Russian Fisheries Management System Performance

(The Sea of Okhotsk Walleye Pollock Fishery Case Study)

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Introduction

For more than 50 years, wild capture fisheries had gone far beyond being an internal matter of fishermen societies. After World War II, technological progress in shipbuilding, mechanics, and hydroacoustics led to a sharp increase of distant-water fishery harvest. Consequently, several major fish resources notably declined due to increased fishing pressure in a short time. That situation required development of international fishery regulation and management systems to constrain the freedom of the sea in relation to distant-water fisheries. World leading fishery states initiated negotiations to conclude a new fisheries treaty.

The management of fish as a renewable resource has received increasing attention since the adoption of the United Nations Convention on the Law of the Sea (UNCLOS) in 1982. At the end of 20th century, facing the need to guarantee food and nutritional security for the world's increasing population, fishery managers raised specific concerns about illegal fishing, catch discards, water pollution, overcapitalization of the fishing industry, etc. In 1995, the FAO adopted the Code of Conduct for Responsible Fisheries that targets the conservation and sustainable use of fishery resources. The Code consists of a collection of principles, goals and elements for action guiding a country's fishing operations and policies be designed to achieve long-term fishery stock sustainability, conservation of resources and aquatic ecosystems, and effective integration of fisheries into coastal area management as a consequence of improved understanding of the ecosystem concept. "*The Code of Conduct has been an unmitigated success, because it captures both the essence of nature conservation and the need for developing countries to grow and prosper*," said Arni Mathiesen, FAO Assistant Director-General for Fisheries and Aquaculture speaking at the 20-years Code Anniversary celebration.

Efficient fishery management, ecosystem-based research of fishery resources, and responsible post-harvest and trade practices present approaches and a toolkit to implement the Code's principles. However, climate change impacts bring increasing uncertainty in many food sectors, including capture fisheries, and climate adaptation approaches will need to be well integrated with the processes of improving fisheries governance (SOFIA 2012). Sustainable fisheries have become a matter of urgent global concern because fishery harvest provided about 17% of the global population's intake of animal protein in 2013. This concern is not about world hunger only. It also reflects societies' rejection of illegal, unregulated, and unreported (IUU) fishing that depletes fishery stocks, destroys marine habitats, and produces seafood that may be unsafe for human consumption.

Since 1995, several international legal instruments were adopted and put in force in order to support a sustainable fishery in the World Ocean. There is the opinion that real progress in securing sustainable fisheries can only be measured by the actions and achievements that become incorporated into routine fisheries management and conservation practices for those concerned (Singh-Renton & McIvor 2015). In view of this, FAO has recently initiated reviewing of current fisheries management and conservation measures in several regions of the world, in particular in the Indian and Pacific Oceans (De Young, 2006, 2007). These reviews are intended to shed light on the level of application and success of internationally-agreed fisheries management paradigms.

In national EEZs, fishery states may apply their own approaches to handle fishery management challenges. Reviewing of such approaches would not only provide transparency for a compliance assessment but may be also useful for comparative inter-regional analysis and development of new useful tools for a regulatory and legal fishery management framework. From this point of view, the largest national fisheries are of particular interest because such fisheries concentrate a bulk of resources, managerial and research efforts, and notably influence a coastal states economy, fisheries venture sustainability, and well-being of coastal communities. These words equally pertain to the Sea of Okhotsk walleye pollock fishery—the biggest in the Russian Far East.

Analysis of the Main Elements of the Regulatory and Legal Framework of the Fisheries Management System in Russia

Evolution of the fishery management in the Russian Federation

The current fishery management structure in Russia originated in the early 2000s. Previous centralized management approaches became obsolete after the dissolution of the Soviet Union in December 1991 and starting of Russian economy re-organization in compliance with private property principles and the conditions essential for market efficiency. The need for developing general policies and guidelines that would allow efficient regulation of fisheries and preserve fishery stocks initiated development of temporary governmental acts, instructions, and reporting forms that have been in force for more than a ten-year period.

Natural walleye pollock stock decline that occurred throughout the North Pacific in the early 1990s has inspired the regulator (i.e., Russian federal government) to place more attention within the new fishery governance system on conservation of marine biological resources. Excessive unregulated fishery pressure on walleye pollock resources in neutral water enclaves in the central Bering and Okhotsk Seas exacerbated the situation. Major fishery stocks reduction as well as a rapid rising bunker fuel costs, splitting of fishery ventures in the privatization process, and emersion of additional administrative barriers in the new business environment led to a notable drop of Russian fishery harvest to below 3.06 million tons in 2004.

While overfishing seemed to be an evident reason for walleye pollock abundance decline, Russian fishery management readily accepted the precautionary approach as a main tool of fishery regulation. In 1990s, the precautionary approach was incorporated into international law on fisheries including the UN Agreement on Straddling and Highly Migratory Fish Stocks and the FAO Code of Conduct for Responsible Fisheries that Russian Federation joined in 1997. In subsequent years, Russia concluded a number of regional fishery agreements providing a framework for combating the IUU fishing and restoration of the walleye pollock stock. In accordance with its international obligations regarding conduct for responsible fisheries, the Russian government needed to expeditiously improve the fisheries regulatory framework. Another engine of advanced policy-making in fisheries was a strong call to action from a continuously evolving stakeholder community that required clear, understandable, and consistent rules of game.

Contemporary legal framework of Russian fisheries management

The contemporary legislative basis of the Russian fisheries management was established in 2003. The Government Edict No. 1265–r of September 2, 2003, "*Fisheries Development Concept of the Russian Federation for the Period until 2020*" and Resolution No. 704 of November 20, 2004, "*About quotas on the water biological resources*" created a new mechanism of long-term (five-year) quota allocation between fishing companies. As became evident from these regulatory legal acts, the Russian Government has made a clear choice in favor of a governance system based on the "vertical" top-down alignment of regulation of fishery operating procedures including allocation of fishing rights (fishing permits), quota allocation, monitoring and control of fishing fleets, and governing of fish harvesting, processing, and trade. Other stated aims of the new legislation were limiting a number of fishery resource users that grew disproportionately large in 1990s, and improving reliability of fishery statistics.

Following a period of many years to draw it up, the Federal Act "*On Fisheries and Water Biological Resources Conservation*" No. 166-FZ (hereafter the Fisheries Act) was signed on December 20, 2004. Its implementation required thirty more legislative documents including 15 governmental resolutions including Resolution No. 583 of September 26, 2005 "*About definition the total allowable catches of aquatic biological resources and making changes to them*". Among other statements, this federal act strengthened the main element of the legal framework of the Russian fisheries management system: annual total allowable catch (TAC) setting for the fishing objects.

Despite there was no special emphasis in the Federal Act nor in the Resolution No. 583 that the TAC principle is obligatory for all marine biological resources, it was immediately applied for the whole set of fisheries including rare fish species harvested mainly as a by-catch and Pacific salmon with their fairly unpredictable magnitude of the spawning run. This approach raised the problems being unresolvable under the regulatory framework conditions: impossibility of by-catch utilization, lower quality of fishery statistics, and lack of on-the-spot regulation and redistribution of fishing effort. Currently, a rule introduced to the Russian fishery regulation in 2009 stipulates that some fishery species may be harvested without an established TAC, with allocation of scientifically grounded volumes among users by an application principle. These rules are mainly applied to fishery resources of low demand and not applicable for any walleye pollock stocks.

In general, fishery management by TAC had more advantages than negative consequences for regulatory and legal framework development. Standard and universal approaches were applied to the management and conservation of federally owned fishery resources. Conditions for fair and long-term allocation of commercial fishing quota and fishing rights were granted by the government in Resolution No. 704 and implemented later in the Federal Act. Rapid growth in the number of users of fishery resources and fishery fleet overcapitalization that became excessive for some fisheries, especially those of resources with a high market demand, was restricted. Instead of auctioning fishing rights, TAC management made it possible to apply a sustainable taxation mechanism to the users of fishery resources, which ensured a regular and

predictable income to the federal budget. Among other measures, comprehensive status reviews of all fishery populations were completed with assessment of their current condition trends.

The fishery regulatory framework based on the new legislation announced a principle of priority of conservation of resources and a precautionary approach to their use. Specific fishing regulations were adapted to the local conditions of each fishery basin.

Types of fisheries in Russia

The established fishery regulation framework concerns all the seven types of fisheries including commercial offshore and near-coastal fishing; subsistence fishing by indigenous people; scientific and test fishing; fishing for training and educational purposes; fishing for enhancement and aquaculture; and recreational and sport fishing.

Pelagic trawl is the main fishing gear for the walleye pollock commercial fishery in the Sea of Okhotsk as well as in other fishing areas (western Bering Sea, waters around the Kurile Islands, etc.). In the Northern Sea of Okhotsk fishing sub-zone (**Figure 1**), 98.7% of total walleye pollock harvest was, in average, fished by pelagic trawls in 2012-2015. In the Western Kamchatka fishing sub-zone, the pelagic trawl proportion averaged 92.5% of total walleye pollock harvest while other 7.5% were fished by Danish seines in near-coastal fishing in those years. In the Kamchatka-Kurile fishing sub-zone, pelagic trawl vs. Danish seine ratio was equal to 76.7% vs. 23.3%. Pelagic trawl fishery is more specialized than a Danish seine fishery. According to on-board monitoring data, fish bycatch (about 20 species with predomination of sculpins and flatfishes) totalled about 1.2% of catch weight. Danish seine fishery catches contain more bycatch species (more than 30 including Pacific herring and smelt) with total bycatch weigh up to 29.4% in particular years (TINRO-Center 2016).

Quotas for scientific and test fishing became negligible after catch processing and any production based on scientific and test fishing catches was prohibited by the Federal Act No. 250-FZ of December 3, 2008. Four other types of fisheries are scarcely applicable to walleye pollock resources.

The newest development in the legal framework of Russian fisheries is establishment of quotas for investment purposes to award fishing companies for ordering new fishing vessels built in Russian shipyards, according to the Federal Act No. 349-FZ of July 3, 2016. Such a quota amount might include up to 20% of EEZ and coastal commercial fishery quotas. In the first application, this mechanism will be applied to high-demand fishery resources including walleye pollock. Implementation of this mechanism of quota allocation in expected in 2019.

Walleye pollock fisheries regulation by the Fishing Rules for the Far Eastern Fishery Basin

Walleye pollock contributed 55.0% of the Russian Far East basin's fishery harvest for the five years (2011-2015) and about two thirds in a historical perspective. Initially, in late 1970s – 1980s, the exploitation rate 0.3 was mostly applied to the pollock TAC calculations. It was just an expert recommendation based on first estimates of walleye pollock natural mortality rate.

However, in those times, pollock biomass was likely underestimated (Shuntov et al. 1993). Then, in the late 1980s, when reliable walleye pollock biomass estimates were obtained, actual harvest rate occurred to be at 0.11-0.14 for all major stocks.

In 1995, well-known paper was published by E. Malkin (1995) that related exploitation rate with age of maturity of fished stocks. Despite some limitation should be applied to the proposed approach, Malkin's coefficients of exploitation rate became widely used for different fishery stocks including walleye pollock: 0.266 for the Sea of Okhotsk and 0.234 for the Bering Sea. In the second half of 1990s, when pollock biomass decline occurred, there were recommendation to decrease the exploitation rate below to 0.2 in accordance to the precautionary approach (Babayan 2000). However, this recommendation was first applied to pollock stocks under rebuilding regime only.

