

Year 2011-2012 Research on the Status of Bering Sea Pollock Stocks

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Contents

Stock status, spatial differentiation and biological of pollock (*Theragra chalcogramma*) in the North-West Bering Sea in 2011 3

Results of pollock's studies, conducted in the second half of 2011 and the first half of 2012 in the Bering Sea 15

**STOCK STATUS, SPATIAL DIFFERENTIATION AND BIOLOGICAL
INDICATORS OF POLLOCK (*THERAGRA CHALCOGRAMMA*) IN THE NORTH-
WEST BERING SEA IN 2011**

Abundance and biomass of pollock in the Bering Sea, as well as in other Far Eastern regions, considerably change on the periods of different duration. In the second half of the first decade of the 2000's pollock's biomass decreased to a minimum level over the past thirty years, for the reasons of natural character that caused also the decline in the annual catch, both in Russia and the USA.

Field studies conducted in 2009-2011 almost the whole area of the Bering Sea pollock showed that in recent years there were three numerous generations – in 2006, 2008 and 2009. In this regard, the pollock biomass increased in 2010-2011, mainly due to generations of 2006 and 2008. Distribution of pollock in the Northwest Bering Sea in the summer-autumn period varies considerably each year depending on the variability of oceanic conditions, the number of generations and the total population biomass, abundance and distribution of feeding zooplankton.

Trawl-acoustic survey in the Northwest Bering Sea (Navarin area) was made in September 2011 outside the territorial waters. Control trawlings during the survey were conducted on a planned grid of stations; the distance between trawls was 40-45 miles, between the tacks – 20 miles. In total, 80 hauls were made in the Chukotka and the Western Bering Sea (in the area to the east of 174⁰) zones.

The relatively high density of clusters (over 100 thousand ind./km² and over 20 tons/km²) was marked in Navarin area in September 2011, on the shelf located between Navarin cape and dividing line, as well as in south and south-east part of the Gulf of Anadyr, which corresponds to the position of Navarin water flow (Fig. 1). The highest density was marked on the shelf, adjacent to the north to the Navarin Canyon and in the south-east part of the Gulf of Anadyr. The pollock generation of 2009 dominated in the first area and pollock generation of 2009 dominated in the second area.

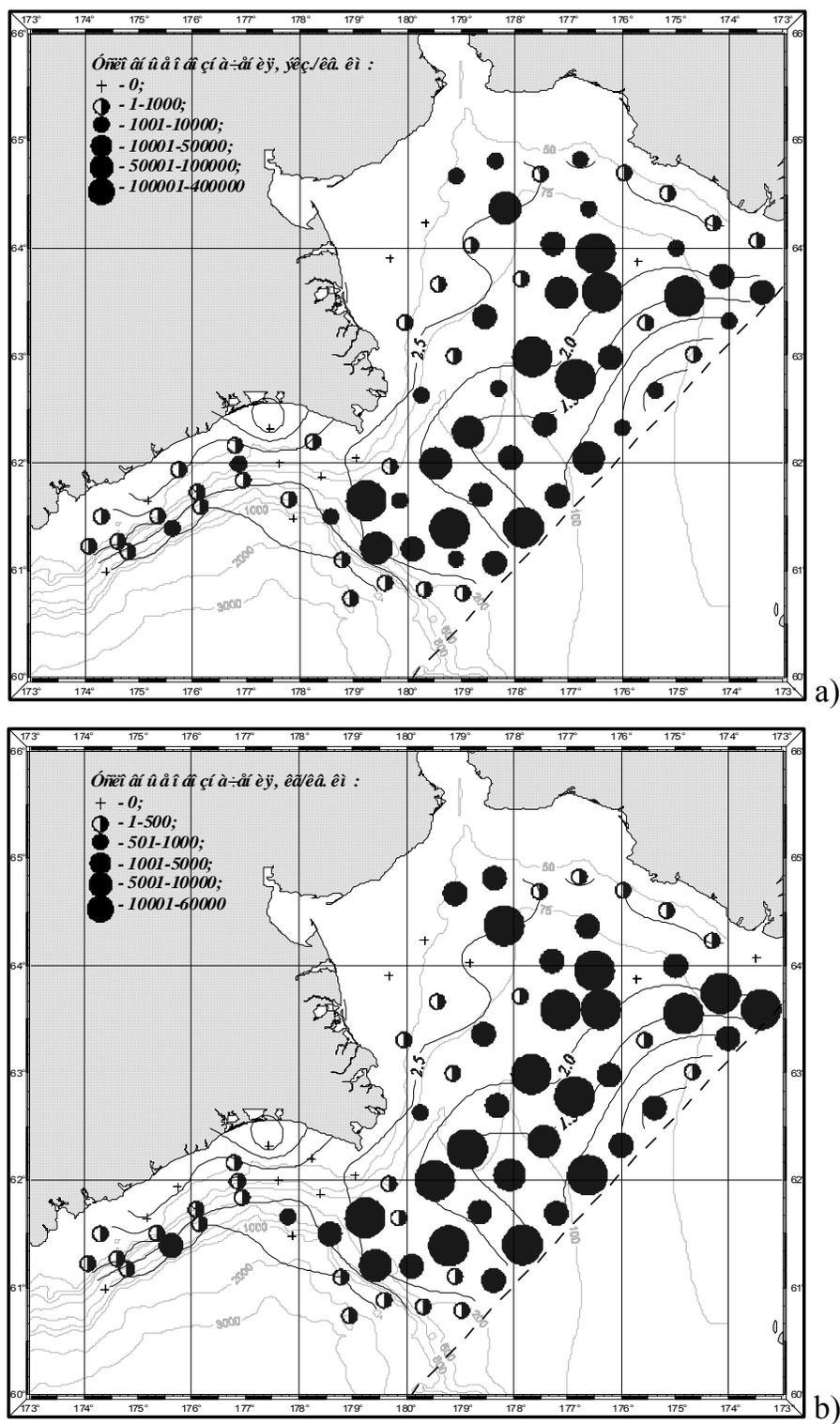


Fig. 1. The density distribution of pollock (a – ind./km²; b – kg/km²) and bottom water temperature in the Northwest Bering Sea 2-17.09.2011

The pollock's size composition was divided into several groups according to age and sexual maturity during considering the spatial differentiation of this species: 1) length up to 18 cm (age 0 +1+); 2) length of 19-28 cm (age 2 +), 3) length of 29-36 cm (age 3 +), 4)

length of 37-44 cm (ages from 4 + to 6 +), 4) length of 45-52 cm (ages from 7 + to 8 +), and 5) length more than 52 cm (age 8 +). The spatial differentiation of different size-age groups of pollock in September 2011, consistent with its customary behavior and distribution in feeding period (Fig. 2).

The fingerlings were distributed on the shelf off the south-east part of the Navarin Canyon, adjacent to the dividing line between zones of Russia and the USA and in the coastal area of the north-east part of the Gulf of Anadyr. The young immature fish (2 + and 3 +) was extended offshore from the central part of the Gulf of Anadyr to the dividing line (depth 75-200 m). The highest density clusters of mature pollock (45-52 cm in length) was recorded over the upper part of the continental slope off north part of the Koryak coast and in the coastal area in the north part of the Gulf of Anadyr, adjacent to Bay of Cross. The most part of pollock in the North-West Bering Sea (zone of Russia) was extended to the shelf and continental slope adjacent to the area located east of 179⁰ E in September 2011.

The development of the seasonal ocean processes was close to the average multi-annual indicators in spring and summer 2011. In early autumn the area of waters with residual winter cooling in the North Bering Sea did not exceed the average multi-annual values, the temperature of near bottom water in Navarin area and in the Gulf of Anadyr also was close to the average multi-annual temperature and higher than in the 2009-2010. Therefore, the water temperature was not a limiting factor for migration and distribution of pollock in the North-West Bering Sea in feeding period during summer and autumn.

Distribution of juveniles and mature pollock in the North-West Bering Sea corresponded to the spatial differentiation of zooplankton, especially copepods and euphausiids, which accounted for the bulk of its diet (Fig. 3). In the areas where numbers of pollock were the greatest, euphausiids and copepods made 54.2-86.8% in the diet of fish with length of 17-30 cm, 64.9-78.3% - in the diet of fish with length of 30-40 cm and 36.1-66.5 % - in the diet of fish with length of 40-50 cm.

The comparison of assessment of medium and large fractions of zooplankton's biomass and stomach fullness index showed the average food security for pollock in Navarin area in autumn 2011.

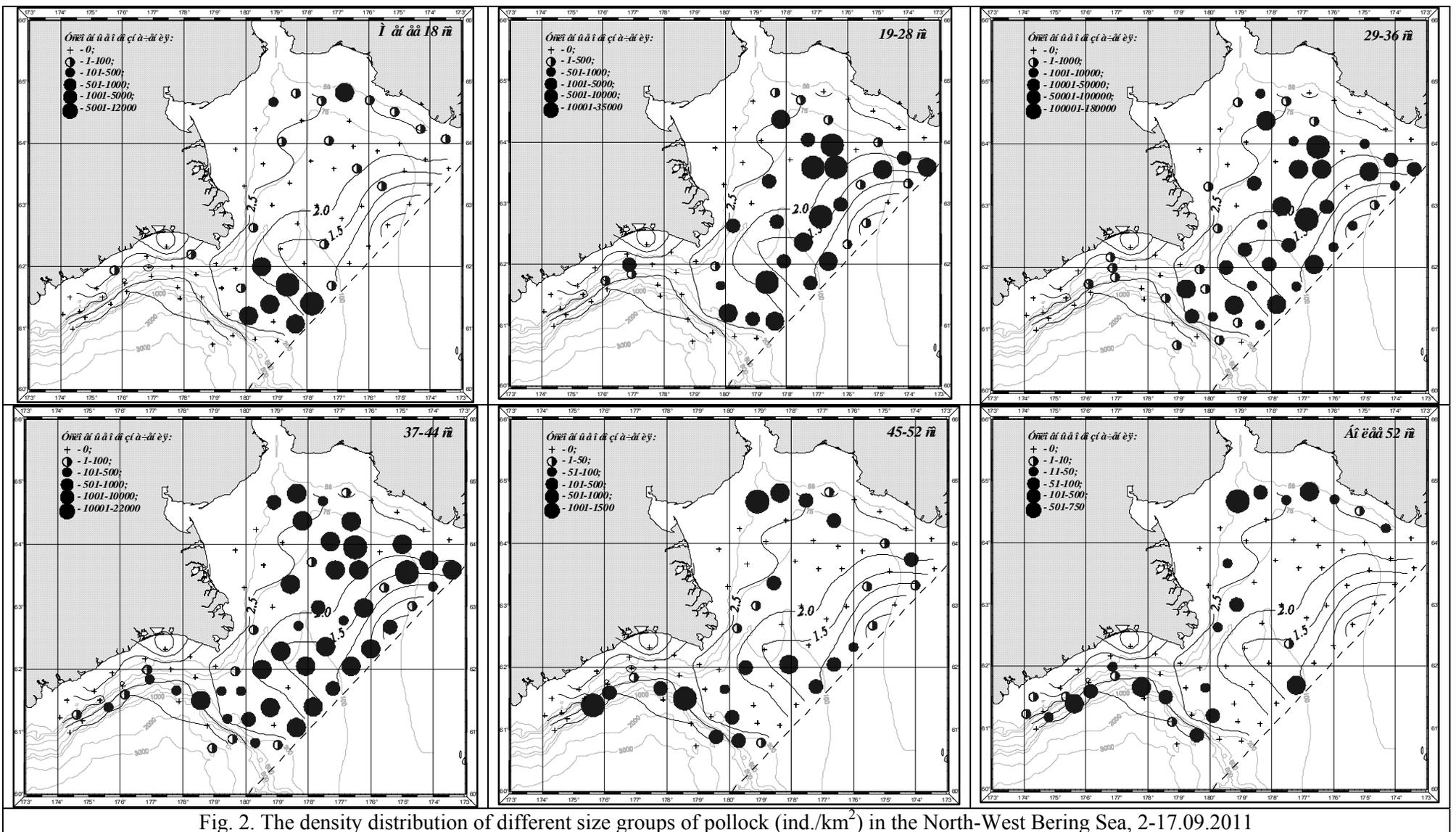


Fig. 2. The density distribution of different size groups of pollock (ind./km²) in the North-West Bering Sea, 2-17.09.2011

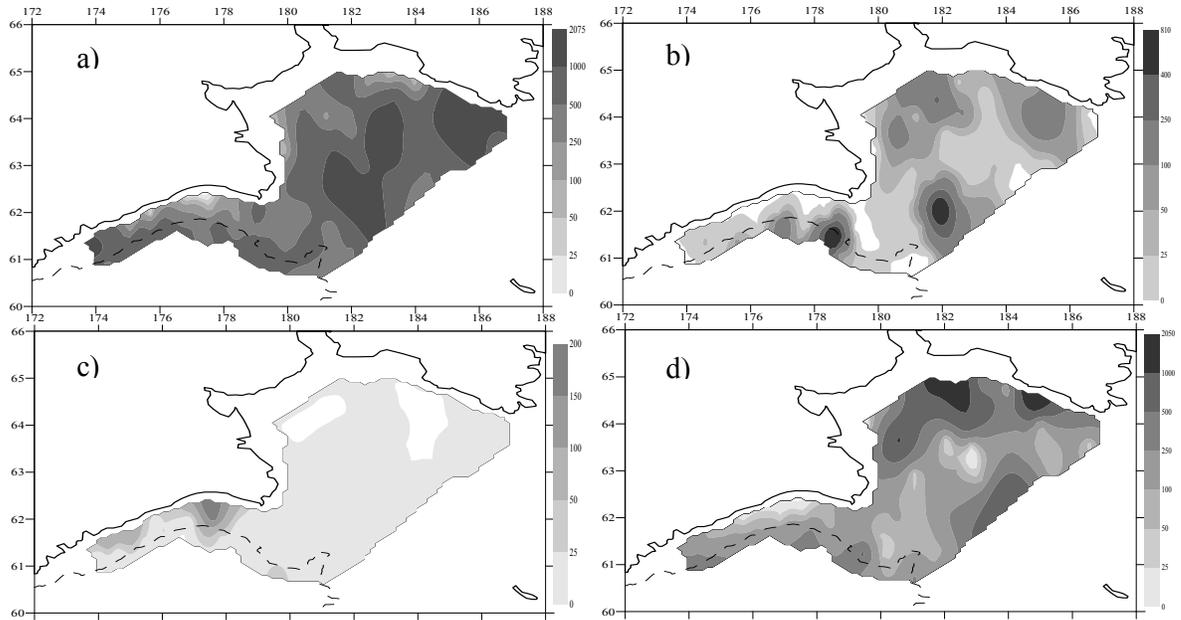


Fig. 3. The distribution of plankton in the epipelagic zone (layer 200-0 m) in the North-West Bering Sea (mg/m^3): a) - Copepoda, b) - Euphausiacea, c) - Amphipoda, d) - Chaetognatha in September 2011

The weighted average size of pollock in catches was analyzed for the Chukchi (area east of $175^{\circ}00$ W) and Western Bering Sea ($174^{\circ}00$ $175^{\circ}00$ E-W) zones separately and was presented by individuals of 5-72 cm in length (Fig. 4). In the Chukchi zone the size range was unimodal, represented mainly by generation of 2008 (M - 32.6 cm); in the Navarin area – two-modal (Fig. 5) due to generations of 2008 and 2009 (M-29.3 cm). The pollock at age 1+ was presented in the second area in insignificant quantity. Attention was drawn to a very low number of numerous generations of 2006 in the North-West Bering Sea (zone of Russia) in September 2011.

