Federal Fishery Agency
PACIFIC BRANCH OF FSBRI “VNIRO” (“TINRO”)

REPORT
ON RESEARCH AND SCIENTIFIC WORKS

POLLOCK FISHERY MONITORING IN THE SEA OF OKHOTSK BY SCIENTIFIC OBSERVERS DURING POLLOCK AND HERRING FISHING SEASON IN 2019

Summary Report

Vladivostok 2019

1 Method of study

Pollock fishing monitoring activities in the winter–spring period of 2019 (Season A) in the Sea of Okhotsk covered Kamchatka-Kuril subzone (KK – 6105.4), West Kamchatka subzone (WK – 6105.2), North Sea of Okhotsk subzone (NSO – 6105.1) and East Sakhalin subzone (ES – 6105.3) and were performed by 13 scientific observers from TINRO. The observers worked on board 15 trawlers belonging to 6 companies. Their observations covered virtually all fishing fleet operating areas during January 01 – April 09 (Fig. 1.1).

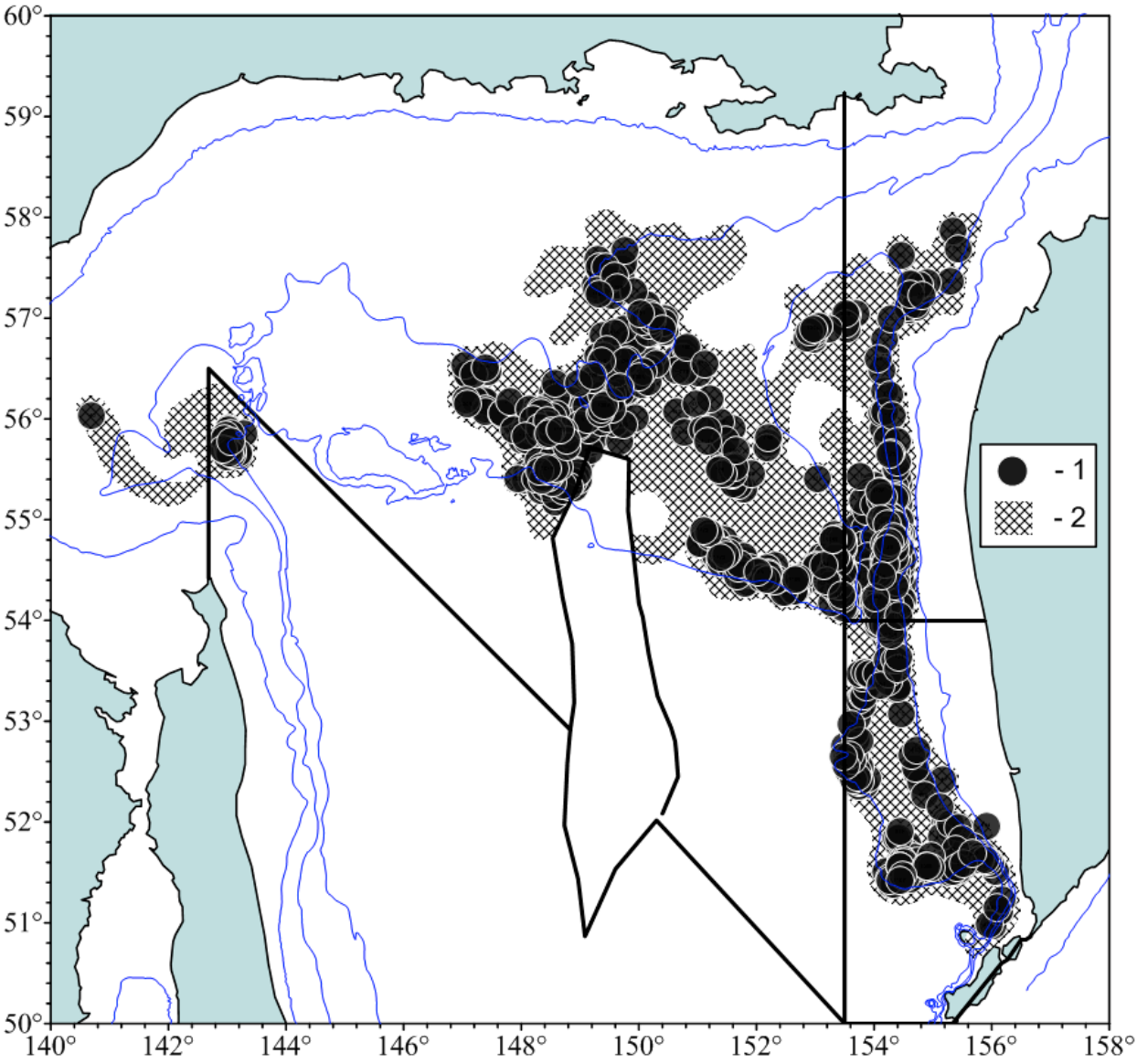


Figure 1.1 – Trawling locations processed by scientific observers (1) and target pollock fishery areas (2) in the Sea of Okhotsk during January 01 – April 09, 2019

In total, TINRO observers worked 766 ship-days and processed 1,168 trawl hauls in the pollock fishery during the Season A of 2019. Weight measurements (WM) with dissection were performed on 253,555 pollock individuals, 13,898 herring individuals and 9,209 individuals belonging to other species. Biological analysis (BA) was performed on 7,395 pollock individuals, 682 herring individuals and 610 individuals belonging to other species. Observations of seabird injury and death and marine mammal by-catch in the pollock fishery were performed at 1,322 observation sites.

In the same period of the preceding year (2018), TINRO observers (14 persons) worked 756 ship-days and processed 907 trawl hauls. Weight measurements with dissection were performed on 177,801 pollock individuals, 18,937 herring individuals and 11,300 individuals belonging to other species. Biological analysis was performed on 4,398 pollock individuals, 1,221 herring individuals and 657 individuals belonging to other species. Observations of seabird injury and death and marine mammal by-catch in the pollock fishery were performed at 1,296 observation sites.

In the Season A of 2017, 12 TINRO observers in the Sea of Okhotsk worked 700 ship-days and processed 706 trawl hauls. Weight measurements were performed on 135,159 pollock individuals, 22,481 herring individuals and 4,741 individuals belonging to other species; biological analysis was performed on 5,661 pollock individuals, 1,075 herring individuals and 808 individuals belonging to other species; observations of seabird injury and death and marine mammal by-catch in the pollock fishery were performed at 814 observation sites.

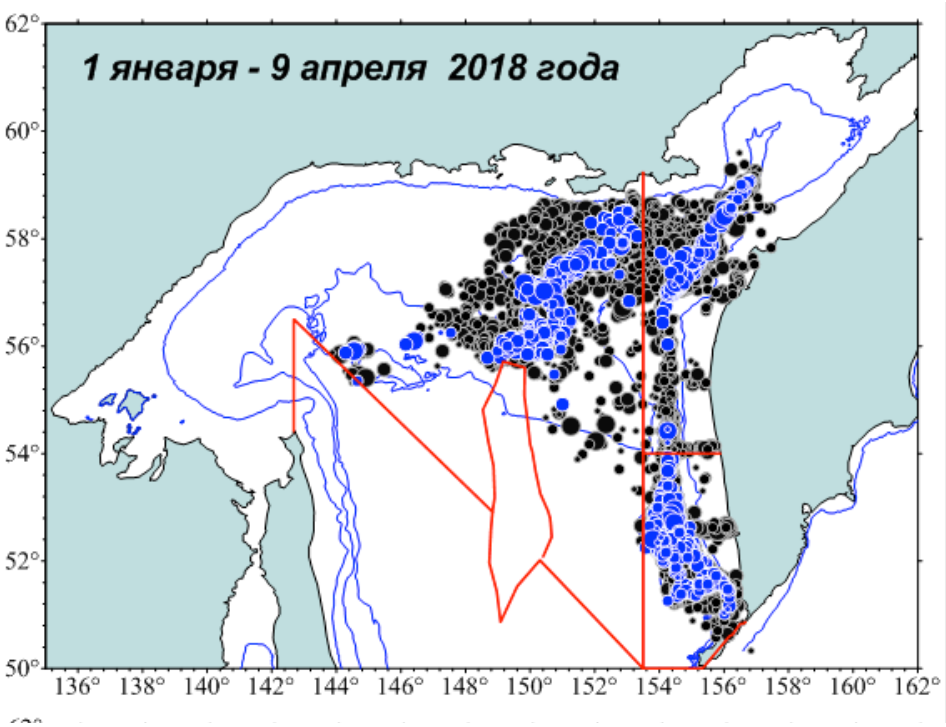
As we can see, the number of analyzed hauls and amount of biological information collected by observers has somewhat increased, with growth of observations of marine mammals and seabirds particularly noticeable.

The following tasks were assigned to the group of scientific observers:

- study of the distribution of pre-spawning and spawning pollock aggregations, identification of the start time of mass spawning activities and localization of pollock spawning grounds in the Sea of Okhotsk;

- witness of fishing on pollock pre-spawning aggregations in order to track the dynamic of fishing parameters: catch per hour, per haul, per fishing ship-day;
- collection of materials for study of the size and age structure, gamete maturity and other biological parameters of pollock in fishing fleet operating areas;
- estimation of juvenile pollock by-catch in pollock fishery;
- qualitative and quantitative assessment of by-catch of other fishes, invertebrates, mammals and birds;
- registration of marine mammal and seabird capture and death through engagement with fishing gear;
- collection, analysis and transmission of day-to-day information on fishing fleet performance in the target pollock fishery to TINRO.

Figure 1.2 shows distribution of catches hauled by fishing vessels engaged in the target pollock fishery and of catches analyzed by TINRO scientific observers during the Season A in 2019 (bottom) and 2018 (top).



