FOURTEENTH ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

Papers submitted

by

the Russian Federation

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Opening statment by the Russian Federation

Mr. Chairman, Ladies and gentlemen,

This is a big honor for the Russian Delegation to take part in the work of the Fourteenth Annual Conference of the Parties to the Convention on conservation and management of pollock resources in the Central Bering Sea. On behalf of the Russian Delegation I would like to thank the Government of the United States of America for organization of this meeting.

As a species in total and as separate stocks, pollock keeps making surprises to us, not always pleasant or understandable. At the 12-th meeting Steve Barbeaux noted an unprecedented decline in pollock biomass within the Central Alleutian Chain. Stocks continue to go down in the eastern Bering Sea; the Bogoslof stock remains to be scarce; the Navarin stock of pollock keeps diminishing for 2006-2007. In 2008 was marked only the small growth of biomass of the Navarin pollock. All this happens despite the precautionary approach to setting TAC and account of the volume of these populations in the ecosystems of the Bering Sea when developing conservation measures. I do not think I shall be mistaken if I dare say that 15 years ago, when the Convention was being signed none of the participants expected to encounter such a complicated mechanism ensuring homeostasis of the species and the populations thereof.

So long depression of Bogoslof population of pollock demands of us to assume new economically sound approaches for the realization of the Convention. I believe that at this Conference we can coordinate the new format of our meetings, which will allow us to cut down expenses appreciably for carrying out annual conferences without lossing of quantity of our discussion about stock biomass of pollock in the Bering Sea.

I also call all participants of the Conference to consolidate our efforts to explore the Bering Sea pollock which will certainly be reflected in accuracy and long-term nature of our forecasts regarding deep water aggregation recovery.

Now I introduce members of Russian delegation.

Review results of Russian research cruises

2.1. Cruise aboard RTMK-S "Vasilyi Kalenov" to the Northwestern Bering Sea in June-December 2008

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This survey was a continuation of researches of the pollock in the Northwestern Bering Sea.

Major tasks of the cruise were:

1) Collection and analysis of biological and biostatistical data.
2) Mapping of the most productive catch fishing areas.
3) Study of population-genetic structure of pollock stocks.
4) Monitoring of size-weight structure and biological state of pollock.
5) Collection of pollock distribution data. Stock assessment.

The solution of the above problems was aimed at: obtaining integrated data needed to identify the sources of formation of pollock concentrations in the northwest and central Bering Sea; appreciating pollock biomass, size of recruitment and biological state.

RTMK-S "Vasilyi Kalenov" was built in 1993 by the project 1288 (type of "Moonzund"). The length of the ship is 108.12 m, maximum width – 19 m, height of board – 12.22 m. The main engine power of the vessel is 5296 kbt, strength of the crew is 85 people.

Trawling operations during survey in June were conducted with a bottom trawl (Fiska) which was built in the USA (the length of upper head line is 55 m) with horizontal net opening 20 m, vertical one – 6-8 m. In August the survey was

conducted with a native bottom trawl (project 201, the length of upper head line is 197.5 m) with horizontal net opening 45 m, vertical one – 6-8 m.

Fishing and fish finding trawlings were conducted with a mid-water trawl (type 252/416) with horizontal net opening 70 m, vertical one – 50 m; during trawling near bottom vertical opening usually was 30-35 m. Mesh size in the codend was 110 mm. During surveys was used a small mesh inset in the codend (mesh size was 10 mm and the mouth of inset was 2.54 m). The length of small mesh inset was 10 m. Disposition of the vessel was determined by the satellite system "Furuno" – GPS plotter GP-3100 mark-2 was used. Navigation of the vessel was realized with the help of videoplotter "TRANSAS" Navis-3000. Complex of fish finding and registering equipment was represented by firms "Furuno" (echo sounder "FCV-1000", 28.5 kHz), "Simrad" SP-70 and Wesmar (trawl control "TCS 770", 50 kHz).