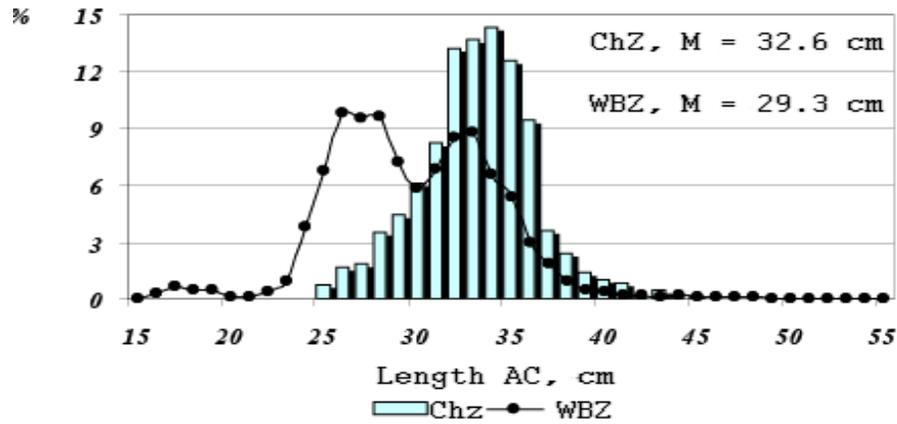


Fig. 4. The size composition of pollock in the catches in the Chukchi (ChZ) and the West Bering Sea (WBZ) (east of 174⁰ E) zones in September 2011

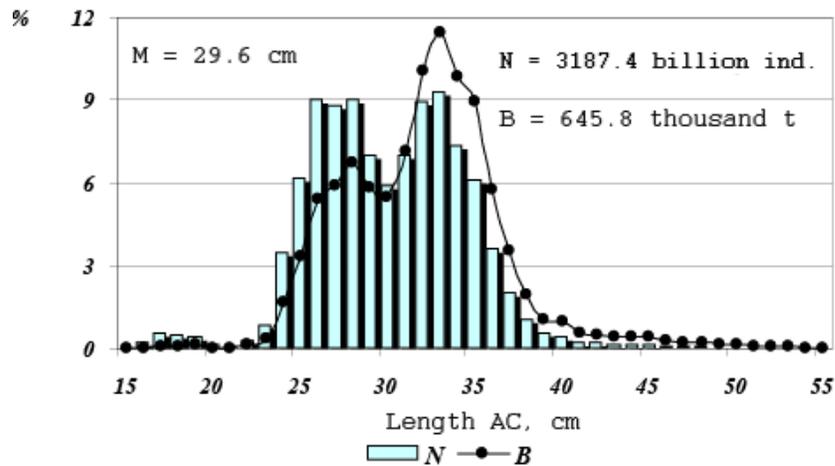


Fig. 5. Distribution of number (N) and biomass (B) of pollock in the North-West Bering Sea by size range in September 2011

The number of young fish increased in the Navarin area in late summer and early autumn period of 2011 compared with the same period in 2010. The young pollock of two generations – 2008 and 2009 – dominated in that area. The fish of those generations in total amounted to more than 92.0% of the total number; there was 55.4% of pollock born in 2008. The number of generation 2006 was significantly lower than in 2010. In the Russian waters during the autumn period the number of this generation was very low and made in the pelagic zone in total, according to trawling and acoustic shooting, about 3.0 %. (Fig. 6).

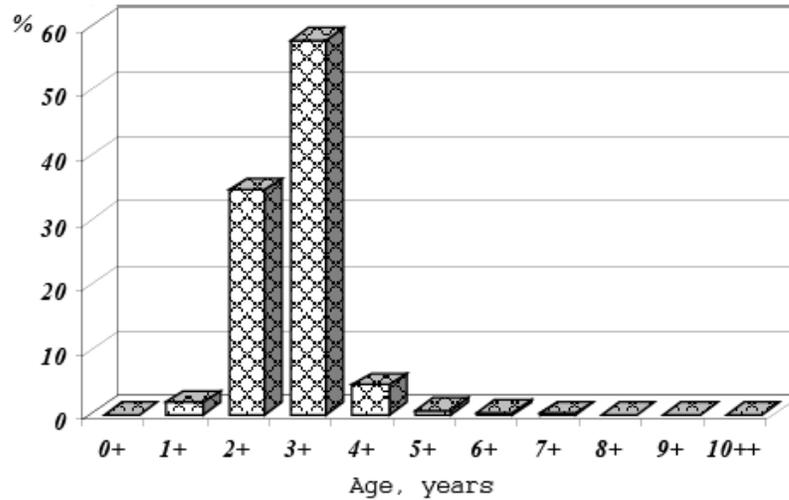


Fig. 6. The age structure of the pelagic pollock in the North-West Bering Sea in September 2011

The high number of fish generations 2006 was observed not only in the North-West Bering Sea, but in the East Bering Sea in summer-autumn 2011 (Fig. 7). According to the bottom trawl survey of Alaska Center (AFSC), the pollock, which was born in 2005 and 2006, and fry at age 1 + (19.5%, 15.7% and 16.6% of the total number of registered fish) dominated in number in the near-bottom layer in the East Bering Sea. It is noteworthy that in comparison with 2010 the relative abundance of numerous generations of 2006 decreased in the East Bering Sea in the bottom layer, from 38.06% to 15.7%. Number of generation 2010 (age 1 +) in long-term comparative data corresponds to the average number of generations. In recent years, the generation of approximately the same number was observed in 2005.

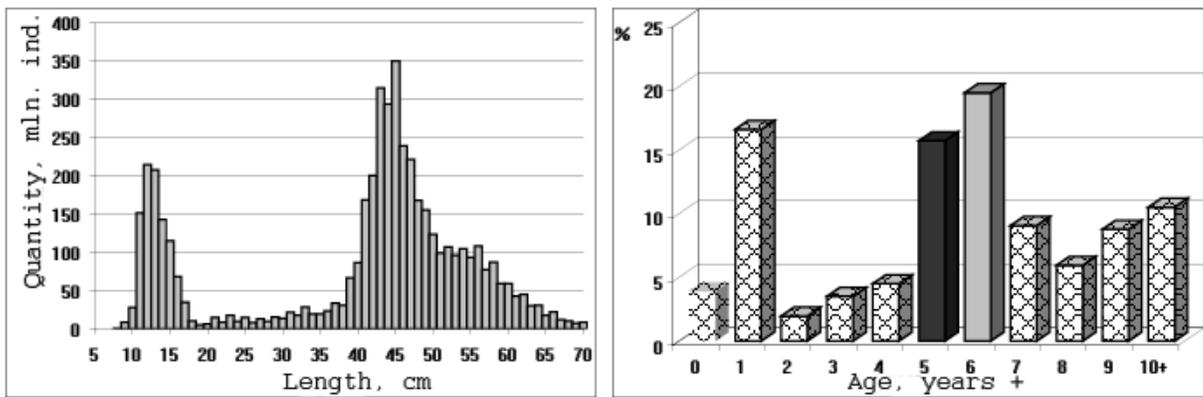


Fig. 7. Size-age composition of pollock on the East Bering Sea shelf in summer 2011, according to the bottom trawl survey data (data on population size groups were provided by the Alaska Fisheries Research Center, AFSC)

The relatively low efficiency of the fishing fleet, which spent a lot of time searching for fish of commercial length, caused the predominance of small-size immature pollock in almost all Navarin area in the autumn.

In September, the vast majority of pollock in the Navarin area was immature fish: 54.3-69.9% of males and 84.0-89.5% of females were at the stage II of maturity. At stage II-III were recorded 25.1-28.3% of males and 6.1-7.1% of females; at stage VI-II – 1.6-2.4% and 1.4-9.2% respectively (Fig. 8). Fish with gonads in prespawning condition was met sporadically. The sex ratio in the North-West Bering Sea was 1.0 : 1.1 with a predominance of males.

Biomass and abundance of East Bering Sea pollock are constantly varies considerably in accordance with the number of components of its generation. During periods of maximum it can reach 14-15 million t. In the early 2000s, biomass, according to accounts of survey, was 7.0-8.5 million t; in 2008-2009 biomass did not exceed 3.3-4.3 million t; in 2010 – increased again to 6.2 million t, which was close to the estimates of the second half of the 1990s and the mid of first decade of the 2000s. In comparison with 2009, in 2010 biomass increased in 1.9 times, number – in 1.6 times because of pollock's generations of 2006, 2008 and 2009. The number of pollock in pelagic waters in the North-West Bering Sea (zone of Russia) in September 2011, according to the trawl-acoustic survey vessel "Professor Kaganovsky", amounted to 1994.1 million ind.

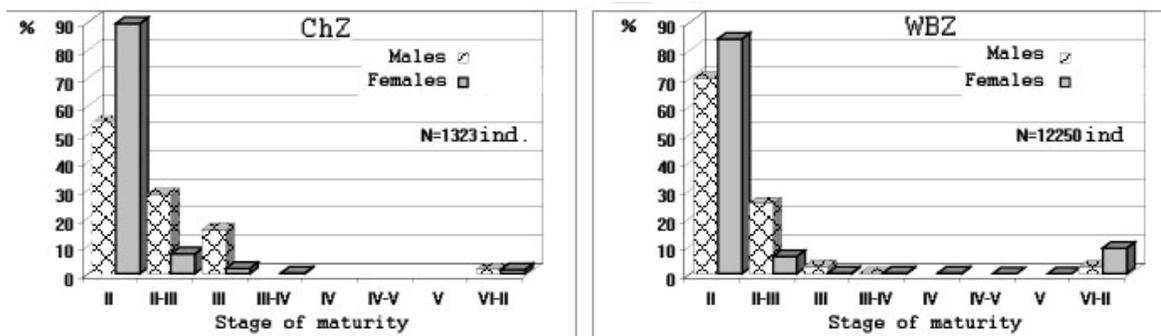


Fig. 8. The ratio of gonad maturity stages of pollock in the North-West Bering Sea (Chukchi and Western Bering Sea zone) in September 2011

The total allowable catch (TAC) of pollock in the West Bering Sea statistical zone (to the east of 174⁰⁰⁰ E) was defined in 310.7 thousand t for 2010. The catch in the area was 273.0 thousand t; including the foreign fleet (Korea, Japan), which worked mainly in the maritime boundary line of Russia and USA, and caught 48.1 thousand t.

In 2011, the total allowable catch in the West Bering Sea zone (to the east of 174⁰⁰⁰ E) slightly increased (by 6.8%) to 331.9 thousand t due to the gradual entry into the fishing part of the population of numerous generations of 2006. Catch of pollock in the area was 282.7 thousand t, nearly 10 thousand t more than last year. Foreign fishing fleet (belongs to the Republic of Korea) caught 48.79 thousand t.

Pollock generations 2008-2009, dominated in the Navarin area in 2011, but the number of generations of 2006 was substantially lower than in 2010. Therefore, the fish of generation 2008 which accounted for 55.4 per cent of the total number of pollock in the region dominated in catch, which caused a higher catch effort in 2011 (Fig. 9).

In contrast to the previous year, when the largest catch per effort of the fishing fleet was recorded in summer, in 2011 fishery was more effective in October-December. In summer the catch per effort in 2010 and 2011 was similar. The marked increase in resources of East Bering Sea pollock as a consequence of

the appearance in several populations of many generations and the increasing prevalence in this region from neighboring areas of the Bering Sea during feeding, summer-autumn period affected on increasing the efficiency of pollock fishing in the West Bering Sea zone in 2010-2011.

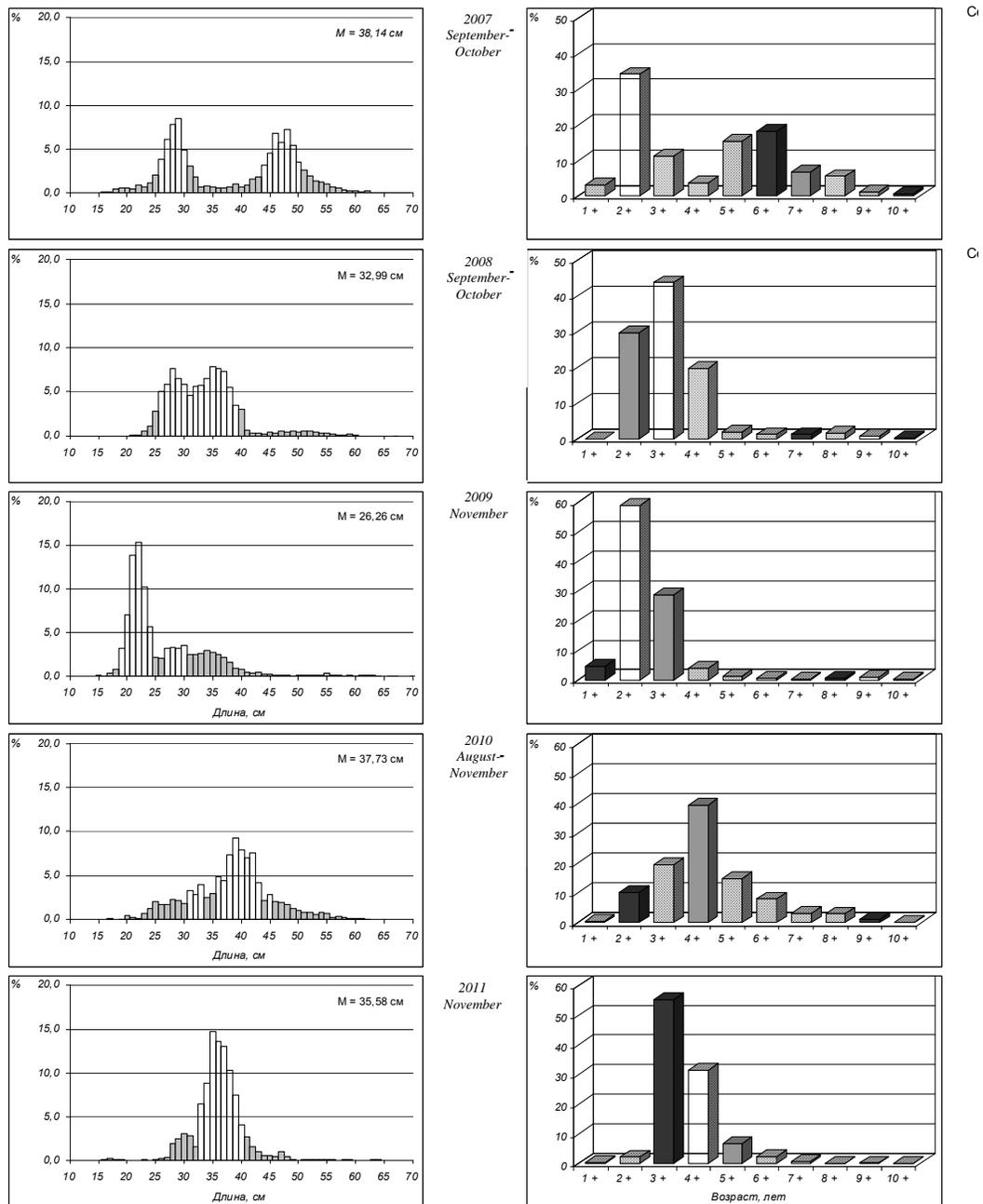


Fig. 9. The size and age composition of pollock from commercial catches in the Navarin area in autumn 2007-2011

The results of trawl-acoustic and bottom surveys in the East and North-West Bering Sea shows the significant interannual changes in the size-age structure of pollock, which determines the size-age composition of commercial catches. However, over the long-term data, the four age groups – (2 +) - (5 +) usually dominate in catches of fishing fleet in the Navarin area (Fig. 10).

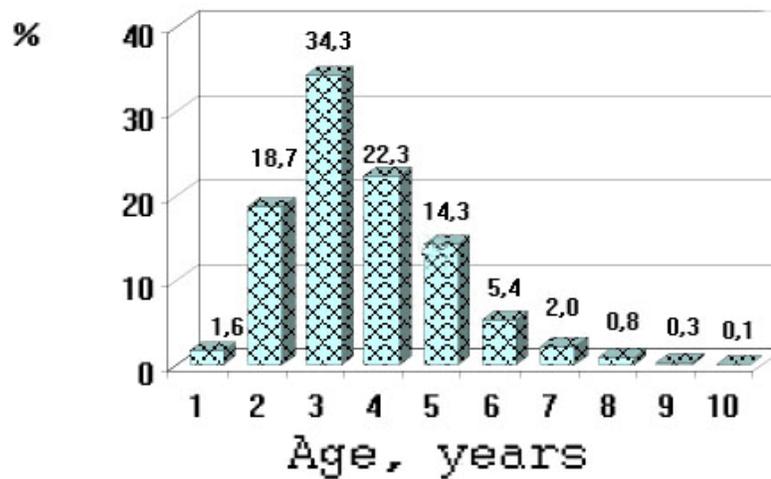


Fig. 10. The average age of pollock (% of number) in commercial catches in the Navarin area of the Bering Sea in 1995-2011 years

**RESULTS OF POLLOCK'S AND HERRING'S STUDIES, CONDUCTED IN
THE SECOND HALF OF 2011 AND THE FIRST HALF OF 2012 IN THE
BERRING SEA**

In the second half of 2011 - the first half of 2012 research on pollock and pacific herring were carried out by specialists of KamchatNIRO in the Bering Sea in following expeditions (Table 1):

Table 1

The list of cruises carried out by KamchatNIRO in the second half of 2011 - the first half of 2012 in the Bering Sea, which conducted research on pollock and herring

Area of work (species which was research)	Time of work	Ship, shipowner	Researchers
West Bering Sea zone, Karagin subzone (pollock)	12.08-21.10.2011	BATM "Alexander Ksenofontov" (JSC "Okeanrybflot")	Negrebov V.L.
West Bering Sea zone, Karagin subzone (herring, pollock)	29.10-31.12.2011	SRTM "Vasily Golovnin" (JSC "Akros")	Shalimanov D.A.
West Bering Sea zone, Karagin subzone (herring, pollock)	17.10-31.12.2011	BATM "Seroglazka" OAO "Farm by Lenin"	Fomin S.N.
West Bering Sea zone, Karagin subzone (pollock)	09.09-09.11.2011	SRTM "Arctic Leader" (LLC RK "Luntos")	Mihalyutin E.A.
Karagin subzone (demersal fish including pollock)	01.08-31.09.2011	LLC "North-Eastern Company" (Shore-based enterprise)	Kupriyanov S.V.
West Bering Sea zone, Karagin subzone (pollock)	25.09-12.12.2011	SRTM "Antaeus" (LLC KPFK "Kamline")	Kilin E.V.
West Bering Sea zone, Karagin subzone (pollock)	17.10-31.12.2011	BATM "Hawtin" (JSC "Okeanrybflot")	Vasilyeva E.A.
Karagin subzone (herring)	05-22.05.2012	Aerial surveys on the spawning grounds,	Bonk A.A., Agafonov S.V.
West Bering Sea zone (pollock)	10.06.2012 – till now	BATM "Irtysk" (JSC "Okeanrybflot")	Veselov S.A.

