Volga (within the Astrakhan region), Ob, Irtysh, Yenisei, Khatanga, Lena, Amur and Pechora rivers, of which more than 43 percent is caught in the Volga, Ob, Irtysh, Amur, Yenisei and Pechora basins (Figure 6.2).

The total catch in the rivers of the Russian Federation in 2018 amounted to 115 585 tonnes (Figure 6.2). The catches included valuable species such as freshwater bream, common carp, northern pike, wels catfish, pike-perch and roach (Appendix 2, Tables 2.1 to 2.9).

Figure 6.2. Inland fish catches in Russian rivers, 1990 to 2018



Source: Authors' elaborations.

6.1.1. Lower Volga Basin (Volga–Caspian fishery basin)

The lower reaches of the Volga and its delta are characterized by large stocks of semi-migratory and river fish. This basin is typified by the huge feeding areas located in the delta and the low salinity zone of the Northern Caspian, which can provide a sufficient forage base for fish stocks.

Over the past 29 years, catches in the Volga River in the Astrakhan region decreased dramatically from 65 428 tonnes in 1990 to 17 425 tonnes in 2018. The reason, as mentioned earlier, was dam construction and pollution of the Volga River by industrial and household wastewater.

The main species in the catches in 2018 were freshwater bream (6 072 tonnes), rudd (1 405 tonnes), *Carassius* spp. (2 244 tonnes), roach (1 270 tonnes), pike-perch (663 tonnes), wels catfish (985 tonnes), common carp (237 tonnes), northern pike (783 tonnes) and asp (422 tonnes).

6.1.2. Ob–Irtysh Basin (West Siberian fishery basin)

In 2018, as in the previous few years, the increase in river flow of the basin and improvement of environmental status continued, which led to an increase in fish catches. In this context, the fish catch in the Ob–Irtysh Basin in 1990 amounted to 11 313 tonnes but in 2018 it had doubled to 22 694 tonnes.

Since 1998, the Ob population of the Siberian sturgeon has been listed in the Red Book of the Russian Federation. Therefore, the catch of this species is forbidden; only limited catch for the purposes of artificial reproduction is allowed. The recorded sturgeon catch in 2018 was 0.3 tonnes.

In 2002, industrial fishing for sterlet sturgeon was forbidden. Fishing is carried out only for scientific and reproduction purposes in accordance with the established quota.

European whitefish stocks are in satisfactory condition; the catch in 2018 amounted to 439 tonnes. sardine cisco (*Coregonus sardinella*) stocks are healthy, the catch of this species having increased from 1 217 tonnes in 1990 to 1 830 tonnes in 2018. The catch of peled increased from 661 tonnes in 1990 to 835 tonnes in 2018. In 2018, there was a decrease in the catch of broad whitefish to 79 tonnes, which was 202 tonnes lower than 1990.

One of the important target species in the Ob–Irtysh Basin is northern pike – its catches are constantly growing and in 2018 amounted to 6 327 tonnes which was 351 percent greater than 1990.

Ide stocks are in very good condition. In 2018, 5 008 tonnes were caught, which was 226 percent greater than 1990. In 2018, 1 392 tonnes of burbot, which is a valuable species, were caught.

6.1.3. Yenisei River Basin (West Siberian fishery basin)

In 2018, 2 954 tonnes of fish were caught in the Yenisei River Basin. As in other large rivers of Western and Eastern Siberia, about 40 percent of catches in the Yenisei River Basin is provided by whitefishes, including muksun (84 tonnes), Arctic cisco (45 tonnes), European whitefish (195 tonnes), vendace (419 tonnes) and peled (208 tonnes).

The river has a low population of sterlet sturgeon and other sturgeon species. In order to restore commercial stocks of sturgeon, industrial fishing for these species has been forbidden in the Yenisei River since 1998. The catch of sturgeons is carried out only for scientific and fish-breeding purposes.

In recent years, the catch of northern pike has grown significantly, amounting to 655 tonnes in 2018, which is 131 percent greater than 1990.

6.1.4. Amur River Basin (Far Eastern fishery basin)

Catches in the Amur River decreased from 8 418 tonnes in 1990 to 6 300 tonnes in 2018. The main commercial species is European smelt (5 070 tonnes in 2018), which accounts for more than 80 percent of the total catch in the Amur River.

6.1.5. Pechora River Basin (Northern fishery basin)

The main rivers in the Northern fishery basin are the Pechora River, with a total catch of 448 tonnes in 2018 and the Northern Dvina River (130 tonnes in 2018).

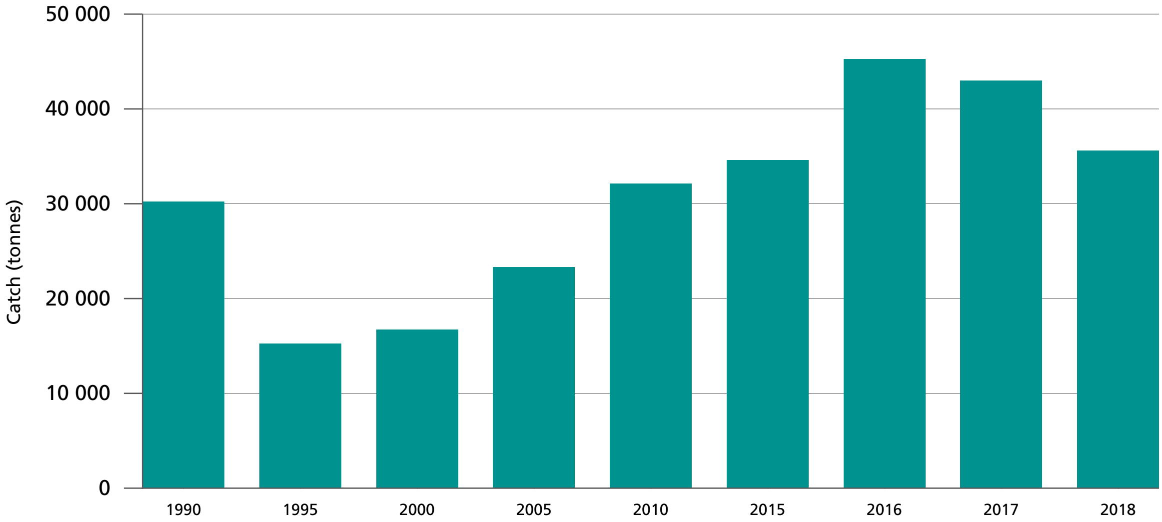
6.2. FISHERIES IN NATURAL LAKES

There are 13.6 million ha of large (more than 10 000 ha) and medium-sized natural lakes (1 000 ha to 10 000 ha) in the Russian Federation. Small natural lakes (up to 1 000 ha) have a total area of 8.9 million ha. However, lakes are unevenly distributed in the Russian Federation. The main lake resources are concentrated in the West Siberian, East Siberian and Northwestern regions of the country (Mamontov, Litvinenko and Sklyarov, 2003).

Large lakes located in industrial and densely populated areas with well-developed road systems are of primary importance for fisheries. Fishing is currently carried out on almost all major lakes.

The total catches of lake fish in the country are relatively small. The recorded fish catch in lakes in 2018 amounted to 35 600 tonnes (13.2 percent of the total fish catch in freshwater bodies of the Russian Federation) (Figure 6.4). There are several reasons explaining the low catches in the lakes. The principal reason is that most of the lakes are located in the sparsely populated and inaccessible Northern and Siberian regions and therefore more than 65 percent of the lakes are not used for fishing. Another reason is the low productivity of many small- and medium-sized lakes (with yields of 0.1 kg/ha to 2.5 kg/ha) as well as the species composition since the LARs are dominated by small and slow-growing species of fish.

Figure 6.4. Inland fish catches in lakes, 1990 to 2018



Source: Authors' elaborations.

Before the economic transformations in the country that took place in the 1990s, the exploitation of LARs of such lakes was carried out thanks to state support, which covered the losses that were unavoidable during fishing. Since 1990, commercial fishing in lakes has decreased, and in hard-to-reach areas, has completely stopped. However, in the transition period after the collapse of the USSR, statistics were incomplete, so the real catches were higher than those in Figure 6.4 thus providing a distorted image.

Currently, the main lake fishery focuses on large lakes with an area of more than 100 km^2. In 2018, about 50 percent of the total catch was accounted for by the seven largest lakes (Figure 6.5).

Depending on the geographical location, large lakes differ in the species composition of their fish fauna. Lakes of the northern regions are characterized by a predominance of species such as European smelt, vendace, roach, pike-perch, sichel and rainbow smelt. In large lakes in the European part of the Russian Federation, the main commercial species are freshwater bream, rainbow smelt, pike-perch and small ordinary species. In the south of Western Siberia, roach, *Carassius* spp., ide and European perch are the most prevalent species. The main targets of fishing in Lake Baikal are roach, Arctic cisco and European perch.

The following sections provide data on the state of fishing in the main lakes of the Russian Federation (also see Appendix 3, Tables 3.1 to 3.10).

6.2.1. Lake Baikal

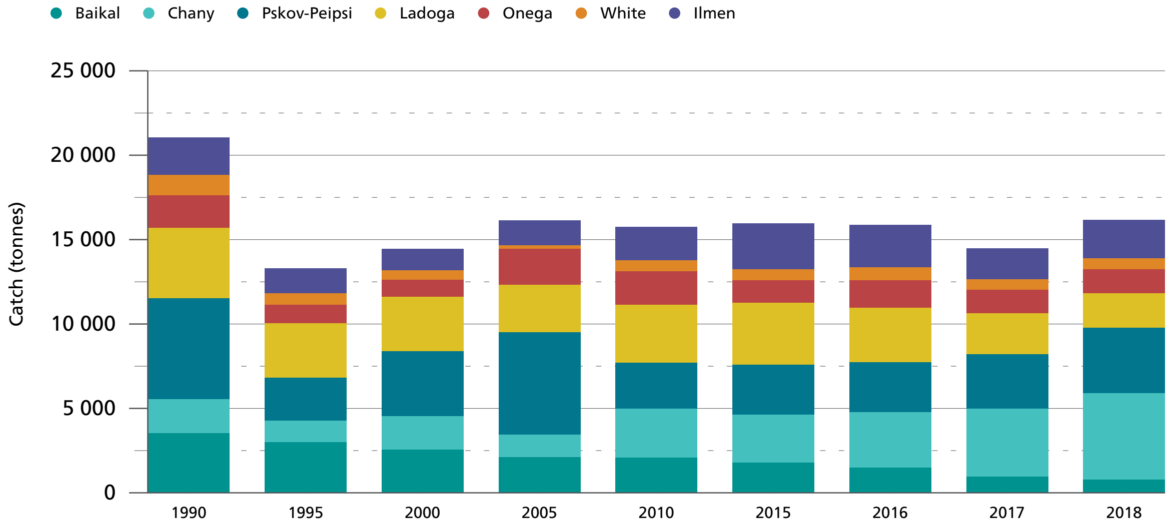
Lake Baikal has an area of 3.15 million ha. Only the shallow part of Lake Baikal is of importance for commercial fisheries. Fisheries in the open part of Lake Baikal with its great depths have not been developed by the fishing industry due to the inaccessibility and low density of fish in these zones.

The main fish hauls in 2018 were roach (414 tonnes), European perch (95 tonnes) and common dace (61 tonnes). Fishing is carried out in the *sor* (shallow bay) system of Lake Baikal, and in scattered lakes in the basins of the Selenga, Barguzin and Upper Angara rivers. The increase in the share in catches of these species was attributed to a decrease in the stocks of Arctic cisco which led to a ban on its industrial fishery.

Since 1990, fish catches in Lake Baikal have decreased 78 percent from 3 554 tonnes to 789 tonnes in 2018.

Catch of Arctic cisco in 2018 amounted to 82 tonnes. This is the minimum value since the resumption of industrial fishing in 1990. The actual catch of Arctic cisco, which included an expert assessment of the unreported catch, was 184 percent higher than the officially recorded catches.

Figure 6.5. Inland fish catches in large Russian lakes, 1990 to 2018



Source: Authors' elaborations.

6.2.2. Lake Chany

This is the largest waterbody of the Chano–Baraba group of lakes in the Novosibirsk region, which is characterized by multicyclic variability of the water level. Commercial stocks of fish in the lake and, therefore the catches, are subject to significant fluctuations. Considering the shallowness of the lake, a drought may cause the surface area to decrease significantly and lead to a decrease in commercial fish stocks by a factor of 2-3.

In 2018, the catches in the lake increased by 153 percents compared to 1990 mainly due an increase in the catches of *Carassius* spp., common carp, roach and European perch. According to 2018 data, 1 318 tonnes of European perch, 1 294 tonnes of *Carassius* spp., about 1 000 tonnes of common carp and 946 tonnes of roach were caught in the lake.

6.2.3. Lake Pskovo–Chudskoye

Since 1990 catches in the lake have decreased by 34 percent and amounted to 3 906 tonnes in 2018. The basis of commercial catches of fish in the lake are European perch (1 145 tonnes), freshwater bream (820 tonnes), pike-perch (761 tonnes), vendace (319 tonnes) and roach (298 tonnes).

6.2.4. Lake Ilmen

This is the main target for fisheries in the Novgorod region. In 2018, 2 252 tonnes of fish were caught in the lake. There was an increase in catches in comparison with 1990 by 1,6 percent. In 2018, the main species caught in the lake were freshwater bream (652 tonnes), zope (600 tonnes) and white bream (267 tonnes).

6.2.5. Lake Ladoga

In 2018, 2 032 tonnes of fish were caught. The basis of commercial catches is European smelt (785 tonnes), European perch (319 tonnes), roach (296 tonnes), freshwater bream (171 tonnes) and vendace (100 tonnes). The catch in 2018 had decreased by 51 percent compared to 1990.

6.2.6. Lake Onega

In 2018, about 1 430 tonnes of fish were caught in the lake, mostly European smelt (702 tonnes) and vendace (433 tonnes). In 2018, the fish catch had decreased by 26 percent compared to 1990.

6.2.7. Lake White/Beloye

In 2018, 638 tonnes of fish were caught, compared with 1990; there was a decrease in catches by 46 percent. The catches were 251 tonnes of freshwater bream, 106 tonnes of sichel, 91 tonnes of rainbow smelt, and 59 tonnes of pike-perch.

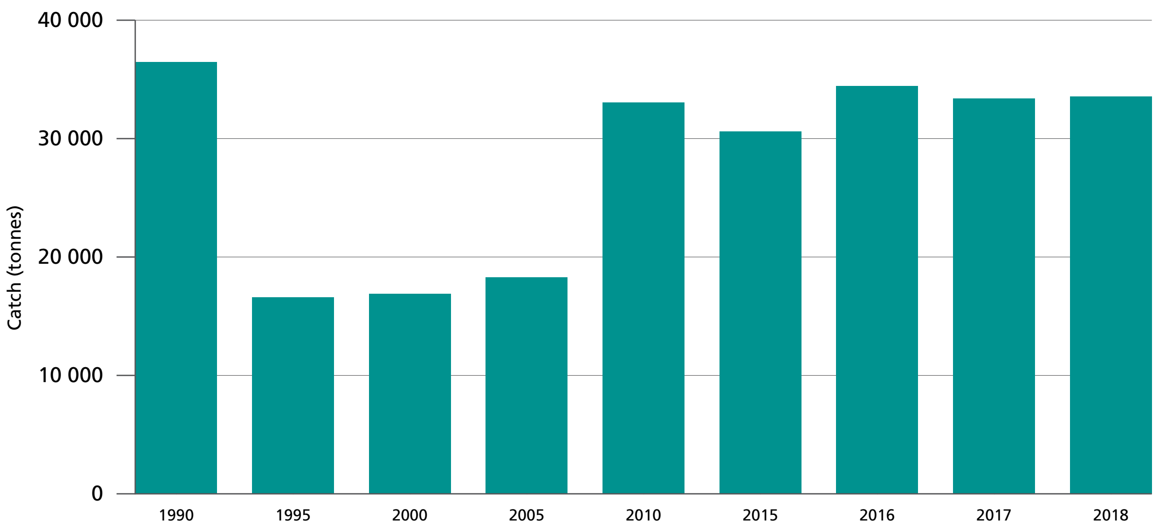
6.3. RESERVOIR FISHERIES

The reservoirs are used comprehensively by various sectors of the national economy.

With respect to fisheries, many reservoirs have advantages due to their location near settlements with developed infrastructure. Large reservoirs (with an area of more than 100 000 ha) account for 3.2 million ha, or almost 70 percent of the total area of waterbodies of this type. The largest reservoirs with an area of more than 100 000 ha include Kuibyshev (625 000 ha), Bratsk (547 000 ha), Rybinsk (455 000 ha), Volgograd (312 000 ha) and Tsimlyansk (270 000 ha). The total area of medium and small reservoirs (less than 100 000 ha) is 1.4 million ha (Mamontov, Litvinenko and Sklyarov, 2003).

Reservoirs are especially significant in the Volga region, in the northwest of the Russian Federation and in Eastern Siberia. In general, the state of the fish stocks in the main reservoirs can be characterized as stable.

Figure 6.6. Inland fish catches in reservoirs, 1990 to 2018



Source: Authors' elaborations.

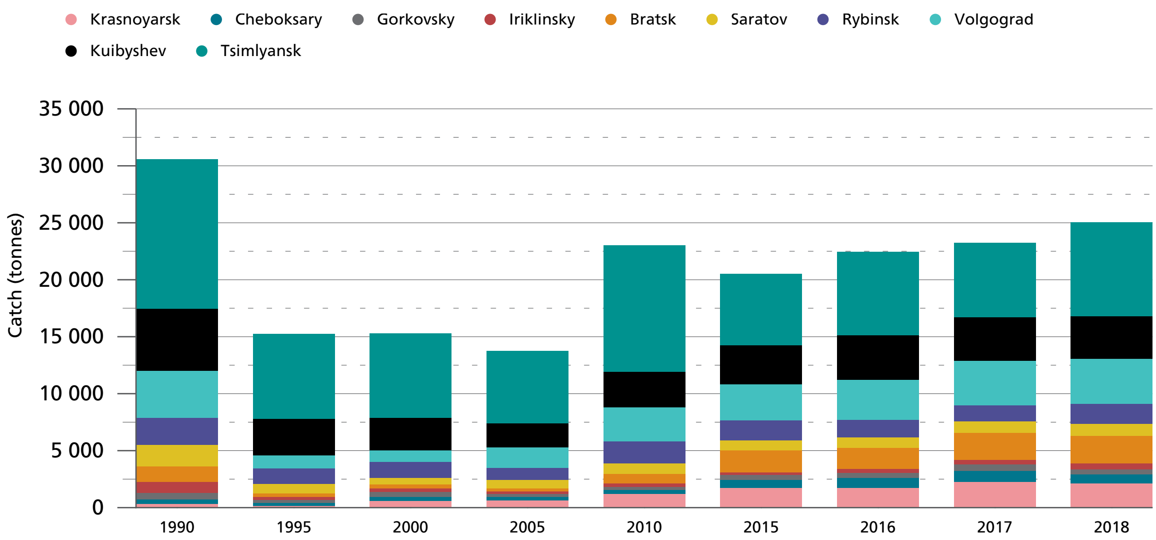
Industrial fishing is carried out mainly in reservoirs created on the Volga, Kama, Don, Kuban, Ob, Yenisei, Angara, Khantayka, Kureyka and Zeya rivers.

The target species in reservoirs are freshwater bream and small ordinary species. Large ordinary fish species are represented in the catches by common carp, pike-perch, wels catfish, burbot, northern pike and silver carp.

Over the past 29 years, the following changes in catches from reservoirs have been observed. From 1990 to 1995, they decreased from 36 480 tonnes to 16 587 tonnes. From 2000 to 2018, there was an increase in catches, which in 2018 amounted to 33 574 tonnes (Figure 6.6).

About 75 percent of the total catch comes from ten large reservoirs in the Volga, Don, Ural, Yenisei and Angara river basins. Fish catches in the largest and most productive reservoirs are shown in Figure 6.7.

Figure 6.7. Inland fish catches in main Russian reservoirs, 1990 to 2018



Source: Authors' elaborations.

The data on fish catches in the main reservoirs of the European part of the Russian Federation, the Urals and Siberia are given in the following section (see also Appendix 4, Tables 4.1 to 4.17).

6.3.1. Tsimlyansk Reservoir (Azov–Black Sea fishery basin)

This reservoir is highly productive. In 2018, the fish catch amounted to 8 226 tonnes. The main target species in the fisheries were *Carassius* spp. (4 999 tonnes), freshwater bream (1 131 tonnes), common carp (851 tonnes), European perch (238 tonnes), pike-perch (208 tonnes), sichel (200 tonnes) and white bream (149 tonnes).

6.3.2. Kuibyshev Reservoir (Volga–Caspian fishery basin)

This is the largest reservoir in the Russian Federation by area. In 2018, 3 769 tonnes of fish were caught. The dominant commercial species were freshwater bream (1 371 tonnes), white bream (582 tonnes), zope (365 tonnes), roach (341 tonnes), pike-perch (296 tonnes) and European perch (156 tonnes). These species account for more than 80 percent of the total catch in the Kuibyshev Reservoir.

6.3.3. Rybinsk Reservoir (Volga–Caspian fishery basin)

This is the third largest reservoir in the Russian Federation in terms of surface area. In 2018, the catch amounted to 1 745 tonnes. The main target species were zope (527 tonnes), freshwater bream, (385 tonnes), roach (360 tonnes) and European perch (152 tonnes).

6.3.4. Volgograd Reservoir (Volga–Caspian fishery basin)

This is at the lowest level of the Volga cascade. In 2018, the total catch amounted to 3 931 tonnes. The main commercial species were Volga pikeperch (634 tonnes), white bream (620 tonnes), freshwater bream (479 tonnes), European perch (469 tonnes), roach (406 tonnes), *Carassius* spp. (385 tonnes), sichel (213 tonnes), silver carp (120 tonnes) and northern pike (105 tonnes). Since 2015, stocks of Volga pikeperch have been increasing in the reservoir and in recent years, there has been a significant increase in catches of *Carassius* spp.

6.3.5. Saratov Reservoir (Volga–Caspian fishery basin)

In 2018, the catch amounted to 1 069 tonnes. The main species caught were freshwater bream (383 tonnes), roach (143 tonnes), white bream (119 tonnes) and European perch (102 tonnes).

6.3.6. Cheboksary Reservoir (Volga–Caspian fishery basin)

The catch of fish in 2018 amounted to 828 tonnes, more than twice the catch of 1990 (392 tonnes). The main target species were freshwater bream (188 tonnes), roach (160 tonnes), white bream (118 tonnes) and European perch (101 tonnes).

6.3.7. Krasnoyarsk Reservoir (West Siberian fishery basin)

This is one of the largest reservoirs in the world. It was created when the Yenisei River was dammed during the construction of the Krasnoyarsk hydroelectric power station. Catches in the reservoir have been increasing annually and in 2018 reached 2 108 tonnes. The main target species were European perch (1 378 tonnes), roach (318 tonnes) and freshwater bream (209 tonnes).

6.3.8. Bratsk Reservoir (Baikal fishery basin)

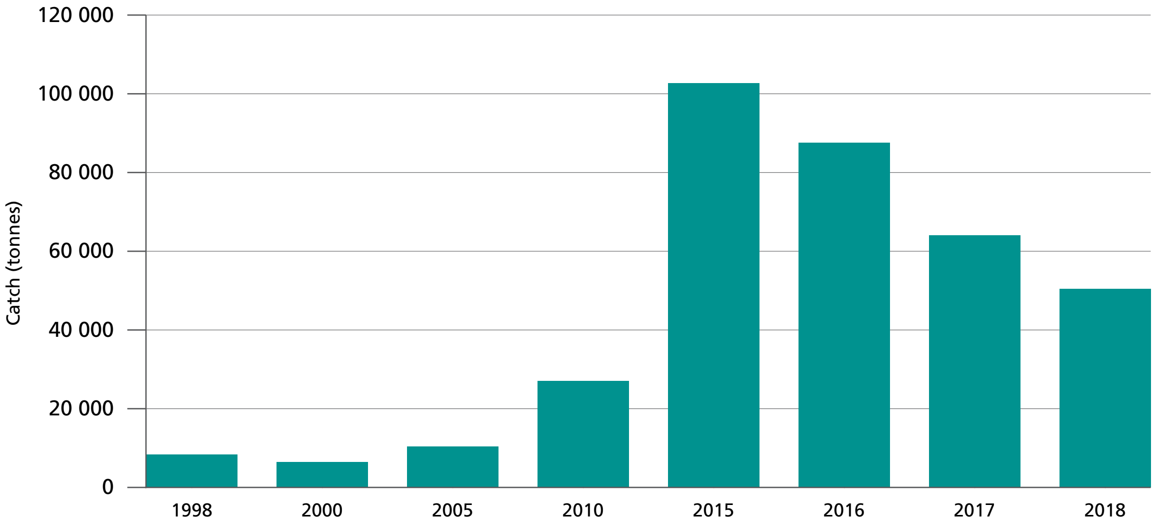
This was created on the Angara River following construction of the Bratsk hydroelectric power station. In 2018, the catch amounted to 2 435 tonnes. The bulk of the catch comprised European perch (1 076 tonnes), roach (691 tonnes) and freshwater bream (411 tonnes).

In 2018, fish catches in the reservoirs of the Northern fishery basin were: Vodlozerskoye (212 tonnes), Vygozerskoye (12 tonnes) and Syamozerskoye (8 tonnes).

6.4. OTHER INLAND WATERBODIES

The term ‘other inland waterbodies’ first appeared in official statistics in 1998. They include small island rivers of Sakhalin and Kamchatka, estuary–coastal systems, the poorly explored waterbodies of Chukotka Autonomous Okrug, river floodplains and so forth.[28]

Figure 6.8. Inland fish catches in other inland waterbodies, 1998 to 2018

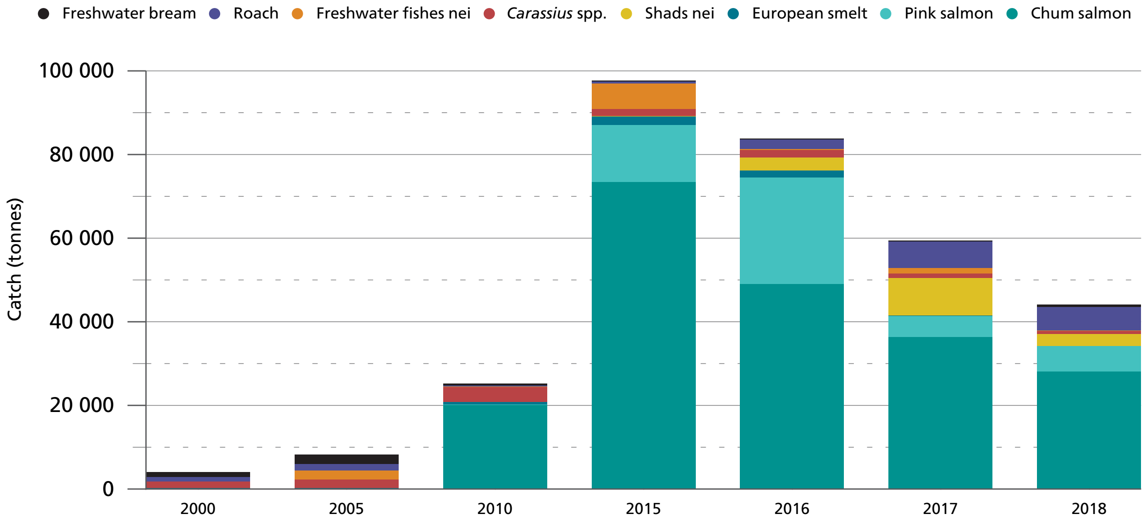


Source: Authors’ elaborations.

In 2018, 50 300 tonnes were caught in other waterbodies, including 28 000 tonnes of chum salmon, 6 000 tonnes of pink salmon, 6 000 tonnes of European smelt; catches of other species amounted to 19 percent of the total catch in other waterbodies (Figure 6.8). The main commercial species in this category of waterbodies are chum salmon, pink salmon and European smelt (Figure 6.9).

[28] Including bays in the lower reaches of the rivers, as well as salty lakes near the sea.

Figure 6.9. Catches of major fish species in other inland waterbodies of the Russian Federation, 2000 to 2018



Source: Authors' elaborations.

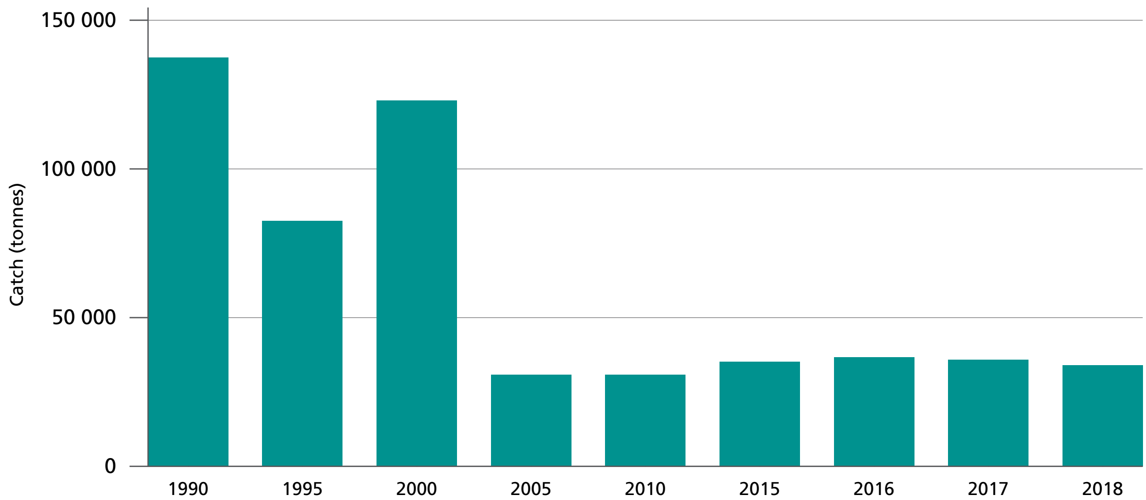
6.5. THE CASPIAN SEA FISHERY

The history of the development of the fishery can be divided into fishing phases for sprat, shad and mullet because, due to the biological characteristics of the species, each was extracted differentially using special tools and in separate fishing areas.

Three species of sprat live in the Caspian Sea: Anchovy sprat (*Clupeonella engrauliformis*), southern Caspian sprat (*Clupeonella grimmi*) and common Caspian kilka (*Clupeonella caspia*).

Until 1990, in some years, sprat extraction in the Caspian reached 400 000 tonnes. However, over the past 15 years, deep changes have occurred in the Caspian marine ecosystem caused by an underwater earthquake[29] and an outbreak of ctenophores (*Mnemiopsis leidyi*) that have undermined the fish feed base. These two circumstances led to the mass death of the anchovy sprat and southern Caspian sprat. The annual catch of sprat by the Russian Federation declined from 132 477 tonnes in 1990 to 983 tonnes in 2018, i.e. a drop of more than 99 percent (Figure 6.10). After this decline, common Caspian kilka began to dominate catches (up to 96.2 percent of the volume). Sprat fishing with lights eventually became unprofitable and almost disappeared (VNIRO, 2018).

Figure 6.10. Fish catches in the Caspian Sea, 1990 to 2018



Source: Authors' elaborations.

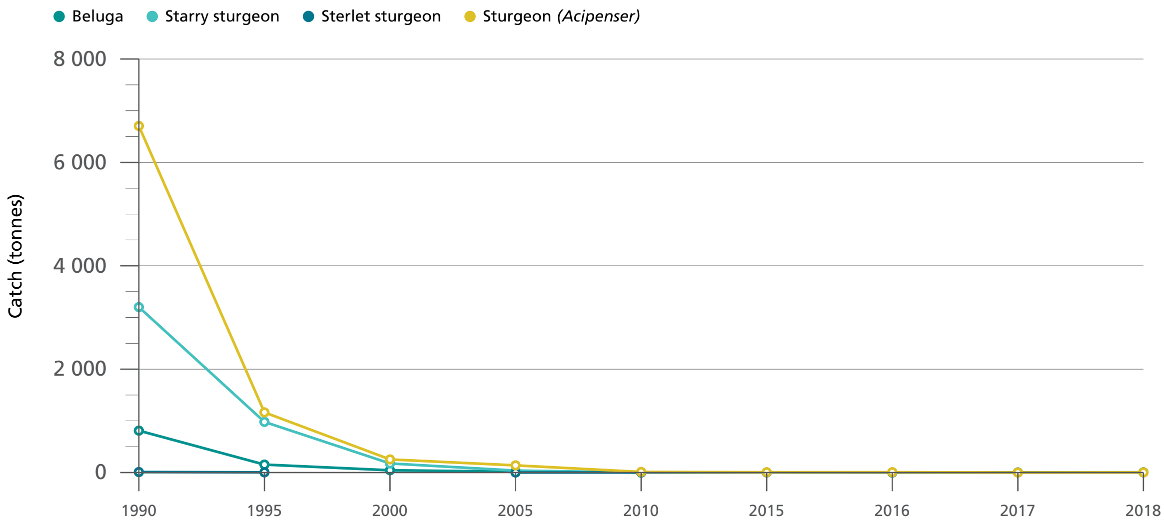
[29] Cyprinids are less susceptible to seismic stresses than other fish. Therefore their population is growing with the decrease in pressure from predators.

Scientists from the Caspian Fisheries Research Institute (CaspNIRKh) have only recently again discovered large sprat stocks and the species can again be caught on an industrial scale of up to 90 000 tonnes per year (Volga, 2019).

Shads are a large family of fish in the Caspian Basin. At present, three types of sea shad stocks are left unfished: Caspian marine shad (*Alosa braschnikowi*), Caspian shad (*Alosa caspia*) and Saposhnikovi shad (*Alosa saposchnikowii*). After the prohibition of net fishing in the sea in the absence of selective fishing methods, shads were not exploited by the fishery, which had a beneficial impact on their stocks (VNIRO, 2018).

Danube sturgeon, Persian, starry, beluga and sterlet sturgeon have also been among the main targets of fishing in the Caspian Sea. However, since the construction of the dam and the regulation of the Volga River flow near Volgograd, there has been a steady decline in the natural reproduction of sturgeons. From 1990 to 1995 the reproduction of sturgeons declined and catches over the years decreased from 10 727 tonnes to 2 600 tonnes (Figure 6.11).

Figure 6.11. Catches of sturgeons in in inland waterbodies of the Russian Federation, 1990 to 2018



Source: Authors' elaborations.

Dwindling sturgeon populations led to a decrease in the catch of sturgeons (Khodorevskaya and Ruban, 2014). In 2000, the industrial production of Caspian beluga sturgeon was suspended in the Russian Federation followed by similar catch bans on Danube and starry sturgeons. Since 2006, legal sturgeon fishing has been carried out here only for the purpose of reproduction and scientific research. Scientific catches are needed to assess sturgeon stock condition, identify their origins, estimate the size of the populations and make forecasts for their development.

Industrial sturgeon fishery in the Caspian has been forbidden since 2006 and the ban remains in place. In 2013, at the Commission on Aquatic Bioresources of the Caspian Sea, which has all the five coastal countries (Azerbaijan, Islamic Republic of Iran (the), Kazakhstan, Russian Federation and Turkmenistan) as members, the introduction of a moratorium on commercial fishing for all types of sturgeon in the Caspian Sea was agreed on by all parties.

In recent decades, illegal fishing has intensified in the Caspian, including group poaching. In the Republic of Dagestan, sturgeon fishing off the coast has become predatory despite the prohibition on commercial fisheries. Currently, work is underway to improve the efficiency of fish protection. Lack of investments in technical equipment for monitoring and surveillance lead to large losses of fish stocks due to IUU fishing and restoring them will be extremely costly (Ivanov and Mazhnik, 1997).

7 Industrial policy and management structure for the exploitation and conservation of stocks of LARs in inland waters

Kolonchin, K.V.,
Yanovskaya, N.V.,
Bekyashev, D. K.,
Bekyashev, K.A., and
Galstyan, G.G.

7.1. INDUSTRIAL POLICY

7.1.1. State monitoring of inland waterbodies and stocks

In terms of fishing in inland waters, the FAF carries out the following activities (GRF, 2008a):

- development of TACs for LARs in inland waters of the Russian Federation, submission of the developed TACs to the State Environmental Expertise and distribution of quotas within these TACs;
- state monitoring of LARs, including their distribution, quantities, quality and reproduction; their habitats; as well as monitoring of fishing activities and the conservation of LARs and the maintenance of a sectoral monitoring system;
- approval of the list of fishing areas, including the inland waters of the Russian Federation;
- maintenance of the State Fisheries Register; and
- Federal state control (supervision) of fisheries and the conservation of LARs.

The FAF also has the right to suspend fishing as well as to terminate the rights to extract (catch) LARs classified as target species in fisheries.

Research organizations and federal state institutions, i.e. basin administrations for the conservation, reproduction of LARs and fisheries management, which are subordinate to the FAF, carry out:

- studies provided by the annual plans for resource research and state monitoring;
- collection of information on the state of LARs and their habitats; and
- monitoring of the distribution, quantity, quality and reproduction of LARs classified as target species in fisheries, as well as their habitats.

The FAF's *territorial bodies* are represented by territorial departments for the control, supervision and protection of LARs (18 units). The territories of several constituent entities of the Russian Federation are assigned to each of them.

State monitoring of LARs in the Russian Federation is carried out by the Federal Agency for Fisheries (FAF). The Centre for Fishery Monitoring and Communications, organized under FAF, maintains the monitoring system of:

- distribution, quantity, quality and reproduction of LARs as well as their habitats; and
- Fisheries and LARs conservation (GRF, 2004).

According to the Federal Law on Fishing and Conservation of Aquatic Biological Resources, 2004, the state monitoring of LARs is conducted for their rational use and conservation as well as to resolve disputes related to fishing and conservation of LARs and to prosecute concomitant violations.

The organization and implementation of monitoring is carried out by the FAF, its research organizations and federal state institutions, i.e. basin departments for fisheries, conservation of LARs and fisheries management.

Relevant data provided by other federal executive bodies as well as citizens and legal entities engaged in fishing for research and control purposes in accordance with established procedures may also be used for monitoring.

Monitoring employs uniform software and methods of observation that are compatible with other state environmental monitoring programmes

The monitoring of LARs is part of the state's environmental monitoring programme, which is a comprehensive monitoring system of the state of the environment, including the components of the natural environment, natural ecological systems, the processes and phenomena occurring in them, and the assessment and forecast of changes in the environmental condition (GRF, 2002; GRF, 2008b; GRF, 2013; FAF, 2009b).

Information on the state of the environment is used by government bodies, constituent entities of the Russian Federation and local governments to develop socio-economic development forecasts as well as federal environmental development and protection programmes.

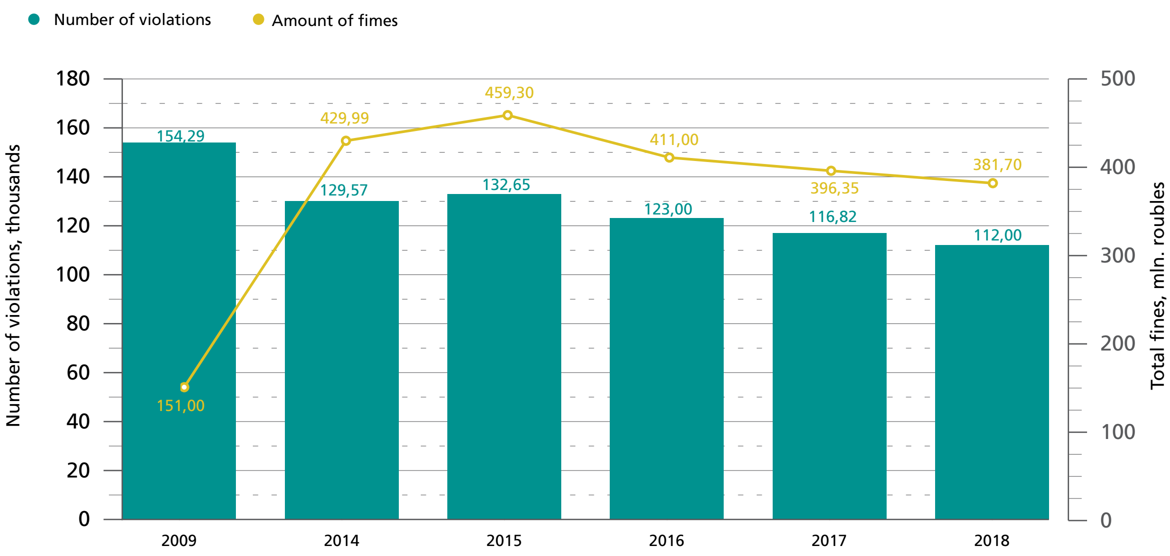
The Ministry of Natural Resources and Environment (MNRE) of the Russian Federation coordinates the organization and operation of a standardized monitoring system. The same body is empowered to create a state database of state environmental monitoring data and is the state operator of this system in collaboration with the FAF (in terms of monitoring LARs).

7.1.2. Basin control, supervision and protection of LARs

Control, supervision and protection of LARs are assigned to 18 territorial departments of the FAF that prevent illegal fishing and take steps to maintain the biodiversity of rivers, lakes and reservoirs of fishery importance.

In addition to addressing IUU, these authorities combat other abuses of the law. Among the most common are discharge of wastewater containing pollutants and the use of the protected shoreline belt (water protection zone) that violates the environmental and fish protection legislation (Figure 7.1).

Figure 7.1. Effectiveness of state control and supervision over LARs and their habitats



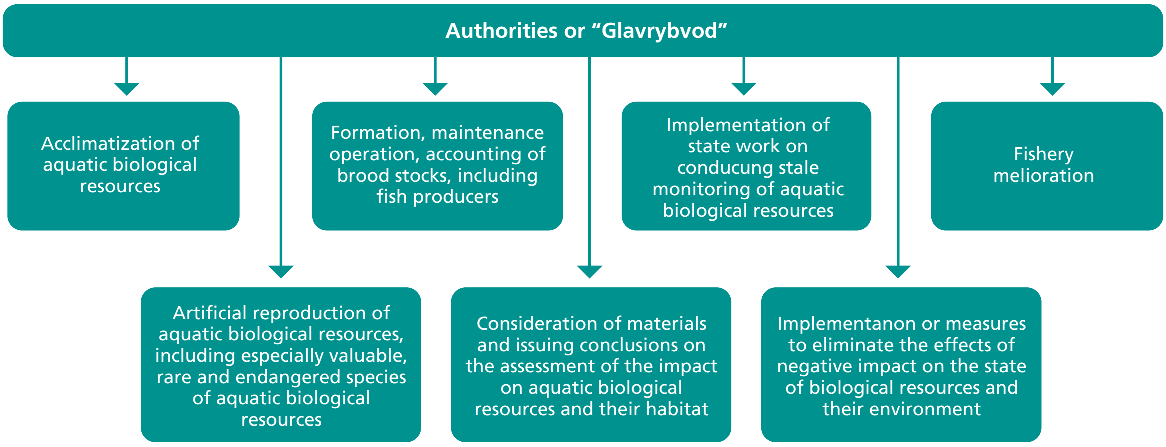
Source: Federal Agency for Fisheries. 2015–2019. Materials of the Board of the Federal Agency for Fisheries 2015-2019 [online]. Available at http://www.fish.gov.ru/ob-agentstve/kollegiya-rosrybolovstva.