The duration of the trawling during cruise varies from 0.50 to 12 hours. During the surveys every catch was fully sorted out by species and weighted. During fishing operations catches (which were typical for given section and time) were analyzed selectively; when catches were big, by-catch was determined by check sample. A trawling card with the information about characteristics of trawling, species composition and the weight of species in catch was filled in for every catch. Samples for measures, individual weighing and bioanalysis of pollock and dominant species were taken away from every catch. Otolites were taken away for age determination. 51046 measures 3990 bioanalysis (3940 full), 3940 morphological analysis were made during the cruise. Also were collected 1643 samples for age determination and 403 samples for genetic studies.

The bioanalysis includes:

- measure by Smith to 1 mm;
- weighing to 1 g;
- weighing without entrails to g;
- determination of sex and maturity stage, 6 units scale (Sakun, Butckaja);
- determination of stomach filling, 5 units scale (0-4);

- determination of food composition and share of each object in food clod.

Gonad and liver were weighed for morphological analysis. Then index of each organ was calculated (ration of organ's weight to body's weight without entrails in per cent).

Data, received from trawling cards, biological and morphological analysis were entered into Excel. Distribution and biomass of hydrobionts were calculated with a *MapDesigner* software developed in VNIRO (Polyakov, 1996) and based on the method of spline–approximation (Ivanov, Stolyarenko, 1988). The following variables and coefficients were used in the calculations:

horizontal opening during the surveys in June – 20 m, in August – 45 m;

coefficient of fishing efficiency 1.0;

spline smoothing 0;

depth coefficient 1000.

The study of hydrobionts includes the following works:

- bottom trawl survey (47 trawling in June and 44 in August) which took place in day time, the duration of trawling was 30-50 min;
- scientific fishing operations.

During the work 482 trawling were made at the depth 50-630 m. Catches for 1 trawling vary from 0 to 80 t.

General characteristic of pollock

Pollock was the most frequent species in the catches. During surveys in June pollock was absent only in 3 catches, in August – in 2. The maximum catch of pollock per hour trawling was 21400 kg and 62746 ind. in June and 7520 kg and 11522 ind. in August. Average weighted catch of pollock per hour trawling in June was 56773.7 ind. and 1236.3 kg, in August – 1807.7 ind. and 1190 kg.

The main concentration of the Navarin pollock in the Western Bering Sea was formed in the area of quasi-stationary eddy to the south off Navarin cape. Which is related to the favourable hydrologic conditions for developing and concentration in

there fishing grounds of the main food items of pollock (euphausiids, hyperiids, shrimps, copepods). In 2008 pollock held at the depth till 250 m, which is usual for this time and area.

During surveys (Karagin subzone, ***June***) pollock in catches was presented with the fish body length of 9-76. Group of 9-18 cm was the greatest (modal group 14 cm) (Fig. 1).