POLLOCK

West Bering Sea zone (61.01)

In August and September researches on specialized pollock's fishery were carried onboard the BATM "Alexander Ksenofontov" in the West Bering Sea (Fig. 11). In August, species' catches ranged from 0.044 to 111.4 tons/trawling, with an average value equal to 16.8 tons. Pollock's share averaged 95.8%.

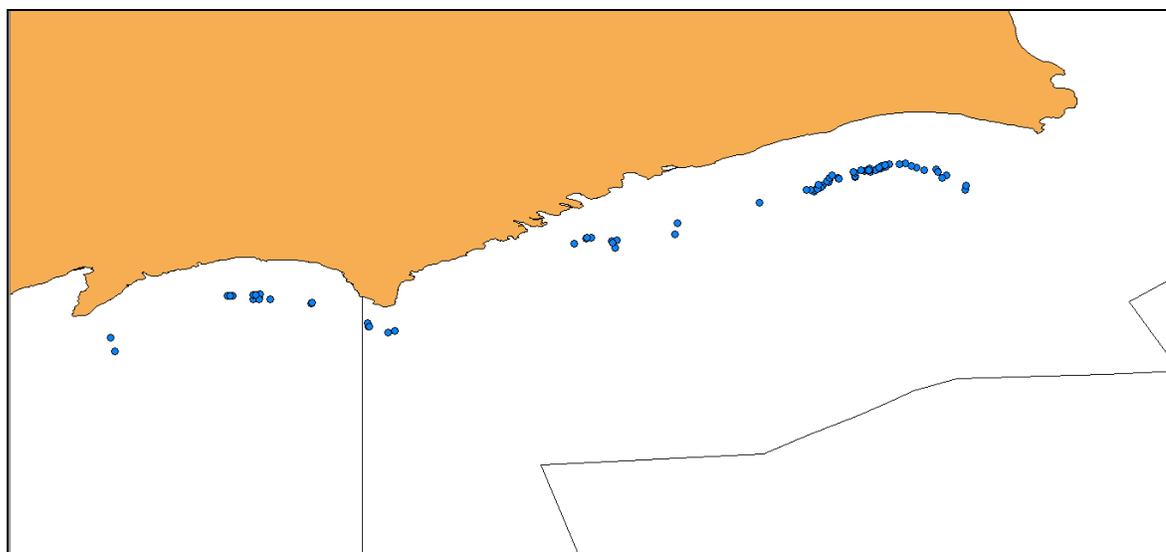


Fig. 11. The scheme of hauls made in the West Bering Sea in August-September 2011 onboard the BATM "A. Ksenofontov "

The length of the fish ranged from 31.1 to 75.0 cm, and the basis of individual catches were specimens of 40.1-46 cm (67.9%) (Fig. 12). The average weight of fish in trawling varied from 0.561 to 0.940 kg with an average value equal to 0.809 kg. The sex ratio was close to 1:1.1 (female - 47.2%). Proportion of immature fish reached 67.8%. Over 75% of females had gonads at maturity stage II, and about 33.3% of males - at stage III (Fig. 13).

In September, BATM "Alexander Ksenofontov" worked in the same area in the 260-450 m isobath. Pollock's catches fluctuated within 0.014-8.2 t/hour of trawling (in average - 2.3). The size of the specimens were 35.1-75.0 cm; fish with length 45.1-54.0 cm (64.1%) dominated in catches (Fig. 14). The curve of the size composition had two distinct maxima in the classes: 45.1-48.0 cm and 50.1-54.0 cm; the second of which was most pronounced (33.9%); 10.6% of the fish had

length less than 45 cm. Average weight of pollock ranged from 0.840 to 1.250 kg with an average value equal to 1.05 kg. Proportion of females was 68.1%, immature individuals - 50.3%. Over 66% of all females had gonads at maturity stage II, 27.1% - on II-III, about 5.5% - on III, and about 46 % of males - at stage III. Significantly increased the proportion of males in stage IV - 38.9% (Fig. 15).

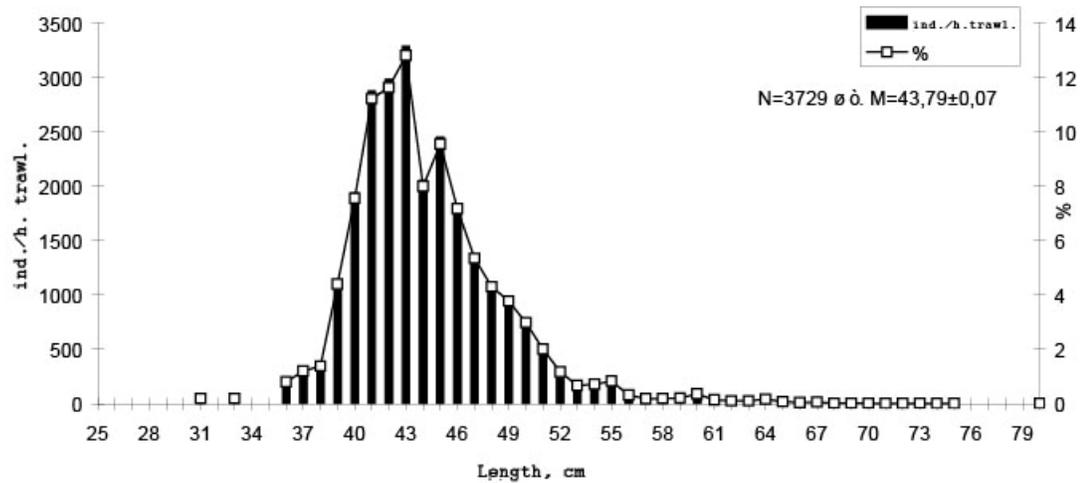


Fig. 12. The size composition of pollock in the West Bering zone in August 2011

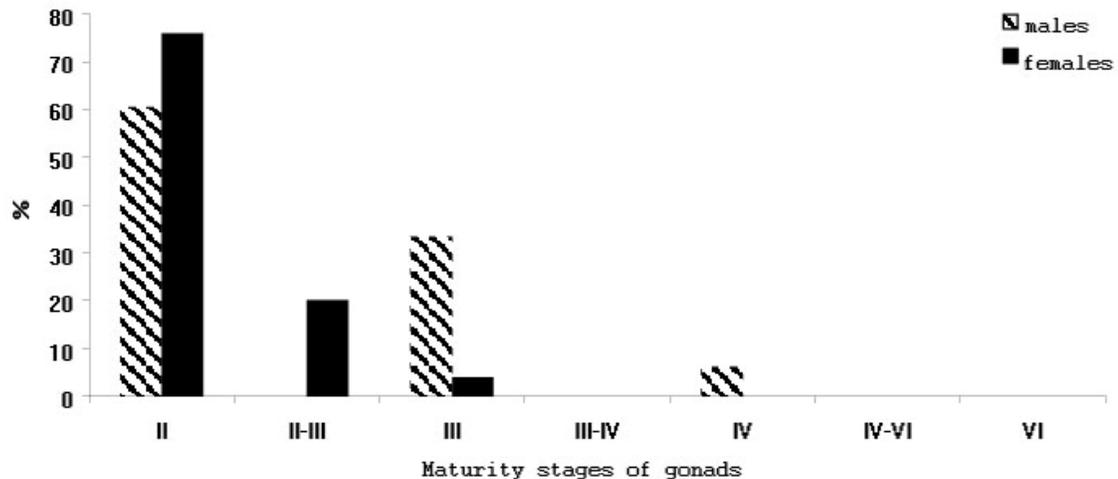
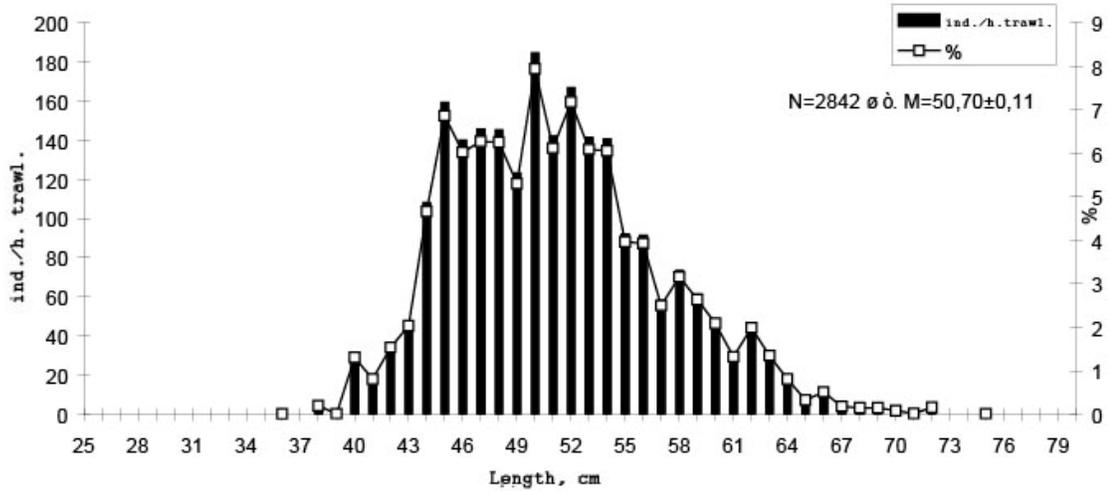


Fig. 13. The ratio of gonad maturity stages of pollock in the West Bering Sea zone (61.01) in August 2011



In Fig. 14. The size composition of pollock in the West Bering Sea zone (61.01) in September 2011

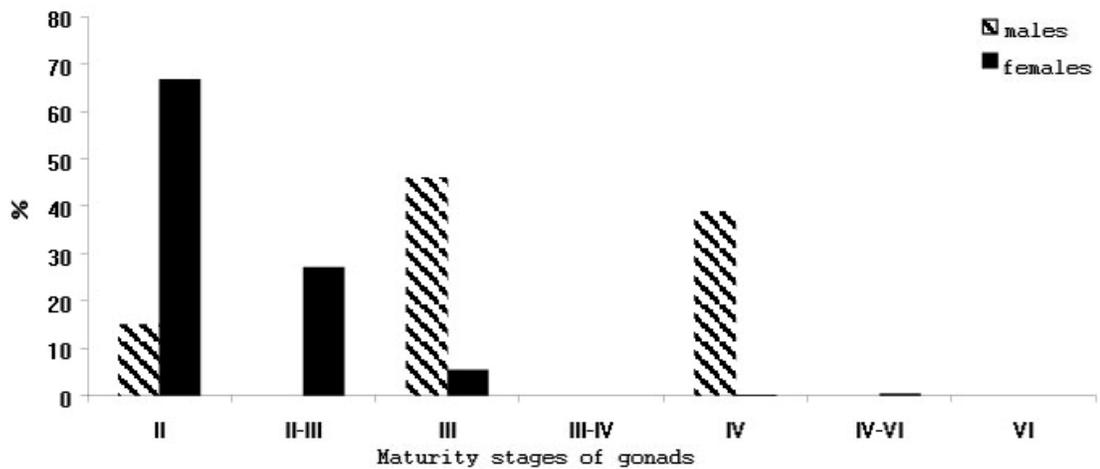


Fig. 15. The ratio of gonad maturity stages of pollock in the West Bering Sea zone (61.01) in September 2011

The researches were carried out in this fishery area in September – November 2011, onboard the SRTM "Arctic Leader". The entire period of work can be divided into two parts: fishery for pollock in the square with the extreme coordinates 60°48'-61°24' N and 172°54'-174°38' E, at depths of 62-250 m; fishery for squid in the range 173 and 176° E at depths of 400-500 m, during which pollock was present as by-catch (Fig. 16).

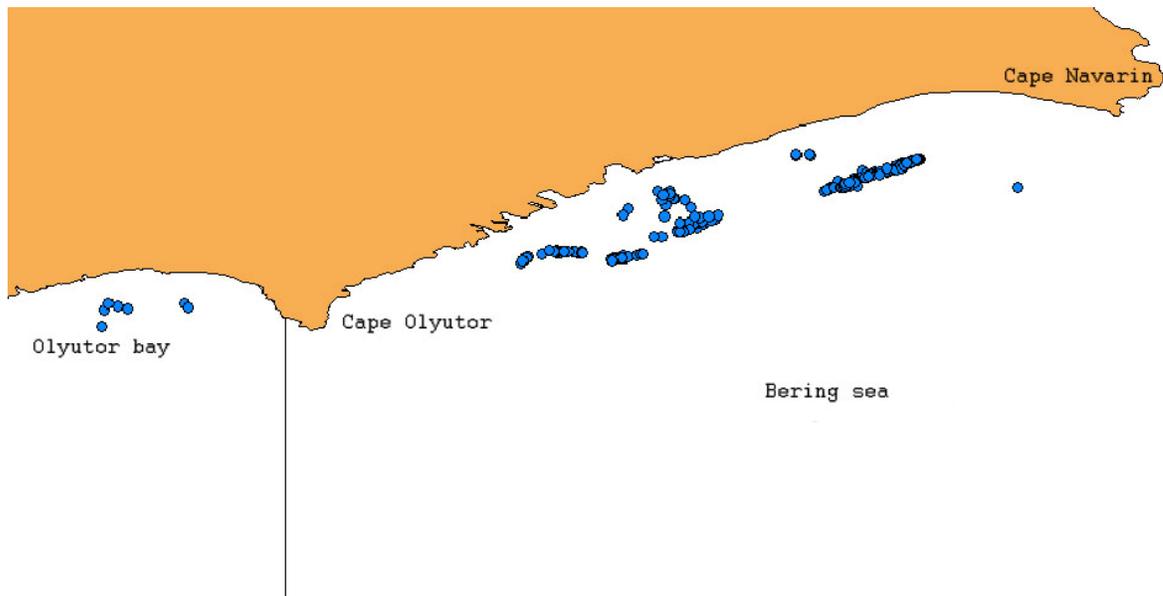
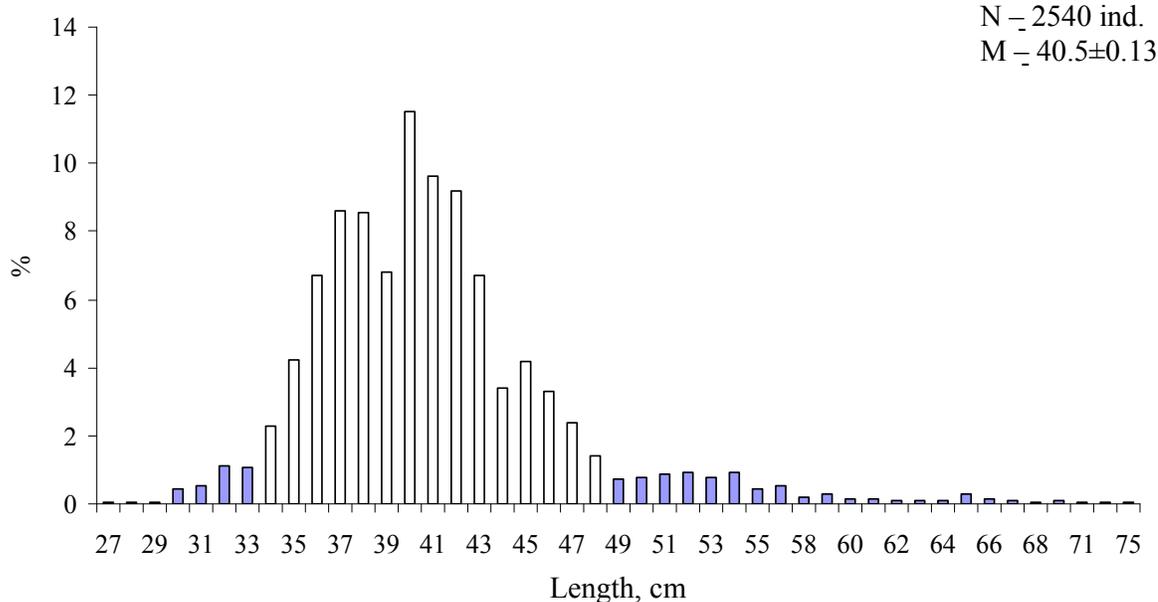


Fig. 16. Areas of work of the SRTM "Arctic Leader" in autumn 2011 in the Bering Sea

In September, during conducting directed pollock fishery, the catches reached 20 t/trawling or 8.1 t/hour of trawling with an average value equal to 1.9 t/hour of trawling. The length of the fish ranged from 27.1 to 75.0 cm, and individuals from size groups 35.1-43.0 cm dominated in catch (71.9%) (Fig. 17). The average length of pollock was 40.5 cm, with an average weight of fish equal to 0.684 kg. The share of fish less than 37.0 cm was on average 25%. Not great preponderance of females over males (58.4%) was observed in the sex ratio. Fish with gonads at the II-III and III stages of maturity: 53.9 and 34.6%, respectively - in males - and 49.5 and 43.0% - females dominated in catch.