One of the main tasks of the inspectors of territorial departments is to protect waterbodies from harm caused by the construction and reconstruction of permanent buildings or structures and the introduction of new polluting technologies (GRF, 2007).

7.1.3. Basin administration for fisheries, reproduction and conservation of LARs

Federal State Budgetary Institution "The Main Basin Department for Fisheries and Conservation of Aquatic Biological Resources" (FSBI 'Glavrybvod') (is a subordinate institution of FAF) and its 28 branches were established to work in the domains of fishing, reproduction and conservation of LARs. Glavrybvod has more than 6 500 employees and 102 fish-breeding farms, including the federal breeding and genetic centre. The activities of Glavrybvod cover the entire territory of the Russian Federation (Figure 7.2).

Figure 7.2. Areas of competence of the Glavrybvod



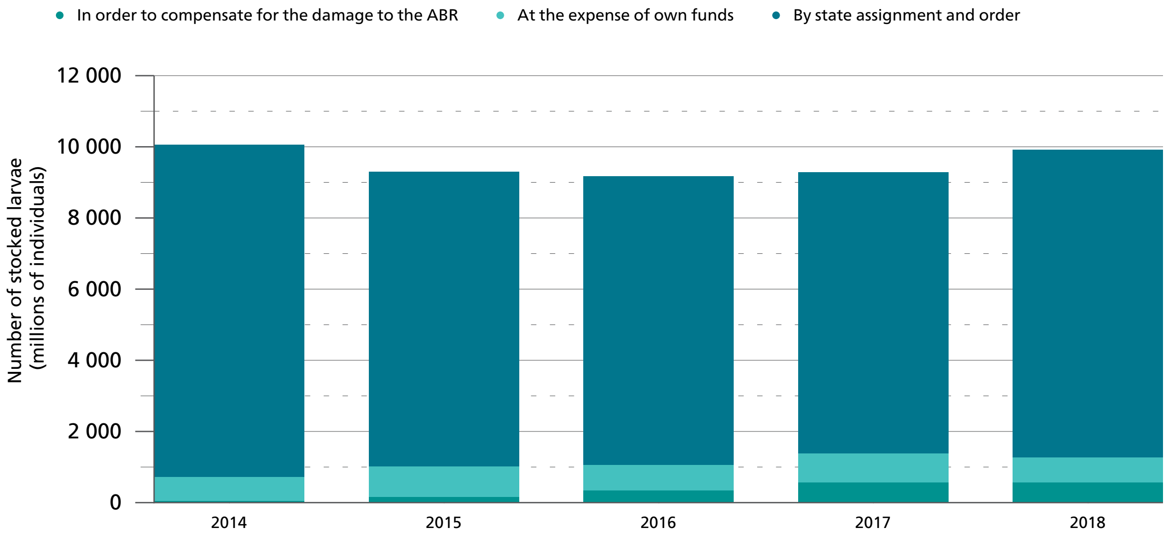
Source: https://glavrybvod.ru/about/ob_organizacii/.

Fish-breeding farms, through state funding, annually grow and release more than 9 million individuals of species on the IUCN Red List of Threatened Species, including:

- Caspian salmon, Black Sea salmon *(Salmo labrax)*, Lake salmon, Baltic and White Sea sea trout, sheefish, green sturgeon *(Acipenser medirostris)*, Siberian sturgeon of the Ob and Baikal populations, Volkhov whitefish *(Coregonus baerii)*, taimen and grayling;
- **over 44 million specimens of particularly valuable fish species** – beluga, kaluga, Amur, Danube, Siberian and starry sturgeon; and
- **over 222 million specimens of valuable fish species** – coho salmon, sea trout, Caspian kutum, Atlantic salmon, Lake salmon, muksun, nelma, sockeye salmon, Baikal omul, European whitefish, pike-perch, masu salmon, sterlet sturgeon and Chinook salmon;
- **The estimated annual stocking efficiency** of the Glavrybvod's activities for the artificial reproduction of LARs **amounts to over 30 000 tonnes of fish.**

The dynamics of the release of juveniles (larvae) of LARs into waterbodies of fishery importance of the Russian Federation from 2014 to 2018 are shown in Figure 7.3 (see also, FAF, 2015–2019; VNIRO, 2016; VNIRO, 2018; VNIRO, 2019).

Figure 7.3. Stocking release of juveniles (larvae) of LARs into inland waterbodies of fishery importance in the Russian Federation



Source: Authors' elaborations.

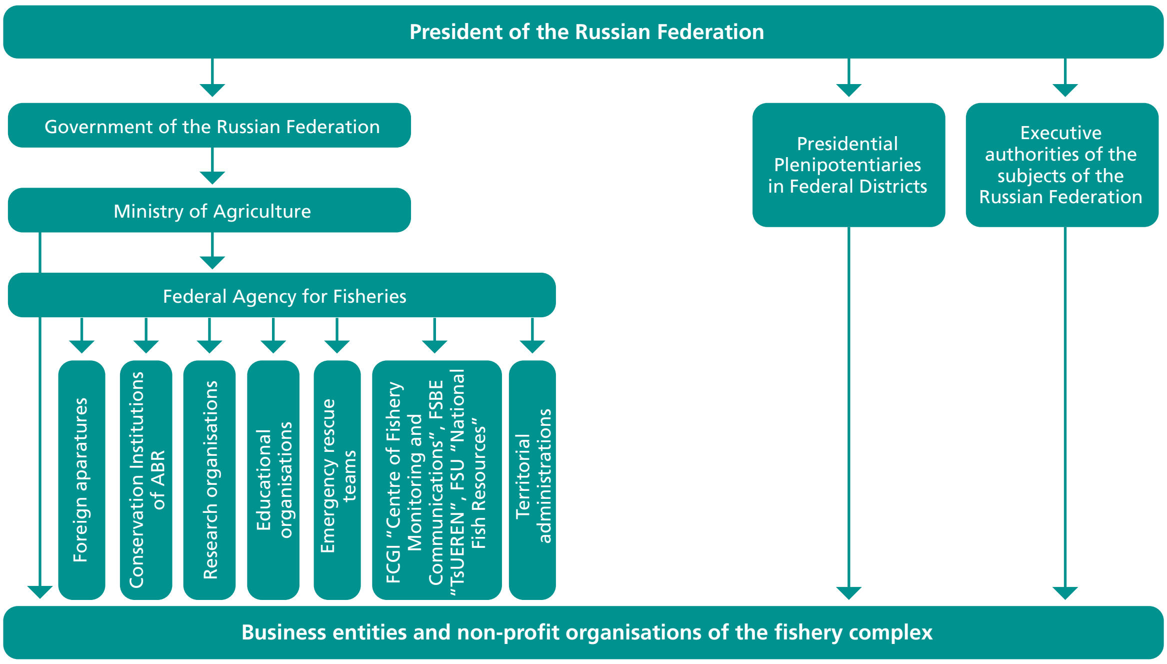
Major companies of the Russian Federation such as Rosneft, Gazprom, LUKOIL, RusHydro, Rosseti, Russian Railways, Rosavtodor, Rosmorport and others are customers of stocking material to compensate for damage caused to LARs.

7.2. POWERS OF FEDERAL EXECUTIVE AUTHORITIES IN THE PUBLIC ADMINISTRATION, EXPLOITATION AND CONSERVATION OF INLAND WATER RESOURCES

Since the USSR was dissolved there have been several administrative reforms, these have, *inter alia*, affected the FAF that has changed nine times since 1990 (GRF, 1991a,b; GRF, 1992; GRF, 1996–1998; GRF, 2004; GRF, 2007–2008a; GRF, 2012a).

The current management structure of the Russian Federation is shown in Figure 7.4.

Figure 7.4. Management structure of the fisheries industry of the Russian Federation



Source: Sakharova, L.A. & Glazunova, E.V. 2015. Analysis of the problems of the functioning of the fishery complex to maintain the balance of aquatic biological resources. Bioeconomics and Ecobiopolitics, 1(1): 104–112. (In Russian).

President of the Russian Federation

The President of the Russian Federation is the head of state and does not belong to any of the federal executive bodies. However, he defines their structure, including fisheries. In addition, the President of the Russian Federation, as Chairman of the State Council, takes part in meetings of the Praesidium of the State Council on the development of the fishery complex. Fisheries may be regulated by presidential decrees.

Government of the Russian Federation

The Government of the Russian Federation, being the highest executive body, adopts resolutions regarding the regulation of fisheries and the conservation of LARs and annually determines the TACs, including in inland waterbodies (GRF, 2009) based on the advice of the research institutions under its jurisdiction. The TAC list for each fishery basin is approved by the Ministry of Agriculture.

The FAF and research organizations under its jurisdiction prepare materials giving a scientific basis for the TAC, justifying changes to the previously approved TAC; data on the stocks of LARs necessary for the preparation of these materials are collected.

In addition, the Russian Government determines the rules for the use of LARs for which no TAC has been established (GRF, 2008b).

Ministry of Agriculture of the Russian Federation

With regard to the management of fisheries in inland waters, the Ministry of Agriculture is entrusted with the functions of developing and implementing state policy and legal regulations in the field of fisheries (GRF, 2008c). The ministry, in terms of fishing in inland waters, has the power to adopt the following normative legal acts:

- compile a list of LARs that are commercially fished in the internal waters of the Russian Federation and for which TAC must be established in each fishery basin;
- list types of vessels, tools and methods for the extraction of LARs; and
- approve annual TACs for LARs in inland waters.

Federal Agency for Fisheries

The FAF has the following responsibilities for the management of inland fisheries:

- determine the annual TACs of LARs in inland waters;
- approve the list of fishing sites;
- protect anadromous and catadromous fish species, transboundary fish species and other LARs in inland waterbodies; and
- issue permits to exploit species for which there are no TACs and control their catch (GRF, 1998).

In terms of catching LARs for which the TACS have not been established, the FAF's central agency instructs its territorial offices to:

- within two working days from receiving from the central agency the recommended volumes of catch of LARs for which the TAC has not been established to disseminate this information to the executive authorities of the administrative units or subjects of the Russian Federation (within their areas of responsibility);
- accept and consider applications and attached materials related to the conclusion of contracts for the use of LARs for which the TAC has not been established; and
- control compliance with fishing rules, other norms of legislation, international agreements (within the authority of the management) by legal entities and individual entrepreneurs who have concluded agreements; control the catch of LARs and provide information about the extraction of LARs by legal entities and individual entrepreneurs; control statistical reporting on the extraction (catch) of LARs by legal entities and individual entrepreneurs (FAF, 2013).

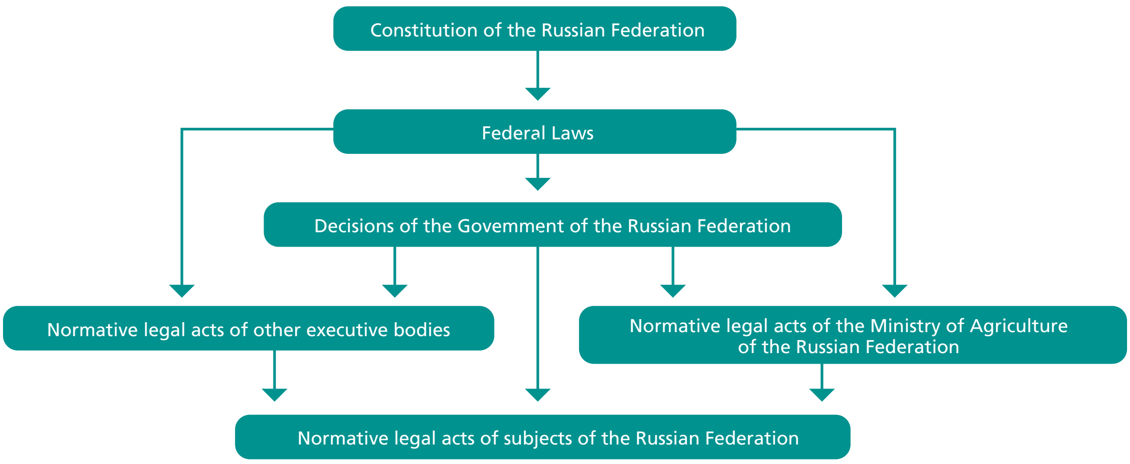
7.3. LEGAL FRAMEWORK AND MANAGEMENT

Key aspects of managing LARs are within the sphere of state regulation. Fishing activities in the country are regulated by the relevant legal framework that includes regulatory documents adopted on different conditions.

Regulatory documents adopted at lower levels must comply with the standards established in documents at higher administrative levels. In other words, the normative legal acts of the federal executive authority in the field of fisheries may not contain requirements that are not provided for in the relevant decree or order of the Government of the Russian Federation, on the basis of which the order was prepared.

This scheme for the formation of a regulatory framework allows the maintenance of the necessary structure, hierarchy and interconnection of adopted documents (Figure 7.5).

Figure 7.5. The legislative hierarchy for fisheries in the Russian Federation



Source: Authors' elaborations.

7.3.1. Federal laws

The legislation on fisheries and the conservation of LARs is based on the following principles (Makoedov, 2015):

- taking into account the importance of LARs as a basis for human existence;
- prioritization of their conservation and rational use as items of property with associated rights;
- prioritization of the conservation of especially valuable and valuable LARs;
- establishment of a differentiated legal regime for LARs;
- participation of citizens, public associations, associations of legal entities (associations and unions) in the resolution of issues related to fishing and conservation of LARs;
- taking into account the interests of the population, for which fishing is the main livelihood;
- provision for the use of LARs in a transparent and open manner;
- determination of the volumes of catch of LARs considering environmental, social and economic factors; and
- chargeable procedure for the use of LARs (collection of payments for catch of LARs).

There are seven Federal laws that regulate fishing activities in inland waters to some extent:

1. Federal Law on Fishing and Conservation of Aquatic Biological Resources No. 166-FZ of 20 December 2004;

2. Federal Law on Recreational Fishing and on Amendments to Certain Legislative Acts of the Russian Federation No. 475-FZ of 25 December 2018;
3. Law of the Russian Federation on the State Border of the Russian Federation No. 4730-1 of 1 April 1993;
4. Federal Law on Wildlife No. 52-FZ of 24 April 1995 (ed. 18.02.2020);
5. Federal Law on Ecological Expertise No. 174-FZ of 23 November 1995 (ed. 27.12.2019);
6. Civil Code of the Russian Federation;
7. Water Code of the Russian Federation No. 74-FZ of 3 June 2006.

The main legislative norms regulating fishing activities in the country are concentrated in the Law on Fishing and Conservation of Aquatic Biological Resources.

Federal Law on Fishing and Conservation of Aquatic Biological Resources No. 166-FZ of 20 December 2004 (GRF, 2004)

Under this law, citizens and legal entities may engage in the following types of fishing in inland waters of the Russian Federation:

- industrial fishing (Article 19.1);
- fishing for scientific research and control purposes (Article 21);
- fishing for educational and cultural purposes (Article 22);
- fishing for aquaculture (fish farming) purposes (Article 23);
- recreational fishing (according to Article 24 of the federal law on ‘Recreational Fishing and on Amendments to Certain Legislative Acts of the Russian Federation’ this applies to activities in the field of recreational fishing that are not regulated by this normative legal act); and
- fishing for the purpose of maintaining a traditional way of life and the implementation of traditional economic activities of the Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation (Article 25).

Federal Law on Recreational Fishing and on Amendments to Certain Legislative Acts of the Russian Federation No. 475-FZ of 25 December 2018 (GRF, 2018)

This normative legal act regulates recreational fishing in the Russian Federation, which is understood as the activity of extraction of LARs carried out by citizens in order to satisfy personal needs, as well as during official physical education and sporting events.

For the purpose of conservation and rational use of LARs and their habitats, the law introduces the concept of the daily catch rate, that is, the volume of the type of LAR allowed to be caught during a calendar day, which is established for each fishery basin[30] of the country.

Law of the Russian Federation on the State Border of the Russian Federation No. 4730-1 of 1 April 1993 (GRF, 1993)

In accordance with Article 21 of this law, fishing, research, survey and other activities are carried out in the Russian Federation’s part of border rivers, lakes and other waterbodies, in inland seas and territorial seas. In order to protect the state border, such activities are always carried out with the permission of the border authorities, and in inland seas and in the territorial seas of the Russian Federation with notification of the border authorities. Information shall be provided on the location, time of fishing, research, prospecting or other activities, the number of participants, and any fishing or other vessels used for this purpose.

[30] Although the laws are established for the fishery basins, the catches permitted in individual waterbodies are also defined.

7.3.2. Acts of the Government of the Russian Federation

Strategy for the Development of the Fisheries Complex of the Russian Federation for the Period up to 2030, approved by Order of the Government of the Russian Federation No. 2798-p of 26 November 2019 (GRF, 2019)

Part VI is devoted to macroregional development, particularly with regard to the Siberian, Ural, Volga and Central Federal districts.

According to the document, due to the lack of access to open sea areas, the prospective development of the fisheries complex in the Siberian, Ural, Volga and Central Federal districts is based on increasing the industrial production of fish (commercial fish farming) and fish processing.

7.3.3. Regulations (normative acts)

The fishing operations are regulated by special normative legal acts — the rules of fishing, which are approved by orders of the Ministry of Agriculture of the Russian Federation and are adopted for each fishery basin. For each of these basins, the inland waters in which fishing is carried out are listed.

Fishing rules for fishery basins, approved by the Ministry of Agriculture of the Russian Federation.

In accordance with Article 17 of the Federal Law on Fishing and Conservation of Aquatic Biological Resources No. 166-FZ of 20 December 2004, the Russian Federation has established the following fishery basins:

1. Azov–Black Sea fishery basin;
2. Baikal fishery basin;
3. Volga–Caspian fishery basin;
4. East Siberian fishery basin;
5. Far Eastern fishery basin;
6. West Siberian fishery basin;
7. Western fishery basin; and
8. Northern fishery basin.

All fishing rules in these eight basins establish:

- types of permitted fishing;
- standards, including standards for the yield of processed LARs (including caviar), as well as parameters and terms of permitted fishing;
- restrictions on fishing and other activities related to the use of LARs, in particular:
  - prohibition of fishing in certain areas and for certain LARs;
  - closure of fishing in certain areas and for selected LARs;
  - minimum size and weight of LARs caught;
  - species and number of permitted tools and techniques for catch of LARs;
  - size of mesh of instruments for catching LARs as well as size and design of tools for catching LARs; and
  - fishing periods in waterbodies of fishery importance.

7.4. INTERNATIONAL COOPERATION IN THE MANAGEMENT OF TRANSBOUNDARY INLAND WATERBODIES/BASINS/STOCKS

The guiding principles for the rational use of transboundary watercourses are the principle of fair and reasonable use of the watercourse as a whole and its resources; the principle of sovereignty over part of transboundary waterbodies; the principle of not causing significant damage to waterbodies or their components; and the principle of cooperation (Teymurov, 2019).

The main problems in transboundary water basins are related to water pollution; deficiency of LARs; insufficiently developed networks of monitoring points; redistribution of LARs; adverse river bed evolution; accuracy of hydrological forecasts; organization of water transport and fishing; aquaculture; compensation for harm caused to transboundary waterbodies (including LARs) by one of the parties (Bekyashev, 2017).

7.4.1 International treaties for the use and protection of transboundary waterbodies

For the Russian Federation, issues of cross-border cooperation in the use and protection of LARs are extremely relevant. The basins of 70 large- and medium-sized rivers of the country are transboundary; 7 141 km of the state boundary are marked by rivers; 475 km by lakes.

The legal regime for the use and protection of transboundary waterbodies of the Russian Federation at the universal level is defined by two international treaties: the United Nations Convention on the Law of Non-Navigational Uses of International Watercourses of 1997 (entered into force for the Russian Federation in 2014) (UN, 1997), and the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (the Russian Federation acceded to this Convention on 6 October 1996) (UN, 1992).

Naturally, legal regulation of the use of transboundary LARs is carried out primarily on the basis of international agreements concluded between the states concerned.

For 24 major waterbodies, the Russian Federation has agreements on joint water use with neighbouring countries. Most of the problems of distribution of LARs and water pollution are related to the conflicting interests of upstream and downstream countries, common hydrotechnical facilities built under the USSR, and their location (full or partial) on the territory of neighbouring states.

The provisions of the 1997 Convention on the Law of Non-Navigational Uses of International Watercourses are reflected in the Russian Federation's bilateral treaties on the use of transboundary waterbodies; of these, only treaties with Ukraine and Finland contain rules concerning cooperation of states in the domain of fisheries.

The agreement between the Russian Federation and Ukraine on the joint use and protection of transboundary waterbodies of 18 October 1992 prescribes measures to discourage uncoordinated activities that can cause harm or damage to fish stocks; to ensure optimal fishing; to take measures to preserve the LARs of waterbodies at the optimal level; and to carry out mutually agreed measures for the protection and reproduction of fish stocks (Government of Ukraine and the Government of the Russian Federation, 1992).

The agreement between the Government of the USSR and the Government of the Republic of Finland on Frontier Watercourses of 24 April 1964 provides for measures to prevent pollution that may cause damage to fish stocks (Article 4). In addition, Chapter IV of this agreement, called 'Fish-Stock and Fisheries', requires the Russian Federation and Finland to take measures to preserve fish stocks and ensure fishing in the salmon- and whitefish-rich transboundary waterbodies listed in the document (Union of Soviet Socialist Republics and the Republic of Finland, 1964).

Some aspects of fishing in the Russian Federation's transboundary waterbodies are regulated by bilateral agreements on cooperation in fisheries. Such agreements have been concluded with Abkhazia, Belarus, China, Ukraine, Estonia and other countries. The following international agreements of the Russian Federation concerning fishing in transboundary waters are currently in force. The first two international agreements dealing with transboundary rivers contain fishery regulations. At the same time, the Agreement with Norway allows only recreational fishing in transboundary rivers, and the Agreement with China provides for recreational and industrial fishing.

Norway, Greense Jakob River (Voriema) and Pasvik River (Patsojoki)

Agreement between the Government of the Union of Soviet Socialist Republics and the Government of Norway on the Regulation of Fishing and Conservation of Fish Stocks in the Greense Jakob River (Voriema) and Pasvik River (Patsojoki) of 7 December 1971 (Government of the Union of Soviet Socialist Republics and the Government of Norway, 1971).

There are no difficulties or issues with the implementation of this agreement. Both rivers flow into the Barents Sea and contain valuable salmon species that need to be protected. The Russian Federation and Norway do not make any claims or demands on each other as regards the implementation of the agreement. There are also no systematic violations of the fishing rules established in the agreement by the citizens of the two states (Government of the Union of Soviet Socialist Republics and the Government of Norway, 1971).

China, Amur River and Ussuri River

Agreement between the Government of the Russian Federation and the Government People's Republic of China Regarding Cooperation in the Sphere of Protection, Regulation and Stock Enhancement of Live Aquatic Biodiversity in the Boundary Waters of the Rivers of Amur and Ussuri of 27 May 1994 (Government of the Russian Federation and the Government of People's Republic of China, 1994).

The situation is different with regard to implementation of this agreement (Government of the Russian Federation and the Government of People's Republic of China, 1994). The Amur River flows into the Sea of Okhotsk and the Ussuri is its tributary. These rivers are extremely rich in fishery resources, which are used in the production of high-quality fish products. In accordance with the 1994 Agreement, the parties declared their desire to protect the decreasing stocks of chum salmon, sturgeon and other valuable fish species. It regulates both industrial fishing in the Amur and Ussuri rivers and fishing by recreational fishers (Article 4).

An integral part of this agreement is the 'Rules for the Protection, Regulation and Stock Enhancement in the Boundary Waters of the Amur and Ussuri Rivers'. They define the list of fish species, aquatic animals and plants of the Amur and Ussuri rivers to be protected and establish minimum fisheries measures for the main aquatic animals and plants and the procedures to determine them. According to the rules, fishers of both parties, when catching fish and animals of smaller size than established, are obliged not to harm them and immediately release them back into the water.

The rules establish a ban on fishing in rivers from 11 June to 15 July and from 1 October to 20 October each year. In addition, a list of waterbodies where a permanent ban on fishing is established is defined by the rules. There are also requirements for fishing gear, as well as bans on various activities that may damage the ecosystem and fish stocks of the Amur and Ussuri rivers.

Belarus, transboundary waters

2011 Rules for Fishing in Transboundary Water Bodies of the Russian Federation and the Republic of Belarus

In addition to the abovementioned agreements, these rules were adopted within the framework of the Joint Russian–Belarusian Commission on Fisheries (Joint Russian–Belarusian Commission on Fisheries, 2011).

As decided by the Joint Commission, bilateral working meetings were held between the Russian Federation and Belarus on the issues of studying, protecting and rationally using LARs in transboundary waterbodies of fisheries importance. The parties exchanged information on the implementation of state control in the field of fisheries and conservation of LARs, including on transboundary watercourses, discussed the results of joint surprise inspections to identify and stop violations of environmental legislation, and exchanged information on persons held liable for violating fishing rules and so forth.

Estonia, Peipus (Chudskoe), Lämmi (Tjoploe) and Pihkva (Pskovskoe) lakes

Agreement between the Government of the Russian Federation and the Government of Estonian Republic on Collaboration in Field of Conservation and Use of Fish Resources in Peipus (Chudskoe), Lämmi (Tjoploe) and Pihkva (Pskovskoe) Lakes of 4 May 1994 (Government of the Russian Federation and the Government of Estonian Republic, 1994).

With regard to fishing in transboundary lakes, the Russian Federation concluded the only bilateral agreement (the Agreement with the Republic of Estonia on Collaboration in Field of Conservation and Use of Fish Resources in Peipus (Chudskoe), Lämmi (Tjoploe) and Pihkva (Pskovskoe) Lakes of 4 May 1994 (Government of the Russian Federation and the Government of Estonian Republic, 1994).

These lakes make up a kind of lake complex, which in geographical literature is often referred to as Lake Peipus. They are inhabited by such commercial species as European perch, pike-perch, freshwater bream, roach and European whitefish among others.

For the purposes of the agreement, the parties established the Intergovernmental Commission on Fisheries in the Peipus, Tjoploe and Pskovskoe lakes, its sessions are held at least twice a year alternately on the territory of each of the parties to the agreement.

The Caspian Sea

Convention on the Legal Status of the Caspian Sea (12 August, 2018) signed by the heads of the Caspian states, 12 August 2018

It is worth mentioning the current situation on international legal regulation of fisheries in the Caspian, which, given its geographical characteristics, is also a transboundary waterbody. In connection with the demise of the USSR in 1991, and the emergence of new independent states, there was a need to define the legal regime of the Caspian Sea and regulate fisheries in it. This waterbody has shorelines in the Russian Federation, Kazakhstan, Turkmenistan, Islamic Republic of Iran (the) and Azerbaijan. Most of the world's sturgeon stocks are concentrated here and important commercial species such as common carp, pike-perch, freshwater bream, mullet and sprat.

In accordance with Article 9 of the 2018 Convention, the parties jointly determined the TACs of LARs in the Caspian Sea and allocated national quotas. Under Article 9, paragraph 4, if a party is unable to fish its quota in the TAC, it may, by entering into bilateral agreements and other arrangements in accordance with national law, grant other parties access to the remainder of its quota in the TAC.

In the territorial waters of the Caspian states, foreign vessels are prohibited from carrying out any fishing activity, manoeuvres or naval exercises with weapons of any kind.

According to paragraph 5 of Article 9 of the Convention of 2018, the procedure and conditions for the fishing of shared stocks of LARs in the Caspian Sea are determined in accordance with a separate agreement between all state parties to the Convention under consideration. This refers to the Agreement on the Conservation and Sustainable Use of Aquatic Biological Resources of the Caspian Sea of 16 December 2014 (FAOLEX, 2014).

The agreement stated for the first time that the shared LARs of the Caspian Sea are the common heritage of its member states.

The shared LARs are sturgeon species, sprats and seals. Other species of fish will be included in the list by the Commission on Aquatic Bioresources of the Caspian Sea in accordance with the 2014 agreement.

This Commission coordinates the activities of the Caspian states on issues related to conservation, reproduction and sustainable use of shared LARs and makes changes to the list of shared stocks. The Commission annually determines the TAC of shared stocks and allocates them to national quotas. A special authority determines fish stocks in certain areas and for specified periods. The Commission has the power to establish minimum size and weight for the various species of LARs and determine the design of fishing gear. An important function of the Commission is to establish export quotas for sturgeon species and products from them (Bekyashev, Bekyashev and Galstyan, 2018).

According to Article 3, the purpose of this agreement is the conservation and sustainable use of LARs of the Caspian Sea, including their joint management.

Within the framework of the 2014 Agreement, the parties cooperate in the following areas:

- coordinated scientific research;
- development of measures to regulate the fishery of shared biological resources;
- development of measures to combat IUU fishing and illegal trafficking of LARs;
- collection, provision and exchange of fishery statistics in a format agreed upon by the parties;
- development and implementation of short-, medium- and long-term programmes for the reproduction and conservation of shared LARs and their habitats, including the production of sturgeon juveniles;
- development of recommendations on the use of fishing gear and fishing technologies for shared LARs; and
- exchange of scientific information and experts as well as conducting relevant seminars, conferences and training events.

In accordance with Article 7 of the 2014 Agreement, commercial fishing of sturgeon species is not prohibited, but is permitted in rivers and their mouths and in marine areas established by the Commission's decision taking into account the traditional fishing methods of each state.

According to Article 5 of the 2018 Convention on the Legal Status of the Caspian Sea, the Caspian Sea is divided into internal waters, territorial waters, fishing zones and common water space.

The sovereignty of each party extends beyond its land territory and inland waters to the adjacent sea belt, called territorial waters, as well as to its bottom and subsoil and the airspace above it. The territorial waters of each state shall not exceed 15 nautical miles from the shoreline.

In accordance with Article 9 of the 2018 Convention, each party shall establish a fishing zone of ten nautical miles adjacent to its territorial waters. In its fishing zone, the party has the exclusive right to fish for LARs.

Lithuania, Lake Vishtynetskoye and the Curonian Lagoon

Lake Vištytis is a transboundary lake located in the territory of the Russian Federation and Lithuania that is used for industrial fishing and for which there is no special international treaty. This lake is home to 22 fish species of which important commercial fish species are vendace, European whitefish, tench, burbot, European eel and various invertebrates, including crayfish and shellfish.

Over the past few years, the Russian Federation and Lithuania have developed common rules for fishing on Lake Vishtynetskoye within the framework of the Joint Russian–Lithuanian Commission on fisheries.

In particular, a bilateral working group has been established to regulate fishing in the Curonian Lagoon and Lake Vishtynetskoye.

In the Rules of Fishing in Lake Vishtynetskoye, it is planned to establish a common single closed season for the protection of spring-spawning fish species (instead of the current situation where each country has its own), as well as common requirements for fishing gear, variety of sizes and species, and so forth. It is noteworthy that the Russian Federation produces about 20 tonnes of fish in Lake Vishtynetskoye annually through industrial fishing, while Lithuania does not carry out any large-scale commercial fishery.

It should be noted that since Lithuania is a member of the European Union (EU), issues related to the fishing of the most valuable commercial species of Lake Vishtynetskoye (e.g. European eel) are regulated within the framework of the Joint Fisheries Commission for the Baltic Sea, to which both the Russian Federation and the European Union are parties. According to European Union regulations, the preservation of European eel stocks is the exclusive domain of the EU, not its members. Within the framework of the Commission, bilateral programmes between the Russian Federation and Lithuania on cooperation in the field of recovery of European eel stocks in the transboundary Lake Vishtynetskoye were developed (Bekyashev *et al.*, 2016).

7.4.2 Waterbodies without treaties

In summary, it can be stated that fishing in transboundary waterbodies of the Russian Federation in certain cases is subject to regulation under special international treaties. In their content, they are largely identical, and have as their main goal the joint use and conservation of LARs stocks.

The legal regulation of fisheries in those transboundary waterbodies of the Russian Federation for which there is no corresponding international treaty, is carried in accordance with the norms of the legislation of the Russian Federation as it relates to fisheries in its territory, i.e. the 2004 federal law 'On Fisheries and the Conservation of Aquatic Biological Resources', and fishing rules that relate to the regulation of fishing in inland waters of the Russian Federation according to the territorial (basin) principle.

7.5. INTERNATIONAL CONVENTIONS RELATED TO INLAND FISHERIES TO WHICH THE RUSSIAN FEDERATION IS SIGNATORY

Convention on Biological Diversity (CBD), 5 June 1992

The Russian Federation ratified the CBD on 5 April 1995. According to the preamble, states have sovereign rights over their own biological resources. In this regard, they are responsible for the conservation of their biodiversity and the sustainable use of their biological resources. The 1992 Convention calls upon states to anticipate, prevent and address the causes of significant reduction or loss of biodiversity at their source.

The basic condition for biodiversity conservation is the preservation of ecosystems and natural habitats, and the maintenance and restoration of viable species populations in their natural conditions.

The conservation and sustainable use of biodiversity (including LARs) is critical to meeting food and health needs. Article 10 of the 1992 Convention provides for consideration of issues of conservation and sustainable use of bioresources in the decision-making process at the national level (UN, 1992).

The Russian Government entrusted the MNRE with ensuring implementation of the obligations arising from this Convention (GRF, 1995).

Convention on Wetlands of International Importance Especially as Waterfowl Habitat of 2 February 1971.

The Russian Federation has been a party to this Convention since 1975.

The preamble of the Convention recognizes the interdependence of humans and the environment and considers the significant environmental functions of wetlands as regulators of the water regime. Wetlands are resources of great economic, cultural and recreational significance.

The parties to the 1971 Convention were confident that the protection of wetlands and their flora and fauna could be achieved by combining forward-looking national policies with coordinated international efforts (UNESCO, 1971).

The Government of the Russian Federation instructed the MNRE to fulfil Russian obligations related to implementation of the 1971 Convention, including in the domain of fishing in wetlands (GRF, 1994).

Convention for the Conservation of Salmon in the North Atlantic Ocean of 1 October 1983

The Russian Federation has been a party to this Convention since 1986.

The Convention established the North Atlantic Salmon Conservation Organization (NASCO), which is an international intergovernmental organization (NASCO, 1983). Its current members are the European Union, Canada, Denmark, Norway, the Russian Federation and the United States of America. The mission of NASCO is to conserve, restore and improve Atlantic salmon stocks and to manage them rationally through international cooperation using available credible scientific information.

This species makes extensive migrations in the ocean and therefore the sustainable management of its stocks in the North Atlantic cannot be carried out without international cooperation.

The 1983 Convention prohibits salmon fishing on the high seas and in most areas of the exclusive economic zones of the North Atlantic.

About 200 rivers of the North Atlantic Basin flow through the territory of the Russian Federation, where Atlantic salmon can appear. They are located in five regions: on the Kola Peninsula, in the Arkhangelsk region, the Republic of Karelia, the Komi Republic and the Nenets Autonomous District; they also flow from the borders of Norway to the Kara Sea (NASCO, 2004).

Wild salmon stocks in the rivers of the Russian Federation (on the Kola Peninsula in particular) are in a fairly stable condition inter alia due to the active implementation of the recommendations for Atlantic salmon management developed by NASCO.

During its membership in NASCO, the Russian Federation has always opposed drift net salmon fishing in the Norwegian Sea due to the significant damage it has caused to the salmon populations in the rivers of the Russian Federation. Such measures have helped to increase salmon stocks in the rivers of the Kola Peninsula, the Arkhangelsk region and Karelia. The cessation of drift net fishing and the introduction of regulatory measures have significantly improved the stocks in the rivers of the Russian Federation, enabling the successful development of recreational activities since the beginning of the 1990s, which now bring significant revenue to budgets at various levels and create additional jobs for Russians.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) of 3 March 1992

The Russian Federation has been a party to this Convention since 1992.

This Convention makes a significant contribution to the conservation of sturgeon species in waterbodies of the Russian Federation. The list of fish species regulated by the 1973 Convention includes, in particular, sturgeon (shortnose sturgeon [*Acipenser brevirostrum*] and Atlantic sturgeon [*Acipenser oxyrinchus*]), carps and Perciformes). For the introduction of these species and export outside the state parties, preliminary issue of a certificate by the administrative authority is required (in the Russian Federation, this is the FAF).

8 Fisheries development and management

Brazhnik, S. Yu., Skakun, V.A., and Bykov, A.D.

8.1. NATIONAL VISION FOR THE DEVELOPMENT OF INLAND FISHERIES (PROSPECTS FOR THE DEVELOPMENT OF FISHERIES AND ENVIRONMENTAL MANAGEMENT)

The national vision for the development of freshwater fisheries is inextricably linked with the state's desire for the rational and sustainable use of LARs. The management measures in place aim at preserving LARs and aquatic ecosystems at an optimal historical level as well as organizing their rational use according to the goals established by the state (Research Institute of Labor, 2019; Makoedov, 2015).

According to FAF (2016) and Brazhnik and Sechin (2009), the main problems of the freshwater fishery complex currently are:

- orientation of the fishery towards the commercially most valuable fish species (sturgeon, salmon, whitefishes and pike-perch), while stocks of less valuable species are underutilized almost everywhere;
- inland fisheries is dominated by small-scale fishers who are unable to invest in expensive equipment and pay for labour costs. The lack of state support and poor technical equipment does not allow them to conduct mobile and rational fishing and the high cost of fuel and lubricants often makes fishing unprofitable. As a result, inland fisheries has been significantly reduced and is currently limited to large waterbodies and rivers. Modern fishing is carried out mainly by nets, which do not require significant labour costs, but at the same time, the selectivity of fishing sharply increases, leading to negative changes in the composition of fish populations;
- the multispecies nature of fishing creates difficulties for its regulation through the establishment of TACs. In some cases, this leads to the need to divide quotas among the many users and, as a result, the size of individual quotas becomes very small and they are quickly used up, which forces users to either stop fishing or not report their catches. This leads to a significant distortion of fisheries statistics. In this situation, the most acceptable way to regulate the fishing pressure on a waterbody is, in addition to establishing the sustainable volumes of catch, to regulate the fishing effort for each waterbody; and
- freshwater fishing in its current form is not sustainable and leads to a significant reduction in the ability of waterbodies to further sustain and develop fishing. On the other hand, there is an unused potential, which makes it possible to increase fish productivity in a short time by introducing certain valuable species of fish (herbivorous species, common carp, and peled). This is especially true for waterbodies in the southern regions of the Russian Federation and Western Siberia.

In addition, FCRF (2019) noted that the problems that impede the development of fisheries in inland waterbodies can also include:

- insufficient consideration of the needs of fishery complexes in the regions when establishing water flow regimes through hydraulic structures of energy facilities;

- low investment attractiveness of fisheries; lack of government support for the enterprises of the fishery complex, similar to support for agricultural producers; and
- insufficient workforce and inadequate materials and technical means in fish protection organizations.

To solve these problems, the following steps will be taken in the near future:
- development of a set of measures to preserve and maintain the natural LARs grounds for spawning, feeding, migration and wintering;
- development of innovative cost-effective technologies for the rational use of LARs;
- expanding work on the artificial reproduction of LARs to enhance fisheries in inland waterbodies;
- development of mechanisms to ensure adequate monitoring and surveillance of fisheries in inland freshwater bodies; and
- development of mechanisms regulating the way of fishing during periods of fish kills.

One issue that requires urgent attention is considering the possibility of state support for the construction and modernization of small-tonnage vessels for the fishing fleet for inland waterbodies.

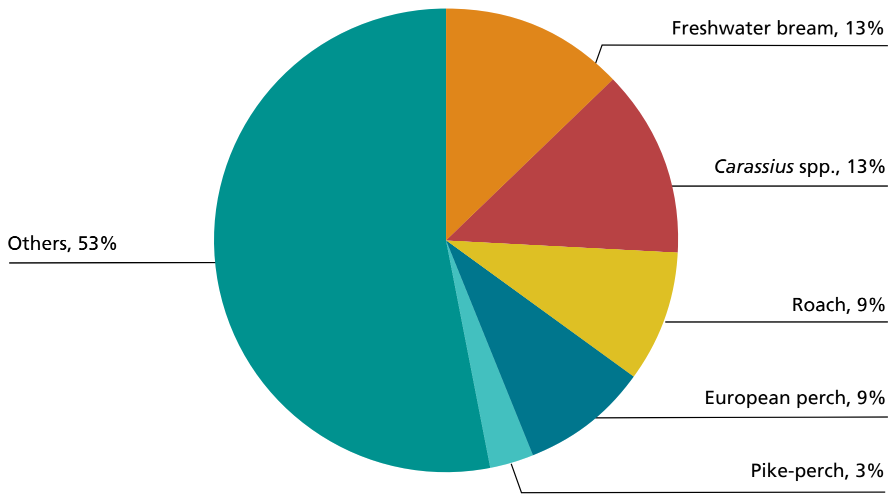
Taking into account the importance and relevance of these main directions of development, the FAF, together with the executive authorities of the constituent entities of the Russian Federation, plan to formulate an effective strategy for the development of fisheries in the inland waterbodies of the Russian Federation.

8.2. THE STATE OF INLAND FISHERIES

8.2.1. Important fish stocks

Among the 130 species of LARs exploited in freshwater fisheries, *Carassius* spp., freshwater bream, roach, European perch, whitefishes and northern pike dominate in catches. Sturgeons and salmonids are valuable fish species, but, due to their relatively low abundance, their numbers are very insignificant in catches (Glubokovsky *et al.*, 2012) (Figure 8.1).

Figure 8.1. Share of catches of the main fish species from the total catch of LARs in inland freshwater bodies of the Russian Federation in 2013



Source: Authors' elaborations.

Carassius spp. – prussian carp (Carassius gibelio) and crucian carp (Carassius carassius)

The two *Carassius* species are not separated in the catch statistics and are therefore recorded as *Carassius* spp. However, the stocks of crucian carp in the waterbodies of the Russian Federation are insignificant and the catches of *Carassius* spp. are mainly represented by prussian carp (Glubokovsky *et al.*, 2012).

Prussian carp is one of the most common commercial fish species of the Russian Federation. It has been widely transplanted to increase the fish productivity of eutrophic waterbodies (Skakun and Brazhnik, 2014).

According to the official statistics, the catch volume of *Carassius* spp. from 2009 to 2018 varied in the range of 18 000 tonnes to 29 000 tonnes. The distribution of *Carassius* spp. catches by fishery basins of the Russian Federation is uneven. The main stocks of this species were concentrated in the Azov–Black Sea (34.9 percent), West Siberian (31.7 percent) and Volga–Caspian (20.6 percent) fishery basins.