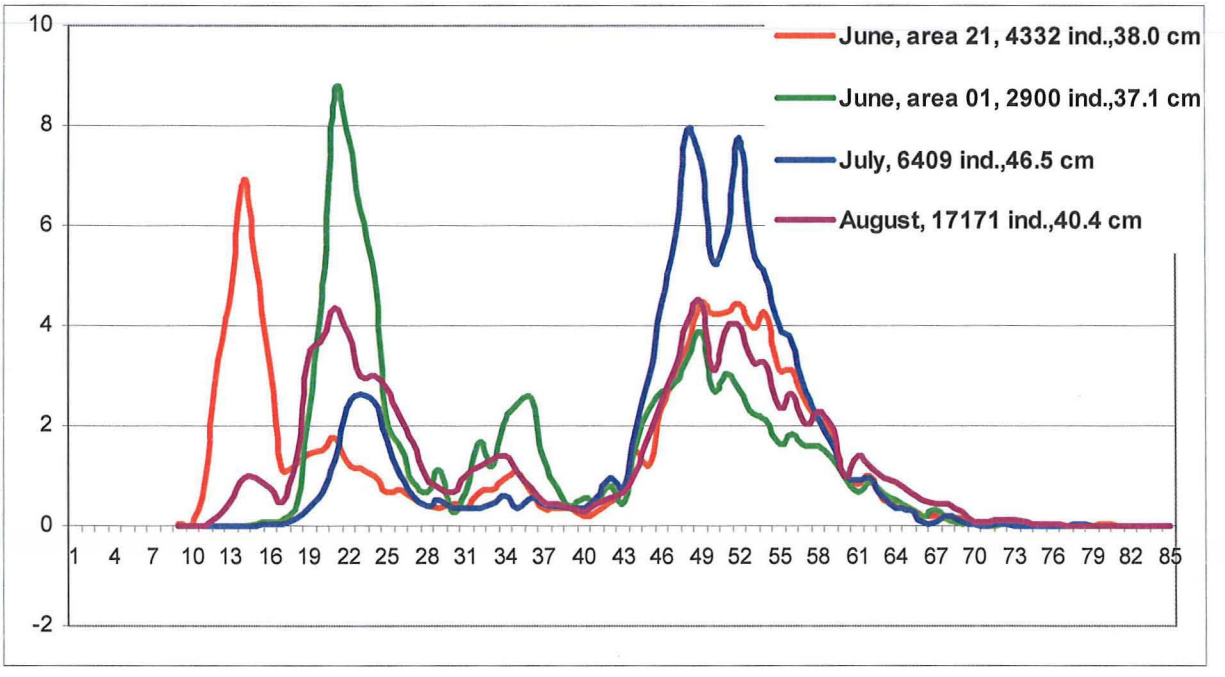

Fig. 1. Length composition of pollock caught by RTMK-S "Vasilyi Kalenov" during bottom surveys and fishing operations in June-August 2008

This group was practically absent in the Western Bering Sea in June and in August it was weakly presented. Group of 19-27 cm dominated in that area.

In ***July*** pollock in catches was presented with the fish body length of 14-78 cm. Females were a little bit larger than males. During this period the gonads of the majority mature pollock were resting (54% of females and 58% of males were at stage VI-II); in other fish the maturing of gonads has begun already (35% of females and 19% were at the stage II-III, 8% of females and 16% of males were at the stage III). Proportion of females and males was equal to 6 / 4 (Tab. 1).

Table 1. Biological characteristics of pollock in July 2008

Measures		
average length, cm/number	46.7/6409	
minimum–maximum	14 - 78	
mode	23, 48, 52	
Bioanalysis		
min.–max. length, cm	14 - 78	
min.–max. weight, g	15.8 - 2535	
share of immature fish, %	27.24	
Indexes	Females	Males
number, ind.	598	391
average length, cm	46.7	41.4
average weight, g	837.7	624.0
prevailed maturity stage of gonads, of mature fish %	II-III – 35.3;III – 7.9; VI - II – 54.0	II-III – 18.7;III – 16.3; VI - II – 58.3
stomach filling, units	2.51	2.64
Morphological indexes of immature fish		
cubic condition index	0.596	0.596
GSI, %	0.65	0.25
HSI, %	8.02	8.33
Morphological indexes of mature fish		
cubic condition index	0.566	0.590
GSI, %	2.51	1.48
HSI, %	6.89	5.79
prevailed food objects, %	calanus – 32.3;euphasiid – 25.8;hyperiid – 36.9; shrimp – 5.3; pollock – 1.4	

The concentrations fished for were feeding; the pollock fed actively (SFU-2.07-2.32). In pollock food predominated euphasiids, hyperiids, shrimps; copepods dominated in the food of young fish. Cannibalism didn't have vital importance in the nutrition of pollock (frequency of occurrence – 1.4%). The high value of hepatosomatic index of immature fish (8.0-8.3%) allowed us to speak about favorable conditions for feeding of pollock in the Western Bering Sea in summer 2008. The mature fish had not fully restored their power inputs for the spawning till July (GSI-6.9-5.8%). At the same time cubic condition index of large and small fish was practically the same.

In ***August*** pollock in catches was presented with the fish body length of 11-83, average length was 40.4 cm (Tabl. 2).