In the same month during the squid fishery with bottom trawl pollock's catches did not exceed 2.8 tons per trawling, and in terms of hours of trawling – 0.7 t (mean – 0.03). The size composition of species differed also. The length of the fish ranged from 40.0 to 71.0 cm, and individuals from size groups 44.1-53.0 cm dominated in catch (68.2%) (Fig. 18). The average length of fish was 50.6 cm and average weight - 1.326 kg. Fish less than commercial measures were not available. Females dominated in the catch, accounting for 69.3% of the total catch, most of which had gonads at maturity stage III (68.9%). Also at males individuals with gonads at the III maturity made basis.



In Fig. 17. The size composition of pollock in the West Bering Sea zone during the specialized fishery in September 2011.

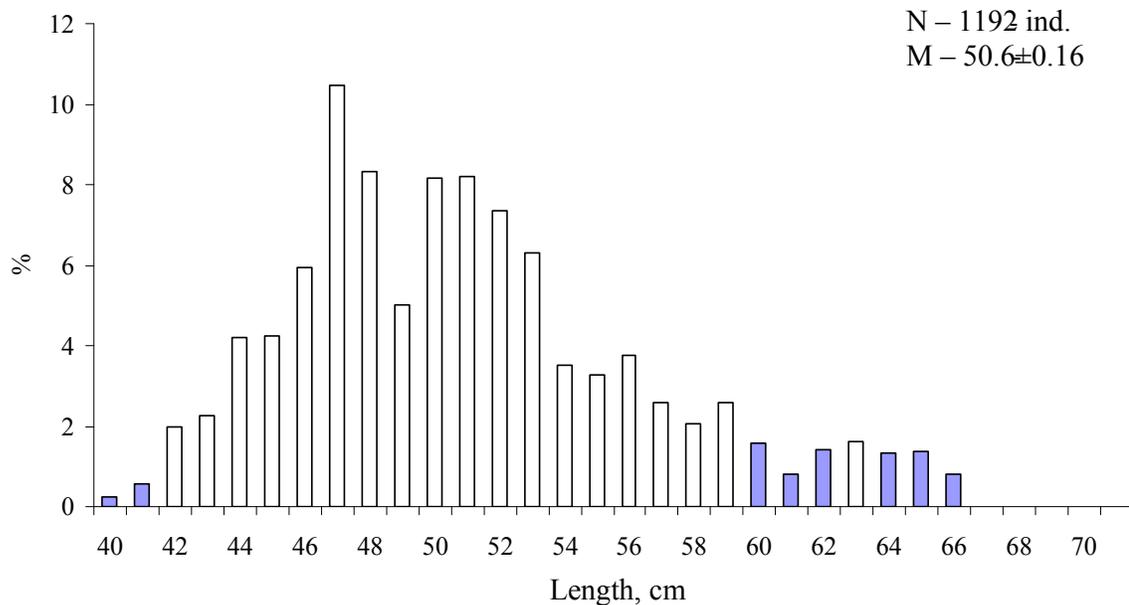


Fig. 18. The size composition of pollock in the West Bering Sea zone during the squid's fishery in September 2011.

In October, works on this vessel were continued in the same mode as in September. Pollock was harvested in an area with extreme coordinates 60°40'-61°10' W and 172°35'-174°42' E at depths of 108-275 m. Catches reached 31.2 tons/trawling. In terms of hours of trawling it was equal to 21.3 t (mean – 7.29). The length of pollock ranged from 30.1 to 58.0 cm, individuals from size groups

34.1-44.0 cm dominated in catch (76.5%). The average length was 38.9 cm pollock, and weight – 0.642 kg. The share of fish less than commercial measures, in average, was 41.1% (Fig. 19). The sex ratio was close to 1/1 with no large predominance of females (54.5%), of which 63.1% had gonads at stage II-III maturity. Among males, 44.2% of the fish were at stage II-III.

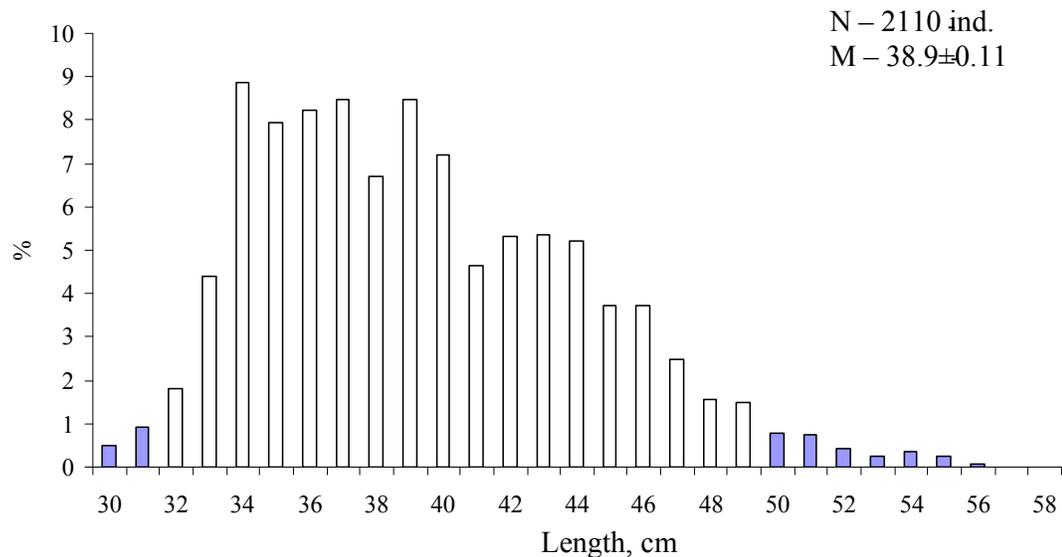


Fig. 19. The size composition of pollock in the West Bering Sea zone during the specialized fishery in October 2011

In the squid fishery by-catch of pollock in October was lower than in September: the maximum catch was 1.0 t/trawling or 0.5 t/hour of trawling (mean – 0.03). The size composition of pollock in this period did not undergo major changes. There were individuals with length from 41.1 to 74.0 cm, and the foundation was made from fish with length 44.1 – 46.0 cm (16.4%) and 48.1-54.0 cm (48.9%) (Fig. 20). Females dominated in the catch, accounting for 64.7%, most of whom had stage III of maturity of the gonads. Most of the males also had stage III of maturity.

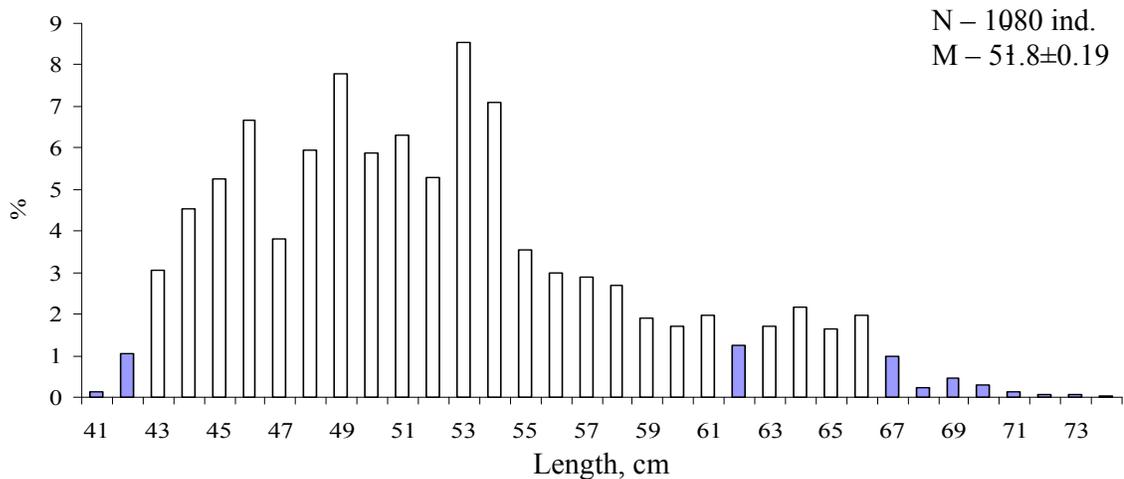


Fig. 20. The size composition of pollock in the West Bering Sea zone during the squid's fishery in October, 2011

In early November in the squid's fishery the pollock's by-catch increased and reached 1.6 t/trawling, and in terms of hours of trawling – 1.9 m (mean – 0.645 m). The size of pollock has changed a lot. Individuals with length 27.1-71.0 cm were marked in catches; fish size groups 47.1-54.0 cm dominated (42.2%). There were 12.5% of fish less than 37.0 cm (Fig. 21). 58.4% of the catches were female, 47.1% of whom had gonads at maturity stage III, and 25.6% at stage II-III. More than half of male (59.9%) had gonad maturity stage III.

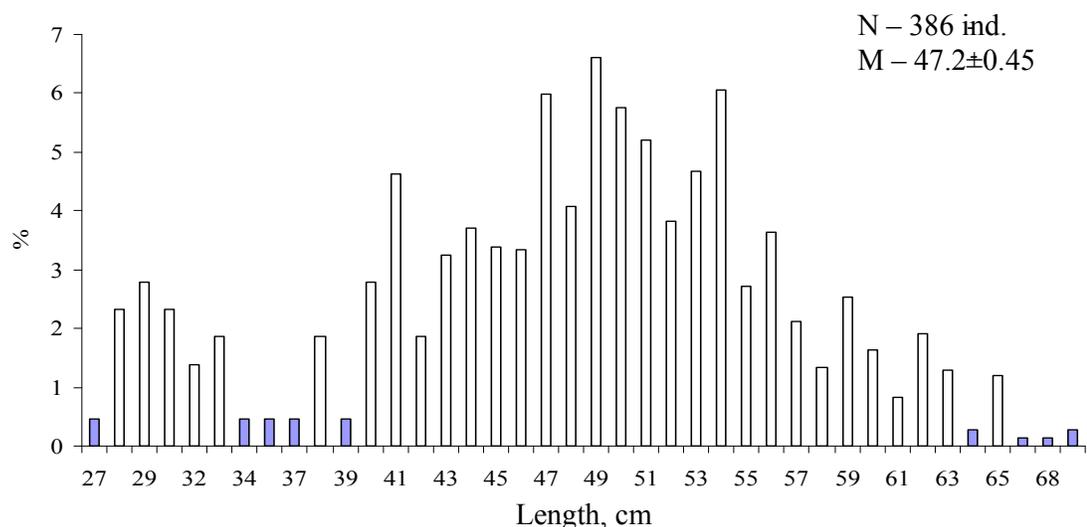


Fig. 21. The size composition of pollock in the West Bering Sea zone during the specialized squid's fishery in November, 2011

Extensive materials were collected during the specialized pollock's fishery in the West Bering Sea area zone onboard the BATM "Hawtin". In October 2011

works were carried out in the area of cape Olyutor (Fig. 22). Pollock catches reached 70 t/trawling or 41 t/hour of trawling. The length of the fish ranged from 27.1 to 58.0 cm, and the individuals from the size groups: 34.1-37.0 cm and 42.1-45.0 cm dominated, their share was 23.7 and 38.35%, respectively (Fig. 23). The share of fish less than 35.0 cm was equal to 6.95%. The average length of fish in the catch was 40.8 cm and average weight – 0.516 kg. Males predominated over females in the sex ratio (53.7%). Among females dominated pollock with gonads at the II-III and III stages of maturity: 34.1 and 37.6%, respectively. Among males, 46.2% of fish had stage III of maturity of the gonads (Fig. 24).

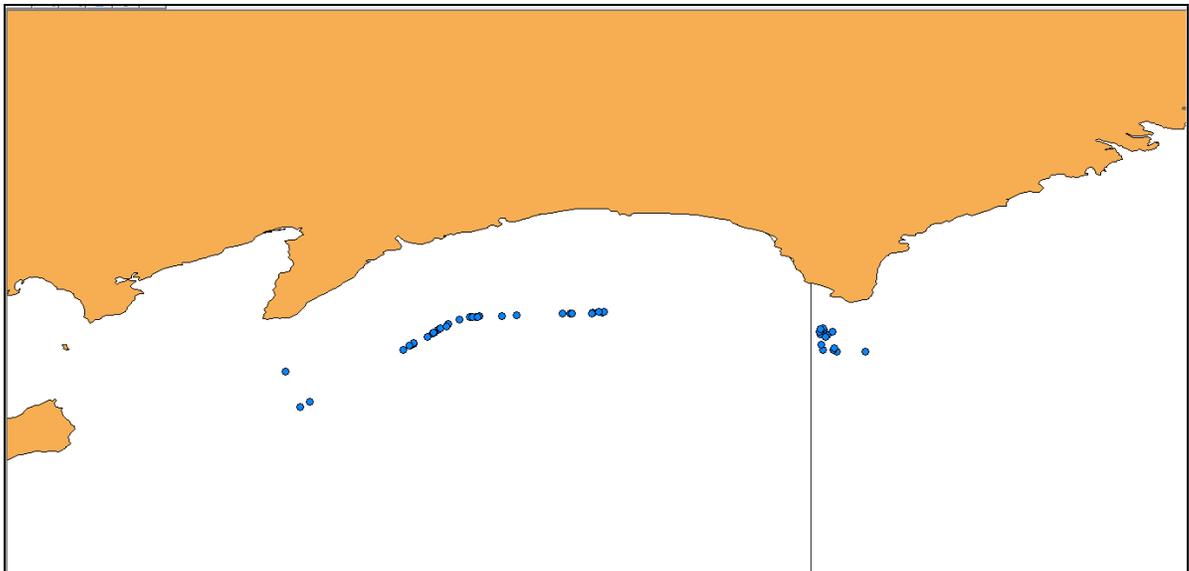


Fig. 22. The scheme of hauls made by BATM "Hawtin" in the West Bering Sea in October-December 2011

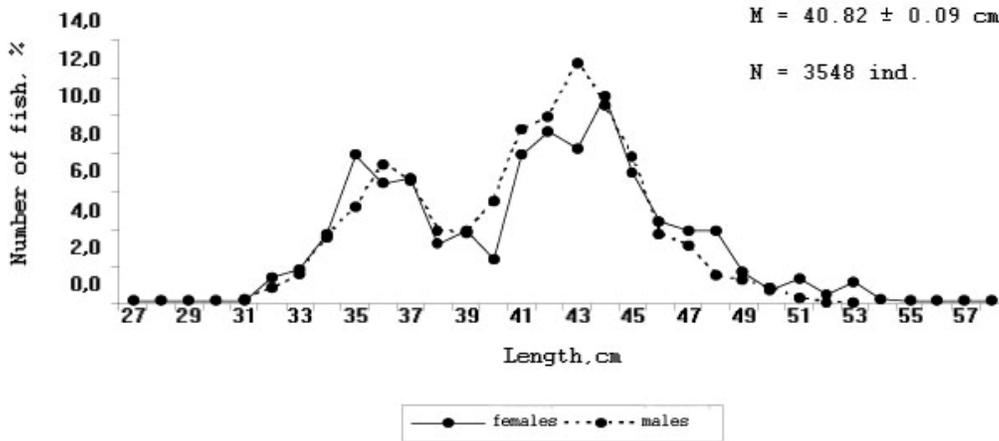


Fig. 23. The size composition of pollock, caught with mid-water trawl in the West Bering Sea zone in October 2011

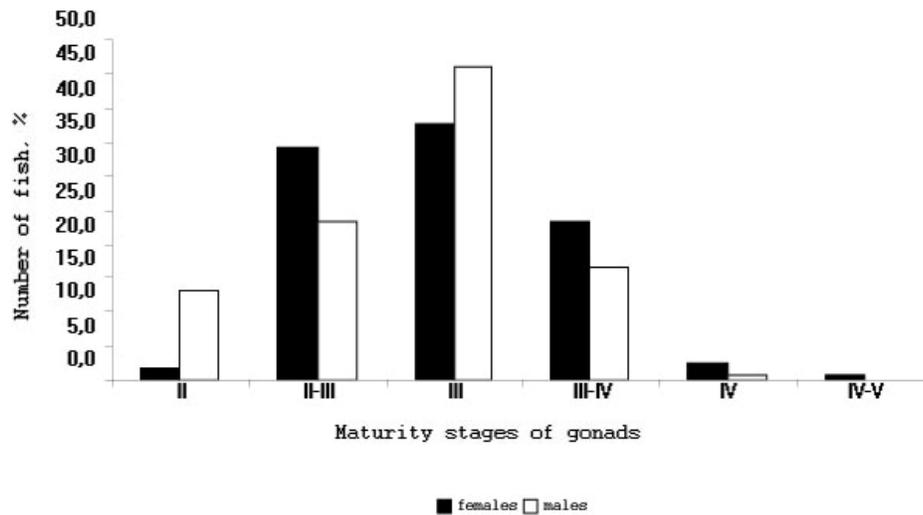


Fig. 24. Maturity stage male's and females' gonads of pollock, caught with mid-water trawl in the West Bering Sea zone in October 2011

In November, in the West Bering Sea zone pollock's catches reached 80 t/trawling (mean – 60 tons). The length of the fish ranged from 29.1 to 57.0 cm. Modal group consisted of individuals with length 41.1-47.0 cm, whose share was 69.0% (Fig. 25). The share of fish less than 37.0 cm was equal to 5.3%. The average length was slightly lower than in October, and was 38.3 cm Average weight of individuals was 459 g. In sex ratio males prevailed over females

(55.0%). Among females and males predominated pollock with gonads at maturity stage III, reaching 39.4% and 42.8%, respectively (Fig. 26).

