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Innovations in Western Arctic Fisheries

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Abstract. The purpose of this article is to substantiate the possibility of increasing the efficiency of fishing and crab harvesting in the Western Arctic through innovation. The relevance of this issue is related to the decline in fishing efficiency due to sanctions imposed by the United States and the European Economic Community on fishing, as well as other factors that increase costs and reduce product value. An analysis of selected indicators of the economic efficiency of fishing in the Murmansk Oblast in 2021 was carried out in comparison with 2013, which is considered the last period of the development stage of fishing in accordance with the classic business life cycle. It was shown that the main impact on the decline in the efficiency of crab fishing and fishing in general was the loss of the crab market in the United States and European countries, as well as the need to reorient sales to the Asia-Pacific region. As a result, import prices for crab in China, Korea and Japan became significantly lower than in the United States (\$40/kg) and in the EEU countries. It was found that prices for live crab in China are almost 3 times higher than for frozen crab, and an innovative system for delivering it to China alive was developed. It was shown that the main innovative factor in increasing efficiency in fishing is the new fleet. The use of new vessels for crab fishing will ensure a 20–50% increase in fishing results, while labor productivity in fishing should increase by about 2 times, and costs should decrease. Proposals have been made to potentially increase fishing efficiency through other innovative factors: introduction of a new catch accounting system, improved logistics, release of new products, digitalization, development of the domestic market through improved pricing and competition, etc. In 2024, prices for live crab in China reached their pre-sanction level in the United States — \$40/kg.

Keywords: *Western Arctic, fishing industry, fisheries, crab fishing, sanctions, innovations*

Introduction

Russian industrial fishing for the exploitation of aquatic biological resources (ABR) in the Arctic is carried out in its western part in the Barents, White and Kara Seas, as well as in the adjacent waters of the Norwegian and Greenland Seas.

The main commercial object, which determines the total catch volume of the Murmansk, Arkhangelsk Oblasts and the Karelian Republic, is cod. Cod catch largely determines the economic indicators of fishing in the Arctic.

A characteristic feature of the cod family is the high volatility of generations. Commercial stocks and catches of cod have changed significantly over the past 75 years. Cod stocks are assessed by Russian and Norwegian biologists. According to their data, commercial and spawning

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stocks of cod reached peak values in 2013–2014, and then began to decline. Currently, the commercial potential of these generations is almost completely exhausted, so its decline is expected in the next 2–3 years. After the numerous generations born in 2011 and 2014 enter the spawning part of the population, an increase in cod biomass cannot be ruled out [1, Bulatov O.A. et al., p. 39].

Important commercial species that significantly affect fishermen's incomes and other indicators of their activities are crabs: Kamchatka crab and opilio crab. Their total allowable catch (TAC) in 2024 was 29,584 tons, including 996 tons in the Kara Sea ¹.

In addition to crabs, in the Kara Sea, according to PINRO, it is possible to catch navaga — ~400 tons, Cheshko-Pechora herring — ~500 tons, Arctic flounder — ~10 tons, Asian smelt — ~5 tons.

The total allowable catch in the White Sea: White Sea herring — ~12.0 tons, Cheshko-Pechora herring — ~2.2 tons, navaga — ~2,500 tons; Asian smelt — ~100 tons, flounder — ~50 tons, cod — ~100 tons, kelp — ~59 tons, fucoids — ~14 tons [2, p. 37].

Currently, about 72.0% of the commercial stocks of the Western Arctic are caught by vessels of the Murmansk Oblast, and based on the results of the study of the development of the fisheries industry in this region, in our opinion, it is possible to draw reasonable conclusions about the level of development of industrial and commercial activities in the Arctic, including the degree of innovation in development.

Arctic fisheries at the growth stage

Russian fisheries, including in the Murmansk Oblast, began to improve their operating results following the adoption by the State Duma in 2008 of laws allowing for the transition to a single agricultural tax (SAT) and an 85% reduction in fees for the use of biological resources. This process, which continued until 2014, can be called a growth stage. As a result, most of the economic and financial indicators of the development of fisheries in the Murmansk Oblast, which accounts for 87.2% of the economic turnover of the fishing industry, improved significantly in 2013 (Table 1). For example, the profitability of sold goods was 37.0%, which should be considered the highest value compared to the results in other countries engaged in fishing in the North Atlantic. Thus, in the Norwegian fishery, considered the best in the world, the operating profitability of the group of vessels fishing for cod and other demersal fish in 2013 was only 18%. At the same time, the operating margin (the ratio of operating income to revenue), which indicates the percentage of revenue remaining with the company or vessel after accounting for the cost of goods and other related

¹ Order of the Federal Agency for Fisheries of December 4, 2023 No. 680 "On the distribution of total allowable catches of aquatic biological resources of the Northern fishery basin, as well as quotas for the extraction (catch) of aquatic biological resources granted to the Russian Federation in the areas of application of international treaties of the Russian Federation in the field of fisheries and conservation of aquatic biological resources, with regard to the types of quotas for their extraction (catch) for 2024". URL: <https://www.garant.ru/products/ipo/prime/doc/408039867/?ysclid=m3mxpc9p6d233429571#review> (accessed 14 November 2024).

expenses, was 15.2%². A similar indicator — the ratio of the net result to turnover in the fishing industry of the Murmansk Oblast in 2013 — was 21.2% [3, Vasilyev A.M. et al., p. 14].