Since 1998, the Harvest Control Rule (HCR) elements – calculations of biomass and fishing mortality reference points began to be used more widely to ground the walleye pollock TAC because the procedure of independent ecological expertize was established by the Russian government. It required more "scientific" approach to develop the fishery forecast for all fishery stocks. For walleye pollock, it was not a simplified procedure like "if estimated biomass is at level _X_, then exploitation rate (or catch, or effort) will be _Y_". All pollock biomass estimations were considered by age classes and specific mortality rates applied. However, walleye pollock researchers and managers always made attempts to solve some pollock fishery problems (i.e., juvenile fish bycatch, discards, herring bycatch near the north-western Kamchatka, etc.) by decreasing the TAC value together with recommendations on fishery closures.

Later, the TAC setting process became more formalized that allows authors of certification report during the MSC evaluation of the Russian Sea of Okhotsk mid-water trawl pollock fishery to write that "the HCR was used for the first time in December 2010 as the basis of the 2012 TAC".

In addition to official management by TAC, a wide array of management measures has been implemented to regulate major Russian fisheries including the walleye pollock commercial fishery. All specific management measures for fisheries are prescribed in the Fishing Rules that are set separately for each sea and inland fishery basin. Geographically, walleye pollock fisheries are regulated by the "*Fishing Rules for the Far Eastern Fishery Basin*" (hereafter Fishing Rules) in the latest version released by the Order of the Ministry of Agriculture of the Russian Federation No. 385 of October 21, 2013.

The Fishing Rules defines time and area openings for commercial fishing, fishing gear type, and construction regulations including a legal mesh size of nets. This rule book also includes standard fishery regulations describing the responsibilities of the fishing company, a list of the documents to be available on board fishing vessels, and minimum legal sizes for fish and other harvested species, by-catch regulations, etc. In consideration of fishing restricted areas, one of the main principles was establishing the goal to protect fish spawning grounds, young fish concentration domains, and important biotopes inhabited by protected and endangered fauna.

Some restricted areas were established by closing fishing activities to protect marine mammals on their feeding grounds and in waters nearby haul-out sites on rookeries and beaches. In general, Fishing Rules for the Far Eastern Fishery Basin set more than fifty permanent and several seasonal fishery closures. Most of closures prohibit usage of any fishing gear while some ban trawls and/or bottom nets.

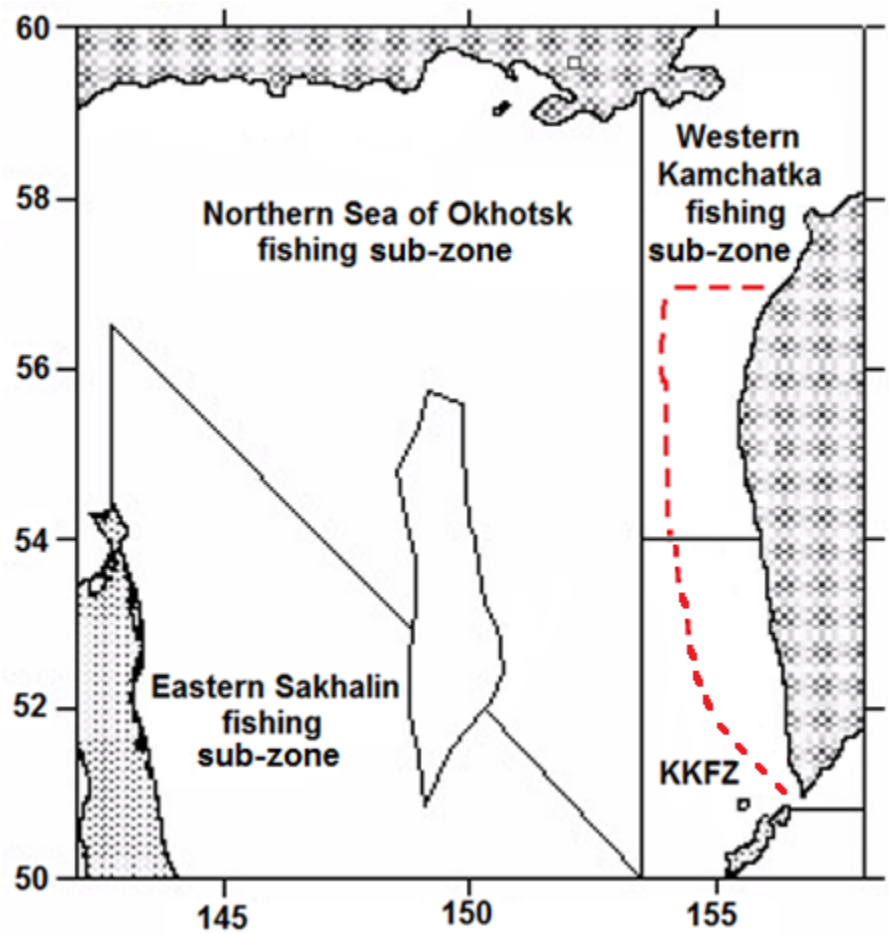

Figure 1. Fishing sub-zone pattern in the northern Sea of Okhotsk. Irregular shape in the central part of the Sea is the neutral waters enclave (the "Peanut Hole"). The area closed to the trawl fishery is depicted by red. KKFZ means the Kamchatka-Kurile fishing sub-zone.

Considering the walleye pollock fishery, all major fishing rules (net mesh size limit, by-catch regulations, etc.) were first set by the Soviet era's Fishing Rules of June 24, 1969, and afterwards, several important restrictions were set by the Fishing Rules of November 24, 1980. In particular, bottom trawl operations were prohibited from using fishing vessels equipped with engine power more than 225 h.p. (approximately 167.8 kW, completely prohibited in 2007). Seven main area closures were also set in 1980. In the current version of Fishing Rules, walleye pollock spawning grounds in the eastern Sea of Okhotsk are protected by a ban on trawl fishing operations in inshore waters shallower than 100 meters along the Kurile Islands, 200 meters along the western Kamchatka coast (southward from 57°N), and 30 meters along the Eastern Sakhalin coast.

Even more effectively, the walleye pollock spawning period is protected by seasonal closures. In the Western Kamchatka and Kamchatka-Kurile fishing sub-zones (**Figure 1**) the winter-spring fishing season is closed with the beginning of pollock mass spawning, but no later than April 1st. After the seasonal closure, the trawl fleet can renew fishing after November 1st, while small vessels (less than 34 meters long) that fish with a Danish seine can renew fishing after June 1st. In the Northern Sea of Okhotsk fishing sub-zone, the winter-spring pollock fishery is stopped with the beginning of pollock mass spawning, but no later than April 10th and opens after October 15th (after June 15th for small seiners).

The walleye pollock fishery is also regulated by fish legal size (≥35 cm for commercial fisheries), allowable by-catch of undersized juvenile fish of no more than 20% of the total number in the catch (8% in the Western Sakhalin fishing sub-zone), trawl and seine net construction and mesh size, and allowable ratio of pollock roe to the round weight equivalents of processed pollock. These measures are explained in detail in other sections.

Performance of political, legal and institutional measures

Adaptive management of fish stocks should be based on multiyear information concerning the abundance of fish in the stock, fish distribution, and the fishery impact including effect of different harvesting strategies on the stock as well as other aspects of the dynamic marine environment (Cox & Kemp 1999). Proceeding from the above description of the regulatory and legal framework of the fisheries management system in Russia, it complies with the basic requirements. Nevertheless, to facilitate performance evaluation, a comparative approach may be efficiently applied.

University of Washington scientists have recently used expert surveys to characterize attributes of research, management, enforcement, and socioeconomics of fisheries management systems in 28 major fishing countries that collectively account for >80% of global total catch (Melnychuk et al. 2016). The survey criteria were purposely specified by the effectiveness in limiting fishing pressure on target species. The individual impact of each management attribute was quantified based on how it affects recent status and trends of stock size and fishing mortality. The Fisheries Management Index (FMI) for each returned survey was calculated as an indicator of the effectiveness of management systems in meeting objectives. With a high FMI value, the Russian Federation ranked in fourth place after the United States, Iceland, and Norway (**Figure 2**).

About ten years prior to this assessment, another research group also conducted a similar survey to estimate the effectiveness of fisheries management systems worldwide (Mora et al. 2009). Their analysis showed that only 7% of coastal states underwent rigorous scientific assessment for generation of management policy, 1.4% also developed participatory and transparent processes to convert scientific recommendations into policy, and less than 1% provided for robust mechanisms to ensure compliance with regulations. There was no characterization of the Russian fisheries management system itself. On a map that presented the results of experts' opinions on the valuation of scientific robustness of the management system, Russia (regarding the Far-Eastern fishery basin) was graded among states with the best performance. Good

performance was noted for such metrics as fishing capacity and reliance on subsidies, as well as the general estimate that the probability of fisheries in the Russian Far Eastern were sustainable in 2004 (Figure 3 in Mora et al. 2009). A satisfactory rating was assigned for transparency in policymaking and for the capability in implementing the Russian fisheries management system. More unexpectedly, proceeding from these results, an overall effectiveness of the Russian fisheries management in the Far East totaled slightly above 50% of the best performance (Figure 3 in Mora et al. 2009). We can conclude that the Russian fisheries management system has seen vast improvements in the areas mentioned above, despite numerous difficulties undeniably stood in the way of its implementation.

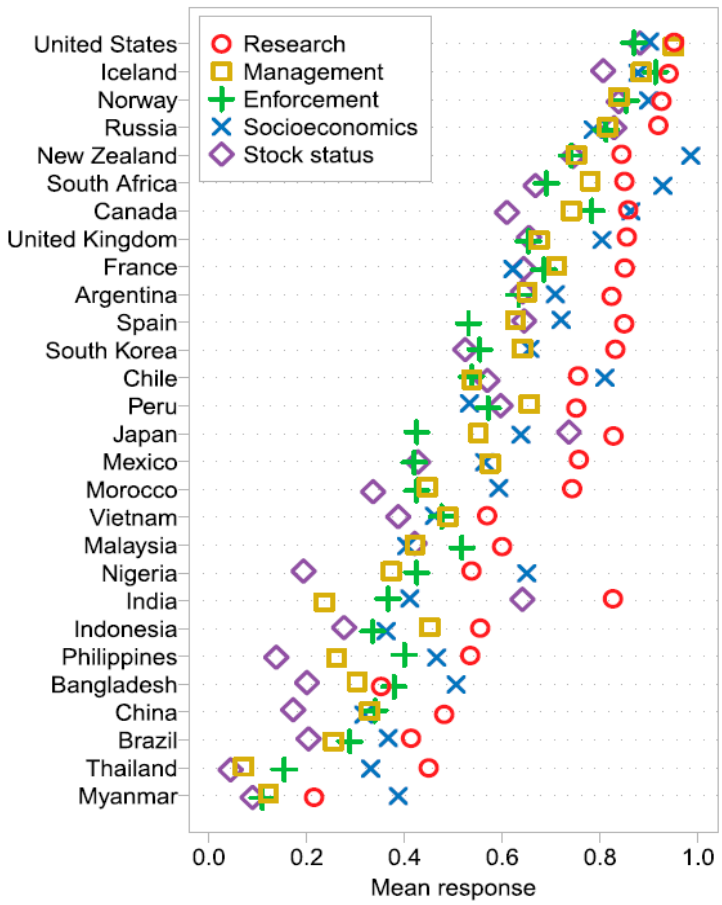

Figure 2. Twenty-eight countries sorted by Fisheries Management Index values, a composite of research, management, enforcement, and socioeconomics dimensions from a survey conducted and analyzed by Melnychuk et al. (2016). Responses were weighted by both respondent expertise and confidence in individual answers provided and adjusted for observed differences among respondent background categories.

