Federal Fisheries Agency
Federal State Budgetary Research Institution
Kamchatka Research Institute of Fisheries and Oceanography
(KamchatNIRO)

RESEARCH REPORT

Subject: Pollock Fishery Monitoring in the Northern Part of the Sea of Okhotsk in January – April 2018

Brief Summary

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SUMMARY

Due to extreme importance of the Sea of Okhotsk pollock fishery, the results of works traditionally performed in January – April during the so-called season A are given special attention. The collected materials form a basis for stock assessment by mathematic modeling methods as well as for stock status predictions and TAC planning.

The purpose was to perform pollock fishery monitoring in the northern part of the Sea of Okhotsk in January – first 10-day period of April 2018.

Objectives:

— to analyze remote (satellite) monitoring data on meteorological conditions, thermal and ice conditions in the northern part of the Sea of Okhotsk during the winter–spring pollock fishing season of 2018;

— to obtain data on species composition and catches per unit effort (CPUE);

— to collect data on key biological parameters of pollock and bycatch species;

— to collect information about bycatch of marine mammals and seabirds.

In total, KamchatNIRO FSBRI observers worked 534 days in the northern part of the Sea of Okhotsk in January – April 2018, analyzed 905 fishing operations, performed 88,451 biological tests of pollock and 27,385 tests of other fish species, organized 731 stations for registration of marine mammal and seabird bycatch.

Meteorological conditions were producing adverse effects on the overall situation in the pollock fishery in the northern part of the Sea of Okhotsk in this year, which were much greater than, say, in the preceding year.

Ice conditions in the fishing season of 2018 did not have any noticeable effect on fishing situation off West Kamchatka and, on the contrary, prevented efficient fleet operations, particularly for medium-tonnage fleets, in some areas of the North Sea of Okhotsk subzone.

Thermal conditions existing in the Sea of Okhotsk in January – April 2018 noticeably affected pollock distribution. Its later incoming migrations and formation of fishable aggregations in North Sea of Okhotsk and West Kamchatka subzones are likely to be caused by highly active cyclonic processes in late January which resulted in an abrupt anomalous fluctuation of weather and hydrological conditions in fishing areas under consideration which lasted almost a whole month. A similar situation was observed in 2015 when an abrupt reduction of winter cooling-down rate was registered beginning from the latter half of January which, same as in 2018, was caused by warm air inflow with deep cyclones coming to the Sea of Okhotsk basin from south. Along with reduced cooling-down rates, considerably higher than normal water temperatures were observed in that year.

The species composition of trawl catches in the target pollock fishery in the northern part of the Sea of Okhotsk in January – first 10-day period of April included 67 fish species and 6 invertebrate species. Pollock was predominating. Its

catches were reaching 220 tons per haul (61.6 tons on average) or 59.9 tons per one trawling hour (12.2 tons on average). In weight terms, the percentage of pollock in some hauls amounted to 99.0% and averaged at 95.5%.

The species composition in the target herring fishery was smaller and included 24 fish species and 1 invertebrate species. Herring catches were reaching 110 tons per haul (50.0 tons on average) or 50.0 and 13.3 tons respectively when converted to one trawling hour. The percentage of herring in catches was reaching 98.3% and averaged at 90.6%. Pollock was a bycatch species with its mean percentage in catches being 9.3%.

The averaged species composition in the seine fishery off West Kamchatka included 31 fish species and 7 invertebrate species. Pollock was predominating with its catches being up to 12.0 tons per seine shoot (=CPUE) or 0.7 tons on average. The percentage of pollock in catches was reaching 98.0% and averaged at 49.1%. Considerable catches were registered for cod and rock sole.

In subzones 61.05.1 and 61.05.4, the bulk of catches during the whole fishing season was composed of pollock with length of 41–46 cm belonging to the 2011 year class. In subzone 61.05.2, individuals with length of 38–42 cm were predominating (62.7%) which belonged to the strong 2013 year class. A small peak in size groups of 29–30 cm can be attributed to 3–4-year-old individuals belonging to mid-strength 2014–2015 year classes. The bycatch of juveniles in some hauls was as high as 60% and, on average, exceeded the established limit of 20%.

In summary, fishing conditions in the northern part of the Sea of Okhotsk in February – March 2018 were unfavorable in terms of qualitative composition of pollock catches in some areas of subzones 61.05.1 and 61.05.2. Virtually everywhere and particularly in West Kamchatka subzone basin between 57th and 58th parallels, catches included high percentages of bycaught juveniles as the strong 2013 year class and two following medium-abundant (by numbers) 2014 and 2015 cohorts joined fishable stock.

As for the timing of pollock spawning activities in 2018, it can be concluded, based on the dynamic of gonad maturation, that it was close to its multi-year mean, i.e. late March – early April.

Our observers registered a bycaught dead ribbon seal (*Histriophoca fasciata*) during the target pollock fishery in the North Sea of Okhotsk subzone and a bycaught live Minke whale (*Balaenoptera acutorostrata*) during the herring fishery in West Kamchatka subzone.

1. WORK AREAS, TIMELINES, RESEARCH TEAM

Research works were performed in January – April 2018 in the northern part of the Sea of Okhotsk within the following subzones: Kamchatka-Kuril, West Kamchatka and North Sea of Okhotsk subzones on board of 4 fishing vessels engaged in the target pollock and herring fisheries using mid-water trawls and 2 vessels engaged in the pollock and bycatch species fishery using Danish seines.

Map of operations of vessels carrying observers on their board is presented in Fig. 2.1.