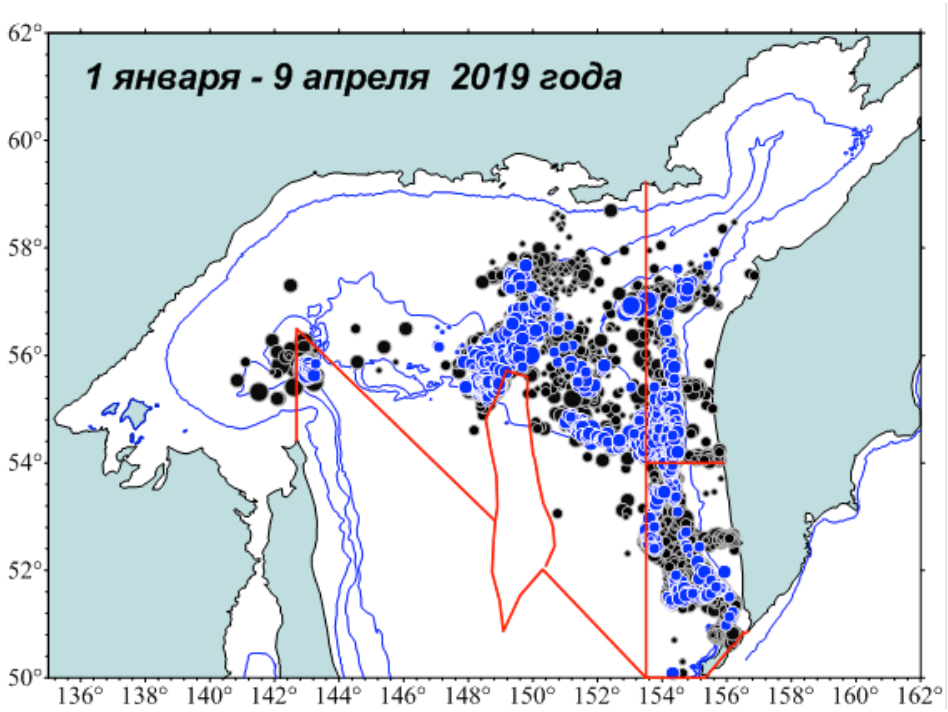


Figure 1.2 – Distribution of catches hauled by pollock fishing vessels (black circles) and of analyzed catches (blue circles) during the Season A of 2018 (top) and 2019 (bottom)

The total area covered by observations of the target pollock fishery virtually did not change in last two years and was as follows: 122.7 thsd km^2 in 2019 and 122.2 thsd km^2 in 2018. However, due to more difficult ice conditions in the northern part of the Sea of Okhotsk in the winter–spring season of 2019, the operating area of fishing vessels was somewhat smaller here than a year before – 152.5 thsd km^2 versus 165.2 thsd in 2018 km^2. In our opinion, it is this circumstance that has led to somewhat higher percentage of coverage of the fishing fleet operating area in the Season A of 2019.

Upon comparison of the operating area of trawlers with observers onboard and total area of the target pollock fishery in the Season A of 2019, it can be stated that overall coverage of the fishing fleet operating area by observers in that season was 80.4% in the northern part of the Sea of Okhotsk (Kamchatka-Kuril, West Kamchatka and North Sea of Okhotsk subzones) which is somewhat more than a year before (74.0%).

Same as in previous years of studies, scientific observers collected fishing and biological information in the areas with highest pollock catches (Fig. 1.3). This is explained by the fact that in the winter–spring period fishing vessels normally work on the densest pollock aggregations and, accordingly, observers based on these vessels control nearly whole pollock catch in the Sea of Okhotsk. In same locations, materials on by-catch of other species of aquatic living resources were collected and observations of seabird injuries and death and marine mammal by-catch in the target pollock fishery were performed.

In total, 196.0 thsd tons of pollock was harvested in the areas covered by scientific observers in the target pollock fishery during Season A of 2019 in Kamchatka-Kuril subzone or 88.9% of total pollock catch in this subzone (220.4 thsd tons) and respective figures for other subzones were as follows: West Kamchatka subzone – 270.7 thsd tons or 96.6% of total catch in this subzone (280.2 thsd tons), and North Sea of Okhotsk subzone – 253.4 thsd tons or 80.0% of total catch in this subzone (316.7 thsd tons).

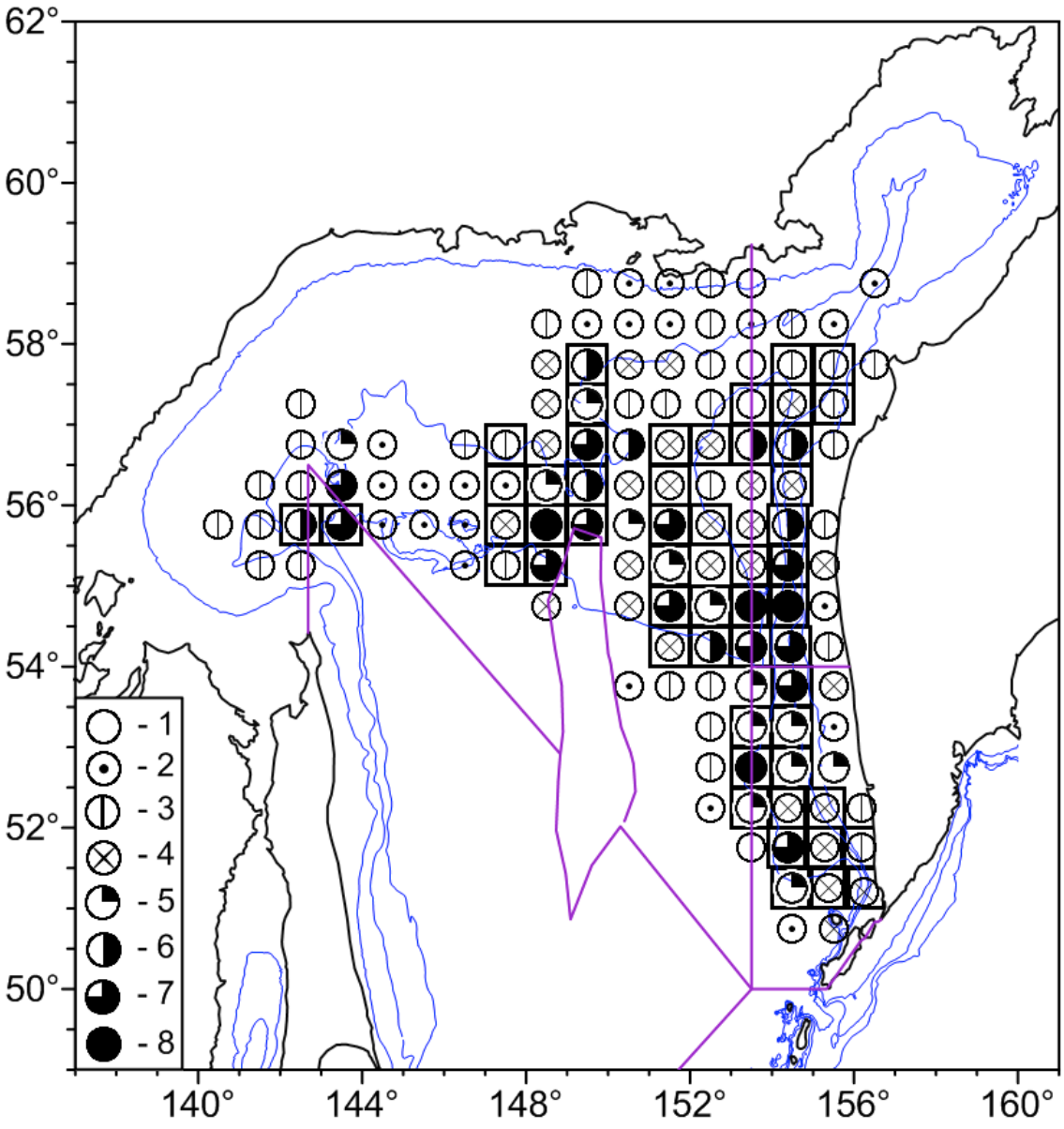


Figure 1.3 – Pollock catch distribution in the target pollock fishery in the Sea of Okhotsk in Season A of 2019
Symbols: 1 – 0; 2 – < 0.01 %; 3 – 0.011-0.1 %; 4 – 0.11-0.5 %; 5 – 0.51-1.0 %; 6 – 1.1-2.0 %; 7 – 2.1-5.0 %; 8 – > 5.0 %.
Squares show locations where data were collected by scientific observers

On the whole, scientific observers controlled 88.1% of catch in the target pollock fishery in all three subzones in the winter–spring period of 2019. Therefore, we can state that the number of hauls processed by observers quite adequately reflects both catch sizes and biological characteristics of the key species – pollock, and quantitative and qualitative composition of by-catches typical of these fishing areas.

According to our observations, pollock fishing areas in the Sea of Okhotsk are fixed and their year-to-year variation is insignificant. Fishing fleets operate on maximum-density pollock aggregations and slight variations in coverage of fishing areas by observers during the fishing season are explained by reconnaissance activities undertaken by some vessels in search of higher-quality raw fish.

Over the last three years (2017, 2018 and 2019), fishing fleet operating area coverage by observations in Season A was 82.7%, 74.0% and 80.4% respectively. Far Eastern scientific institutes provided 18, 23 and 21 scientific observers respectively including 12, 14 and 13 observers from TINRO. As we can see, the increased number of observers did not result in any significant growth of fishing fleet operating coverage by observations, which means that pollock fishery monitoring is currently performed by an optimal number of scientific observers. We believe that 20 scientific observers are quite sufficient to collect fishing and biological information during the target pollock fishery in Season A.

3 Overview of fleet operations in pollock fishery in Season A of 2019

Pollock TAC in 2019 was as follows: North Sea of Okhotsk subzone – 347.1 thsd tons, West Kamchatka subzone – 347.1 thsd tons and Kamchatka-Kuril subzone – 269.8 thsd tons which amounts to a total of 964.0 thsd tons. Same as in 9 previous years, quotas for two “Kamchatka” subzones (61.05.2 and 61.05.4) were combined an aggregate TAC of 616.9 thsd tons.

In January 2019, same as in 2018, pollock fishing activities were concentrated in Kamchatka-Kuril subzone (Fig. 3.1). Monthly catch in this subzone was about 130.6 thsd tons (177.8 thsd tons a year ago). Catch intensity in West Kamchatka and North Sea of Okhotsk subzones was low, with pollock harvested as by-catch in herring and other fisheries. Fleet number in all subzones was reaching 98 vessels with an average of 69. Last year’s figures for January were larger – 106 and 73 respectively. Mean catch per vessel was 72.4 tons in 2019 and

82.9 tons in 2018. The whole fleet's daily catch was 5.2 thsd tons on average in this January and 6.1 thsd tons in January of 2018. Total pollock catch in the northern part of the Sea of Okhotsk in January 2019 was 157.3 thsd tons which is 32 thsd tons less than in 2018 (189.3 thsd tons).