Table 1

Production and economic indicators of the fishing industry in the Murmansk Oblast³

Indicators	2013	2014	2015	2017	2020	2021	2022	2023	Ratio 2023 to 2013 (% , times)
Total catch, ths. tons	691	574	681	689	574	622	576	475	68.7
Production, ths. tons	592.4	573.3	576.5	579.7	490.3	549.2	516.0	492.3	83.1
Turnover, mln rubles	33079	48844	68192	73614	91688	127634	97537	113517	3.43 times
Export to other RF subjects, ths. tons	190.0	n/d	n/d	88.9	96.8	90.8	n/d	n/d	47.8
Export of fish products, ths. tons	304.2	324.7	313.8	352.7	272.6	319.1	n/d	n/d	104.9
Export of products, mln dollars	627.7	882.7	850.0	1060	1099	1698	---	---	2.7 times
Export of products, mln rubles	19992	57022	56780	67329	79026	125067	---	---	6.25 times
Net result, mln rubles	7017	8022	25532	36191*	54935*	86577*	45074*	25546*	3.64 times
Profitability of sold goods, %	37.0	44.9	67.3	69.5	81.5	116.0	59.0	47.8	+ 10.8
Expenses per 1 ruble of products, kopecks	71.3	68.1	58.6	55.2	50.6	42.8	n/d	n/d	60.0
Average consumer prices at the end of the year, rubles/kg - frozen fish uncut	65.7	84.8	105.0	125.5	153.5	175.6	210.7	216.8	3.3 times
- frozen fish cut (except salmon)	147.3	169.7	221.7	253.6	319.5	318.3	361.8	392.0	2.66 times
- salted herring	123.0	154.7	230.3	244.5	229.8	265.1	345.1	360.5	2.93 times
- fillet	177.2	218.7	325.9	364.5	479.5	500.2	611.1	688.3	3.88 times
Catch per 1 person employed in fishing, tons	120.5	125.4	130.7	135.3	108.6	113.9	101.1	86.4	94.5
Purchasing power of the population of the Moscow Oblast, kg/month	485.6	398.4	350.0	312.9	303.7	291.4	311.9	338.2	-30.3
- frozen fish uncut									
- frozen fish cut	216.6	199.1	165.7	153.2	146.0	160.7	181.6	187.0	-13.7

* — indicator in fishing and fish farming

² Lønnsomhetsundersøkelse for fiskeflåten 2017 / Profitability survey on the Norwegian fishing fleet 2017. Statistikkavdelingen. Bergen. 2019. P. 10-13. URL: <https://www.fiskeridir.no/Yrkesfiske/Tall-og-analyse/Statistiske-publikasjoner/Loennsomhetsundersokelse-for-fiskeflaaten> (accessed 03 September 2024).

³ Source: compiled by the author.

Arctic fisheries at the maturity stage

The year 2014 should be considered a period of major changes in the functioning of fisheries and other sub-sectors of the Russian fishing industry, including the Northern Basin. This is associated with a decline in the ruble's exchange rate against the US dollar from 31.85 rubles in 2013 to 38.47 rubles and 61.0 rubles in 2014–2015, and an even greater decline to 73.66 rubles in 2021, as well as an increase in prices for exported fish products and a good state of the raw material base of the fishery. As a result of the influence of these factors, each ton of catch by fishermen in the Murmansk Oblast generated an increased net result: in 2013 — 10,082.2 rubles, in 2014 — 11,955.2 rubles, in 2015 — 37,492.4 rubles. Subsequently, it increased to 95,705 rubles in 2020 and to 139,142 rubles in 2021. The cost of 1 ton of export products in 2014, compared to 2013, also increased by 34.8% (from 2,063.0 to 2,781.5 US dollars) and had an upward trend. In ruble terms, the growth in the specific value of exports was observed to be even greater — by 67.2% (from 65,719.9 to 175,614.4 rubles). The share of catches sent for export increased from 57.8% to 74.1%, including for cod — from 71.8% to 91.2%, for haddock — from 47.0% to 96.8%⁴. The extent to which the economic and financial indicators of the Murmansk Oblast fisheries activity changed in 2014–2021 compared to 2013 is shown in Table 1.

In our opinion, the main indicators that objectively characterize fishing in terms of its production success and socio-economic impact on society are turnover, net financial result and the volume of fish products consumed, which is determined by fish product prices and the purchasing power of the population. The analysis of these indicators, presented in Table 1, shows that the turnover in fisheries in 2021, compared to 2013, increased by 3.86 times. Since the volume of production in 2021 decreased by 43.2 thousand tons (by 7.3%) compared to 2013, the entire increase in turnover is due to an increase in the cost of a unit of sold products and the depreciation of the ruble against the dollar.

Since 2014, the main area of activity for fishing companies has been the export of their products^{5,6}. Despite a decrease in catch and production by 69.0 thousand tons (10.0%) and 43.2 thousand tons (7.3%) respectively compared to 2013, sales of fish products abroad in 2021 increased by 14.9 thousand tons (4.9%) in real terms. At the same time, turnover in 2013 was generated by exports by 60.4% [(627.7×31.85): 33078], and in 2021 — by 98.8% [(1697.9×73.66): 125,067.5%]. “Consequently, in 2013, the share of turnover from sales of fish products and other financial operations in Russia was about 39.6%, and in 2021 — only ~1.2%. This applies to the en-

⁴ Scientific and applied foundations of the state policy for the functioning of the resource-based economy on the shelf and in the coastal zone of the Russian Arctic in the context of globalization: research report (interim) / Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Kuranov Yu.F., Fadeev A.M. [et al.]. Apatity, 2015, 120 p.

⁵ Ibid.

⁶ Scientific and applied foundations of sustainable development and modernization of marine economic activities in the Western part of the Arctic Zone of the Russian Federation: research report (interim) / Luzin Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Vopilovskiy S.S., Fadeev A.M. [et al.]. Apatity, 2021, 128 p.

tire range of fish products. The export of bottom-dwelling fish species had a particularly strong impact on the formation of economic turnover, since their export abroad amounted to more than 90%, as well as crabs” [4, Vasilyev A.M., p. 52].

“Calculations based on the data presented in Table 1 show that the main factors contributing to the increase in the value of exports in ruble terms in 2021, compared to 2013, are the depreciation of the ruble against the US dollar and the increase in export prices. Due to the increase in the physical volume of product sales abroad, the growth in the value of exports in 2021, compared to 2013, amounted to only 977.8 million rubles (4.9%). The decline in the ruble exchange rate from 31.85 to 73.66 rubles per 1 dollar caused an increase in the value of exports and turnover by 75% (95,367 million rubles), while an increase in the value of 1 ton of fish in exports from 2,063.3 to 5,320.9 US dollars led to an increase in turnover by 20.1% (31,289.2 million rubles)” [3, Vasilyev A.M. et al.].

Unreasonably high prices for fish products on the domestic market contributed to the formation of high financial indicators, which confirms the low level of fish consumption by the population.