The most significant *Carassius* spp. fishery in 2018 took place in the Tsimlyansk Reservoir (5 000 tonnes), the Volga River in the Astrakhan region (2 200 tonnes) and Lake Chans (1 300 tonnes). High biological adaptability of the species, extended portioned spawning, coupled with the increasing eutrophication of a significant part of waterbodies, contribute to its wider distribution and increase in numbers, especially in waterbodies in the south and central part of the Russian Federation. The state of its reserves can be characterized as favourable and increasing.

Freshwater bream

This is also one of the most widespread fish species living in freshwater bodies of the Russian Federation. Its range in the north reaches the basin of the White Sea and the eastern part of the Barents Sea (the Pechora River); it is also found in the low salinity areas of the Azov, Black and Caspian seas in the south. Currently, it has successfully acclimatized and is prolific in the Ob–Irtysh and Lake Baikal basins (Reshetnikova, 2002). Being introduced into the Bratsk Reservoir in the 1970s, it quickly increased its numbers and created significant commercial stocks.

The stocks of freshwater bream nationwide are currently stable and are in some regions even growing due to the expansion of its range. In many reservoirs of the Russian Federation, it is highly abundant. From 2009 to 2018, the official catch of freshwater bream in the freshwaters of the Russian Federation was in the range of 20 000 tonnes to 30 000 tonnes.

The Tsimlyansk, Kuibyshev, Rybinsk, Gorkiy, Ivankovo, Kama, Saratov, Volgograd and Novosibirsk reservoirs, as well as Beloye, Ilmen and Peipsi lakes, are considered the most significant waterbodies for the freshwater bream fishery (Glubokovsky *et al.*, 2012; Skakun and Brazhnik, 2014).

Roach

This species is widespread within the Azov–Black Sea and Volga–Caspian fishery basins and forms semi-anadromous species (*taran* and *vobla* in Russian). Its distribution area also includes freshwater bodies of Siberia. There is no roach in the Amur River Basin and the rivers flowing into the Pacific Ocean (Reshetnikova, 2002).

In the last five years, the catch of roach varied from 10 900 tonnes to 33 600 tonnes. Commercial reserves of roach are concentrated mainly in the rivers, lakes and reservoirs of the West Siberian fishery basin, where catches make up 10 678 tonnes (31.7 percent of the total catch volume of this species in the Russian Federation). Roach is less abundant in the reservoirs of the Volga–Caspian, Western and Baikal fishery basins.

Despite the significant catches, roach does not belong to the target species due to its low market value; therefore, its stocks are used below the optimal level. The condition of this species in the waterbodies of the Russian Federation is more than safe.

Pike-perch

Pike-perch is one of the most valuable commercial species in the freshwater reservoirs of the Russian Federation. Large-scale acclimatization measures to introduce it as an effective predator for biological control have contributed to the expansion of the distribution range of pike-perch in the Russian Federation (Brazhnik, Mitenkov and Skakun, 2012).

The main catches of this species are concentrated in the Volga–Caspian (57 percent) and Western (19 percent) fishery basins. The share of its catches in West Siberian (11 percent), Azov–Black Sea (10 percent) and Northern (3 percent) basins is considerably lower.

Despite the mass distribution of the pike-perch in the waters of the country, only 16 of them are traditionally considered the most significant in the fishery of this species – Tsimlyansk, Kuibyshev, Rybinsk, Gorkiy, Cheboksary, Kama, Saratov, Volgograd and Novosibirsk reservoirs as well as Ladoga, Onega, Chany, White, Vozhe, Ilmen and Peipsi lakes. These waterbodies contribute more than 70 percent of the total catch volume of pike-perch in the Russian Federation (Glubokovsky *et al.,* 2012; Brazhnik, Mitenkov and Skakun, 2012).

Having high commercial value and being a target for commercial and recreational fishing, pike-perch suffers high anthropogenic pressure. In various waterbodies where the fishing pressure is especially high (for example, Rybinsk, Tsimlyansk reservoirs, Lake Ilmen), stocks have been reduced and their condition is close to being overexploited. However, in the whole country, the state of pike-perch stocks can be described as satisfactory. This is partly because the species is less dependent on the water-level regime of reservoirs during the spawning period compared to phytophilic fish.

Whitefishes

This group (Coregoninae) includes 14 species grouped in three genera *Coregonus* (the largest), *Stenodus* (nelma and sheefish) and *Prosopium* (round whitefish). The total amount of possible catch and TAC for 2012 was estimated at 19 700 tonnes. Peled, broad whitefish, Arctic cisco, humpback whitefish and vendace have the greatest commercial significance.

Peled

This species lives in lakes and rivers of the Arctic coast from the Mezen River in the west to the Kolyma River in the east. Catches of peled from 2000 to 2010 ranged from 2 240 tonnes to 1 907 tonnes.

As a result of acclimatization work, the population of peled in the Yenisei Basin has significantly expanded to the south. This species was brought into waterbodies of the republics of Tyva and Khakassia, and also Buryatiya and Sakha (Yakutia). The largest stocks of peled are recorded in the Tyumen region and the rivers of Yakutia. In general, the state of the stocks of this species is not a concern and can be characterized as satisfactory.

Broad whitefish

This is a valuable and important target in the fisheries. The Ob population of broad whitefish is in a poor state. Since 2006, its total catch in waterbodies of the Ob Basin has generally declined. In the Yenisei Basin, the stocks of this species are dispersed across numerous, and often hard-to-reach reservoirs, which helps to maintain its numbers at a satisfactory level. The stocks of broad whitefish in the reservoirs of Yakutia are limited and are declining slightly. The main share of catches comes from the Yana, Indigirka and Kolyma rivers.

Baikal omul

This is a valuable commercial species whose stocks have been intensively exploited for more than two centuries. From 1939 to the present day, commercial catches have ranged from 9 000 tonnes in 1942 to 1 826 tonnes in 2016. At present, its catch is conducted only for scientific research purposes, artificial reproduction and to sustain the traditional lifestyle of Indigenous Peoples (Sokolov and Peterfeld, 2018; Petukhova, Bobyrev and Sokolov, 2019). In general, the state of the stocks of this species in Lake Baikal is still characterized as critical.

Humpback whitefish

Humpback whitefish is mainly caught in the reservoirs of the West Siberian, East Siberian and Baikal fishery basins. It is one of the main commercial species. Its catch in the last ten years has been stable at about 1 000 tonnes.

In the West Siberian Basin, two large stocks of humpback whitefish from respectively the Ob River and the Taz River form the basis of the catch. They are characterized by having different feeding and spawning sites. In addition, there are small local groups of humpback whitefish in Gydan Bay and in the lakes of the Yamal Peninsula, but those fisheries are poorly developed.

The catch of humpback whitefish in the Yenisei Basin in the 1970s and 1980s was distinguished by relative stability, an average of 500 tonnes was caught annually, of which about 350 tonnes were caught in the rivers of the basin. In 2018 and 2019 the recorded humpback whitefish catch amounted to about 600 tonnes.

In the East Siberian fishery basin, humpback whitefish has less importance in the fisheries, its catches in the last five years have been around 400 tonnes/year. The state of stocks of this species in both the West Siberian and the East Siberian fishery basins is satisfactory.

Nelma

This species is threatened everywhere. Since 2018, in the Yenisei fishery region, according to a joint decision between scientific institutions and fishing companies, commercial fishing of this species has not been carried out.

Vendace and sardine cisco

Vendace is common in the European part of the Russian Federation (basins of the Baltic, White and Barents seas) and is represented by lake, and less often by a lake–river form or morph. There are no anadromous types.

From the Kara River to the Bering Sea, sardine cisco is common; it is typically anadromous and semi-anadromous, sometimes forming a lake morph.

From 2000 to 2019, in general, the catch of both species ranged from 2 000 tonnes to 8 000 tonnes in the Russian Federation. However, their stocks, as species with short life cycles, experienced significant fluctuations depending on the hydrological conditions of the year (Glubokovsky *et al.*, 2012). In general, the state of the stocks is not a concern.

Sturgeon species

The sturgeon catches in freshwaters are represented by 11 species. At present, all species are included in the IUCN Red Book; Atlantic and green sturgeons, as well as a number of populations of other species are in a threatened state and are included, or planned for listing, in the Red Book of the Russian Federation.

The number of Caspian sturgeons is unstable and constantly experiencing significant fluctuations; the highest catches were noted at the beginning of the last century (39 400 tonnes) and in the mid-1970s (27 400 tonnes). The current state of the natural populations of sturgeons is characterized as catastrophic. In this regard, the catch is carried out only for research and scientific purposes, as well as for fish-farming reproduction (Vlasenko, 2012).

Kaluga and Amur sturgeon

The fishing of kaluga and Amur sturgeon is currently prohibited; the only type of legal fishing that is carried out is for monitoring the state of the population and for artificial reproduction (Glubokovsky *et al.*, 2012).

Siberian sturgeon

This species lives in the Ob–Irtysh Basin, the Yenisei River Basin and in the rivers of the Republic of Yakutia. All populations of Siberian sturgeon, apart from the Lena River population, are listed in the Red Book of the Russian Federation. Commercial fishing of Siberian sturgeon is carried out in the lower reaches of the Lena River, but its stocks and catches have halved over the past decade (Glubokovsky *et al.*, 2012).

Sterlet sturgeon

The main areas where the stocks of sterlet sturgeon are still preserved in more or less commercial quantities are the Northern Dvina River, the Kuibyshev Reservoir, the Ob–Irtysh River and the Yenisei River Basin. In all the Volga reservoirs (except Kuibyshev), it has completely lost its commercial significance. An extremely small population of sterlet sturgeon (with a stock of about 33 tonnes) lives in the Oka River and its tributaries. In the Kuybyshev Reservoir, official catches declined by 97 percent, from 41.2 tonnes in 1989 to 1.3 tonnes in 2010. Many factors have caused the catastrophic decline from the reduction of natural spawning grounds to extremely high commercial pressure on the population.

There was a specialized fishery for sterlet sturgeon in the Northern Dvina Basin until the 1990s, however, from 2000 to 2010, sterlet sturgeon catches decreased from 9 tonnes to 200 kg.

Siberian sterlet sturgeon (Acipenser ruthenus marsiglii)

This subspecies is widespread in the Ob–Irtysh Basin, while several subpopulations have formed, the most numerous are irtyshskoe and obskoe. Despite the apparent abundance of Siberian sterlet sturgeons in the basin, catches decreased from 20 tonnes to 5 tonnes from 2002 to 2005. Commercial fisheries for Siberian sterlet sturgeons was banned, and catch quotas were allocated only for research purposes and reproduction (Glubokovsky *et al.*, 2012).

The role of Siberian sterlet sturgeons in the fishery on the Yenisei is small; its share in the annual catch, as a rule, has not exceeded 1 percent. Its maximum catches (134 tonnes to 162 tonnes) were recorded from 1942 to 1945 because these fish were in high demand, but the statistics do not reflect the true volumes being caught, in fact they greatly understate them. Since 1998, fisheries have been prohibited and currently the fishing of Siberian sterlet sturgeons in the reservoirs of the Krasnoyarsk region (Krasnoyarsk Territory, the republics of Tyva and Khakassia) is carried out only for fish farming and research purposes (Glubokovsky *et al.*, 2012).

Caspian Sea stocks

From the middle of the 1930s to date there has been an overall decrease in the stocks and catches of valuable commercial fish in the Caspian Sea. The catch of white salmon in the Volga–Caspian fishery basin, which amounted to hundreds of tonnes in the 1930s, had almost stopped by 2010 (the official catch is now less than 1 tonne) due to the critical state of its stocks. A similar trend has been observed for sturgeons (VNIRO, 2018).

The annual catch of large mainstream species of semi-anadromous fish (freshwater bream, common carp and pike-perch) was between 100 000 tonnes and 150 000 tonnes in the 1930s to 1950s; however, it fell to between 22 000 tonnes and 28 000 tonnes from 1985 to 2016. The annual catch of roach has also decreased significantly – from between 40 000 tonnes and 80 000 tonnes in the 1940s to 1960s to between 1 000 tonnes and 1 600 tonnes at present. The decrease in the population of commercial species of semi-anadromous fish occurred due to overfishing and worsening conditions for natural reproduction (Demin, 1962; Mirzoyan and Khodorevskaya, 2017).

The state of sea shad (Caspian shads, Caspian marine shad) stocks as well as Caspian sea sprat have been less affected by fishing, although stocks of Caspian anadromous shad (*Alosa kessleri*) (Volga shad and black-backed shad) in the Volga River Delta were already undermined by overfishing at the beginning of the twentieth century, and areas of shad fishing were moved to the south, to the western coast of the Caspian Sea.

Since fishing with drift and set gillnets for shads at sea was forbidden back in the 1960s, due to the significant by-catch of juvenile sturgeons, the specialized fishery for sea shads was short-lived and the fishing pressure on their populations was moderate. After the ban on sea fishing, shad fishing was almost non-existent, which positively affected their stocks (Demin, 1962, 1963).

Sprats

Until the 1950s, fishing for sea sprat was insignificant, irregular and oriented towards stocks of common Caspian kilka (coastal fishing with set seines catching between 7 000 tonnes and 30 000 tonnes). The introduction of a new technology for fishing allowed sea sprat fishing in open areas of the sea, and by 1958 their catch had reached 146 000 tonnes (with a maximum catch of 442 000 tonnes in 1971).

In the species composition of the catches, anchovy sprat (85.5 percent) ranked top. Annual catch volumes of sea sprat until 1990 varied on average between 221 000 tonnes and 320 000 tonnes. After the mass death of populations of the anchovy sprat and Southern Caspian sprat, their catches sharply decreased (VNIRO, 2018). However, to date, there has been a significant increase in their numbers, which, given the loss of fishing and processing facilities, leads to underutilization of sea sprat stocks.

8.2.2. Threats to internal stocks and fisheries

Overfishing, pollution, hydropower dam construction and unsustainable development of inland regions causes irreparable damage to fisheries resources and their habitats. The issues listed below for the waterbodies of eight fishery basins are of a regional nature.

In the Northern fishery basin, the greatest threats to the natural habitat of LARs are the wastewaters from industry, runoff from agro-industrial complexes, sewage from housing and communal services, fish escaping from aquaculture systems, waste from water transport, oil and gas exploration, dredging and extraction of non-metallic and building materials from the bottom of waterbodies and so forth (Gorbachev, 2008).

Intensive mineral pollution leads to the simplification of the structure of biotic communities in waterbodies, in particular, to a decrease in species diversity, and the disappearance of stenobiontic species. Many trout farms under construction in Karelia have significant influence on the state of hydrobionts. Trout farms are significant sources of pollution because of unconsumed fish feed and metabolic products. As it was demonstrated by the latest hydrochemical research, nitrogen and phosphorus are the main causants of pollution since these nutrients are the limiting factors in lakes and reservoirs (Il'mast and Sterligova, 2014).

Challenges involved with the extended reproduction of LARs, especially those of material and economic importance, should be solved through the development of new effective biotechnologies in order to obtain useful products of animal origin, while ensuring the conservation of natural populations and ecosystems (Pavlov and Striganova, 2005).

In the waterbodies of the Western fishery basin, the main threats to the development of fishery complexes are overfishing and pollution of inland waters. High fishing pressure and poaching have led to serious changes in the structure of fish communities almost everywhere and a decrease of valuable species in the fisheries; some of them are listed in the Red Book of the Russian Federation (Kostyunichev *et al.*, 2015).

Since the mid-1970s, the ecosystem of the Pskov–Chudsky Reservoir has undergone significant changes related to eutrophication, changes in the ratio of organic nitrogen and phosphorus, a steady reduction in the abundance of zooplankton and fluctuations in water temperature. The overall transformation of the ecosystem has inevitably affected the fish population. One of the adverse effects associated with excess phosphorus is the decrease in oxygen concentration, in some cases resulting in fish kills, which in turn can lead to a sharp deterioration in the conditions for the development of juvenile fish (Bobyrev, 2016).

Increasing temperatures have also affected the structure of fish assemblages and their biological indices. Thus, the negative correlation between the catches of rainbow smelt in Ilmen Lake and its water temperature can be explained by the fact that this species belongs to the group of the Arctic faunistic complex, i.e. it is a representative of cold water ichthyofauna. In this reservoir, the rainbow smelt lives near the southern border of its habitat in the northwest of the Russian Federation (Boitsov, 2014).

The Baikal fishery basin includes the waterbodies of the Irkutsk region, the Republic of Buryatia and the Trans-Baikal region. Thanks to the uniqueness of Lake Baikal, declared by UNESCO as a part of the world's natural heritage, the Baikal region is of international importance. Despite the measures taken to preserve Lake Baikal, serious problems remain. Due to increased anthropogenic influence (deforestation, pollution of spawning rivers and destruction of natural spawning grounds), the ecological situation in spawning and wintering areas is deteriorating, with reduced effectiveness of natural reproduction. Great damage to fisheries is caused by poaching and increasing uncontrolled fishing pressure on valuable fish species. Construction of the Angarsk Reservoir cascade (Irkutsk, Bratsk, Ust–Ilimsk) broke the natural reproduction of many fish stocks. Valuable species of fish such as sturgeon, sterlet sturgeon, taimen, lenok and European whitefish are currently very rare (Voronova *et al.,* 2015; Smirnov, Smirnova-Zalumi and Orlov, 2013).

The main threats to fish stocks in the water facilities of the West Siberian fishery basin are construction of hydropower dams, overfishing, pollution and habitat destruction, which lead to structural changes in the ichthyofauna. While the abundance of sturgeon and whitefishes has significantly decreased, the populations of common carp and pike-perch have expanded their distribution to the north of the Lower Ob River (Pavlov and Mochek, 2006; Gadinov and Kryuchkova, 2008). In addition, there are occasional 'phenological failures', caused by the shifts in time of spawning and larvae hatching and leading to increased death of fish eggs or fish larvae drifting or migrating downstream. After spawning and river freezing, an autumn floating of ice was observed on some circumpolar rivers, leading to driftage of whitefish eggs along with *frazil*[31] outside the spawning grounds. Early and strong spring warming leads to premature hatching of larvae that die from starvation. This has been the most common phenomenon in the last decade. Until the early 1990s, winter kill on the Ural spawning rivers (i.e. the Synia, Harbey and Longot'egan tributaries) occurred about once every five years. The impact of winter kills on egg mortality has subsequently decreased. These facts indicate the effect of global climate change on freshwater fish species in the Arctic (Bogdanov, 2014).

In the East Siberian fishery basin, the Lena, Kolyma, Indigirka and Yana rivers are the most important for fisheries. The Olenek, Anabar, Alazeya, Khroma, Chondon, Omola rivers – and the Aldan and the Viluy (major tributaries of the Lena) are also important for fisheries. The lakes constitute the most productive waterbodies located in the basins of the Yana, Indigirka, Kolyma and Middle Lena rivers including the Viluy Basin. The most serious anthropogenic impact on the fish stocks in the second half of the twentieth century was overfishing (commercial, recreational and poaching) (GSR, 2014).

The main threats to LARs of the Far Eastern fishery basin are environmental pollution, illegal and unreported fishing, as well as the introduction of invasive aquatic animals, including fish and invertebrates, carried out deliberately or accidentally by human beings (Svirsky and Barabanchshikov, 2009; Lyzova, 2007).

For the complex of reservoirs of the Volga–Caspian and Azov–Black Sea fishery basins located in the most populated regions, the main threats to the development of the fishery complex are pollution of waterbodies by biogenic substances, non-treated urban wastewater and petrochemical discharge, unreported overfishing (including by recreational fishers), intensive navigation, water intake for household needs, irrigation of agricultural lands, death of fish passing through hydropower turbines and extraction of non-metallic building materials (Kondrat'eva, Zakharov and Khaliullina, 2012; Gerasimov and Brazhnik, 2014; Loginov and Gelashvili, 2016).

8.3. MANAGEMENT STRATEGY

8.3.1. Total Allowable Catch (TAC) and recommended annual catch (RAC) in inland waters (fishery basin features)

The volumes of TACs in the waters of the Russian Federation are established for LARs that are included in the 'List of Species of Aquatic Biological Resources for Which the Total Allowable

[31] Soft amorphous ice formed in turbulent water.

Catch is Established', approved by the order of the Ministry of Agriculture of the Russian Federation of 1 October 2013, No. 365 (MoA, 2013). For other species of LARs, the recommended catch volumes are determined.

The fishery science authority of the Russian Federation annually disseminates the TACs of LARs for 50 commercial stocks in inland freshwater bodies.

In 2019, the catch volume for commercial fishing in inland waters amounted to 38 800 tonnes, which was slightly higher than 2018 (37 700 tonnes). The recommended volumes of catch of LARs for which TACs were not fixed in 2019 amounted to 169 200 tonnes, which was higher than 2018 (162 400 tonnes) and 2017 (165 300 tonnes).

Fishing of LARs for which TAC is established and those for which TAC is not established is carried out in inland waters of 42 constituent entities of the Russian Federation.

In 27 regions, fishing of species without established TAC is carried out. In inland waters of 16 constituent entities of the Russian Federation industrial fishing is not carried out at all (FCRF, 2019).

Northern fishery basin

The TAC is fixed for sterlet sturgeon in the Northern Dvina River and its tributaries, lake salmon of the Shuya River (the Onega Lake Basin), European whitefish, pike-perch and Arctic cisco.

This basin is distinguished by the largest lake resources among the fishery basins located in the European part of the Russian Federation. In the Republic of Karelia alone, there are more than 60 000 lakes and there are more than 110 000 in the Murmansk region. The other regions of the Russian Federation, which are part of the Northern fishery basin, also have a very significant lake resources (Matishov and Chinarina, 2005).

However, most lakes belong to the 'small' category with water surface area up to 10 km^2 and have low productivity indicators not exceeding 10 kg/ha to 20 kg/ha. Such waters, as a rule, are of no interest to any type of officially registered fishing. The reason for the non-development of fisheries in these reservoirs is not only their insignificant fish productivity, but also because of low population density in the region, as well as a poorly developed road network.

The largest and most significant waterbodies of the Northern fishery basin in terms of fisheries are Lake Onega and the Northern Dvina and Pechora rivers. These waterbodies are sites of commercial, licensed fishery and angling which, however, does not lead to the full exploitation of the resources. In Lake Onega the resources of whitefish and pike-perch are the most intensively exploited; the other fish species are significantly underutilized. The exploitation of species such as as vendace and European smelt in Lake Onega has decreased in the last three years.

Thus, compared with the rather significant fish resources in the basin, the demand for them is low, and the possibility to further develop fisheries here is also very low (Brazhnik *et al.*, 2013). Fish stock status in the Northern fishery basin is illustrated in Table 26.

Table 26. Fish stock status in the Northern fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)						
	1990–1994	1995–1999	2000–2004	2005–2009	2010–2014	2015–2018	Stock status
Roach	180	125	170	307	415	986	U
Carassius spp.	122	200	198	12	680	6	U
European smelt	840	816	760	993	1 118	783	O
Freshwater bream	931	553	231	288	322	438	O
European perch	595	145	134	323	736	511	U
Vendace	452	466	378	608	895	1 479	O
Pike-perch	701	84	316	221	261	158	O
Northern pike	522	305	124	273	335	690	O

Source: VNIRO.

Western fishery basin

The TAC is set for European whitefish, pike-perch and European smelt.

The bulk of the catches in the basin is provided by Ladoga, Pskovsko–Chudskoye and Ilmen lakes where the intensity of fishing is quite high; basin development indicators are good at 61.6 percent.

Total catches in Lake Ladoga have been decreasing recently, especially for whitefishes and pike-perch, which are in high demand among the population; the commercial use of vendace, European smelt and small ordinary fish is at a fairly low level. Their stocks can be considered as a fishing reserve.

In addition, the fish stocks of small lakes and reservoirs, which are very significant (Brazhnik *et al.*, 2013), can also be considered as fishing reserves. Fish stock status in the Western fishery basin is illustrated in Table 27.

Table 27. Fish stock status in the Western fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)						
	1990–1994	1995–1999	2000–2004	2005–2009	2010–2014	2015–2018	Stock status
Roach	1 455	724	2 442	1 569	2 840	1 628	U
White bream	1 267	602	437	277	719	447	U
European smelt	1 327	1 315	2 242	1 313	1 919	1 327	O
Freshwater bream	2 202	1 531	2 361	1 910	2 577	2 176	O
European perch	1 222	633	1 169	1 411	2 479	1 820	U
Zope	1 014	240	543	425	861	873	O
Rainbow smelt	1 312	910	704	776	1 138	1 139	O
Pike-perch	1 932	732	1 184	1 419	1 138	1 139	F

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

The Azov–Black Sea fishery basin

The TAC is set for pike-perch, roach, vimba bream, freshwater bream, white bream, silver and bighead carp and crayfish (genera *Astacus* and *Pontastacus*).

The most intensively exploited water reservoir in the basin is the Tsimlyanskoe Reservoir where there are almost no underutilized resources. The situation is different in other reservoirs in the region. Indigenous fish species are represented by low-value species of fish that are of no interest to fishers; fishing enterprises are poorly equipped technically; there is significant macrophyte proliferation in individual waterbodies, which obstructs the use of the entire area of reservoirs for fishing in the vegetative period; and there is lack of infrastructure for storing and processing fish, so no more than 50 percent of the maximum sustainable yield of commercial fish stocks is used.

In the Don River, within the boundaries of the Voronezh and Volgograd regions, commercial fishing is not conducted; only angling occurs.

For this fishery basin, the most effective way to increase catch is to improve the quality of the ichthyofauna in the reservoirs by introducing valuable fast-growing species of fish capable of building up a significant biomass in a short time ie. herbivorous fish and common carp. To improve the conditions for the reproduction of semi-migratory fish species and increase their stocks, a number of enhancement measures are required (Dvoryankov, 2000). Fish stock status in the Azov–Black Sea fishery basin is illustrated in Table 28.

Table 28. Fish stock status in the Azov–Black Sea fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)						
	1990–1994	1995–1999	2000–2004	2005–2009	2010–2014	2015–2018	Stock status
Roach	2 782	5 767	5 063	616	523	565	F
White bream	1 742	2 295	1 867	1 266	1 050	432	U
Carassius spp.	1 012	3 551	3 619	2 457	7 575	6 164	U
Common carp	1 027	564	590	283	446	453	O
Freshwater bream	9 493	6 484	7 313	2 341	2 201	1 445	O
European perch	668	1 221	2 118	201	265	293	U
Pike-perch	1 271	1 243	1 040	192	675	396	F
Sichel	483	245	264	73	296	181	O

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

The Volga–Caspian fishery basin

The TAC is set for beluga, starry sturgeon, Danube sturgeon, Persian sturgeon, sterlet sturgeon, blackback shad (*Alosa kessleri*), roach, pike-perch, freshwater bream, carp, wels catfish, northern pike and crayfish.

The basin is the region with the highest population density in the country with 89.4 people/ km^2 and in Moscow and the Moscow region this figure is 395 people/ km^2 compared to an average population density in the Russian Federation of 8.3 people/ km^2. Therefore, the pressure on LARs is very high.

The basin is divided into two fishery management areas – South and North.

Table 29. Fish stock status in the Volga–Caspian fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)						
	1990–1994	1995–1999	2000–2004	2005–2009	2010–2014	2015–2018	Stock status
Roach	18 745	9 050	5 610	3 917	4 825	7 331	F
White bream	2 125	1 230	1 843	2 634	4 067	3 693	U
Carassius spp.	1 985	2 517	4 624	3 831	6 604	10 387	U
Caspian sprat	102 399	103 896	45 958	13 249	1 631	1 225	O
Rudd	2 174	2 964	3 761	5 615	7 862	7 573	U
Freshwater bream	12 371	20 229	13 611	18 752	16 465	16 537	O
Wels catfish	6 153	6 699	3 745	7 367	7 959	6 880	O
Northern pike	3 281	3 822	3 435	5 677	6 035	6 635	O

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018..

Annual catches and status of fish stocks in the Volga–Caspian fishery basin are available in Table 29. The bulk of the catch in the basin is in the reservoirs of the Volga–Kama cascade. The situation in these reservoirs is ambiguous. The Ivankovo Reservoir is currently completely closed for fishing, only sports–recreational fishing is allowed, and the populations of fish are expanding; however, due to low availability of food, growth is slow. Only one-third of the whole fish stocks of the Uglich Reservoir is being used (Brazhnik *et al.*, 2013).

Fish stocks of the Rybinsk, Gorky, Cheboksary, Kuibyshev, Kamsky, Votkinsky, Saratov and Volgograd reservoirs are used quite intensively; catches vary from 65 percent to 90 percent of the maximum sustainable yield. The increase in the number of fishing gear and fishers on the reservoir has not led to an increase in the catch volume, which indicates high fishing pressure currently.

At present there are practically no significant reserves for further developing fisheries in these waters. However, a considerable rise in captures could be achieved by optimizing fishing via sets of fishing gear specifically designed for each body of water and by diminishing the fishing pressure on the most valuable species to allow their stocks to recover. It would be proactive to develop angling and sports fishing in small waterbodies where aquaculture is practised and to develop fish farming in cooling ponds of hydropower and nuclear power plants in the region.

The Baikal fishery basin

The TAC is established only for LARs of Lake Baikal – Arctic cisco, grayling and European whitefish.

The most important species in the basin was formerly Arctic cisco, but the state of its stocks is now catastrophic. In 2017, the total biomass of the stock was at a historic minimum (6 800 tonnes), which led to the introduction of a ban on its commercial catch from October 2017 (Sokolov, Peterfeld and Vasilyev, 2018). Fishery of Arctic cisco is currently carried out in very limited quantities for subsistence by Indigenous Peoples, for artificial reproduction and for research purposes. Stock protection measures have been strengthened, especially during spawning migrations. These measures led to a slight increase in its total biomass and spawning stock in 2019.

Fish stocks in Lake Gusinoe (the Republic of Buryatia) are also being exploited quite intensively and the catch in recent years has been about 90 percent of the predicted yield. In the largest waterbodies of the Irkutsk Region – the Bratsk and Ust'-Ilim reservoirs – fishing is currently conducted mainly in areas located near roads; areas located further away from the waterbodies have no fisheries. Small reservoirs and rivers of the region can hardly be considered as promising for fisheries because of their low productivity and inaccessibility; the potential fisheries for possible development in these reservoirs does not exceed 250 tonnes. At present, almost no fishing is carried out in the reservoirs of the Trans-Baikal Territory (Brazhnik *et al.*, 2013). For average annual catches and stock status of the fish in the Baikal fishery basin refer to Table 30.

Table 30. Fish stock status in the Baikal fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)			
	2005–2009	2010–2014	2015–2018	Stock status
Roach	973	1 654	1 490	U
Carassius spp.	524	475	274	U
Freshwater bream	99	209	562	O
European perch	406	747	1 584	U
Arctic cisco	1 425	1 822	769	F

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

West Siberian fishery basin

The TAC is established for Siberian sturgeon, sterlet sturgeon, European whitefish, muksun, peled, tugun, broad whitefish, nelma, round whitefish, different species of char (*Salvelinus* spp.), taimen, lenok and Arctic cisco.

The basin is divided into two fishery regions: the Ob–Irtysh and the Yenisei.

In the Yenisei fishery region, the fishery of the subordinate (primarily lake) systems of large rivers (the Yenisei and the Angara) has practically not been developed. Fishing is mainly carried out on rivers and focuses on catching valuable whitefish species; there is practically no fishing of burbot, northern pike and other ordinary fish species. The fishery in the Krasnoyarsk and the Sayano–Shushensky reservoirs is quite well developed.

In the Ob–Irtysh fishery region, fishing is currently concentrated in the Ob and Irtysh river basins, where fishing has increased 2 to 4 folds since the USSR period. As a result, the stocks of whitefishes and sturgeons are fished close to their maximum sustainable yield and implementing measures that will lead to rebuilding these valuable stocks is very important. The main inland fisheries resource remains stocks of ordinary fish, burbot and northern pike, which are still not fully exploited (Brazhnik *et al.*, 2013). Annual catches and LAR stock status in the West Siberian fishery basin are shown in Table 31.

Table 31. Fish stock status in the West Siberian fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)			
	2005–2009	2010–2014	2015–2018	Stock status
Roach	3 461	5 083	9 328	U
Gammarus	3 015	2 209	2 860	O
Carassius spp.	2 507	4 644	6 760	U
Freshwater bream	1 525	2 775	2 709	O
European perch	946	3 127	5 518	U
Vendace	2 979	2 610	3 208	O
Northern pike	2 233	2 930	9 998	U
Ide	2 836	3 701	8 232	O

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

East Siberian fishery basin

TACs are established for Siberian sturgeon, European whitefish, broad whitefish, peled, sardine cisco, lenok, round whitefish, muksun, tugun, nelma and taimen.

The main area of the basin is occupied by the Republic of Sakha (Yakutia) with huge water resources comprising 9 000 rivers, 145 500 lakes and one reservoir. However, only 28 rivers, 8 000 lakes and the Vilyui Reservoir are used by fisheries.

Fishing in Yakutia is based on semi-anadromous whitefish species (nelma, muksun and Arctic cisco) along the paths of their spawning migrations. Their catch reaches 80 percent of the total catch in the republic. Such species as northern pike, burbot, European perch, roach, common dace, Arctic grayling and Arctic char are widespread in the reservoirs of Yakutia; their stocks are in good condition and underutilized by fishing. The ‘crucian’ lakes (lakes where catches are dominated by *Carassius* spp.) are mainly concentrated in the central part of the republic and are also underutilized.

The basin also includes the West Chukchi and Chaun fishery regions of the Chukotka Autonomous District. Currently, due to underfunding and the extreme inaccessibility of most of the waterbodies in these areas, fisheries research is minimal. Expert assessments showed that actual catch in this part of the region is about 15 percent higher than what is officially reported. Most of all, this concerns valuable whitefish species. It appears impossible to provide a proper assessment of the use of freshwater fish stocks and their stocks for future fishery development in this region (Brazhnik *et al.*, 2013). Fish catches and stock status in the East Siberian fishery basin is illustrated in Table 32.

Table 32. Fish stock status in the East Siberian fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)			
	2005–2009	2010–2014	2015–2018	Stock status
Carassius spp.	1 166	454	714	U
Muksun	561	386	244	F
Arctic cisco	686	852	840	O
Vendace	712	993	826	O
European whitefish	617	464	588	O
Broad whitefish	756	736	1 229	F
Northern pike	122	305	440	O

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

The Far Eastern fishery basin

TACs are established for many species: lamprey (*Lampetra, Entosphenus* and *Lethentron*), Amur sturgeon, kaluga, so-iuy mullet (*Planiliza haematocheila*), common carp, *Carassius* spp., predatory carp, barbel steed, humpback, Mongolian redfin, northern pike, wels catfish, silver carp, bighead carp, burbot, snakehead (*Channa argus*), taimen, yellow catfish (*Tachysurus fulvidraco*), Ussuri catfish (*Pelteobagrus ussuriensis*), ukley (*Culter alburnus*), asp, yellowfin (*Xenocypris macrolepis*) and smallscale yellowfin (*Plagiognathops microlepis*), white Amur bream (*Parabramis pekinensis*), ide, European whitefish, Amur whitefish (*C. ussuriensis*), Khadary-whitefish (*Corgeonus chadary*), lenok and grayling.

Less than 50 percent of the maximum sustainable yield are caught in the fisheries. Rather substantial stocks for further exploitation exist, in particular, in the estuarine–coastal ecosystems of the Primorsky Territories; significant unfished stocks are also found in continental freshwater bodies. For example, the stocks of sharpbelly in Khanka Lake are (according to different estimations) between 2 000 tonnes and 17 000 tonnes. At present, the fishery of this species is carried out by Chinese fishers only (the volume of their catches is about 200 tonnes), while the stocks status permits catches of up to 1 000 tonnes. However, fishers of the Russian Federation do not consider sharpbelly to be an attractive target species due to the labour-consuming nature of the fishery. There is also no demand for thousands of tonnes of clams and not less than 1 000 tonnes of river prawns from the basins of Khanka Lake and the Ussury River.

The Amur River is the largest river in the basin; the fishery mainly targets anadromous species. Stock exploitation is at low rate, currently annual catches do not exceed 1 000 tonnes to 1 200 tonnes and fish stocks have grown in recent years. The main reason is poor development of fishery in the Primorsky Territories and the short fishing season for ordinary fish species. Stock exploitation of the Zeya and the Bureya reservoirs is also insufficient and is about 30 percent of what is possible.

The potential yield of freshwater fish stocks of Chukchi Autonomous District is currently no more than 15 percent due to the sparse population and the remote locations of most waterbodies.

Freshwater living resources of the Sakhalin region and the Kamchatka Territories are very lightly exploited and extracted volumes are insignificant and of no importance in these areas (Brazhnik et al., 2013). The status of the fish stocks and volume of annual catches in the Far Eastern fishery basin are shown in Table 33.

Table 33. Fish stock status in the Far Eastern fishery basin (U: Underexploited; F: Fully exploited; O: Overexploited)

Species	Average annual catches (tonnes)						
	1990–1994	1995–1999	2000–2004	2005–2009	2010–2014	2015–2018	Stock status
Pink salmon	3 861	15 780	18 760	31 965	19 322	15 277	O
Chum salmon	6 865	6 636	13 045	29 181	45 535	49 355	O
Sockeye salmon	8 143	6 403	11 325	17 670	15 246	5 959	O
European smelt	955	866	1 716	2 308	5 404	6 421	O
Coho salmon	2 019	1 238	1 103	1 619	1 722	2 717	O
Freshwater bream	5 787	379	1 247	2 306	109	57	U
Carassius spp.	2 524	2 708	2 084	2 109	1 063	422	U
Arctic char	219	429	729	1 193	1 348	1 290	O

Source: Federal Statistical Observation (FSO). Undated. Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018.

8.3.2. The role of stocking and species introductions in restoring, conserving and increasing fish catches in inland waterbodies

Introduction, which is a special case of translocation, is the deliberate or accidental movement of a species into the wild in areas where it does not live naturally. The introduction of non-native species is usually carried out with the aim of improving fisheries and obtaining economic benefits.

Re-introduction is the deliberate introduction of a species into the wild in areas where it previously lived but was lost for various reasons so that it may form a selfsustaining population.

Re-stocking, ie. releasing artificially reared fish when populations have fallen below critical levels and stock recovery is in question, is another management strategy.

The first recorded cases of fish acclimatization in water bodies of Russia date back to the second half of the 18th century. Broader work in this direction was carried out in the 19th century, which was facilitated by the experiments of V.P. Vrassky, carried out at the country's first Nikolsky fish hatchery. In the XX century, the volume of acclimatization work in our country has largely increased. Over the course of several decades (50-80s), they were carried out on a particularly large scale. By the 1930s work on the acclimatization of whitefishes in the Ural lakes and Lake Sevan, common carp - in Lake Balkhash were successful. In 1931 -1934 the introduction into the Caspian Sea of the Black Sea mullets - golden grey mullet (*Chelon aurata*) and leaping mullet (*C. saliens)* were successfully completed. In general, in the first half of the XX century about 50 species of fish were successfully introduced in 800 reservoirs of the USSR. The most intensive introduction of valuable species was carried out in the second half of the 20th century. From 1948 to 1963, 1 500 fish introductions of 45 species were carried out in 911 water bodies (mainly lakes and reservoirs). In 1964-1967 batches of 40 fish species from 9 families were transported to 863 water bodies (lakes, reservoirs, rivers and seas). For introduction, 25 salmon species, 22 cyprinids and 27 sturgeon species were used. In the period from 1967 to 1979, 49 species of fish were resettled in order to acclimatize. From 1980 to 1990, 250-300 introductions of 30-35 species of fish and 13 species of invertebrates were carried out annually in the USSR. The work on the introduction of invertebrates with the aim of improving the food supply of water bodies turned out to be effective. For the period 1948-1978 more than 480 introductions of 66 species of feed invertebrates were carried out in 145 water bodies of the former USSR (75 reservoirs, 65 lakes, three rivers and two seas).

Nowadays artificial reproduction of LARs is used to support inland fisheries in two ways:

Firstly, the maintenance of valuable commercial fish populations at a level that allows sustainable fishing and to obtain maximum catches. A typical example of this is the artificial reproduction of chum and pink salmon in the Far East (mainly in the Sakhalin region) in salmon hatcheries of various forms of ownership. Another group of fish farms working in this direction are spawning and nursery farms built in lagoons of the southern seas of the Russian Federation (mainly in the Astrakhan region). The main species being reared are semi-anadromous species (freshwater bream, common carp, pike-perch and roach).

Secondly, the maintenance of the stocks of valuable commercial fish species at a stable level and the restoration of populations of species that had commercial value in the near past. Such fish-breeding enterprises include most of the state-owned fish-breeding farms, which grow juveniles of valuable sturgeon, salmon, whitefish and cyprinids to different ages for stocking.

Most of the state-owned salmon hatcheries of the FAF were built during the USSR years to compensate for the negative impacts caused by the construction of hydropowerplants on the country's river systems. Many hatcheries (for example, salmon hatcheries in the Leningrad region) were built back in the 1920s to 1930s, and the Nikolsky hatchery is more than 100 years old (Khainovsky and Ul'yanov, 2015).

The current scheme for the artificial reproduction of LARs proposes different sources of funding for fish-farming work. The fish-breeding farms of the FAF meet their obligations using state funds. Fish-breeding enterprises of various forms of ownership are being stocked up by young valuable fish species using funds coming from compensation for the predicted damage to LAR stocks during construction on waterbodies, regional budget funds, and in recent years predominantly from the state.

The most valuable and main target for artificial reproduction in the western regions of the Russian Federation is Atlantic salmon. Currently, 11 state salmon hatcheries are engaged in the breeding of Atlantic salmon. Seven of them are located in the White Sea Basin (within the borders of the Murmansk region and the Republic of Karelia), and four are located in the Baltic Sea Basin (the Leningrad region). Many local salmon populations are maintained mainly by farm breeding. Atlantic salmon and sea trout are reproduced in the Baltic Sea Basin at three hatcheries.

As a result of this work, natural breeding of Atlantic salmon in the Neva, Narva and Luga Rivers was restored and the populations are now self-sustaining; moreover, the Onega population of Atlantic salmon has been removed from the Red Book of the Russian Federation (Khainovsky and Ul'yanov, 2015).

Another important species that is artificially reproduced in the Baltic Sea Basin is the European whitefish. Since 2010, about 150 000 juveniles of this species weighing 2 g to 10 g, from the West Baltic experimental centre, have been released annually in the Curonian Lagoon within the boundaries of the Kaliningrad region (Khainovsky and Ul'yanov, 2015).

About 20 organizations participate in the artificial reproduction of LARs in the Azov–Black Sea fisheries basin. Sturgeons (Danube sturgeon, starry sturgeon and sterlet sturgeon) and Black Sea salmon are mainly reproduced in hatcheries. In connection with the catastrophic state of the stocks of anadromous and semi-anadromous fish species in the waterbodies of Rostov District there has been a steady decrease in the release of juveniles of these species in all hatcheries in recent years. The total release of sturgeon juveniles by all the Azov Sea sturgeon breeding hatcheries in 2000 was 38.4 million individuals, but it sharply decreased to 19.5 million in 2004 due to a shortage of spawners (Matishov, Matishov and Berdnikov, 2005).