Table 2. Biological characteristics of pollock in August 2008

Measures		
average length, cm/number	40.4/17171	
minimum–maximum	11 - 83	
mode	14/15, 21, 34, 49, 52, 61	
Bioanalysis		
min.–max. length, cm	13 - 76	
min.–max. weight, g	14.7 - 3110	
share of immature fish, %	38.37	
Indexes	Females	Males
number, ind.	272	218
average length, cm	44.9	36.7
average weight, g	923.8	534.2
prevailed maturity stage of gonads, of mature fish %	II-III – 52.0;III – 23.5; VI - II – 16.2	II-III – 26.0;III – 42.3; VI - II – 30.9
stomach filling, units	2.54	2.42
Morphological indexes of immature fish		
cubic condition index	0.620	0.595
GSI, %	0.54	0.20
HSI, %	9.33	9.20
Morphological indexes of mature fish		
cubic condition index	0.616	0.641
GSI, %	2.58	1.73
HSI, %	9.45	9.08
prevailed food objects, %	calanus – 36.0; euphasiid – 24.5; hyperiid – 21.7; shrimp – 12.1; pollock – 0.4	

The gonads of mature females were at stages II-III – 52 and III – 23.5%. Males had gonads at stages VI-II – 53.8 and III – 30.8%. Gonadosomatic index of males increased from 1.48% in July till 1.73% in August. The increase of female's index was less significant. Proportion of females and males was equal to 4.5 / 5.5. 38% of analyzed fish were immature. The pollock continued to feed actively. In its food dominated calanus, euphasiids, hyperiids and shrimps. Cannibalism was rare than in July – 0.4%. SFU was 2.4-2.5. Hepatosomatic index was high either in immature or in mature fish (9.1-9.5%). Cubic condition index also a little bit increased – 0.595-0.641. So

in August the conditions for feeding of pollock in the Western Bering Sea were favorable as in July.

In ***September*** during fishing operations pollock in catches was presented with the fish body length of 13-76 cm, with weight 14.7-3110 g; average length was 36.6 см (Fig. 2).

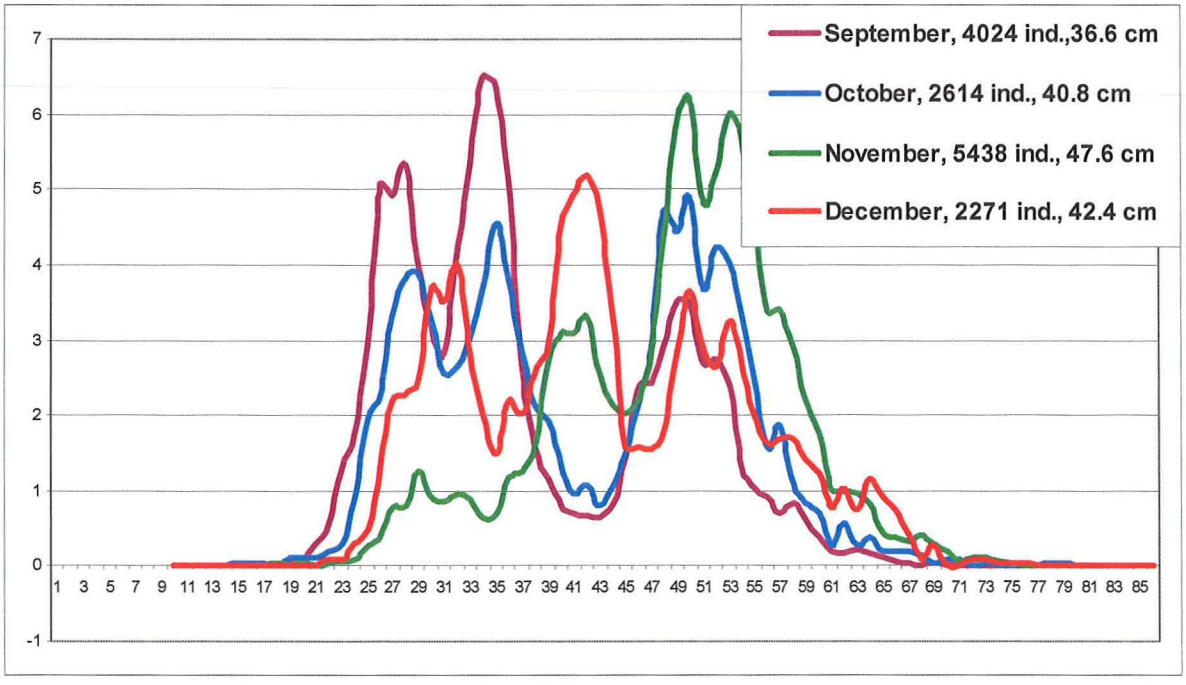

Fig. 2. Length composition of pollock caught by RTMK-S "Vasilyi Kalenov" during fishing operations in September-December 2008.