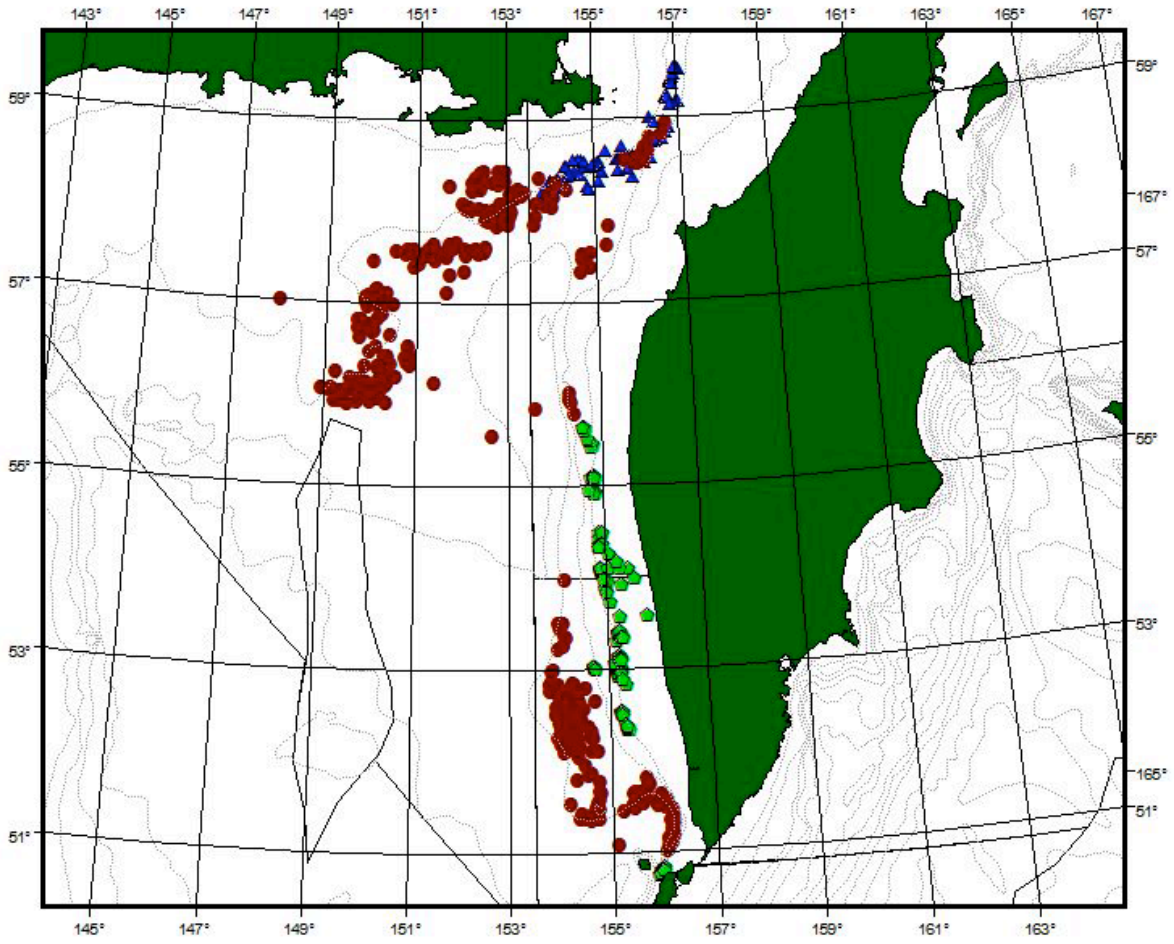

Figure 2.1. Coverage by observers in 2018 (burgundy color circles – target pollock trawl fishery; blue triangles – target herring trawl fishery, green diamonds – pollock Danish seine fishery)

2. STUDY METHODS

All works performed by KamchatNIRO observers were performed in accordance with standard methods generally accepted for ichthyologic surveys.

2.1. Assessment of catch size and species composition

The quantitative and species composition of catches was determined by at least 1 catch every day, with all fishing operations registered (coordinates, catch, etc.).

Information about each fishing operation was entered into a fishing operation card and included coordinates, water depth and fishing operation depth, duration of operation, total catch, etc. Observers based on shipboard identified fishing gear's full name, type and key parameters (vertical and horizontal opening distance, mesh size, etc.).

Total catch size was determined visually based on the volume it occupied in the receiving bin. To identify its species composition, we consecutively sampled approximately 300 individuals belonging to the target species (pollock, herring, etc.) and all bycaught species. Furthermore, we inspected the remaining catch to register species not included in this sample. Then we counted individuals of each species in the sample and determined the range of length variation and mean weight of one individual.

We identified species using various identification keys (manuals) such as "Field Identification Key for Commercial and Dominant Species in the Far Eastern Seas of Russia" (V.N. Tuponogov, L.S. Kodolov, 2014).

The species composition of catches was determined as follows:

1) we deducted total catch of individuals not covered by sampling from total catch weight;

2) then we expressed the species composition of our test sample in per cent by weight, i.e. we determined the weight percentage of each species in the weight of the whole test sample;

3) as the weight of the remaining portion of catch was known (see paragraph 1 above), we determined the weight of each species in it in accordance with its share (in %) in the test sample.

4) quotient obtained through dividing the weight of harvested aquatic organisms by their mean weight is their total number expressed in individuals.

Upon completion of these calculations, which included but were not limited to range of length variation, mean weight of individuals, catch in kilograms and in individuals, data on the species composition of catch were transferred from deck log to haul card. This card mandatorily specified the target species (or group of target species) of the fishing operation.

Due to objective reasons (limited working space on deck), observers on board of the RS *Sibir* sometimes were not able to determine the species composition of catches. In such cases, they evaluated the target species (pollock)

and listed all species found in the catch without specifying their amount and percentage.

2.2. Biological analysis

After determination of the species composition, observers performed biological analysis of dominant commercial fishes.

Mass pollock measurements with dissection (MMD) were performed on 1–2 catches every day. Observers measured fish length as per Smith (from the tip of snout to the end of middle rays of the caudal fin, length spacing 1 cm, right boundary). Then fish was dissected and its sex and gonad maturity stage was identified. Gonad maturity stages for pollock, cod and saffron cod were determined as per field identification manuals developed by N.P. Sergeyeva and A.I. Varkentin (2015) and a standard 6-point scale was used for other fish species.

When measurements were made without dissection, only Smith length was measured.

Full biological analysis (FBA) was performed on commercial fishes as well as on all rare and valuable species (halibuts, etc.). Analysis frequency rate was 30 to 50 individuals every day. Effort was taken to cover by analysis sufficient numbers of not only most frequently occurring in catches size groups but also of large-sized individuals and particularly small-sized individuals as well as separately females and males. The required number of tests is 10 females and 10 males per each 1 cm of the size distribution row in each fishing area (zone or subzone).

FBA included weight of the whole fish and fish without viscera, its length with an accuracy of 0.1 cm as per Smith (from the tip of snout to the end of middle rays of the caudal fin, AC) and commercial length (from the tip of snout to the end of scales, AD), weight of liver (for codfishes only) and gonads (with an accuracy of 1 g), determination of sex and gonad maturity stage for males and females, visual evaluation of stomach fullness in scores (0 to 4 on a 5-point scale) and food contents. Gonads and liver (for codfishes only) were weighed during FBA in addition to weighing of individuals.

Fish was weighed on a scale resistant to sea motions (manufactured by Marell).

To determine fish age, observers collected scales (from herring) or otoliths (from all other species). All data characterizing the biological condition of fish were entered into FBA log and such entry included date, coordinates, trawling number and depth. Numbering was consecutive for each fish species.

Special analysis (SA) is a simplified variety of full biological analysis omitting some parameters and either including or not including sampling of structures characterizing age of fish. It was performed for some rare species (instead of FBA) or low-value commercial fishes (sculpins, skates, etc.).This analysis included measurement of Smith length with an accuracy of up to 0.1 cm, whole fish weight, determination of sex and gonad maturity stage for males and females, with or without sampling of structures characterizing age of fish.

2.3. Collection of information about bycatch of non-target species and accidental bycatch and mortality of marine mammals

During all daytime operations, bycatch and mortality of marine mammals was monitored where possible.