The sturgeon breeding hatcheries of Krasnodarsky Territories and Rostov District located on the lagoons of the east coast of the Azov Sea (the Eastern Akhtarsk group, Beisug Lagoon, Eisk Lagoon, Chernoerkovsk Lagoon) are reproducing semi-anadromous fish such as roach, freshwater bream and pike-perch. The total volume of roach juveniles released annually over the last five years varied from 5.3 billion to 6.1 billion individuals (Matishov, Matishov and Berdnikov, 2005; Bogachov and Platonova, 2014).

The main national capacity for artificial breeding of sturgeon and commercial semi-anadromous species in the Volga–Caspian fishery basin is in the Volga–Caspian fishery subdistrict. There are seven sturgeon breeding hatcheries in Astrakhan District implementing the government decision to breed juveniles of valuable species for release to preserve their natural populations.

More than 100 million juveniles of beluga, Danube, starry, sterlet and fringebarbel sturgeon (*Acipenser nudiventris*) were released into the Caspian Sea annually at the end of the twentieth century. Since 1954 (i.e. since the beginning of commercial farming) until now more than 2.2 billion juvenile sturgeons have been released into the Caspian Sea, most of them (73 percent) by the Russian Federation. At present several Caspian sturgeon stocks rely on the stocking of juveniles from hatcheries for their survival – beluga sturgeon (99 percent), Danube sturgeon (6 percent) and starry sturgeon (41 percent). This is because there are no natural spawning grounds for beluga in the unregulated part of the Lower Volga (i.e. below the Volgograd hydropower station) and only few spawning grounds for Danube sturgeon; only starry sturgeons still have suitable areas available for natural breeding (Vasilyeva, Naumov and Sudakova, 2015).

Organized and well-established artificial reproduction of sturgeons began to decrease at the beginning of the current century due to a shortage of financing for sturgeon breeding hatcheries and a lack of spawners from natural breeding due to the degradation of the sturgeons' habitats, and due to illegal fishing activities. In good years (1986 to 1990), when sturgeon breeding hatcheries had enough pond spaces of good quality, some of those spaces were used twice, and more than 80 million juveniles were released.

Since 2000, the numbers of sturgeon juveniles released into waterbodies of the Volga–Caspian fishery basin began to decrease. From 2000 to 2005, 47 million to 50 million juveniles were released annually; this declined to 42 million in 2008 and just 19.5 million in 2012. However, the situation subsequently improved and in recent years the number of sturgeon juveniles released has stabilized at 32 million to 34 million (Vasilyeva, Naumov and Sudakova, 2015).

In addition to the sturgeon hatcheries located in the Volga Delta and the estuarine sections of rivers (for example the sturgeon breeding hatcheries in the Republic of Dagestan), there are sturgeon breeding hatcheries that release sturgeon juveniles in both the regulated areas of the Volga River (reservoirs of the Volga–Kama cascade) and in river sections with natural hydrological regimes of the Volga Basin. For example, sturgeon juveniles that are artificially reproduced by the Volgograd sturgeon hatcheries are released in the Volgograd region in the dam zone of the Volga hydroelectric power plant. Between 1961 and 1995, 312 million sturgeon juveniles were released into the river, including 17.49 million juvenile Danube sturgeon (Nikolaev *et al.,* 2015). Juveniles of sterlet sturgeon, common carp, northern pike, pike-perch and herbivorous fishes are regularly or periodically released into all reservoirs of the Volga–Kama cascade. However, to date, the stocking of these species does not appear to have had any significant impact on their populations in these waterbodies (Tairov, Shakirova and Severov, 2013).

Another stocking programme involves the non-migratory sterlet sturgeon, which is being artificially reproduced in the basin of the Volga's largest right tributary, the Oka. The hatcheries of the FAF release about 130 000 juveniles into the Oka River each year (funded by the state), however the compensation for damage funds are paying for the stocking of many more juveniles (for example, about 2.25 million juveniles in 2015). In 2002, the total official sterlet sturgeon stocking of rivers and reservoirs in the Russian Federation was 4.52 million specimens; the proportion of sterlet sturgeon in the Oka River from hatcheries increased to 41.9 percent (i.e. 1.893 million specimens). The number of sterlet sturgeon in the Oka River has grown significantly in recent years (Bykov, 2017).

Semi-anadromous fish species are artificially reproduced in the Astrakhan region at the spawning and growing farms located in the Volga Delta from broodstock of freshwater bream, common carp and pike-perch annually harvested in the natural environment. For semi-anadromous fish species, which still have natural spawning, the role of artificial reproduction in spawning–growing farms increases in dry years, when they provide up to 15 percent to 20 percent of ordinary fish catches. In the twentieth century, the volumes of artificial reproduction of common carp were significant and could exceed 1 billion juveniles annually. From 1971 to 1980, the release of common carp juveniles for example averaged 1 262.5 million/year. From 2011 to 2015, the release of common carp juveniles from the spawning and growing farms decreased to 10 million to 12 million per year. Since 2016, there has been a tendency to increase the volume of juveniles released to 15.1 million to 18.9 million per year (Vasilyeva, Naumov and Sudakova, 2015; Anokhina and Zaitsev, 2018).

In Siberia, artificial reproduction aims to preserve sturgeons and whitefishes (European whitefish, peled, muksun) populations in the Ob and the Yenisei river basins, as well as in Lake Baikal. Farm reproduction of sturgeon in the Lena Basin is not organized. Over the past ten years there has been a tendency to reduce the number of sturgeon juveniles released. The average three-year release of sturgeon from two sturgeon breeding hatcheries has decreased from 5.3 million to 3.8 million. One of the main reasons for the decline is the shortage of spawners. To solve this problem, broodstocks of sturgeons were created in each of these basins and they are successfully exploited in the food industry (Litvinenko, Semenchenko and Kapustina, 2015).

There is no salmon farming in Siberia. The reproduction of Arctic char is only carried out on a small scale at one fish and incubation hatchery from where 200 000 to 300 000 Arctic char juveniles are released annually. Work on gathering and incubating the eggs of taimen, lenok and grayling in the Yenisei, Altai and the Urals (as well as lenok in Lake Baikal) is experimental.

The reproduction of whitefishes (European whitefish, peled, muksun) is the most extensive activity. Currently, there are 14 fish breeding farms in Siberia and the Urals specializing in the reproduction of this group of fish. The total production of whitefish larvae in 2010 amounted to 975 million, and in 2011 this rose to 1 455 million. Over the past few years there has been a tendency to reduce the number of whitefish larvae (European whitefish, peled, muksun) released annually. From 2001 to 2003 on average 1.92 billion larvae were released per year; this declined to 1.46 billion from 2009 to 2011 (Litvinenko, Semenchenko and Kapustina, 2015) and only 0.97 billion in 2019. The decrease in the volume of artificially reproduced whitefish is mainly due to organizational and financial constraints. The main species used for artificial reproduction are

Baikal omul and peled. In 2011, 46 percent of all released larvae was Baikal omul and 37 percent was peled; in 2019, 0.45 billion Baikal omul larvae were released.

The main species for artificial reproduction in the Far East are Pacific salmons (*Oncorhynchus* spp.) (Kaev and Ignatyev, 2015). As of 2019, the release of juveniles was carried out by 72 salmon hatcheries (one hatchery was under reconstruction), 28 hatcheries were state-owned, 5 were on loan and 40 belonged to private entrepreneurs. Most of the salmon hatcheries are located in the Sakhalin region (50), of which 17 are located in the Kuril Islands, 9 in the Khabarovsk Territory, 5 in Kamchatka, 4 in the Magadan region and 4 in Primorye.

A total of 1 118 million Pacific salmon juveniles were released in 2019. The main release of 927.2 million (83 percent) was in the Sakhalin–Kuril region. In the Khabarovsk Territory, 91.1 million (8 percent) were released and 41.41 million (4 percent) were released in Kamchatka; in the Primorsky Territory, 45.73 million were released (4 percent) and from hatcheries of the Magadan region, 12.6 million were released (1 percent). Of the total number of released salmon juveniles, federal hatcheries accounted for 32 percent or 357.6 million (including 284.7 million chum salmon [80 percent] and 53.4 million pink salmon [15 percent]). Non-state-owned hatcheries accounted for 68 percent of the released fish or 760.4 million specimens (including 534.1 million chum salmon [70 percent] and 226.3 million pink salmon [30 percent]).

Of the six species of Pacific salmons produced from hatcheries in the Far East, chum salmon prevailed at 818.8 million followed by pink salmon with 279.6 million juveniles (respectively 73.2 percent and 25 percent of all released juveniles). The number of other released species was much lower. Thus, juvenile-wise, the release of coho salmon 0+ amounted to 2.45 million (0.2 percent), coho salmon 1+ 540 000 (0.05 percent), sockeye salmon 15.32 million (1.4 percent), Chinook salmon 870 000 (0.1 percent) and masu salmon 414 000 (0.04 percent).

The survival of hatchery-reared juvenile pink salmon during the marine period of life has been estimated in different regions through tagging studies, but whether stocked fish have higher or lower survival rates than wild fish is not clear. For the contribution of stocked fish to salmon landings, a comparison between the number of juveniles released from hatcheries and their relative abundance in the subsequent catches was made. On this basis it was established that from 1970 to the 1980s there was a 2.5-fold increase in the return of the number of hatchery-reared pink salmon. The growth of pink salmon catches in the 1990s was also explained by the success of its breeding in hatcheries. Survival rate during the marine period of life of hatchery pink salmon (5.8 percent) was significantly higher in those years than that of wild fish (1.5 percent). Catches of chum salmon doubled from 1970 to the 1980s compared to the previous period (1946 to 1955) which is also explained by the success of its hatchery breeding (Kaev and Ignatyev, 2015).

However, despite successes with combining natural reproduction and hatchery breeding, the impact stocked fish has had on the natural reproduction of salmon has not yet been studied in detail (Kaev and Ignatyev, 2015).

Currently, there is no economic incentive for hatcheries to achieve high returns because the release of juveniles into waterbodies is externally funded, therefore the effectiveness (returnable share) of the stocking programmes is not taken into account. As of 2006, only 15 percent of salmon hatcheries in the Far East were effective in terms of their successful support of local fishing.

As for rivers with remaining natural reproduction, it is much more efficient to invest in maintaining existing conditions, which is much more profitable than building and maintaining salmon hatcheries (Kaev and Ignatyev, 2015).

Additionally, in the Amur River Basin, activities related to the artificial reproduction of kaluga and Amur sturgeon are ongoing. The release of kaluga and Amur sturgeon juveniles from sturgeon breeding hatcheries in recent years has averaged between 500 000 and 2 million individuals respectively (Koshelev, Kolobov and Shmigirilov, 2013).

One of the main problems involved with artificial reproduction at the moment is the low efficiency of the work, which is associated with the outdated equipment of most hatcheries, the use of conservative technologies and often with the use of incomplete feeds that do not meet the food requirements of the fish. The fish being released are often either too young or, when larger, physiologically inferior individuals.

In conclusion, it should be noted that without proper attention to the protection of fish stocks and drastic measures to combat large-scale illegal fishing, all efforts to reproduce artificially valuable commercial fish will be futile.

8.3.3. Habitat engineering and biomanipulation

Habitat engineering and biomanipulation is used to improve the conditions of natural reproduction and feeding of valuable fish species in waterbodies, and improve the conditions for fishing. It includes the following thrusts (Anonymous, 2015; Department of Agriculture, 2015):

- dredging and (or) excavation works;
- removal of aquatic plants from a waterbody;
- the creation of artificial reefs and bottom landscapes in order to improve the ecological condition of the waterbody; and
- biomanipulation.

Fisheries enhancement is carried out by federal state budgetary institutions subordinate to the FAF, legal entities, citizens, including individual entrepreneurs, and government authorities of the constituent entities of the Russian Federation.

Dredging operations are recommended in some river sections where fish spawning migrations have been blocked because of the shallowing of small stream mouths due to siltation. Also in braided rivers where the hydrological and hydrochemical regimes may have caused the buildup of mineral and organic sediment that affect fish migration paths. The most relevant habitat engineering is conducted to maintain anadromous and semi-anadromous fish stocks at sites where spawning migrations pass along relatively shallow rivers and in the delta channels of larger rivers. It is also possible to carry out such work for non-migratory species of fish where the hydrological connection between waterbodies and rivers has been lost (Rostovtsev *et al.,* 2015). The effectiveness of these measures depends significantly on the dynamics of the water level during the spawning season. As maximum water discharge happens during spring in most rivers of the Russian Federation, such work for spring-spawning fish is possible only in dry years, when water levels are below average. Few positive results in this context have been described in the literature (Shibaev, 2017). This is not surprising as natural processes occurring in estuarine zones, especially in rivers with high sediment load (for example, the Terek River), along with wind–wave phenomena in their mouths, will lead to rapid washing out of dredged areas so the positive impact of this on fish stocks is relatively shortlived.

Regarding the removal of water plants from a waterbody, this is implemented, for example, when macrophytes overgrow the paths of spawning migrations of semi-anadromous fish in the river deltas of the southern seas of the Russian Federation, such as the Volga Delta (Katunin, Berezhnov and Nemoshkalov, 2003) or the Terek River (Abdusamadov and Abdusamadov, 2019). However, the mechanical removal of wetland vegetation in bayous is directly related (as during dredging) to the flow. Thus even a total mowing of helophytes in bayous with a low flow will not have a positive effect. For example, only with water releases through the Kargaly hydroelectric facility to the lower reaches of the Terek River for water supply to spawning grounds in volume of not less than 100 m^3/s, can the number of semi-anadromous fish populations increase (Abdusamadov and Abdusamadov, 2019).

Overgrowth of shallow waterbodies of fishery importance in the southern regions of the country should be addressed by removing the plants if these waterbodies (or a group of them) are important for the natural reproduction of valuable commercial fish species. Examples of such waterbodies are the groups of lagoons on the eastern coast of the Sea of Azov and secondary waterbodies in the delta of the Volga River. For example, thanks to the Azov lagoons, the Krasnodar Territory was one of the leading producers of fish in southern Russia in the twentieth century, providing (in the mid-twentieth century), average annual catches of 25 000 tonnes (Denisenko, 2017).

The regulation of freshwater river runoff and its diversified use without considering the requirements of fisheries and conservation efforts, intensive agricultural activities (the use of mineral fertilizers and defoliants, the development of irrigated agriculture and an increase of water disposal) have led to an increase in the rate of anthropogenic eutrophication of estuaries and, as a result, to a decrease of suitable fish habitats and excessive overgrowth.

Nowadays, the total volume of raw biomass of influxes of aquatic vegetation in the Azov lagoons is estimated to be more than 2 million tonnes (up to 1985, it was only 1.2 million tonnes); it is already impossible to remove it from the waterbodies by mechanical means alone (Denisenko, 2017). In practice, the mowing of wetland vegetation is carried out without removing the plant material from the waterbody, which worsens the oxygen regime at a critical time for intensive fish feeding.

Biological control is the most optimal and repeatedly tested method of controlling higher aquatic vegetation in waterbodies, i.e., the introduction of macrophyte feeding fish. For example, the annual stocking of herbivorous fish species (i.e. grass carp, common carp and bighead carp) in the Azov lagoons in sufficient quantities could reduce macrophyte biomass to 10 tonnes/ha to 15 tonnes/ha, which corresponds to the values considered optimal for the spawning of semi-migratory fish, as well as the feeding and downstream migration of their juveniles into the sea. The stocking of certain lagoons with herbivorous species would, in addition to the biological controlling effect, allow the production of up to 100 kg/ha of marketable herbivorous fish products or a total of approximately 6 000 tonnes (Denisenko, 2017). Similar undertakings would increase the populations of semi-anadromous and non-migratory commercial fish species in the secondary waterbodies of the Terek Delta and catches in the Tersko–Caspian fisheries subdistrict of the Caspian Sea (Abdusamadov, 1986).

Biological methods have also been used to combat overgrowth in the reservoirs of regional hydroelectric power stations and atomic power stations. Stocking of herbivorous fish here also showed that biological control is the most effective way to control these plants. Compared with chemical and physical methods, using herbivorous fish gives positive results without degrading the ecological state of a waterbody (Bykov, 2016; Bykov, Staroverov and Korolev, 2015).

Habitat engineering also includes the creation of artificial reefs or bottom landscapes in waterbodies to increase the efficiency of natural reproduction of valuable commercial species of fish of phytophilous spawners where there is a lack of suitable spawning substrates. However, dedicated long-term studies on this issue have not been conducted in recent years. Until now, the influence of such work on the recruitment of the most important and valuable target species in fisheries (freshwater bream, pike-perch, northern pike and wels catfish) has not been established. Usually, low-value ecologically adaptable species (roach, European perch, bleak and freshwater bream) effectively spawn in such locations. Concomitantly, work on direct modification of bottom landscapes, such as the formation of 'fish wintering holes' in the beds of shallow rivers using dredges for sand and gravel extraction (Bykov and Mitenkov, 2018) or the construction of gravel spawning grounds for the reproduction of sturgeons is being carried out.

For example, deepening of shallow (1 m to 2 m) sections of the Oka River to 3 m to 6 m and more, leads to replacement of low-value non-commercial rheophilic species with ichthyocenosis of the reach with a higher concentration of valuable commercial species. Hydroacoustic surveys of separate water areas in some sections of the Oka exposed to dredging operations confirmed that commercial fish species concentrate in 'holes' deepened to 5 m to 8 m (Bykov and Mitenkov, 2018). The spawning grounds of sturgeons in the Lower Volga, for example, where there is a shortage of spawners are not relevant in this context.

Predatory and low-value species of LARs are removed in places where the juveniles of valuable fish species are released from fish-breeding farms of the FAF, in order to increase the survival and growth of valuable species. However, as with most of the fisheries' enhancement activities described above there are no studies to evaluate the effectiveness of catching predatory and low-value fish species in various aquaculture ranching facilities. Difficulties in conducting such studies are also connected to the fact that not only predatory fish but also commercial fish (with annual TACs) are caught and their catch is already carried out in these waterbodies under commercial quotas.

In lakes of the south of Western Siberia where winter kills occur, habitat enhancements are recommended to increase their fish productivity and exploitation. So for the successful rearing and overwintering of fish introduced for feeding (polyculture of common carp, whitefishes, herbivorous fish [grass carp, silver carp], pike-perch and northern pike), the following activities are necessary: deepening a small part of a lake bed with a dredger to a depth of 6 m to 7 m; constructing a small (0.1 ha to 0.3 ha), but deep water reservoir on the shore of the lake; and installing aeration equipment during the winter. The most important way to increase the fish productivity of the region's waterbodies is bottom sediment loosening; this results in acceleration of oxidation of alluvium sediments so oxygen consumption is reduced in the frozen period; excess hard and soft vegetation are removed, seine fishing grounds are cleared and production of phyto- and zooplankton increases. Fish, especially zooplanktivores, grow more quickly and accumulate biomass in the summer and in autumn by an average of 1.5 percent compared with fish from waterbodies without any enhancement. The waterbody thus becomes hypereutrophic instead of eutrophic, which increases fish productivity (Mukhachev and Medvedev, 2013). Rearing of common carp, whitefish and herbivorous fish in polyculture guarantees the production of 150 kg/ha to 200 kg/ha of large commercial fish. To suppress low-value fish (eg. belica [*Leucaspius delineatus*] and Chinese sleeper [*Perccottus glenii*]), predatory species such as pike-perch and northern pike juveniles should also be moved into lakes for biological control (Mukhachev and Medvedev, 2013).

Special attention is also being paid to enhancement activities aimed at improving the living conditions of Caspian Sea anadromous and semi-anadromous fish and LARs in the estuary and avandelta of the Volga River.

The Volga River and its numerous tributaries annually bring up to 10 million tonnes of suspended solids into the estuary, which in the form of silty sediments, sand and soil, are deposited in numerous watercourses forming rifts; this also affects the shallow avandelta part of the Northern Caspian Sea, including 24 fish passages (with a length of 551 km) and 2 600 km of channels with spawning areas.

As a result of these negative phenomena the flow rate decreases; hydrological, hydrochemical and ecological conditions of the waterbodies deteriorate and the efficiency of natural reproduction of LARs in the Volga–Caspian fishery basin is reduced.

To maintain the depth, width and length of river channels as is close as possible to the requirements of the desirable species of fish, and to create more favourable conditions for natural reproduction of LARs, habitat rehabilitation activities are carried out annually.

Fish habitats are improved by *inter alia* clearing fish migration channels, enhancing spawning migration, securing earlier flooding of spawning grounds (by 10-15 days), followed by warming up of water at these sites and development of feed for larvae and juveniles, and, as a result, stimulation of natural reproduction.

The destruction of excessive hard and soft aquatic vegetation in waterbodies of fishery value also has a positive effect on the state of LARs.

More favourable conditions are being created for the migration of juveniles and adults to their feeding grounds; during this movement, the flow rate of spawning waterbodies and channels, adjacent to fish passage channels, has been improved to 80 percent, which results in the reduction of the development of blue-green algae during summer. This also prevents waterlogging in the estuarine zone of canals where they converge with flowing waterbodies. Work on connecting separated waterbodies with flowing ones prevents juveniles from dying (Salieva, undated; Bykov, Staroverov and Korolev, 2015).

8.3.4. Inland fisheries research programmes

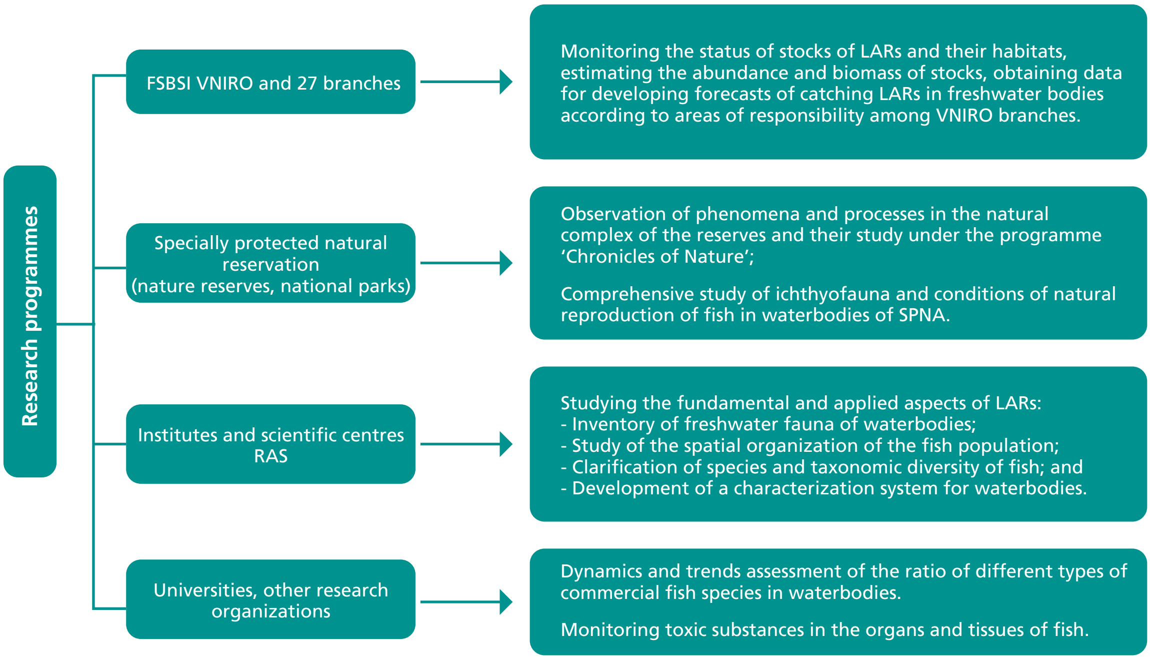
The need to develop research programmes for fishing for research purposes is determined by legislation of the Russian Federation (GRF, 2004; GRF, 2009; FAF, 2009a).

Fisheries for scientific research and control purposes are carried out to determine the TACs of LARs, to assess the stocks, for which TACs are not established (with the exception of those included in the Red Book of the Russian Federation). Measures for the conservation of LARs and their habitats are also developed.

Fisheries for scientific research and control purposes are carried out on the basis of annual plans for carrying out resource studies of LARs. Both citizens and legal entities have the right to develop and implement programmes using LARs for research purposes.

Currently, work related to the study of LARs in freshwater bodies of the Russian Federation is carried out in accordance with more than 40 programmes developed by various organizations to perform a variety of tasks (Figure 8.2).

Figure 8.2. Organizations conducting research on LARs and the main tasks they perform



Source: Authors’ elaborations.

Despite the variety of tasks stipulated by research programmes for the study of LARs, all programmes have a similar structure and contain information about the programme writers, authors and co-authors of the programme; purposes and tasks of the work, types of research; a brief description of the methods of collecting and processing material; planned start and end dates; information about the area of work; species, sex and size composition of LARs planned for fishing; and information on fishing gear and vessels needed for the planned work.

To minimize the pressure on LARs, special attention is paid to substantiate the volumes of LARs needed for the programme.

Of greatest interest is the ‘Programme for the Development of Fisheries Research in Freshwater Water bodies of the Russian Federation 2020-2024’, developed in 2019, which outlines all areas of comprehensive research that are most significant for the development of freshwater fisheries both in the country as a whole and in its individual regions. The programme also provides for the implementation of six separate subprogrammes on the study of the most significant and problematic waterbodies and fish stocks:

1. ‘Fisheries studies of the Volga River’;
2. ‘Fisheries studies of Ladoga and Onega lakes’;
3. ‘Fisheries studies of Lake Baikal’;
4. ‘Fisheries studies of the Pechora River’;
5. ‘Fisheries studies of the Amur River’;
6. ‘Whitefishes of the Urals and Western Siberia’.

8.3.5. Enforcement and control measures to combat illegal or prohibited fishing

The increase in illegal fishing has had disastrous consequences for the environment. The growing rate of illegal predatory destruction of LARs leads to the disappearance of valuable commercial and ecologically significant species of aquatic fauna and flora, depriving science of the opportunity to objectively determine the actual size of the catch from the habitat and to determine sustainable levels of catch and necessary measures to preserve their stocks.

The prerequisites for organizing an effective fight against crime are identifying its characteristics, establishing its causes and conditions and creating a system to combat it (Kalenov, 2003).

Ensuring the rule of law with respect to the exploitation of LARs is carried out by law enforcement bodies and control and supervisory bodies of the FAF and the Prosecutor's Office (Ryabov, 2014). To date, there are about 140 legal acts at various levels that directly regulate sanctions in this respect (Raskina, undated).

The classification of criminal acts that are related to the illegal catch of LARs in rivers, reservoirs and canals, according to the fishing rules are:

- fishing without permission and without an allocated quota for the catch of LARs, with the exception of LARs that are freely harvested in accordance with the legislation of the Russian Federation;
- fisheries exceeding the volume of catch quotas allocated to them by fishing areas and types of LARs;
- catch of LARS in forbidden periods and in areas closed to fishing;
- catch of LARs in quota volumes exceeding those specified in the permit for their catch;
- catch of LARs using explosives, toxic and narcotic drugs, piercing fishing gear, firearms and other fishing gear prohibited by the legislation of the Russian Federation;
- receiving LARs (or products from them) of one species on board of a fishing vessel under the name of another species or without specifying the species composition; surrendering catches without weighing or other forms of accounting;
- catching of LARs in wintering pits, on navigable channels, at dams, closer than 500 m to locks, less than 500 m from sewage outlets, in spawning places or on migration routes to them;
- catching LARs by rutting, crushing, using rattling and 'poling' (this requirement does not apply to the Indigenous Peoples of the North, Siberia and the Far East, who are allowed to use traditional tools and fishing methods that are prohibited for all other users);
- record keeping and presentation of information on the catch of LARs with distortion of the actual volume of the catch, its species composition, fishing gear used, timing, types of use and methods of the catch; and
- spearfishing during the spawning period in places of mass and organized recreation of citizens, as well as the use of spearfishing from the shore, using floating equipment and standing in the water; hunting using scuba gear and other self-contained underwater breathing apparatus (Krepyshova, 2014).

8.3.6. Regulations to protect stocks from fishing and environmental impacts

Environmental issues in the internal waters of the Russian Federation, with the exception of the internal sea waters of the Russian Federation, are mainly regulated by laws and regulations of the Russian Federation (GRF, 2004a; GRF, 2004b; GRF, 2002; GRF, 1995; GRF, 1996). The fishing rules are binding on legal entities and citizens engaged in fishing and other activities related to the use of LARs.

In order to maintain suitable conditions for the reproduction of LARs, fish protection zones and coastal protective zones have been established, where restrictions on economic and other activities are introduced (GRF, 1996; GRF, 2008d).

To ensure the conservation of LARs and their rational use, the following fishing restrictions may be in place (Makoedov, 2015):

1. prohibition of fishing in certain areas and in relation to certain types of LARs;
2. the closure of fishing in certain areas and in relation to certain types of LARs;
3. minimum size and weight of caught LARs;
4. types and quantity of permitted gear and methods of catch;

5. the mesh size of the gear for the catch of LARs, the size and design of the gear for the catch of LARs;
6. the distribution of areas of catch of LARs (area, subarea, fishing zone and fishing subzone) among groups of vessels differing in gear for the catch of LARs, types and sizes;
7. periods of catch of LARs for groups of vessels of different gear types, models (capacity) and sizes;
8. the number and types (capacity) of vessels that can carry out commercial fishing and coastal fishing simultaneously in the same area of catch of LARs;
9. the time of going out to sea for industrial fishing;
10. periods of fishing in waterbodies of fishery importance;
11. other fishing restrictions established in accordance with federal laws.

Rare and endangered species of LARs are being protected (GRF, 2002; GRF, 1995).

State and federal programmes aimed at protecting the habitat of LARs as well as their protection and rational use have been developed (GRF 2012b; GRF, 2012c).

During territorial planning, urban zoning, architectural and construction design, building, reconstruction, overhaul of capital construction facilities, the introduction of new technological processes and other activities, measures should be taken to preserve LARs and their environments (GRF, 2004c).

Water quality standards are being established, including standards for maximum permissible concentrations of harmful substances in waterbodies where fishing takes place (GRF, 2006; MoA, 2016); the amount of damage caused to LARs is determined (GRF, 2008e).

9 References

Abdusamadov, A.S. 1986. Biology of grass carp, silver carp and bighead carp, acclimatized in Tersky District of the Caspian Sea. *Journal of Ichthyology,* 26(3): 42–54.

Abdusamadov, A.S. & Abdusamadov, T.A. 2019. *Ecological state and ways of reproduction of fisheries value of the Terek River.* Proceedings of the national scientific and practical conference 'State and Perspectives of Scientific and Practical Development of Fisheries Industry'. Makhachkala. pp. 222–230.

Anokhina, A.Z. & Zaitsev, V.F. 2018. To the question of state of natural and artificial sturgeons breeding in the Volga-Caspian basin. *Bulletin of Astrakhan STU. Series: Fisheries,* 1: 111–117.

Anonymous. 2015. Procedure for the conduct of biological amelioration of water bodies. *Fish Breeding and Fisheries,* 9: 62–70.

Anonymous. Undated. *All About Fishing.* Online. Available at http://ribalka-vsem.ru/index/sposoby_lovli_ryby/0-669.

Asanov, A.Yu. 2016. Aquatic biological resources of the Penza region, the Sura River. *Bulletin of Astrakhan STU. Series: Fisheries,* 2: 7–14.

Association of Rosokhotrybolovsoyuz (AOR). *Rosokhotrybolovsoyuz* [online]. Available at http://rors.ru/fishing/

Averin, A.N. 2015. Indigenous peoples: dynamics of development. *Bulletin of the Buryatsky State University,* 14A: 70–75.

Babiy, A.A. 2008. *Fishing base on Lake Onega. Biological resources of Lake Onega.* Petropavlovsk, Karelian Scientific Department of the Russian Academy of Sciences. 272 pp.

Bakhtiyarov, R.S. & Fedorova, A.V. 2018. Fishery in the USSR during the Great Patriotic War. *News of Orenburg Agricultural University,* 2(70): 241–243.

Barabanov, V.V. 2017. *Assessment of the impact of recreational fishing on aquatic biological resources and development of measures for its regulation in the conditions of the Volga-Caspian basin (Astrakhan region).* Novosibirsk. (PhD synopsis).

Barabanov, V.V., Tkach, V.N. & Prosvirin, D.N. 2016. A comparative assessment of the size composition of fish from catches of industrial and recreational fishing in the Astrakhan region. *Bulletin of Astrakhan STU. Series: Fisheries,* 2: 34–42.

Bekyashev, D.K. 2017. *International legal problems of fisheries management: a monograph.* Moscow, Prospect, 512 pp. (In Russian)

Bekyashev, D.K., Shuvalova, T.V., Pekarsky, A.N., Teymurov, E.S. & Dyachek, E.D. 2016. International legal regulation of fisheries in transboundary water bodies. *Fisheries (Rybnoye Khozyaystvo),* 1: 28-37. (In Russian)

Bekyashev, K.A., Bekyashev, D.K. & Galstyan, G.G. 2018. The Caspian Sea and its resources under the protection of international law. *Fisheries (Rybnoye Khozyaystvo),* 5: 21–27. (In Russian)

Ber, K. & Danilevsky, N. 1860–1875. *Research on the state of fisheries in Russia*. I–IX.

Bobyrev, A.E., Kriksunov, E.A., Burmensky, V.A., Sheremet'ev, A.D., Mordvintsev, P.A., Melnik, M.M. & Afanasyev, E.A. 2014. Dynamics of biotic community of inland fresh waters on the example of Peipsi Lake. In *Current status of inland water bioresources,* pp. 51–58. Proceedings of Second All-Russian Conference with International Participation, 6–9 November, 2014. Volume 1. Borok, Russia, Poligraf-Plus.

Bogachev, A.N. & Platonova, M. Sh. 2014. Questions of artificial reproduction of living resources in water bodies of the Azov-Black Sea fishery basin. In *Main problems of fisheries and protection of water bodies of Azov-Black Sea basin,* pp. 32–40. Rostov-on-Don.

Bogdanov, V.D. 2014. Current status and problems of whitefishes stocks restoration in the lower Ob'. In *Current status of inland water bioresources*, pp. 59–64. Proceedings of Second All-Russian Conference with International Participation, 6–9 November, 2014. Volume 1. Borok, Russia, Poligraf-Plus.

Bogoyavlensky, D. 2012. *Recent data on the number of peoples of the North.* Institute of Demography HSE University, 2012 [online]. Available at http://csipn.ru/glavnaya/actual/1204-

Boitsov, V.D. 2014. Structure of long-term fluctuations of rainbow smelt and water temperature in Il'men Lake. *In Current status of inland water bioresources,* pp. 65–73. Proceedings of Second All-Russian Conference with International Participation, 6–9 November, 2014. Volume 1. Borok, Russia, Poligraf-Plus.

Brazhnik, S. Yu. & Sechin, Yu. T. 2009. Optimization of freshwater fisheries in Russia. In *Proceedings of the Symposium on Interactions between Social, Economic and Ecological Objectives of Inland Commercial and Recreational Fisheries and Aquaculture, Antalya, Turkey, 21-24 May, 2008,* pp. 272–276. EIFAC Occasional Paper No. 44. Rome, FAO.

Brazhnik, S.Yu. 2011. Bioresources of fresh waters of Russia: yesterday, today, tomorrow // *In Current status of inland water bioresources,* pp. 91-98. Proceedings of the First All-Russian Conference with international participation in town of Borok. - Vol. 1 Moscow: Akvaros.

Brazhnik, S.Yu., Mitenkov, Yu.A. & Skakun, V.A. 2012. Current stock status of sander (*Stizostedion lucioperca)* in fresh water bodies of the Russian Federation. *Proceedings of Kaliningrad State Technical University (KSTU),* 24: 193–199.

Brazhnik, S.Yu., Bondarenko, L.G., Barabanchshikov, E.I., Gadinov, A.N., Matkovsky, A.K., Prusov, S.V. & Ustyuzhinsky, G.M. 2013. Usage and stocks of freshwater fishery base in Russia. *Proceedings of Kaliningrad State Technical University (KSTU),* 28: 11–25.

Bykov, A.D. 2016. Fishery value and estimation of grass carp influence on ecosystem of cooling ponds in Central Russia. *Fish Breeding and Fisheries,* 2: 25–36.

Bykov, A.D. 2017. The problems of artificial sterlet sturgeon breeding in basin of the Oka River. *Fish Breeding and Fisheries,* 12(143): 818.

Bykov, A.D. & Mitenkov, Yu.A. 2018. The results of fishery survey of the Oka River within Moscow Region. *Trudy VNIRO*, 171: 123–140.

Bykov, A.D., Staroverov, N.N. & Korolev, A.V. 2015. To the question of biological amelioration of the Chshekinskoe reservoir. *Fish Breeding and Fisheries,* 2: 79–82.

Demin, D.Z. 1962. **Semi-**anadromous fish of the delta of the Terek River. *Journal of Ichthyology,* 1–2(22): 90–99.

Demin, D.Z. 1963. Reproduction of sturgeons of the Caspian Sea in the rivers of Dagestan. In *Sturgeon farming in the reservoirs of the USSR,* pp. 102–107. Moscow, Publishing House of the Academy of Sciences of the USSR.

Denisenko, O.S. 2017. Biological amelioration of the Azov Sea lagoons in Krasnodarsky Territories and the possibilities of using means ensured as compensation of losses to aquatic living resources. *Bulletin of Astrakhan STU. Series: Fisheries:* 34–41.

Ministry of Agriculture of the Russian Federation. 2014. *On confirmation of procedure for the conduct of biological amelioration of water bodies.* Decree of Ministry of Agriculture of the Russian Federation No. 530 of 26 December 2014.

Dvoryankov, V.A. 2000. Fishing in Russia on the eve of changes. – Moscow. Publishing House: International Relations. 184 pp

Federal Agency for Fisheries (FAF). 2006. *Report on the activities of the Lower-Ob's Department for Fisheries and Conservation of Aquatic Biological Resources in 2006.* Tyumen, 2007. 214 pp.

FAF. 2008. *Report on the activities of Amur's Department for Fisheries and Conservation of Aquatic Biological Resources in 2007.* Khabarovsk, 2008. 254 pp.

FAF. 2009a. *On approval and confirming procedure of work programs during fishery for scientific and control purposes, and fishery for aquaculture, reproduction and acclimatization of aquatic living resources.* Order of the Federal Agency for Fisheries of 30 January 2009, No. 61 [online]. Available at http://legalacts/ru/doc/prakaz-rosrybolovstva-ot-30012009-n-61-o/

FAF. 2009b. *On approval of the instructions on the transfer of data of state monitoring of aquatic biological resources by the subordinate to the federal agency for fisheries research organizations and federal state institutions – basin departments for the conservation, reproduction of aquatic biological resources and organization of fisheries.* Order of the Federal Agency for Fishery No. 1020 of 13 November 2009.

FAF. 2009c. *Report on the activities of Central Department for Fisheries and Conservation of Aquatic Biological Resources in 2007.* 93 pp.

FAF. 2011. *Concept of the development of fisheries in inland fresh water bodies of the Russian Federation till 2020*. Order of the Federal Agency for Fisheries of 28 April, 2011, No. 433.

FAF. 2013. *On the organization of work on the provision for use of aquatic biological resources, the total allowable catch of which is not established, as well as the organization of control over their catch.* Order of the Federal Agency for Fishery No. 287 of 18 April 2013.

FAOLEX. 2014. *Agreement on the Conservation and Sustainable Use of Aquatic Biological Resources of the Caspian Sea of 29 September 2014.*

Saint Petersburg branch of the VNIRO ("GosNIORKH" named after L.S. Berg"). 2002. *Report on the state of fisheries, on the current state of fisheries of inland waters of the Russian Federation.* GosNIORH.

Federal Statistical Observation (FSO). Undated. *Form No. 1-П (fish). Information on the catch of fishes, other aquatic biological resources and production of commercial aquaculture (commercial fish farming) objects for 1990-2018*.

Federation Council of the Russian Federation (FCRF). 2019. *The development of inland fisheries: problems and prospects.* Federation Council of the Russian Federation Round Table, 30 May 2019 [online]. Available at http://council.gov.ru/activity/activities/roundtables/106212/ (accessed 28 November 2019).

Food and Agriculture Organization of the United Nations (FAO). 2010. *Inland fisheries.* FAO Technical Guide for Inland Fisheries. No. 6. Ankara, FAO. p. 44.

Gadinov, A.N. & Kryuchkova, G.N. 2008. Artificial breeding of sturgeons in the aims of preservation of ichthyofauna biodiversity of the Yenisei River. *Bulletin of KrasGAU, Krasnoyarsk,* 4: 148–153.

Gerasimov, Yu.V. & Brazhnik, S.Yu. 2014. Importance of natural and anthropogenic factors in long-term dynamics of fish resources in Rybinskoe reservoir. *In Current status of inland water bioresources,* pp. 140–145. Proceedings of Second All-Russian Conference with International Participation, 6–9 November, 2014. Volume 1. Borok, Russia, Poligraf-Plus.

Glubokovsky, M.K., Tarasyuk, S.N., Zver'kova, L.M., Semenyak, L.V., Murzov, N.N., Petrova, N.V., Brazhnik, S.Yu. & Skakun, V.A. 2012. *Raw fish base of Russian fisheries in 2012: Areas under Russian jurisdiction: information and analytical materials.* VNIRO. 511 pp.

Gololobov, E.I. & Mostovenko, M.S. 2016. The fishing and hunting economy of the North of Western Siberia in the 1960–1980s: from fishing to the industry. *Bulletin of Ugric Studies,* 3(26): 111-123.

Golubtsov, A.S. & Malkov, N.P. 2006. Features of the ichthyofauna of the upper Ob within the Republic of Altai in terms of biogeography and biodiversity conservation. In *Ecology of fish of the Ob-Irtysh Basin,* Moscow, pp. 333–354.

Gorbachev, S.A. 2008. Anthropogenic factors and their importance in forming habitat quality of hydrobionts. In *Aquatic living resources of Onega Lake,* pp. 180–185. Petrozavodsk, Karelian Scientific Center of RAS.

Government of the Russian Federation (GRF). 1991a. *On reorganization of the government bodies of the RSFSR.* Executive Order of the President of the RSFSR, No. 242 of 18 December 1991.

GRF. 1991b. *On the Committee of Fisheries under the Ministry of Agriculture of the RSFSR.* Executive Order of the President of the RSFSR, No. 273 of 14 December 1991.

GRF. 1992. *On the structure of the central bodies of federal executive power.* Executive Order of the President of the Russian Federation, No. 1148 of 30 September 1992.

GRF. 1993. *On the state border of the Russian Federation*. Law of the Russian Federation No. 4730-1 of 1 April 1993.