Pollock fishing in West Kamchatka subzone began in February 2019 and its monthly catch here was about 150.2 thsd tons (Fig. 3.1). Catch in Kamchatka-Kuril subzone was 104.0 thsd tons in 2018 and only about 71.7 thsd tons in February 2019. Up to 132 vessels of various types operated in February in all three subzones, with an average number being 109. The last year's average for February was larger by 4 vessels. Mean catch per vessel was 74.7 tons in February 2019 and 69.7 tons in February 2018, with the fleet's total mean daily catch being 8.3 and 7.9 thsd tons respectively. Total Pollock catch in February was 232.7 thsd tons which is more than in February 2018 (219.9 thsd tons). Still, total cumulative catch since year's beginning in the northern part of the Sea of Okhotsk remained almost 20 thsd tons less than in the last year (389.9 thsd tons in 2019 and 409.2 thsd tons in 2018).

In March 2019, same as a year ago, pollock fishing activities were most intensive in North Sea of Okhotsk and West Kamchatka subzones (Fig. 3.2). The pollock fishing flotilla counted up to 144 vessels and averaged at 129 vessels. Last year's figures were 154 and 126 respectively. Mean catch per vessel in March 2019 was somewhat higher than a year ago and amounted to 88.3 tons (84.7 tons in 2018). As a result, total catch by the whole flotilla was 352.9 thsd tons which is 22.5 thsd tons more than in 2018 (330.4 thsd tons). It should be noted that fleet locations were affected by ice conditions in March 2019.

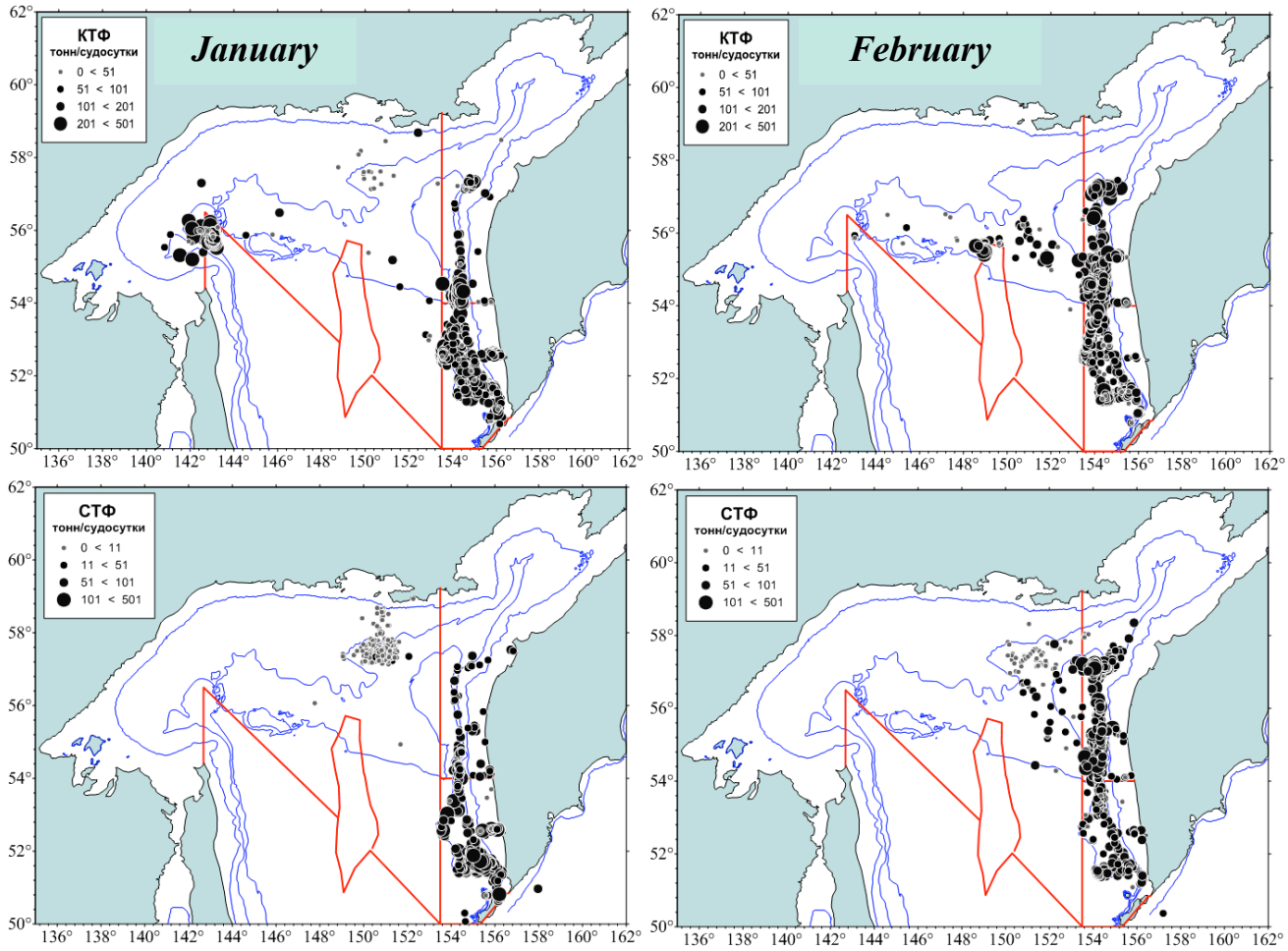


Figure 3.1 – Fleet locations in target pollock fishery in January and February 2019

КТФ = Large tonnage fleet
СТФ = Medium tonnage fleet
тонн / судосутки = tons / per ship-day

During 01–09 April 2019, target pollock fishery in the northern part of the Sea of Okhotsk was active only in North Sea of Okhotsk subzone (Fig. 3.2) and yielded 98.2 thsd tons of pollock, which is 13.3 thsd tons more than in the last years (84.9 thsd tons).

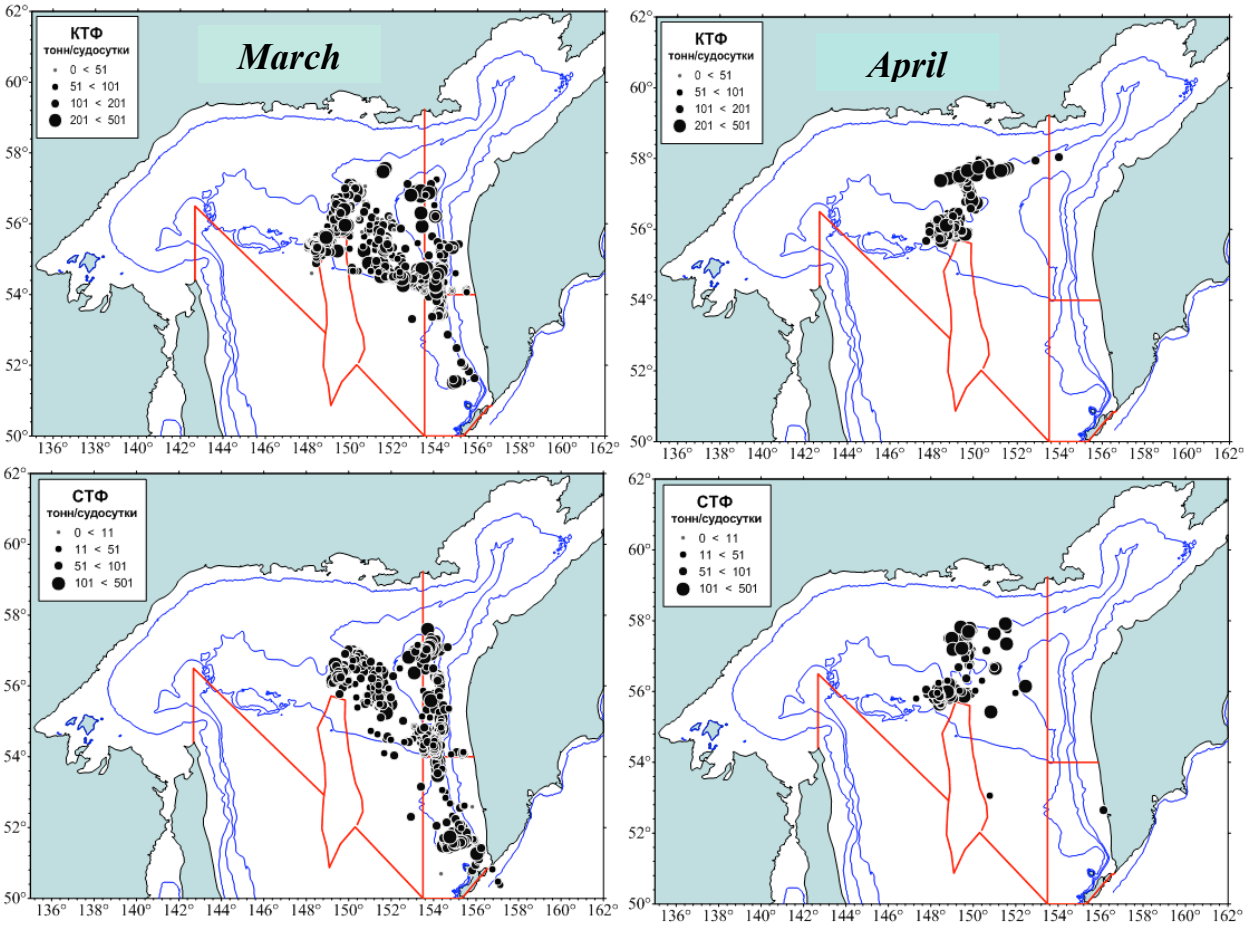


Figure 3.2 – Fleet locations in target pollock fishery during March 01 –April 09, 2019

КТФ = Large tonnage fleet
СТФ = Medium tonnage fleet
тонн / судосутки = tons / per ship-day

During the winter–spring fishing season of 2019, total daily pollock catch by all vessels was gradually growing, as more catchers became engaged and more fishing operations were performed, from 0.6 thsd tons up to 6.6 thsd tons by mid-January. It remained on the same level (about 5.9 thsd tons) till mid-February, then abruptly rose to 10.6 thsd tons and remained high till late March averaging at 11.2 thsd tons. High daily catches in this period were supported primarily by a very high mean catch per vessel. Total mean daily pollock catch by all vessels during the fishing season amounted to 8.5 thsd tons which slightly more than a year ago (8.3 thsd tons) (Fig. 3.3).