Recent analysis by Melnychuk et al. (2016) suggests that countries with greater wealth generally have greater capacity for investment in management and that is why the most influential factors involved were monetary investment in management systems. Per capita gross domestic product had the strongest effect on FMI (Melnychuk et al. 2016). An investment pattern also plays an important role. The ratio of beneficial subsidies (i.e., investment in research, management, and enforcement) to landed value positively influenced the FMI, while the ratio of fleet capacity-enhancing subsidies to landed value influenced the FMI negatively. An important observation is that countries with greater reported catches in their own EEZs had greater FMI, suggesting that

with greater landed value derived from fisheries resources, countries invest more to better manage those resources.

That is especially fair for the case of walleye pollock, which is fished exclusively in the Russian EEZ. The walleye pollock stock decline in the early 1990s was exacerbated by over-pressure from unregulated fishing by foreign fleets in international waters of central enclaves during their migrations beyond the EEZ ("Peanut Hole" in the Sea of Okhotsk and "Donut Hole" in the Bering Sea). After special efforts were undertaken by coastal countries' diplomatic corps to protect walleye fishery stocks in international waters, the Russian fisheries management system demonstrated a specific sensitivity to conservation of these stocks.

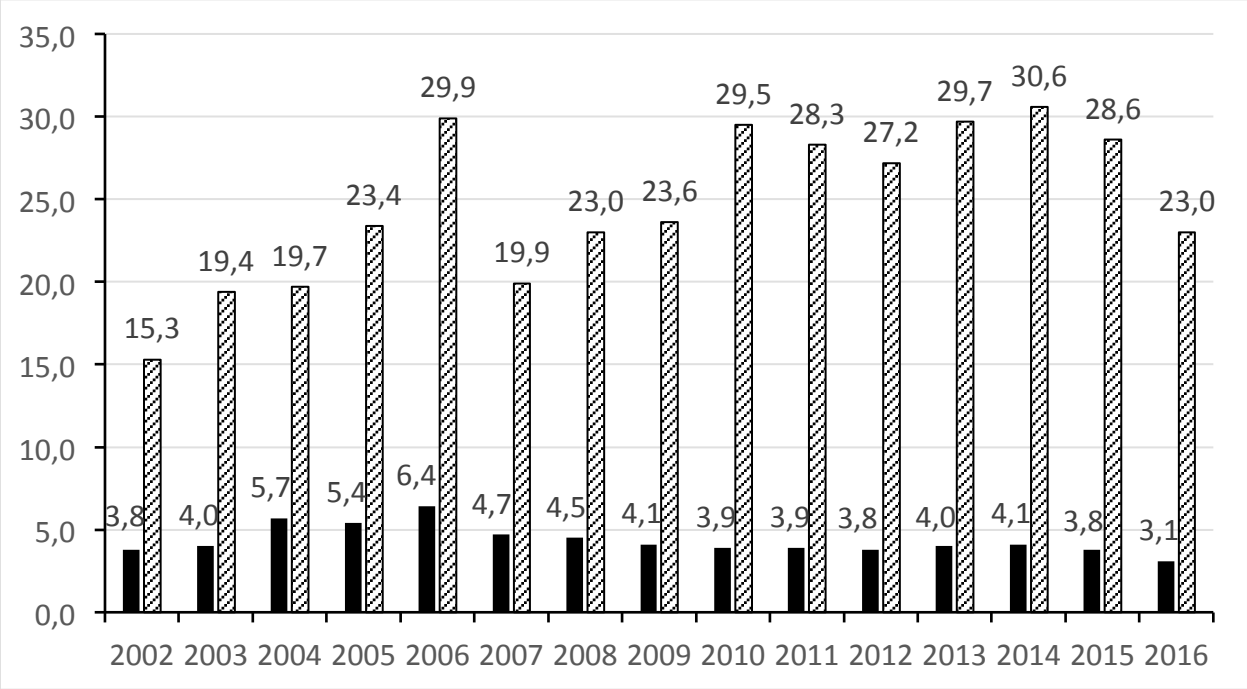

Figure 3. Annual (fishing season in November–April) roe production (light columns, 1,000 metric tons) and roe proportion (black columns, %) of the round catch weight in the walleye pollock fishery in the northern Sea of Okhotsk, 2002–2016 (TINRO-Center 2016).

No other species fishery management involves such a wide array of regulations to meet the requirements of stock sustainability. There is a rule that regulates the proportion of pollock roe that may be retained onboard a vessel and the round catch weight of walleye pollock. From November to April, the proportion of pollock roe should be not more than 4.5% of the round catch weight in any fisheries in all regions, except for the main walleye pollock fishing area in the Sea of Okhotsk: the Western-Kamchatka, the Kamchatka-Kurile, and the Northern Sea of Okhotsk fishing sub-zones. In these sub-zones, the roe proportion is regulated by a monthly target ratio: 1.0% in November, 2.0% in December, 2.7% in January, 4.0% in February, 5.0% in March, and 7.0% in April. These standards are strictly enforced by the Border Service of the Federal Security Service of Russia (hereafter the Border Service). In 2002–2008, the roe proportion rule was merely of an advisory nature, and often violated (**Figure 3**). Since the 2008 pollock fishing season, the roe proportion rule became a regulation, and 17 large tonnage

trawlers were apprehended for its violation. Since 2008, the walleye pollock roe proportion has not exceeded an average of 4.1% for the whole fishing season. That is evidence of success of applying a regulation preventing the wasteful practice of pollock processing by a "stripping" the roe from female fish and discarding part of the pollock catch without further processing to collect the more valuable roe product from a relative amount of fishing quota. In 2008–2013, the roe proportion ratio was an object of thorough onboard and laboratory investigations and, then, obtained its final shape adopted by the last revision of the Fishing Rules.

Transparency in fisheries management mechanisms

There are several milestones that correspond to development of a transparent decision-making process in the Russian fisheries management system. First, transferring of TAC determination beyond the fisheries managing authorities was initiated by the Russian government in 1997. Independent institution of ecological appraisals of the TAC projections was established under the Ministry of Natural Resources and the Environment of the Russian Federation while the Ministry of Agriculture (and then the Committee for Fisheries) supervised fisheries regulation and management. Practically, it means that scientific experts from universities and academia received ultimate rights to assess data availability and quality of preparation of the TAC projections by fishery science specialists. An important aspect of ecological appraisal is to make it sure that the particular fishing practice and proposed rate of commercial harvesting of the fish stock under consideration will not damage marine ecosystems, vulnerable habitats, and sustainability of resources. While it was a bit complicated in the beginning, the networking process between developers and reviewers led to significant improvement in organization of the fishery forecast, developing the management plan within the fishery science framework, successful exploration of the theoretical basis of fishery forecasting, and wide implementation of the precautionary approach (Babayan 2000). The Branch Council on Fisheries Forecasting was established by the Federal Agency for Fisheries in 2004.

The second positive step in increasing transparency between government and stakeholders was the obligatory inclusion of public hearings in the process of TAC legalization. These public hearings are widely announced in mass-media to inform stakeholders, residents of the coastal regions, NGO representatives, and public activists. This was not a totally new mechanism because fishing rights holders previously had access to TAC development information and opportunity to discuss a draft TAC and management plan at the scientific fisheries institution reporting sessions and at meetings of a regional fishery council (advisory body established at the regional authorities). However, obligatory status of public hearings increased the role of public considerations and upgraded communication to a higher level.

At public hearings, fishermen often insist in clarifying the fishing rules and make fishing regulations more solid. A recent example related to the walleye pollock fishery regulation was a fishermen's proposal at the public hearings on the TAC-2017 projection to prohibit specialized fishing for pollock westward of 174°E to enhance conservation of the overfished Western Bering Sea pollock population (WWF 2016). With support of fishery science, this initiative was

included in the order of the Federal Agency for Fisheries to introduce amendments to the Fishing Rules for the Far-Eastern basin.

Since 2000, the Pacific Research Fisheries Center (TINRO-Center) in response to the increasing trend in fishermen awareness began publishing pre-seasonal forecasts for the major regional fisheries including the Sea of Okhotsk walleye pollock fisheries. This publication contains a review of stock conditions; a summary of previous fishing season and up-coming season expectations; forecasts on long-term weather, hydrological, and thermal conditions; and information on new and amended regulations and market conditions, etc. It quickly became popular among stakeholders and managers as an information bulletin.

Private certification schemes and eco-labelling played an important role in increasing transparency and improving communication to the public on TAC setting for correspondent fisheries. Fishermen seeking to enter the international market of products certified by the standards of the Marine Stewardship Council (MSC) themselves insisted on full transparency of all processes related to TAC determination, fishing rights, and individual non-transferable catch quotas (INTQ) shares allocation. Large fishermen associations began creating their own web-based information resources, e.g., the Pollock Catchers Association, which publishes fishing season outlooks and reviews, scientific and market information, proposals on regulation framework improvements, etc.

Since 2005, the Russian Government considered a transfer of fishery research institutes that functioned in a legal form of venture to federal state budgetary scientific organizations as an important measure to increase independence of business units and decision-making transparency in determination of TAC and preparation of regulatory measures. This transition was finally completed in 2015, and fishery research institutes continued functioning government-financed budgetary institutions with all correspondent restrictions being applied. The main idea is that while supported by a national government, fishery research institutes will continue on a voluntary basis to enjoy the independence from business collaborators and cooperation with fishing ventures, which have a direct interest in the scientific research outcome. Increasing of governmental science independence of business is considered a positive factor to increase transparency in development of scientific advice. Nevertheless, government would be able to safeguard the capacity of scientific institutions to conduct expensive and necessary marine research and fishery monitoring. Considering the current research fleet conditions in the Far-Eastern basin, where the newest vessels were built more than 20 years ago, this matter is therefore of concern.

Transparency in fishing rights allocation in Russia will be tested again before 2019, when a mechanism of investment quota allocation will be first implemented while the INTQ shares will be set out for 15-year period. Currently, with existence of reputable and consolidated fishermen association, which unites the major walleye pollock fishing companies, i.e. Pollock Catchers Association (PSA), there are more expectations that a process will be equitable and open to public.

National system of disclosing information on measures for aquatic biological resources conservation and fisheries management in Russia

In 2007, the Russian Federal Agency for Fisheries created a country-wide network consists of 18 territorial departments, whose responsibility is to perform fisheries management, regulation, fishery enforcement in inland waters, disclosure of information to stakeholders and the public, etc. Territorial departments also coordinate efforts on fisheries regulation and fishery stock conservation with regional authorities that is exceptionally important for regulation of coastal fisheries organized with distributed responsibilities, i.e. Pacific salmon fisheries. Each territorial department supports an informative websites by uploading all information on adopted measures for fishery resources conservation and fisheries management, obtaining and renewal of fishing permissions and licenses, electronic copies of regulatory documents, regional fishery news, and relevant scientific information, as well as contact information for staff and a hot-line to the operations desk. All these websites are linked to the Federal Agency for Fisheries website with the most comprehensive database of statutory regulations in fisheries and fishery resources conservation.