Regarding the latter fact, a scientific article by A.M. Vasilyev, E.A. Lisunova “What’s Wrong with Prices in Russian Arctic Fisheries after 2013” was sent to the Ministry of Fisheries, which was published in the ECO journal in 2023 [5]. The response was signed by the head of the Department of Economics and Investments, A.G. Mikhalevich: “The approaches you propose to reduce the level of wholesale and retail prices for fish products will be taken into account if an order is received to prepare amendments to the current legislation in the field of activities of the fisheries complex.”

“A significant increase in turnover led to a decrease in costs per 1 ruble of production in 2021, compared to 2013, from 71.3 kopecks to 42.8 kopecks (by 60.0%), as well as to an increase in the net result by 12.34 times and the profitability of goods sold from 37.0% to 116.0%, despite an increase in fuel costs over the specified period by approximately 50% and wages — by 2.94 times” [3, Vasilyev A.M. et al.].

Along with favorable conditions for fishing, production and sale of fish products in the period under review, the Northern Basin had a significant number of relatively efficient fishing vessels. According to the Northern Basin Vessel Register, as of January 1, 2017, there were 224 vessels, of which 191 units (85.2%) were considered actively used, including 181 vessels (84.5%) owned by enterprises of the Murmansk Oblast. Of these, 9 out of 10 units were large trawlers, 102 units were medium-sized vessels, and 17 out of 25 units were small fishing vessels. Of the 102 medium-sized trawlers, 48 units (47.1%) were the most productive, purchased on the secondary market in Western countries⁷. In the Murmansk Oblast in 2000–2014, the production of fillets, which is considered one of the indicators characterizing the level of innovation in production in

⁷ Scientific and applied foundations of the state policy for the functioning of the resource-based economy on the shelf and in the coastal zone of the Russian Arctic in the context of globalization: research report (final): 0234-2014-0006 / Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Kuranov Yu.F., Fadeev A.M. [et al.]. Apatity, 2017, 123 p.

the fishing industry, amounted to 2.1%–6.9% of the total catch, while in the Far Eastern basin, this figure decreased from 5.3% in 2000 to 1.1% in 2014⁸. In the subsequent period, up to 25% of cod and haddock catches were used for fillet production in the Murmansk Oblast in some years.

Thus, the composition of the main production assets, economic and financial indicators of the development of fisheries in the Murmansk Oblast remained at a high level during the period under review until 2021. For example, the average level of profitability of fish product sales in 2015–2021 was about 80%, which is 3–5 times higher than the level observed in the fisheries of foreign countries in the North Atlantic^{9, 10, 11}. Scientists Kuzin V.I. and Kharin A.G., who studied the profitability of Russian fisheries in 2015–2016, which was then about 50%, called it “phenomenally high” [6, p. 653]. This period, in accordance with the classical theory of business life cycles, was a stage of maturity.

Implementation of innovations is the modern necessity

However, it should be noted that the factors that have ensured the current level of Arctic fisheries — good stocks of commercial aquatic species, high prices for fish products, a weak ruble, high levels of foreign trade and government preferences — are highly volatile. They may change under the influence of unresolved problems: the need to implement the Food Security Doctrine by increasing fish product supplies to the domestic market; a decrease in commercial aquatic species stocks and a reduction in catch quotas; the influence of the external market situation and a reduction in domestic wholesale prices in order to increase the consumption of fish products and develop related sectors of the national economy; participation in the global division of open ocean resources for political reasons.

The political factor manifested itself in 2022 and is currently in effect through a ban on Russian vessels entering the ports of the EEC and the USA and on the sale of fish products produced in Russia in these countries. The sanctions had the greatest negative impact on crab exports, which accounted for 42.0% of the turnover of the Murmansk Oblast’s fishing industry in 2021. These sanctions coincided with the payment of increased fees for the use of commercial bio-resources, as well as the introduction of export customs duties. During the same period, there was a decrease in the stocks of the main commercial species — cod — and a reduction in fishing

⁸ On the development of the fisheries complex of the Russian Federation: working group of the Presidium of the State Council. URL: http://vniro.ru/files/Gossovet_doklad.pdf (accessed 02 September 2024).

⁹ Økonomiske og biologiske nøkkeltall frå dei norske fiskeria — 2020 / Economic and biological figures from Norwegian fisheries — 2020. URL: norkkeltall-2020.pdf?sequence=1 (accessed 03 September 2024).

¹⁰ Scientific and applied foundations of sustainable development and modernization of marine economic activities in the western part of the Arctic Zone of the Russian Federation: research report (interim) / Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Kuranov Yu.F., Fadeev A.M. [et al.]. Apatity, 2018, 115 p.

¹¹ Scientific and applied foundations of sustainable development and modernization of marine economic activities in the western part of the Arctic Zone of the Russian Federation: research report (interim) / Luzin Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Vopilovskiy S.S., Fadeev A.M. [et al.]. Apatity, 2020, 128 p.

quotas. Under the influence of the above factors, profits in the Russian fishing industry in 2022 decreased by 32% compared to the previous year (from 231 to 158 billion rubles)¹².

In the article “The Impact of Export-Import Policy on the Economic Security of the Fishing Industry under Sanction Pressure” by E.V. Levkina and co-authors, some analysis of the impact of sanctions on fisheries and socio-economic processes was carried out, but no ways of reducing this impact are mentioned. In addition, we do not entirely agree with some of the authors’ conclusions regarding fish prices and the decline in the purchasing power of the population. Apparently, there are some differences in the fishing basins [7, p. 18].

All analyzed indicators in the fishing industry of the Murmansk Oblast have deteriorated, and this trend continued in 2023. Thus, turnover in 2022 decreased by 23.6% compared to 2021, the net result decreased by 47.9%, and profitability decreased by 57.0 points (Table 1). This was largely influenced by the ban on crab exports to the USA and Europe and the sale of cod and haddock in EEC countries at a significant discount (price reduction).

In order to improve the situation with crab sales, exports to China, Korea and Japan were increased, which led to a significant decrease in import prices in these countries in 2023. Thus, in Korea, the price of Kamchatka crab fell from \$25.4/kg in 2022 to \$15.4/kg in 2023 (by 39.4%), and the price of snow crab fell by 44.3% (from \$14.9/kg to \$8.3/kg).