By 10 April 2019, pollock catch by pelagic trawls in the commercial fishing mode in RF EEZ (target fishery) by all vessels has totaled about 817.2 thsd tons

(Table 3.1) which is 29 thsd tons more than a year ago (788.2 thsd tons). Pollock catch by other fishing gear, mostly Danish seine fishery off West Kamchatka, was some 23.8 thsd tons or 12.8 thsd tons less than in 2018 (36.6 thsd tons).

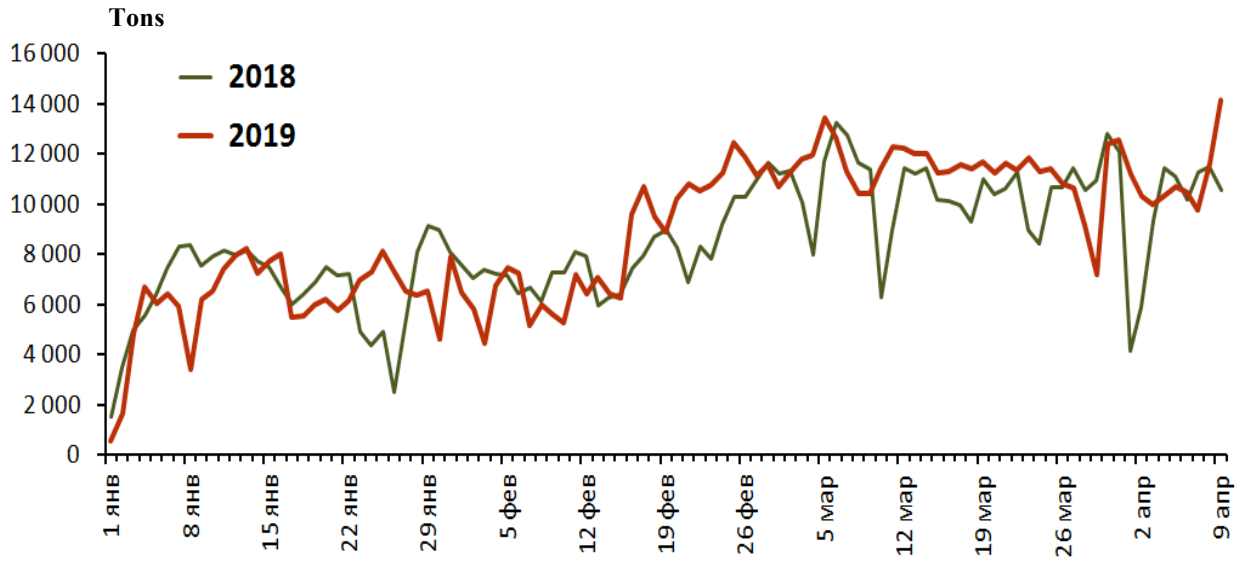


Figure 3.3 – Dynamic of daily pollock catch in the northern part of the Sea of Okhotsk (WK, KK and NSO subzones) in Season A of 2018 and 2019

"Kamchatka" subzones taken together yielded 524.0 thsd tons in January – March 2019 which is nearly 30 thsd tons more that the last year's figure.

Table 3.1 – Pollock TAC, yield and percentage of TAC use by fishing areas in the northern part of the Sea of Okhotsk in January – early April 2019

Subzone	TAC, thsd tons	Ship-days in target trawl fishery	Number of hauls in target fishery	Total yield, thsd tons		Percentage of TAC use by all fishing gear types since year's start, %
				trawls	all fishing gear types	
61.05.1	347.1	3069	8343	316,683	316,863	**91.3**
61.05.2	347.1	3112	7936	280,176	288,561	
61.05.4	269.8	3076	7824	220,362	235,628	**85.0**
Total	**964.0**	**9257**	**24103**	**817,221**	**841,052**	**87.2**

Upon summarizing results of the Sea of Okhotsk pollock season of 2019, we would like to note the following.

Total pollock catch in the Season A of 2019 was 841.1 thsd tons (87.2% of TAC). Catch in the same period of 2018 was 824.8 thsd tons (85.3% of TAC).

According to our assessments, pollock stock in the northern part of the Sea of Okhotsk is currently at a higher than medium level which has been confirmed by results of the pollock fishery. Mean catch per vessel was 84.2 tons in January – April of 2019 and 82.2 tons in the same period of the last year.

Meteorological conditions in the winter–spring season of 2019 had smaller adverse effects on fishing conditions in process of pollock fishing in the northern part of the Sea of Okhotsk than in 2017–2018, when deep cyclones frequently affected directly the Sea of Okhotsk basin bringing storm weather. A relatively small number of such cyclones were observed in 2019.

Ice conditions during the pollock fishing season of 2019 had no critical effects on fishing conditions off West Kamchatka and, on the contrary, prevented effective performance of fleets, particularly medium-tonnage vessels, in some areas of the North Sea of Okhotsk subzone.

4 Results of scientific observers' activities during target pollock fishery in the northern part of the Sea of Okhotsk in Season A of 2019

4.1 Kamchatka-Kuril subzone

During the winter–spring period of 2019, scientific observers collected fishing and biological information onboard fishing vessels in the Kamchatka-Kuril subzone from January 04 to March 19 nearly over the entire water basin (Fig. 1.3).

According to their data for Kamchatka-Kuril subzone, pollock was harvested above depth contours of 190 to 620 m in January. Its densest commercial aggregations in the subzone were observed in the area between 51°15' and 52° N (Fig. 4.1.1). Catches per 1 trawling hour varied here in the range of 1.4 to 60 t

averaging at 8.3 tons. Pollock size distribution varied from 20 to 68 cm and was dominated by individuals 40–45 cm long who accounted for 53% of the number of individuals in catches (Fig. 4.1.2). Mean pollock size was 42.4 cm. The percentage of under-size individuals (AC length < 37 cm) was small and averaged 11.0% over a month. Sex ratio was roughly equal with a small excess of females (51.3%) (Table 4.1.1). The gametes of most females and males were at II gonad development stage, respective percentages being 53.3% and 49.9% (Table 4.1.1).

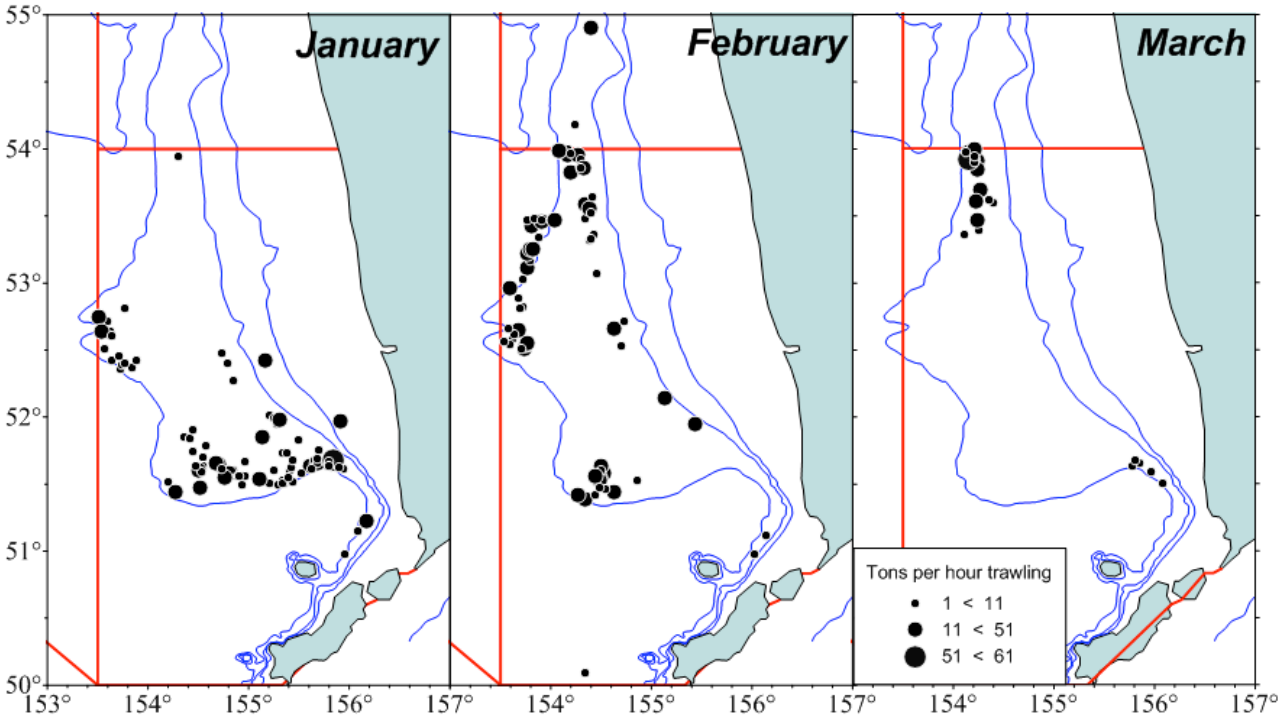


Figure 4.1.1 – Pollock catch distribution in Kamchatka-Kuril subzone by data of scientific observers, Season A of 2019

In February, pollock was harvested above depth contours of 205–550 m, with its densest aggregations moving northwards and being observed north of 52°30’ N (Fig. 1.3). Catches per 1 trawling hour in the northern part of the subzone varied in the range of 1.7 to 46.7 tons. Mean catch per 1 trawling hour somewhat increased on January and amounted to 11.4 tons. Pollock size distribution underwent no significant changes compared with January. The bulk of catches were individuals 41–46 cm long (47%) averaging at 43.4 cm (Fig. 4.1.2). The

percentage of under-size individuals (AC length < 37 cm) continued being low and averaged at 8.3% of the number of individuals in catches over a month. More females occurred in catches and their percentage grew to 54.6% (Table 4.1.1). The gametes of most females and males continued being at II gonad development stage, respective percentages being 51.6% and 43.6% (Table 4.1.1).