The Federal Agency for Fisheries website and many of the territorial department websites also provide a fishery news feed. However, none of them gives the public an opportunity to discuss this news on-site. This gap is readily filled by fishery inform-media with the most popular and largest of them being the media holding Fishnews.ru. Several years ago, the "Open Industry" project was created by Fishnews.ru to develop a coordinated public position, conclusions, and proposals on the most important issues for the fisheries sector. Another popular web source of fishery news feed is a web media Fishnet.ru. Throughout the far-eastern region, such web media as fishkamchatka.ru, fishery research institutes (e.g., www.tinro-center.ru), and fisherman associations (dalryba.ru, www.pollock.ru, www.russianpollock.com) also significantly contribute to the news flow related to fisheries. Considering the walleye pollock fishery in the Sea of Okhotsk, TINRO-Center electronically publishes weekly fishery reviews, including weather and fishing condition forecasts, current cumulative TAC percentage, by-catch information, number of current scientific observers at-sea, etc. As of March 2017, fifteen scientific observers oversee the Sea of Okhotsk walleye pollock fishery onboard commercial fishing vessels (TINRO-Center 2017).

Beyond the web media space, the Russian fisheries management authorities communicate with citizens in accordance with requirements of the system for handling public appeals. This system is rather conservative with a routine 30-day responding time to both electronic and hard-copy appeals. National, regional and fisheries newspapers have lost popularity with further development of electronic media. Nevertheless, some official bulletins, e.g. “Rossiyskaya Gazeta”, continue as the official publications. Presidential decrees, governmental resolutions, and diverse ministry orders come into force after publication in the pages of “Rossiyskaya Gazeta”.

Effectiveness analysis of fisheries monitoring and control system

Recent developments in fisheries monitoring in Russia

The informational system for monitoring fisheries sectors in Russia was established by the then State Committee for Fisheries in 1996 (Order No. 185 of 10 October 1996). This system was based on collection and processing of fishing ship activities daily data (SDD) as well as on operational and statistical reports on catches and seafood production by fishery ventures. Satellite positioning data began to supplement these information flows in 1999, when regional centers of monitoring were established by the Government Resolution No. 226 of 26 February 1999. Real-time data on fishing vessel positions transferred by technical means of control (TSC) significantly improved efficiency of monitoring fishing fleet sectors and laid the groundwork for the contemporary fishery enforcement system (Koshkareva 2006).

Data on fishing fleet positioning are analysed by the regional coordination centers of the Border Guard Service of the Federal Security Service of Russia, who enforce fishing regulations in the Russian EEZ and adjacent waters under international agreements. The Federal Agency for Fisheries is responsible for proper functioning of the system, including establishment of procedures for equipping vessels with TSC and defining eligible types of TSC.

The technical side of the fishing sector monitoring is under constant control of the Federal state budgetary establishment «Fishery and Communications Monitoring System Center» (FCMSC), which is directly subordinated to the Federal Agency for Fisheries. In 2015, problems emerged with the use of TSC "Argos" that became non-compliant with the Russian regulatory requirements for data transmission after changes in the system architecture by the producer. Russian fishery enterprises were required to replace satellite systems “Argos” by other TSC types first until March 31, 2016, then until January 1, 2017. Two outdated types of “Inmarsat” TSC transmitters also were ordered to be replaced.

Experts relate the TSC “Argos” replacement with development of the Russian national satellite-based system “Gonets”. In September 2016, an agreement was signed between the JSC Satellite System Gonets and FCMSC to perform the functions of the operator of the “Gonets” satellite system commissioned by the Russian Federal Space Agency (Roscosmos). The Roscosmos looks to become a leading player in the further development the state monitoring system for aquatic biological resources, including the use of the "Gonets" satellites. Besides monitoring fishing sector, the FCMSC and Roscosmos agreement provides for use of space technologies for commercially beneficial services including telecommunications and navigation systems.

An ongoing task in implementation of the agreement is creation of around-the-clock technical support, improving the usability of monitoring system and raising the level of data security. To date, many components of the monitoring system have been patented, and painstaking work is underway to develop the software products necessary for its effective functioning. Establishing a technical support service is a significant addition to the system because nothing like this has been implemented so far. Creation of the regional service centers network of the "Gonets" system was organized on the basis of the branch network of FCMSC in Murmansk, Petropavlovsk-Kamchatsky, Yuzhno-Sakhalinsk, Vladivostok, Novorossiysk, and Kaliningrad.

The technical support service of satellite positioning began to work in the Russian Far East fishing basin in autumn of 2016. It met with an exceptional demand among fishermen. Now it is planned to create one service in the same format that will erase barriers between electronic services of fishery monitoring, satellite positioning, and their technical maintenance. As in many civil systems, the establishment of a single emergency telephone number looks quite reasonable to resolve any issue related to the fishing fleet monitoring system and satellite positioning.

A new procedure for equipping fishing fleet vessels with TSC has been approved for implementation on January 1, 2017. It contains the requirement to use of a two-component set of ship equipment: TSC and automatic identification system (AIS). The vessel's TSC system will be recognized as a functional unit if all its equipment is functioning simultaneously.

In general, renovation of fisheries monitoring technical supply and involvement of national producers and service suppliers should increase reliability and no-failure operational capability of the system. What may have been perceived to be negative, the costs of equipment replacement is at the ship owner's expense , which was rather sensitive for small fishery business ventures and resulted in some protests from these groups. A tight timeline, which was initially set out for such expensive and technically complex task as TSC replacement, was not achievable for the ship owners, especially for vessels involved in walleye pollock fishery in the Sea of Okhotsk.

Scientific on-board monitoring provides fisheries science with data for assessment of stock status and dynamics and for fishery forecasting. Though stock dynamics projection models become more and more sophisticated each year and involve ecosystem, physical, and economic aspects, no model can function adequately without accurate biological and fishery data. A system of scientific monitoring in Russian fisheries includes collection, processing, and analysis of scientific information derived from both the biological studies of catch and from fishery statistics. Annually, 14-15 qualified scientific observers graduate from training courses at the Pacific Research Fisheries Center (TINRO-Center) to observe the walleye pollock fishery in the Sea of Okhotsk (Fishnews 2015). Besides onboard fishery observations, the sectoral monitoring data are used both for increasing the database and for fisheries enforcement. On a daily basis every fishing vessel operating within the Russian EEZ transmits information on its activities and position. This information on the fishing fleet activities and at-sea catch processing is quickly analyzed by research institutions and used for decision-making.

Fisheries enforcement and combating IUU fishing in the Russian Far East

The Coast Guard (CG) Department of Border Service is acquiring contemporary patrol cutters and air fleet to protect fishery resources in the Russian EEZ. Currently, the surface Russian CG fleet consists of 32 large multifunctional cutters and numerous smaller patrol ships (Barents Observer 2015). CG patrol vessels deploy to almost all major fishing areas of the Russian EEZ. According to weekly reviews of the Sea of Okhotsk walleye pollock fishery, two CG cutters now supervise fishing operations in the northern Sea of Okhotsk. Thirty-six Coast Guard inspectors enforce fishing and transshipment operations including trawl hauls, fish processing, and recording information onboard the commercial fishing fleet (Rosrybolovstvo 2017).

Russian CG inspectors widely apply a practice of at-sea fishing vessel inspection with regard to ships suspected of involvement in IUU fishing operations, as well as a large volume of routine fishing fleet inspections. Violators are apprehended and convoyed into nearest port to face legal prosecution.

According to the CG press-center, 77 Russian and foreign vessels were apprehended in the Russian EEZ for violation of fishery regulations and IUU fishing, 72 of which were seized in the far-eastern fishing region, in 2014. Of the illegal aquatic bioresources traffic, 2.417 thousand tons of fishery products (mostly crabs) were seized throughout the Far East. In 2015, 67 fishing vessels including 23 foreign ones were apprehended in the far-eastern fishing region. Among the latter, 17 vessels used "flags of convenience". On these vessels, 129.8 tons of illegal crabs were found—notably less than in 2014. In total, more than 2,700 individuals and legal entities were brought to administrative responsibility for violation of the Fishing Rules in 2015. Seventy-seven people, including eight foreigners were convicted for poaching. Eleven fishing vessels were confiscated by the state, six of them were flagged by the "flags of convenience" (Faraway Outskirts 2016).

These statistics are not applicable to the walleye pollock fishery, where violations of fishery regulations have become relatively rare. During the ongoing fishing season, CG inspectors have a plan to enforce more thoroughly catch reporting and preclude “transfer of INTQ” from one fishing sub-zone to another, i.e., reporting catch from one sub-zone that was actually caught in another sub-zone. In past years, thorough analysis of SDD and vessel positioning data reduced the intensity of such violations, but it is too early to exclude this type of violation from future attention (Evening News of Petropavlovsk 2017). Other violations that border officials face relatively often are the presence of a vessel in a closed area conducting fishing-related activities, as well as interfering with the TSC operation to distort the information being conveyed about the vessel’s position.

In 2013, Russia approved the “National Action Plan to prevent, deter and eliminate IUU fishing”. One year later, the Ministry of Agriculture specified policies and key actions to implement the National Action Plan in its Resolution No. 14-r of February 18, 2014. The list of actions foresaw development and adoption of numerous legal acts that clarifies uncertainties in the legal framework of fishery management, analyzes its compliance to international fishery management systems, incorporates stricter measures of treatment of IUU vessels, increases penal sanctions, etc.

While the Russian enforcement system is strong and capable enough to protect the aquatic living resources, the judicial sector, which continues to be overburdened, needs to be strengthened. Sometimes, after the Fishing Rules violator apprehension, the trial takes an enormously long time to be completed. In such cases, fish owner’s economical losses caused by vessel detention may massively exceed an amount of estimated damage to natural resources.

Russia pays attention to international collaboration in marine fishery resources conservation. In last eight years, several bilateral agreements to prevent, deter, and eliminate IUU-fishing were signed by Russia with neighboring Pacific Rim countries: Republic of Korea in 2009, Democratic People’s Republic of Korea, Japan, and People’s Republic of China in 2012, and

with the United States in 2015. A Memorandum of Understanding is signed on this matter between Russia and Canada in July 2012. In addition, Russia is an active participant of twelve international fisheries organizations that provide scientific research, conservation, and fisheries management in numerous regions of the World Ocean.

Fisheries Management Measures Performance

Management of fishing fleet capacity

Fisheries management measures listed in the Fishing Rules, legal codes and other regulations may be conventionally divided on prohibitive and stimulating measures. When prohibitive measures require an appropriate communication, strong enforcement, and effective and fair system of justice, the second group of measures require favourable economic conditions and correspondent governmental guaranties.

Situation with the fishing fleet capacity was always contradictory in Russia. The Soviet era-heritage consisted of a large number of vessels built mainly in 1970s-1980s that occurred enclosed in the Russian EEZ after the far-sea expeditionary fisheries collapsed without the state support. Capacity of that fishing fleet allowed to harvest up to 11.4 million tons of fish shortly before the Soviet Union dissolution in 1991. At the same time, world markets opened up for Russian fishing companies with cessation of strict governmental regulation of export sales. Opened seafood market opportunities were large and included much wider spectrum of products than just frozen gutted fish, which represented a larger portion of the marine food production in the Soviet Union.

These circumstances stimulated an import of fishing fleet with better processing capabilities. For large fish trawlers and longline vessels, import operations were even supported by Russian government. At the end of the Soviet period, the government approved proposals for the fishing ship construction at foreign shipyards with their subsequent transfer to Russian owners under the terms of international leasing (bareboat charter). Shipbuilding at the foreign shipyards in Germany, Norway and Spain under the Russian government guarantee for international leasing began in 1989. According to the bareboat charter scheme, 15 large trawlers of the "Sodruzhestvo" type and 35 middle tonnage trawlers of the “Nevel’sk” and “Mys Korsakova” types were dispatched to the Russian Far East alone since 1990. All these vessels were specialized to the walleye pollock trawl fishery (Davydov 2006).