In Japan, the price of Kamchatka crab decreased by 54.0% (from 7,487 yen to 3,444 yen), snow crab — by 34.0% (from 2,939.4 yen to 1,940.0 yen).

In China, the average price of all crabs decreased by 41.8% (from \$18.85/kg to \$10.97/kg).

The price of all Russian crab exports in 2023 decreased by 16.9% compared to 2022 (from \$22.57/kg to \$18.76/kg)¹³.

One of the measures to reduce the amount of Russian crabs on the markets of these countries in order to increase export prices could be an increase in sales on the domestic Russian market. However, according to crab fishermen, the sale of crabs on the Russian market is hampered by strict legal requirements for arsenic content in crab products, which are absent on Western markets. In addition, before the sanctions were imposed, crab harvesters in the Murmansk Oblast did not need this, selling about 80% of boiled and frozen Kamchatka crab to the United States at a price of \$40/kg (2,946.0 rubles/kg at the 2021 exchange rate), and the rest —to Europe. Therefore, neither the wholesale nor the retail crab markets in Russia were developed until recently, and the price decline in 2022–2023 was observed to a lesser extent than in the Asia-Pacific countries, where the Russian market had reoriented itself.

A comparison of wholesale crab prices in Moscow and the Moscow Oblast in 2023, which amounted to 2,550 rubles/kg for Kamchatka crab legs and the average price for Kamchatka crab

¹² Crab sanctions and rising costs have smashed fishermen’s profits in 2022. URL: <https://www.rbc.ru/business/19/05/2023/64661e1c9a7947be9570e337?ysclid=lyym6ugtob116029959> (accessed 02 September 2024).

¹³ Prices for crab exports from Russia are falling more than for the domestic market. URL: <https://fishretail.ru/news/tseni-eksporta-kraba-iz-rf-snigayutsya-461396> (accessed 03 September 2024).

meat at 2,600 rubles/kg and for snow crab legs at 945 rubles/kg, shows that they are significantly higher than the average ruble price of imports of Kamchatka crab to Korea in 2023, amounting to 1,312.85 rubles/kg and snow crab — 707.5 rubles/kg, as well as the average import price of Kamchatka crab to Japan, which is 1,817.6 rubles/kg, and snow crab at 1,551.3 rubles/kg, as well as the average import price of all frozen crab by China, which is 935.2 rubles/kg.

A comparison of the average price of Russian crab exports in 2023 with the average price of Chinese imports shows that it is 71.0% higher ¹⁴.

Currently, Murmansk companies engaged in crab fishing and wholesale crab sales offer a wide range of products at the following wholesale prices: Kamchatka crab meat — from 2,000 to 6,000 rubles/kg, Kamchatka crab legs in shell — from 1,800 to 3,790 rubles/kg, Kamchatka crab claws in shell — from 1,400 to 2,950 rubles/kg, live Kamchatka crab — from 1,700 to 2,500 rubles ^{15, 16, 17, 18}.

In St. Petersburg, crab products are presented in approximately the same range as in Murmansk, but there are significantly more offers. Prices vary significantly, depending on the type of crab product: whole live Kamchatka crab — from 2,350 to 3,490 rubles/kg, whole frozen Kamchatka crab — from 1,400 to 3,500 rubles/kg, Kamchatka crab meat — from 2,500 to 8,000 rubles/kg, Kamchatka crab claws in shell — from 1,400 to 3,333 rubles/kg, Kamchatka crab legs — from 1,320 to 2,800 rubles/kg, Kamchatka crab meat for salads — from 2,500 to 3,750 rubles/kg, snow crab legs — from 950 to 1,270 rubles/kg, snow crab claws — from 825 to 998 rubles/kg, stripe crab meat — from 2,400 to 3,500 rubles/kg ^{19, 20, 21, 22, 23}.

Comparing prices for crab products on the domestic market of Russia with prices in the Asia-Pacific countries, first of all, one should pay attention to the Chinese market, which account-

¹⁴ Crab sanctions and rising costs have smashed fishermen's profits in 2022. URL: <https://www.rbc.ru/business/19/05/2023/64661e1c9a7947be9570e337?ysclid=lyym6ugtob116029959> (accessed 02 September 2024).

¹⁵ Delivery of fish and seafood products. URL: <https://xn----gtbl0afhph3b.xn--p1ai/catalog/moreprodukty> (accessed 03 September 2024).

¹⁶ Crab wholesale. URL: https://www.avito.ru/murmanskaya_oblast_produkty_pitaniya?q=%D0%BA%D1%80%D0%B0%D0%B1+%D0%BE%D0%BF%D1%82%D0%BE%D0%BC&ysclid=lz16m4lemx839344871 (accessed 03 September 2024).

¹⁷ Crabs in Murmansk. URL: <https://www.cenotavr.ru/murmansk/kraby> (accessed 03 September 2024).

¹⁸ Crab fresh frozen. URL: <http://krabmurmansk.ru/> (accessed 03 September 2024).

¹⁹ Crab wholesale. URL: https://www.avito.ru/sankt-peterburg/produkty_pitaniya?q=%D0%BA%D1%80%D0%B0%D0%B1+%D0%BE%D0%BF%D1%82%D0%BE%D0%BC&ysclid=lyzy6tf7l9737063297 (accessed 03 September 2024).

²⁰ Kamchatka crab wholesale in Saint Petersburg. URL: https://spb.regorg.ru/goods/krab_kamchatskij_optom.html?ysclid=lyzyiwsre844676680 (accessed 03 September 2024).

²¹ Buy crab wholesale, Saint Petersburg and Leningrad Oblast. URL: https://www.fishnet.ru/pricelist/russia/saint_petersburg_region/krab/?ysclid=lyzyxoq0yx182200984 (accessed 03 September 2024).

²² Crab wholesale in Saint Petersburg. URL: <https://fishretail.ru/peterburg/trade/seafood/krab> (accessed 03 September 2024).