In December, in the West Bering Sea zone the specialized pollock's fishery was extended in the area of cape Olyutor. Trawlings were conducted in a range of depths from 325 to 650 m, in horizons of 115-260 m. The maximum catch was 93.0 tons/trawling (mean – 44.7). The length of pollock ranged from 27.1 to 65.0 cm (Fig. 27). The basis of the catch consisted of individuals from two modal groups: 35.1-37.0 cm and 41.1-47.0 cm, whose share was 17.8 and 59.6%, respectively. The share of fish less than 37.0 cm did not exceed 6.0%. The average length of pollock in the catch was 41.6 cm and average weight – 0.568 kg. In the sex ratio females slightly predominated over males (52.4%). Among females dominated fish with gonads at maturity stage III - 34.2%. In males, the development of sexual products occurred more intensively, 44.5% of them were in stage III-IV maturity (Fig. 28).

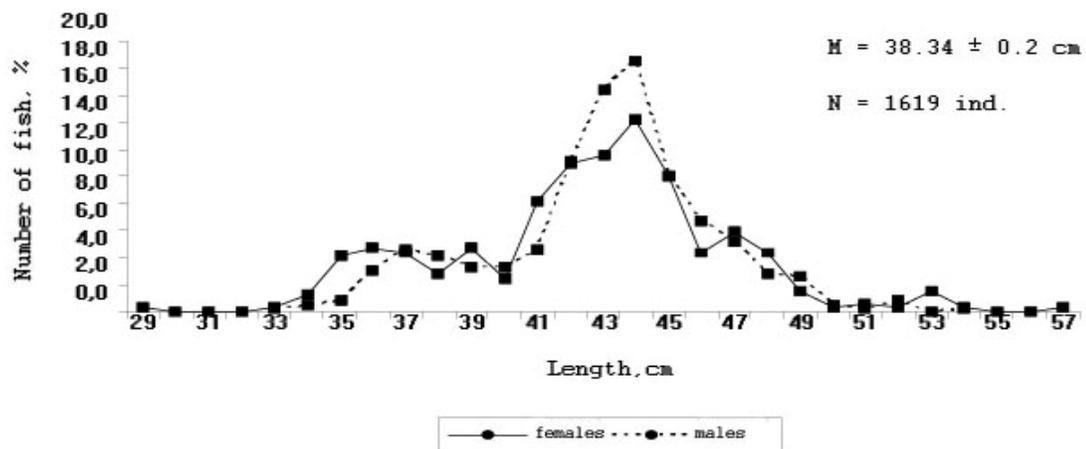


Fig. 25. The size composition of pollock, caught with mid-water trawl in the West Bering Sea zone in November 2011

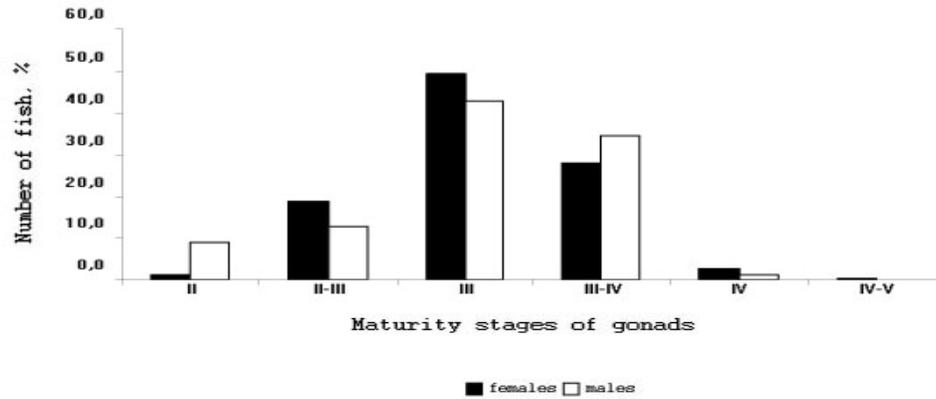


Fig. 26. Maturity stage male's and females' gonads of pollock, caught with mid-water trawl in the West Bering Sea zone in November, 2011

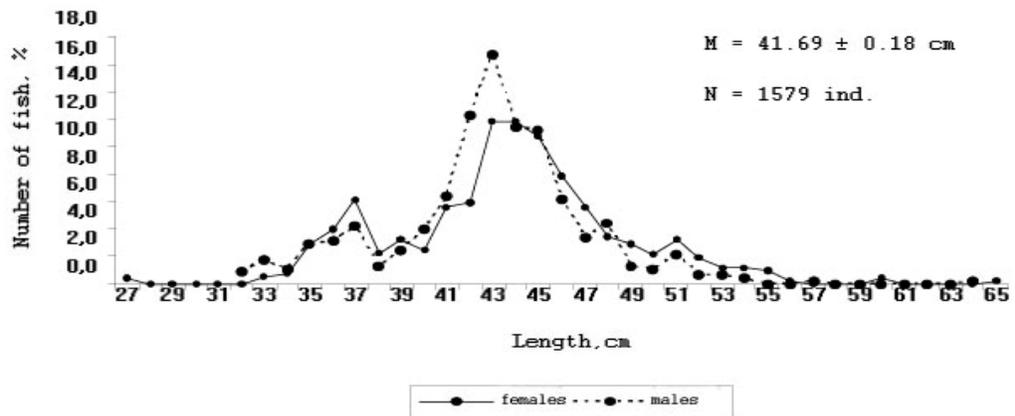


Fig. 27. The size composition of pollock, caught with mid-water trawl in the West Bering Sea zone in December, 2011.

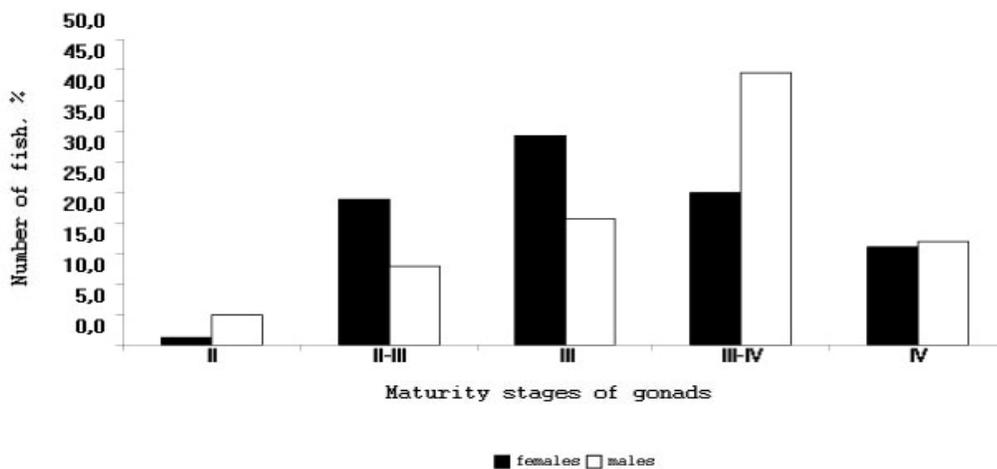


Fig. 28. Maturity stage male's and females' gonads of pollock, caught with mid-water trawl in the West Bering Sea zone in in December, 2011

By result of three trawlings made in the West Bering Sea zone in early December 2011 onboard the SRTM "Antaeus" with bottom trawl (Fig. 29), the length of pollock in by-catches ranged from 31.1 to 58.0 cm, reaching in average, 42.5 cm. Fish with length 43.1-44.0 cm, whose share was 28.8% predominated in catches (Fig. 30). The average weight of pollock was equal to 691.0 g.

Thus, the size composition of pollock in commercial catches in 2011 differed by type of fishery as well as by month. In general, at bottom squid's trawl fishery, pollock (by-catch) was larger than in mid-water trawl catches (exception - June) (Fig. 31). The tendency to reduce the average length of pollock in the catch from May to September, and then some increase of it was noticed during specialized fishery of this species.

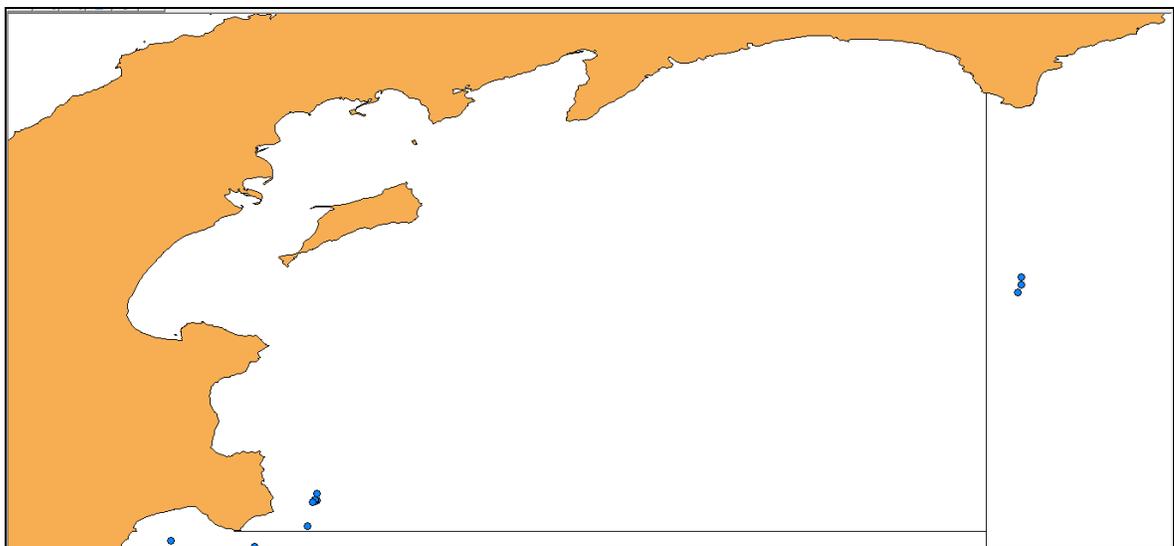


Fig. 29. The scheme of hauls made by SRTM "Antaeus" during commercial fishery in September-December, 2011

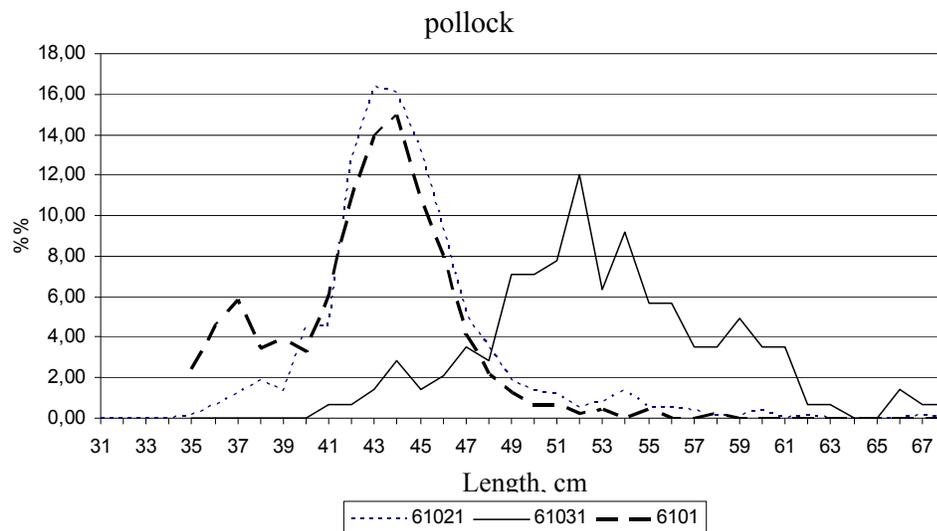


Fig. 30. The size composition of pollock, the results of studies onboard the SRTM "Antaeus" in 2011 (subzone 61.02.1: N = 592, M = 44.3; 61.03.1: N = 141, M = 52.6; 61.01: N = 461, M = 42.5)

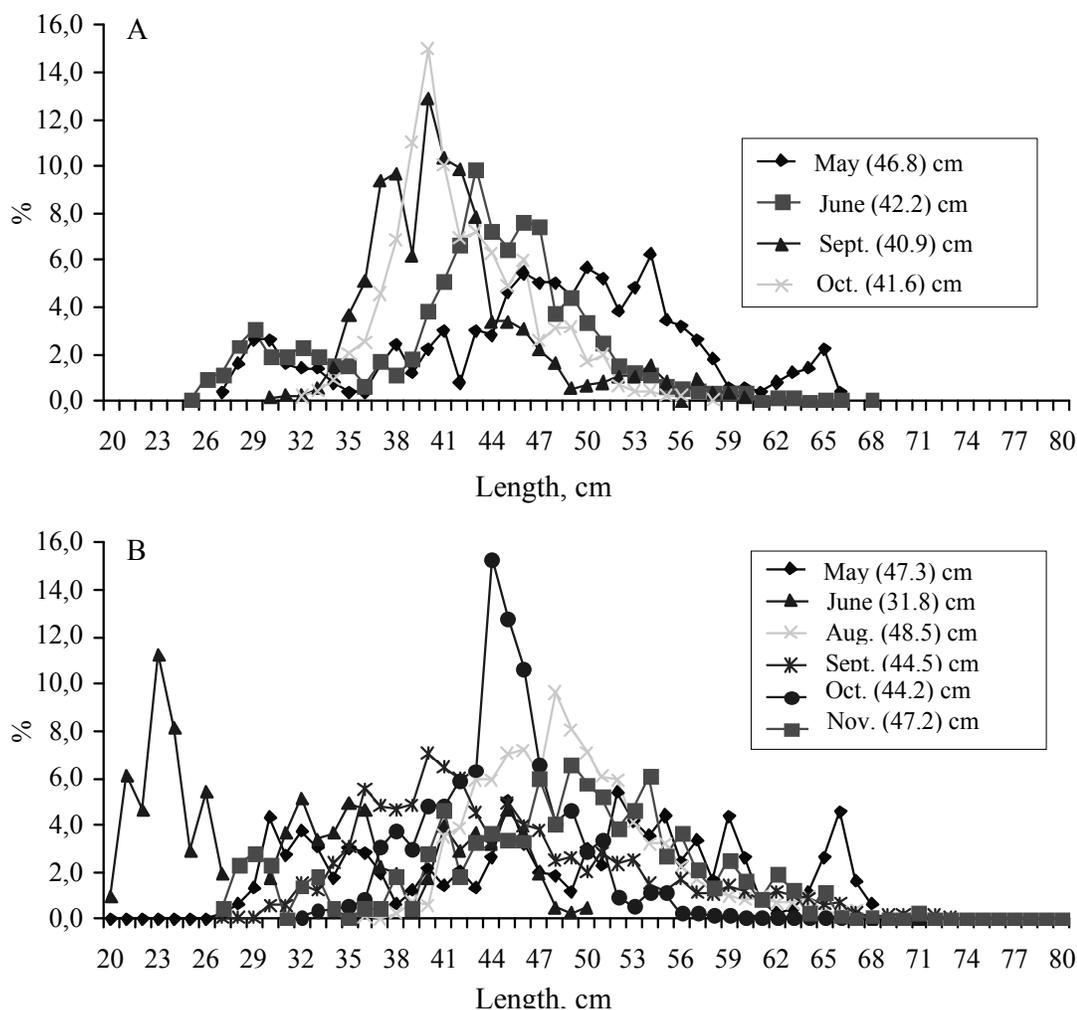


Fig. 31. The size composition of pollock in the Navarin area during specialized fishery of other hydrobionts with mid-water (A) and bottom (B) trawls in 2011

The final size range of pollock in commercial catches in 2011 was obtained by summing the dimensional structure on months deliberately to a catch, age — on dimensional age key made on the basis of age determination by otoliths (Fig. 32). Thus, in this year, the basis of commercial trawl catches made fish with 37-44 cm in length at the age of 5-7 years. Fish generation of 2006 dominated in catch. Generation of 2008 in this year's catch was relatively large only in the autumn.