In 2001, Russian fishing fleet contained 147 vessels built under the bareboat charter scheme. However, this mechanism of fleet renovation did not fulfill expectations for a range of reasons including the challenges of a transitional economy, “devaluation” of governmental guarantee, and decline of walleye pollock stocks effected by overfishing. Through five years, the number of vessels under the bareboat charter decreased 47. Since January 2009, the Russian government finally prohibited the use of vessels under the bareboat charter in the Russian EEZ.

The most effective measure to control the fishing fleet capacity was the long-term INTQ allocation system established by Russian government since 2004. The lack of free access to the fishery resources virtually stopped a massive almost uncontrolled growth of fishing vessel import

to Russia from the worldwide (**Figure 4**). Due to decrease in the import and ageing of fleet built in 1970s-1980s, a number of Russian fishing vessels and processors steady decline since 2002. The lack of building capacity of contemporary large-tonnage fishing vessels inside country led to situation, when 85.2% of fishing vessels, including 89.0% of catchers are used for longer than their replacement age in 2010.

In 2009, the Federal Agency for Fisheries adopted the "*Strategy for the development of the Russian Federation fisheries complex for the period until 2020*" (hereafter the Strategy) that set key tasks in further development of material and technical basis of the national fishing sector. It was planned that up to 380 fishing and 120 refrigerator vessels will be built until 2020. However, the goals of this document were not achieved. In relation to the fishing fleet renovation, a rate of the Strategy implementation was evaluated at 26% only in 2015. Major revision of the Strategy with a time frame until 2030 is started in the Federal Agency for Fisheries and Ministry of Agriculture with active participation of the All-Russian Association of Fish Companies, Businessmen and Experts (VARPE 2016).

In the beginning of 2016, the fishing fleet on the Russian Far East consisted of 82 large-tonnage trawlers and 302 middle-tonnage vessels. During 2015, 39 vessels including 7 large-tonnage trawlers were decommissioned by different reasons. According to experts' opinion, the current fleet capacity is still enough for harvesting of walleye pollock and Pacific herring TACs. However, some shortage of fishing fleet capacity may occur after 2020.

Some fleet renovation expectations is related to the establishment of investment quotas. To receive fishing rights, the investor should assume the obligation either to purchase vessels built in Russia or to set up fish processing facilities. To date, major principles and approaches of this type of quotas allocation and related issues are still under discussion between the Ministry of Agriculture and VARPE (Zverev 2017).

Since August 2012, the Russian Federation became a member of the World Trade Organization (WTO) and accepted all obligations related to its membership. Fisheries, alone among all industries, are mentioned as requiring improved WTO discipline to control subsidies to prevent over-growth in fishing fleet capacity and, potentially, overfishing. According to draft governmental resolutions, investment quotas will be allocated to attract national investment for shipbuilding of vessels larger than 55 m long. Apparently, future implementation of the mechanism of investment quota allocation required a thorough analysis from the point of view of the WTO process.

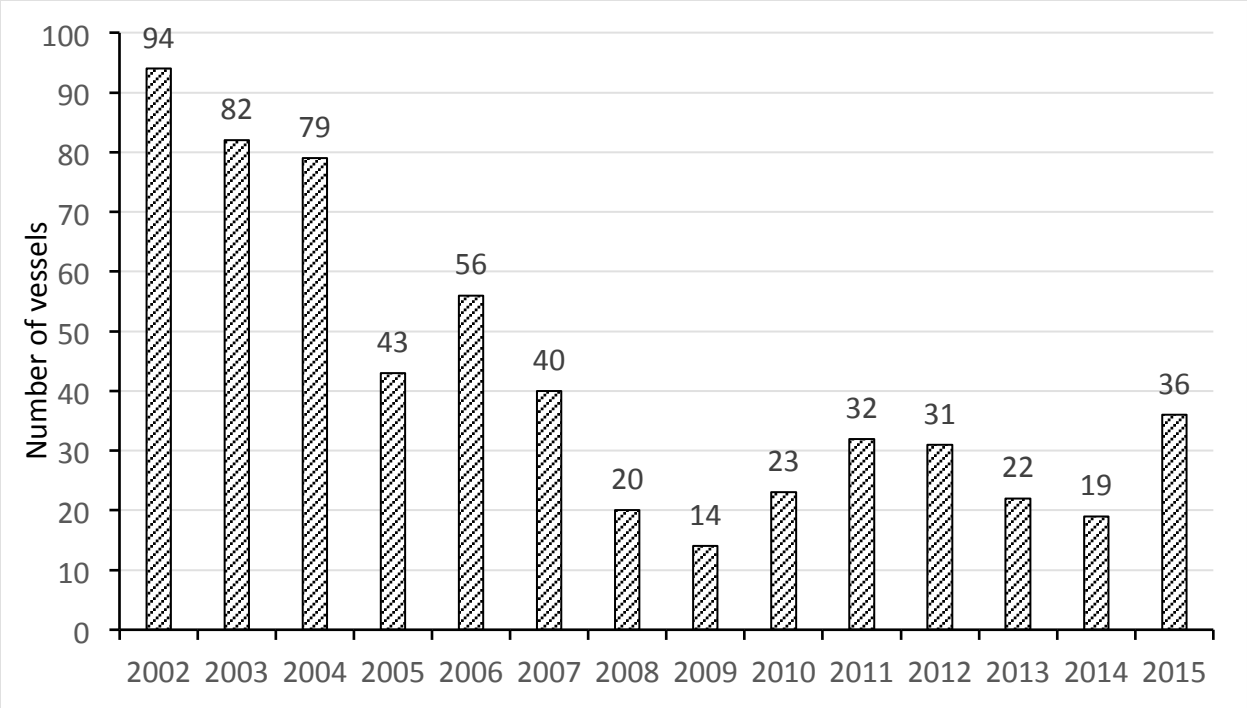

Figure 4. Number of fishing vessels imported to Russia, 2002-2015, after Naumov (2013) with additions.

Creating a special economic conditions to promote responsible fishing in Russia

All along the complicated way of the fisheries management system establishment in Russia, the government constantly declares "good behaviour support" to the fishermen society. There were special measures in force to promote a fishing without the Fishing Rules violations by giving "well-behaving" companies a priority access to a fishing rights and fishing quotas. The lack of infringements was taken into considerations, when fish quotas in the Russian Far East were allocated by auction, and fishing areas for coastal fishery were distributed by the regional steering commissions. With the further development of the regulatory and legal framework, such measures are gradually losing their importance as a tool to promote responsible fishing.

Proposals to revive a similar approach are regularly expressed, even by the enforcement group representatives, on taking INTQ shares from the most recalcitrant and persistent of violators and re-distribute them between laws abiding fishing companies. Nevertheless, fishing companies' concerns to suffer sensitive economic losses in a case when the Fishing Rules violation violations are detected and punished remain more effective stimulating mechanisms than a reward and recognition scheme, which is currently undeveloped.

A crucial element of progress in this matter became the ecological certification of particular fisheries and fishery production. In the contemporary World with a progressively enhancing public awareness in nature conservation, consumer demand for sustainable fishery products drives the seafood market to encourage fishery companies performing a responsible fishing by

awarding them higher ex-vessel prices than they had before received for the same type of products. Despite several certification agencies exist across the world fishery sector, the Marine Stewardship Council (MSC) remains the most well-known and reputable. The MSC was founded in 1997 by the WWF and an international food corporation Unilever. It is registered as a charity in the U.K. and a non-profit organization in the United States. Since 1999, the MSC operated on an independent basis. Several large fishing companies and fishermen associations in Russia participate in MSC certification that positively highlights the major Russian fisheries, including walleye pollock, Pacific salmon, cod, haddock, and king crab. From other side, the MSC certification allows to make fisheries business in Russia more transparent and open for public, positively influenced many related activities, including enforcement, monitoring, researches, and statistics. To date, marine fisheries' output certified by MSC contributes up to 27% of total Russian fishery harvest and this portion will undoubtedly increase in future. The Sea of Okhotsk walleye pollock fishery first received the MSC certification in September 2013.

Recognizing leading Russian fishing companies as responsive fishers allow them taking advantage of positive PR on the local labour market. There is a deficit of skilled labor power in main fishery regions due to recent failures in the education sector and declining popularity of marine professions among the rising generations. In this situation, stable fishing companies are able to carry out a systematic work with personnel ensuring them a long-term employment and enjoying benefits from their gaining qualification and experiences.

A long-term INTQ allocation, now for 15 years, stimulate fishing companies and associations to contribute into fish stocks and fishery ecosystems sustainability. The best possible approach is a further support of fishery science including as routine monitoring programs as development of ecosystem-based management principles. Ecosystem-based management is a relatively new fishery management system that recognises explicitly how large-scale fishing may alter food web linkages and affect sustainability in aquatic ecosystems and what measure may help to mitigate the impact of fishery pressure as well as the climate change effects on marine ecosystem. In the long term, timely development of the ecosystem-based management approach might allow to avoid significant economic losses from potential fishery stocks decline. Moreover, fishery science in Russia laid a good background to the ecosystem-based management framework development while real steps still have not been taken on recognition of its importance and necessity of implementation (Fluharty et al. 2010). Recently, the Russian fisheries management was characterized as having a "fail" grade of the ecosystem-based management performance together with other 16 of 33 countries included in survey (Pitcher et al. 2009). One of important recommendation to upgrade the economic viability of the Russian fishery is to pay more attention to the ecosystem aspects.

Small-scale fisheries in the scope of walleye pollock fisheries in the Sea of Okhotsk

Small-scale fisheries considerations usually opposite this type of life-sustaining activity to commercial fishing especially to a large-scale fisheries that may overexploit marine resources and destroy marine ecosystems. In Russia, there is a similar story of complicated relationships between the commercial fishery in the EEZ and commercial fishery in the near-shore waters. In

the Russian Far East, large-scale commercial fishery always had an expeditionary character. In 1990s, with the World seafood market opening, it also obtained a well-expressed export orientation. Low technological capacity of the Russian fishing fleets together with higher export demand for chipper raw material for second-step processing stimulated producing mainly a frozen and gutted fish, which remains the main Russian fisheries output product contributing 57.1% for the last twelve years (Radchenko 2013). By fish species, Russian export is represented by walleye pollock on about 46%. Notable part of walleye pollock catch goes to China for double-frozen fish fillets production.

Near-coastal fishery was initially envisaged as a separate entity that will supply a fresh seafood on a local markets and fish processing facilities to ensure livelihoods of population in the coastal towns and settlements. Correspondingly, there were several restrictions applied to the near-shore coastal fishery concerning assortment of fish products (ban for on-board processing and freezing of catch), special landing regulations, etc.

Establishment of near-coastal fishery was supported by regional authorities, who foresaw an opportunity to participate, directly or indirectly, in the INTQ shares allocation for this type of fishery. In the first turn, regional authorities tried to promote city- and settlement-forming fishing enterprises – large cooperatives, which also were the main offshore fishery players in the Soviet era. Consequently, many of these enterprises obtained the INTQ shares, e.g., of walleye pollock TAC, as for offshore as for near-shore fishery. Then, through a chain of large fishing cooperatives splits and transformations, large and small businesses also received an access to both types of the INTQ.