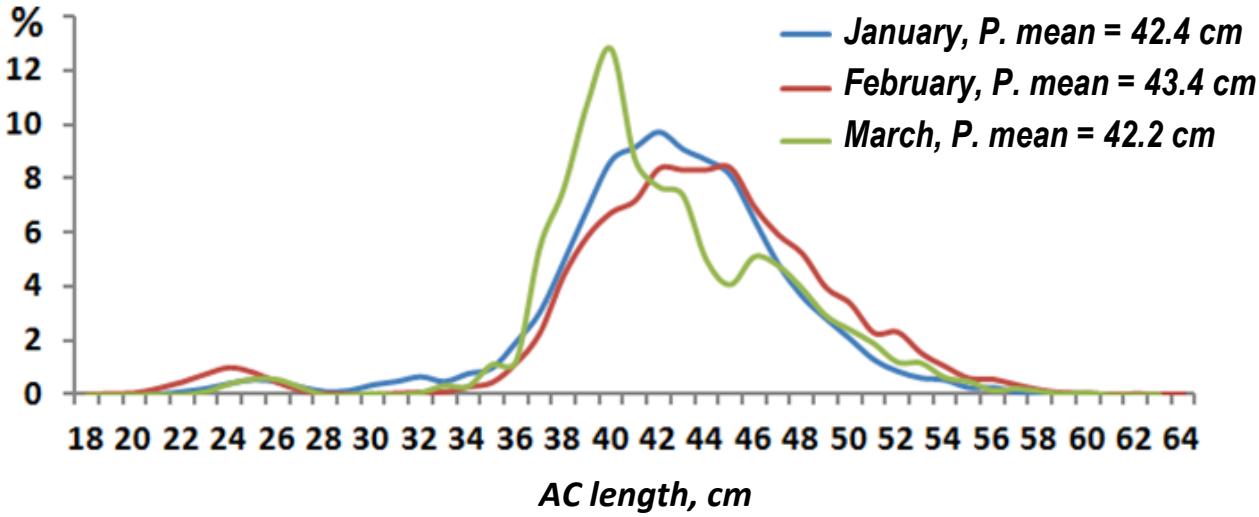


Figure 4.1.2 – Size distribution of pollock catches in Kamchatka-Kuril subzone by data of scientific observers, Season A of 2019

In March, pollock aggregations distributed in the extreme north of Kamchatka-Kuril subzone above depths of 240–485 m (Fig. 4.1.1). Compared with the preceding months, pollock size distribution in trawl catches shifted toward smaller sizes (Fig. 4.1.2). The bulk of catches were individuals 38–43 cm long (55%). The by-catch of under-size individuals increased but not much – to 10.6%. The percentage of "roe-carrying" females significantly grew (gonad maturity stages III-IV and IV – 59.1% in total) as did that of males with gonads at maturity stage IV – 70.0%.

4.2 West Kamchatka subzone

In 2109, observers collected data onboard fishing vessels in the West Kamchatka subzone from January 28 to March 26 in the main fleet operating area between 54° and 56° N.

In January, observers collected fishing and biological information about pollock in extreme south of the subzone (south of 55° N above depth contours of 190–390 m (Fig. 4.2.1). Catches per 1 trawling hour varied here in the range of 0.8 to 40.0 tons and averaging at 16.7 tons.

According to data of observers for West Kamchatka subzone in February, pollock was harvested up to 57°30’ N above depths of 190–600 m (Fig. 4.2.1). Its densest commercial aggregation was observed between 54° and 56° N, with maximum catches per 1 trawling hour reaching 120 tons and mean hourly catch over a month was 49.8 tons.

In March, the most efficient pollock fishing location in West Kamchatka subzone was the area between 54° and 55° N (Fig. 4.2.1). However, mean pollock catch per 1 trawling hour in this area significantly decreased from February and amounted to 18.2 tons.

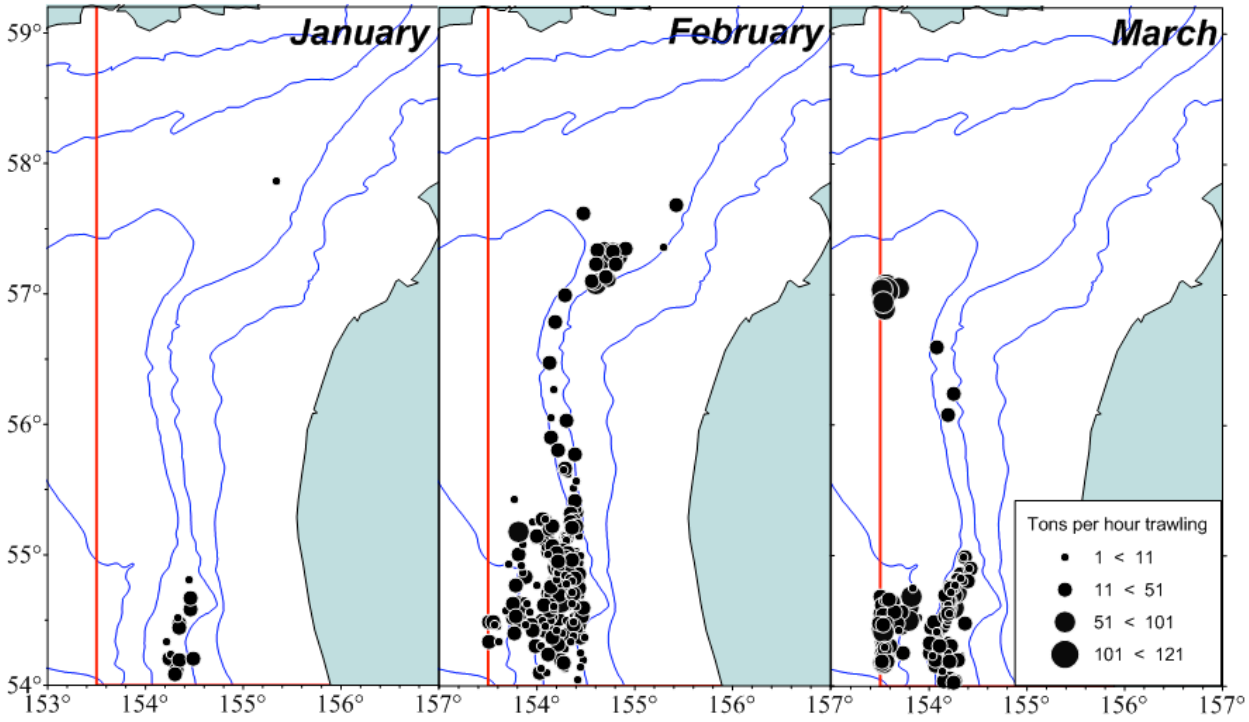


Figure 4.2.1 – Pollock catch distribution in West Kamchatka subzone by data of scientific observers, Season A of 2019

Pollock size distribution was varying insignificantly in the West Kamchatka subzone during this fishing season (Fig. 4.2.2). Individuals 36–42 cm long dominated in February and March, accounting for 57% and 66% respectively. By-catch of juveniles in these months was 28.0% and 30.2% respectively. Mean pollock size was 40.3 cm in February and 39.8 cm in March. In contrast with the last year's fishing season, the percentage of immature pollock individuals (gonad maturity stage II) in catches by fishing vessels was low and varied in the range of 11.8% to 28.8%. This is explained by the fact that fishing flotillas were operating mostly in the area adjacent to the main pollock spawning ground off West Kamchatka ((54º-56º N) where by-catch of juveniles is traditionally small (Fig. 4.2.1). As for the last year, relatively favorable fishing conditions were observed in the northern part of the West Kamchatka subzone (north of 56° N), i.e. commercial aggregations of pollock encompassed also the northern slopes of TINRO Depression where aggregations of juveniles are distributed, that's why immature pollock percentages in catches reached up to 60.4% in some periods.

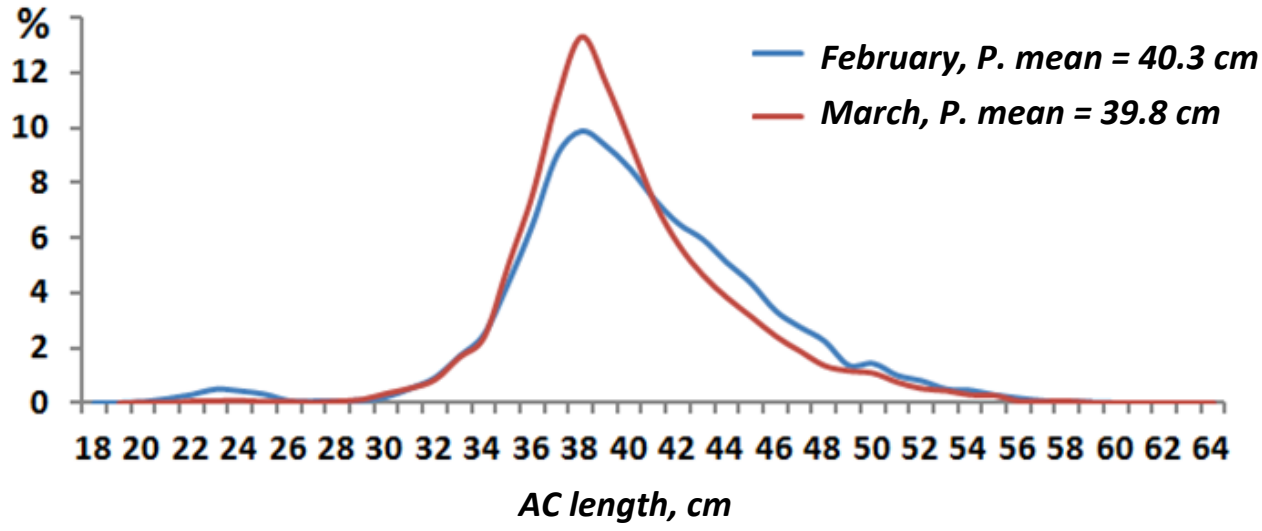


Figure 4.2.2 – Size distribution of pollock catches in West Kamchatka subzone by data of scientific observers, Season A of 2019

4.3 North Sea of Okhotsk subzone

In 2019, observers collected information in the North Sea of Okhotsk during February 02 through April 09. In February, their observations covered water depths of 140 to 500 m (Fig. 4.3.1).