When fishing gear was hauled on board of the ship, all captured marine mammals (live and dead) were counted, if any. Animal species was identified using one of the following identification manuals:

— A.Yu. Artyukhin, V.N. Burkanov. 1999. Marine birds and mammals of the Far East;

— V.V. Melnikov. 2001. Field identification key of marine mammals for Pacific waters of Russia;

— A.M. Burdin, O.A. Filatova, E. Khoyt. 2009. Marine mammals of Russia.

Observers determined the sex of animals and took pictures.

They watched the releasing procedure for all live marine mammals captured in fishing gear.

They stated in notes to daytime fishing operation cards whether marine mammal bycatch was registered or not.

If bycaught marine mammals were found, special registration cards were filled in (for live or dead animals).

2.4. Registration of seabird bycatch

Bycatch and death of seabirds was monitored during all daytime operations.

When fishing gear was hauled on board of the ship, all captured seabirds (live and dead) were counted, if any. Bird species was identified using such identification manuals as *A.Yu. Artyukhin, V.N. Burkanov. 1999. Marine birds and mammals of the Far East.* Observers took pictures of birds.

Live birds were released.

If any bird tags were found, observers photographed them, registered their color, shape and number.

Observers stated in notes to daytime fishing operation cards whether seabird bycatch was registered or not.

If any birds were bycaught, observers filled in a special bird registration card.

2.5. Information and reporting

Every week (Monday by 10:00 a.m.), KamchatNIRO observers sent collected data by e-mail to KamchatNIRO Institute and to FFA fishing area chief officer – Omelchenko Yu.V. based on supertrawler *Vasily Kalenov*.

Their reports included the following information:

— operating area (coordinates, subzone, fishing depths);

— number of operations analyzed during reporting period and cumulative number since year's beginning;

— variation ranges and mean pollock catch per unit effort (per haul and per 1 trawling hour);

— variation ranges and mean pollock weight;

— relative ratio of pollock females (%);

— pollock size distribution (spaced at 1 cm) in individuals or per cent;

— ratio of gonad maturity stages for pollock females and males;

— number of analyzed individuals of each species and of each analysis method during reporting period and cumulative number since year's beginning (e.g.: MMD pollock 2,000/15,000, FBA 100/500, etc.).

If works were performed in different subzones during the same reporting period, findings were reported for each area separately. If mass measurements of other fish species were performed in the reporting period, their results were also included in reports.

Operational information received from observers was also forwarded to TINRO-Center and used in analytical materials prepared for video teleconferences held by P.S. Savchuk, Federal Fisheries Agency deputy director, every week on Tuesdays.

Either during voyage or immediately after completion of voyage, all collected information was entered into a dedicated database run by the Marine Commercial Fishes Laboratory. Upon return to port, all collected materials, pollock and bycatch species biological analysis logs and updated database were handed over to responsible persons in respective subdivisions.

3. VOLUME OF COLLECTED MATERIALS

Information about the volume of collected biological data broken down by analysis types, aquatic organism species and fishing areas is presented in Appendix 2.

In total, KamchatNIRO FSBRI observers worked 534 days, analyzed 905 fishing operations, performed 88,451 biological tests of pollock and 27,385 tests of other fish species, organized 731 stations for registration of marine mammal and seabird bycatch.

4. KEY FINDINGS OF STUDIES

4.2. Information about species composition and catches per unit effort (CPUE)

The species composition of trawl catches in the target pollock fishery in the northern part of the Sea of Okhotsk in January – first 10-day period of April included 67 fish species and 6 invertebrate species. Pollock was predominating. Its catches were reaching 220 tons per haul (61.6 tons on average) or 59.9 tons per one trawling hour (12.2 tons on average) (Appendix 3). In weight terms, the percentage of pollock in some hauls amounted to 99.0% and averaged at 95.5%. The second most frequently occurring in catches species was pacific herring. Its catches were reaching 30.0 tons per haul (2.3 tons on average) or 7.1 tons per one trawling hour (0.5 tons on average) with maximal and average percentage in catches of 50% and 3.6% respectively.

The species composition in the target herring trawl fishery was smaller and included 24 fish species and 1 invertebrate species. Herring catches were reaching 110 tons per haul (50.0 tons on average) or 50.0 and 13.3 tons respectively when converted to one trawling hour (Appendix 4). The percentage of herring in catches was reaching 98.3% and averaged at 90.6%. Pollock was a bycatch species. Its catches changed from 0 tons to 44.1 tons per haul (5.4 tons on average) or from 0 tons to 10.0 tons per one trawling hour (1.3 tons on average) with its mean percentage in catches by weight being 9.3%.

The averaged species composition in the Danish seine fishery off West Kamchatka included 31 fish species and 7 invertebrate species (Appendix 5). Pollock was predominating with its catches being up to 12.0 tons per seine shoot (=CPUE) or 0.7 tons on average. The percentage of pollock in catches was reaching 98.0% and averaged at 49.1%. Considerable catches were registered for cod and rock sole.

4.3. Data on key biological parameters of pollock and bycatch species

When preparing the report, information collected by all scientific observers in the northern part of the Sea of Okhotsk during the 2018 fishing season is being processed and analyzed. In addition, it is planned that primary data will be traditionally shared with other Far Eastern fishery research institutes. Brief information presented below is based on research findings obtained by KamchatNIRO observers only.

Fish length in the target trawl pollock fishery in January 2018 in Kamchatka-Kuril subzone – key fishing area in that month – varied from 30 to 71 cm and individuals of 40–44 cm size group (45.8%) belonging to the 2011 year class were predominating in catches (Fig. 4.3.1). The percentage of individuals shorter than the commercial length of 35 cm (37 cm according to Smith) was low and averaged at 3.7%.

One month later, the bulk of catches in subzone 61.05.1 were individuals born in 2011 belonging to size groups of 41–46 cm (47.6%). A small peak on the size distribution curve was registered for classes of 33–35 cm and attributed to the strong 2013 year class. Bycatch of juveniles in some hauls significantly exceeded the limit of 20% and averaged at 21.3%. The bulk of catches in subzone 61.05.2 was composed of individuals with length of 38–42 cm (62.7%). A small peak in size groups of 29–30 cm can be attributed to 3–4-year-old individuals belonging to medium-strong year classes of 2014–2015. Bycatch of juveniles averaged at 20.8%. As for subzone 61.05.4, virtually no changes in pollock size distribution were registered here in this month.

In March, pollock size distribution in the North Sea of Okhotsk subzone was roughly same as in February. Individuals with length of 41–46 cm (59.4%) at the age of 7–8 years were predominating in catches. Mean bycatch of individuals of under-commercial sizes was 8.5%. In West Kamchatka subzone, the bulk of catches was presented by individuals with length of 33–41 cm (58.5%). Accordingly, mean bycatch of juveniles was exceeding the established limit value and reached up to 48.2%. In Kamchatka-Kuril subzone, size distribution changes were insignificant.

Individuals with length of 42–46 cm were predominating in catches in subzone 61.05.1 in April (63.7%) and bycatch of juveniles averaged at 1.0%.