GRF. 1994c. *On measures to ensure the fulfillment of obligations of the Russian Party arising from the Convention on Wetlands of International Importance especially as Waterfowl Habitat of 2 February 1971.* Decree of the Government of the Russian Federation No. 1050 of 13 September 1994.

GRF. 1995a. *On measures to implement the Convention on Biological Diversity.* Decree of the Government of the Russian Federation, No.669 of 1 July 1995.

GRF. 1995b. *On the animal world*. Federal Law of 24 April 1995 N 52-ФЗ [online]. Available at http://www.consultant.ru/document/cons_doc_LAW_6542/

GRF 1996. *On the structure of federal executive bodies.* Executive Order of the President of the Russian Federation, No. 1177 of 14 August 1996.

GRF. 1997. *On the partial amendment of paragraph 3 of Decree of the President of the Russian Federation No. 249 of 17 March 1997.* Executive Order of the President of the Russian Federation, No. 504 of 19 May 1997.

GRF. 1998. *On the structure of federal executive bodies.* Executive Order of the President of the Russian Federation, No. 1142 of 22 September 1998.

GRF. 2002. *On environmental protection.* Federal Law No. 7-FZ of 10 January 2002.

GRF. 2004a. On *fishing and conservation of aquatic biological resources.* Federal Law No. 166-FZ of 20 December 2004.

GRF. 2004b. *Issues of the Federal Agency for Fisheries.* Decree of the Government of the Russian Federation, No. 182 of 7 April 2004.

GRF. 2004c. *Urban planning codex of the Russian Federation of 29 December 2004 N 190-FZ* (as amended on 27 December 2019) [online]. Available at http://www.consultant.ru/document/cons_doc_LAW_51040/

GRF. 2006. *Water codex of the Russian Federation dated 6 June 2006 N 74-ФЗ.* As amended on 8 February 2019) (as amended and supplemented, entered into force on 1 January 2020) (online). Available at http://www.consultant.ru/document/cons_doc_LAW_60683/

GRF. 2007a. *On the Russian State Committee for fisheries.* Decree of the Government of the Russian Federation, No. 733 of 1 November 2007.

GRF. 2007b. *Issues of the structure of federal executive bodies.* Executive Order of the President of the Russian Federation, No. 1274 of 24 September 2007.

GRF. 2008a. *Regulation on the Federal Agency for Fisheries.* Decree of the Government of the Russian Federation, No. 444 of 11 June 2008.

GRF. 2008b. *Issues of the system and structure of Federal Executive bodies.* Executive Order of the President of the Russian Federation, No. 863 of 30 May 2008.

GRF. 2008c. *On approval of the regulations on the implementation of state monitoring of water biological resources and the application of its data.* Decree of the Government of the Russian Federation, No. 994 of 24 December 2008.

GRF. 2008d. *On the preparation and conclusion of an agreement on the use of aquatic biological resources, the total allowable catch of which is not established.* Decree of the Government of the Russian Federation, No. 643 of 25 August 2008.

GRF. 2008e. *Regulation on the Ministry of Agriculture of the Russian Federation.* Approved by Decree of the Government of the Russian Federation No. 450 of 12 June 2008.

GRF. 2008f. *On approval of the rules for the establishment of fish protection zones.* Decree of the Government of the Russian Federation of 6 October 2008 N 743 [online]. Available at https://rg.ru/2008/10/10/ryba-dok.html

GRF. 2008g. *On establishing the amount of damage caused to aquatic living resources and which should be considered large.* Decree of the Government of the Russian Federation of 18 August 2008 N 625 [online]. Available at https://base.garant.ru/12162036/

GRF. 2009. *Regulation on the determination and approval of the total allowable catch of aquatic biological resources and its change.* Decree of the Government of the Russian Federation No. 531 of 25 June 2009.

GRF. 2009. *On approval of directive about fishery in the aims of scientific and control purposes.* Decree of the Government of the Russian Federation of 13 November 2009, No. 921 [online]. Available at https://base.garant.ru/2169912/

GRF. 2012a. *On amendments to certain acts of the Government of the Russian Federation on the activities of the Ministry of Agriculture of the Russian Federation and the Federal Agency for Fisheries.* Decree of the Government of the Russian Federation No. 666 of 30 June 2012.

GRF. 2012b. *On the federal target program 'Protection of Lake Baikal and the Socio-Economic Development of the Baikal Natural Territory for 2012–2020'.* Decree of the Government of the Russian Federation of 21 August 2012 No. 847 [online]. Available at https://www.garant.ru/products/ipo/prime/doc/70119234/

GRF. 2012c. *On the federal target program 'Development of the water management complex of the Russian Federation in 2012–2020'.* Decree of the Government of the Russian Federation of 19 April 2012 N 350 [online]. Available at https://base.garant.ru/70166354/

GRF. 2013. *On state ecological monitoring (state environmental monitoring) and the state fund of state ecological monitoring data (state environmental monitoring).* Decree of the Government of the Russian Federation, No. 681 of 9 August 2013.

GRF. 2018. *Federal law on recreational fishing and on amendments to certain legislative acts of the Russian Federation No. 475-FZ* of 25 December 2018.

GRF. 2019. *Strategy for the development of the fisheries complex of the Russian Federation for the period up to 2030*. Approved by Order of the Government of Russia No. 2798-p of 26 November 2019.

GRF. 2020. *The doctrine of food safety of the Russian Federation.* Approved by Decree of the President of the Russian Federation dated 21 January 2020, No. 20.

Government of the Russian Federation and the Government of Estonian Republic. 1994. *Agreement between the Government of the Russian Federation and the Government of Estonian Republic on collaboration in field of conservation and use of fish resources in Peipus (Chudskoe), Lämmi (Tjoploe) and Pihkva (Pskovskoe) lakes of 4 May 1994.*

Government of the Russian Federation and the Government of People's Republic of China. 1994. *Agreement between the Government of the Russian Federation and the Government of People's Republic of China regarding cooperation in the sphere of protection, regulation and stock enhancement of live aquatic biodiversity in the boundary waters of the rivers of Amur and Ussuri of 27 May 1994.*

Government of Sakha (Yakutya) Republic (GSR). 2014. *On approval of conception of development of fisheries industry of Sakha (Yakutya) Republic for 2014-2020 and activity plan ('Roadmap') of development of fisheries industry of Sakha (Yakutya) Republic for 2014-2020.* Government Decree of Sakha (Yakutya) Republic dated 23 December 2014, No. 1518-p.

Government of the Union of Soviet Socialist Republics and the Government of Norway. 1971. *Agreement between the Government of the Union of Soviet Socialist Republics and the Government of Norway on the regulation of fishing and conservation of fish stocks in the Greense Jakob river (Voriema) and Pasvik river (Patsojoki) of 7 December 1971.*

Government of Ukraine and the Government of the Russian Federation. 1992. *Agreement between the Government of Ukraine and the Government of the Russian Federation concerning the joint use and protection of transboundary waters of 18 October 1992.*

Grimm, O. 1893. Fisheries and capture of sea animals. In *Agriculture and forestry in Russia*. SPB.

Gundrizer A.N. 1992. The impact of economic activity on the fish stocks of the Tom River basin. In *Ecology of an industrial city (methodological developments).* Tomsk. pp.153–160.

Il'mast, N.V. & Sterligova, O.P. 2014. Lake ecosystems of Karelia in conditions of anthropogenic transformation. *In Current status of inland water bioresources,* pp. 213–218. Proceedings of Second All-Russian Conference with International Participation, 6–9 November, 2014. Volume 1. Borok, Russia, Poligraf-Plus.

Ivanov, V.P. & Mazhnik, A.Yu. 1997. Fisheries of the Caspian basin (White Book). *Fisheries,* 1(18).

Joint Russian–Belarusian Commission on Fisheries. 2011. *Rules for fishing on transboundary water bodies of the Russian Federation and the Republic of Belarus of 2011.* JRBCF.

Kaev, A.M. & Ignatyev, Yu.I. 2015. Development of the Pacific salmon's factory breeding in Sakhalin-Kuriles region and its importance for fishery. *Trudy VNIRO*, (153): 95–104.

Kalenov, S.E. 2003. Illegal catching of aquatic living resources: causes and prevention. *Siberian Law Journal,* 1: 75–80.

Karnaukhov, G.I. 2019. The use of stock of aquatic biological resources for fishing and recreational fishing in the Chograi reservoir. *International Scientific Journal,* 10(88), Part 1: 92–94.

Karpenko, V.I. 2014. Stock assessment and management of the pacific salmon fishery in Kamchatka, Petropavlovsk-Kamchatsky, 2014.

Katunin, D.N., Berezhnov, G.V. & Nemoshkalov, S.M. 2003. *Biological amelioration of small water courses of the Volga Delta.* Astrakhan. 67 pp.

Khainovsky, K.B. & Ul'yanov, A.G. 2015. Artificial breeding of aquatic living resources in Kaliningrad District: experience, problems, perspectives. *Trudy VNIRO,* 5 (153): 57–73.

Khodorevskaya, R.P. & Ruban, G.I. 2014. About the state of sturgeon populations in the Volga-Caspian basin after the construction of dams. In *Current status of inland water bioresources*. Volume 2. Moscow, Poligraf-Plus.

Khoroshko, P.N., Vlasenko, A.D. & Novikova, A.S. 1971. *Atlas of spawning grounds for sturgeon in the Volga basin.* Volgograd. 90 pp.

Klokov, K.B., Krasovskaya, T.M. & Yamskov, A.N. 2002 Ethnocultural aspects of nature management of the Arctic region of Russia. *Geography and Natural Resources,* 4: 23–29.

Kondrat'eva, T.A., Zakharov, S.D. & Khaliullina, L.Yu. 2012. Mining and quarrying of non-metallic minerals impact on ecosystems of the Kuibyshevskoe reservoir. *Bulletin of Kazan Technological University,* 15(19): 116–119.

Koshelev, V.N., Kolobov, V.Yu. & Shmigirilov, A.P. 2013. Present knowledge on status of populations of sturgeons at the border of the Middle Amur and Low Amur. *Problems of Fisheries,* 14, 1(53): 45–52.

Kostyunichev, V.V., Bogdanova, V.A., Shumilina, A.K. & Ostroumova, I.N. 2015. Artificial breeding of fish in the North-West of Russia. *Trudy VNIRO,* 153: 26–41.

Kostyurin, N.N., Barabanov, V.V. & Aseinov, D.D. 2014. Determination of the impact of recreational fishing on aquatic biological resources of the Volga-Caspian fishing subarea (Astrakhan region) 2012. *Bulletin of the Fisheries Science,* 1(1): 16–28.

Krepysheva, S.K. 2014. Content features of criminal activity in the field of illegal turnover of aquatic living resources. *Privolzhsky Scientific Journal,* 1(29): 86–95.

Kuznetsov, V.A. 1978. *Features of fish reproduction in a regulated river flow.* Kazan, Kazan University Press. 160 pp.

Kuznetsov, I. 1902. *Essay on Russian fishing.*

Leonov, S.N. & Shevaryova, Ya.S. 2017. Problems and perspectives for the development of traditional types of economic activity of indigenous peoples of the North and Far East. *Regionalistica,* 4(2): 26–45.

Litvinenko, A.I., Semenchenko, S.M. & Kapustina, Ya.A. 2015. Artificial breeding of valuable fish species of the Urals and Siberia: status, problems and perspectives. *Trudy VNIRO,* 153: 74–84.

Loginov, V.V. & Gelashvili, D.B. 2016. Impact on aquatic living resources of reservoirs of the Volga-Kama cascade from hydroelectric power stations. *Problems of Ecology,* 4: 4–25.

Lyzova, A.V. 2007. Transboundary pollution influence of the Amur River on aquatic living resources. *Izvestiya TINRO*. pp. 262–274.

Makoedov, A.N. 2015. Scientific foundations of fisheries. Textbook. – Moscow. Publishing house Media-M. 464 pp.

Makoedov, A.N. & Kozhemyako, O.N. 2007. *Basics of fisheries policy in Russia.* Moscow, Publishing house National Fish Resources.

Mamontov, Yu.P., Ivanov, D.I., Litvinenko, A.I. & Sklyarov, V.Ya. 2005. *Fishery in inland fresh water bodies of Russia.* SPb. 100 pp.

Mamontov, Yu.P., Litvinenko, A.I. & Sklyarov, V.Ya. 2003. *Fisheries in inland freshwater bodies of Russia (White Book).* Tyumen. 66 pp.

Matishov, G.G. & Chinarina, A.D. 2005. *Ichthyofauna of small rivers and lakes of Murman region: biology, ecology, resources.* Apatity, Publishing House of Kola SC RAS. 264 pp.

Matishov, G.G., Matishov, D.G. & Berdnikov, S.V. 2005. Status of fish breeding and ways of revival of living resources of the Sea of Azov. *Bulletin of South Scientific Centre of RAS,* 1(4): 30–37.

Melnikov, V.N. 1991. *Fishing gears configuration and technology of fish catching.* Moscow, Agropromizdat. 1991. 384 pp.

Mikhailov, S.V. 1962. *Economics of the fishing industry of the USSR.* Moscow, Pischepromizdat. 288 pp.

Ministry of Agriculture (MoA). 2013. *On approval of the list of types of aquatic living resources, for which the total allowable catch is established.* Order of the Ministry of Agriculture of the Russian Federation of 1 October 1, 2013, No. 365.

MoA. 2014. *On approval of fishing rules for the Baikal fishery basin.* Order of the Ministry of Agriculture of Russia of 7 November 2014, No. 435 [online]. Available at http://docs.cntd.ru/document/420233780

MoA. 2016. *On the approval of water quality standards for water bodies of fishery value, including the standards of maximum permissible concentrations of harmful substances in the water bodies of fishery value*. Order of the Ministry of Agriculture of Russia of 13 December 2016. No. 552. [online]. Available at https://files.stroyinf.ru/Data2/1/4293745/4293745251.pdf

MoA. 2019. Order of Ministry of Agriculture of Russia of 23 October 2019. No. 596.

Ministry of Natural Resources and Ecology of the Russian Federation (MNRE). 2015. *Fifth national report: Biodiversity conservation in the Russian Federation.* Ministry of Natural Resources and Ecology of the Russian Federation. 124 pp.

MNRE. 2018. *On the state of Lake Baikal and measures for its protection in 2017.* State report. Ministry of Natural Resources and Ecology of the Russian Federation. 223 pp.

Ministry of Sports of Russia. 2014. *The rules of fishing sport.* Approved by the Order of the Ministry of Sports of Russia 20 March 2014, No. 140.

Mirzoyan, A.V. & Khodorevskaya, R.P. 2017. Biodiversity of water living resources of the Volga-Caspian fisheries basin. *Bulletin of the Astrakhan STU. Series: Fisheries.* 2017. No. 4: 49–60.

Mukhachev, I.S. & Medvedev, M.M. 2013. Ecological and fishery bio-amelioration of lakes of Armizonsky District of Tyumen' Region. *Bulletin of Tyumen State University. Ecology and Natural Management,* 12: 165–174.

Murin, V.A. 1978. *Essay on the history of fisheries in pre-revolutionary Russia.* Kiev, Fisheries of the Soviet Union. p 187.

Murin, V.A. 1979. *Essay on the history of fisheries of the USSR*. Kiev, Fisheries of the Soviet Union. 261 pp.

National Information Agency "Natural Resources" (NIA-Priroda). 2019. *On the state and use of water resources of the Russian Federation in 2016, 2017, 2018.* State Report. NIA-Priroda.

Nikolaev, A.I., Syrbulov, D.N., Nikolaeva, N.A., Burtsev, I.A., Savicheva, N.A. & Marchenko, T.M. 2015. Artificial breeding of sturgeons on Volgograd sturgeon hatchery. *Trudy VNIRO,* 153: 154–164.

Nikonorov, I.V. 1996. *Ecology and fisheries*. Moscow, Publishing House Forwarder. 256 pp.

North Atlantic Salmon Conservation Organization (NASCO). 1983. *Convention for the Conservation of Salmon in the North Atlantic Ocean of 1 October 1983.*

NASCO. 2004. *NASCO: Twenty-year milestones and next steps for NASCO - a vision for the future.* Edinburgh, NASCO. 16 pp.

Okhotina, T.M. 2008. The role of hunting and fishing in the culture of life support of the Mordovian people. *Izvestia: Herzen University Journal of Humanities & Sciences*, 228–233.

Pacific State University. Undated. Indigenous peoples of the Far East. In *Regional studies of the Far East.* Pacific State University. Law Institute, chair of History of the Fatherland, State and Law [online]. Available at http://pnu.edu.ru/ru/faculties/full_time/uf/iogip/study/studentsbooks/materials/regionovedenie/part4/

Parliamentary Newspaper. 2020. With Free Fishing You Have to Wait a Bit. Parliamentary newspaper, January 2020 [online]. Available at https://www.pnp.ru/social/s-besplatnoy-rybalkoy-pridyotsya-nemnogo-povremenit.html

Pavlov, D.S. & Mochek, A.D. eds. 2006. *Ecology of Fishes from Ob-Irtysh Basin.* A.N. Severtsov Institute of Ecology and Evolution of RAS. Tobol'sk Biological Station, KMK, 2006. 596 pp.

Pavlov, D.S. & Striganova, B.R. 2005. Biological resources of Russia and main directions of fundamental researches. In *Mainstays of biological resources management,* pp. 4–20. KMK, Tov. of Scientific Publications.

People's Commissariat of Agriculture of RSFSR (PCA). 1930. *Review of the pre-war and current state of the fisheries of the USSR (up to and including 1927), Moscow, 1930.* Proceedings of the Scientific Institute, Vol. 4, People's Commissariat of Agriculture of the RSFSR. 761 pp.

Peterfeld, V.A. & Sokolov, A.V. 2016. The current state of cisco stocks (*Coregonus migratorius* Georgi) in Lake Baikal. *Fisheries,* 3: 72–75.

Petukhova, N.G., Bobyrev, A.E. & Sokolov A.V. 2019. State of the Selenga population of Baikal cisco in conditions of moratorium on catching. *Trudy VNIRO,* 177: 140–150.

Raskina, T. Undated. *Supervision of the implementation of legislation in the field of fisheries and the conservation of aquatic living resources* [online]. Available at https://wiselawyer.ru/poleznoe/39468-nadzor-ispolneniem-zakonodatelstva-sfere-rybolovstva-sokhraneniya-vodnykh

Rosstat. Regions of Russia (RoR). 2019. *Socio-economic indicators. 2019.* Stat. compt/Rosstat. 1204 pp.

Rosstat. RoR. 2020. *Socio-economic indicators. 2020.* Stat. compt/Rosstat. 996 pp.

Rostovtsev, A.A., Khakimov, R.M., Interesova, E.A. & Babkina I.B. 2015. Biological amelioration of overflow land of the mid-Oka River: problems and perspectives. *Siberian Bulletin of Agricultural Science,* 1(242): 68–74.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 1998. *Domestic fisheries: stages of formation and development prospects.* Edited by Sysoev, N.P. & Shpachenkov, Yu.A., Moscow, VNIRO. 1998. 369 pp.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 2001. *Statistical information on the fishing industry of Russia 2000-2001.* Moscow, VNIRO. 85 pp.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 2002. *Statistical information on the fishing industry of Russia 2001-2002.* Moscow, VNIRO. 70 pp.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 2003. *Statistical information on the fishing industry of Russia 2002-2003.* Moscow, VNIRO. 115 pp.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 2005. *Statistical information on the fishing industry of Russia 2004-2005.* Moscow, VNIRO. 85 pp.

Russian Federal Research Institute of Fisheries and Oceanography (VNIRO). 2010. *Reference materials for drift fishing of Pacific salmon.* Edited by Gritsenko, O.F. Moscow, VNIRO. 196 pp.

Ruzsky, M.D. 1920. Fish of the Tom River. *Bulletin of the Institute for the Study of Siberia* №2 In *Proceedings of the Natural History Department,* No. 1, pp. 29–41.

Ryabov, N.A. 2014. *The practice of supervision of the implementation of legislation in the field of turnover of aquatic living resources.* Entrepreneurship and Law. Information and Analytical portal. [online]. Available at http://lexandbusiness.ru/

Salieva, A.R. Undated. *Status and prospects of solving the ecosystem problems of the Volga-Caspian region.* (online]. Available at https://revolution.allbest.ru/ecology/00946858_0.html

Sechin, Yu.T. 2010. *Bioresource studies in inland waters. –Kaluga*. Publishing House of Scientific Literature "Eidos". 204 pp.

Sechin, Yu.T. 2014. The effectiveness of forecasting fish catches in freshwater bodies. Trudy VNIRO, *Aquatic biological resources,* Volume 151, pp. 151–157. Moscow, VNIRO.

Sergeev, V.N. 2004. Russian fish industry - 13 years of free swimming. *Food Industry,* 4: 22–26.

Sharonov, I.V. 1972. Infiltration of the northern and southern forms into the Kuibyshevskoe reservoir. *Proceedings of Tatar branch of* GosNIORKH*, Kazan,* 22: 178–179.

Shibaev, S.V. 2017. Estimation of efficiency model of biological amelioration of spawning rivers. *Bulletin of KrasGAU,* 47: 64–70.

Skakun, V.A. & Brazhnik, S.Yu. 2014., Current status of stocks and catches of the most widespread fish species of inland freshwater bodies of Russia. In *Current status of inland water bioresources,* Volume 2. Moscow, Poligraf-Plus.

Smetaninm, A.N. 2006. *The history of fishing in the Far East.* Petropavlovsk-Kamchatsky. 51 pp.

Smirnov, V.V., Smirnova-Zalumi, N.S. & Orlov, S.I. 2013. Current trends in distribution and commercial catches of Arctic cisco (*Coregonus autumnalis migratorius [Georgi*]). *Izvestiya of Irkutsk State University*, *Series: Biology.Ecology*, 3(1): 63–67.

Sokolov, V.E., Chernov, Yu.I. & Reshetnikov, Yu.S. 1994. Russian National Program for the Conservation of Biological Diversity. In *Biodiversity: degree of taxonomic knowledge*. Moscow. Publishing House Sience, pp. 4-12, 77-85.**Sokolov, A.V. &, Peterfeld, V.A.** 2018. About the reasons of banning commercial fishery of Arctic cisco (*Coregonus autumnalis migratotius, Georgi*) in Baikal Lake in current period. In *Aquatic living resources, aquaculture and ecology of water bodies,* pp. 158–164. VI International Baltic Forum, September 3–6, 2018.

Sokolov, V.A., Peterfeld, V.A. & Vasilyev, D.A. 2018. Current status estimation of stock of Arctic cisco with the use of analytical methods. *Bulletin of Fisheries Science,* 1: 35–45.

Spodina, V.I. 2014. Features of fishing in small reservoirs (on the materials of forest nenets). *Ethnographic Review,* 5: 129–145.

St. Petersburg University. 2011. Reform of 1861 in Russia: causes and historical lessons. *Bulletin of St. Petersburg University,* 5(2): 3–17.

Svirsky, V.G. & Barabanchshikov, E.I. 2009. Biological invasions as an element of anthropogenic pressure on hydrobionts community of Khanka Lake. *Russian Magazine of Biological Invasions,* 2: 29–35.

Tairov, R.G., Shakirova, F.M. & Severov, Yu.A. 2013. Current status of artificial breeding of valuable species of fish and biological amelioration of fisheries water bodies of the mid-Volga area (on the example of Kuibyshevskoe reservoir). *Fisheries,* 4: 53–57.

Teymurov, E.S. 2019. *International legal regulation of rational use and protection of freshwater.* Publishing House Statute, 2019. Moscow. 174 pp. (In Russian)

Trifonov, A.V. 2010. *River fishing boats. Vessels of the fishery fleet of inland waters. History and development perspectives.* Publishing House TransLit. 144 pp.

Tyaptirgyanov, M.M. 1988. *Anthropogenic ecological succession of the aquatic ecosystem of the Chroma river.* Yakutsk, Yakutsk Branch of the Siberian Branch of the USSR Academy of Sciences. 168 pp.

Tyumen branch of the VNIRO ("Gosrybcenter") 2003a. *Commercial fishing gear for inland waters of Russia.* Handbook, Volume 2. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 186 pp.

Tyumen branch of the VNIRO ("Gosrybcenter") 2003b. *Commercial fishing gear for inland waters of Russia.* Handbook, Volume 3. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 248 pp.

Tyumen branch of the VNIRO ("Gosrybcenter") 2003c. *Commercial fishing gear for inland waters of Russia*. Handbook, Volume 4. Edited by A.I. Litvinenko. Tyumen, Gosrybtsenter. 242 pp.

United Nations (UN). 1992a. *Convention on Biological Diversity of 5 June 1992*.

UN. 1992b. *Convention on the Protection and Use of Transboundary Watercourses and International Lakes of 17 March 1992.*

UN. 1997. *UN Convention on the Rights of Non-Navigational Uses of International Watercourses of 21 May 1997.*

Union of Soviet Socialist Republics and the Republic of Finland. 1964. *Agreement between the Union of Soviet Socialist Republics and the Republic of Finland on border water systems of 24 April 1964.*

United Nations Educational, Scientific and Cultural Organization (UNESCO). 1971. *Convention on Wetlands of International Importance Especially as Waterfowl Habitat of 2 February 1971.*

USSR Ministry of Fisheries. Central Research Institute of Information and Technical and Economic Research of Fisheries of the USSR. (CRIITERF) 1905–1989. *Statistical information on catching fish, seafood and aquatic mammals in Russia for 1900-1917.* Moscow, 1974.

USSR Ministry of Fisheries. 1950–1989. *Data from the Central Statistical Bureau of the USSR, 1950-1989.*

USSR Ministry of Fisheries. CRIITERF. 1964. *A collection of statistical data on the dynamics of fish, whales, aquatic mammals and seafood catches in the fishing industry of the USSR for 1913, 1930-1963*. Moscow, 1964.

USSR Ministry of Fisheries (CRIITERF**).** 1971. *Statistical and economic reference data on the extraction of fish, whales, aquatic mammals and seafood in 1860-1969.* Moscow.

USSR Ministry of Fisheries. CRIITERF**.** 1980. *Statistical information on the catch of fish, the production of whales, sea animals and seafood for the period from 1860 to 1978.* Moscow. 100 pp.

USSR Ministry of Fisheries. CRIITERF**.** 1981. *Statistical information on fish catches, harvesting of aquatic mammals and other objects of fishing in the Azov-Black Sea, Caspian and Aral basins for 1976-1980.* Moscow. 19 pp.

USSR Ministry of Fisheries (VNIERH). 1991. *Fisheries of the USSR for 1900-1990 (statistical and economic reference book), Volume 2. Raw material base of the fishing industry.* Moscow, USSR Ministry of Fisheries, All-Russian Research and Design Institute of Economics, Information and Automated Fisheries Management Systems (VNIERH). 284 pp.

USSR Ministry of Fisheries (VNIERH). 1994. *Fisheries of Russia for 1992-1993.* Moscow, VNIERH.

USSR Ministry of Fisheries (VNIERH). 2000. *Fisheries of Russia for 1998-1999.* Moscow, VNIERH.

USSR Ministry of Fisheries (VNIERH). 2003. *Fisheries of Russia for 2001-2002.* Moscow, VNIERH.

USSR Ministry of Fisheries (VNIERH). 2006. *Parameters and working conditions of fishermen.* Moscow, VNIERH. 198 pp.

Vasilyeva, L.M., Naumov, V.V. & Sudakova, N.V. 2015. Features of current status of artificial breeding of sturgeons in the Volga-Caspian basin. *Natural Sciences,* 4(53): 90–95.

Vlasenko, A.D. 2012. Current status and main problems of fish stocks restoration of the Volga-Caspian basin. *Problems of Fisheries,* 13, 4(52): 719–735

Volga. 2019. *Volga.* Newspaper article [online]. Available at https://astravolga.ru/na-kaspii-uspeshno-vozobnovilsja-promysel-kilki/

Voronkov, V.V. & Belousov A.N. 2015. International theory and practice of measures for the conservation of biodiversity, approaches to its valuation and measures for restoration and compensation. *Fisheries,* 1: 13–16.

Voronova, Z.B., Dzyumenko, N.F., Afanas'ev, S.G., Zhuravlev, O.I. & Peterfeld, V.A. 2015. History of development and status of artificial breeding of aquatic living resources in Baikal fishery basin. *Trudy VNIRO,* 153: 85–94.

Yamal. 2018. Quotas Have Been Allocated for Traditional Fishing. 27 December 2018. Available at http://www.Arcticinfo.ru/news/korennye_narody/Na_YAmale_vydeleny_kvoty_dlya_osushchestvleniya_traditsionnogo_rybolovstva_/

Yamal. 2020. Quotas for Traditional Fishing Increased by 20%. 15 January 2020. Available at http://www.Arcticinfo.ru/news/korennye_narody/Na_YAmale_uvelicheny_na_20_kvoty_na_traditsionnoe_rybolovstvo/

List of species in this review

Invertebrate species

Scientific name	English name	Transcription of Russian name	Russian name
CRUSTACEA	Crustaceans	Rakoobraznye	Ракообразные
Astacidae	Euro-American crayfishes	Raki rechnye	Раки речные
Astacus sp.	European crayfish	Shirokopaliy rechnoy rak	Широкопалый речной рак
Pontastacus sp.	Danube crayfish	Rak uzkopaliy	Рак узкопалый
Cambaridae	Euro-American crayfishes	Raki	Раки
Artemiidae	Brine shrimps	Artemii	Артемии
Artemia salina	Brine shrimp	Artemiya	Артемия
Gammaridae			
Gammarus spp.	Gammarus	Gammarus	Гаммарус
Lithodidae	King crabs	Kraboidy	Крабоиды
Paralithodes brevipes	Brown king crab	Krab kolyuchyi	Краб колючий
INSECTA			
Chironomidae	Chironomids, lake flies	Motil	Мотыль (хирономиды)

Fish species

Scientific name	English name	Transcription of Russian name	Russian name
PETROMYZONTIFORMES	Lampreys	Minogoobraznye	Миногообразные
Petromyzontidae	Lampreys	Minogovye	Миноговые
Entosphenus tridentatus	Pacific lamprey	Minoga tihookeanskaya	Минога тихоокеанская
Lampetra spp.	Lampreys	Minogi	Миноги
Lampetra fluviatilis	European river lamprey	Minoga rechnaya (evropeyskaya)	Минога речная (европейская)
Lampetra planeri	European brook lamprey	Minoga ruchjevaya (evropeyskaya)	Минога ручьевая европейская
Lethenteron kessleri	Siberian brook lamprey	Minoga sibirskaya rechnaya	Минога сибирская речная
Lethenteron reissneri	Far Eastern brook lamprey	Minoga dalnevostochnaya ruchjevaya	Минога дальневосточная ручьевая
ACIPENSIRIFORMES	Sturgeons, paddlefishes	Osetroobraznye	Осетрообразные
Acipenseridae	Sturgeons	Osetrovye	Осетровые
Acipenser baerii	Siberian sturgeon	Osetr sibirskyi	Осетр сибирский
Acipenser brevirostrum	Shortnose sturgeon	Osetr tuporiliy	Осетр тупорылый
Acipenser gueldenstaedtii	Danube sturgeon	Osetr russkyi (dunayskyi)	Осетр русский (дунайский)
Acipenser medirostris	Green sturgeon	Osetr sakhalinskiy	Осетр сахалинский
Acipenser nudiventris	Fringebarbel sturgeon	Ship	Шип
Acipenser oxyrinchus	Atlantic sturgeon	Osetr atlanticheskyi	Осетр атлантический
Acipenser persicus	Persian sturgeon	Osetr persidskyi	Осетр персидский
Acipenser ruthenus	Sterlet sturgeon	Sterlet	Стерлядь
Acipenser ruthenus marsiglii	Siberian sterlet sturgeon	Sibirskaya sterlet	Сибирская стерлядь
Acipenser schrenckii	Amur sturgeon	Osetr amurskyi	Осетр амурский
Acipenser stellatus	Starry sturgeon	Sevriuga	Севрюга
Huso dauricus	Kaluga	Kaluga	Калуга
Huso huso	Beluga	Beluga	Белуга

Scientific name	English name	Transcription of Russian name	Russian name
ANGUILLIFORMES	Eels	Ugreobraznye	Угреобразные
Anguillidae	River eels	Ugrevye	Угревые
Anguilla anguilla	European eel	Ugor rechnoy obyknovennyi	Угорь речной обыкновенный
CLUPEIFORMES	Herrings, anchovies, shads etc.	Seldeobraznye	Сельдеобразные
Clupeidae	Herrings, shads, sardines, and menhadens	Seldevye	Сельдевые
Clupea harengus	Herring	Seld obyknovennaya	Сельдь обыкновенная
Alosa spp.	Shads	Seld prokhodnaya	Сельдь проходная
Alosa braschnikowi	Caspian marine shad	Seld dolginskaya	Сельдь долгинская
Alosa caspia	Caspian shad	Puzanok kaspyiskyi	Пузанок каспийский
Alosa kessleri	Caspian anadromous shad, black-backed shad	Seld chernospinka astrakhanskaya	Астраханская селедка-черноспинка
Alosa saposchnikowii	Saposhnikovi shad	Bolsheglazyi puzanok	Большеглазый пузанок
Alosa volgensis	Volga shad	Seld volzhskaya	Сельдь волжская
Sprattus	Sprats	Kilki	Кильки
Clupeonella	Caspian tyulka	Tyulki	Тюльки
Clupeonella cultriventris	Caspian sea sprat	Kilka kaspyiskaya	Килька каспийская
Clupeonella caspia	Common Caspian kilka	Kilka obyknovennaya	Килька обыкновенная
Clupeonella engrauliformis	Anchovy sprat	Kilka anchousovidnaya	Килька анчоусовидная
Clupeonella grimmi	Southern Caspian sprat	Kilka bolscheglazaya	Килька большеглазая
CYPRINIFORMES	Carps, barbels etc.	Karpoobraznye	Карпообразные
Cyprinidae	Cyprinids	Karpovye	Карповые прочие
Abramis brama	Freshwater bream	Leshch	Лещ
Alburnus alburnus	Bleak	Ukleya	Уклея
Alburnus chalcoides	Danube bleak	Shemaya	Шемая
Ballerus ballerus	Zope	Sinets	Синец
Ballerus sapa	White-eye bream	Beloglaska	Белоглазка
Blicca bjoerkna	White bream	Gustera	Густера
Carassius spp.		Carass	Карась
Carassius gibelio	Prussian carp	Carass serebryanyi	Карась серебряный
Carassius carassius	Crucian carp	Carass zolotoy	Карась золотой
Chanodichthys dabryi	Humpback	Gorbushka	Горбушка
Chanodichthys erythropterus	Predatory carp	Verkhoglyad	Верхогляд
Chanodichthys mongolicus	Mongolian redfin	Mongolskiy krasnoper	Краснопер монгольский
Chondrostoma nasus	Common nase	Podust	Подуст
Ctenopharyngodon idella	Grass carp	Belyi amur	Амур белый
Culter alburnus	Ukley	Ukley	Уклей
Cyprinus carpio	Common carp	Sazan, karp	Сазан, карп
Diptychus maculatus	Scaly osman	Osman	Осман
Gobio gobio	Gudgeon	Peskar	Пескарь
Hemibarbus labeo	Barbel steed	Kon-gubar	Конь-губарь
Hemibarbus maculatus	Spotted steed	Kon pestryi	Конь пестрый
Hemiculter leucisculus	Sharpbelly	Vostrobrushka	Востробрюшка
Hypophthalmichthys molitrix	Silver carp	Tolstolobik belyi	Толстолобик белый
Hypophthalmichthys nobilis	Bighead carp	Tolstolobik pestryi	Толстолобик пестрый
Leuciscus aspius	Asp	Zherekh	Жерех
Leucaspius delineatus	Belica	Verhovka	Верховка
Leuciscus idus	Ide	Yaz	Язь
Leuciscus leuciscus	Common dace	Yelets	Елец

Scientific name	English name	Transcription of Russian name	Russian name
Leuciscus waleckii	Amur ide	Yaz amurskyi	Язь амурский
Parabramis pekinensis	White Amur bream	Leshch belyi amurskyi	Лещ белый амурский
Pelecus cultratus	Sichel	Chekhon	Чехонь
Plagiognathops microlepis	Smallscale yellowfin	Melkocheshuynyi zheltoper	Мелкочешуйный желтопёр
Phoxinus phoxinus	Eurasian minnow	Golyan	Гольян речной
Rhynchocypris percnurus	Lake minnow	Golyan ozernyi	Гольян озерный
Rutilus frisii	Kutum	Vyrezub	Вырезуб
Rutilus kutum	Caspian kutum	Kutum	Кутум
Leuciscus baicalensis	Siberian dace	Chebak, sibirskyi elets	Чебак, сибирский елец
Rutilus rutilus	Roach	Vobla, taran, plotva	Вобла, тарань, плотва
Scardinius erythrophthalmus	Rudd	Krasnoperka	Краснoперка
Squalius cephalus	Chub	Golavl	Голавль
Tinca tinca	Tench	Lin	Линь
Tribolodon brandtii	Pacific redfin	Ugai	Угай
Vimba vimba	Vimba bream	Rybets	Рыбец
Xenocypris macrolepis	Yellowfin	Zheltoper	Желтопер
Catostomidae	Suckers	Tschoukutschanovye	Чукучановые
Catostomus catostomus	Longnose sucker	Tschokutschan	Чукучан
Cobitidae	True loaches	Vyunovye	Вьюновые
Misgurnus anguillicaudatus	Pond loach	Vyun	Вьюн
SILURIFORMES	Catfishes	Somovidnye	Сомовидные
Bagridae	Naked catfishes	Kosatkovye	Косатковые
Pelteobagrus ussuriensis	Ussuri catfish	Kosatka-plet	Косатка-плеть
Tachysurus fulvidraco	Yellow catfish	Kosatka-skripun kitayskaya	Косатка-скрипун китайская
Siluridae	Sheatfishes	Somovye	Сомовые
Silurus glanis	Wels catfish	Som	Сом
ESOCIFORMES	Pikes	Shchukovidnye	Щуковидные
Esocidae	Pikes	Shchukoye	Щуковые
Esox lucius	Northern pike	Shchuka	Щука
OSMERIFORMES	Smelts	Koryushkovye	Корюшковые
Osmeridae	Smelts	Koryushkovye	Корюшковые
Mallotus villosus	Capelin	Moyva	Мойва
Osmerus spp.	Smelts nei	Koryushki	Корюшки
Osmerus mordax dentex	Arctic rainbow smelt	Koryushka aziatskaya zubastaya	Корюшка азиатская зубастая
Hypomesus olidus	Pond smelt	Koryushka malorotaya	Корюшка малоротая
Osmerus eperlanus	European smelt	Koryushka evropeyskaya	Корюшка (европейская)
Osmerus mordax	Rainbow smelt	Snetok, koryushka americanskaya	Снеток, корюшка американская
SALMONIFORMES	Salmons, trouts, whitefishes	Lososevidnye	Лососевидные
Salmonidae	Salmonids	Lososevye	Лососевые
Brachymystax lenok	Lenok	Lenok	Ленок
Coregonus spp.	Whitefishes	Sigy	Сиги
Coregonus albula	Vendace	Ryapushka, ripus	Ряпушка, рипус
Coregonus autumnalis	Arctic cisco	Omul arkticheskyi	Омуль арктический
Coregonus baerii	Volkhov whitefish	Sig volkhovskyi	Сиг волховский
Coregonus chadary	Khadary-whitefish	Sig-khadary	Сиг-хадары
Coregonus lavaretus	European whitefish	Sig	Сиг
Coregonus migratorius	Baikal omul	Omul baikalsky	Омуль байкальский
Coregonus muksun	Muksun	Muksun	Муксун

Scientific name	English name	Transcription of Russian name	Russian name
Coregonus nasus	Broad whitefish	Chir	Чир
Coregonus peled	Peled	Peled	Пелядь
Coregonus pidschian	Humpback whitefish	Pygian	Пыжьян
Coregonus lavaretus pidschian n. *smitti*	Teleskoye whitefish	Teleckyi sig	Телецкий сиг
Coregonus pravdinellus	Pravdin's whitefish	Sig Pravdina	Сиг Правдина
Coregonus sardinella	Sardine cisco	Sibirskaya ryapushka	Сибирская ряпушка
Coregonus tugun	Tugun	Tugun	Тугун
Coregonus ussuriensis	Amur whitefish	Amurskyi sig	Амурский сиг
Hucho taimen	Taimen	Taimen	Таймень
Oncorhynchus gorbuscha	Pink salmon	Gorbusha	Горбуша
Oncorhynchus keta	Chum salmon	Keta	Кета
Oncorhynchus kisutch	Coho salmon	Kizhuch	Кижуч
Oncorhynchus masou	Masu salmon	Sima	Сима
Oncorhynchus mykiss	Mikizha, Rainbow trout	Mikizha	Микижа
Oncorhynchus nerka	Sockeye salmon	Nerka	Нерка
Oncorhynchus tshawytscha	Chinook salmon	Chavycha	Чавыча
Prosopium cylindraceum	Round whitefish	Valek	Валек
Salmo caspius	Caspian salmon	Losos caspyiskyi	Лосось каспийский
Salmo labrax	Black Sea salmon	Losos chernomorskyi	Лосось черноморский
Salmo salar	Atlantic salmon	Semga	Семга
Salmo salar morpha *sebago*	Lake form of Atlantic salmon	Losos ozernyi	Лосось озерный
Salmo trutta	Sea trout	Kumzha	Кумжа
Salvelinus alpinus	Arctic char	Golets (arkticheskyi)	Голец (арктический)
Salvelinus lepechini	Lake char	Paliya	Палия
Salvelinus leucomaenis	Whitespotted char	Kundzha	Кунджа
Stenodus leucichthys	Sheefish	Belorybitsa	Белорыбица
Stenodus nelma	Nelma	Nelma	Нельма
Thymallus arcticus	Arctic grayling	Kharius	Сибирский хариус
Thymallus thymallus	Grayling	Kharius	Хариус
GADIFORMES	Cods, hakes, haddocks	Treskoobraznye	Трескообразные
Gadidae	Cods and haddocks	Treskovye	Тресковые
Eleginus nawaga	Navaga	Navaga	Навага
Gadus morhua	Atlantic cod	Treska atlanticheskaya	Треска атлантическая
Lotidae	Hakes and burbots	Nalimy	Налимы
Lota lota	Burbot	Nalim	Налим
ATHERINIFORMES	Silversides	Aterinoobraznye	Атеринообразные
Atherinidae	Silversides	Aterinovye	Атериновые
Atherina boyeri	Big-scale sand smelt	Aterina	Атерина
GASTEROSTEIFORMES	Sticklebacks and seamoths	Kolyushkoobraznye	Колюшкообразные
Gasterosteidae	Sticklebacks and tubesnouts	Kolyushkovye	Колюшковые
Gasterosteus aculeatus	Three-spined stickleback	Kolyushka (trehiglaya)	Колюшка (трехиглая)
SCORPAENIFORMES	Scorpionfishes and flatheads	Skorpenoobraznye	Скорпенообразные
Cottocomephoridae	Bighead sculpins	Zheltokrylki	Желтокрылки
Cottocomephorus grewingkii	Baikal yellowfin sculpin	Zheltokrylka (chernogrivka in Baikal)	Желтокрылка (черногривка в оз. Байкал)
Paracottus knerii	Stone sculpin	Kamennaya shirokolobka	Каменная широколобка
Abyssocottidae	Deep-water sculpins	Shirokolobki	Широколобки
Procottus jeittelesii	Red sculpin	Krasnaya shirokolobka	Красная широколобка