The gonads of mature females were at stages II-III – 49.7 and III – 30.8%. Males had gonads at the same stages II-III – 44.9 and III – 43.1%. 5.8% females and 12.8% males had gonads at stage VI-II (Tab. 3.).

Gonadosomatic index was lower than in August (for both sexes) may be because of smaller sizes of pollock. Proportion of females and males was equal to 4.4 / 5.6. 36% of analyzed fish were immature. Feeding activity of pollock remained high in September. In food of pollock dominated euphasiids, copepods, hyperiids, shrimps. In the area with coordinates 61°20′N, 178°45′W (where pollock stayed at the depth 185-200 m) in pollock food dominated

myctophidae. Good conditions favored accumulation of energy resources for wintering. So hepatosomatic index increased in September (9.1-9.8% in mature fish, 11.8% in immature fish). Cubic condition index increased either (till 0.625-0.658).

Table 3. Biological characteristics of pollock in September 2008

Measures		
average length, cm/number	36.6/4024	
minimum–maximum	17 - 68	
mode	25/27, 33, 49, 57.	
Bioanalysis		
min.–max. length, cm	13 - 76	
min.–max. weight, g	14.7 - 3110	
share of immature fish, %	35.61	
Indexes	Females	Males
number, ind.	229	181
average length, cm	41.1	37.8
average weight, g	592.1	465.7
prevailed maturity stage of gonads, of mature fish %	II-III – 49.7;III – 44.5; VI - II – 5.8	II-III – 44.0;III – 43.1; VI - II – 12.8
stomach filling, units	2.64	2.45
Morphological indexes of immature fish		
cubic condition index	0.657	0.658
GSI, %	0.51	0.20
HSI, %	11.8	11.8
Morphological indexes of mature fish		
cubic condition index	0.652	0.633
GSI, %	1.92	1.67
HSI, %	9.09	9.78
prevailed food objects, %	calanus – 24.5; euphasiid – 45.8; hyperiid – 12.1; shrimp – 10,1; myctophidae – 5.4	

In ***October*** during fishing operations pollock in catches was presented with the fish body length of 14-78 cm; average length was 40.8 см.

There was 28.5% of immature fish in catches. Females slightly dominated numerically. More mature fish had gonads at stage III, in catches appeared females at

stage IV (4.4%). GSI increased from 1.9 till 3.1% (females) and from 1.7 till 3.0% (males) (Tab. 4).

Table 4. Biological characteristics of pollock in October 2008

Measures		
average length, cm/number	40.77/2614	
minimum–maximum	14 - 78	
mode	28, 33, 49, 51.	
Bioanalysis		
min.–max. length, cm	21.1 - 67.0	
min.–max. weight, g	66 - 2352	
share of immature fish, %	28.48	
Indexes	Females	Males
number, ind.	169	161
average length, cm	43.0	42.7
average weight, g	694.3	688.1
prevailed maturity stage of gonads, of mature fish %	II-III – 22.6;III – 71.3; IV – 4.4; VI - II – 1.7	II-III – 19.8;III – 71.1; VI - II – 9.1
stomach filling, units	1.83	1.69
Morphological indexes of immature fish		
cubic condition index	0.643	0.663
GSI, %	0.68	0.23
HSI, %	12.0	11.8
Morphological indexes of mature fish		
cubic condition index	0.638	0.646
GSI, %	3.08	2.97
HSI, %	10.4	9.88
prevailed food objects, %	calanus – 3.3; euphasiid – 52.6;hyperiid – 16.4; shrimp – 15.3; pollock – 1.9	

Pollock continued to feed (SFU-1.76). As in September, in the food of pollock dominated crustacean (euphasiids – 52.6%). Cannibalism was not significant (1.9%). Cubic condition index increased till 0.638-0.646 among maturate fish in October; among immature fish cubic condition index was the same as in September. Hepatosomatic index of mature fish increased till 9.9-10.4%; that index stayed at high level among immature fish.