In 2016, for example, 120 commercial fishery stakeholders (fishing companies, cooperatives, and individual fishers) possessed INTQ for walleye pollock in one or several fishery regions within the Russian exclusive economic zone and on the continental shelf (hereafter EEZ). Ninety-one of them had rights to fish pollock in the Sea of Okhotsk (Federal Agency for Fisheries' Order No. 926 of December 10, 2015). Up to 131 commercial fishery stakeholders, about a half of the same ones as in the first butch, possessed INTQ for walleye pollock in coastal waters, 46 of them – within the Sea of Okhotsk (Federal Agency for Fisheries' Order No. 927 of December 10, 2015). For the ongoing walleye pollock fishery in 2017, situation is practically the same: 62 of the total 120 fishing companies holding INTQ for walleye pollock in EEZ, the same time hold INTQ shares for walleye pollock in the near-shore waters.

Situation described above complicated the walleye pollock fishery management and fishery monitoring. Potentially, such mess might lead to "transfer of INTQ" from near-shore fishery to offshore one to legitimate fish processing and freezing. There were numerous attempts to regulate near-coastal fishery by fishing vessel size and distance from the coast (or port) but expert and managers did not come to the agreement. Finally, the Russian government's Resolution No. 162 of February 22, 2012, allows use of catch quotas for near-coastal fishery throughout the EEZ and continental shelf areas in several regions including the Sea of Okhotsk. Then, the Federal Act of the Russian Federation of July 2, 2013 No. 148-FZ "*About the aquaculture (fish breeding) and about modification of separate legal acts of the Russian*

Federation" allowed fish processing and freezing in areas and for fish species designated by the Government. Government resolution on this matter is still pending.

Finally, these decisions leveled out differences between EEZ and near-coastal commercial fishery categories. According to proposals under consideration, merge of their INTQs is expected since 2018, and these types of fisheries will not be separated in future. We may conclude that a problem was solved in favour of near-coastal fishery, which get rid of restrictions. Since the near-coastal fishery INTQs for walleye pollock equal at 7.3% of the total TAC portion allocated for the commercial fishery, this fishery type may be considered as a small-scale one.

Considering subsistence fishing by indigenous peoples of the North, Siberia and the Far East of Russian Federation, the Fisheries Act stipulates that their fishing for the purpose of providing traditional lifestyles and traditional economic activities may be carried out without the provision of a fishing site and without permission, except for the harvesting of rare and endangered species. Since 2007, the Federal Agency for Fisheries manages this type of fishing by providing catch limits in accordance to applications and collecting fishery statistics. Incorporating subsistence fishing by indigenous peoples in the near-coastal commercial harvesting is proposed from time to time. However, trawl and/or Danish seine walleye pollock fishery is not the case related to the traditional lifestyles and traditional economic activities of indigenous peoples. Walleye pollock resources are not requested by indigenous peoples and provided for this type of fishing.

Conservation of marine biodiversity, vulnerable habitats and ecosystems

The Fishing Rules prohibit fishing practices that may deteriorate conditions of the natural habitats of aquatic fauna. When this regulation is violated, the penalty is supplemented with the charge of full monetary compensation of harm to the environment, according to the Federal Act No. 7-FZ of January 10, 2002 "*On Environmental Protection*".

Marine communities' biodiversity, habitat and ecosystem protection measures are ensured by the fishing gear type and contraction regulations, and for biodiversity – also by bycatch regulations. Bottom trawl are prohibited at the specialized walleye pollock fishery. Moreover, in the northern Sea of Okhotsk, bottoms trawls use are banned for all other fish species for exception of part of the Kamchatka-Kurile fishing sub-zones beyond the continental shelf edge (deeper than 200 m).

Pelagic trawl for walleye pollock fishing is a relatively habitat-friendly fishing gear. Construction and mesh size of trawls for walleye pollock fishery are strictly regulated to protect juvenile fish. The double-layered cod-end, trawls without square mesh insert between cod-end and cylindrical section of 7 m for middle-tonnage trawlers and 10 m for large tonnage trawlers, trawls with mesh size less than 100 mm (for the capron net) and 110 mm (for any other net), any devices that can block the mesh or reduce its size – all these items are purposely prohibited by the Fishing Rules. Selective inserts ensures significant increase of average pollock body length in trawls catches – up to 6-7 cm, and notable decrease of juvenile fish bycatch (Smirnov et al. 2011).

Danish seine contacts sea bottom during the fishing operation. Therefore, there are more concerns related to this fishing gear. Russian fishery science conducts fishing parameters and rate of bycatch monitoring in relation to the Danish seine construction (Terentyev & Chernova 2010, Shirokov et al. 2012). These researches may produce a new Danish seine fishery regulation in the future.

Legal bycatch rate at the specialized fisheries is limited by 2% of target species catch (excluding marine mammals, crabs and shrimp, and few prohibited species of aquatic biological resources like sturgeons). In case of accidental bycatch of prohibited species or exceedance of a legal weight, by-caught species should be released, regardless of their condition, into the natural habitat with the least damage. The user must make records and report about limit-exceeding bycatch or bycatch of prohibited species to the territorial bodies of the Federal Agency for Fisheries, which issued the fishing permit. For the further fishing operation, vessel should change the position of the next trawling haul or the position of the next seine sweep to at least 5 nautical miles from any point of the previous haul or sweep produced excessive bycatch.

The most important accomplishment allowed successful protection of vulnerable fish habitats and marine ecosystems is well-developed by Russian fishery science understandings on fishery ecosystems distribution and structure in the far-eastern seas, their behavior, and long-term forecast of their status. Advanced studies on marine ecosystems in the Russian EEZ resulted in development of understanding on their trophic structure, functional characteristics, and main driving forces in their dynamics (Shuntov 2016a). Ecosystem models were elaborated for the Bering and Okhotsk Sea that have close geographical location, similar environmental conditions, and fauna composition to compare their biological and fish productivity (Aydin et al. 2002, Radchenko 2015). Concepts on climate-oceanographic regime shifts, alternative dynamics of some common fish species in pelagic communities, many-years stability of benthic communities on shelf in the absence of anthropogenic stress should be notes among the last notable scientific developments of the Russian fishery science. This large amount of scientific knowledge and understandings will allow to produce a relevant scientific advice to the fisheries management under different climate scenarios.

Measures to maintain or restore depleted walleye pollock stocks

Walleye pollock super-population (Shuntov et al. 1993) in the northern and north-eastern part of the Sea of Okhotsk did not considered as a depleted fishery stock even in a time of relative decrease of its abundance in 1990s. Only one its part – the eastern Sakhalin fishery stock was under regime of conservation and restoration in 2000-2006.

In 1970s – 1980s, walleye pollock was widely distributed in the eastern Sakhalin shelf waters and considered to be the most abundant pelagic fish species as well as in the entire Sea of Okhotsk. Annual walleye pollock catch at the northeastern Sakhalin exceeded 200,000 tons, at the southeastern Sakhalin – reached 160,000 tons. Then, in 1990s, walleye pollock abundance began to decline (**Figure 5**), and pollock catch there dropped below to 15,000–20,000 tons. In 2000-2006, commercial pollock fishery quota was not allocated along the eastern Sakhalin coast.

Only a test fishing for stock condition monitoring was conducted with an annual catch below 1,000 tons.

Since 2004, gradual growth of walleye pollock abundance was observed there. In 2005-2007, ichthyoplankton survey data confirmed increased trawl survey estimations of fishery stock abundance. First significant TAC (48,400 tons) was established for 2009, and since that year the Eastern-Sakhalin fishing sub-zone became again an important fishing ground for the end of winter fishing season in the Sea of Okhotsk.

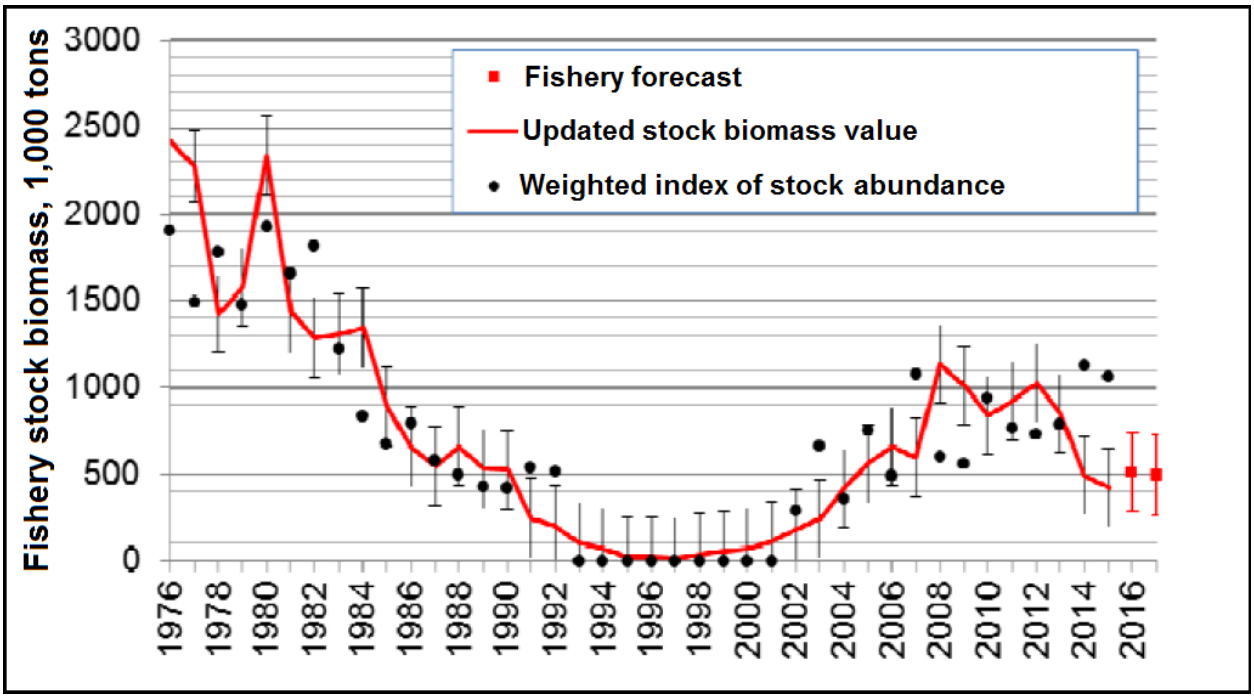

Figure 5. Walleye pollock fishery stock biomass dynamics in the Eastern-Sakhalin fishing sub-zone in 1976-2015 with the fishery forecast on 2016-2017. Updated indices based on modeling are given with 95%-confidence interval, after TINRO-Center (2016).

As it is evident from the Eastern-Sakhalin walleye pollock stock dynamics example, pollock stock condition may be highly variable in particular fishery regions. Such significant changes are unlikely related to the fishery pressure and, probably, related to environmental condition change (Shuntov 2016b). Within the Sea of Okhotsk, relatively quick stock fluctuations may occur due to pollock migrations from the neighbouring regions and back. From another side, protective regime and establishment of rebuilding plan will undoubtedly help to the fishery stock restoration and fishery resumption.

Another walleye pollock stock in the far-eastern seas under the rebuilding plan is the Western Bering Sea stock. In recent years, the Western Bering Sea walleye pollock is targeted in a less degree then the neighbouring pollock stocks. Fishery on this walleye pollock population might be completely closed. However, the near-coastal Danish seine fishing for groundfish from small boats has a large social significance for the Kamchatka region, especially for small settlements.