²³ Crab claws wholesale in Saint Petersburg. URL: https://spb.pulscen.ru/price/400510-kleshni-kraba/f:31348_optom (accessed 03 September 2024).

ed for 40.9% of all Russian exports in 2023. It is notable for the fact that the price of live crab was already 2.9 times higher than the price of frozen crab in 2023 (\$32.56 vs. \$11.09); in 2024, it was 2.74 times higher (\$36.59 vs. \$13.35)²⁴.

Taking this fact into account, in 2023 the Antey LLC group of companies thoroughly developed and implemented an innovative scheme for delivering live crab to China, using air and road transport, as well as the Northern Sea Route, which in 2023 delivered about 1,000 tons of live crab to China. Currently, three-quarters of crab exports to China from the Northern Basin consist of live crab²⁵ [8, Klimenko P., p. 25].

The above Chinese prices for live Kamchatka crab are comparable to prices in St. Petersburg, but higher than the prices declared by participants in the export process in Murmansk. Chinese prices for frozen crab — 945.4–1,170 rubles/kg — are comparable to Russian prices only for the legs and claws of the snow crab. The rest of the prices in the Russian range are higher.

In Japan, the cost of Kamchatka frozen crab was 2,052 rubles/kg in 2023 and 2,116.6 rubles/kg this year. In Russia, prices for this product range from 1,400 to 3,500 rubles/kg.

Due to the lack of information on prices for a wide range of crab products in the Asia-Pacific region (similar to Russia), it can be assumed that they are lower than the prices stated in Murmansk and St. Petersburg. Intermediaries selling crabs in Russia are guided by prices in the USA and Europe, but do not take into account the purchasing power of Russians. For this reason, demand for crab products is low, as stated by producers.

There are high hopes that the digital online platform “Fish from the Net” will help solving the problem of reducing prices for fish and seafood. The launch of this IT project was agreed upon at the second fishing industry forum in St. Petersburg by the FSBI “Center for Fisheries Monitoring and Communications Systems” and LLC “GC Trading Technologies”. “With the help of this online trading platform, it will be possible to buy fish and seafood directly from fishermen on the day of the catch, receive the goods in your city without an unnecessary trade markup and monitor the catch volumes of all registered Russian fishermen” [9, Vasilyev A.M., p. 24].

The composition of the fishing fleet has a significant impact on the productivity of crab fishermen and the financial performance of crab fishing companies.

As of the beginning of 2020, the main crab fishing company North-West Fishing Consortium (NWFC) operating in the Western Arctic had 12 physically and morally obsolete vessels, and there were 19 of them in the Northern Basin. Changes in the composition of the crab fleet began in 2019, when legislation was adopted on paid auctions for the distribution of crab quotas and obligations of auction winners to build new vessels at Russian shipyards. Ten crab catchers-processors of the KSP02 project are planned to be built for crab fishing in the Western Arctic.

²⁴ Fish Courier-Profi: weekly bulletin on the international fish business, 2024, no. 28 (1009), pp. 25–26.

²⁵ 6 vessels with live crab are sailing along the Northern Sea Route from the Barents Sea to the Far East. URL: <https://dzen.ru/a/ZR9J4yQpoAgww1yU?ysclid=Izi03755z1639856567> (accessed 03 September 2024).

Three new crab catchers-processors, built according to the KSP02 project, the prototype of which was a vessel built in Turkey in 2020, have entered service. According to NWFC specialists, they are equipped with the most advanced developments in the industry and meet the latest world-class requirements ²⁶.

The new crab catchers-processors are equipped with automated factories. They are powered by energy-efficient engines with AUN3 automation, allowing them to be operated by a single operator from the bridge without the constant presence of personnel in the engine room. Environmentally friendly coolants are used. The number of traps has doubled. Digitalization of production process management is provided. Greater independence from weather conditions is ensured. These innovations ensure an increase in fishing results by 20–50% ^{27, 28}.

The above composition of the fishing fleet made it possible, as shown in the period under review, to achieve high results in the development of Arctic commercial fish stocks. However, it should be remembered that it was operated under conditions of state preferences, favorable fishing environment and absence of sanctions.

The age of most vessels was over 30 years, with a norm of 20–25 years. The level of mechanization and automation of production processes on board did not meet modern requirements, and the range of products manufactured on them was very limited. The fishing capacity of the trawlers available in 2021, given the changed hydrological conditions in the fishing areas, was insufficient to catch all the quota volumes of fish allocated to the enterprises. The total undercatch was 75.3 thousand tons (14.3%), including 59.5 thousand tons of cod (14.5%) and 15.9 thousand tons of haddock (13.9%). It should also be noted that the volumes of capelin allocated for Russian fishing have not been exploited for many years. Earlier, in 2009–2017, there was also an undercatch of 28,554.4 tons of cod and 17,893.5 tons of haddock. The average percentage of development of these fish species for the specified period was: 99.1% for cod and 97.7% for haddock. As a result of the above-mentioned facts, at the next meeting of the Presidium of the State Council in 2015, a decision was made to build a new fishing fleet at Russian shipyards, stimulated by the allocation of quotas for highly liquid biological resources — cod and haddock.

“The renewal of the fishing fleet had to be combined with bringing its total capacity in line with the capabilities of the raw material base. A serious obstacle to resolving this dilemma, especially in bottom fishing, is the legally established “dispersion” of quota objects among numerous low-power users” [10, Kuranov Yu.F., p. 734]. The limited availability of commercial biological resources reduces the ability of enterprises to renew their fleets. This fact is still relevant today.

²⁶ Construction of crab vessels. Results of 2019. Prospects for vessel construction in 2020–2025. URL: <https://infoline.spb.ru/upload/iblock/21d/21dde5f55cbb9e845be340b1567f4de5.pdf?ysclid=iz86k5dbex65093736> (accessed 03 September 2024).

²⁷ New crab catchers will ensure significant increase in catches, safety and environmental friendliness of the fishery — FFA study. URL: <https://dzen.ru/a/Y859tbbrYXwx-XQK?ysclid=iz4glgk13y109996136> (accessed 03 September 2024).

²⁸ Analysis of the parameters of new crab fishing vessels. URL: https://fsarf.ru/upload/analitika/%D0%9A%D1%80%D0%B0%D0%B1%D0%BE%D0%BB%D0%BE%D0%B2%D1%8B_%D0%BD%D0%BE%D0%B2%D1%8B%D0%B9%20%D1%84%D0%BB%D0%BE%D1%82.pdf (accessed 03 September 2024).