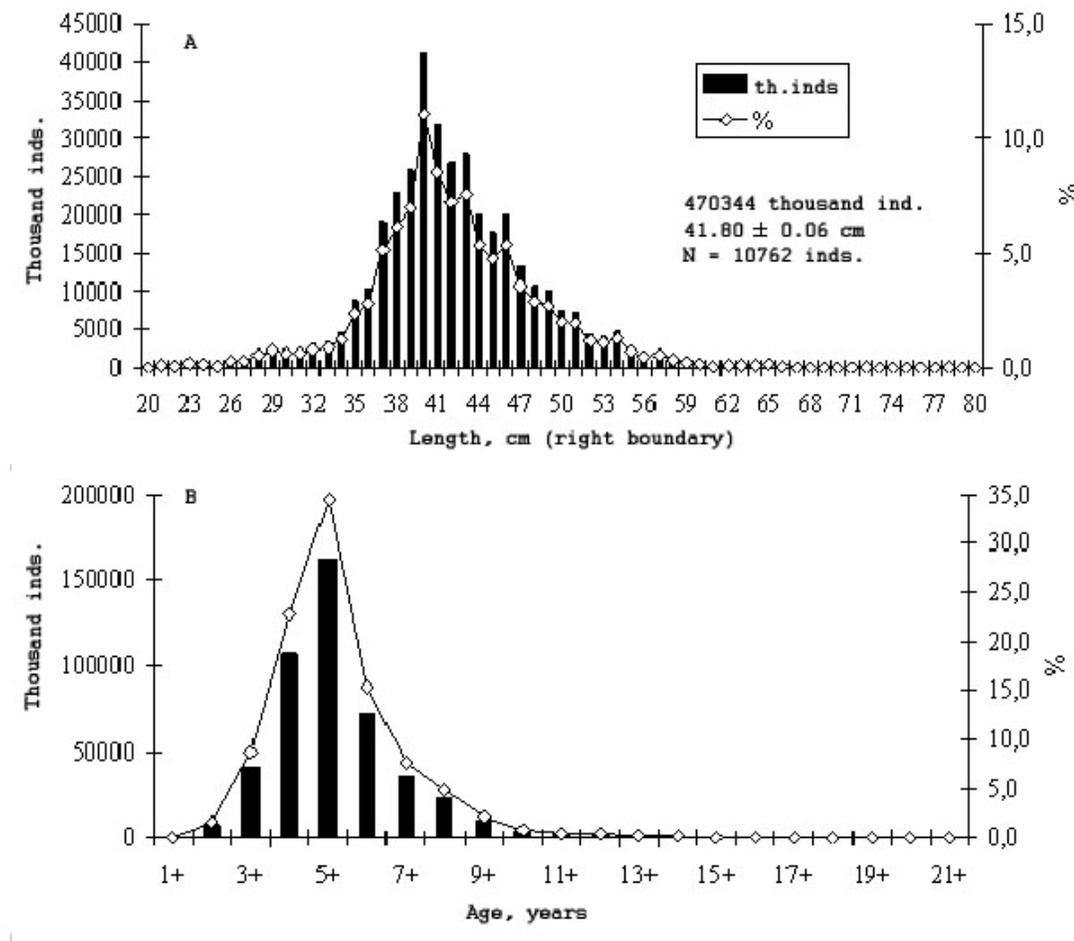


Fig. 32. The final size (A) and age (B) composition of pollock in commercial catches in the Navarin area in 2011

Karaginsky subzone (61.02.1)

The researches were performed in this area during specialized pollock's fishery onboard the BATM "A. Ksenofontov" in August (Fig. 33). Clusters of pollock were harvested over the 150-280 m isobaths at depths 136-275 m. The catches of pollock ranged from 0.02 to 13.0 t/hour of trawling (mean – 1.7). Fish's

length ranged from 25.1 to 66.0 cm, and individuals of size group 40.1-46.0 cm dominated in catch (73.7%) (Fig. 33). The average weight of fish varied from 0.561 to 0.725 kg with an average value equal to 0.618 kg. Males predominated over females (56.3%), and the relative number of immature individuals of both sexes was equal to 56.1% (Fig. 34). Among mature fish dominated individuals with gonads on stage II-III of maturity.

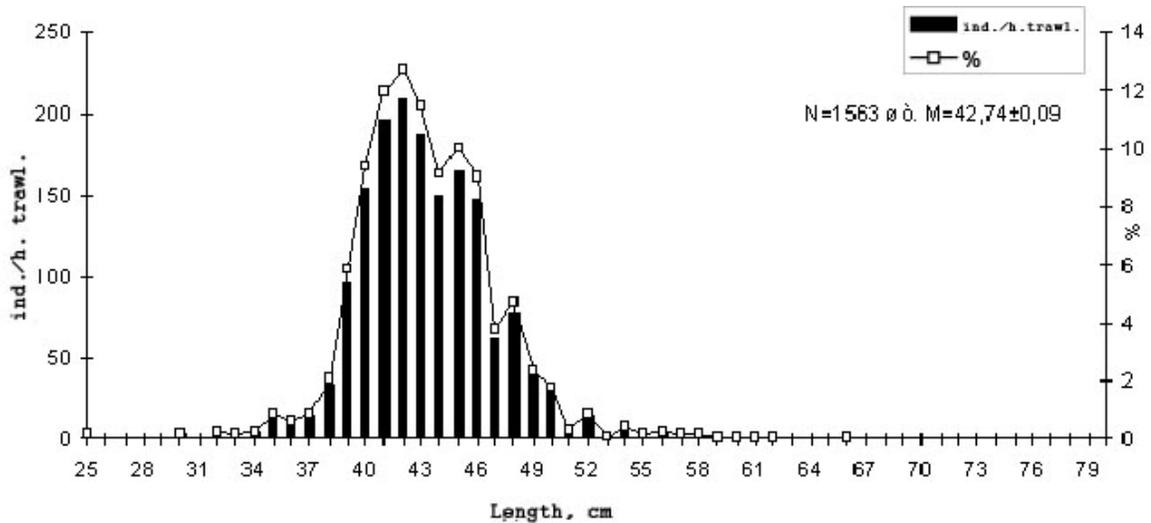


Fig. 33. The size composition of pollock in Karagin subzone (61.02.1) in August 2011

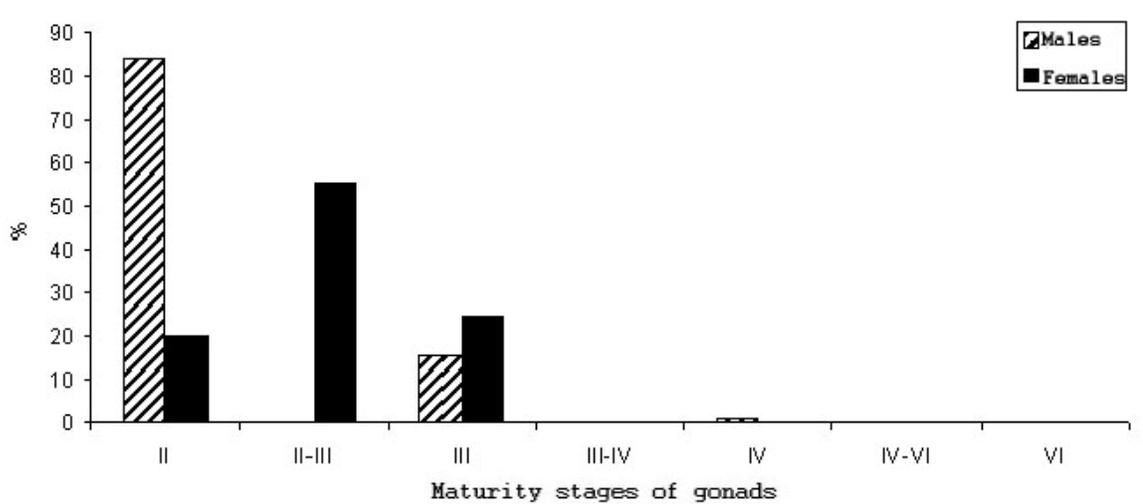


Fig. 34. The ratio of pollock's gonad maturity stages in Karagin subzone (61.02.1) in August 2011

According to data, collected onboard the SRTM "Antaeus," which carried out the trawl fishery in Karagin subzone in the September-December 2011, the length of pollock in the catch ranged from 35.1 to 67.0 cm, reaching an average of 44.3 cm. The average weight was equal to 0.635 kg.

According to data, collected onboard the BATM "Hawtin", pollock was met everywhere between cape Gauvin and cape Olyutor from October to December. In October, catches of species reached 34 tons/trawling or 13 t/hour of trawling (mean – 10). The length of pollock ranged from 32.1 to 55.0 cm, with an average length of 39.7 cm. Basis of the catches consisted of fish from size group of 40.1-45.0 cm (66.8%) (Fig. 35). The average individual weight was equal to 0.497 kg. In the sex ratio, males slightly predominated over females (55.3%). Among females predominated pollock with gonads at the II-III and III stages of maturity: 46.2 and 39.8%, respectively. Among males, 47.4% of fish had stage III of gonads' maturity (Fig. 36).

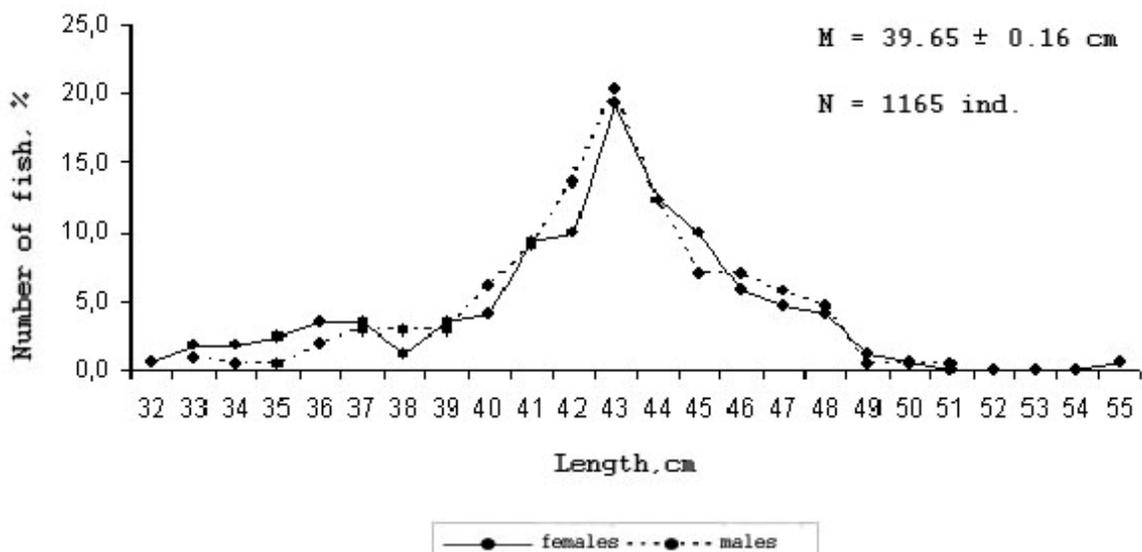


Fig. 35. The size composition of pollock from the catches, made with mid-water trawls in Karagin subzone in October 2011

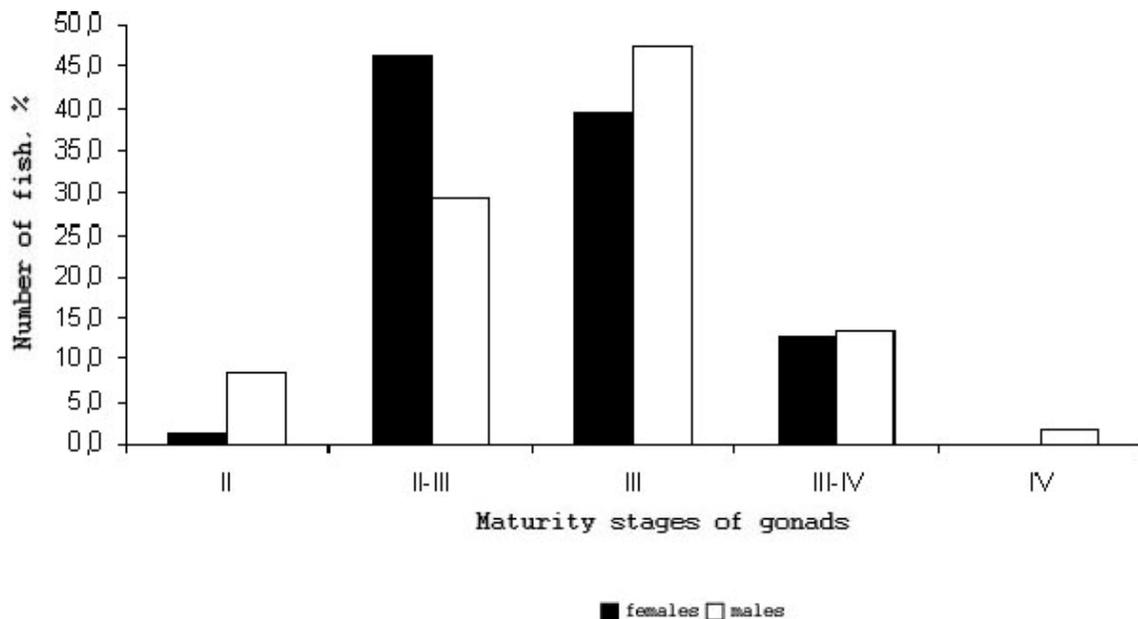


Fig. 36. Maturity of the gonads of males and females of pollock from the catches, made with mid-water trawls in Karagin subzone in October 2011

In November in Karagin subzone pollock's catches increased and reached 90 t/trawling. The size composition of pollock became much broader and reached 25.1-83.0 cm, with an average length equal to 40.5. Basis of the catches consisted of fish from size group of 35.1-47.0 cm (81.75%) (Fig. 37). The average individual weight was 521 g. In the sex ratio males slightly predominated over females (52.7%). Among females dominated pollock with gonads at the II-III and III stages of maturity: 27.4 and 42.2%, respectively. Among males, 42.2% of fish had stage III of gonads' maturity (Fig. 38).

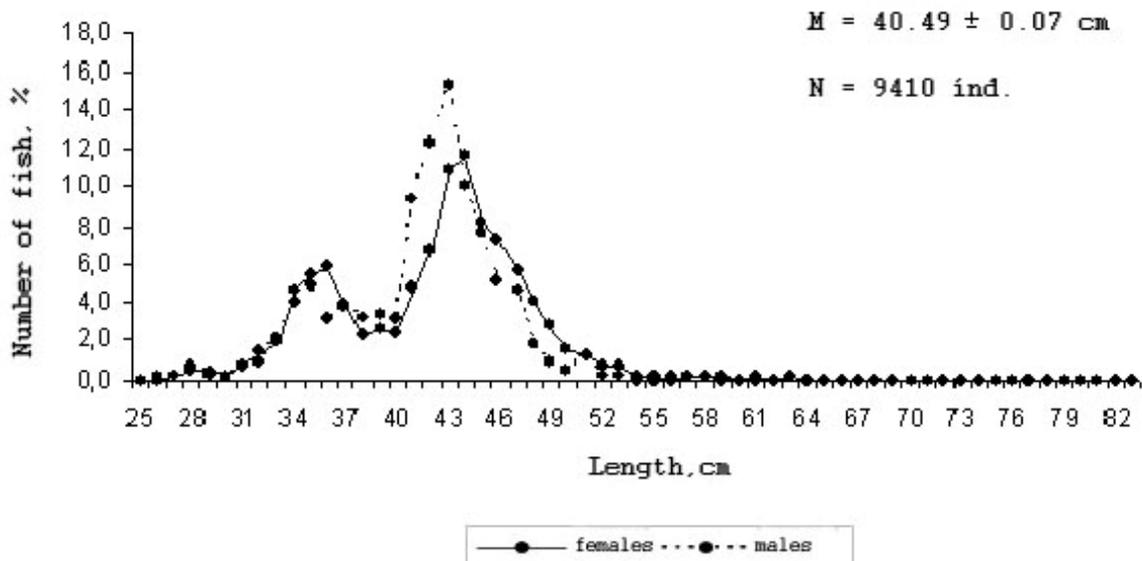


Fig. 37. The size composition of pollock from the catches, made with mid-water trawls in Karagin subzone in November 2011

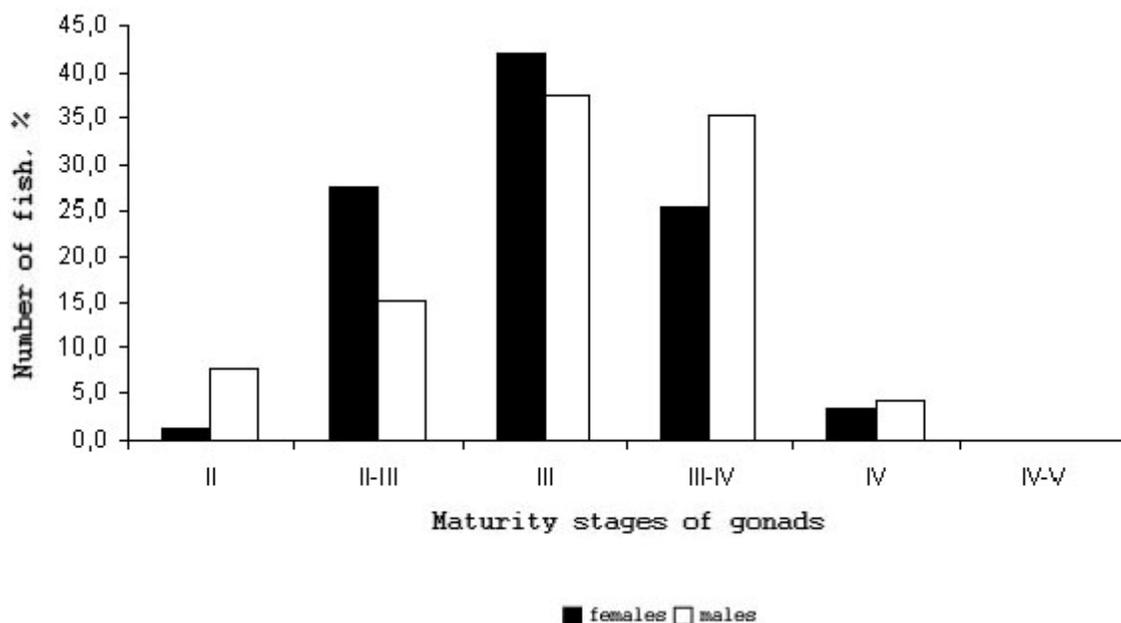


Fig. 38. Maturity of the gonads of males and females of pollock from the catches, made with mid-water trawls in Karagin subzone in November 2011

In December, catches of pollock were lower compared with the previous month in Karagin subzone. The maximum catch per hour of trawling was 50 t (mean – 32 t). The size composition of pollock already was 33.1-63.0 cm, with an average length equal to 44.1 cm. Basis of the catches consisted of fish from size

group of 40.1-46.0 cm (74.3%) (Fig. 39). The share of fish less than 37.0 cm was high and amounted to 28.7%. The average individual weight was equal to 606 g. In the sex ratio males dominated over females (60.6%). Among females predominated pollock with gonads at the III and III-IV stages of maturity: 34.0 and 32.5%, respectively. Among males, 43.1% of fish had stage III-IV of gonad's maturity (Fig. 40).