Scientific name	English name	Transcription of Russian name	Russian name
Cottidae		Rogatkovye	Рогатковые
Cottus sibiricus	Siberian sculpin	Podkamenschik sibirskyi	Сибирский подкаменщик
MUGILIFORMES	Mullets	Kefaleobraznye	Кефалеобразные
Mugilidae	Mullets	Kefalevye	Кефали
Chelon auratus	Golden grey mullet		
Chelon saliens	Leaping mullet		
Planiliza haematocheila	So-iuy mullet	Pilengas	Пиленгас
PERCIFORMES	Perchers, gobies, snakeheads	Okuneobraznye	Окунеобразные
Channidae	Snakeheads	Zmeegolovye	Змееголовые
Channa argus	Snakehead	Zmeegolov	Змееголов
Gobiidae	Gobies	Bychki	Бычки
Odontobutidae	Freshwater sleepers	Goloveshkovye	Головешковые
Perccottus glenii	Chinese sleeper	Rotan	Ротан
Percidae	Perches	Okuniovye	Окуневые
Gymnocephalus cernuaus	Ruffe	Yorsh	Ёрш (обыкновенный)
Perca fluviatilis	European perch	Okun rechnoy (presnovodnyi)	Окунь речной (пресноводный)
Sander lucioperca	Pike-perch	Sudak	Судак
Sander volgensis	Volga pikeperch	Bersh	Берш
Sparidae	Sea breams	Karassi morskye	Караси морские
Diplodus annularis	Annular seabream	Karass morskoy	Карась морской
PLEURONECTIFORMES	Flatfishes	Kambaloobraznye	Камбалообразные
Pleuronectidae	Righteye flounders	Kambalovye (pravostoronnie)	Камбаловые (правосторонние)
Platichthys flesus	European flounder	Kambala rechnaya	Камбала (речная европейская)

Appendix 1

Table 1.1. Catches in inland waters of the Russian Federation in 1990 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea
TOTAL	**356 114**	**151 870**	**30 223**	**36 480**	**137 541**
Crustaceans	22	22			
Mussels	201	201			
Subtotal finfish	**355 891**	**151 647**	**30 223**	**36 480**	**137 541**
Arctic char, sheefish	469	469			
Asp	298	298			
Atlantic salmon	308	297	11		
Burbot	3 055	2 510	338	207	
Caspian Sea sprat	132 477				132 477
Caspian shad	3 089	2 749			340
Chinook salmon	1 083	1 083			
Chum salmon	3 540	3 540			
Coho salmon	1 457	1 457			
Cyprinids	14 557	5 887	365	8 305	
Incl. white bream	6 197	284		5 913	
Carassius spp.	4 064	2 604	3	1 457	
Rudd	1 147	1 135		12	
European eel	136			136	
European perch	2 738	763	1 067	908	
European river lamprey	21	21			
European smelt	1 755	1 095	606	54	
Freshwater bream	30 755	17 908	2 293	10 554	
Freshwater fishes nei	43 319	29 570	7 703	1 523	4 523
Ide	4 529	2 663	1 754	112	
Mullets	214	214			
Northern pike	7 802	4 880	2 302	620	
Pike-perch	8 654	821	3 865	3 968	
Pink salmon	1 476	1 476			
Rainbow smelt	1 302		1 277	25	
Roach	35 274	27 096	2 216	5 962	
Sichel	1 722	1 303		419	
Sockeye salmon	11 280	11 280			
Sturgeons	10 727	10 495		31	201
Tench	558	553		5	
Three-spined stickleback, ruffe, bleak	237	166	41	30	
Wels catfish	11 670	11 419	4	247	
Whitefishes nei	18 784	11 633	6 381	770	
Incl. Arctic cisco	2 453	568	1 831	54	
Zope, white-eye bream	2 605	1		2 604	

Table 1.2. Catches in inland waters of the Russian Federation in 1995 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea
TOTAL	**212 874**	**98 407**	**15 273**	**16 587**	**82 607**
Crustaceans	12	12			
Subtotal finfish	**212 862**	**98 395**	**15 273**	**16 587**	**82 607**
Arctic char, sheefish	340	340			
Asp	55	3	4	27	21
Atlantic salmon	68	15	53		
Burbot	993	550	225	218	
Caspian Sea sprat	80 205				80 205
Caspian shad	1 478	1 430		7	41
Chinook salmon	738	738			
Chum salmon	10 049	10 049			
Coho salmon	1 213	1 213			
Common carp	752	175	303	147	127
Cyprinids	11 887	7 580	117	3 765	425
Incl. white bream	3 106	327	65	2 714	
Carassius spp.	5 206	3 562	520	1 046	78
Rudd	2 350	1 466	532	5	347
European eel	8			8	
European perch	2 234	975	81	1 003	175
European river lamprey	40	40			
European smelt	3 118	1 066	1 994	58	
Freshwater bream	29 142	20 979	1 175	6 542	446
Freshwater fishes nei	3 460	291	2 343	826	
Ide	1 977	1 448	493	36	
Masu salmon	13	13			
Mullets	31	31			
Navaga	193	193			
Northern pike	4 938	3 927	295	204	512
Pike-perch	3 271	1 110	1 181	931	49
Pink salmon	8 862	8 862			
Rainbow smelt	1 006	71	891	44	
Roach	19 630	16 165	1 792	1 539	134
Shads nei	1	1			
Sichel	435	88	81	259	7
Sockeye salmon	8 229	8 229			
Sturgeons	2 276	2 189		18	69
Tench	1 300	1 087	3	7	203
Three-spined stickleback, ruffe, bleak	337		337		
Wels catfish	4 590	4 277	7	123	183
Whitefishes nei	8 273	4 760	3 453	60	
Incl. muksun	1 041	1 041			
Arctic cisco	2 492	243	2 241	8	
Broad whitefish	96	96			
European whitefish	1 321	1 008	269	44	
Peled	887	882	4	1	
Vendace	2 315	1 369	939	7	
Zope, white-eye bream	1 720	500	445	765	10

Table 1.3. Catches in inland waters of the Russian Federation in 2000 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
TOTAL	**292 368**	**129 284**	**16 731**	**16 901**	**6 440**	**123 012**
Crustaceans	957	18	932	6	1	
Incl. Gammarus	932		932			
Euro-American crayfishes	25	18		6	1	
Subtotal finfish	**291 411**	**129 266**	**15 799**	**16 895**	**6 439**	**123 012**
Arctic char, sheefish	616	615	1			
Asp	171	131	3	32		5
Atlantic salmon	63	60	3			
Burbot	1 765	1 597	78	78	12	
Caspian Sea sprat	117 914					117 914
Caspian shad	1 273				980	293
Chinook salmon	264	264				
Chum salmon	14 546	14 546				
Coho salmon	1 419	1 419				
Common carp	4 007	2 681	323	305	19	679
Cyprinids	20 390	11 193	1 323	5 874	1 794	206
Incl. white bream	4 123	540	104	3 247	232	
Carassius spp.	11 202	5 588	1 219	2 627	1 562	206
Rudd	4 182	3 978				204
European eel	6				6	
European perch	4 026	1 836	944	850	254	142
European river lamprey	24	24				
European smelt	3 825	1 820	1 797	53	155	
Freshwater bream	23 794	14 664	1 977	4 620	1 292	1 241
Freshwater fishes nei	13 111	12 340	354	408		9
Ide	2 378	2 154	144	80		
Masu salmon	3	3				
Mullets	35				33	2
Navaga	11	6	5			
Northern pike	8 863	7 519	386	176	20	762
Pikeperch	3 863	997	1 357	656	726	127
Pink salmon	24 277	24 277				
Rainbow smelt	608		581	25	2	
Roach	13 973	8 795	1 775	1 929	1 100	374
Sea trout	1	1				
Sichel	1 198	752	43	398		5
Silver carp	8	8				
Sockeye salmon	6 872	6 872				
Sturgeons	594	583	2	5		4
Tench	1 904	1 828	6	1		69

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
Three-spined stickleback, ruffe, bleak	1 116	352	686		7	71
Wels catfish	7 199	6 050	4	57		1 088
Whitefishes nei	9 132	5 879	3 157	57	39	
Incl. muksun	1 171	1 171				
Arctic cisco	1 828	112	1 709	7		
Broad whitefish	647	647				
European whitefish	1 200	905	281	14	39	
Peled	2 240	2 032	207	1		
Vendace	1 957	962	960	35		
Zope, white-eye bream	2 162		850	1 291		21

Table 1.4. Catches in inland waters of the Russian Federation in 2005 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
TOTAL	**219 237**	**136 401**	**23 297**	**18 271**	**10 422**	**30 846**
Crustaceans	3 175	22	3 121	28	4	
Incl. Gammarus	3 094		3 094			
Euro-American crayfishes	81	22	27	28	4	
Aquatic invertebrates nei	7		7			
Subtotal finfish	**216 055**	**136 379**	**20 169**	**18 243**	**10 418**	**30 846**
Arctic char, sheefish	772	741	31			
Asp	125	76	2	36		11
Atlantic salmon	13	13				
Burbot	2 112	1 702	176	234		
Caspian Sea sprat	23 310					23 310
Caspian shad	46					46
Chinook salmon	205	205				
Chum salmon	20 250	20 250				
Coho salmon	442	442				
Common carp	2 257	940	114	159	81	963
Cyprinids	20 324	8 708	2 237	5 544	2 070	1 765
Incl. white bream	3 759		1 004	2 538		217
Carassius spp.	12 032	5 095	1 184	2 973	2 070	710
Rudd	3 785	2 865	49	33		838
European eel	2		1	1		
European flounder	7	7				
European perch	4 913	1 355	1 240	1 388	467	463
European river lamprey	61	61				
European smelt	4 644	1 895	2 598	9	142	
Freshwater bream	21 937	10 633	2 109	5 624	2 361	1 210
Freshwater fishes nei	4 520	1 316	216	769	2 210	9
Ide	4 596	4 039	292	265		

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
Masu salmon	9	9				
Mullets	17	2			12	3
Navaga	43	43				
Northern pike	7 978	5 846	625	349	68	1 090
Pike-perch	3 121	83	2 315	699		24
Pink salmon	42 680	42 680				
Rainbow smelt	485		477	8		
Roach	10 122	5 333	1 693	1 509	1 522	65
Sea trout	2	2				
Shads nei	6				6	
Sichel	521	96	120	303		2
Sockeye salmon	15 742	15 742				
Sturgeons	236	209				27
Tench	1 488	972	13	54	7	442
Three-spined stickleback, ruffe, bleak	1 489	361	626	49	453	
Wels catfish	5 381	3 724	167	72	5	1 413
Whitefishes nei	14 694	8 893	4 704	83	1 014	
Incl. muksun	1 370	1 370				
Arctic cisco	2 712	1 312	1 400			
Broad whitefish	1 763	1 361	37		365	
European whitefish	1 683	1 007	377	26	273	
Peled	2 268	1 701	154	37	376	
Vendace	4 683	1 957	2 736	20		
Zope, white-eye bream	1 505	1	413	1 088		3

Table 1.5. Catches in inland waters of the Russian Federation in 2010 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
TOTAL	**262 983**	**139 913**	**32 121**	**33 069**	**27 079**	**30 801**
Crustaceans	3 459	38	3 237	110	71	3
Incl. brine shrimp	945		945			
Gammarus	2 245		2 245			
Euro-American crayfishes	269	38	47	110	71	3
Aquatic invertebrates nei	21	17			4	
Subtotal finfish	**259 503**	**139 858**	**28 884**	**32 959**	**27 004**	**30 798**
Arctic char, sheefish	1 627	1 586	37	2	2	
Asp	462	269	4	90		99
Atlantic salmon	70	68	2			
Burbot	2 373	1 872	269	204	28	
Caspian Sea sprat	2 588				45	2 543
Caspian shad	116	31				85

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
Chinook salmon	99	99				
Chum salmon	46 874	26 774			20 100	
Coho salmon	1 183	1 183				
Common carp	3 430	932	238	709	73	1 478
Cyprinids	38 688	6 901	6 992	8 700	3 735	12 360
Incl. white bream	5 000	1 213	331	2 567	46	843
Carassius spp.	22 192	1 920	6 651	6 017	3 595	4 009
Rudd	10 049	2 355	10	116	57	7 508
European flounder	152	152				
European perch	11 351	2 817	3 431	3 275	70	1 758
European river lamprey	24	24				
European smelt	4 999	1 958	2 386	1	654	
Freshwater bream	30 626	15 849	2 069	9 261	506	2 941
Freshwater fishes nei	5 551	550	2 199	2 353	258	191
Grass carp	1	1				
Ide	5 143	4 406	373	172	192	
Masu salmon	10	10				
Mullets	346				16	330
Navaga	103	103				
Northern pike	10 348	5 569	861	657	202	3 059
Pike-perch	3 483	862	1 250	1 286	46	39
Pink salmon	17 982	17 966	1		15	
Rainbow smelt	242	33	128	81		
Roach	15 745	8 051	4 077	3 271	141	205
Sea trout	12	9	2	1		
Sichel	1 279	77	212	988	1	1
Silver carp	39	11	3			25
Sockeye salmon	22 100	22 086			14	
Sturgeons	139	65	1	2	70	1
Tench	3 729	1 123	24	70	18	2 494
Three-spined stickleback, ruffe, bleak	1 191	538	489	164		
Wels catfish	10 980	7 601	4	171	39	3 165
Whitefishes nei	14 455	10 282	3 280	114	779	
Incl. muksun	936	913	23			
Arctic cisco	2 300	1 066	1 230	4		
Broad whitefish	1 055	673	160		222	
European whitefish	1 846	1 138	547	45	116	
Peled	1 907	1 280	179	38	410	
Vendace	5 567	4 368	1 141	27	31	
Zope, white-eye bream	1 963		552	1 387		24

Table 1.6. Catches in inland waters of the Russian Federation in 2015 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
TOTAL	**285 090**	**82 083**	**34 619**	**30 610**	**102 644**	**35 134**
Crustaceans	4 251	23	4 124	79	20	5
Incl. brine shrimp	1 790		1 790			
Gammarus	2 247		2 247			
Euro-American crayfishes	214	23	87	79	20	5
Aquatic invertebrates nei	404	25	377		2	
Subtotal finfish	**280 435**	**82 035**	**30 118**	**30 531**	**102 622**	**35 129**
Arctic char, sheefish	2 288	1 906	66		316	
Asp	190	78		112		
Atlantic salmon	145	143	2			
Big-scale sand smelt	11					11
Burbot	2 213	1 718	300	172	23	
Caspian Sea sprat	1 507					1 507
Caspian shad	771	157				614
Chinook salmon	310	310				
Chum salmon	73 387		2		73 385	
Coho salmon	8 460	7 890			570	
Common carp	3 522	455	515	507	180	1 865
Cyprinids	33 848	3 890	5 518	9 658	3 278	11 504
Incl. white bream	4 786	2	400	2 123	1 051	1 210
Carassius spp.	18 710	814	5 029	7 018	1 683	4 166
Rudd	7 415	1 410	19	149	11	5 826
European flounder	1	1				
European perch	11 045	1 114	3 978	4 488	19	1 446
European river lamprey	369	354			15	
European smelt	10 315	6 040	2 209		2 066	
Freshwater bream	20 116	6 546	2 631	6 594	128	4 217
Freshwater fishes nei	7 675	354	119	263	6 152	787
Grass carp	85	8	4	32	3	38
Ide	5 004	3 936	622	186	260	
Masu salmon	1	1				
Mullets	687					687
Navaga	42	11	1		30	
Northern pike	12 435	4 968	1 689	588	365	4 825
Pike-perch	3 970	514	1 165	1 191	879	221
Pink salmon	18 949	5 292			13 657	
Rainbow smelt	1 588	21	1 453	114		
Roach	13 510	5 813	3 494	3 324	596	283
Sea trout	43	3	39	1		
Shads nei	24	22			2	
Sichel	1 233	1	392	760		80
Silver carp	909	213	42	427	107	120
Sockeye salmon	20 525	20 150			375	
So-iuy mullet	29				29	

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other water bodies
Sturgeons	48	37		2	8	1
Tench	987	143	22	97	8	717
Three-spined stickleback, ruffe, bleak	1 166	636	363	167		
Wels catfish	7 326	1 009	16	73	55	6 173
Whitefishes nei	13 524	8 301	4 297	810	116	
Incl. muksun	705	657	45		3	
Arctic cisco	2 596	1 776	816	3	1	
Broad whitefish	1 083	395	673		15	
European whitefish	1 636	1 007	506	35	88	
Peled	2 817	1 368	1 359	86	4	
Vendace	4 241	2 652	898	686	5	
Zope, white-eye bream	2 177		1 179	965		33

Table 1.7. Catches in inland waters of the Russian Federation in 2016 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
TOTAL	**292 890**	**88 937**	**45 257**	**34 428**	**87 597**	**36 671**
Crustaceans	7 148	16	6 530	99	497	6
Incl. brine shrimp	2 931		2 625		306	
Gammarus	4 048		3 878		170	
Euro-American crayfishes	169	16	27	99	21	6
Aquatic invertebrates nei	842	356	481	1	4	
Subtotal finfish	**284 900**	**88 565**	**38 246**	**34 328**	**87 096**	**36 665**
Arctic char, sheefish	830	303	50		477	
Asp	526	52	1	122		351
Atlantic salmon	139	127	12			
Big-scale sand smelt	10					10
Burbot	3 977	3 405	357	181	34	
Caspian Sea sprat	1 509					1 509
Caspian shad	1 130	152				978
Chinook salmon	150	150				
Chum salmon	54 680	5 713	9		48 958	
Coho salmon	797	268			529	
Common carp	3 367	256	599	531	163	1 818
Cyprinids	43 043	8 258	8 720	11 490	2 283	12 292
Incl. white bream	4 380	686	495	1 907	39	1 253
Carassius spp.	27 437	4 314	7 589	8 850	1 792	4 892
Rudd	7 371	1 043	17	150	14	6 147
European flounder	3	2	1			
European perch	13 196	2 766	5 149	3 867	157	1 257
European river lamprey	49	33	13		3	
European smelt	7 193	3 549	2 021		1 623	
Freshwater bream	24 364	7 819	3 117	9 031	168	4 229
Freshwater fishes nei	7 249	5 690			234	1 325

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
Grass carp	102	31	3	28	1	39
Ide	10 029	8 359	1 152	193	325	
Masu salmon	1	1				
Mullets	787					787
Navaga	71	24	27		20	
Northern pike	19 077	11 187	2 297	642	352	4 599
Pike-perch	4 838	931	1 473	2 066	36	332
Pink salmon	28 763	3 169	28		25 566	
Rainbow smelt	1 720	63	1 515	142		
Roach	18 190	8 902	3 549	3 105	2 381	253
Sea trout	34	3	31			
Shads nei	3 279	74	46		3 159	
Sichel	1 713	273	386	995	5	54
Silver carp	854	268	40	377	82	87
Sockeye salmon	2 410	2 179			231	
So-iuy mullet	267	267				
Sturgeons	61	55		1	5	
Tench	994	286	26	87	19	576
Three-spined stickleback, ruffe, bleak	1 536	831	612	75	18	
Wels catfish	7 308	997	9	76	63	6 163
Whitefishes nei	18 501	12 122	5 982	194	203	
Incl. muksun	622	601	16		5	
Arctic cisco	1 826	1 141	667	1	17	
Broad whitefish	1 930	1 187	699		44	
European whitefish	2 820	2 072	631	32	85	
Peled	4 500	1 648	2 683	150	19	
Vendace	6 480	5 150	1 286	11	33	
Zope, white-eye bream	2 153		1 021	1 125	1	6

Table 1.8. Catches in inland waters of the Russian Federation in 2017 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
TOTAL	**270 559**	**94 218**	**42 981**	**33 384**	**64 036**	**35 940**
Crustaceans	5 219	886	3 949	93	287	4
Incl. brine shrimp	2 601		2 601			
Gammarus	2 458	871	1 327		260	
Euro-American crayfishes	160	15	21	93	27	4
Aquatic invertebrates nei	497		494		3	
Subtotal finfishes	**264 843**	**93 332**	**38 538**	**33 291**	**63 746**	**35 936**
Arctic char, sheefish	1 360	266	43		1 051	
Asp	931	374		132		425
Atlantic salmon	252	248	2		2	
Burbot	5 121	4 445	454	179	43	
Caspian Sea sprat	1 062					1 062
Caspian shad	1 157	140				1 017

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
Chinook salmon	3	3				
Chum salmon	38 934	2 640	33		36 261	
Coho salmon	1 015	75			940	
Common carp	4 821	296	1 470	865	224	1 966
Cyprinids	40 750	9 899	7 719	9 319	1 329	12 484
Incl. white bream	4 582	1 147	324	1 618	32	1 461
Carassius spp.	24 317	4 130	7 203	7 396	1 069	4 519
Rudd	8 062	1 504	4	131		6 504
European flounder	4	4				
European perch	14 958	3 024	5 198	5 067	244	1 425
European river lamprey	346	316			30	
European smelt	8 871	5 930	2 725	15	201	
Freshwater bream	24 772	9 414	3 195	7 613	246	4 304
Freshwater fishes nei	7 410	5 297	115	274	1 453	275
Grass carp	164	28	1	60	1	74
Ide	10 902	9 607	900	161	234	
Marine fishes nei	73	73				
Mullets	762	5				757
Navaga	16	16				
Northern pike	22 499	14 266	2 366	704	279	4 884
Pike-perch	5 463	1 260	1 656	2 171	48	328
Pink salmon	6 706	1 468	171		5 067	
Rainbow smelt	1 375		1 375			
Roach	20 585	5 601	4 445	3 932	6 338	269
Sea trout	318	2	300	16		
Shads nei	9 008	20		23	8 965	
Sichel	1 629	242	298	932	6	151
Silver carp	849	391	31	264	18	145
Sockeye salmon	520	3			517	
So-iuy mullet	119	119				
Sturgeons	43	39		1	3	
Tench	779	116	24	83	11	545
Three-spined stickleback, ruffe, bleak	1 201	728	433	40		
Wels catfish	7 057	1 087	9	110	60	5 791
Whitefishes nei	21 099	15 720	5 022	219	138	
Incl. muksun	455	452			3	
Arctic cisco	1 235	1 021	198	16		
Broad whitefish	2 163	1 291	862		10	
European whitefish	3 132	2 641	386	35	70	
Peled	4 856	2 111	2 544	156	45	
Vendace	8 983	7 929	1 032	12	10	
Zope, white-eye bream	1 909	170	553	1 111	37	34

Table 1.9. Catches in inland waters of the Russian Federation in 2018 (tonnes)

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
TOTAL	**269 084**	**115 585**	**35 597**	**33 574**	**50 347**	**33 981**
Crustaceans	4 939	1 267	3 099	113	455	5
Incl. brine shrimp	1 823		1 823			
Gammarus	2 926	1 249	1 265		412	
Euro-American crayfishes	190	18	11	113	43	5
Aquatic invertebrates nei	287	19	252		16	
Subtotal finfish	**263 858**	**114 299**	**32 246**	**33 461**	**49 876**	**33 976**
Arctic char, sheefish	1 127	297	47		783	
Asp	1 102	456	1	120	20	505
Atlantic salmon	94	86	5		3	
Big-scale sand smelt	6					6
Burbot	5 833	5 303	317	170	43	
Caspian Sea sprat	983					983
Caspian shad	912	141				771
Chum salmon	30 419	2 271	100		28 048	
Coho salmon	596	94			502	
Common carp	5 929	303	2 233	1 159	212	2 022
Cyprinids	47 428	24 146	4 470	5 879	988	11 945
Incl. white bream	4 594	694	413	1994	28	1 465
Carassius spp.	29 011	13 429	4 026	6 487	754	4 315
Rudd	7 704	1 406	4	138		6 165
European flounder	3	3				
European perch	14 136	2 340	5 441	4 714	171	1 470
European river lamprey	51	25			26	
European smelt	8 836	5 359	1 486	12	1 979	
Freshwater bream	26 440	11 218	3 016	7 550	655	4 001
Freshwater fishes nei	7 465	2 959	558	3 116	375	457
Grass carp	268	63		65		140
Ide	11 140	9 835	826	200	279	
Marine fishes nei	181	158			23	
Mullets	555					555
Navaga	29	29				
Northern pike	21 985	14 352	1 931	696	307	4 699
Pike-perch	5 830	1 326	1 687	2 324	66	427
Pink salmon	7 235	1 061	29		6 145	
Rainbow smelt	1 446		1 442	4		
Roach	33 648	20 753	3 093	3 948	5 585	269
Sea trout	10	10				
Shads nei	3 078	220		23	2 835	
Sichel	1 625	266	321	923	3	112
Silver carp	1 365	443	34	588	112	188
Sockeye salmon	381	19			362	
So-iuy mullet	86				86	
Sturgeons	42	5	34	1	1	1

Species	TOTAL	Rivers	Lakes	Reservoirs	Caspian Sea	Other waterbodies
Tench	638	122	42	84	13	377
Three-spined stickleback, ruffe, bleak	632	303	322	6	1	
Wels catfish	6 264	1 012	10	168	56	5 018
Whitefishes nei	13 614	9 104	4 106	237	167	
Incl. muksun	543	542			1	
Arctic cisco	1 135	1 050	83	2		
Broad whitefish	1 451	730	697		24	
European whitefish	2 166	1 695	353	43	75	
Peled	3 073	1 055	1 815	153	50	
Vendace	4 842	3 628	1 158	39	17	
Zope, white-eye bream	2 446	217	695	1 474	30	30

Appendix 2

Table 2.1. Catches in the Volga River in the Astrakhan region (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**65 428.0**	**51 782.5**	**38 985.0**	**21 203.8**	**24 401.2**	**16 447.4**	**15 475.2**	**18 393.9**	**17 425.5**
Euro-American crayfishes					15.9	10.1	10.2	10.9	13.9
Subtotal finfish	**65 428.0**	**51 782.5**	**38 985.0**	**21 203.8**	**24 363.6**	**16 411.8**	**15 404.9**	**18 339.0**	**17 408.0**
Asp	139.0					0.3	0.0	450.2	422.4
Carassius spp.			124.6			1.5	0.2	2 524.4	2 244.1
Common carp	3 220.0	2 026.5	2 564.3	913.3	468.7	199.9	199.1	229.3	236.8
European perch			109.4			0.4	0.1	690.2	910.1
European river lamprey		0.8							
Freshwater bream	12 420.0	18 144.8	4 717.3	8 128.3	7 629.4	5 780.0	5 541.8	6 400.1	6 072.2
Freshwater fishes nei	9 253.0	8 237.4	11 708.3	6 619.3	7 381.8	6 675.0	6 189.2	44.1	3.8
Grass carp						0.1	0.0	23.3	62.3
Ide						0.1			
Nelma				3.1	0.3	0.1	0.1	0.1	0.1
Northern pike	2 822.0	2 547.9	3 943.2	1 539.9	1 635.8	693.0	672.2	761.2	783.3
Pike-perch	690.0	788.4	985.8	100.0	396.8	477 8	512.5	677.2	663.1
Roach	17 388.0	13 312.7	6 533.1	1 802.2	2 382.4	1 332.9	1 100.1	1 441.1	1 315.5
Rudd			112.8			0.7	0.0	1 504.4	1 405.5
Salmonids nei	6.0	47.0							
Shads nei	1 609.0	1 412.0	1 261.1	72.7	31.2	146.5	152.5	139.8	140.1
Sichel						0.2	0.1	241.9	265.6
Silver carp						0.3	0..0	341.1	393.6
Sturgeons nei	10 300.0	1 238.0	468.3	0.7	12.7	5.8	4.1	0.5	0.6
Tench			177.2	377.6	644.3	137.1	130.3	112.6	114.3
Volga pikeperch						0.1	0.0	483.1	498.5
Wels catfish	7 581.0	4 027.0	6 279.6	1 646.6	3 802.0	984.8	962.3	1 051.3	985.1
White bream						0.4	0.3	1 097.4	677.2
Zope						0.1	0.1	169.7	217.0

Table 2.2. Catches in the Volga River below the Volgograd Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**234.6**	**52.1**	**20.9**	**30.1**	**23.2**	**3.2**	**2.4**	**6.7**	**6.1**
Subtotal finfish	**234.6**	**52.1**	**20.9**	**30.1**	**23.2**	**3.2**	**2.4**	**6.7**	**6.1**
Asp	7.9	2.8	1.0	2.5	1.3	0.2	0.1	0.4	0.2
Burbot					0.3		0.0	0.1	0.0
Carassius spp.	11.6	5.8	3.4	8.2	4.5	0.5	0.7	0.6	0.3
Chub							0.1	0.1	0.1
Common carp	0.3		0.5	1.0	0.6	0.1	0.0	0.1	0.1
Common nase	5						0.0		0.0
European perch	1.7	0.1	0.3	3.6	3.3	0.2	0.1	0.2	0.1
Freshwater bream	7.9	6.4	1.8	4.2	3.1	0.7	0.5	1.4	1.0
Freshwater fishes nei				2.0					
Grass carp				0.5	0.0	0.0	0.1	0.1	0.3
Ide	4.9	0.5	0.5	1.6	1.4	0.2	0.1	0.2	0.1

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Northern pike	1.7	0.5	0.2	1.1	0.9	0.1	0.0	0.1	0.1
Pike-perch	8.6	1.2	0.3	1.1	1.4	0.6	0.2	2.2	2.0
Roach	0.1		0.1	1.2	2.4	0.1	0.1	0.2	0.1
Rudd	3.4		0.2		0.3	0.0		0.0	
Shads nei	29.2	8.0	5.6		0.1				0.3
Sichel	0.1		0.1	0.7	0.6	0.0	0.1	0.1	0.1
Silver carp			3.0	0.5	0.1	0.1	0.2	0.5	0.7
Sturgeons nei	144.4	23.8	2.1		0.0				0.2
Vimba bream						0.1	0.0	0.1	0.1
Volga pikeperch			0.2		0.6	0.1	0.0	0.1	0.1
Wels catfish	2.8	1.7	1.4	1.5	0.8	0.1	0.1	0.2	0.1
White bream	4.0	1.3	0.1		1.2	0.1	0..0	0.1	0.1
Zope	1.0		0.1	0.4	0.2	0.0	0.0	0.0	0.0

Table 2.3. Catches in the Don River in the Volgograd region (tonnes) (below the dam of the Tsimlyanskaya hydroelectric station)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**1 960.9**	**517.8**	**276.3**	**62.5**	**8.3**	**2.5**	**1.0**	**catch is banned**	
Euro-American crayfishes				0.3					
Subtotal finfish	**1 960.9**	**517.8**	**276.3**	**62.2**	**8.3**	**2.5**	**1.0**		
Asp				2.3	0.1	0.1	0.1		
Bleak			1.2						
Carassius spp.	499.2	101.2	77.8	10.3	1.6	0.5	0.1		
Common carp	0.3			0.3	0.0	0.1			
European perch	2.4			0.3	0.6		0.0		
Freshwater bream	1 117.2	322.1	117.1	16.3	1.2	0.9	0.4		
Freshwater fishes nei	13.4	0.1	1.1	10.8					
Grass carp				0.1	0.0	0.0	0.0		
Ide				0.5	0.0	0.0	0.0		
Northern pike	0.1	3.9		0.8	0.9		0.0		
Pike-perch	91.1	4.8	1.1	3.2	0.8		0.0		
Roach		0.9		1	0.8	0.1	0.0		
Roach	13.7	4.1	6.2						
Rudd	4.0				0.2		0.0		
Shads nei	36.3	0.5							
Sichel	57.0	29.1	65.3	6.5	0.5	0.2	0.0		
Silver carp	24.3	17.7	1.8	8.0	0.0	0.3	0.2		
Sturgeons nei	31.3	6.2	0.7						
Vimba bream	8.7	12.9	2.8		0.1	0.1	0.0		
Wels catfish				0.5	0.1		0.0		
White bream	61.9	14.3	1.2		1.1	0.3	0.1		
White-eye bream					0.1		0.0		
Zope				1.3	0.1	0.1	0.0		

Table 2.4. Catches in the Irtysh River within the Omsk region (tonnes)

Species	1990*	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**1 888.6**				**29.3**	**24.6**	**40.6**	**43.1**	**139.9**
Subtotal finfish	**1 888.6**				**29.3**	**24.6**	**40.6**	**43.1**	**139.9**
Burbot					2.0	1.6	0.6	0.7	3.0
Carassius spp.	1 141.9				7.5	2.9	7.4	8.4	6.4
Common carp	503.6						0.3	0.1	
European perch	14.2				1.7	1.7	1.1	1.0	10.0
Freshwater bream	14				6.0	5.8	8.7	9.0	32.3
Ide	13.8				2.2	2.4	2.6	2.9	12.7
Northern pike	11.6				3.0	3.4	5.3	6.2	31.9
Peled	15.8								
Pike-perch	0.9				2.2	2.2	2.1	2.0	17.6
Roach	171.2				3.8	4.2	12.1	12.3	25.6
Sterlet sturgeon	1.6								
Sturgeons nei					0.9	0.5	0.4	0.5	0.4

* Catch from mainland and floodplain lakes

Table 2.5. Catches in the Northern Dvina River (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**243.9**	**203.5**	**159.2**	**153.0**	**121.4**	**125.4**	**140.5**	**104.7**	**130.1**
Subtotal finfish	**243.9**	**203.5**	**159.2**	**153.0**	**121.4**	**125.4**	**140.5**	**104.7**	**130.1**
Atlantic salmon	18.0	15.0	10.0		4.9	7.0	5.5	4.5	0.1
Burbot	1.1	2.1	3.2	4.6	5.6	4.7	5.3	3.2	4.2
Common dace					0.1	0.0			
European flounder	5.1	3.2	1.2			1.1	1.6		2.1
European perch	1.8	1.8	2.0	1.8	3.8	2.0	1.8	1.1	1.0
European river lamprey	21.0	10.0	10.3	11.7	0.6	0.6	2.2	2.0	2.0
European smelt	10.0	5.0	1.0						
European whitefish	0.1	0.5	2.2	4.8	1.9	0.1	0.9	0.9	0.8
Freshwater bream	154.0	135.0	95.0	65.4	67.7	70.8	66.8	56.4	53.2
Freshwater fishes nei				1.5		11.0	27.5	14.2	47.0
Grayling				10.0	0.3		0.0		
Ide	10.5	9.8	12.4	23.0	8.7	4.4	4.2	3.4	3.1
Nelma	0.2								
Northern pike	10.4	12.3	15.8	25.7	15.9	11.2	11.0	8.1	8.2
Pike-perch				0.4	5.6	7.2	7.6	5.9	5.4
Pink salmon								1.1	
Roach	3.7	3.8	4.1	4.2	5.7	2.8	2.8	1.8	1.4
Ruffe					0.1	0.0	0.0		0.0
Sturgeons nei	8.0	5.0	2.0		0.5	1.4	2.1	0.9	0.9
White-eye bream						1.3	1.2	1.2	0.9

Table 2.6. Catches in the Ob River Basin (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**11 313.3**	**11 561.0**	**12 528.0**	**14 469.9**	**14 822.5**	**18 310.9**	**23 356.4**	**23 965.4**	**22 694.3**
Subtotal finfish	**11 313.3**	**11 561.0**	**12 528.0**	**14 469.9**	**14 822.5**	**18 310.9**	**23 356.4**	**23 965.4**	**22 694.3**
Arctic char				0.1		1.3	0.5	0.0	1.8
Arctic cisco				54.5	96.8	14.0	17.8	24.3	17.4
Broad whitefish	300.0	320.0	380.0	418.4	258.1	109.7	127.5	119.8	79.5
Burbot	1 540.9	1 350.0	1 265.0	1 171.0	861.7	1 160.6	1 325.4	1 423.9	1 392.1
Carassius spp.	324.7	235.0	180.0	44.5	201.9	478.0	624.8	680.6	643.2
Chinese sleeper							0.3	1.0	0.0
Common dace			125.0	356.9	372.7	480.2	466.4	404.3	410.6
European perch	72.4	185.0	265.0	472.9	390.9	843.1	1 253.4	1 157.3	1 033.8
European smelt	280.0	150.0	80.0	27.2	100.1	8.4	94.0	40.2	62.4
European whitefish						453.1	510.4	432.9	438.9
Freshwater bream	189.3	230.0	280.0	314.6	414.8	580.3	699.8	728.8	713.2
Freshwater fishes nei	164.0			2.0				1.0	6.4
Grayling								0.4	0.0
Humpback whitefish	549.0	590.0	601.0	607.7	709.7	0.0	0.0	0.0	0.0
Ide	1 537.3	2 135.0	2 638.0	2 703.3	4 093.0	3 606.8	4 920.9	5 112.3	5 008.1
Muksun	973.0	750.0	470.0	381.0	302.4	0.4	3.8	0.0	1.2
Nelma	286.0	120.0	80.0	43.7	109.1	0.1	33.5	0.0	0.3
Northern pike	1 401.7	1 508.0	1 809.0	2 043.1	1 799.7	3 609.5	5 662.3	6 875.0	6 327.0
Peled	661.0	720.0	780.0	809.2	933.2	579.4	656.5	908.4	835.5
Pike-perch	30.6	20.0	10.0	4.1	12.1	24.7	28.3	16.9	36.7
Roach	1 548.4	1 845.0	2 080.0	3 308.5	2 918.5	4 062.6	5 030.5	3 983.3	3 553.2
Ruffe	162.0	238.0	265.0	334.9	287.4	489.1	436.2	371.9	299.9
Sterlet sturgeon	24.0	10.0							
Sturgeons nei	52.0	30.0	10.0	3.3		4.8	5.5	0.0	0.3
Tugun				2.0	7.7	2.7	3.8	1.4	2.6
Vendace	1 217.0	1 125.0	1 210.0	1 367.0	952.7	1 802.1	1 454.8	1 681.6	1 830.3

Table 2.7. Catches in the Amur River (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**8 418.0**	**2 693.8**	**2 604.4**	**2 759.1**	**2 807.9**	**7 623.6**	**4 525.2**	**7 381.3**	**6 300.0**
Subtotal finfish	**8 418.0**	**2 693.8**	**2 604.4**	**2 759.1**	**2 807.9**	**7 623.6**	**4 524.2**	**7 381.3**	**6 300.0**
Arctic char						1.7	0.0	0.0	0.0
Asp			3.1	8.5	14.0	31.9	30.6	38.4	33.6
Bleak			0.3	0.6	0.7	0.6	0.9	3.8	0.9
Burbot	2.0	2.2	0.2	7.0	12.9	18.1	15.3	17.4	7.4
Carassius spp.	315.5	140.1		180.0	312.7	320.9	357.3	318.9	307.5
Chum salmon	3 540.0	2 079.7	1 033.9	380.0					
Common carp	34.0	14.6	12.9	24.0	34.6	62.6	56.1	62.3	65.6
Common nase	39.1	15.5	5.0	35.0	65.1	127.5	97.4	108.9	88.2
European river lamprey	50.8	18.6	13.1	16.5	20.5	353.1	1.0	313.7	12.7

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
European smelt	1 804.8	343.1	555.3	1 176.5	1 798.0	5 915.5	3 343.9	5 722.6	5 069.9
European whitefish	16.0	1.2	8.8	36.5	64.8	50.6	42.9	56.9	60.4
Freshwater bream	1.2	0.4	1.6	17.5	33.5	30.6	27.3	28.7	25.4
Freshwater fishes nei	912.5	14.2	3.6	17.0	30.8	53.5	35.4	49.7	48.6
Grayling			3.0	10.0	13.1	15.1	13.2	21.8	19.1
Ide	58.8					0.0	0.0	0.0	170.9
Kaluga	61.9	11.5	61.0	30.0					
Lake char						0.0	0.0	0.0	0.0
Lenok	7.9	0.1	5.4	16.0	27.1	41.9	39.0	49.6	40.3
Mongolian redfin	5.2		2.2	15.0	28.7	64.5	61.2	63.2	62.0
Northern pike	47.1	8.6	24.1	30.0	35.8	82.1	87.5	87.2	71.8
Pink salmon	1 476.0	…	791.2	520.0					
Pond loach	1.5		31.7	10.0					
Predatory carp	20.9	7.5	3.9	28.0	51.6	46.4	40.9	48.5	12.6
Siberian dace		28.5	20.5	5.8					
Snakehead		0.5		1.0	1.0	0.8	1.0	1.4	1.6
Spotted steed	7.6	0.9	2.4	16.5	32.5	65.7	87.0	100.9	93.6
Sturgeons nei		3.5	14.3	27.5	41.9	2.0	1.5	1.8	0.7
Taimen	1.1	0.8	0.2	1.5	3.2	3.5	2.5	1.3	0.6
Ussuri catfish		0.4		15	21.1	75.7	65.0	83.8	79.5
Wels catfish	14.9	1.9	6.1	13.5	20.6	23.1	31.9	35.4	27.0
Amur ide				120.0	143.8	236.2	86.3	165.0	0.0

Table 2.8. Catches in the Pechora River within the Arkhangelsk region (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**185.5**	**87.7**	**90.9**	**54.5**	**11.0**	**147.3**	**167.7**	**262.2**	**245.4**
Subtotal finfish	**185.5**	**87.7**	**90.9**	**54.5**	**11.0**	**147.3**	**167.7**	**262.2**	**245.4**
Arctic cisco	4.2		0.7		0.9				
Atlantic salmon			4.0			7.2		13.2	15.1
Broad whitefish	13.0					0.9	1.6		
Burbot	2.7		5.1	1.3		3.5	3.8	3.0	13.3
European flounder								0.3	1.2
European perch	6.3		4.0	1.6		3.1	1.3	0.7	9.1
European smelt									1.0
European whitefish	46.0		6.7	9.1	10.2	20.3	33.3	13.2	42.6
Freshwater fishes nei			1.2					130.0	2.0
Grayling	0.7								
Ide	5.0		18.8	14.0		8.2	8.7	5.0	27.6
Nelma	6.4								
Northern pike	52.4		5.2	14.4		21.6	24.6	20.8	34.9
Peled	18.8		0.3			8.0	3.5	5.4	
Pink salmon						1.0		3.1	
Roach	9.0		9.9	14.1		6.0	8.3	6.0	44.1
Vendace	21.0		35.0			67.7	82.6	61.6	54.6