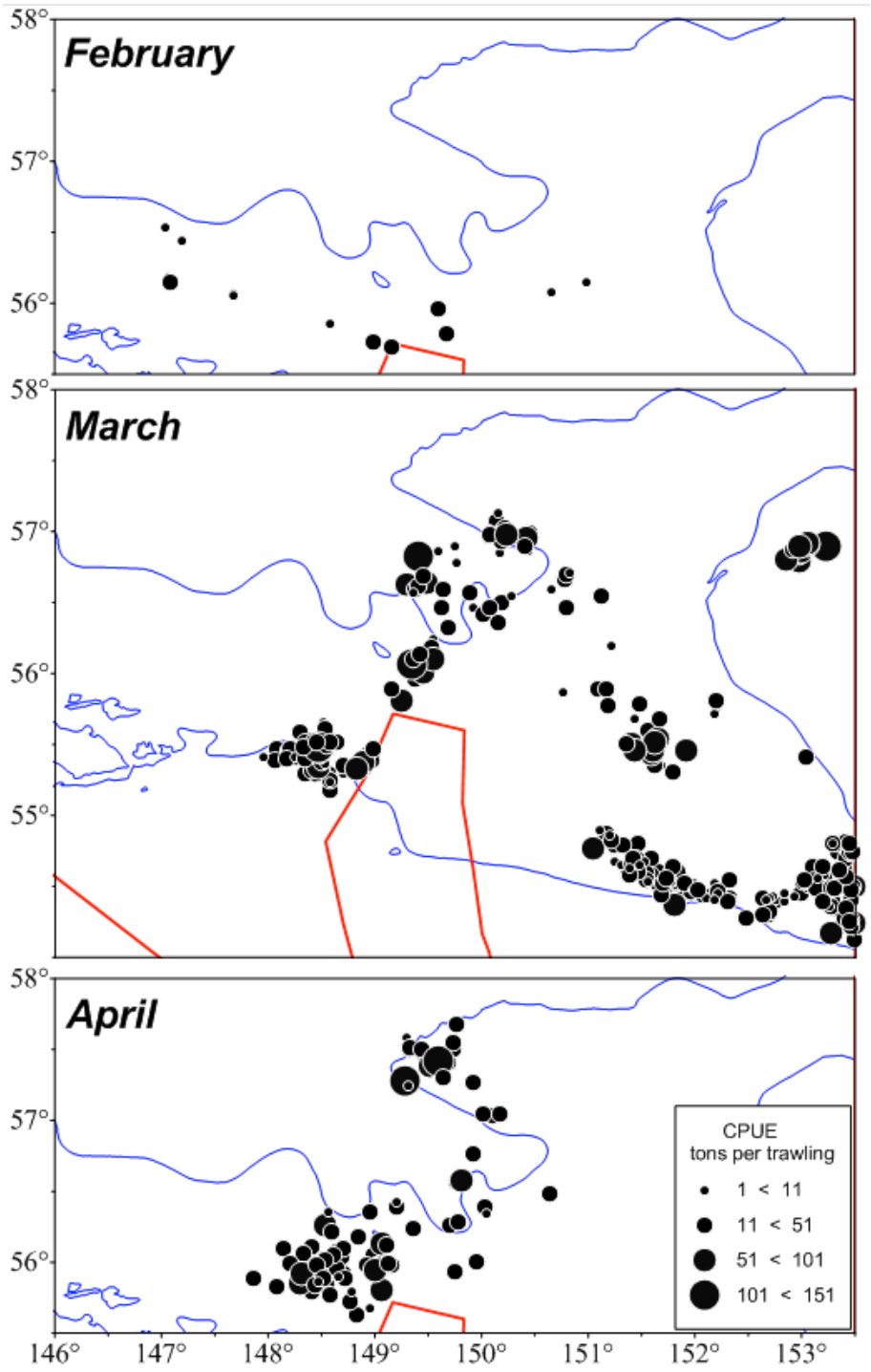


Figure 4.3.1 – Pollock catch distribution in North Sea of Okhotsk subzone by data of scientific observers, Season A of 2019

Pollock catches per trawling hour were not high and averaged at 7.1 tons over a month. Pollock size distribution varied from 20 to 60 cm and was dominated by individuals 35 to 46 cm long (73.4% of the number of individuals in catches) (Fig. 4.3.2). Average monthly percentage of undersize individuals (AC length under 37 cm) was 34.1%. Males dominated in catches – 55.3%.

In March, observers collected fishing and biological information about this subzone in the main fleet operating area at water depths of 175 to 818 m. Mean pollock catch per trawling hour noticeably grew and amounted to 22.8 tons. During the whole month, the operating area of fishing flotillas was limited by the ice edge position – vessels worked on pollock aggregations in the central part of the subzone and near Lebed Elevation (between 54° and 57° N) (Fig. 4.3.1). For comparison, in March 2018 pollock aggregations in the North Sea of Okhotsk subzone on which fishing vessels worked were distributed farther north – between 56° and 58° N.

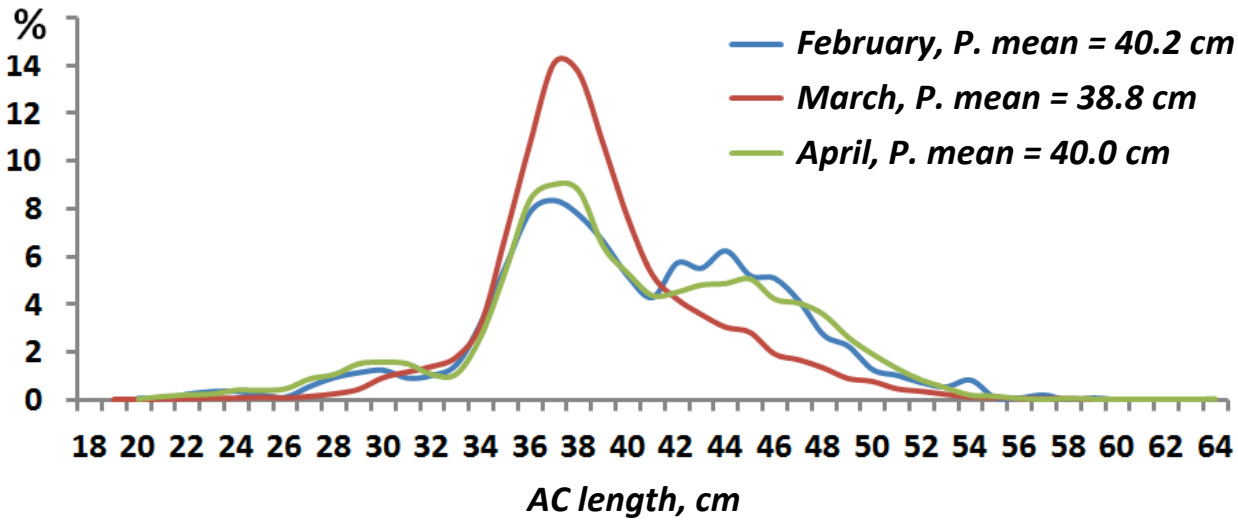


Figure 4.3.2 – Size distribution of pollock catches in North Sea of Okhotsk subzone by data of scientific observers, Season A of 2019

According to observers' data, pollock individuals 19 to 63 cm long occurred in the North Sea of Okhotsk subzone in March 2019, with individuals 38–44 cm dominating and accounting for up to 80% of the number of individuals in catches (Fig. 4.3.2). The percentage of undersize pollock individuals (AC length < 37 cm)

was high and averaged at 41.1%. Unlike in the preceding month, catches in March were dominated by females – 54.3% (Table 4.3.1). Gametes in 30.8% of females and 54.6% of males were at gonad development stage IV. First spawning individuals appeared with percentages of females and males at gonad maturity stage V being 4.3% and 10.3% respectively (Table 4.3.1).

The area where scientific observers were collecting data did not change significantly in the first nine days of April but reduced and encompassed water depths of 140–390 m (Fig. 4.3.1). In comparison with March, mean pollock catches per trawling hour slightly grew and amounted to 25.5 tons.

It should be noted that, according to observers' data for the North Sea of Okhotsk subzone, mean pollock size in catches in this fishing season was varying insignificantly and was as follows during three months discussed earlier: 40.2 cm, 38.8 cm and 40.0 cm (Fig. 4.3.2). Mean by-catch of undersize pollock was high and amounted to 34.1% in February, 41.1% in March and 36.1% in April. At the same time, such high percentage of under-size by-catch was largely caused by individuals, belonging to the strong 2013 year-class, almost all of who have joined the commercial stock. According to our observations, this year-class is represented mostly by stunted individuals – that's why although pollock individuals 36–37 cm long were mature they did not reach the commercial size prescribed by the Fishing Rules (longer than 37 cm). As seen in Fig. 4.3.2, the percentage of really immature individuals (juveniles) in this fishing season was much lower – thus, the percentage of individuals 35 cm long and smaller varied in the range of 16% to 18%. Of note that the situation with a very slow growth rate of individuals belonging to a strong year-class (stunting) is not typical of the Sea of Okhotsk and mature individuals are normally larger than the prescribed commercial size.

5 Species composition of by-catch in the pollock fishery in the Sea of Okhotsk

Similarly to previous studies, special attention in organization of scientific observer activities onboard vessels, engaged in pollock commercial fishing in the

Sea of Okhotsk, was given to assessment of the by-catch of both abundant and well-known fishes and commercial invertebrates, and rarely occurring species. For this purpose, observers were familiarized during relevant training with principles of species identification and provided with fish and invertebrate identification keys specific to the northern part of the Sea of Okhotsk and contiguous waters. That's why species composition of by-catches included a significant number of species depending on the fishing area. Fish by-catch, its percentage, qualitative and quantitative characteristics considerably vary depending on location and timing of fishing for the target species – pollock.

In total, 118 fish and invertebrate species including 7 squid species, 1 shrimp species and 6 jellyfish species were found in analyzed hauls during the pollock fishery in the northern part of the Sea of Okhotsk in Season A of 2019 (Table 5.1).