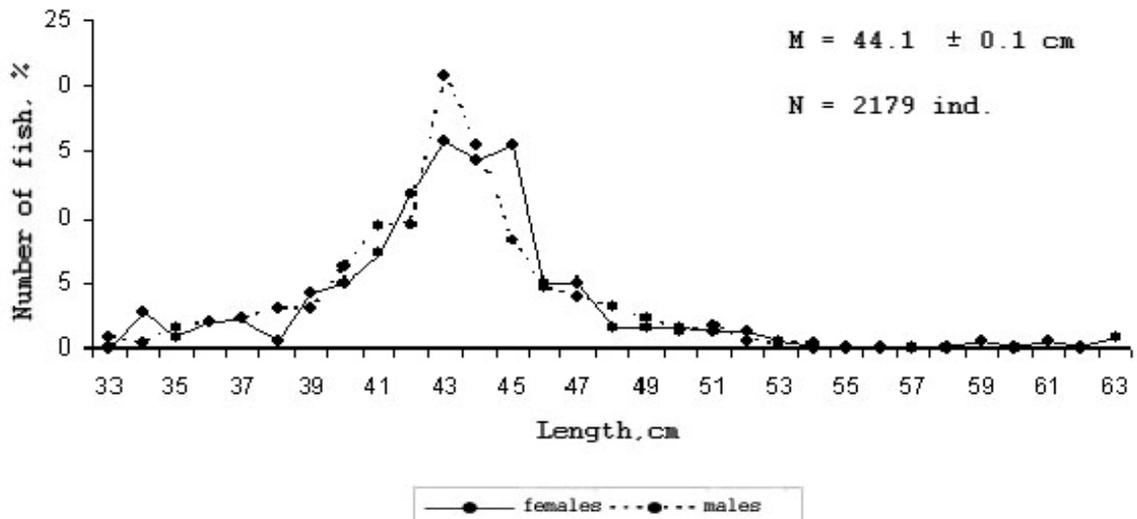


Fig. 39. The size composition of pollock from the catches, made with mid-water trawls in Karagin subzone in December 2011

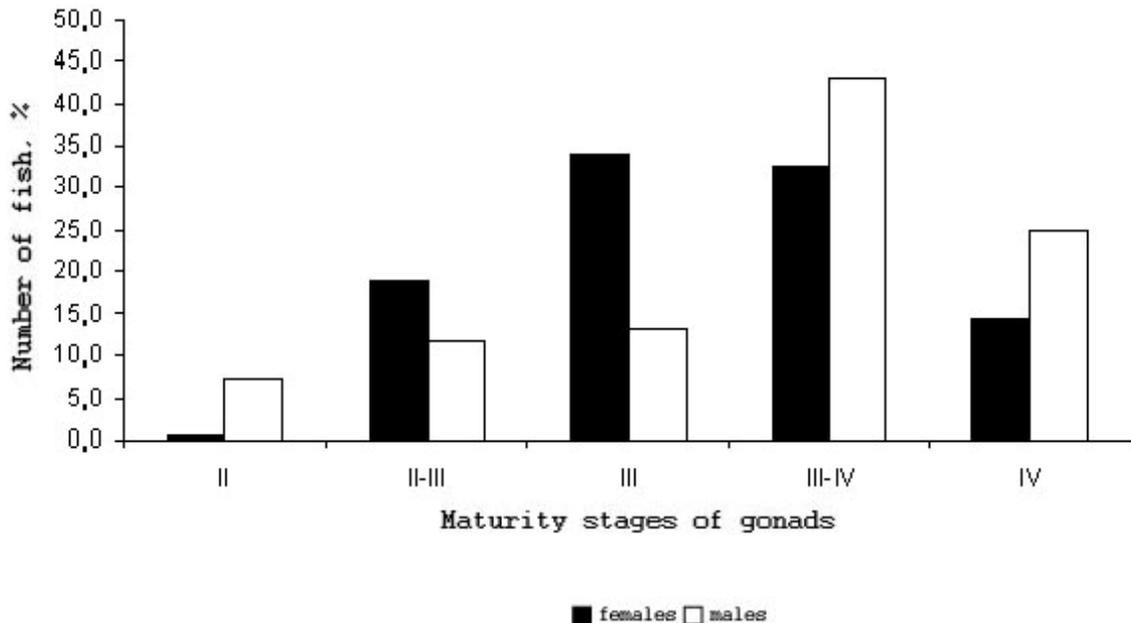


Fig. 40. Maturity of the gonads of males and females of pollock from the catches, made with mid-water trawls in Karagin subzone in December 2011

According to data collected during pollock's fishery for pollock in the Karagin subzone onboard the SRTM "Arctic Leader", catches of species in November reached 8.0 t/trawling, and, in terms of hours trawling, - 2.18 t (mean – 1.02 t). The size composition of pollock varied from 30.1 to 63.0 cm. Basis of the catches consisted of fish from three size groups: 34.0-39.0 (40.0%), 43.0-44.0 (10.2%) and 46.0-47.0 (11.2%) (Fig. 41). The average length of pollock was 40.6 cm, average weight – 0.644 kg. The number of females in the catch was less than that of males, of which 52.8% had gonads at maturity stage III. Among males, the majority of fish had, in approximately equal proportions, the gonads at II, II-III and III stages of maturity.

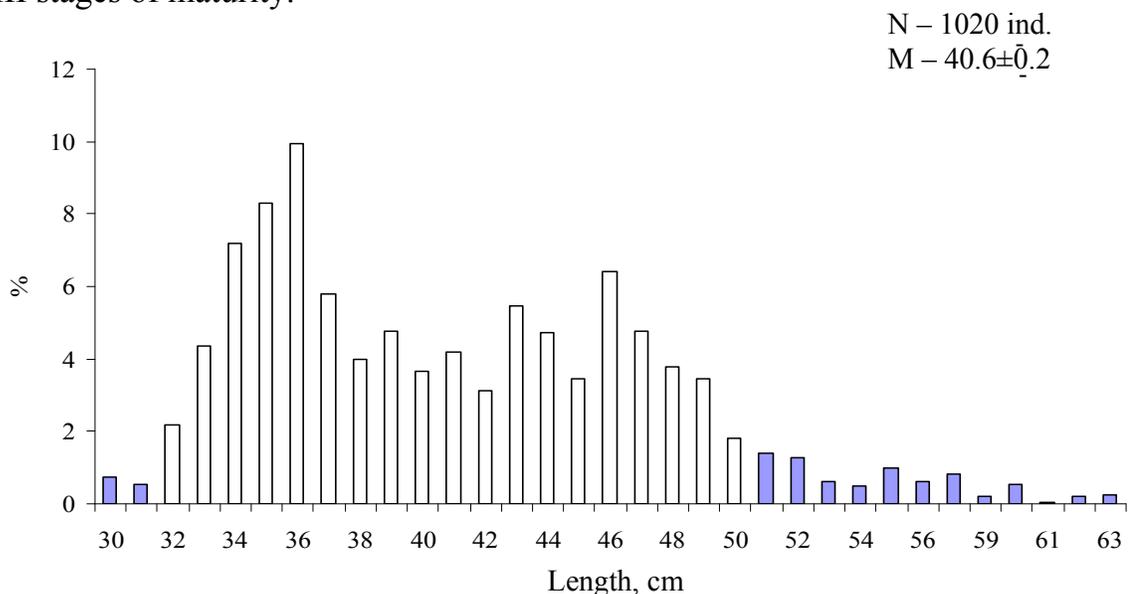


Fig. 41. The size composition of pollock from the catches, made with mid-water trawls in Karagin subzone in November 2011

Some information about the value of catches and the biological status of pollock in the Karagin subzone was collected onboard the SRTM "Vasily Golovnin" implemented specialized herring's fishery in October-December 2011 (Fig. 42).

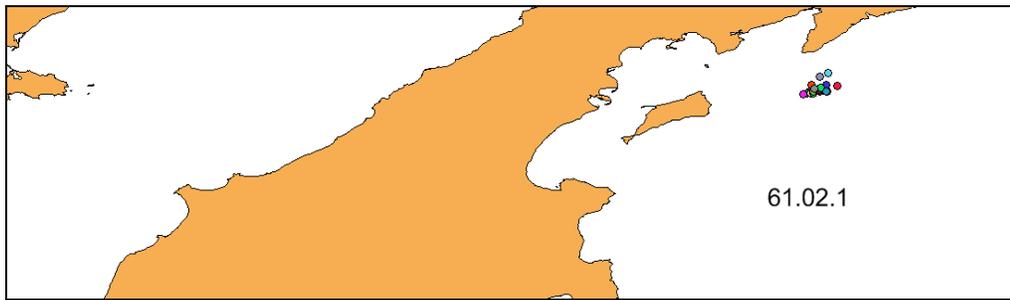


Fig. 42. The scheme of hauls made by SRTM "W. Golovnin "in October-December 2011

Pollock's catches per unit effort varied in the range 2.7-12.3 t/hours of trawling (average – 7.6 t/hour). The average weight of fish ranged from 0.350 to 0.613 kg (mean – 0.482 kg). The sex ratio was close to 1:1. The share of pollock in the catch did not exceed 10.3%. The resulting curve of the size composition had several peaks, but, in general individuals with length from 42.0 to 46.0 cm (52.6%) dominated in catch. Most of the males had gonads at II (64.3%) and III (35.7%) stages of maturity. Among females, the majority of fish also had the ovaries in II (62.0%) and III (22.9%) stages of maturity (Fig. 43).

During the period of work of the BATM "Seroglazka" in November 2011 in the Olyutor bay, the pollock distributed in small clusters: during the daytime fish was in the bottom layers, in the evening it performed vertical migration and dispersed in the water column. The scheme of hauls, targeting pollock catch is shown in Figure 44.

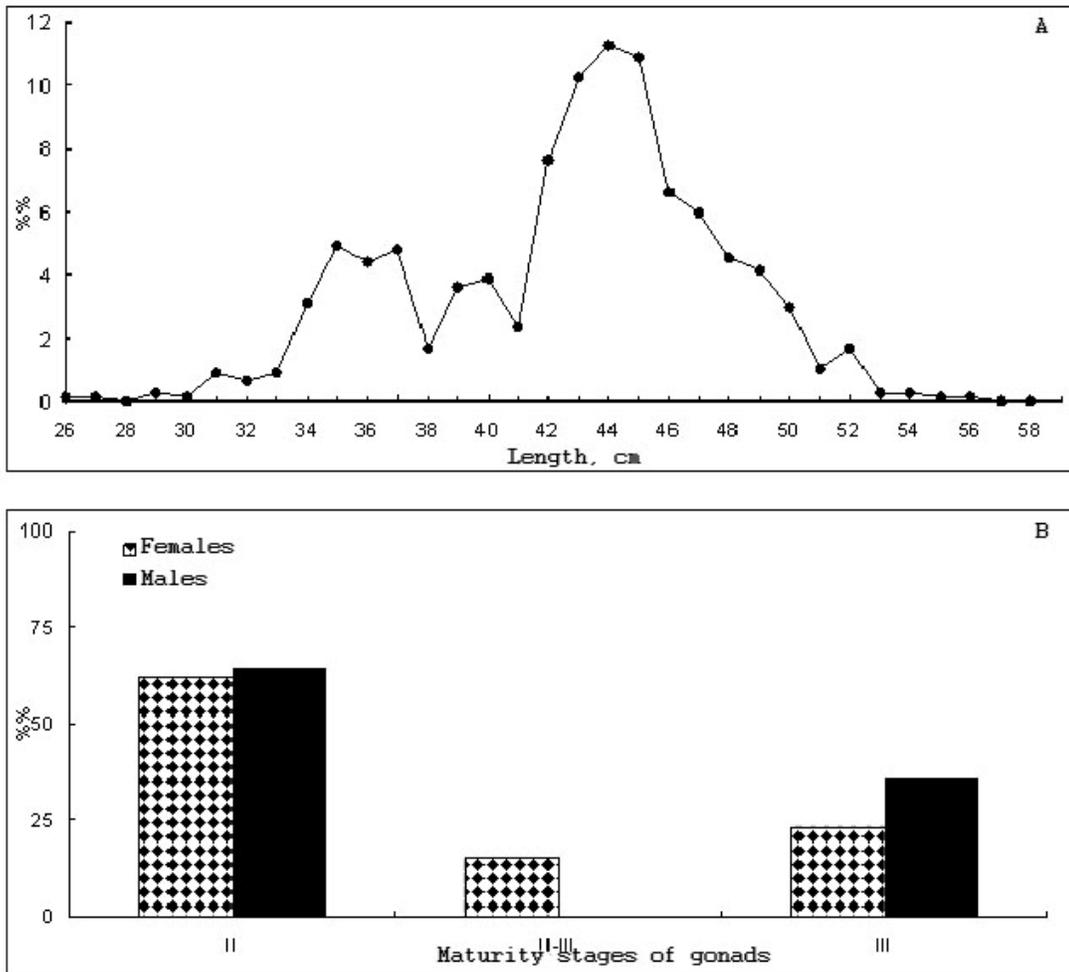


Fig. 43. The size composition (A), the ratio of gonad maturity stages (B) of pollock in Karagin subzone in November 2011



Fig. 44. The scheme of hauls made by BATM "Seroglazka" in November 2011

The share of pollock in the catch was, on average, 91.0% of the total weight of caught fish. Catches ranged from 3.3 to 12.5 t/hour trawling (average – 7.5 t/hour of trawling). The length of the fish ranged from 15.1 to 56.0 cm. Two dimensional size groups were thus allocated: 30.1-37.5 and 39.1-47.1 cm; their share, on average, accounted for 47.8 and 43.4%, respectively. The average sizes of fishes by sex slightly differed: the females' rate was 38.5 cm, and males – 38.6 cm (Fig. 45). The average weight of pollock in catch ranged from 0.412 to 0.514 kg, the average weight of all the analyzed specimens was 0.442 kg. Males predominated over females (53%). On average, 58.6% of all specimens were immature. Individuals with gonads at stages III-IV maturity dominated in catch (Fig. 46).