Pollock size distribution in Danish seine catches off West Kamchatka in February – March was roughly the same as in trawl catches (Fig. 4.3.2). The bulk of catches was composed of individuals belonging to size groups of 40–46 cm.

In summary, fishing conditions in the northern part of the Sea of Okhotsk in February – March 2018 were unfavorable in terms of qualitative composition of pollock catches in some areas of subzones 61.05.1 and 61.05.2. Virtually everywhere and particularly in West Kamchatka subzone basin between 57th and 58th parallels, catches included high percentages of bycaught juveniles as the strong 2013 year class and two following medium-abundant 2014 and 2015 cohorts joined fishable stock.

It should be noted that the north-eastern part of the Sea of Okhotsk is a traditional habitat for pollock junior age groups. Juvenile aggregations normally stay together with large-sized pollock, therefore juveniles under commercial size are always present in catches. It is also known that, if a strong year class comes into existence, juveniles may be distributed in the winter-spring season near the shelf edge and at seabed drop-off virtually all over West Kamchatka coast, as the case was in 2010 when strong year classes of 2004–2005 were joining fishable stock.

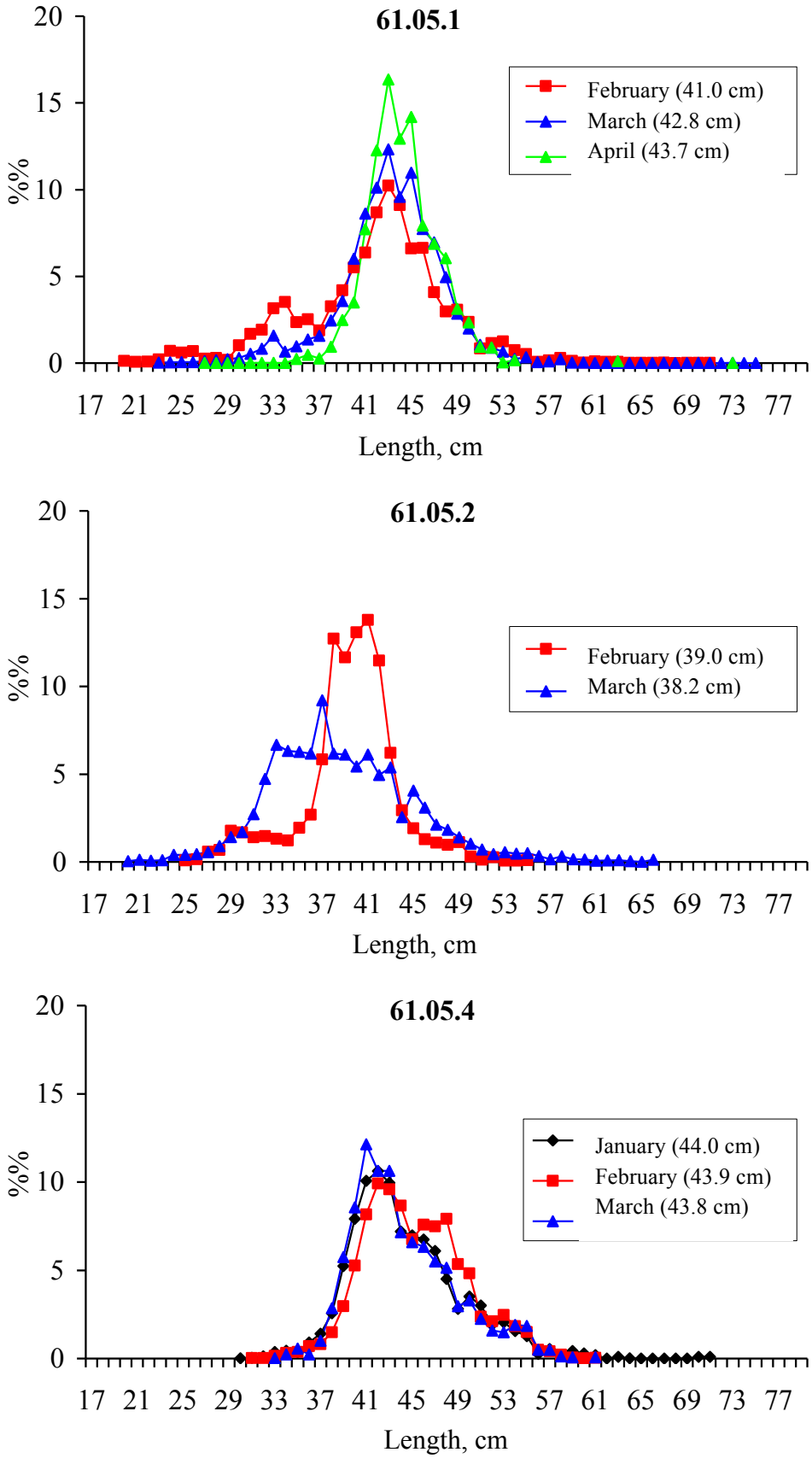

Fig. 4.3.1. Pollock size distribution in trawl fishery catches in January – first 10-day period of April 2018 in the northern part of the Sea of Okhotsk

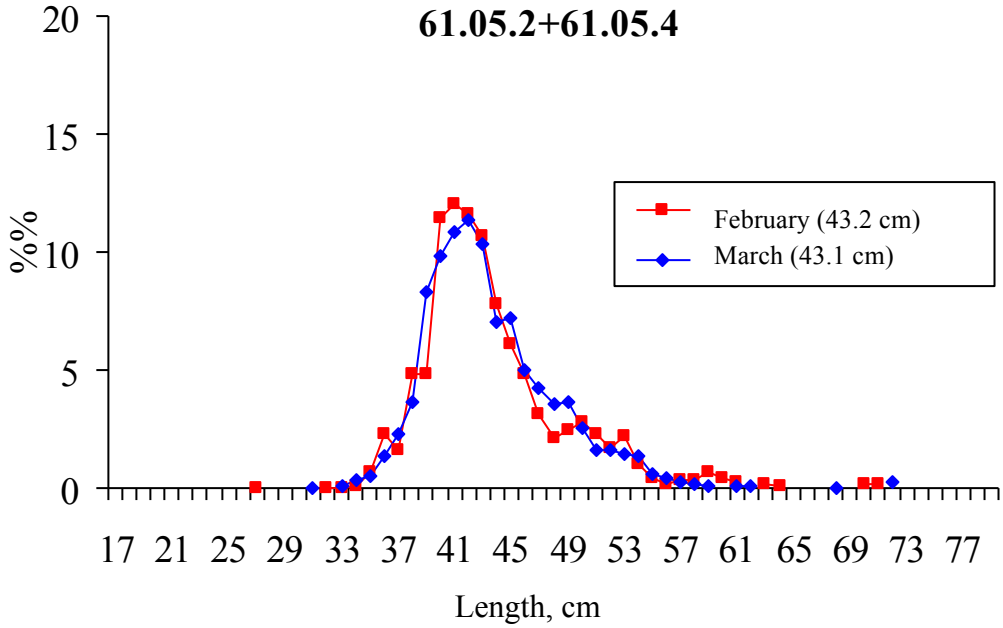

Fig. 4.3.2. Pollock size distribution in Danish seine fishery catches in February – March 2018 in the northern part of the Sea of Okhotsk

As for the timing of pollock spawning activities in 2018, it can be concluded based on the dynamic of gonad maturation that it was close to its multi-year mean, i.e. late March – early April.