The article by Yu.F. Kuranov "Resource Provision for the Renewal of the Fishing Fleet" contains proposals aimed at overcoming existing resource limitations, which are also relevant today [11, p. 205].

In total, 105 vessels have been submitted for construction in the first stage, including 22 units for the Northern Basin; this, according to the calculations of the Federal Agency for Fisheries, will renew 80% of the production capacity for fishing ²⁹.

"According to available information, six trawler-processors of project 170701 with a total production capacity of 150 tons of fish per day, six trawler-processors of project KTM 01 with a production capacity of 140 tons of fish per day, six trawlers of project 1701 with a capacity of 70 tons per day and four longline processor-trawlers with a daily capacity of 24 tons are intended for construction and operation in the Northern Basin" [12, Vasilyev A.M., p. 29].

Analyzing the technical and economic data of the trawlers-processors under construction, we note the following ^{30, 31, 32, 33, 34}:

- on the new super-trawlers arriving in the Northern Basin, in addition to fillets, minced meat, minced surimi, fish meal, fat, canned goods will be produced using the latest technologies and equipment;
- the productivity of the freezing equipment trawler-processors is 2.75 times greater than that of the Kronstadt-class LFFTs, which are almost equal in size, and 1.7 times greater than that of the more modern Sevryba-2-class trawlers;
- the productivity of the freezing equipment of the new Project 1701 trawler is 1.2 times greater than that of the Sevryba-2 type vessel, which is similar in length;
- the trawler-processors of projects 170701 and KTM 01 are equipped with fish meal units (FMU), while the vessels of project 1701 have a line for processing waste from fish cut into marketable products; both are important both from an economic point of view and in terms of improving the environmental friendliness of the fishery;
- the power of the main engines on the new vessels is much greater compared to previously built trawlers; this means that they can use more efficient trawls and, if necessary, trawl at a higher speed, therefore, they can have higher fishing productivity;

²⁹ Scientific and applied foundations of sustainable development and modernization of marine economic activities in the western part of the Arctic Zone of the Russian Federation: research report (concluding): 0226-2019-0022 / Luzin Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Vopilovskiy S.S., Fadeev A.M. [et al.]. Apatity, 2022, 157 p.

³⁰ Technical characteristics of the large fishing freezer trawler type "Pulkovskiy meridian". URL: https://soviet-trawler.narod.ru/pages/ussr/pulkovskiy_meridian.html (accessed 03 September 2024).

³¹ Technical characteristics of the large fishing freezer trawler type "Kronstadt". URL: https://soviet-trawler.narod.ru/pages_r/ussr/kronshtadt_r.html (accessed 03 September 2024).

³² Technical characteristics of the trawler-processor project 170701. URL: https://www.fishnet.ru/news/novosti_otrasli/obzor-po-rybopromyslovym-sudam/ (accessed 03 September 2024).

³³ Technical characteristics of the trawler-processor of the KMT 01 project. URL: https://www.fishnet.ru/news/novosti_otrasli/obzor-po-rybopromyslovym-sudam/ (accessed 03 September 2024).

³⁴ Technical characteristics of the trawler of the 1701 project. URL: <https://www.korabel.ru/fleet/info/67509.html> (accessed 03 September 2024).

- small crews should mean a high level of automation in the engine room and mechanization of labor at the fish factory [12, pp. 28–29].

“The published information about the new trawlers indicates that, in comparison with the vessels in operation, their use will ensure at least a twofold increase in labor productivity, a reduction in costs, an increase in the production of deep-cut fish products (fillets, surimi mince and others), and the waste-free use of fish raw materials.

The trawlers “Barents Sea” and “Norwegian Sea”, built and operating in the Arctic seas, have been highly praised by experts and rated as the best vessels in their class. The trawler “Barents Sea” received an award as the best trawler according to Baird Maritime” [12, p. 28].

The article by Yu.F. Kuranov “Trends in the Development and Updating of the Fishing Fleet in the Northern Basin” [10, p. 737] shows what factors need to be taken into account when determining the quantitative and structural composition of the fishing fleet. These factors are largely reflected in the new fleet currently under construction. Institutional and economic instruments for supporting and stimulating new fishing vessels are justified.

The program for building a fishing fleet with the support of “Invest Quotas” is the subject of the article by E.V. Klippenstein and co-authors “Fishing Fleet Development Program: Expectations and Realities”, in which this material is criticized. An analysis of the article shows that it contains at least 14 comments. Most of them can be agreed with. Some of them mainly concern only the Far Eastern basin. For example, in 2011, an analysis of the use of the fishing fleet was carried out in the Northern basin. It showed that in 2010, 40.7% of the existing fleet did not participate in the fishery due to a lack of a raw material base. This fact was the main reason for the weak participation of company owners in the renewal of the fleet. Therefore, the shortage of the fishing fleet indicated in the article should be correlated with the state of the fishing resources. The article does not contain any data on the advantages of the new vessels over the existing ones, even though they have already significantly increased the production of pollock fillets [13; 14, Nikitin V.F. et al., p. 53].

“Estimating the average daily catch of the new processing trawlers at 75% of the nominal value according to the project and their presence in the fishery at the level of the trawler “Sevryba-2” for 268 days a year, it can be calculated that their total annual catch of cod and haddock can amount to 454 thousand tons. For 2024, the Russian-Norwegian Fisheries Commission has allocated a quota of 311.7 thousand tons for cod and haddock. Thus, the new vessels can fully master the TAC for cod, haddock and halibut in the North-East Atlantic. In this regard, in the near future there will be problems with providing fishing quotas for vessels currently in operation. Moreover, cod and haddock quotas are already insufficient.

According to the fishing fleet register as of 01.01.2022 and decisions of the Federal Fisheries Agency for 2022, cod and haddock fishing quotas in the Northern Basin were held by ~92 enterprises with 121 medium-tonnage vessels, 7 small vessels and 46 small vessels. Of these, 32 me-

dium-tonnage vessels were under 30 years old, 41 units were 30–35 years old and 48 units were over 35 years old” [12, p. 29].