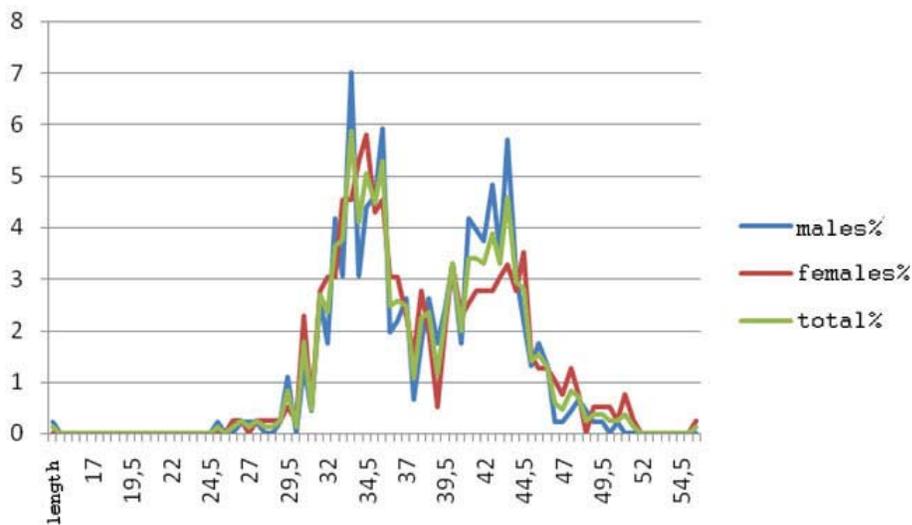


Fig. 45. The size composition of pollock (females: Lav. = 38.5 cm, n = 396 individuals; males: Lav = 38.6 cm; n = 456 individuals; total Lav. = 38.6 cm; n = 852 individuals) according to research by BATM "Seroglazka in November 2011 "

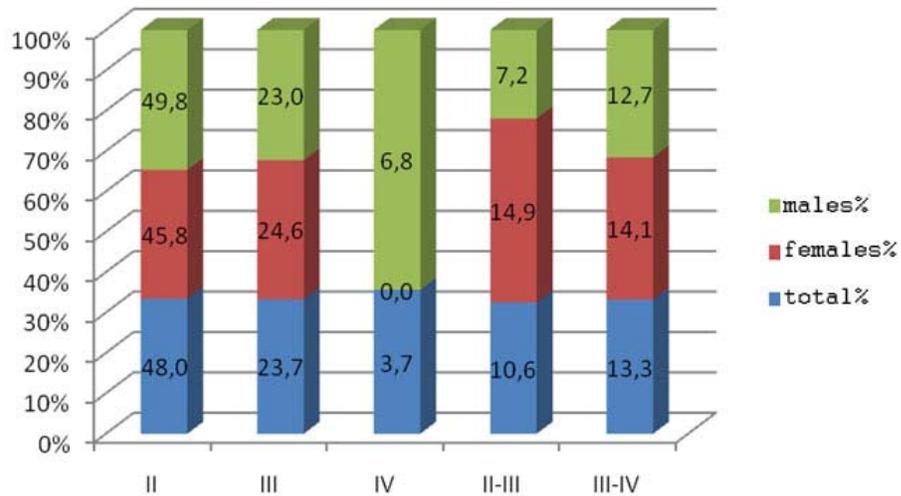


Fig. 46. Pollock maturity stages, according to research by BATM "Seroglazka" in November 2011

Observations on the biological status of pollock in snurrevod catches in the Karagin subzone were performed on the fish processing plant of the LLC "North-Eastern Company." Pollock length varied from 22 to 76 cm with an average value equal to 46.1 cm (Fig. 47).

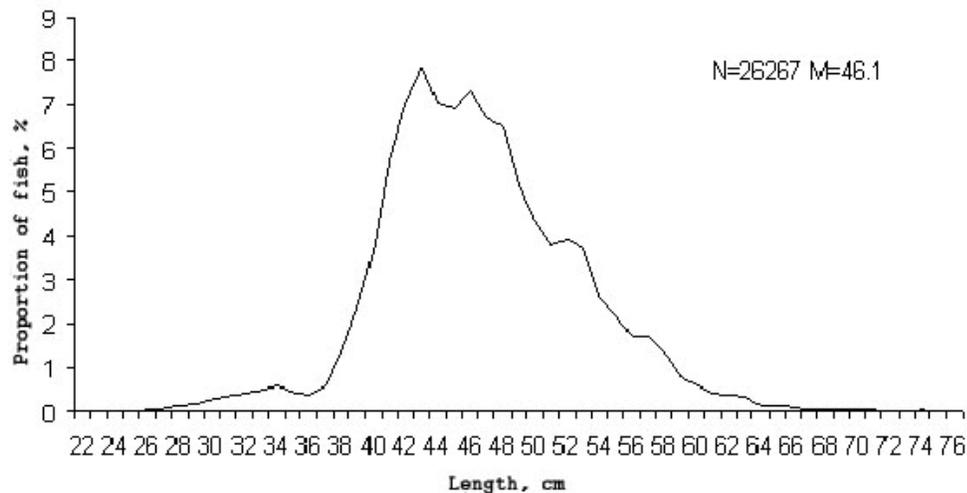


Fig. 47. The size composition of the pollock in snurrevod catch in Karagin subzone (August-September, 2011)

Thus, in 2011 the fish generation of 2006 dominated in the trawl catches; their share was 31 and 27% in Karagin subzone and in the western part of the West Bering Sea zone respectively (Fig. 48). The share of fish generation of 2007 also

had a fairly high proportion – 23 and 25% respectively. Typically, fishing is based there on the cohorts who are active migrants and go out of Karagin subzone on feeding in the Olyutor-Navarin area.

No significant changes occurred in snurrevod catches up to 2009 (Fig. 49). In recent years, their base was made of big pollock longer than 50 cm at age 7 and older. However, it should be noted that in 2009 small amounts catch of pollock appeared less than 40 cm appeared in snyurrevod catches, and by-catch fish up to 5 years of age increased. In 2010 the average length of pollock in the catch decreased even more, and was 47.1 cm, while the proportion of fish up to 40 cm reached 14.4%. The proportion of 4-5 years old fish increased significantly in catches, which accounted for one third of the catch. In 2011 the proportion of fish in these age cohorts decreased to 28%, and 76.8% of individuals in snyurrevod catch was represented by 5-8 years old fish.

The BATM "Irtyshsk" began monitoring the pollock's dimensional and biological structure in catches of pollock in the commercial trawl fishery in the Bering Sea at June 10, 2012. At present, research area covered the eastern part of the Olyutor bay and Navarin area between 172°20' and 176°11' E, trawling were carried out with mid-water trawl. In Olyutor bay catches ranged from 7.3 to 38.1 tons per trawling; along the Koryak coast catches were more – from 12.6 to 90.0 tons per haul. The length of pollock in the catch to the west of Olyutor cape ranged from 36 to 56 cm; individuals of the two size groups – 40 cm and 44-45 cm – dominated in catch (Fig. 50). The average length of pollock amounted 43.3 cm, average weight – 0.526 kg. Dimensions of pollock in the Navarin area ranged from 25 to 58 cm long; fish with length 38 and 45 cm dominated in catch. The average length was 38.8 cm, average weight - 0.450 kg. The share of non-target fish length was equal to 29.4%.

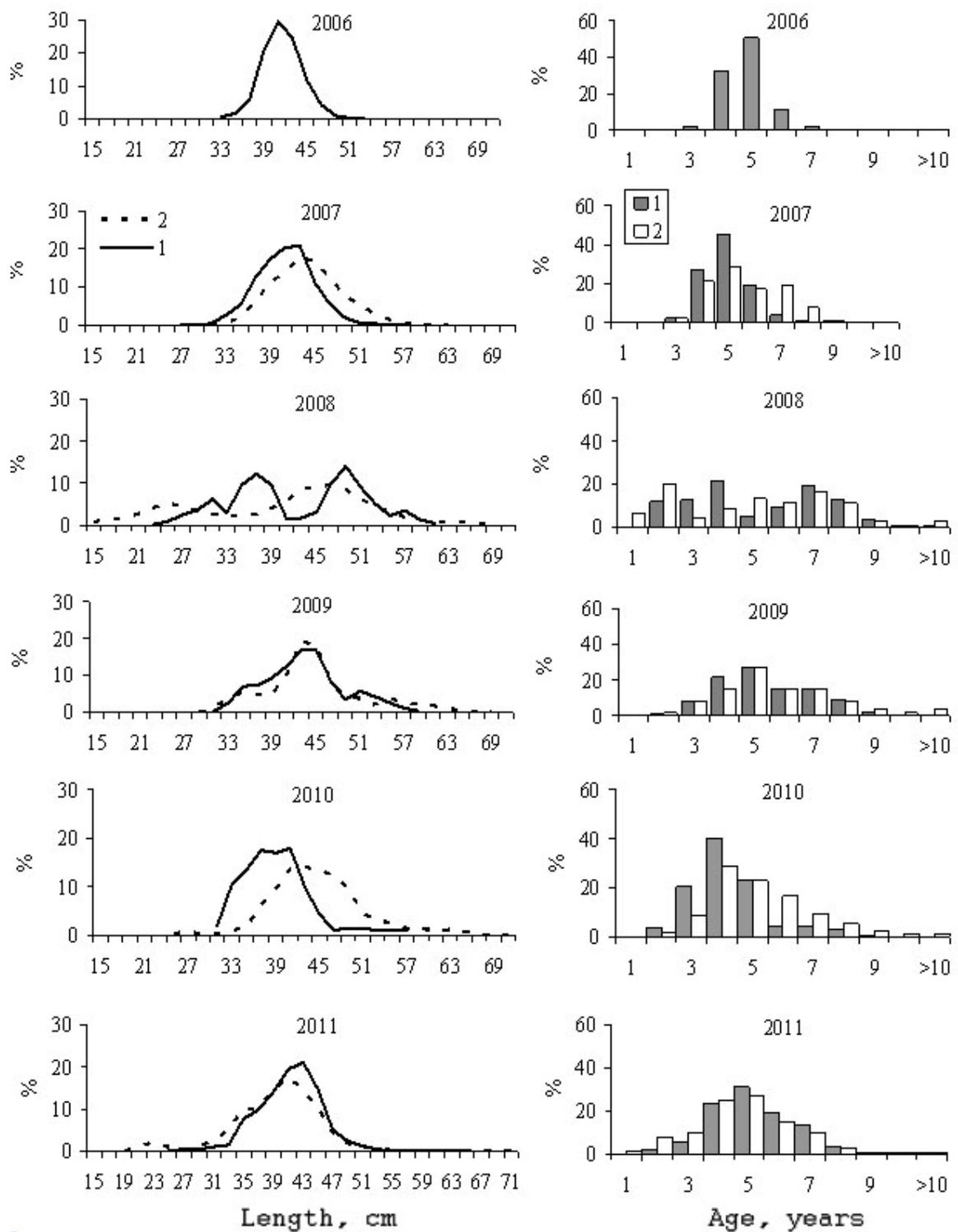


Fig. 48. Size-age composition of the West Bering Sea pollock in trawl catches in Karagin subzone (1) and in the West Bering Sea zone to the west of 174° E (2)

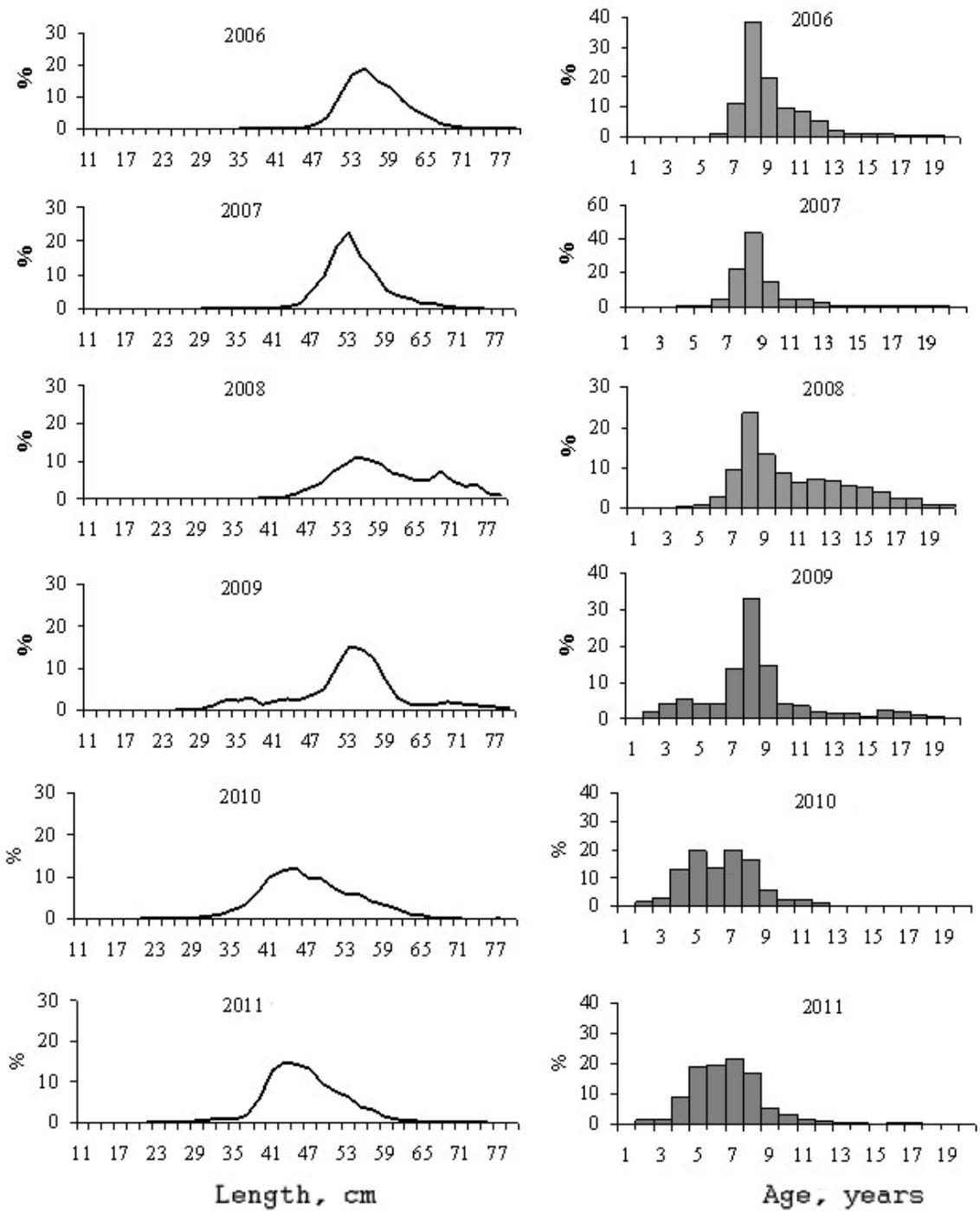


Fig. 49. Size-age composition of pollock in the West Bering Sea pollock durring surrevid fishery in Karagin subzone.

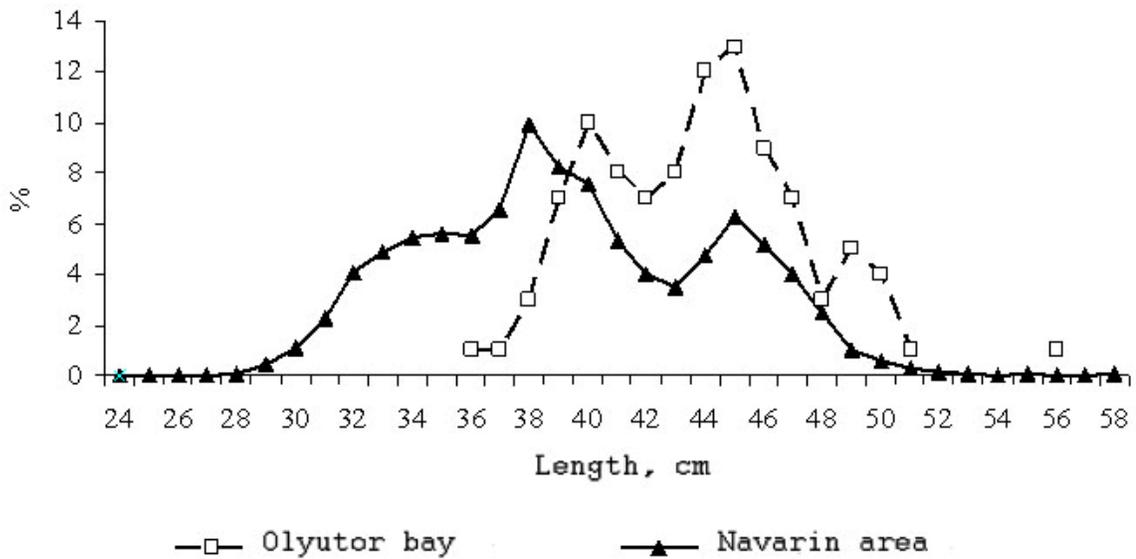


Fig. 50. The size composition pollock's commercial catches in the West Bering Sea in June 2012

The state of gonads' maturity of pollock was normal for this time of year. The spawning season was almost over, only a few individuals were in spawning state. The share of immature fish to the east of Olyutor bay was high – up to 46.3% among the males and 38.7% among females – because of a great number of small-size pollock in catches. In the initial stages of maturity was 39.8% of males and 43.1% of females (Fig. 51).

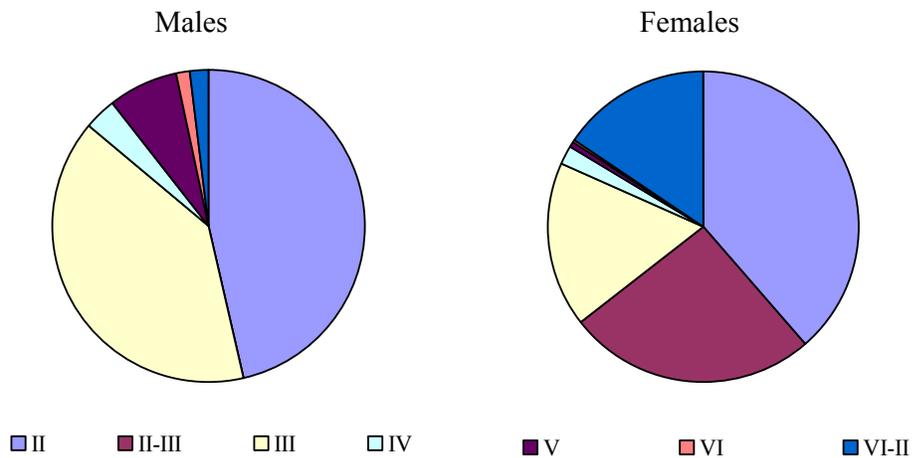


Fig. 51. Maturity of the pollock's gonads in the fishery catches in the Navarin area in June 2012