By observers' data, during the target herring fishery in January in the North Sea of Okhotsk subzone and in April in West Kamchatka subzone, pollock also occurred in catches, mostly juveniles (89.1% and 88.2% respectively) (Fig. 4.3.3).

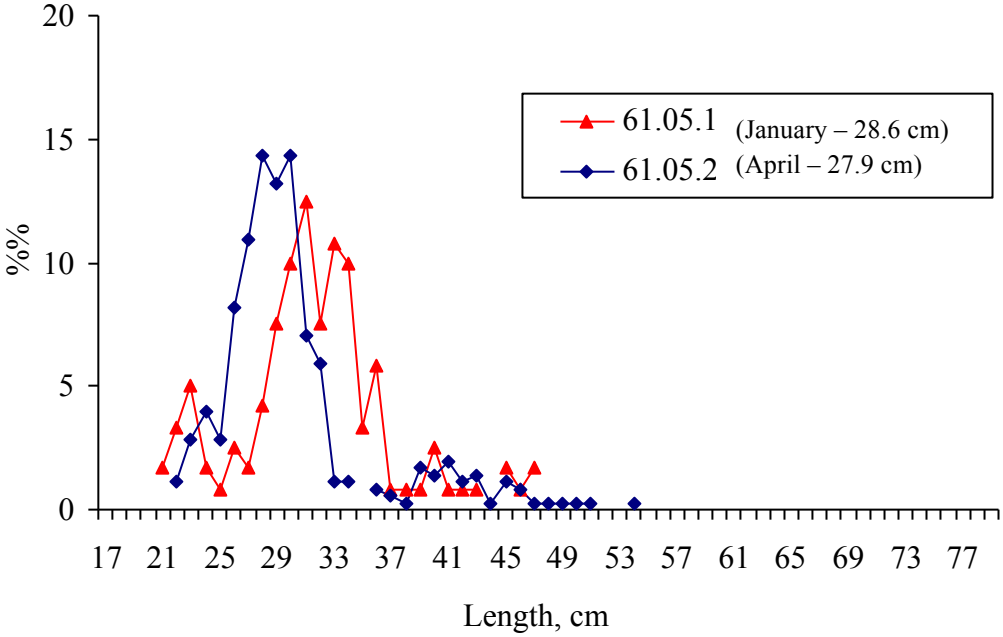

Fig. 4.3.3 Size distribution of pollock bycaught in the target herring fishery in the North Sea of Okhotsk and West Kamchatka subzones in 2018

Biological information about other commercial fish species is presented in respective voyage reports prepared by observers.

4.4. Information about marine mammal and seabird bycatch

On 29 March 2018, our observer based on the BATM-type trawler registered a bycaught ribbon seal (*Histriophoca fasciata*) during operations in ice in the North Sea of Okhotsk subzone at coordinates $57^0$03’17 N, $149^0$52’3 E. The animal was seemingly captured in trawl at the moment of trawl shooting because it was found in the very beginning of the cod-end when fish was poured into the receiving bin. That trawling operation lasted for 8 hours and the ribbon seal had no chance to survive. The animal turned out to be a female with its maximum length from nose tip to tail being 147 cm and its circumference behind flippers being 154 cm. Its weight was approx. 90 kg.

The fact of ribbon seal bycatch was entered into a fishing operation card and special card for registration of dead animal bycatch.

On 15 April 2018, bycatch of a Minke whale (*Balaenoptera acutorostrata*) was registered on board of the vessel during herring fishing in West Kamchatka subzone at coordinates $59^0$06’7 N and $156^0$57’8 E. These mammals normally approach harvesting vessels during herring fishing when they haul their trawls and feed on stunned herring falling out from the trawl. This animal seemed to approach the trawl when it was hauled and entangled its caudal fin in the area where trawl ropes pass to a mesh panel. When the trawl was hauled, the whale periodically surfaced to breathe and jerked trying to disengage itself from the trawl but obviously entangled itself even more. It was hauled together with the trawl to the trawl ramp. The trawl master cut several ropes in which the animal was entangled and the whale safely and without visible injuries slipped down the ramp to the water. After that, it made several shallow dives, seemingly to regain its normal state, and then disappeared after a deep dive.

This fact was also recorded in a fishing operation card and special card for registration of live animal bycatch.

No seabird bycatch was registered by observers during fishing operations.

Appendix 2

Volume of bioligocal information collected by KamchatNIRO observers in the SOO pollock fishery in January-April 2018

Specie / Area	61051	61052	61054	Total
Size measuring				
Clupea pallasii	10494	9915	589	20998
Eleginus gracilis		201	418	619
Gadus macrocephalus	542			542
Hippoglossoides elassodon	18		266	284
Lepidopsetta polyxystra			1242	1242
Limanda aspera			1506	1506
Theragra chalcogramma	37667	17440	27694	82801
Total	**48721**	**27556**	**31715**	**107992**
Full biological analysis				
Albatrossia pectoralis			8	8
Atheresthes evermanni			21	21
Clupea pallasii	920	790		1710
Eleginus gracilis	1	1		2
Gadus macrocephalus	45	31	16	92
Glyptocephalus stelleri	1			1
Hippoglossoides elassodon	67	1	102	170
Hippoglossoides robustus			5	5
Hippoglossus stenolepis			1	1
Lepidopsetta polyxystra	1		101	102
Limanda aspera	13	6		19
Limanda sakhalinensis	11			11
Oncorhynchus nerka			1	1
Pleuronectes quadrituberculatus	4			4
Reinhardtius hippoglossoides matsuurae	2	1	28	31
Sebastes aleutianus			1	1
Sebastes alutus	2			2
Sebastes glaucus	9			9
Sebastolobus alascanus			2	2
Sebastolobus macrochir			2	2
Theragra chalcogramma	2960	890	1800	5650
Total	**4036**	**1720**	**2088**	**7844**
Special analysis				
Aptocyclus ventricosus			4	4
Atheresthes evermanni			6	6
Bathyraja matsubarai	1		1	2
Bathyraja parmifera	1		2	3
Bathyraja violacea	4		1	5
Clupea pallasii	119			119
Hippoglossoides elassodon			4	4
Hippoglossus stenolepis			1	1
Pandalus borealis			2	2
Total	**125**		**21**	**146**
Grand total	**52882**	**29276**	**33824**	**115982**

Appendix 3

Average catch composition during target trawl pollock fishery in the SOO in January-April 2018 on data collected by KamchatNIRO observers