In this fishery, walleye pollock has lower value in comparison with other harvested by fish species: Pacific cod, Pacific halibut, flatfishes, sea perches, etc., since that is a round-year fishing without opportunities to collect pollock roe, as the most valuable product, during the most part of time. As it is mentioned above, specialized fishing for pollock westward of 174°E is prohibited to enhance conservation of the Western Bering Sea pollock population that should assist the stock rebuilding.

Measures to prevent pollution, waste, and discards

Since 1983, Russia is a Party to the MARPOL that was developed through the International Maritime Organization (IMO). The MARPOL 73/78 Regulations sets rules and discharge standards for various harmful substances from the vessels and is the main international tool to protect marine environment conservation from any kind of pollution. Compliance with these limitations requires personnel, equipment and procedures for collecting, sorting, processing, storing and disposing of garbage. A vessel may be equipped by an incinerator for a burning of industrial wastes and other flammable garbage. However, concerns about possible air pollution by such facilities are disputed last years.

Port authorities have a responsibility to control a vessel compliance with the MARPOL requirements in ports. During sailing in the EEZ or territorial waters of the Russian Federation, compliance to the MARPOL requirements is regulated by the Federal Act "*On Environmental Protection*" and departmental orders, i.e. the Federal Agency for Fisheries' orders for the fishing vessels. The Fishing Rules contain additional restrictions considering fish processing discards. Shredded waste from the fish processing can be discharged beyond three nautical miles from the nearest shore excluding port water areas and zones of sanitary protection of water objects. Discarding legally harvested fish resources is completely prohibited.

Marine environment pollution contribute a minor part in total number of registered environmental crimes – about 0.01-0.06% while the illegal fishing – 42.4-46.0% in 2000-2014. The Russian Criminal Code provides for criminal liability for the MARPOL requirements violation, but the correspondent Criminal Rule No. 252 is rarely used. In 2012-2014, three individuals were convicted for such violations while the administrative monetary penalties are applied more often. The applicable administrative penalty rate on environmental regulation violators progressively increases in the last years. After the last increase in July 2013, a fine may be equal to 1-25-fold the size of the minimum wage (100 roubles) for individuals, 3-200 – for officials, and 30-3000 – for legal entities. It is important to note that imposition of administrative and/or criminal liability for violating environmental laws does not result in relief from civil liability to compensate damage inflicted on the environment.

The Russian Federation is an active player on the IMO global arena. In November 2016, Russia comes forward with an initiative on development of IMO Assembly resolution to encourage as many states as possible to ratify MARPOL Annex VI (setting restrictions for sulphur content in marine fuel). Most of the MARPOL member states agree with the proposal.

Despite Russian law deals with environmental protection is rather strict, and environmental enforcement is in charge to protect marine ecosystems and resource, raising of environmental awareness is key to a future progress in this field. Non-governmental ecological organisations (NGOs) may play a significant role in the public ecological education by running projects related to marine environment conservation. Several of them, as a large international (WWF, the World Conservation Union), as a regional ones (e.g., the Sakhalin Environment Watch) already perform such activities. The fishing industry might pay more attention and efforts to support of such socially significant projects.

Scientific basis of fishery regulation

Russian fishery science possesses considerable data massifs, set of knowledge and ideas, and well-developed and tested instruments to manage fishery resources on the basis of ecosystem principles. Since 2000, inventories of the available data and electronic databases have being under establishment to support management advice. One example of such collections is the series of atlases on distribution of nekton, groundfish and benthos, and plankton in all regions of the Russian Far Eastern EEZ dating from the 1970s – 2010s with associated data attached in tables. Each of those publications contains verified and summarized primary information of all the effective scientific trawl and plankton net hauls in the areas surveyed that is several tens of thousands records for all the most abundant fishing objects. Those enormous databases are solid background for planning of further research process and making management decisions.

A strong basis for the Russian fishery science capacity-building was established by the integrated sea expedition approach developed by V. Shuntov since 1984 (Shuntov et al. 1996). In integrated marine expeditions, a wide array of research was performed simultaneously, which include oceanographic surveys, plankton and trawl net hauls, examination of nekton trophology, and hydroacoustic observations. Developed methods of on-board information processing allowed to establish the monitoring system of far-eastern seas' ecosystem status (Shuntov 2001). Together with the laboratory data processing and analyses, this research approach initiated a new scientific discipline: the ecosystem studies of marine biological resources that was readily accepted by many research teams throughout the Pacific Rim.

Considering walleye pollock studies, the key scientific breakthrough allowing for critical improvement of fishery management was the revealing of the functional structure of species distribution in far-eastern seas in the early 1990s. Key understandings were developed on walleye pollock in the Sea of Okhotsk as a single macro-population with several centers of spawning and the wide exchange by specimens (Shuntov 2016a, Shuntov et al. 1993, Temnykh 1990). Regional and seasonal fishing closures to protect pollock spawning and juvenile fish, determining the legal percentage of undersized fish in the by-catch, transferability of INTQ in the Western-Kamchatka and Kamchatka-Kurile fishing sub-zones—all these fishery management elements were grounded in well-developed understandings on walleye pollock distribution and migrations.

Another important scientific breakthrough was development of understandings of the periodic fluctuation of common pelagic fish stock abundances in the far-eastern seas. At the beginning, this phenomenon was interpreted as a walleye pollock–Pacific herring fluctuation with periodic replacement of one species by another in pelagic fish communities (Naumenko et al. 1990). Further ecosystem research revealed that the high carrying capacity of the Sea of Okhotsk pelagic ecosystem allows for retention of a relatively high abundance of herring in periods of growing walleye pollock abundance (Shuntov et al. 1993), and vice versa.

Walleye pollock is a relatively long-lived fish that keeps the fishery in good conditions when the stock consists of several strong and super-strong year classes. When in poor condition, it is usually made up of solely one strong year class. Two strong year classes in 1995 and 1997 maintained an exploitable level of pollock biomass in the first half of 2000s. The 2004 and 2005 year-classes initially appeared to be relatively strong and this was reflected later by surveys and fishery statistics. In 2009, the walleye pollock spawning stock increased by 10.1 billion fish with the 2004 and 2005 year-classes accounting for 80% of this growth (**Figure 6**).

Among the regional oceanography factors, the combinations of intensive inflow of Pacific waters with the West Kamchatka Current, a low intensity of the Compensating Current, and mild ice conditions create favorable preconditions for strong walleye pollock recruitment. There are weak but significant correlations between the water transport by the Compensative Current and walleye pollock year class abundance at age 2 (with lag = 2 years): $r = -0.46$; and year class abundance in ages 3-4 (with lag = 3.5 years): $r = -0.30$ (Radchenko et al. 2010).

Current climate conditions in the North Pacific are characterized by a progressive warming. For the walleye pollock in the Sea of Okhotsk, as a sub-Arctic fish in the Arctic latitudes with severe thermal conditions, many consequences of warming will be favourable. That is a highly important conclusion to apply an adaptive approach to regulation of pelagic fish fisheries in the northern Sea of Okhotsk to support sustainable fisheries management in the face of climate change.

It may be concluded that the Russian fishery science are very efficient in evaluating impacts of environmental factors on target stocks and other species belonging to the same Sea of Okhotsk ecosystem. At its current level of efforts, commercial fishery have not a destructive effect neither on the Sea of Okhotsk ecosystem nor on aquatic biological resources. Furthermore, the fishery ecosystem has significant reserves, which makes it important to continue the ecosystem research in order to develop recommendations for fisheries management. An increase in the useful yield of fish products may be considered as one on the main goals of fisheries management at the current status of the Sea of Okhotsk ecosystem (Radchenko 2015).

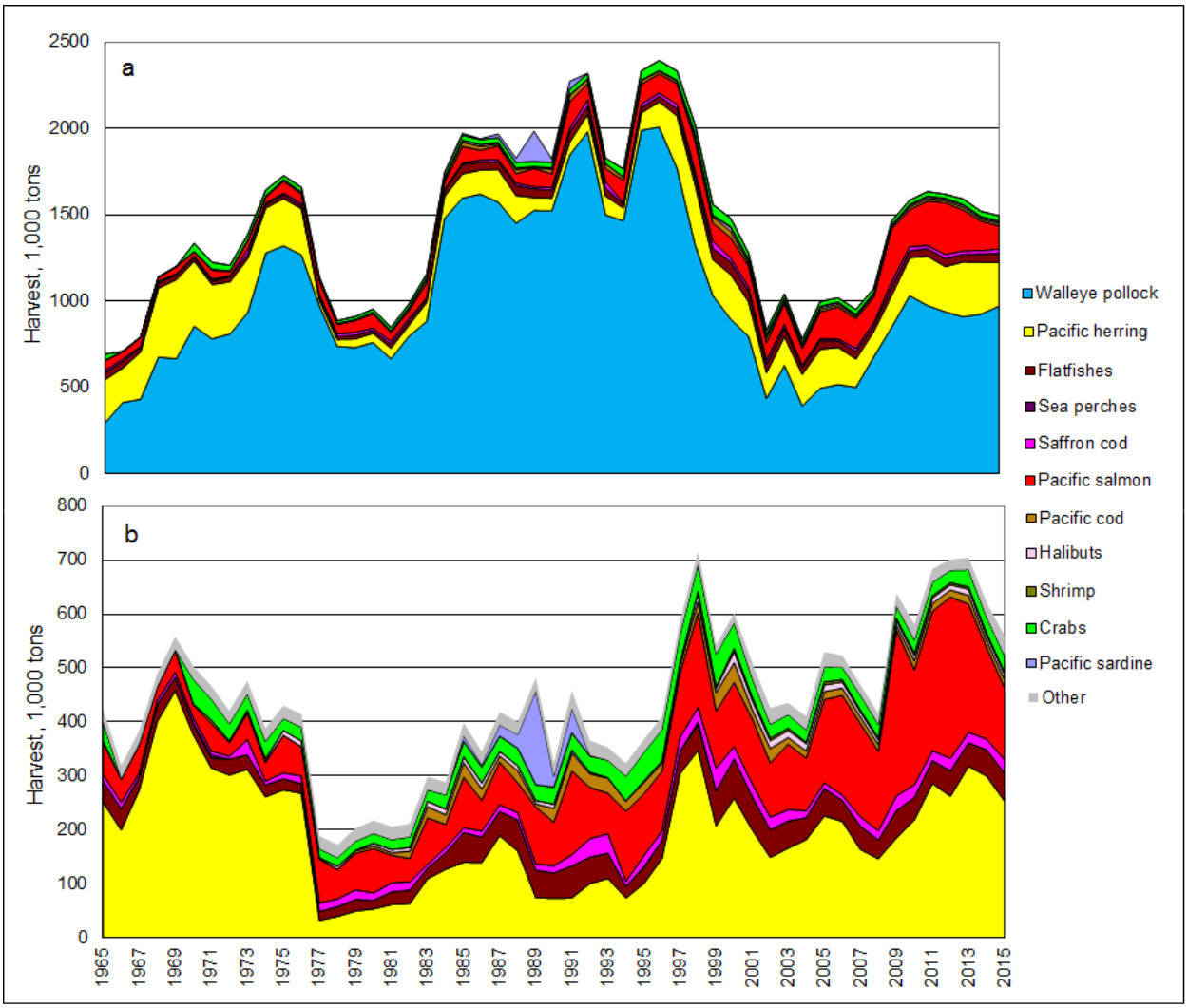

Figure 6. Total Russian fishery harvest in the Sea of Okhotsk, 1965-2015 (a). The same without walleye pollock (b). After Radchenko et al. 2010, with additions.