In comparison with two preceding years of studies, the number of species of aquatic living resources found in catches has noticeably increased. Thus, total number of species in catches in Season A was 92 in 2018 and 76 in 2017. This increase in the winter–spring period of 2019 occurred primarily due to occasional captures of species having no commercial importance.

Same as in previous years of studies, the most diverse fish families in terms of species composition were Cottidae, Pleuronectidae, Zoarcidae, Liparidae (7 to 12 species each), while other families were represented by 1 to 5 species (Table 5.1). Pollock percentage in catches for the Sea of Okhotsk as a whole was slightly above 97% as in previous years. Second-largest species in catches in terms of occurrence was herring – 2.5%. Smooth lumpsucker was the third-largest species. With the latter species' occurrence being at 44.9%, its percentage in catches was 0.01%. Fourth- and fifth-largest species in occurrence terms were Commander squid (27.4%) and cod (15.8%). The percentage of other species, even those with an occurrence rate in the range of 1.5% to 10%, was within 0.01% and that of the rest species was at the level of 3–5 digits after the decimal point.

The by-catch of the Sea of Okhotsk's most abundant fish species – northern smoothtongue (Leuroglossus schmidti) was rather high as usual, though lower than

in a year ago. This reduction is explained by the fact that in Season A of 2019 fishing activities were low above large water depths in vicinity of TINRO Depression where increased smoothtongue aggregations are observed. Of the total number of species found in the Sea of Okhotsk, TAC is applicable to 20 species and RY (recommended yield) is applicable to 26 species. Other species have no commercial importance and are not subject to fishing regulations as species of no commercial or scientific value nor included in protected or endangered species lists.

The aggregate percentage of pollock and herring in catches in the Sea of Okhotsk in the Season A of 2019 was 99.98%, same as in two preceding years of our studies.

Smooth lumpsucker was the third-largest species, same as in two above discussed subzones, with an occurrence rate of 33.6% (Table 5.4). It should be noted that this position was earlier held by Soldatov's lumpsucker. All other by-catch species accounted for a vanishingly small value – from thousandth to hundred-thousandth fractions of per cent. It should be noted that roughly same ratio of by-catch species was observed during all years of by-catch studies which is evidence of a stable ratio of aquatic organism species in the northern part of the Sea of Okhotsk and absence of any adverse effects of the pollock fishery both on commercial and background ichthyic fauna species.

Table 5.1 – Ratio of aquatic organism species in trawl catches in the pollock fishery in the northern part of the Sea of Okhotsk, Season A of 2019

Specie	Management regime	Occurrency rate, %	Portion in catches, %
Theragra chalcogramma	ОДУ	100,000	**97,424**
Aptocyclus ventricosus	Н/П	44,876	**0,010**
Berryteuthis magister	Н/П	27,385	**0,004**
Clupea pallasii	ОДУ	15,813	**2,535**
Gadus macrocephalus	ОДУ	11,749	**0,005**
Bothrocarichthys microcephalus	Н/П	10,954	**0,0005**
Hippoglossoides elassodon	Р/В	8,392	**0,001**
Careproctus rastrinus	Н/П	7,332	**0,0004**

Specie	Management regime	Occurrency rate, %	Portion in catches, %
Lycogrammoides nigrocaudatus	Н/П	6,095	**0,0003**
Boreoteuthis borealis	Н/П	5,124	**0,001**
Reinhardtius hippoglossoides	ОДУ	5,124	**0,001**
Eumicrotremus soldatovi	Н/П	4,594	**0,001**
Glyptocephalus stelleri	ОДУ	4,505	**0,0002**
Hippoglossoides robustus	ОДУ	3,799	**0,0002**
Atheresthes evermanni	ОДУ	3,622	**0,001**
Leuroglossus schmidti	Н/П	3,622	**0,011**
Reinhardtius hippoglossoides matsurau	ОДУ	3,092	**0,0003**
Phacellophora camtshchatica	Н/П	2,827	**0,0001**
Chrysaora melonaster	Н/П	2,473	**0,0002**
Bothrocarichthys nigrocaudata	Н/П	2,297	**0,0001**
Lycogrammoides schmidti	Н/П	2,297	**0,0001**
Sebastes glaucus	ОДУ	2,208	**0,0002**
Malacocottus zonurus	Н/П	1,943	**0,0002**
Bothrocara brunneus	Н/П	1,855	**0,0003**
Careproctus furcellus	Р/В	1,678	**0,0001**
Hippoglossoides sp.	Р/В	1,590	**0,001**
Lycodes soldatovi	Р/В	1,502	**0,001**
Bothrocarina sp.	Н/П	1,413	**0,00001**
Coryphaenoides cinereus	Н/П	1,413	**0,0001**
Bothrocara zestum	Н/П	1,237	**0,00002**
Bathyraja parmifera	Р/В	1,148	**0,0002**
Gonatus kamtschaticus	Н/П	0,972	**0,0001**
Gonatus madokai	Н/П	0,972	**0,0001**
Lycogramma soldatovi	Н/П	0,883	**0,00005**
Myoxocephalus polyacanthocephalus	Р/В	0,883	**0,0004**
Eleginus gracilis	ОДУ	0,795	**0,0001**
Gonatus onyx	Н/П	0,795	**0,0001**
Lipolagus ochotensis	Н/П	0,795	**0,000005**
Limanda sakhalinensis	ОДУ	0,707	**0,00003**
Sebastes alutus	Н/П	0,707	**0,00001**
Careproctus rosseofuscus	Н/П	0,618	**0,00005**
Alepisaurus ferox	Н/П	0,530	**0,0001**
Hemilepidotus gilberti	Р/В	0,530	**0,00005**
Oncorhynchus tschawytscha	ОДУ	0,530	**0,0003**
Somniosus pacificus	Р/В	0,530	**0,0002**
Albatrosia pectoralis	Н/П	0,442	**0,0003**
Careproctus macrodiscus	Н/П	0,442	**0,000003**
Gymnacanthus detrisus	Р/В	0,442	**0,00004**

Specie	Management regime	Occurrency rate, %	Portion in catches, %
Allolepis hollandi	Н/П	0,353	**0,000002**
Careproctus colletti	Н/П	0,353	**0,00001**
Liparis ochotensis	Н/П	0,353	**0,00002**
Malacocottus sp.	Н/П	0,353	**0,000002**
Paraliparis grandis	Н/П	0,353	**0,000002**
Atolla wyvilei	Н/П	0,265	**0,000003**
Bathyraja aleutica	Р/В	0,265	**0,0001**
Dasycottus setiger	Н/П	0,265	**0,00003**
Elassodiscus tremebundus	Н/П	0,265	**0,00003**
Glyptocephalus zachirus	Р/В	0,265	**0,000001**
Hemilepidotus papilio	Н/П	0,265	**0,00002**
Laemonema longipes	Н/П	0,265	**0,00004**
Lumpenella sp.	Н/П	0,265	**0,0000004**
Lycodes tanakai	Р/В	0,265	**0,00002**
Mallotus villosus	Р/В	0,265	**0,00001**
Oncorhynchus keta	ОДУ	0,265	**0,00001**
Opisthoteuthis californiana	Н/П	0,265	**0,0001**
Pandalus borealis	ОДУ	0,265	**0,000001**
Sebastolobus macrochir	ОДУ	0,265	**0,00003**
Zaprora silenus	Н/П	0,265	**0,000005**
Zestichthys tanakai	Н/П	0,265	**0,00001**
Anotopterus nikparini	Н/П	0,177	**0,000002**
Blepsias bilobus	Н/П	0,177	**0,000001**
Careproctus cyclocephalus	Н/П	0,177	**0,000003**
Careproctus cypselurus	Н/П	0,177	**0,000005**
Careproctus rostrinum	Н/П	0,177	**0,000004**
Careproctus sp.	Н/П	0,177	**0,000003**
Elassodiscus sp.	Н/П	0,177	**0,000001**
Glyptocephalus sp.	Р/В	0,177	**0,000004**
Gonatopsis japonicus	Н/П	0,177	**0,00001**
Hemilepidotus jordani	Р/В	0,177	**0,000002**
Hemitripterus villosus	Н/П	0,177	**0,0001**
Hippoglossus stenolepis	ОДУ	0,177	**0,00002**
Icosteus aenigmaticus	Н/П	0,177	**0,00002**
Limanda aspera	ОДУ	0,177	**0,00001**
Lumpenella longirostris	Н/П	0,177	**0,000001**
Melletes papilio	Р/В	0,177	**0,000002**
Myoxocephalus jaok	Р/В	0,177	**0,000001**
Myoxocephalus sp.	Р/В	0,177	**0,000003**
Osmerus dentex	Р/В	0,177	**0,00002**
Percis japonicus	Н/П	0,177	**0,0000002**

Specie	Management regime	Occurrency rate, %	Portion in catches, %
Sarritor frenatus	Н/П	0,177	**0,000002**
Stenobrachius sp.	Н/П	0,177	**0,0000001**
Aequorea sp.	Н/П	0,088	**0,000004**
Atheresthes stomias	Р/В	0,088	**0,000003**
Aurelia limbata	Н/П	0,088	**0,000002**
Bathyraja maculata	Р/В	0,088	**0,00001**
Bathyraja sp.	Р/В	0,088	**0,000001**
Belonella borealis	Н/П	0,088	**0,0000004**
Cyanea capillata	Н/П	0,088	**0,00000001**
Enophrys diceraus	Р/В	0,088	**0,000002**
Eogonatus tinro	Н/П	0,088	**0,00001**
Eumicrotremus orbis	Н/П	0,088	**0,00003**
Lampanyctus regalis	Н/П	0,088	**0,0000001**
Lepidopsetta polyxistra	ОДУ	0,088	**0,00003**
Lethenteron camtschaticum	Н/П	0,088	**0,0000005**
Leuroglossus sp.	Н/П	0,088	**0,00000004**
Lycodes palearis	Р/В	0,088	**0,00000005**
Magnisudis atlantica	Н/П	0,088	**0,00001**
Oncorhynchus kisutch	ОДУ	0,088	**0,000002**
Oneirodes sp.	Н/П	0,088	**0,0000002**
Oneirodes thompsoni	Н/П	0,088	**0,0000004**
Pleuronectes quadrituberculatus	ОДУ	0,088	**0,0000003**
Pleuronectidae	Р/В	0,088	**0,000001**
Scopelosaurus harryi	Н/П	0,088	**0,000001**
Sebastes borealis	Н/П	0,088	**0,00001**
Squalus suckleyi	Р/В	0,088	**0,00001**

6 Marine mammal and seabird by-catch in pollock fishery

Similarly to previous years of studies and according to voyage plans, duties of scientific observers in the course of target pollock fishery monitoring activities included observations of death and injuries of marine mammals and seabirds during fishing (trawling) operations. Such observations were normally performed at the time of trawl hauling-in because just at this moment animal and bird contacts with fishing gear are most likely.