Before the introduction of sanctions by Western countries, it was planned that new trawlers would arrive in the Northern Basin by 2027. The current estimated date for their full arrival is 2030. Most of the current fleet of fishing vessels will still be in operation when the new vessels arrive, and their owners will still have fishing quotas. This raises the question of what to do with these vessels and their owners.

The first way to solve this problem, in our opinion, is to write off or sell old vessels with compensation and purchase quotas by the owners of processor trawlers.

The second option for providing new trawlers with sufficient fishing quotas, in our opinion, is the creation of enterprises in the form of business entities of various organizational and legal forms by the owners of new vessels and bio-resource quotas.

In addition, it should be noted that cod stocks are currently at a low level, but the available knowledge gives reason to hope that they will increase significantly in the near future.

The above composition of the fishing fleet, ordered during the first stage of its construction, mainly consists of trawler-processors. The existing fishing fleet does not include high-performance seiners for catching and delivering pelagic fish to coastal enterprises. At the same time, fishermen in the Northern Basin systematically fail to utilize the quotas allocated for capelin, polar cod, and in recent years — cod and haddock. For example, this year, out of 78 thousand tons of allocated capelin resources, only 42 thousand tons have been utilized. Coastal enterprises are operating at approximately 50% of their production capacity due to a shortage of fish raw materials, and the population of the Murmansk Oblast is not being supplied with chilled fish. In this regard, in our opinion, it is advisable to stimulate orders for the construction of several small, high-performance seiners with RSW tanks. It is also necessary to upgrade coastal fishing vessels by equipping them with liquid ice production systems to improve the quality of fish products. The government has clarified the requirements for shipbuilding under the fisheries investment quota program. Ship hulls and materials are to be manufactured in Russia ³⁵.

It is known that the Murmansk Sea Fishing Port, ship repair and other enterprises servicing fishing vessels fell into decline after the transition to a market economy due to the lack of fishing vessels entering Russian ports. The main reasons for this were the customs clearance requirements for trawlers purchased abroad, long voyages, poor service and others [15].

Taking this into account, it is advisable to create a new regime for fishing vessels to enter Russian ports for unloading fish products, repairs and other services. For these purposes, as is known, the Murmansk Sea Port has become state-owned and will be modernized.

It is advisable for Russian fisheries, primarily new trawlers-processors, to switch to a digital system for determining the volume of fish caught. The existing method of calculating catch vol-

³⁵ Kuzmin V. Shipbuilding under the “Quotas under the Keel” mechanism received new sovereign rights. URL: <https://rg.ru/2024/02/21/na-svoih-verfiah.html?ysclid=m0nf1oflg9740639088> (accessed 03 September 2024).

umes by recalculating finished products using cutting coefficients does not contribute to preserving commercial stocks due to the possibility of discarding small fish. It also allows for significant inaccuracies in determining catch volumes due to the use of different methods in the production of the same types of products. In order to eliminate this, other methods of determining catch have long been sought.

A new, more accurate method “has been used for over 20 years in the pollock fishery by US fishing companies in the Bering Sea, where about 30 American vessels similar to the new Russian trawlers-processors operate. In the late 1990s, the problem of pollock overfishing arose there. Since then, fish have been weighed on American vessels using conveyor scales, which has stabilized the bio-resource stock”³⁶ and increased the efficiency of fish usage.

“Considering the above, in May 2021, members of the Fishing Fleet Owners Association (FFA) approached the Russian Ministry of Agriculture with an initiative to introduce catch weighing. In this case, the focus was on pollock.”³⁷ “The existing method of calculating catches of pollock and other fish species by converting finished products into catches threatens to reduce the population of these fish, according to the Fishing Fleet Owners Association. The authors of the appeal believe that weighing will make it possible to quickly solve the problem of fish being thrown overboard for various reasons. This means that the resource will be used more economically.”³⁸

“Representatives of the association explained that the Far Easterners plan to invest more than a billion dollars in the construction of a new fleet and are interested in the sustainability of the pollock population...”³⁹ The above fully applies to cod fishing in the Barents and Norwegian Seas.

“In December 2021, the FFA prepared and sent proposals to the Federal Agency for Fisheries on the method and technical means of weighing catches on fishing vessels. The proposals were prepared as part of the development of the relevant decision of the Council on Agro-Industrial Complex and Nature Management under the Federation Council.

It is proposed to ensure weighing by installing flow scales on board fishing vessels, which can be installed between the conveyors transporting fish from the receiving bunker to the ship’s processing plant. Thus, the entire mass of the catch will be taken into account before processing begins. It is proposed to transfer the weighing data to the Federal State Budgetary Institution Centre of Standardization, Metrology and Certification (FSBI CSMC) without the participation of the vessel’s crew, and only then provide access to information on the weight of the catch to the vessel’s command.

³⁶ Russian fishermen will weigh their catches in a new way. URL: <https://rg.ru/2021/08/24/reg-szfo/rossijskie-rybaki-budut-vzveshivat-ulovy-po-novomu.html> (accessed 05 September 2024).

³⁷ Ibid.

³⁸ Pollock is being prepared for weighing. URL: <https://www.kommersant.ru/doc/4802766> (accessed 05 September 2024).

³⁹ Russian fishermen will weigh their catches in a new way. URL: <https://rg.ru/2021/08/24/reg-szfo/rossijskie-rybaki-budut-vzveshivat-ulovy-po-novomu.html> (accessed 05 September 2024).

The FFA believes that this approach will prevent the possibility of fish being discarded from the vessel (the so-called return of catches to the environment under the guise of other by-catches), including juvenile fish. The weight of the catches received by the vessel will be compared with the weight of the products made from them.

The decision to weigh catches directly will not only ensure the conservation of commercial fish stocks, but also increase their total allowable catches in the future.”⁴⁰

“The Federal Agency for Fisheries called the FFA initiative “essentially correct”. However, they note that there is currently no single algorithm for weighing trawl catches, as all fishing gear is different. In addition, if fish of non-commercial size (less than 34 cm) are included in the catch volume, it will be necessary to change the entire procedure for calculating the total allowable catch (TAC), which currently only applies to adult pollock⁴¹.