Specie	Lenth, cm		Average weight, kg			Catch per operation, kg			CPUE, kg / effort			Share in catch by weigth, %		
	min	max	min	max	av.	min	max	av.	min	max	av.	min	max	av.
Bothrocarina microcephalus	25	25	0,120	0,120	0,120	0	0,2	0,0	0	0,1	0,1	0	0,00	0,00
Bothrocarichthys nigrocaudata	27	56	0,277	1,080	0,679	0	19,9	0,2	0	2,3	0,7	0	0,03	0,01
Bothrocara zestum	26	62	0,706	1,190	1,021	0	44,0	2,0	0	7,0	1,0	0	0,27	0,01
Bathyraja parmifera	61	136	1,420	6,800	3,620	0	6,8	0,1	0	6,8	3,6	0	0,02	0,03
Bathyraja sp.	88	63	5,640	5,640	5,640	0	5,6	0,0	0	5,6	5,6	0	0,01	0,04
Bathyraja maculata	37	98	6,897	6,897	6,897	0	289,7	1,9	0	21,7	6,9	0	0,29	0,05
Bathyraja violacea	35	102	0,500	6,210	3,003	0	12,4	0,2	0	6,2	3,0	0	0,02	0,02
Bathyraja matsubarai	28	92	3,725	6,280	4,576	0	208,6	1,5	0	15,6	4,6	0	0,21	0,04
Clupea pallasii	18	35	0,176	0,421	0,267	0	29970,0	2345,6	0	7142,9	463,9	0	50,00	3,64
Oncorhynchus nerka	55	55	2,160	2,160	2,160	0	2,2	0,0	0	2,2	2,2	0	0,00	0,02
Albatrossia pectoralis	50	74	0,410	1,440	0,803	0	13,4	0,1	0	2,4	0,8	0	0,05	0,01
Theragra chalcogramma	**20**	**78**	**0,314**	**0,830**	**0,588**	**0**	**220000,0**	**61638,4**	**0**	**59850,5**	**12161,0**	**0**	**99,00**	**95,54**
Gadus macrocephalus	24	98	0,120	8,560	2,179	0	184,2	4,8	0	26,3	2,2	0	0,19	0,02
Eleginus gracilis	46	46	0,830	0,830	0,830	0	4,2	0,0	0	0,8	0,8	0	0,01	0,01
Sebastolobus alascanus	41	41	0,920	1,080	1,000	0	1,1	0,0	0	1,1	1,0	0	0,00	0,01
Sebastes glaucus	28	40	0,453	1,240	0,761	0	8,2	0,1	0	1,2	0,8	0	0,01	0,01
Sebastes alutus	25	36	0,550	0,550	0,550	0	3,3	0,0	0	1,2	0,6	0	0,02	0,00
Sebastes aleutianus	44	45	1,494	1,494	1,494	0	4,5	0,0	0	1,5	1,5	0	0,01	0,01
Sebastolobus macrochir	37	37	0,860	0,930	0,895	0	0,9	0,0	0	0,9	0,9	0	0,00	0,01
Enophrys diceraus	34	38	0,468	0,580	0,524	0	3,7	0,0	0	0,8	0,5	0	0,00	0,00
Hemilepidotus jordani	29	37	0,370	0,383	0,377	0	49,8	0,4	0	11,1	0,4	0	0,04	0,00
Gymnacanthus galeatus	22	22	0,120	0,120	0,120	0	2,2	0,0	0	0,4	0,1	0	0,00	0,00
Gymnacanthus pistilliger	27	32	0,305	0,305	0,305	0	3,1	0,0	0	0,4	0,3	0	0,01	0,00
Hemilepidotus gilberti	28	37	0,260	0,481	0,398	0	30,8	0,5	0	6,8	0,4	0	0,02	0,00
Hemilepidotus hemilepidotus	24	28	0,290	0,380	0,316	0	1,5	0,0	0	0,4	0,3	0	0,01	0,00
Myoxocephalus jaok	46	58	1,250	4,270	2,755	0	42,7	0,7	0	16,0	2,8	0	0,03	0,02
Hemilepidotus papilio	31	35	0,410	0,430	0,420	0	4,2	0,1	0	0,5	0,4	0	0,01	0,00
Gymnacanthus detrisus	33	35	0,500	0,530	0,515	0	1,6	0,0	0	0,5	0,5	0	0,00	0,00
Melletes papilio	24	37	0,228	0,580	0,432	0	64,3	0,9	0	9,9	0,4	0	0,23	0,00

Myoxocephalus polyacanthocephalus	39	46	1,170	1,540	1,355	0	9,4	0,1	0	1,7	1,4	0	0,02	0,01
Ulca bolini	27	27	0,340	0,340	0,340	0	1,4	0,0	0	0,3	0,3	0	0,00	0,00
Hemitripterus villosus	22	48	1,200	2,750	1,711	0	27,6	0,8	0	6,1	1,7	0	0,08	0,01
Malacocottus zonurus	18	25	0,160	1,440	0,386	0	42,3	0,5	0	3,2	0,4	0	0,04	0,00
Percis japonica	34	39	0,348	0,348	0,348	0	5,2	0,0	0	0,6	0,3	0	0,01	0,00
Hypsagonus quadricornis	33	33	0,350	0,350	0,350	0	1,4	0,0	0	0,4	0,4	0	0,00	0,00
Podothecus veternus	22	23	0,080	0,080	0,080	0	0,2	0,0	0	0,1	0,1	0	0,00	0,00
Eumicrotremus asperrimus	12	23	0,150	0,307	0,231	0	676,1	7,7	0	66,0	0,8	0	0,50	0,01
Aptocyclus ventricosus	10	38	0,210	2,154	0,808	0	530,9	28,1	0	127,0	5,0	0	1,33	0,04
Eumicrotremus soldatovi	15	24	0,150	0,540	0,269	0	22,8	1,4	0	5,1	0,3	0	0,09	0,00
Careproctus macrodiscus	42	42	1,380	1,380	1,380	0	1,4	0,0	0	1,4	1,4	0	0,00	0,01
Careproctus rastrinus	16	39	0,087	1,124	0,528	0	47,4	1,1	0	3,6	0,5	0	0,09	0,00
Careproctus colletti	39	41	0,800	1,060	0,930	0	3,2	0,0	0	1,1	0,9	0	0,01	0,01
Careproctus furcellus	24	30	0,380	0,540	0,466	0	10,2	0,2	0	1,8	0,5	0	0,01	0,00
Careproctus sp.	39	39	0,960	0,960	0,960	0	1,0	0,0	0	1,0	1,0	0	0,00	0,01
Careproctus cypselurus	31	31	0,450	0,450	0,450	0	1,4	0,0	0	0,5	0,5	0	0,00	0,00
Crystallichthys mirabilis	23	24	0,280	0,304	0,286	0	0,3	0,0	0	0,3	0,3	0	0,00	0,00
Elassodiscus tremebundus	15	33	0,130	0,480	0,249	0	21,6	0,7	0	6,0	0,2	0	0,06	0,00
Liparis ochotensis	28	45	0,965	1,200	1,054	0	55,6	0,4	0	9,8	1,1	0	0,04	0,01
Careproctus roseofuscus	29	33	0,612	0,612	0,612	0	14,7	0,1	0	1,7	0,6	0	0,02	0,00
Bothrocarichthys microcephalus	23	42	0,089	0,640	0,273	0	1,3	0,0	0	0,6	0,3	0	0,00	0,00
Lycogrammoides schmidti	25	33	0,234	0,234	0,234	0	5,6	0,0	0	1,6	0,2	0	0,01	0,00
Bothrocara mollis	24	24	0,120	0,120	0,120	0	0,1	0,0	0	0,1	0,1	0	0,00	0,00
Lycogrammoides nigrocaudatus	22	54	0,060	0,840	0,428	0	31,5	1,6	0	9,9	0,4	0	0,07	0,00
Lycodes soldatovi	62	70	1,298	1,870	1,536	0	11,2	0,1	0	1,9	1,5	0	0,03	0,01
Lycodes concolor	44	88	0,300	5,040	2,670	0	5,0	0,0	0	5,0	2,7	0	0,01	0,02
Bothrocara soldatovi	62	62	1,620	1,620	1,620	0	4,9	0,0	0	1,6	1,6	0	0,01	0,01
Hippoglossoides robustus	33	37	0,415	0,600	0,508	0	11,2	0,1	0	1,2	0,5	0	0,02	0,00
Hippoglossoides elassodon	21	44	0,143	1,536	0,389	0	194,1	8,2	0	19,3	1,1	0	0,29	0,01
Atheresthes evermanni	26	68	0,510	2,760	1,762	0	60,1	1,0	0	10,0	1,8	0	0,10	0,01
Atheresthes stomias	52	53	1,730	1,730	1,730	0	5,2	0,0	0	1,7	1,7	0	0,01	0,01
Reinhardtius hippoglossoides matsuurae	35	74	0,420	3,690	1,759	0	8160,0	56,6	0	1813,3	12,6	0	12,91	0,10