Russian fishery statistics

Fishery statistics data in Russia originate from an individual vessels SDDs that come through the sectoral monitoring system to the Federal Agency for Fisheries, then, to the Federal State Statistics Service (Rosstat) of the Russian Federation and, then, to FAO on a regular basis. By another data channel, primary data is accumulated by Rosstat's regional divisions, which in turn submit the information to the central office. According to Russian legislation, larger fisheries companies (with more than 100 employees) must report directly to Rosstat regional divisions in accordance with reporting forms. This forms state the production results in terms of value and quantity by types of fish and production operations. If comparison of two data channels reveals discrepancies, this became a reason of on-site inspections in the fishery enterprises. Nevertheless, sometimes, total catch estimations by two data sets demonstrated notable discrepancies – up to 5.0% in 2012 (Selin 2015).

In the Russian fishery statistics, aquatic biological resources catch and aquaculture production are presented in accordance with the national fisheries biological classification that serves as the basis for the statistical form No. 1-P (Fish), the Foreign Economic Activity Commodity Nomenclature of the Customs Union (FEACN CU), and the Russian National Classification of Products, which are, in general, comparable with the ASFIS List of Species for Fishery Statistics Purposes of FAO. Federal Agency for Fisheries regularly publishes on its website (section "Statistics and Analytics") the fishing quota usage reports, production results, import and export statistics, and dynamics of seafood consumer prices in large cities. Aggregated quarterly data become available there with a time lag of four-six weeks, annual data – of two-three months that is necessary for data verification process. At the FAO website, Russian fishery data are available now for 2015. Data for 2014 were included in the State of World Fisheries and Aquaculture (SOFIA) Report published in June 2016.

Fishery statistics is an object of major concern for the governmental fisheries management system. The session of the Presidium of the State Council for the Development of the Fisheries Complex held in Moscow on October 19, 2015, recommended to undertake a special measures to improvement of statistical data acquisition system in the fisheries sector of the Russian Federation.

Main factor that negatively contributes in accuracy of fishery statistics in the Russian capture fisheries, including walleye pollock fishery, is a many-years practice of the catch weight estimation through production records with conversion factors. Some scientists consider this method as a primitive and archaic that is not used anywhere in the World (Smirnov et al. 2011). This method has no efficiency in bycatch estimation and does not motivate fishermen to keep non-target species and prevent discards. Nevertheless, such approach was relatively recently recommended by FAO as a supplementary method for the catch weight estimation (FAO 1999). The catch weight estimation through the weight of production with conversion factors is applied in the European Union fisheries (Sopina 2014).

In Russia, this method use was elaborated in details. Regulation is based on the government approval document for "*Uniform Standards of Waste, Losses, Output of Finished Products and Consumption of Raw Materials when Producing Food Products from Marine Hydrobionts*" (State Committee for Fisheries 2002) that covers all commercial fishery species or groups of species, processing methods, product types and their methods of storage and packaging as an output of multi-year technological investigations and measurements. Results of recent studies allow a fine tuning of used conversion factors depending on fishing area, season, and biological parameters of raw fish (Sopina 2014).

In the United States, a motion-compensated belt-conveyor scale, or "flow" scale is used for the catch weight estimation in walleye pollock fishery. The flow scale is considered as a reliable, trouble-free, and easy to operate equipment in a seafood processing factory on a fishing vessel (Dorn et al. 1997). The flow scale performed within the error limits of ±3% of true weight in daily materials tests where a known weight of fish was passed across the scale. However, a slight, but consistent, positive bias of +l% was detected during each season. Despite a reliability

of the flow scale, the NOAA reveals an under-reporting of fishery catch by the American trawlers resulting from the scale mis-adjustment in 2007-2013 (Fishnet 2015).

The catch weight estimation in Russian fisheries will be undoubtedly develop toward direct measurement of captured fish before it come to the processing. At present, direct catch weighing (or calculation) method is obligatory for the experimental near-coastal fishing from vessels up to 24 meter long in the six-mile zone off the Sakhalin region that was established in 2016. In recent years, fishery scientists' concerns on accuracy of applied catch weight estimation method have begun to be shared by fishermen community and fishery sector management (Smirnov et al. 2011). However, adaptation of new regulation should be a gradual process preceded by a thorough technological studies and testing.

Transboundary Fish Stocks Management

The transboundary fish stock management are regulated by the Federal Act "On the Exclusive Economic Zone of the Russian Federation" No. 191-FZ of 17 December 1998. It stipulates that, if the transboundary fish stock is revealed in the Russian EEZ as well as in the adjacent waters, the Russian Federation cooperates with other countries toward this stock or stocks conservation and improvement of their conditions. Provisions for transboundary fishery stocks conservations are under implementation through the international and bilateral fishery agreements. Among twelve international fishery agreements mentioned above, one is closely related to the walleye pollock resources conservation – the Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea (hereafter the Central Bering Sea Convention).

The Central Bering Sea Convention was signed by six signatory Parties on 16 June 1994: People's Republic of China, Japan, the Republic of Korea, the Republic of Poland, the Russian Federation, and the United States. It established an international regime for conservation, management, and optimum utilization of walleye pollock resources in the Convention area, which contains the high seas of the Bering Sea beyond 200 nautical miles from the baselines from which the breath of the territorial sea of the coastal States of the Bering Sea is measured.

In late 1970s–1980s, gradually growing walleye pollock stocks from the eastern and, in less degree, western Bering Sea shelves began migrating to the central Bering Sea neutral waters, so called "Donut Hole", where a large-scale trawl fishery for pollock subsequently emerged. Japanese scientists reported finding large concentrations of pollock in the Aleutian Basin in the 1970s and spawning pollock in the Donut Hole in 1983 (Bailey 2011). Fisheries had grown steadily, and reported catches from the Donut Hole reached 360,000 tons of pollock in 1985. Russian fishing fleet joined to this fishery in 1986 and, two years later, reported harvests in the Donut Hole reached 1.396 million tons in 1988 (Fadeev & Wespestad 2001). Two years later, the harvest dropped to 293,000 tons, and the fishery was nearly halted in 1992 with a take of less than 10,000 tons. In 1993, a moratorium was finally put in place by international agreement just prior to the 1994 signing of the Central Bering Sea Convention (Bailey 2011).

After 23 years of conservation of the central Bering Sea walleye pollock stock there are no any evidences of its restoration and prospects for a fishery resumption. In the frame of the Central

Bering Sea Convention, Russia actively participate in the Scientific and Technical Committee work and annual meetings that are held in a virtual format in the last years.

Since mid-1990s, the Russian Federation and the United States develop a cooperative fishery management in the northern Bering Sea, where migrating walleye pollock stock may occur under a double fishery pressure in both states' EEZ. After initial period of disputes, a good scientific and technical cooperation framework established for that area. Mutual stock assessment (since 2004), regular consultations, and wide scientific information exchange including supporting rationale for TAC and input data are in force. Undoubtedly, this cooperation in fishery stock conservation and optimal use is one of the most successful example in the North Pacific region.

The neutral water area in the central Sea of Okhotsk (the Peanut Hole) is entirely surrounded by Russian EEZ. Large-scale walleye pollock fishery by fishing fleets of other countries was launched there in 1991, and fishery harvest peaked at 698,000 in 1992. Fishing opportunities for the Russian fishery companies were limited in 1992-1993 since a part of the adopted TAC was reserved for the supposed taking by the foreign fleet despite no catch information was available from those vessels.

In 1993, Russian Federation agreed with China, Japan, Poland, and South Korea to cease pollock fishing in the Peanut Hole with presenting fishing quotas for pollock within the Russian EEZ to Asian neighbour countries. In 2001, the UN Straddling Fish Stocks Agreement came into force and created a framework helped to implement a management of straddling stocks. Since 1995, walleye pollock fishery in the Peanut Hole is completely prohibited as for Russian fishing vessels as for the foreign fleet.

Five years ago, the Russian Federation requested the United Nations to declare the Peanut Hole to be part of Russia's continental shelf. In November 2013, UN subcommittee accepted the Russian argument, and UN Commission on the Limits of the Continental Shelf ruled in favor of the Russian Federation in March 2014. This circumstance promotes the walleye pollock stock in the central Sea of Okhotsk.

As a country of stock origin, Russia benefits from high degree of international cooperation, availability of stock status and fishery information, and transparency of decision-making in the transboundary walleye pollock stocks conservation and management. Following this long-term interests, the Russian Federation encouraged the neighbouring Asian states to continue along the same lines in the frame of bilateral agreements.

Conclusions

The Russian fisheries management system is based on the strong "vertical" top-down alignment of regulation of fishery operating procedures. Despite the formal subordination to the Ministry of Agriculture, the Federal Agency for Fisheries is a stand-alone entity with extensive powers in fields of fishery management, support of scientific research and monitoring, international fisheries cooperation, etc. The Russian fisheries enforcement system is strong to perform a monitoring, control, and surveillance functions and capable enough to protect the aquatic living resources, and fishery science has vast resources knowledge and understandings to evaluate

impacts of anthropogenic and environmental factors on target stocks and ecosystems and to forecast their dynamics.

With all these positive with all these positive affirmations, the fisheries management system is quickly developing and still far from being stable. Major emerging elements like new mechanism of fishing quota allocation may significantly influence system performance. Another changing element is the Russian fishery science with a new legal status of scientific institutes. New legal status looks to be more restrictive in order to keep a scientific fleet capacity on required level. All scientific vessels on the Russian Far East were built in the past century while the larger ones – still in the Soviet era. Quick changes of the fisheries management system require a regular review during a period of new element adaptation.

The regulatory and legal framework of the fisheries management system in Russia was greatly improved since the beginning of 2000s. Main undertaken step was a creation of new mechanism of long-term quota allocation between fisheries companies that increase degree of decision-making transparency in the fishing sector, introduced an effective tool to control the fishing fleet capacity, and stimulated fishing companies and associations to contribute into fish stocks and fishery ecosystems sustainability.

As for fishermen community-wise, increasing public awareness and strengthening of role of fishermen associations are an encouraging sign of a growing transparency in the mechanisms for fisheries management. It is indicative that the most competent and reputable associations were formed by fishermen involved in the major Russian fisheries – for walleye pollock and crabs. Participation of fishermen associations in the ecological certification of fishery production is a one of evident benefits to the association members and reinforces positive processes in regional fishermen communities. The VARPE as a central body assembling individual fishermen associations and enterprises also began playing a greater role in modernization of the fisheries management legal framework.

One of recommendation to further Russian fisheries management system development is a development of measures to improvement of statistical data acquisition system in the fisheries sector. Such an improvement will be unlikely possible without advanced development of the catch weight estimation methods. Adaptation of new method should be a gradual process based on solid scientific research. It will be the basis of success for a bycatch management, modernization of technological processes, and expansion of high value-added products range.

In a longer-term perspective, recommendation may be made to pay more attention to the ecosystem aspects of fishery management. Implementation of the ecosystem-based fisheries management promises tools for the fishing regulation refinement, optimization of fishing closures pattern in space and time, mitigation of unfavourable climate change effects, and, in general, increase of sustainability of the fishery-stock system. For the fisheries managers it is also important that the ecological and human dimensions will be likely more and more included in appraisals to evaluate the status of fisheries in future.

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