A significant reduction in labor costs, as well as operational and administrative costs for management can be achieved through the following processes in Arctic fisheries and crab harvesting:

- introduction of an electronic fishing log⁴²;
- digitalization of the “Fishing Permit” document⁴³;
- digitalization of documents in the Federal State Information System (FSIS) “Mercury”⁴⁴;
- equipping vessels with domestic technology for transmitting daily vessel reports via a domestic satellite constellation⁴⁵;
- resolving the issue of technical sovereignty in the use of broadband Internet on fishing vessels⁴⁶;
- development and implementation of a hardware and software complex that provides for circular accounting and control of fuel on a vessel⁴⁷.

⁴⁰ FFA sent proposals to Rosrybolovstvo on the method and technical means of weighing catches. URL: <https://konkurent.ru/article/45604> (accessed 04 September 2024).

⁴¹ Pollock is being prepared for weighing. URL: <https://www.kommersant.ru/doc/4802766> (accessed 05 September 2024).

⁴² The transition of the Russian fishing industry to digital has been supported // Fish Kurier-Profi: weekly bulletin on the international fish business, 2021, no. 37 (865), p. 54. URL: <https://www.fishnet.ru/issues/rk-profi/865.html> (accessed 05 September 2024).

⁴³ Russian fishermen will weigh their catches in a new way. URL: <https://rg.ru/2021/08/24/reg-szfo/rossijskie-rybaki-budut-vzveshivat-ulovy-po-novomu.html> (accessed 05 September 2024).

⁴⁴ What is FSIS “Mercury”. URL: <https://its.1c.ru/db/fgismercury/content/4/hdoc> (accessed 04 September 2024).

⁴⁵ Course towards digitalization: new opportunities and IT solutions for the fishing industry were discussed at MRF-2019. URL: <https://fish.gov.ru/news/2019/07/11/kurs-na-tsifrovizatsiyu-novye-vozmozhnosti-i-it-resheniya-dlya-rybnoj-otrasli-obsudili-na-mrf-2019/> (accessed 04 September 2024).

⁴⁶ Russian fishermen will weigh their catches in a new way. URL: <https://rg.ru/2021/08/24/reg-szfo/rossijskie-rybaki-budut-vzveshivat-ulovy-po-novomu.html> (accessed 05 September 2024).

⁴⁷ All-round accounting and control of fuel on board a vessel: consumption, bunkering, reserves, issuance. Monitoring of ship equipment parameters. URL: <https://sputnik-flot.ru/krugovoj-uchet-topliva-na-sudne> (accessed 04 September 2024).

Conclusion

For the fishing industry of the Murmansk Oblast, which is Arctic fishery, the year 2013, in accordance with the theory of the business life cycle, was, in our opinion, a period marking the end of the growth stage. The formed fishing potential made it possible to develop the available quotas of aquatic resources, supply processing enterprises with fish raw materials, provide the population with finished products, and develop further by acquiring new, more productive vessels. About 40 companies engaged in bottom fishing (~50% of the total) and 6 companies engaged in pelagic hydrobiont fishing (20% of the total) were creditworthy. They had sufficient shares of biological resources to finance the construction of trawlers according to the schemes existing in countries with developed shipbuilding⁴⁸.

The maturity stage was observed in 2014–2021. “During this period, the industrial potential created in 2004–2013 was mainly used. Economic conditions were favorable for the development of fish and seafood exports due to the weakening of the Russian ruble against the US dollar and an increase in export prices for fish products” [3, Vasilyev A.M. et al.]. The good condition of commercial stocks of cod and haddock contributed to the development of fisheries and exports. Economic and financial indicators for fisheries reached a high level. Only consumption of fish products by the population was at a low level (Table 1).

During this period, the profitability of fish product sales averaged ~80%, and in 2021 it reached 116%. However, enterprise managers did not adequately update their fishing fleet and sold fish on the domestic market at prices that did not allow the population to consume it in sufficient quantities. Fishing was criticized by the President of the Russian Federation V.V. Putin and was not approved by the country’s population. This served as a reason for building a fishing fleet by stimulating the process with additional quotas for cod and haddock. Currently, new fishing vessels and crab catchers are world-class know-how, which, along with other innovations, will make it possible to successfully resist the sanctions imposed by Western countries against the Russian fishing industry.

Since the basis of economic activity of the Arctic fisheries is the export of fish products, the ban on the sale of the main expensive product — crab — to the USA and the EU, as well as the sale of cod at a discount, led to a decrease in sales profitability in 2022 to 59.0%, and in 2023 — to 47.8% and to a decrease in the economic efficiency of fisheries as a whole. To overcome this situation, the heads of the Fisheries Agency and owners of enterprises in the Murmansk Oblast took measures in 2022–2023 to reorient the export of fish and seafood products to countries in Asia, Africa and Latin America, and to improve logistics and technologies for delivering crabs to new markets. “In 2023, Russia will export fish products to 80 countries,” said Agriculture Minister Dmitry Patrushev at the international fisheries forum in St. Petersburg. “In 2021, there were 58 coun-

⁴⁸ Scientific and applied foundations of the state policy for the functioning of the resource-based economy on the shelf and in the coastal zone of the Russian Arctic in the context of globalization: research report (interim) / Institute for Economic Studies of the Kola Science Center of the Russian Academy of Sciences; scientific advisor Vasilyev A.M.; responsible executives: Vasilyev A.M., Kuranov Yu.F., Fadeev A.M. [et al.]. Apatity, 2015, 120 p.

tries, in 2022 — 60.”⁴⁹ At the same time, most of the cod in 2024 was still sent to European countries⁵⁰.

The measures taken to change the logistics of exports are giving positive results. Thus, an increase in the supply of live crabs to China made it possible to increase their export value by 1.74 times in January–September 2024 (from \$486 million to \$847 million)⁵¹.

Among the measures aimed at improving the efficiency of the fleet, an increase in prices for fish supplied to the domestic market is also used. Thus, wholesale prices for haddock in August 2024, compared to their level in December 2022, increased by an average of 64%^{52, 53}.

Digitalization is an innovative element in the country’s fisheries, including in Arctic fisheries, contributing to increased management and production efficiency.

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