Pleuronectes quadrituberculatus	26	52	0,170	2,750	1,717	0	80,3	0,6	0	14,2	1,7	0	0,06	0,01
Hippoglossus stenolepis	63	138	3,240	34,700	15,767	0	34,7	0,3	0	34,7	15,8	0	0,06	0,12
Lepidopsetta polyxystra	31	50	0,270	1,400	0,835	0	7,0	0,1	0	1,4	0,8	0	0,02	0,01
Glyptocephalus stelleri	37	38	0,500	0,500	0,500	0	1,0	0,0	0	0,5	0,5	0	0,00	0,00
Limanda sakhalinensis	20	29	0,120	0,170	0,148	0	8,8	0,1	0	0,7	0,1	0	0,01	0,00
Limanda aspera	18	41	0,160	0,840	0,632	0	76,9	2,1	0	13,6	0,6	0	0,07	0,00
Berryteuthis anonychus	10	22	0,175	0,175	0,175	0	10,5	0,1	0	2,0	0,2	0	0,03	0,00
Gonatus sp.	32	58	0,920	0,920	0,920	0	1,8	0,0	0	0,9	0,9	0	0,00	0,01
Pandalus borealis	9	15	0,014	0,023	0,019	0	0,6	0,0	0	0,0	0,0	0	0,00	0,00
Berryteuthis magister	9	32	0,082	0,248	0,149	0	80,3	2,2	0	11,5	0,3	0	0,11	0,00
Belonella borealis	26	50	0,865	0,865	0,865	0	5,2	0,0	0	1,1	0,9	0	0,01	0,01
Gonatopsis borealis	18	29	0,345	0,550	0,451	0	4,7	0,1	0	0,6	0,5	0	0,01	0,00

Appendix 4

Average catch composition during target trawl herring fishery in the SOO in January-April 2018 on data collected by KamchatNIRO observers

Specie	Lenth, cm		Average weight, kg			Catch per operation, kg			CPUE, kg / effort			Share in catch by weigth, %		
	min	max	min	max	av.	min	max	av.	min	max	av.	min	max	av.
Bothrocarichthys nigrocaudata	24	32	0,222	0,222	0,222	0	4,9	0,2	0	0,6	0,2	0,02	0,02	0,00
Clupea pallasii	**20**	**35**	**0,115**	**0,345**	**0,245**	**8247,8**	**109988,3**	**49914,3**	**2918,8**	**49985,7**	**13347,5**	**36,97**	**98,30**	**90,61**
Gadus macrocephalus	42	53	1,240	1,820	1,553	0	7,4	0,4	0	1,8	1,6	0,00	0,01	0,01
Eleginus gracilis	40	41	0,500	0,500	0,500	0	1,0	0,0	0	0,5	0,5	0,00	0,00	0,00
Theragra chalcogramma	**19**	**67**	**0,118**	**0,752**	**0,389**	**0**	**44119,5**	**5442,4**	**0**	**10000,0**	**1363,2**	**0,09**	**63,03**	**9,25**
Melletes papilio	24	33	0,275	0,385	0,320	0	9,3	0,5	0	2,2	0,3	0,00	0,01	0,00
Enophrys diceraus	26	26	0,220	0,220	0,220	0	1,1	0,0	0	0,2	0,2	0,00	0,00	0,00
Hemilepidotus gilberti	21	36	0,321	0,580	0,415	0	12,5	2,1	0	2,9	0,5	0,00	0,04	0,00
Gymnacanthus detrisus	32	37	0,490	0,540	0,515	0	11,9	0,5	0	3,4	0,5	0,01	0,02	0,00
Blepsias bilobus	20	20	0,130	0,130	0,130	0	0,7	0,0	0	0,3	0,1	0,00	0,00	0,00
Hemitripterus villosus	27	27	0,690	0,690	0,690	0	2,8	0,1	0	0,7	0,7	0,00	0,00	0,00
Aptocyclus ventricosus	18	33	0,710	1,435	0,959	0	29,6	3,3	0	14,3	1,1	0,00	0,03	0,01
Eumicrotremus soldatovi	16	22	0,180	0,326	0,255	0	2,9	0,1	0	2,0	0,3	0,00	0,03	0,00
Eumicrotremus asperrimus	16	23	0,160	0,260	0,210	0	1920,0	60,2	0	349,1	10,9	0,00	2,40	0,07
Crystallichthys mirabilis	20	21	0,220	0,220	0,220	0	0,4	0,0	0	0,2	0,2	0,00	0,00	0,00