Table 2.9. Catches in the Yenisei River Basin (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 041.9**	**1 682.6**	**1 607.2**	**1 877.1**	**2 004.4**	**2 241.4**	**2 388.6**	**2 491.4**	**2 953.9**
Subtotal finfish	**2 041.9**	**1 682.6**	**1 607.2**	**1 877.1**	**2 004.4**	**2 241.4**	**2 388.6**	**2 491.4**	**2 953.9**
Arctic char	0.6	0.1	2.8			5.3	4.0	5.4	7.1
Arctic cisco	36.7	113.6	109.8	141.3	140.4	67.9	81.5	47.4	45.5
Broad whitefish	3.5	23.1	31.5	34.3	58.8	103.3	95.4	65.2	77.0
Burbot	435.6	336.5	114.0	82.5	268.3	257.4	313.7	407.2	349.2
Carassius spp.	24.2	17.7	5.7	18.6	3.1	3.4	5.0	0.4	0.6
Common carp	0.9	9.0	4.7	2.5	0.6	0.5	0.3	0.1	0.1
Common dace	152.4	12.6	7.5	13.0	29.4	19.2	25.3	31.1	40.7
European perch	268.8	100.1	275.3	401.4	150.6	214.5	125.2	126.2	151.1
European smelt		11.7	14.7	24.0	60.1	116.0	110.8	166.8	226.0
European whitefish	137.0	204.5	172.7	171.2	200.9	280.6	289.4	168.4	194.8
Freshwater bream	2.0	41.7	185.3	202.9	25.7	67.6	85.3	92.7	74.1
Freshwater fishes nei	25.0	26.0	71.5	23.7	60.6	0.1			
Grayling	22.5	4.9	4.0	12.2	35.7	55.5	62.2	62.4	122.1
Ide	83.2	31.6	5.9	7.4	35.3	28.8	39.8	35.0	99.1
Lenok			0.2	0.5	0.5	0.7	0.6	0.7	1.1
Muksun	1.9	281.7	287.9	311.8	257.4	220.5	247.5	74.5	83.6
Nelma	1.1	35.5	8.4	17.2	22.1	18.3	20.0	21.5	24.6
Northern pike	282.7	86.3	67.5	79.0	270.2	273.7	312.2	522.3	654.5
Peled	195.6	84.4	40.1	49.6	115.8	225.4	235.6	143.2	207.5
Roach	285.1	73.5	140.3	177.2	110.7	84.1	71.7	104.6	103.0
Ruffe				0.4	0.1				
Siberian sturgeon	12.0	43.2	3.7	5.0	0.9	0.8	0.6	0.8	0.8
Sterlet sturgeon	22.9	8.6	1.5	1.4	0.3	0.5	0.3	0.4	0.5
Taimen	0.2		3.2	0.3	0.4	1.4	2.0	2.4	3.7
Tugun	8.9	3.4	2.0	9.2	12.4	25.8	33.1	42.8	68.1
Vendace	39.1	132.9	47.0	90.5	144.1	170.1	227.1	369.9	419.1

Table 2.10. Catches in the Lena River Basin (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 318.7**	**…**	**…**	**1 659.2**	**1 548.4**	**1 732.4**	**1 712.8**	**1 731.4**	**2 061.3**
Subtotal finfish	**2 318.7**	**…**	**…**	**1 659.2**	**1 548.4**	**1 732.4**	**1 712.8**	**1 731.4**	**2 061.3**
Arctic cisco	520.2			577.7	650.0	721.2	578	628.5	748.6
Broad whitefish	56.5			12.4	17.1	12.3	19.9	18.0	19.0
Burbot	69.9			21.3	42.4	52.8	98.6	144.2	140.7
Carassius spp.	278.7			376.7					
Common dace	22.3			3.8	12.1	3.5	9.1	13.5	10.6
Eurasian minnow	12.0								
European perch	56.0			7.8	19.0	25.6	30.1	34.0	32.0
European whitefish	39.2			26.4	17.0	70.3	89.7	84.6	80.3

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Freshwater fishes nei					23.5	19.2	25.5	24.9	24.2
Grayling	6.0			6.5	8.3	1.2	5.1	6.6	7.1
Ide	0.8			0.7	11.0	13.7	6.8	5.3	9.7
Lenok	4.4				6.7	0.1	3.4	4.6	4.7
Muksun	565.3			315.4	292.3	259.8	211.3	230.9	299.9
Nelma, sheefish	57.5			27.5	34.5	38.1	41.7	41.3	43.3
Northern pike	83.2			28.1	66.1	121.9	147.5	209.9	163.4
Peled	35.8			11.1					
Roach	87.8			6.1	15.6	10.4	28.0	30.4	28.0
Round whitefish					3.2				
Ruffe					1.4				
Siberian sturgeon	9.5								
Taimen	9.6			5.0	6.8	3.0	3.5	3.8	3.5
Tugun	12.7			0.7	5.0	0.2	5.4	8.0	9.5
Vendace	391.3			232.0	316.4	379.2	409.3	243.0	437.0

Table 2.11. Catches in the Kolyma River Basin (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 450.7**	**656.8**	**875.5**	**775.8**	**648.8**	**600.7**	**641.2**	**767.4**	**669.1**
Subtotal finfish	**2 450.7**	**656.8**	**875.5**	**775.8**	**648.8**	**600.7**	**641.2**	**767.4**	**669.1**
Arctic char	3.1	0.1	2.1	5.7			0.7		
Arctic cisco	7.0				0.9			0.2	0.2
Broad whitefish	217.5	115.5	91.9	139.4	106.6	103.7	123.7	192.7	186.4
Burbot	89.2	25.3	22.2	25.4	46.6	32.5	26.5	32.5	37.4
Carassius spp.	1.3	17.6	4.0	7.0			3.5		32.1
Common dace	48.5	28.0	29.9	22.2	31.4	52.0	21.5	32.8	
Eurasian minnow	49.7								
European perch	22.7	29.9	9.1		4.1	2.2	1.1	1.1	1.5
European whitefish	202.6	198.9	151.3	161.3	128.8	107.9	128.1	137.2	139.7
Freshwater fishes nei	0.1				0.3				
Grayling	0.9	0.1	0.2		2.6	0.5	0.4	0.8	0.6
Lenok	0.1				3.6			0.5	0.4
Longnose sucker	28.1	14.8	6.3	13.3	8.0	5.3	6.3	4.1	4.5
Muksun	98.7	9.4	3.6	6.9	2.1	1.2	1.9	0.5	0.3
Nelma, sheefish	10.2	0.5	0.5	1.2	1.4	0.9	0.9	0.9	0.2
Northern pike	248.5	68.7	91.0	117.4	113.7	119.3	125.6	118.8	119.7
Peled	278.7	68.6	186.7	105.3		8.4	8.0	7.4	7.3
Round whitefish					0.5				
Siberian sturgeon	2.3								
Taimen								4.9	
Vendace	1 141.5	79.4	276.7	170.7	198.2	166.8	193.0	233.0	138.8

Appendix 3

Table 3.1. Catches in Lake White (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**1 188.0**	**690.4**	**556.5**	**199.2**	**680.3**	**673.2**	**776.2**	**609.5**	**638.3**
Subtotal finfish	**1 188.0**	**690.4**	**556.5**	**199.2**	**680.3**	**673.2**	**776.2**	**609.5**	**638.3**
Asp			0.3		0.2	0.3	0.7		
Bleak				0.1	0.1	0.6			
Burbot		3.1	5.3	0.7	1.6	1.6	0.6	0.9	1.0
European perch		13.2	10.3	14.4	64.4	82.3	43.1	28.9	26.5
Freshwater bream	112.0	144.7	95.3	94.5	205.1	142.9	251.9	217.6	251.4
Freshwater fishes nei	470.0							0.5	0.4
Ide		0.3	0.2	0.2	1.0	0.4	0.1	0.0	
Northern pike	32.0	17.5	13.5	11.5	14.0	18.6	17.6	22.0	22.4
Pike-perch	155.0	110.2	90.6	7.1	27.5			45.6	58.5
Rainbow smelt	390.0	243.1	280.6		78.0	108.3	75.7	80.6	90.9
Roach		20.9	12.0	24.5	117.5	78.6	60.5	44.4	28.1
Rudd				0.2	0.2	0.0			
Ruffe		10.7	5.3	2.2	7.0	10.7	6.9	3.2	2.8
Sichel		55.3	17.1	30.2	124.1	144.1	179.1	104.5	105.9
Vendace		0.7	0.2		0.1	2.4	1.2	1.0	0.9
Volga pikeperch	29.0	22.9	6.3	5.1	28.3	67.7	116.0	50.8	38.0
White bream				2.3	5.8	9.6	21.4	8.2	10.9
White-eye bream					0.1				
Zope		47.8	19.2	6.2	5.4	5.1	1.4	1.2	0.6

Table 3.2. Catches in Lake Kubenskoe (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**435.0**	**283.6**	**309.1**	**231.4**	**174.6**	**114.7**	**178.7**	**126.3**	**135.3**
Subtotal finfish	**435.0**	**283.6**	**309.1**	**231.4**	**174.6**	**114.7**	**178.7**	**126.3**	**135.3**
Bleak				0.1					
Burbot		0.2	0.8	0.2	0.8	0.3	0.6	0.3	0.2
Carassius spp.					0.2	0.0	0.0		
European perch		23.0	23.9	24.2	40.0	10.6	6.5	11.0	9.2
European whitefish				0.5	0.6			0.1	0.6
Freshwater bream	237.0	134.5	155.7	88.2	65.9	60.4	104.7	56.8	65.1
Freshwater fishes nei	129.0	0.8	23.6					2.0	
Ide		7.9	10.1	4.7	5.7	1.9	2.0	1.0	0.6
Northern pike	47.0	23.9	25.8	24.2	16.7	21.2	29.6	22.6	25.5
Pikeperch	22.0	10.2	2.4	4.3	5.1			7.1	20.3
Roach		42.9	41.6	83.7	37.4	19.0	34.5	25.1	13.5
Ruffe		40.2	25.2	0.7	0.7				
White bream				0.6	1.5	1.3	0.9	0.3	0.3

Table 3.3. Catches in lakes of the Arkhangelsk region (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL		**207.3**	**132.6**	**285.9**		**40.4**	**34.7**	**26.6**	**28.3**
Subtotal finfish		**207.3**	**132.6**	**285.9**		**40.4**	**34.7**	**26.6**	**28.3**
Arctic char			0.7	5.9		2.0	3.9	3.0	3.9
Burbot		0.7	1.3	8.3		1.9	1.4	0.5	0.8
Carassius spp.				7.5					
Common dace		5.5							
European perch		24.2	12.7	48.4		4.6	3.6	3.1	2.9
European whitefish		24.6	4.1	7.3			1.0		0.3
Freshwater bream		0.1	73.5	46.9		12.5	9.4	6.5	6.0
Freshwater fishes nei		5.1	6.0	11.5					
Grayling				0.6					
Ide		99.1	9.8	7.1		1.5	1.1	1.2	1.3
Northern pike		11.5	4.2	43.3		7.8	6.8	5.3	5.8
Peled		4.2	2.6			0.0	0.0		
Pike-perch				1.1		5.4	4.5	3.2	3.6
Roach		32.2	14.7	48.4		2.7	2.9	1.8	1.8
Ruffe		0.1							
Vendace			3.0	49.7		2.1		1.9	1.8

Table 3.4. Catches in Lake Onega (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Total	**1 933.5**	**1 115.7**	**1 017.7**	**2 152.4**	**1 981.8**	**1 323.5**	**1 605.7**	**1 385.3**	**1 429.8**
Subtotal finfish	**1 933.5**	**1 115.7**	**1 017.7**	**2 152.4**	**1 981.8**	**1 323.5**	**1 605.7**	**1 385.3**	**1 429.8**
Atlantic salmon	6.1	59.3	3.3	0.0	3.2	1.6	0.5	0.3	0.2
Burbot	186.8	66.1	34.8	97.6	77.8	49.7	58.3	60.9	51.1
European perch	40.4	14.9	13.5	84.3	86.5	40.1	135.0	78.5	62.3
European smelt	319.8	597.1	690.2	1 392.7	1 186.6	673.8	772.9	676.5	701.5
European whitefish	97.8	41.1	37.5	30.3	15.3	13.9	13.8	13.1	18.2
Freshwater bream	35.2	11.4	12.8	38.9	47.3	33.5	36.5	47.7	43.8
Freshwater fishes nei	408.3		27.9				0.0	8.2	48.2
Lake char		0.7	1.2	4.2	7.6	5.1	4.1	4.2	3.7
Northern pike	14.5	1.5	2.7	15.9	24.8	18.6	16.9	26.8	24.6
Pike-perch	19.9	6.2	9.1	19.2	4.6	19.9	18.0	21.0	19.3
Roach	37.0	9.7	9.3	39.9	39.7	18.3	15.1	21.2	23.5
Ruffe	25.5	6.8	0.3	32.2	32.1	7.9	7.2	0.0	0.0
Three-spined stickleback	25.7	19.8		11.5	19.1	1.5	1.3	0.0	0.0
Vendace	716.5	281.1	175.1	385.6	436.9	439.6	526.2	426.9	433.4
White bream					0.3	0.0	0.0	0.0	0.0

Table 3.5. Catches in Lake Baikal (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**3 553.8**	**3 002.7**	**2 561.2**	**2 133.6**	**2 106.4**	**1 805.6**	**1 513.3**	**980.4**	**789.3**
Subtotal finfish	**3 553.8**	**3 002.7**	**2 561.2**	**2 133.6**	**2 106.4**	**1 805.6**	**1 513.3**	**980.4**	**789.3**
Baikal cisco	1 831.1	2 241.4	1 709.3	1 399.5	1 230.1	793.2	622.2	198.0	82.1
Burbot	43.8	13.3	17.9	14.4	12.2	24.2	21.0	14.6	22.1
Carassius spp.	1.7	9.5	11.1		8.7	29.6	24.5	33.8	28.0
Common carp	0.4		11.6	6.1	3.7	9.8	8.7	7.1	13.0
Common dace	302.0		8.8		63.8	0.0	65.4	56.7	60.9
European perch	215.4	30.4	46.1		56.1	92.6	89.9	75.2	95.1
European whitefish	13.4	1.0	8.4	5.7	6.1	9.3	11.1	8.5	12.9
Freshwater bream			0.4	0.0	0.3	2.5	2.5	5.7	7.2
Freshwater fishes nei	1.9		0.7	688.0	0.0		0.0		0.1
Grayling	24.1	0.7	8.3	4.4	8.9	14.5	13.7	11.8	11.1
Ide	6.6	16.2	7.4	1.8	6.5	14.0	14.0	15.6	16.9
Northern pike	52.5	34.9	13.2	13.1	12.1	28.4	30.8	28.3	25.1
Roach	1 060.5	655.3	717.5		697.8	727.8	608.6	524.5	413.7
Sichel					0.0	57.2	0.0	0.0	0.0
Wels catfish	0.4		0.5	0.3	0.4	2.5	0.8	0.5	1.0

Table 3.6. Catches in Lake Ilmen (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 216.0**	**1 455.9**	**1 265.1**	**1 458.4**	**1 972.6**	**2 708.6**	**2 509.9**	**1 833.8**	**2 251.5**
Subtotal finfish	**2 216.0**	**1 455.9**	**1 265.1**	**1 458.4**	**1 972.6**	**2 708.6**	**2 509.9**	**1 833.8**	**2 251.5**
Asp			0.1	0.0	3.8	0.1	0.2	0.1	0.0
Bleak			17.4	14.5	43.8	39.9	0.6	6.8	4.4
Burbot		108.0	0.1	0.6	0.6	0.0	0.0	0.2	3.5
Carassius spp.			0.7	0.6	0.5	0.3	4.7	1.0	11.8
European perch		150.7	53.2	52.0	89.2	149.7	149.7	120.3	100.1
Freshwater bream	540.0	482.0	374.6	434.0	439.0	620.1	584.2	465.4	651.7
Freshwater fishes nei	1 389.0		1.2						
Ide		2.9	12.8	8.4	13.8	7.5	9.5	7.8	12.8
Northern pike	187.0	97.8	108.0	107.4	153.4	212.3	187.8	130.3	217.1
Pikeperch	100.0	25.8	76.1	122.3	108.3	121.9		44.0	62.1
Rainbow smelt		99.0	24.5	17.8	49.8				0.8
Roach		90.3	119.0	116.8	204.1	258.6	259.1	230.1	155.4
Rudd						5.5	5.2	1.1	0.1
Ruffe			8.8	27.7	36.0	40.8	12.6	11.9	14.2
Sichel		1.9	24.0	85.4	87.0	158.1	168.4	68.7	139.8
Tench				0.0	1.9	0.1	0.1	1.9	11.3
Wels catfish			0.6		0.0	0.0		0.0	0.2
White bream		0.6	60.0	68.6	195.7	239.8	267.4	205.2	266.7
Zope		396.9	384.0	402.3	545.5	854.0	860.3	539.0	599.5

Table 3.7. Catches in Lake Ladoga (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**4 172.0**	**3 200.9**	**3 208.0**	**2 791.7**	**3 425.4**	**3 660.7**	**3 249.7**	**2 435.9**	**2 032.0**
Subtotal finfish	**4 172.0**	**3 200.9**	**3 208.0**	**2 791.7**	**3 425.4**	**3 660.7**	**3 249.7**	**2 435.9**	**2 032.0**
Atlantic salmon	5.0	0.1	0.1		0.0		0.0		
Bleak		1.3			0.0	0.0	0.0		
Burbot		19.6	4.1	13.7	55.0	18.1	16.2	16.5	11.3
Common dace				0.7	4.3	0.0	0.0		
European perch		242.5	204.8	216.9	393.0	458.3	540.8	333.6	318.7
European smelt	683.0	1 396.6	1 107.1	1 205.1	1 199.3	1 535.0	1 248.2	971.1	784.5
European whitefish	310.0	191.2	226.9	126.3	156.6	59.8	76.8	56.6	29.5
Freshwater bream	112.0	52.6	76.9	52.0	199.4	284.9	221.9	198.9	171.0
Freshwater fishes nei	979.0	11.5	16.3	241.3	0.0			2.2	3.2
Ide		1.9	0.3	2.9	16.0	3.5	2.6		
Lake char		30.0	7.3	12.4	16.1	9.1	5.5	5.0	4.7
Northern pike	47.0	16.0	11.0	32.0	62.8	42.5	33.4	32.3	28.3
Pike-perch	388.0	320.5	429.3	344.2	343.8	212.9	174.3	132.4	104.2
Roach		155.0	178.5	212.4	375.3	489.8	332.8	332.7	295.6
Rudd			0.1		0.0	0.0	0.0		
Ruffe		31.8	121.1		107.0	46.1	58.5	56.6	33.2
Sichel		23.6	1.6	4.9	1.0	32.8	37.5	27.4	32.0
Vendace	1 648.0	656.6	780.6	320.5	424.9	311.5	348.1	146.7	100.2
Vimba bream		0.7	4.6	2.0	0.3	10.7	5.9	5.3	9.9
Wels catfish					0.1	0.0	0.0		
White bream		49.0	37.0		69.5	134.3	137.1	106.3	93.8
Zope		0.4	0.4	4.4	1.1	11.4	10.2	12.3	11.9

Table 3.8. Catches in Lake Chany (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 018.0**	**1 266.9**	**1 977.4**	**1 326.5**	**2 902.0**	**2 840.7**	**3 277.7**	**4 019.6**	**5 106.7**
Subtotal finfish	**2 018.0**	**1 266.9**	**1 977.4**	**1 326.5**	**2 902.0**	**2 840.7**	**3 277.7**	**4 019.6**	**5 106.7**
Carassius spp.		1.0	1 200.1	614.2	1 744.3	876.4	923.9	1 126.3	1 293.9
Common carp		275.7	300.0	102.9	155.1	306.4	218.9	409.2	999.4
European perch	120.0	260.4	106.5	171.8	378.8	866.4	1 054.0	1 253.9	1 318.2
Freshwater bream			270.3		2.7	4.9			0.1
Freshwater fishes nei	413.0								
Ide	1 063.0	364.0	100.5	264.6	166.6	100.7	240.9	218.2	229.8
Northern pike								23.2	43.1
Pike-perch	126.0	26.4		36.8	28.2	106.6	96.0	167.6	275.8
Roach	296.0	339.3		136.2	426.3	579.3	744.0	821.2	946.4
Vendace		0.1							

Table 3.9. Catches in Lake Galich (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**162.4**	**110.8**	**507.7**	**38.8**	**19.6**	**47.2**	**65.7**	**32.2**	**30.1**
Subtotal finfish	**162.4**	**110.8**	**507.7**	**38.8**	**19.6**	**47.2**	**65.7**	**32.2**	**30.1**
Asp							0.5		0.1
Bleak				1.2	0.7	3.1	2.1	0.7	0.6
Burbot									0.1
Carassius spp.			0.2		0.1		0.1	0.1	0.1
Chub									0.5
European perch			0.2	0.3	0.2	9.2	11.9	6.1	4.8
Freshwater bream	43.1	108.5	215.2	17.0	3.4	8.2	10.2	6.9	7.5
Freshwater fishes nei	1.8	0.1	277.4			7.1			
Ide					0.1				
Northern pike	1.2	2.2	10.8	1.1	3.6	1.6	4.8	1.9	0.6
Pike-perch			3.3		0.5	0.3	3.3	0.5	1.0
Roach			0.6	17.4	10.2	11.2	15.4	8.5	9.7
Rudd					0.1	6.5	8.9	2.9	4.4
Ruffe	116.3			1.1	0.6				
Sichel							0.7		0.1
Tench								0.1	
Wels catfish								0.4	0.6
White bream				0.6	0.1		7.8	4.1	

Table 3.10. Catches in Pskovsko–Chudskoe Lake (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**5 965.0**	**2 569.4**	**3 874.2**	**6 064.6**	**2 702.4**	**2 961.1**	**2 944.6**	**3 213.0**	**3 905.5**
Subtotal finfish	**5 965.0**	**2 569.4**	**3 874.2**	**3 831.6**	**2 702.4**	**2 961.1**	**2 944.6**	**3 213.0**	**3 905.5**
Asp		4.2	2.1	2.0					
Burbot	107.2	13.9	13.7	40.6	24.6	43.5	40.5	37.2	41.9
Carassius spp.		1.4			1.3				
European perch	690.9	323.9	414.4	627.8	810.4	864.4	790.8	859.9	1 144.8
European whitefish	41.7	10.9	4.5	5.5	2.1	0.6	0.6	0.5	0.6
Freshwater bream	549.0	299.8	702.6	1 150.9	642.0	646.5	689.9	718.4	820.2
Freshwater fishes nei	1 994.5	1.0	0.3	25.0		37.3	35.8		
Ide		0.6	3.0	2.0	0.0				
Northern pike	281.3	88.0	193.9	223.0	116.3	130.8	131.0	122.5	102.3
Pike-perch	987.0	659.2	739.8	1 749.6	430.3	630.5	665.4	839.4	761.1
Rainbow smelt	888.0	548.5	275.5	624.1	0.1	1.3	3.8	5.8	236.3
Roach	67.4	445.9	681.5	1 013.6	379.5	379.9	385.1	437.3	297.8
Ruffe		152.8	834.2	536.0	240.3	211.8	190.0	168.2	181.4
Tench		3.4							
Vendace	358.0	0.6	1.4			14.4	11.5	23.8	319.3
Vimba bream				2.0					
White bream		15.3	7.3	62.5	55.5				

Table 3.11. Catches in Lake Khanka (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**182.0**	**95.4**	**68.7**	**31.7**	**34.3**	**225.3**	**170.9**	**196.8**	**180.4**
Subtotal finfish	**182.0**	**95.4**	**68.7**	**31.7**	**34.3**	**225.3**	**170.9**	**196.8**	**180.4**
Carassius spp.	1.0	7.8	6.4	4.4	7.1	21.3	16.8	28.9	23.1
Common carp	14.5	27.1	11.1	4.7	6.8	45.1	41.1	47.7	41.3
Freshwater fishes nei	111.5	2.4	0.3	2.6	4.0	17.6	9.0	2.0	
Humpback		11.8	3.7		1.0	15.6	9.6	7.7	5.9
Mongolian redfin	14.4	4.7	2.6	0.8	2	13.6	12.9	16.6	11.6
Northern pike	0.7	1.4	2.4	1.5	2.3	11.6	8.7	10.7	10.2
Pikeperch			0.3					0.0	
Predatory carp	31.5	12.4	4.3	5.1	2.2	26.5	23.5	27.7	21.6
Sharpbelly									14.0
Silver carp		4.5	4.2	4.4	2.5	35.9	24.8	31.4	30.5
Snakehead			0.3	0.1	0.3				
Spotted steed		16.7	27.9	3.7	2.5	24.9	16.5	15.6	14.6
Ussuri catfish	5.2		2.2	1.0	1.0				
Wels catfish	3.2	6.6	3.0	3.5	2.6	13.1	8.0	8.6	7.8

Appendix 4

Table 4.1. Catches in the Ivankovo Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**336.4**	**180.9**	**189.7**	**158.1**	**21.7**	**27.1**	**10.8**	**0.2**	**0.2**
Subtotal finfish	**336.4**	**180.9**	**189.7**	**158.1**	**21.7**	**27.1**	**10.8**	**0.2**	**0.2**
Asp		0.0	0.1						
Bleak	0.2	0.0	0.4			1.1	0.2		
Carassius spp.		0.0	4.5		1.5	1.5	0.4		
Common carp	0.2								
Common carp							0.1		
European perch	2.2	1.6	3.3	3.4	3.8	5.5	1.8		
Freshwater bream	300.5	170	172.9	147.3	7.2	8.1	4.0	0.1	0.1
Freshwater fishes nei	0.8	0.1		2.0					
Northern pike	2.7	0.0	0.1	0.3	2.1	2.3	0.8		
Pike-perch	4.5	0.3	0.2	1.0	2.4	2.8	1.4	0.1	
Roach	23.7	8.5	6.7	4.1	4.1	4.1	0.5	0.0	0.1
Sichel	0.2	0.1							
Silver carp					0.2				
Tench	0.1				0.1	0.0	0.0		
Wels catfish					0.2	0.0	0.1		
White bream	1.1	0.3	1.5		0.1	1.7	0.5		

Table 4.2. Catches in the Gorky Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**578.3**	**253.8**	**401.6**	**253.6**	**285.0**	**425.8**	**437.8**	**570.6**	**446.1**
Subtotal finfish	**578.3**	**253.8**	**401.6**	**253.6**	**285.0**	**425.8**	**437.8**	**570.6**	**446.1**
Asp	2.0	0.6	2.9	2.4	2.6	13.6	13.3	14.2	10.7
Bleak	0.0	0.0	0.0	0.0	0.1	0.2	0.3	1.1	0.7
Burbot	1.5	0.3	0.5	0.4	1.6	4.0	3.3	2.8	2.3
Carassius spp.	0.1	0.0	0.0	1.2	3.2	5.3	4.4	12.9	4.4
Common carp	0.0	0.0	0.0	0.1	0.8	2.7	1.6	2.6	1.4
European perch	0.1	8.9	2.7	17.5	29.0	24.7	36.8	79.6	25.7
Freshwater bream	321.2	143.3	162.1	94.2	140.7	153.5	157.3	166.1	168.7
Freshwater fishes nei	0.0	0.7	10.6	0.0	1.1	1.1	1.2	3.7	2.3
Ide	1.1	0.5	3.1	0.9	2.1	8.5	5.6	8.0	6.6
Northern pike	7.3	2.1	7.6	5.8	12.2	26.5	26.0	25.8	27.6
Pike-perch	19.3	0.7	13.9	9.6	12.7	34.1	24.2	53.8	26.1
Roach	191.4	89.9	163.5	96.0	48.9	89.7	106.3	114.4	89.5
Sichel	12.4	5.3	15.2	7.2	5.7	17.7	16.7	17.9	23.7
Tench	0.0	0.1	0.0	0.5	1.0	1.7	1.1	1.8	0.8
Volga pikeperch	0.0	0.0	0.0	2.5	2.5	10.5	10.8	35.9	22.5
Wels catfish	0.3	0.5	0.6	0.7	0.7	5.3	4.9	5.3	5.0
White bream	21.5	0.7	9.3	6.1	13.6	20.6	17.6	18.4	20.4
White-eye bream	0.0	0.0	0.0	0.2	0.3	0.2	0.2	0.0	0.0
Zope	0.1	0.2	9.6	8.3	6.2	6.1	6.2	6.4	7.7

Table 4.3. Catches in the Cheboksary Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**392.3**	**262.3**	**370.2**	**304.0**	**351.7**	**731.2**	**853.0**	**938.5**	**828.0**
Subtotal finfish	**392.3**	**262.3**	**370.2**	**304.0**	**351.7**	**731.2**	**853.0**	**938.5**	**828.0**
Asp	1.5	0.9	1.2	2.3	3.1	8.1	8.6	11.8	7.7
Burbot	3.2	3.2	3.2	3.2	3.2	3.2	3.2	4.0	2.4
European perch	0.4	0.0	16.0	10.7	22.7	76.1	92.7	91.8	101.0
Freshwater bream	93.0	124.5	108.8	92.3	124.0	248.1	243.7	258.9	188.4
Freshwater fishes nei	10.0	9.3	2.5	6.9	15.6	38.0	52.9	54.4	67.2
Ide	0.3	1.0	0.5	1.0	2.7	6.0	6.8	8.9	9.1
Northern pike	41.6	11.3	18.8	11.6	11.6	33.1	50.8	54.4	44.3
Pike-perch	10.0	3.9	7.8	13.7	12.2	34.4	47.1	48.4	41.0
Roach	157.4	66.1	27.9	96.7	98.7	145.1	168.6	184.7	160.1
Sichel	22.9	18.1	116.5	3.4	4.7	23.5	50.1	48.8	49.8
Sturgeons nei	3.2	0.7	0.2	0.0	0.0	0.0	0.0	0.1	0.1
Wels catfish	0.8	1.6	1.1	4.8	4.9	13.1	13.5	15.5	12.8
White bream	24.8	7.9	57.3	47.9	43.7	86.6	100.0	108.0	117.5
White-eye bream	1.1	0.0	0.0	0.0	0.0	10.9	11.5	43.0	19.3
Zope	22.1	13.8	8.5	9.6	4.7	4.9	3.6	5.8	7.3

Table 4.4. Catches in the Kuibyshev Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**5 459.3**	**3 240.0**	**2 853.5**	**2 114.2**	**3 093.5**	**3 460.9**	**3 912.2**	**3 819.6**	**3 769.1**
Subtotal finfish	**5 459.3**	**3 240.0**	**2 853.5**	**2 114.2**	**3 093.5**	**3 460.9**	**3 912.2**	**3 819.6**	**3 769.1**
Asp	6.2	11.0	5.5	5.8	10.9	13.4	22.8	23.0	21.0
Bleak	2.5	0.0	1.1	5.2	94.2	109.3	52.4	26.5	33.0
Burbot	13.3	33.0	5.3	4.5	0.0	9.9	14.3	10.6	10.8
Carassius spp.	22.0	20.0	65.8	32.1	93.8	142.0	153.4	151.2	136.2
Caspian tyulka	43.2	132.3	112.1	0.1	140.0	72.4	41.1	22.5	18.8
Common carp	39.6	36.0	89.3	20.3	49.1	57.0	63.3	72.7	84.1
European perch	32.5	59.0	25.3	53.2	88.4	175.7	173.8	182.3	156.4
Freshwater bream	2 094.7	1 377.0	928.8	543.8	960.7	1 020.7	1 320.1	1 325.3	1 371.0
Freshwater fishes nei	515.7	3.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Ide	4.0	6.0	18.3	7.2	16.4	74.3	17.2	20.6	19.8
Northern pike	56.1	43.0	14.4	33.9	24.8	14.9	16.4	25.2	27.7
Pike-perch	255.6	121.0	88.7	94.8	180.0	192.0	266.6	295.5	295.8
Roach	359.6	303.0	239.8	263.6	280.0	387.9	427.5	389.5	341.1
Ruffe	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sichel	127.3	90.0	97.7	85.5	149.0	471.8	194.3	186.4	162.3
Silver carp	12.0	0.7	0.0	0.0	2.5	1.5	2.2	1.1	1.3
Sturgeons nei	19.1	14.0	5.0	0.0	1.3	0.7	0.4	0.0	0.2
Volga pikeperch	118.0	15.0	25.3	50.4	93.2	97.0	138.2	116.6	113.4
Wels catfish	30.3	27.0	6.1	6.9	17.7	9.0	8.9	12.8	14.1
White bream	407.3	252.3	573.8	535.1	515.1	188.9	546.6	551.5	582.3
White-eye bream	112.5	64.0	24.0	5.4	21.0	12.7	27.5	16.4	15.1
Zope	1 186.9	632.0	526.5	366.4	347.9	410.0	425.2	389.9	364.7

Table 4.5. Catches in the Saratov Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**1 886.9**	**811.0**	**535.1**	**727.8**	**934.9**	**880.0**	**905.2**	**985.9**	**1 069.1**
Euro-American crayfishes	**0.0**	**0.0**	**6.3**	**16.3**	**26.3**	**28.0**	**28.7**	**26.4**	**31.1**
Subtotal finfish	**1 886.9**	**811.0**	**528.8**	**711.5**	**908.6**	**852.1**	**876.5**	**959.5**	**1 038.0**
Asp	3.0	1.7	1.9	1.7	4.2	4.4	3.9	5.2	6.9
Bleak	4.2	2.0	0.0	2.5	1.3	2.6	1.6	0.9	0.2
Burbot	14.9	3.1	0.1	0.5	3.8	4.4	4.0	4.4	7.4
Carassius spp.	6.1	1.0	10.1	17.0	13.2	22.5	22.3	25.2	25.7
Chub	0.0	0.0	0.0	0.0	0.0	2.0	1.7	1.5	0.8
Common carp	1.9	0.0	0.0	1.7	1.2	5.6	7.4	8.3	11.7
European perch	15.6	15.0	30.0	86.7	104.4	101.2	98.0	102.0	101.8
Freshwater bream	644.8	312.8	192.6	202.4	340.6	278.6	283.7	344.7	382.5
Grass carp	0.0	0.0	0.0	0.8	1.3	5.5	6.7	6.6	6.4
Ide	8.5	5.9	12.1	8.5	14.0	12.6	11.2	12.4	13.2
Northern pike	44.0	17.0	11.0	13.2	24.7	28.6	36.3	37.4	51.8
Pike-perch	105.1	23.7	9.2	12.6	31.1	34.4	58.6	64.4	74.4
Roach	233.2	224.6	92.5	167.0	145.9	138.4	134.5	136.6	143.3
Rudd	0.0	0.0	0.0	0.4	10.6	14.5	14.8	15.1	16.2
Ruffe	0.1	0.0	0.0	0.0	0.0	1.3	1.2	0.2	0.0
Sichel	69.4	20.0	10.1	14.6	21.2	17.0	17.2	13.6	12.7
Silver carp	40.5	0.1	2.5	10.2	12.2	14.6	15.4	14.9	15.7
Sturgeons nei	8.2	3.0	0.1	0.0	0.0	0.0	0.2	0.2	0.2
Tench	0.0	1.0	0.5	1.5	4.9	5.5	5.9	5.0	6.2
Volga pikeperch	98.7	6.3	1.6	0.5	8.9	14.5	15.3	16.6	17.6
Wels catfish	3.3	3.0	0.5	0.7	4.0	4.6	5.8	7.2	9.6
White bream	186.9	83.8	111.1	129.2	123.0	118.3	111.8	116.8	119.4
White-eye bream	1.5	2.0	0.0	0.0	0.7	0.8	0.7	0.6	0.2
Zope	397.0	85.0	41.5	37.5	37.4	20.0	18.2	19.7	14.1

Table 4.6. Catches in the Volgograd Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**4 106.2**	**1 119.6**	**972.3**	**1 835.0**	**3 014.8**	**3 142.5**	**3 515.2**	**3 896.2**	**3 930.8**
Euro-American crayfishes	**0.0**	**0.0**	**0.0**	**5.1**	**42.1**	**27.9**	**33.5**	**37.1**	**49.5**
Subtotal finfish	**4 106.2**	**1 119.6**	**972.3**	**1 829.9**	**2 972.7**	**3 114.6**	**3 481.7**	**3 859.1**	**3 881.3**
Asp	4.4	2.9	6.0	13.7	37.5	59.4	60.8	62.7	53.0
Bleak	0.0	0.0	0.0	0.7	1.7	0.7	2.7	2.7	1.4
Burbot	5.8	5.8	1.2	6.7	9.1	7.6	10.5	10.9	8.9
Carassius spp	24.5	25.4	89.9	132.6	270.4	357.0	362.2	401.1	385.0
Chinese sleeper	0.0	0.0	0.0	0.0	0.8	0.2	0.8	0.9	0.6
Chub	10.3	4.8	0.0	4.8	9.1	15.1	18.3	20.2	17.3
Common carp	1.6	0.8	1.3	23.4	53.2	35.5	39.4	47.2	53.1
Common nase	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
European perch	83.3	33.7	73.3	167.2	282.9	382.9	422.5	507.8	469.2
Freshwater bream	1 280.0	419.2	225.5	454.8	536.4	370.5	420.4	445.6	479.3
Freshwater fishes nei	7.3	18.1	283.0	57.4	158.9	100.3	109.2	120.8	120.5

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Gobies	0.0	0.0	0.0	0.0	0.4	0.2	0.6	0.7	0.5
Grass carp	0.0	0.0	0.1	0.3	0.0	17.8	15.1	26.8	18.7
Ide	84.8	15.8	30.0	27.6	52.5	59.3	64.0	51.8	48.2
Northern pike	108.9	23.9	33.1	62.2	116.0	96.5	102.3	106.7	105.0
Pike-perch	607.8	119.1	47.3	94.9	211.1	140.4	153.8	167.6	180.1
Roach	293.7	92.6	148.9	183.6	315.1	339.2	379.4	396.6	406.4
Rudd	12.1	4.5	0.0	32.4	76.4	88.5	102.0	112.8	117.5
Ruffe	0.0	0.0	0.0	0.0	0.6	0.3	1.0	1.5	0.7
Shads nei	27.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sichel	32.2	10.9	16.6	35.4	91.9	150.9	188.4	219.4	213.0
Tench	4.5	6.2	0.0	20.4	48.0	68.9	67.4	57.3	56.6
Vimba bream	0.0	0.0	0.0	0.0	7.3	1.9	18.7	27.7	33.6
Volga pikeperch	479.0	65.0	0.0	73.7	166.5	231.5	285.2	403.9	454.4
Wels catfish	14.9	6.5	2.8	8.0	26.8	16.6	16.5	22.2	25.3
White bream	970.1	235.2	0.0	415.6	469.1	554.6	616.3	627.6	619.5
White-eye bream	19.9	17.4	0.0	4.4	11.7	7.4	9.0	5.3	3.8
Zope	34.1	4.5	7.8	10.1	19.3	11.4	15.2	11.3	9.7

Table 4.7. Catches in the Bratsk Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**1 360.0**	**293.0**	**358.0**	**269.0**	**826.4**	**1 940.4**	**1 865.2**	**2 378.2**	**2 435.4**
Subtotal finfish	**1 360.0**	**293.0**	**358.0**	**269.0**	**826.4**	**1 940.4**	**1 865.2**	**2 378.2**	**2 435.4**
Arctic cisco	54.1	8.0	7.0	0.1	0.5	0.8	0.3	0.8	1.0
Burbot	35.2	1.0	1.2	0.0	0.6	1.0	1.0	1.0	1.0
Carassius spp.	17.8		21.0	23.1	69.0	148.2	156.2	210.5	216.5
Common carp			1.2	0.4	1.0	13.0	14.3	10.4	15.3
Common dace	3.9		0.1		0.6	0.1	0.1	8.1	7.4
European perch	653.5	179.2	163.3	157.2	379.7	995.6	912.4	1 113.6	1 075.8
Freshwater bream	69.4	9.0	54.1	23.7	81.5	211.1	258.1	318.7	410.7
Freshwater fishes nei		1.2							
Grayling					0.1	0.1		0.6	
Muksun	0.9								
Northern pike	13.7		0.2	0.1	0.2	6.8	4.3	8.3	10.7
Peled			0.3		0.3	0.4	0.5	1.8	1.0
Roach	510.8	94.6	109.0	64.1	290.4	550.5	507.9	698.3	690.9
Ruffe						3.6	2.5	3.0	
Wels catfish	0.7		0.6	0.4	2.8	9.1	7.7	3.2	5.2

Table 4.8. Catches in Iriklinsky Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**943.0**	**299.3**	**334.8**	**221.1**	**291.3**	**227.1**	**360.8**	**409.9**	**489.5**
Subtotal finfish	**943.0**	**299.3**	**334.8**	**221.1**	**291.3**	**227.1**	**360.8**	**409.9**	**489.5**
Carassius spp.			26.1	15.9	38.8	41.5	42.1	35.1	33.7
Common carp	1.0		0.9	0.3	1.3	1.1	1.8	1.8	3.5
European perch		32.8	208.8	151.1	185.7	74.1	213.1	248.5	280.5
European whitefish	768.0	43.1	13.3	0.2	0.0	0.0	0.0	0.0	0.0
Freshwater bream	17.0		2.8	4.3	2.4	27.5	27.7	27.4	33.7
Freshwater fishes nei	84.0	154.2	16.7						
Ide			12.2	7.2	13.8	6.2	3.6	4.2	3.8
Northern pike	2.0		0.3	0.1	0.7	1.4	1.7	2.0	2.7
Pike-perch	71.0	33.3	7.4	7.4	10.7	27.5	27.6	31.6	40.6
Roach		35.9	46.2	20.7	29.1	45.5	42.7	57.4	83.2
Ruffe					6.5	0.1	0.0		0.4
Vendace	0.0	0.0	0.0	13.8	2.3	1.6	0.0	1.4	5.9
Wels catfish			0.1	0.1		0.5	0.6	0.6	1.5

Table 4.9. Catches in Zeya Reservoir (tonnes)

Species	1990	1995	2000	2011	2015	2016	2017	2018
TOTAL	**126.4**	**8.3**	**7.7**	**20.7**	**7.5**	**8.6**	**7.2**	**2.7**
Subtotal finfish	**126.4**	**8.3**	**7.7**	**20.7**	**7.5**	**8.6**	**7.2**	**2.7**
Burbot				1.5	0.5	0.4	0.0	0.2
Carassius spp.	24.3	4.6	7.0	5.1	2.5	3.2	3.0	0.9
Freshwater fishes nei			0.6					
Northern pike	100.0	2.5	0.1	3.9	2.5	3.2	2.8	1.0
Ussuri catfish		0.6		2.5	0.5	0.4	0.3	0.2
Wels catfish	1.0	0.6		1.3	0.5	0.5	0.3	0.2
Amur ide	1.1			6.4	0.9	0.9	0.7	0.2

Table 4.10. Catches in the Syamozersky Reservoir (tonnes)