In total 1,322 hauling-in observations were performed during the winter–spring period of 2019 (Table 1.1) which is somewhat more than in the same period of 2018 (1,180).

As in earlier years, locations of observations of animal and bird contacts with fishing gear virtually coincided with analyzed trawling locations in 2019 (Fig. 1.1).

Due to lack of financing, TINRO did not and does not perform any target studies of marine mammals in last two decades; that's why observers were additionally instructed to perform visual count surveys on occurrence of cetaceans and pinnipeds.

In summary, none of the scientific observers working onboard fishing vessels in the Sea of Okhotsk in January – April 2019 registered any case of capture of cetaceans, pinnipeds (Steller's sea lions and fur seals as well as ice-living forms of seals) or birds in trawls. Only occasional contacts both with warps and with side wings (on the outer side) of trawls were observed during trawling operations for the most abundant bird species – fulmars and slaty-backed gulls which did not result in any injuries or deaths.

During the entire period of their activities in the winter–spring season of 2019, observers registered 2 cases of slaty-backed gull death (2 individuals) and 3 cases of fulmar death (7 individuals). Also, one injured slaty-backed gull, one injured glaucous-winged gull and 8 injured fulmars (in 3 cases) were registered. Both dead and injured birds were registered in early February off West Kamchatka in the area between 53° and 55° N after strong storms with snowing. Dead and injured birds were normally found on the water or on deck in the morning.

Visual observations performed by scientific observers based on fishing vessels allowed to gather nformation about marine mammal distribution in the target pollock fishing area in the northern part of the Sea of Okhotsk in the winter–spring period of 2019.

The following marine mammal animals were observed in the operating area: Steller's sea lions, northern fur seals, Minke whales and killer whales. The most

frequently occurring species was Steller's sea lion. The latter was observed in 35 cases, with a total of 153 animals counted (Fig. 6.1). Sea lions were normally seen on ice floes both as separate individuals, small groups (2 to 8 animals) or harems (10 to 20 animals). Individual animals swimming in the sea were also observed.

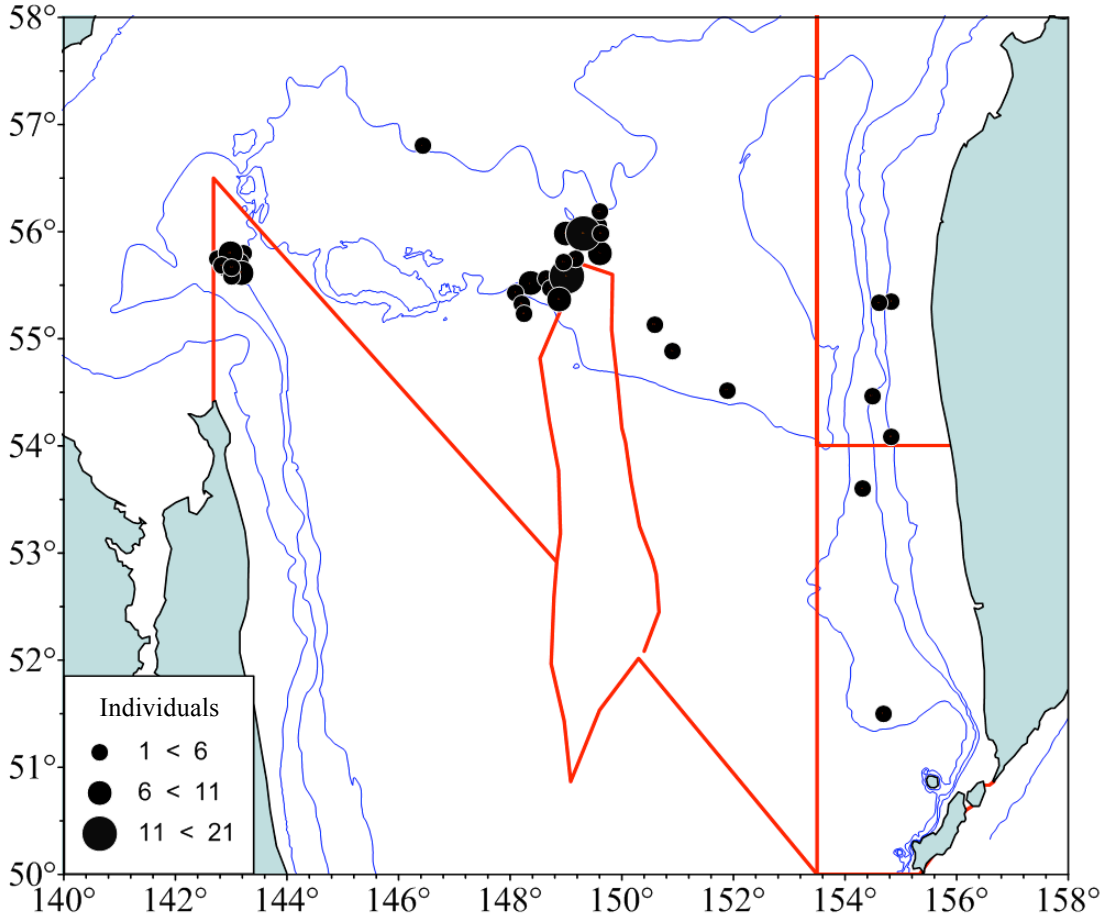


Figure 6.1 – Steller's sea lion distribution according to data of scientific observers in the northern part of the Sea of Okhotsk in winter–spring of 2019

Northern fur seal was observed three times during the period under consideration (10 individuals in total), killer whale was observed two times (7 individuals) and Minke whale - two times (1 individual in each case).

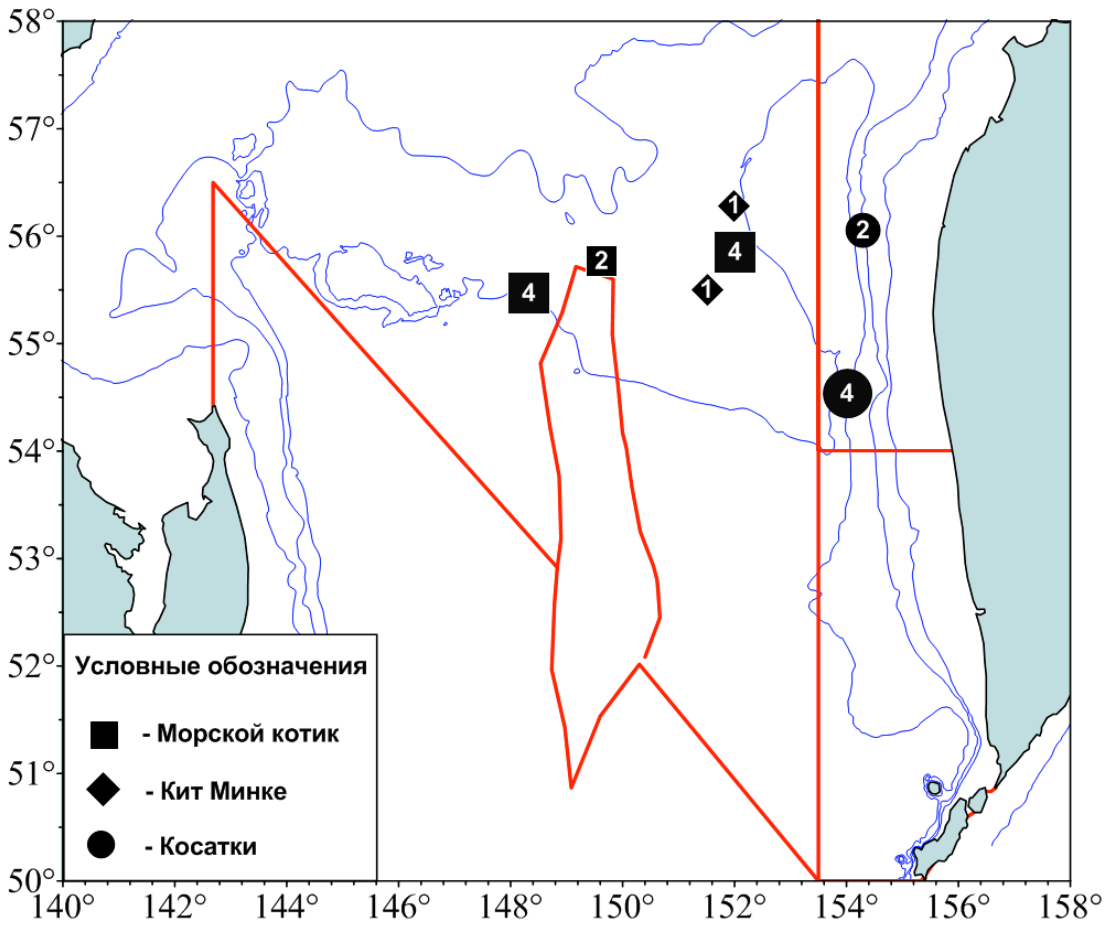


Figure 6.2 – Northern fur seal, Minke whale and killer whale distribution according to data of scientific observers in the northern part of the Sea of Okhotsk in winter–spring of 2019. Figures mean the number of observed animals

Условные обозначения = Symbols
Морской котик = Fur seal
Кит Минке = Minke whale
Косатки = Killer whales

In summary, marine mammals were visually observed in the operating area of scientific observers on ice floes or on the sea surface, but no cases of their injury or death caused by fishing gear were registered in the target pollock fishery in the northern part of the Sea of Okhotsk in the Season A of 2019.