Liparis ochotensis	41	41	0,920	0,920	0,920	0	2,8	0,1	0	0,9	0,9	0,00	0,00	0,01
Careproctus roseofuscus	31	32	0,620	0,620	0,620	0	1,2	0,0	0	0,6	0,6	0,00	0,00	0,00
Careproctus rastrinus	20	35	0,155	0,960	0,457	0	13,4	0,9	0	2,0	0,5	0,00	0,02	0,00
Careproctus colletti	22	23	0,198	0,198	0,198	0	0,4	0,0	0	0,2	0,2	0,00	0,00	0,00
Lycodes palearis	35	36	0,260	0,260	0,260	0	0,5	0,0	0	0,3	0,3	0,00	0,00	0,00
Bothrocarichthys microcephalus	21	31	0,108	0,173	0,149	0	9,5	0,6	0	1,8	0,2	0,01	0,03	0,00
Lycogrammoides nigrocaudatus	21	26	0,134	0,134	0,134	0	3,4	0,1	0	0,6	0,1	0,01	0,01	0,00
Hippoglossoides elassodon	34	34	0,310	0,310	0,310	0	0,3	0,0	0	0,3	0,3	0,00	0,00	0,00
Limanda aspera	30	39	0,360	0,540	0,433	0	3,2	0,2	0	0,6	0,4	0,00	0,01	0,00
Pandalus borealis	10	15	0,024	0,024	0,024	0	3,6	0,1	0	0,5	0,0	0,01	0,01	0,00

Appendix 5

Average catch composition during Danish seiner pollock fishery in the SOO in January-April 2018 on data collected by KamchatNIRO observers

Specie	Lenth, cm		Average weight, kg			Catch per operation, kg			CPUE, kg / effort			Share in catch by weigth, %		
	min	max	min	max	av.	min	max	av.	min	max	av.	min	max	av.
Bathyraja violacea	67	67	1,650	1,650	1,650	0	1,7	0,0	0	1,7	1,7	0,01	0,01	0,12
Bathyraja parmifera	50	92	0,900	6,500	2,800	0	65,0	1,3	0	65,0	2,8	0,12	21,55	0,21
Osmerus mordax dentex	31	32	0,167	0,167	0,167	0	0,5	0,0	0	0,5	0,2	0,01	0,01	0,01
Gadus macrocephalus	**29**	**90**	**0,550**	**6,350**	**2,698**	**0**	**7849,2**	**371,8**	**0**	**7849,2**	**371,8**	**0,47**	**84,53**	**28,02**
Theragra chalcogramma	**21**	**75**	**0,500**	**0,900**	**0,705**	**0**	**11756,9**	**737,6**	**0**	**11756,9**	**698,9**	**9,42**	**98,00**	**52,67**
Eleginus gracilis	25	47	0,431	0,431	0,431	0	578,7	6,7	0	578,7	5,5	1,14	90,00	0,41
Anoplopoma fimbria	36	36	0,600	0,600	0,600	0	0,6	0,0	0	0,6	0,6	0,01	0,01	0,05
Hexagrammos octogrammus	34	41	0,600	0,800	0,683	0	402,4	6,6	0	402,4	6,6	1,00	3,01	0,50
Hexagrammos lagocephalus	24	30	0,225	0,225	0,225	0	75,4	0,7	0	75,4	0,7	0,75	0,75	0,05
Gymnacanthus detrisus	28	39	0,275	0,650	0,418	0	816,4	27,8	0	816,4	27,8	0,79	5,56	2,10
Triglops forficatus	28	28	0,150	0,150	0,150	0	30,0	0,3	0	30,0	0,3	0,50	0,50	0,02
Triglops scepticus	20	21	0,100	0,100	0,100	0	20,0	0,3	0	20,0	0,3	0,16	0,33	0,02
Myoxocephalus polyacanthocephalus	34	64	0,500	6,100	2,300	0	949,2	10,3	0	949,2	10,3	0,08	15,82	0,78
Hemilepidotus jordani	30	46	0,350	1,450	0,840	0	684,0	14,4	0	684,0	14,4	0,24	6,84	1,09
Hemilepidotus gilberti	32	34	0,450	0,450	0,450	0	101,7	1,0	0	101,7	1,0	1,69	8,24	0,07

Hemitripterus villosus	41	41	1,050	1,050	1,050	0	12,6	0,1	0	12,6	1,1	0,07	0,07	0,08
Podothecus sturioides	22	34	0,125	0,250	0,188	0	44,3	0,8	0	44,3	0,8	0,37	0,74	0,06
Percis japonica	33	33	0,300	0,300	0,300	0	0,3	0,0	0	0,3	0,3	0,00	0,00	0,02
Careproctus rastrinus	21	38	0,200	1,900	1,050	0	186,2	2,0	0	186,2	2,0	0,56	3,72	0,15
Careproctus furcellus	43	43	1,200	1,200	1,200	0	211,2	2,0	0	211,2	2,0	1,76	1,76	0,15
Crystallichthys mirabilis	25	42	0,250	1,250	0,800	0	242,5	3,5	0	242,5	3,5	0,11	4,04	0,27
Lycodes brunneofasciatus	43	43	0,300	0,300	0,300	0	29,1	0,3	0	29,1	0,3	0,48	0,48	0,02
Hippoglossoides sp.	34	41	0,250	0,700	0,495	0	843,8	13,7	0	843,8	13,7	0,71	4,96	1,03
Pleuronectes quadrituberculatus	28	52	0,300	0,300	0,300	0	105,9	1,2	0	105,9	1,0	0,66	48,75	0,08
Limanda sakhalinensis	23	36	0,207	0,207	0,207	0	519,9	5,0	0	519,9	4,9	0,15	6,56	0,37
Hippoglossus stenolepis	40	86	1,000	8,400	2,740	0	30,0	0,5	0	30,0	2,7	0,02	0,60	0,21
Lepidopsetta polyxystra	**19**	**54**	**0,075**	**0,771**	**0,488**	**0**	**5386,2**	**132,3**	**0**	**5386,2**	**127,9**	**0,53**	**64,85**	**9,64**
Limanda aspera	35	35	0,550	0,550	0,550	0	194,2	1,8	0	194,2	1,8	0,31	1,94	0,14
Atheresthes stomias	49	58	1,350	2,400	1,783	0	281,6	2,7	0	281,6	2,7	0,02	2,35	0,20
Atheresthes evermanni	47	58	0,300	2,400	1,019	0	1207,2	16,2	0	1207,2	16,2	0,50	7,10	1,22
Paralithodes camtschaticus			3,020	3,020	3,020	0	15,1	0,1	0	15,1	3,0	0,15	0,15	0,23
Chionoecetes sp.			0,020	0,020	0,020	0	9,7	0,1	0	9,7	0,1	0,16	0,16	0,01
Cucumaria ochotensis			0,300	0,300	0,300	0	50,4	0,5	0	50,4	0,5	0,50	0,50	0,04
Octopus sp.			2,400	2,400	2,400	0	2,4	0,0	0	2,4	2,4	0,02	0,02	0,18
Cucumaria sp.			0,083	0,150	0,117	0	35,2	0,4	0	35,2	0,4	0,24	0,70	0,03
Buccinum sp.			0,100	0,100	0,100	0	9,7	0,1	0	9,7	0,1	0,16	0,16	0,01
Strongylocentrotus sp.			0,010	0,010	0,010	0	5,4	0,1	0	5,4	0,1	0,03	0,03	0,00