Species	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**47.1**	**77.3**	**19.1**	**8.9**	**8.4**	**11.3**	**7.5**	**8.4**
Subtotal finfish	**47.1**	**77.3**	**19.1**	**8.9**	**8.4**	**11.3**	**7.5**	**8.4**
Bleak			0.3	0.7	0.1	0.0		
Burbot	0.5	0.4	0.8	0.5	0.5	0.7	0.2	0.5
European perch	3.1	10.0	3.1	1.3	0.5	0.6	0.4	0.1
European smelt	29.0	52.8	3.2	0.3		0.0		
European whitefish	0.2	0.2	0.1		0.0	0.0	0.1	0.5
Freshwater bream	0.8	0.6	2.5	1.3	1.1	2.4		1.3
Freshwater fishes nei		10.8						
Northern pike	0.4	0.2	0.4	0.7	0.7	1.2	0.9	1.1
Pike-perch	3.5	1.8	1.6	3.0	4.6	5.9	5.0	4.9
Roach	3.1	0.5	2.9	0.6	0.2	0.1		
Ruffe	6.5		4.1	0.3	0.0	0.0		
Vendace			0.1	0.3	0.7	0.4	0.9	

Table 4.11. Catches in the Vodlozersky Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**227.2**	**109.6**	**95.6**	**242.9**	**125.8**	**67.1**	**102.0**	**269.7**	**212.0**
Subtotal finfish	**227.2**	**109.6**	**95.6**	**242.9**	**125.8**	**67.1**	**102.0**	**269.7**	**212.0**
Burbot	23.0	2.8	6.7	18.7	7.6	6.0	7.8	10.3	10.3
European perch	29.7	15.5	3.8	32.1	13.4	8.3	12.3	66.8	51.9
European smelt					0.6			4.0	
European whitefish	0.3	0.2	0.2	1.3	0.1	0.4	0.0		
Freshwater bream	26.4	9.7	10.6	23.0	20.3	10.8	26.4	42.6	32.6
Freshwater fishes nei			16.3					6.8	0.0
Ide	2.6	3.3	1.3	2.0	1.7	1.6	2.6		
Northern pike	23.3	6.1	8.1	20.7	10.0	7.3	11.3	36.9	30.4
Pike-perch	47.2	20.4	20.8	31.8	12.7	3.7	3.0		11.4
Rainbow smelt	13.3	10.7	8.8	7.6					3.5
Roach	25.6	18.6	1	25.5	24.4	8.0	8.0	28.9	20.0
Ruffe	21.5	3.1		36.0	12.5	6.0	4.8		
Vendace				5.8	0.8	1.9	1.9	5.3	3.3
White bream	0.1	9.0		4.0	1.5	0.3	0.5		
Zope	14.2	10.2	18.0	34.4	20.4	12.9	23.3	68.0	48.7

Table 4.12. Catches in Vygozersky Reservoir (tonnes)

Species	1990	1995	2000	2010	2015	2016	2017	2018
TOTAL	**246.1**	**47.1**	**44.4**	**8.6**	**13.2**	**14.4**	**15.0**	**11.9**
Subtotal finfish	**246.1**	**47.1**	**44.4**	**8.6**	**13.2**	**14.4**	**15.0**	**11.9**
Burbot	7.5	0.5	0.4	0.3	1.7	1.7	1.5	2.0
European perch	7.1	3.1	0.7	1.1	1.1	1.7	2.4	1.9
European smelt	53.6	29.0	0.5					
European whitefish	2.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0
Freshwater bream	37.8	0.8	2.3	2.3	4.9	5.7	6.2	4.3
Freshwater fishes nei	2.3	0.0	0.9				0.1	0.2
Ide	1.0			0.3	0.1	0.1	0.0	0.0
Northern pike	20.6	0.4	0.8	1.0	2.2	1.8	2.3	2.5
Pike-perch	46.6	3.5	3.1	1.7	1.5	0.9		0.4
Roach	11.0	3.1	0.4	1.1	1.1	1.7	1.7	0.6
Vendace	56.5	6.5	35.1	0.8	0.5	0.9	0.9	0.0

Table 4.13. Catches in the Krasnoyarsk Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**324.5**	**141.1**	**601.5**	**651.3**	**1 199.0**	**1 714.9**	**1 749.9**	**2 284.0**	**2 108.2**
Subtotal finfish	**324.5**	**141.1**	**601.5**	**651.3**	**1 199.0**	**1 714.9**	**1 749.9**	**2 284.0**	**2 108.2**
Arctic cisco		0.1	0.1	0.4	2.5	2.1			
Burbot	0.2	0.2	0.2	0.7	3.7	9.1	12.6	18.6	13.1
Carassius spp.	0.3	3.9	3.9	10.3	30.5	26.2	24.6	32.2	22.6
Common carp				18.8	20.7	21.8	33.0	39.7	27.3
Common dace					0.5	0.5	0.4	0.4	0.5
European perch	33.6	54.7	249.5	357.3	712.8	1 130.9	1 064.6	1 433.9	1 377.7
Freshwater bream	65.8	39.2	167.1	150.4	215.9	192.8	198.3	241.3	208.6
Freshwater fishes nei	159.7	16.5	71.3						
Grayling						1.0	0.1	0.1	
Northern pike	1.3	1.4	1.8	4.6	12.0	19.3	24.9	36.0	27.9
Peled	4.8	0.8	0.8	0.9	11.7	69.3	130.1	125.6	112.0
Roach	58.8	24.3	102.4	107.9	188.7	241.9	261.3	356.1	318.5
Ruffe								0.1	

Table 4.14. Catches in the Krasnodar Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**231.1**	**114.5**	**56.2**	**41.0**	**65.1**	**49.2**	**61.1**	**74.0**	**78.3**
Subtotal finfish	**231.1**	**114.5**	**56.2**	**41.0**	**65.1**	**49.2**	**61.1**	**74.0**	**78.3**
Asp	0.7		0.4		0.0	0.0	0.0	0.0	0.5
Carassius spp.			2.0		17.6	12.9	17.1	19.4	19.5
Common carp	1.5		0.2		0.2	0.1	0.3	0.2	1.1
Freshwater bream	43.6	18.8	16.0	20.1	25.9	19.0	21.5	26.6	25.3
Freshwater fishes nei		20.0	8.0	20.7	0.1				0.2
Pike-perch	0.2		0.5		0.4	0.1	0.5	0.5	1.6
Roach			2.8		0.3	0.2	0.7	1.3	2.3
Rudd					0.0	0.1			
Sichel	85.7	74.0	16.5		18.5	15.7	18.6	22.1	21.7
Silver carp	88.0	0.8	0.0	0.1	0.1	0.6	0.9	1.5	1.7
Wels catfish	0.1				0.0	0.0	0.2	0.1	0.5
White bream	11.3	0.9	9.8		1.9	0.5	1.2	2.4	4.0

Table 4.15. Catches in Tsimlyansk Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**13 092.3**	**7 427.6**	**7 399.6**	**6 345.0**	**11 070.8**	**6 257.4**	**7 307.6**	**6 537.9**	**8 226.0**
Euro-American crayfishes						**0.5**	**0.4**	**0.1**	
Subtotal finfish	**13 092.3**	**7 427.6**	**7 399.6**	**6 345.0**	**11 070.8**	**6 256.8**	**7 307.2**	**6 537.8**	**8 226.0**
Asp	27.7	7.5	13.9	9.3	28.8	8.1	7.2	8.9	14.8
Carassius spp.	192.5	209.6	1 126.2	1 029.1	4 994.2	3 481.4	4 636.7	4 430.5	4 999.2
Common carp	434	109.7	212.0	94.3	391.2	102.8	160.1	449.7	850.9
European perch	0.0	18.9	46.5	27.6	148.4	32.0	36.5	128.2	237.9

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
Freshwater bream	4 971.9	3 636.4	2 338.1	2 230.4	2 398.2	1 411.2	1 515.6	785.0	1 130.8
Freshwater fishes nei	218.7	304.5	321.5	857.2	666.7	262.6	227.2	118.0	126.2
Ide	2.6	2.1	1.9	1.0	17.5	0.6	0.5	2.6	8.9
Kutum, Caspian kutum	13.0	24.3	6.8	2.7					
Northern pike	84.1	56.9	20.1	17.4	96.2	12.0	8.7	25.6	39.3
Pike-perch	896.0	160.8	164.6	178.6	203.8	197.7	213.6	125.1	208.6
Roach	553.0	376.6	461.2	278.4	257.0	202.1	96.2	47.4	73.0
Sichel	37.3	15.9	53.0	60.4	413.1	43.3	36.6	164.7	200.5
Vimba bream	135.4	35.9	15.4	26.6	53.9	22.2	33.3	18.6	24.9
Volga pikeperch	895.4	199.4	100.2	47.8	116.1	14.3	19.9	14.6	28.0
Wels catfish	172.5	69.9	40.1	24.4	82.5	10.2	15.3	40.8	87.3
White bream	4 200.1	2 123.5	2 417.4	1 380.5	1 109.6	440.0	284.5	148.3	149.4
Zope	258.2	75.7	60.7	79.4	93.6	16.3	15.3	29.9	46.3

Table 4.16. Catches in the Veselovsky Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**372.0**	**54.4**	**152.6**	**455.4**	**319.2**	**0.0**	**183.3**	**593.2**	**742.2**
Euro-American crayfishes							**6.2**	**2.9**	
Subtotal finfish	**372.0**			**455.4**	**319.2**	**0.0**	**177.1**	**590.3**	**742.2**
Carassius spp.	61.0		37.9	34.4	82.5		66.6	375.5	297.2
Common carp	20.0		0.1				0.2	0.9	
European perch	10.0		2.2				8.9	20.8	29.2
Freshwater bream	93.0		28.1	31.5	18.1		39.1	64.9	99.6
Freshwater fishes nei	4.0		6.2	354.0				0.1	2.3
Grass carp							0.2	0.1	
Northern pike	6.0		0.1				0.2	0.2	
Pike-perch	13.0	7.9	4.3	4.5	1.6		10.6	26.3	16.5
Roach	50.0	46.5	5.2	13	7.7		27.5	57.4	132.0
Rudd							1.4	2.8	4.7
Silver carp	15.0		0.0	0.0	198.8		7.0	27.3	154.6
Volga pikeperch	12.0		0.8						
Wels catfish	7.0		0.4				2.2	1.8	6.1
White bream	81.0		67.3	18.0	10.5		13.2	12.2	

Table 4.17. Catches in the Rybinsk Reservoir (tonnes)

Species	1990	1995	2000	2005	2010	2015	2016	2017	2018
TOTAL	**2 414.5**	**1 383.8**	**1 448.3**	**1 041.2**	**1 922.8**	**1 754.0**	**1 533.8**	**1 427.3**	**1 744.8**
Subtotal finfish	**2 414.5**	**1 383.8**	**1 448.3**	**1 041.2**	**1 922.8**	**1 754.0**	**1 533.8**	**1 427.3**	**1 744.8**
Asp	4.1	1.9	0.3	0.5	2.9	5.3	5.1	5.9	5.3
Bleak			0.4		7.8	0.3			
Burbot	101.9	168.0	58.7	25.9	88.2	61.1	45.7	31.2	33.5
Carassius spp.		0.1	0.2	0.1	4.0	12.1	12.5	10.8	10.4
Caspian tyulka				3.4	0.1				0.4
European perch	42.4	4.9	18.3	19.1	329.9	231.4	167.7	121.0	152.3

Freshwater bream	795.1	450.2	382.6	263.2	404.1	355.9	334.6	294.4	384.5
Freshwater fishes nei	21.7	4.5				0.1			
Ide	6.4	1.8	0.8	0.7	4.1	11.1	8.1	7.8	9.1
Northern pike	111.1	38.8	58.8	12.6	58.2	76.0	46.6	36.6	56.3
Pike-perch	293.1	147.2	158.3	70.6	72.6	99.1	59.9	59.7	70.0
Rainbow smelt	11.3	33.4							
Roach	411.4	194.8	257.5	189.2	362.9	312.1	288.1	297.7	360.2
Ruffe					37.7	9.9			0.0
Sichel	32.0	25.2	72.8	33.5	45.9	52.8	54.0	52.9	50.4
Tench						0.0			
Volga pikeperch				4.1	7.4	53.4	32.6	25.9	43.3
Wels catfish	16.3	13.7	4.3	3.2	2.0	3.8			0.1
White bream	10.3	1.1	1.1	1.5	13.3	29.8	24.0	32.5	42.2
Zope	557.4	298.1	434.6	413.7	481.5	439.7	454.8	450.8	526.8

Appendix 5

Table 5.1. Catches in inland waters of the Russian Federation by fishery basins in 1990 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Volga–Caspian Basin	Azov–Black Sea Basin
TOTAL	**356 114**	**89 519**	**4 945**	**12 353**	**228 445**	**20 852**
Crustaceans	22				22	
Mussels	201				201	
Subtotal finfish	355 891	89 519	4 945	12 353	228 222	20 852
Arctic char, sheefish	469	451	7		11	
Asp	298				269	29
Atlantic salmon	308		303	5		
Burbot	3 055	2 576	231	107	141	
Caspian Sea sprat	132 477				132 477	
Caspian shad	3 089				3 089	
Chinook salmon	1 083	1 083				
Chum salmon	3 540	3 540				
Coho salmon	1 457	1 457				
Cyprinids	14 557	2 225			7 330	5 002
Incl. white bream	6 197				1 622	4 575
Carassius spp.	4 064	1 671	7		1 301	1 085
rudd	1 147				1 143	4
European eel	136			136		
European perch	2 738	975	122	1 452	177	12
European river lamprey	21		21			
European smelt	1 755	689	383	683		
Freshwater bream	30 755	1	604	2 867	18 009	9 274
Freshwater fishes nei	43 319	33 931			8 406	982
Ide	4 529	3 580	111		708	130
Mullets	214					214
Northern pike	7 802	1 693	280	515	5 224	90
Pike-perch	8 654		320	2 890	3 536	1 908
Pink salmon	1 476	1 476				
Rainbow smelt	1 302		403	888	11	
Roach	35 274	9 772	203	876	22 354	2 069
Sichel	1 722			58	991	673
Sockeye salmon	11 280	11 280				
Sturgeons	10 727	329	8		10 359	31
Tench	558				558	
Three-spined stickleback, ruffe, bleak	237		237			
Wels catfish	11 670	19			11 471	180
Whitefishes nei	18 784	14 442	1 698	1 876	768	
Incl. Arctic cisco	2 453	2 449	4			
Zope, white-eye bream	2 605		14		2 333	258

Table 5.2. Catches in inland waters of the Russian Federation by fishery basins in 1995 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Volga–Caspian Basin	Azov–Black Sea Basin
TOTAL	**212 874**	**58 457**	**3 244**	**8 939**	**131 287**	**10 947**
Crustaceans	12				12	
Subtotal finfish	**212 862**	**58 457**	**3 244**	**8 939**	**131 275**	**10 947**
Arctic char, sheefish	340	340				
Asp	55			10	35	10
Atlantic salmon	68		68			
Burbot	993	558	80	142	213	
Caspian Sea sprat	80 205				80 205	
Caspian shad	1 478				1 478	
Chinook salmon	738	738				
Chum salmon	10 049	10 049				
Coho salmon	1 213	1 213				
Common carp	752	452			190	110
Cyprinids	11 887	3 200	14	75	5 795	2 803
Incl. white bream	3 106		10	65	741	2 290
Carassius spp.	5 206	3 200	4	10	662	1 330
rudd	2 350				2 350	
European eel	8			8		
European perch	2 234	430	109	830	835	30
European river lamprey	40	19		20	1	
European smelt	3 118	1 041	680	1 397		
Freshwater bream	29 142	7 204	302	1 750	15 266	4 620
Freshwater fishes nei	3 460	3 335	17	40	68	
Ide	1 977	1 726	129	5	107	10
Masu salmon	13	13				
Mullets	31					31
Navaga	193	193				
Northern pike	4 938	1 380	130	340	3 008	80
Pikeperch	3 271		177	1 190	1 324	580
Pink salmon	8 862	8 862				
Rainbow smelt	1 006		254	672	80	
Roach	19 630	2 825	146	980	14 106	1 573
Shads nei	1					1
Sichel	435		55	80	120	180
Sockeye salmon	8 229	8 229				
Sturgeons	2 276	170			1 436	670
Tench	1 300			10	1 290	
Three-spined stickleback, ruffe, bleak	337		297	40		
Wels catfish	4 590	20			4 500	70
Whitefishes nei	8 273	6 460	728	859	226	
Incl. muksun	1 041	1 041				
Arctic cisco	2 492	2 442	50			
Broad whitefish	96	96				
European whitefish	1 321	918	158	202	43	
peled	887	747	140			
vendace	2 315	1 095	380	657	183	
Zope, white-eye bream	1 720		58	491	992	179

Table 5.3. Catches in inland waters of the Russian Federation by fishery basins in 2000 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Volga–Caspian Basin	Azov–Black Sea Basin
TOTAL	**292 368**	**76 574**	**5 164**	**14 050**	**181 288**	**15 292**
Crustaceans	957	932			16	9
Incl. Gammarus	932	932				
Euro-American crayfishes	25				16	9
Subtotal finfish	**291 411**	**75 642**	**5 164**	**14 050**	**181 272**	**15 283**
Arctic char, sheefish	616	615	1			
Asp	171	3		8	144	16
Atlantic salmon	63	56	7			
Burbot	1 765	1 564	62	64	75	
Caspian Sea sprat	117 914				117 914	
Caspian shad	1 273				1 273	
Chinook salmon	264	264				
Chum salmon	14 546	14 546				
Coho salmon	1 419	1 419				
Common carp	4 007	695			3 086	226
Cyprinids	20 390	3 529	57	1 520	8 335	6 949
Incl. white bream	4 123			152	1 475	2 496
Carassius spp.	11 202	3 429	7	939	2 578	4 249
rudd	4 182				4 182	
European eel	6			6		
European perch	4 026	1 406	84	1 083	1 394	59
European river lamprey	24	13	11			
European smelt	3 825	1 955	763	1 107		
Freshwater bream	23 794	1 317	351	3 221	15 379	3 526
Freshwater fishes nei	13 111	458	2 377	518	9 456	302
Ide	2 378	2 162	89	32	92	3
Masu salmon	3	3				
Mullets	35					35
Navaga	11	11				
Northern pike	8 863	3 461	96	438	4 841	27
Pike-perch	3 863	79	148	1 245	1 349	1 042
Pink salmon	24 277	24 277				
Rainbow smelt	608		289	319		
Roach	13 973	3 666	103	1 712	7 585	907
Sea trout	1	1				
Sichel	1 198		117	325	429	327
Silver carp	8	8				
Sockeye salmon	6 872	6 872				
Sturgeons	594	75	24	1	493	1
Tench	1 904			2	178	1 724
Three-spined stickleback, ruffe, bleak	1 116	254	31	813	17	1
Wels catfish	7 199	246		1	6 911	41
Whitefishes nei	9 132	6 672	487	1 020	953	
Incl. muksun	1 171	1 171				

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Volga–Caspian Basin	Azov–Black Sea Basin
Arctic cisco	1 828	1 827	1			
Broad whitefish	647	647				
European whitefish	1 200	581	109	415	95	
Peled	2 240	1 166	103	130	841	
Vendace	1 957	1 280	274	386	17	
Zope, white-eye bream	2 162	15	67	615	1 368	97

Table 5.4. Catches in inland waters of the Russian Federation by fishery basins in 2005 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Azov–Black Sea Basin	Western Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	219 237	87 465	4 094	7 527	12 730	71 346	29 193	3 232	3 650
Crustaceans	3 175				3	43	3 129		
Incl. gammarus	3 094						3 094		
Euro-American crayfishes	81				3	43	35		
Aquatic invertebrates nei	7					7			
Subtotal finfish	**216 055**	**87 465**	**4 094**	**7 527**	**12 727**	**71 296**	**26 064**	**3 232**	**3 650**
Arctic char, sheefish	772	613	6			3	61	14	75
Asp	125	21		30	6	68			
Atlantic salmon	13		13						
Burbot	2 112	7	279	5	55	49	1 656	25	36
Caspian Sea sprat	23 310					23 310			
Caspian shads	46					46			
Chinook salmon	205	205							
Chum salmon	20 250	20 250							
Coho salmon	442	442							
Common carp	2 257	29		95	204	1 799	124	6	
Cyprinids	20 324	429	16	2 473	1 751	9 762	4 254	658	981
Incl. white bream	3 759		7	1 399	235	2 118			
Carassius spp.	12 032	184	9	1 074	1 483	3 894	3 749	658	981
rudd	3 785				33	3 752			
European eel	2		2			0			
European flounder	7		7			0			
European perch	4 913	213	218	587	241	1 647	1 620	197	190
European river lamprey	61	17	44						
European smelt	4 644	1 992	1 396		1 205		51		
Freshwater bream	21 937	1 377	362	2 298	2 205	15 003	668	24	
Freshwater fishes nei	4 520	131	33		157	3 400	758	35	6
Ide	4 596	895	74	2	567	81	2 975	2	
Masu salmon	9	9							
Mullets	17				9	8			
Navaga	43	41	2						
Northern pike	7 978	142	527	18	703	4 303	2 127	27	131
Pike-perch	3 121	22	72	234	2 216	536	41		

Species	TOTAL	Far Eastern Basin	Northern Basin	Azov–Black Sea Basin	Western Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
Pink salmon	42 680	42 680							
Rainbow smelt	485		8		477				
Roach	10 122	140	264	1 589	1 343	2 986	3 730	67	3
Sea trout	2		2						
Shads nei	6				6				
Sichel	521		30	67	132	292			
Sockeye salmon	15 742	15 742				0			
Sturgeons	236	58				168	10		
Tench	1 488			23		1 465			
Three-spined stickleback, ruffe, bleak	1 489	404	100		578	72	335		
Wels catfish	5 381	17	4	25	28	5 306		1	
Whitefishes nei	14 694	1 589	594		453		7 654	2 176	2 228
Incl. muksun	1 370						693	158	519
Arctic cisco	2 712						196	1 808	708
Broad whitefish	1 763	876					453	6	428
European whitefish	1 683	513	53		132		779	31	175
peled	2 268						2 151	6	111
vendace	4 683		541		321		3 367	167	287
Zope, white-eye bream	1 505		41	81	391	992			

Table 5.5. Catches in inland waters of the Russian Federation by fishery basins in 2010 (tonnes)

Species	Total	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	**262 983**	**97 886**	**4 646**	**11 107**	**12 547**	**90 598**	**37 772**	**4 666**	**3 761**
Crustaceans	3 459			1	82	186	3 190		
Incl. gammarus	2 245						2 245		
Brine shrimp	945						945		
Euro-American crayfishes	269			1	82	186			
Aquatic invertebrates nei	21					19	2		
Subtotal finfish	**259 503**	**97 886**	**4 646**	**11 106**	**12 465**	**90 393**	**34 580**	**4 666**	**3 761**
Arctic char, sheefish	1 627	1 571	49	2			5		
Asp	462	50		4	91	313	4		
Atlantic salmon	70		70						
Burbot	2 373	14	251	80	1	136	1 739	36	116
Caspian Sea sprat	2 588					2 588			
Caspian shads	116					116			
Chinook salmon	99	99							
Chum salmon	46 874	46 874							
Coho salmon	1 183	1 183							
Common carp	3 430	41			491	2 717	176	5	
Cyprinids	38 688	1 407	21	476	7 393	20 991	8 196	156	48
Incl. white bream	5 000		15	390	1 172	3 423			

Species	Total	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
Carassius spp.	22 192	325	6	2	6 193	7 632	7 848	156	30
rudd	10 049	31		84	28	9 906			
European flounder	152		152						
European perch	11 351		351	1 826	235	4 562	3 293	445	639
European river lamprey	24	21	3						
European smelt	4 999	2 237	1 187	1 415			160		
Freshwater bream	30 626	33	418	1 795	2 590	23 350	2 209	82	149
Freshwater fishes nei	5 551	239	26	232	44	4 823	163	12	12
Grass carp	1					1			
Ide	5 143	469	127	47	21	159	4 297	12	11
Masu salmon	10	10							
Mullets	346	5			11	330			
Navaga	103		103						
Northern pike	10 348	961	254	578	134	6 011	2 085	45	280
Pike-perch	3 483		240	910	368	1 809	156		
Pink salmon	17 982	17 982							
Rainbow smelt	242		78	75	1	88			
Roach	15 745	2 058	270	1 614	373	5 989	3 648	1 785	8
Sea trout	12		12						
Sichel	1 279		124	95	448	612			
Silver carp	39				14	25			
Sockeye salmon	22 100	22 100							
Sturgeons	139	42	2			66	29		
Tench	3 729			21	5	3 703			
Three-spined stickleback, ruffe, bleak	1 191	1	108	506	30	218	326	1	1
Wels catfish	10 980	24		1	111	10 798	43	3	
Whitefishes nei	14 455	465	771	585		2	8 051	2 084	2 497
Incl. muksun	936						560	146	230
Arctic cisco	2 300		1				240	1 556	503
broad whitefish	1 055						931	9	115
European whitefish	1 846	65	114	159			1 274	15	219
peled	1 907		9	1			1 488		409
vendace	5 567		647	425		2	3 414	158	921
Zope, white-eye bream	1 963		29	844	104	986			

Table 5.6. Catches in inland waters of the Russian Federation by fishery basins in 2015 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	**285 090**	**136 532**	**4 777**	**13 691**	**10 896**	**75 938**	**33 002**	**5 582**	**4 672**
Crustaceans	4 251			1	133	77	4 020	20	
Incl. gammarus	2 247						2 227	20	
Brine shrimp	1790				129		1661		
Euro-American crayfishes	214			1	4	77	132		
Aquatic invertebrates nei	404			24	78	80	222		
Subtotal finfish	**280 435**	**136 532**	**4 777**	**13 666**	**10 685**	**75 781**	**28 760**	**5 562**	**4 672**
Arctic char, sheefish	2 288	2 232	16				24	1	15
Asp	190					190			
Atlantic salmon	145		145						
Big-scale sand smelt	11					11			
Burbot	2 213	27	124	75		105	1 709	52	121
Caspian Sea sprat	1 507					1 507			
Caspian shads	771					771			
Chinook salmon	310	310							
Chum salmon	73 387	73 387							
Coho salmon	8 460	8 460							
Common carp	3 522	148			265	2 627	455	27	
Cyprinids	33 848	1 912	21	920	7 846	19 203	3 330	250	366
Incl. white bream	4 786		11	408	443	3 924			
Carassius spp.	18 710	397	10	502	7 402	7 453	2 330	250	366
rudd	7 415	49		10	1	7 355			
European flounder	1		1						
European perch	11 045		944	2003	113	3 554	3 057	1 330	44
European river lamprey	369	354	2	13					
European smelt	10 315	7 608	674	1 909			124		
Freshwater bream	20 116	139	344	1 720	1 507	15 001	979	426	
Freshwater fishes nei	7 675	123	11	36	5	7 141	339	10	10
Grass carp	85				12	73			
Ide	5 004	259	86	22	2	178	4 418	21	18
Masu salmon	1	1							
Mullets	687					687			
Navaga	42		42						
Northern pike	12 435	130	574	573	26	6 782	3 906	260	184
Pike-perch	3 970		148	1 044	234	2 410	134		
Pink salmon	18 949	18 725	224						
Rainbow smelt	1 588		108	1 480					
Roach	13 510		160	1 943	214	4 656	4 972	1 542	23
Sea trout	43		43						
Shads nei	24		11		13				
Sichel	1 233		144	191	59	782		57	
Silver carp	909				336	573			
Sockeye salmon	20 525	20 525							

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
So-iuy mullet	29	29							
Sturgeons	48	2	5			8	6		27
Tench	987			12		975			
Three-spined stickleback, ruffe, bleak	1 166	1	28	475		169	489	4	
Wels catfish	7 326	49		1	20	7 241		15	
Whitefishes nei	13 524	2 111	902	384			4 696	1 567	3 864
Incl. muksun	705						307	130	268
Arctic cisco	2 596		1				84	1 196	1 315
broad whitefish	1 083	14	4				268	6	791
European whitefish	1 636	83	130	60		3	955	44	361
peled	2 817		54	1		1 433	889	1	439
vendace	4 241	1	713	323		131	2 193	190	690
Zope, white-eye bream	2 177		20	865	33	1 137	122		

Table 5.7. Catches in inland waters of the Russian Federation by fishery basins in 2016 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	**292 890**	**98 813**	**4 344**	**12 390**	**8 536**	**82 905**	**73 712**	**5 157**	**7 033**
Crustaceans	7 148			2	24	119	6 991	12	
Incl. Gammarus	4 048						4 036	12	
Brine shrimp	2931						2931		
Euro-American crayfishes	169			2	24	119	24		
Aquatic invertebrates nei	842			22		352	468		
Subtotal finfish	**284 900**	**98 813**	**4 344**	**12 366**	**8 512**	**82 434**	**66 253**	**5 145**	**7 033**
Arctic char, sheefish	830	701	12	3			78	21	15
Asp	526		1	10	91	424			
Atlantic salmon	139		137	2					
Big-scale sand smelt	10					10			
Burbot	3 977	32	180	68		115	3 374	71	137
Caspian Sea sprat	1 509					1 509			
Caspian shads	1 130					1 130			
Chinook salmon	150	150							
Chum salmon	54 680	54 680							
Coho salmon	797	797							
Common carp	3 367	97		2	161	2 574	500	33	
Cyprinids	43 043	1 460	81	549	5 882	24 955	8 124	297	1 695
Incl. white bream	4 380		23	511	299	3 547			
Carassius spp.	27 437	437	10	20	5 578	12 316	8 091	297	688
Rudd	7 371			18	5	7 348			
European flounder	3		3						
European perch	13 196		402	1 771	45	3 253	6 278	1 402	45

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
European river lamprey	49	3	30	16					
European smelt	7 193	4 504	775	1 644			270		
Freshwater bream	24 364	30	508	2 053	1 577	17 033	2 669	494	
Freshwater fishes nei	7 249	881	32	37	23	6 183	67	13	13
Grass carp	102				6	96			
Ide	10 029	211	100	26	1	161	9 504	21	5
Masu salmon	1	1							
Mullets	787					787			
Navaga	71		71						
Northern pike	19 077	190	207	542	18	5 938	11 600	109	473
Pike-perch	4 838		155	1 103	245	3 131	204		
Pink salmon	28 763	28 753	10			0			
Rainbow smelt	1 720		158	1 170		392			
Roach	18 190		144	1 183	124	3 498	11 832	1 380	29
Sea trout	34		4	30					
Shads nei	3 279	3 007	36	46	38	152			
Sichel	1 713		179	391	55	1 088			
Silver carp	854				206	648			
Sockeye salmon	2 410	2 410							
So-iuy mullet	267	260			7				
Sturgeons	61	5	10			9	11		26
Tench	994	146		17		822	9		
Three-spined stickleback, ruffe, bleak	1 536	1	39	283		102	1 109	2	
Wels catfish	7 308	42		1	18	7 235		12	
Whitefishes nei	18 501	452	1 044	495		7	10 618	1 290	4 595
Incl. muksun	622	1					288	106	227
Arctic cisco	1 826	1	3				124	911	787
broad whitefish	1 930	41	5				616	10	1 258
European whitefish	2 820	82	147	123			1 662	56	750
Peled	4 500	4	32				3 778	2	684
Vendace	6 480		857	372		7	4 150	205	889
Zope, white-eye bream	2 153		26	924	15	1 182	6		

Table 5.8. Catches in inland waters of the Russian Federation by fishery basins in 2017 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	**270 559**	**67 042**	**12 046**	**11 809**	**10 757**	**80 512**	**76 167**	**5 936**	**6 290**
Crustaceans	5 219				57	256	4 897	9	
Incl. Gammarus	2 458					134	2 315	9	
Brine shrimp	2601					36	2565		
Euro-American crayfishes	160				57	86	17		
Aquatic invertebrates nei	497			5		412	80		
Subtotal finfish	**264 843**	**67 042**	**12 046**	**11 809**	**10 700**	**79 844**	**71 190**	**5 927**	**6 290**
Arctic char, sheefish	1 360	1 228	14	3		4	40	21	50
Asp	931			5	19	906	1		
Atlantic salmon	252		112	140					
Burbot	5 121	23	138	71	7	80	4 535	88	179
Caspian sea sprat	1 062					1 062			
Caspian shads	1 157					1 157			
Chinook salmon	3	3							
Chum salmon	38 934	38 934							
Coho salmon	1 015	1 015							
Common carp	4 821	204		4	533	2 558	1 492	30	
Cyprinids	40 750	1 880	16	411	6 417	23 224	8 130	299	373
Incl. white bream	4 582		8	392	500	3 682			
Carassius spp.	24 317	444	2	12	5 816	9 241	8 130	299	373
Rudd	8 062		3	7	74	7 978			
European flounder	4		4						
European perch	14 958	2	361	1 599	451	3 560	6 884	2 047	54
European river lamprey	346	327	7	12					
European smelt	8 871	6 684	925	971			291		
Freshwater bream	24 772	31	440	2 471	1 278	15 875	3 883	794	
Freshwater fishes nei	7 410	16		18	16	6 492	844	12	12
Grass carp	164				34	129	1		
Ide	10 902	197	72	16	34	131	10 425	20	7
Marine fishes nei	73				72	1			
Mullets	762	5				757			
Navaga	16		16						
Northern pike	22 499	130	1 092	449	124	6 190	13 764	142	608
Pike-perch	5 463	2	167	1 286	540	3 022	446		
Pink salmon	6 706	6 398	308						
Rainbow smelt	1 375		81	1 294					
Roach	20 585		3 121	1 270	411	4 262	9 831	1 653	37
Sea trout	318		302			16			
Shads nei	9 008	8 824	13		31	140			
Sichel	1 629		104	250	307	968			
Silver carp	849				295	554			
Sockeye salmon	520	520							
So-iuy mullet	119	114			5				

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
Sturgeons	43	4	1		2	4	7		25
Tench	779			19	37	722	1		
Three-spined stickleback, ruffe, bleak	1 201		3	278		11	906	3	
Wels catfish	7 057	54			52	6 947		4	
Whitefishes nei	21 099	447	4 661	524			9 708	814	4 945
Incl. muksun	455						110	115	230
Arctic cisco	1 235		3				73	513	646
broad whitefish	2 163	1	1				417	9	1 735
European whitefish	3 132	67	1 038	57			1 188	51	731
Peled	4 856	2	38	1		101	4 042	4	668
Vendace	8 983		3 581	466		1	3 878	122	935
Zope, white-eye bream	1 909		88	713	35	1 072	1		

Table 5.9. Catches in inland waters of the Russian Federation by fishery basins in 2018 (tonnes)

Species	TOTAL	Far Eastern Basin	Northern Basin	Western Basin	Azov–Black Sea Basin	Volga–Caspian Basin	West Siberian Basin	Baikal Basin	East Siberian Basin
TOTAL	**269 084**	**52 297**	**5 295**	**16 269**	**13 157**	**101 887**	**68 466**	**4 945**	**6 768**
Crustaceans	4 939			1	76	177	4 681	4	
Incl. gammarus	2 926					62	2 860	4	
Brine shrimp	1823					11	1812		
Euro-American crayfishes	190			1	76	104	9		
Aquatic invertebrates nei	287	9	4		85	173	16		
Subtotal finfish	**263 858**	**52 288**	**5 291**	**16 268**	**12 996**	**101 537**	**63 769**	**4 941**	**6 768**
Arctic char, sheefish	1 127	997	11	3			57	22	37
Asp	1 102			17	62	1 023			
Atlantic salmon	94		94						
Big-scale sand smelt	6					6			
Burbot	5 833	20	135	586	6	585	4 166	93	242
Caspian Sea sprat	983					983			
Caspian shads	912					912			
Chum salmon	30 419	30 419							
Coho salmon	596	596							
Common carp	5 929	153		2	852	2 656	2 227	39	
Cyprinids	47 428	1 656	13	1 529	6 443	26 372	9 733	250	1 432
Incl. white bream	4 594		11	476	487	3 620			
Carassius spp.	29 011	408	1	41	5 859	12 536	8 489	250	1 427
Rudd	7 704			8	84	7 612			
European flounder	3		3						
European perch	14 136		336	1 906	564	3 877	5 852	1 558	43
European river lamprey	51	26	15	10					

Species	**TOTAL**	**Far Eastern Basin**	**Northern Basin**	**Western Basin**	**Azov–Black Sea Basin**	**Volga–Caspian Basin**	**West Siberian Basin**	**Baikal Basin**	**East Siberian Basin**
European smelt	8 836	6 888	759	784			405		
Freshwater bream	26 440	27	460	2 460	1 418	18 239	3 304	532	
Freshwater fishes nei	7 465	4	35	3	7	6 795	597	12	12
Grass carp	268				56	212			
Ide	11 140	207	94	548	35	1 643	8 579	24	10
Marine fishes nei	181	21	8	6	135	11			
Mullets	555					555			
Navaga	29	9	9				11		
Northern pike	21 985	133	887	1 875	128	7 628	10 722	118	494
Pike-perch	5 830	3	161	1 121	566	3 309	670		
Pink salmon	7 235	7 231	4						
Rainbow smelt	1 446		100	1 306			40		
Roach	33 648		518	2 115	1 511	16 909	10 678	1 384	533
Sea trout	10		1	9					
Shads nei	3 078	2 886	44		8	140			
Sichel	1 625		106	254	304	961			
Silver carp	1 365				720	645			
Sockeye salmon	381	381							
So-iuy mullet	86	83			3				
Sturgeons	42	1	1			8	8		24
Tench	638			44	38	555	1		
Three-spined stickleback, ruffe, bleak	632		3	244		9	373	3	
Wels catfish	6 264	49	15	1	94	6 098		7	
Whitefishes nei	13 614	498	1 414	457		59	6 346	899	3 941
Incl. muksun	543						142	150	251
Arctic cisco	1 135		3				63	457	612
Broad whitefish	1 451	23					288	10	1 130
European whitefish	2 166	71	627	30		9	865	53	511
Peled	3 073		18			20	2 376	10	649
vendace	4 842		766	427		30	2 612	219	788
Zope, white-eye bream	2 446		65	988	46	1 347			

Appendix 6

The following figures come from the almanac Russia's fish industry, 2005. LLC Publishing House 'Darin':

Amur sturgeon, page 314

Beluga sturgeon, caught in 1989, page 113

During the haul of seine ice fishing, page 102

Harvesting of broodstock, page 250

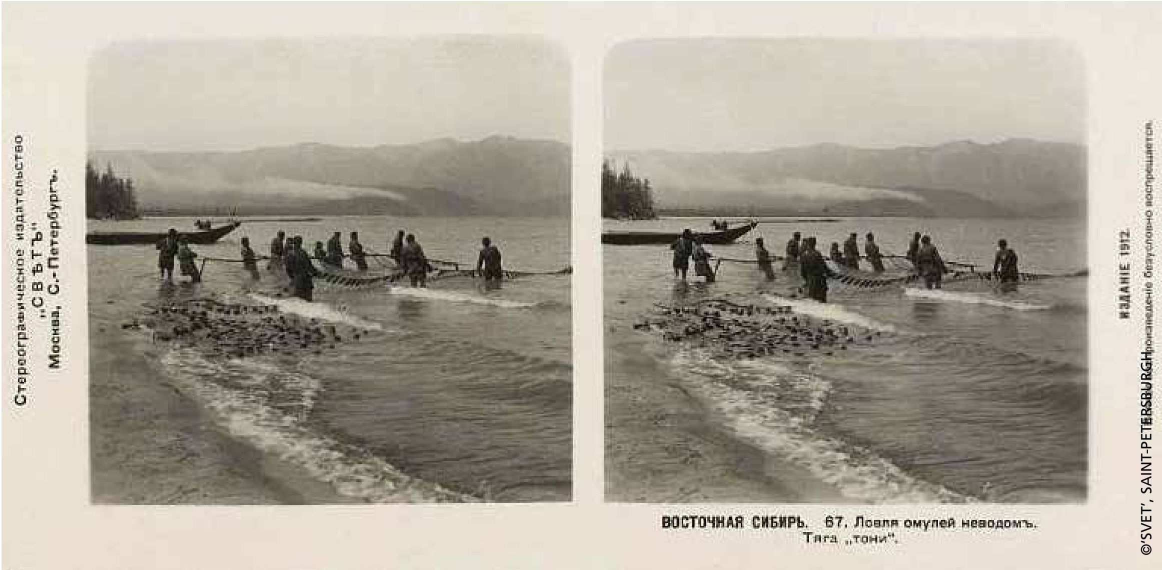
The following figures come from ***Essays on the history of Baikal fisheries*** (Bazov, A.V., forthcoming). Moscow, VNIRO.

Recovering the seine on a seine boat, 1947.

Setting nets by residents of Kultuk village on South Baikal Lake.

Photo by V.S. Zhitenev, 1927. Available at http://cult-and-art.net/society/14325-bajkal__kultuk_20e_gody__zhiteli_kultuka__#otherpubs

Catching omul with a seine, dragging of a tonya, 1912.



Landing of omul at the Oymur fish station, 1950s.

Returning to the fish station with the catch.

Photo by E.D. Bryukhanenko. *Chronicle of the Angara Region* [online]. Available at https://i.irklib.ru/cgi/irbis64r_61/cgiirbis_64.exe?P21DBN=HRONP&I21DBN=HRONP&S21FMT=fullwebr&C21COM=S&S21CNR=20&S21REF=1&S21ALL=(I%3C.%3E%3E%3 % 3C.% 3EV = EXT% 3C.% 3E) & S21SRW = GOD

Taimen.

Photo by E.D. Bryukhanenko. Chronicle of the Angara Region [online]. Available at: https://i.irklib.ru/cgi/irbis64r_61/cgiirbis_64.exe?P21DBN=HRONP&I21DBN=HRONP&S21FMT=fullwebr&C21COM=S&S21CNR=20&S21REF=1&S21ALL=(I%3C.%3E%3E%3 % 3C.% 3EV = EXT% 3C.% 3E) & S21SRW = GOD

Omul, 1947.

Catch of spawning omul, 1948.

Seine net catch.

The Russian Federation is the largest country in the world occupying one-third of Eurasia and it has enormous water resources and fish from inland waters has always been a central part of the diet in the Russian Federation and a major contributor to national food security. Inland fisheries are highly diversified and provide employment to 40 500 fishers in industrial fisheries. In addition an estimated 2.4 million amateur and recreational fishers and around 150 000 Indigenous Peoples fish for subsistence and small-scale trade.

Historic production figures surpassed 500 000 tonnes of fish from Russian inland fisheries, but have declined over the last 40 years and current official catches are around 270 000 tonnes. However, unrecorded catches by recreational/amateur fishers add up to an estimated 100 000 tonnes annually, and subsistence catches by Indigenous Peoples probably add another 67 000 tonnes; and finally, illegal catches may add another 50 000 tonnes, suggesting that total landings are not far from what was caught in the past.

The Russian Federation has invested significant resources and efforts into developing and managing inland fisheries and aquaculture. The review presents the current management structure and summarizes the comprehensive legislation governing inland fisheries, including also the agreements with the neighbouring countries sharing some of the major waterbodies or rivers.

ISBN 978-92-5-138617-0 ISSN 2070-7010

9 789251 386170

CC9895EN/1/05.24