In ***November*** pollock in catches was presented with the fish body length of 16-74 cm; average length was 47.6 см. Pollock with body length 22-74 cm and weight 74-3433 g was analyzed (Tab. 5)

Table 5. Biological characteristics of pollock in November 2008

Measures		
average length, cm/number	47.61/5438	
minimum–maximum	16 - 74	
mode	28, 43, 49, 52.	
Bioanalysis		
min.–max. length, cm	22.4 - 73.8	
min.–max. weight, g	74 - 3433	
share of immature fish, %	23.68	
Indexes	Females	Males
number, ind.	417	343
average length, cm	46.9	44.8
average weight, g	884.3	759.5
prevailed maturity stage of gonads, of mature fish %	II-III – 12.2; III – 84.0; IV – 2.2; VI - II – 0.6	II-III – 13.0;III – 68.6; IV – 5.0; VI - II – 12.3
stomach filling, units	1.87	1.50
Morphological indexes of immature fish		
cubic condition index	0.645	0.639
GSI, %	0.52	0.17
HSI, %	11.3	10.9
Morphological indexes of mature fish		
cubic condition index	0.635	0.640
GSI, %	3.06	3.91
HSI, %	11.1	10.1
prevailed food objects, %	calanus – 6.0; euphasiid – 38.4; hyperiid – 5.5; shrimp – 18.1; myctophidae – 20.2	

23.7% of fish was immature. Mature fish had gonades mainly on stages II-III -49.7 and III – 44.5% (II-III 12.2% of females and 13% of males; III 84 and 68.6% correspondingly).

Pollock continued to feed but its feeding activity decreased by the end of November (SFU – 1.5-1.9). As in the previous month pollock fed on crustasean. The share of myctophidae was high (20.2%) because fishing operations took place

at the depths more than 180-190 m, where myctophidae was the main food object of pollock. The hepatosomatic index of immature fish became to decrease in November (that index reached its maximum in October); the hepatosomatic index of mature pollock reached its maximum in November and then began to decrease.

In ***December*** pollock in catches was presented with the fish body length of 21-75 cm; average length was 41.32 cm (Tab. 6)

Table 6. Biological characteristics of pollock in December 2008

Measures		
average length, cm/number	41.32/2271	
minimum–maximum	21 - 75	
mode	31, 41, 49, 52.	
Bioanalysis		
min.–max. length, cm	22.7 - 72.8	
min.–max. weight, g	85 - 3235	
share of immature fish, %	35.17	
Indexes	Females	Males
number, ind.	153	137
average length, cm	42.1	41.3
average weight, g	659.4	605.9
prevailed maturity stage of gonads, of mature fish %	II-III – 15;III – 77; III –IV – 4; IV – 2;VI - II – 2	II-III – 20.7;III – 63.2; III-IV – 2.3; IV-2.3; VI-II – 11.5
stomach filling, units	1.20	0.93
Morphological indexes of immature fish		
cubic condition index	0.632	0.623
GSI, %	0.53	0.15
HSI, %	11.3	10.5
Morphological indexes of mature fish		
cubic condition index	0.618	0.631
GSI, %	2.53	3.44
HSI, %	10.3	9.6
prevailed food objects, %	euphasiid – 52.4; hyperiid – 25.5; shrimp – 9.1; pollock – 1.4; calanus – 1.0	

There was 35.2% of immature fish in catches in December because at that period pollock of smaller (than in November) size was fished. GSI of mature fish was a little bit

smaller at the same reason. The mature condition was approximately the same as in November. Proportion of females and males was equal to 6 / 4.

Pollock continued to feed but its feeding activity decreased by the end of December because the feeding period of pollock generally ended. Pollock fed on pelagic and near-bottom crustasean (euphasiids, hyperiids, shrimps). Cannibalism didn't have vital importance in the nutrition of pollock.

So during the feeding period in summer and autumn 2008 pollock fed basically on pelagic and near-bottom crustasea. For small pollock it was copepods, for larger – shrimps. Euphasiids and hyperiids played an important role in the feeding of all size-weight groups. In the nutrition of large (more than 40 cm) pollock fish became imtortant; at the area with the depths more than 180-190 m myctophidae dominated in pollock food (Fig. 3).

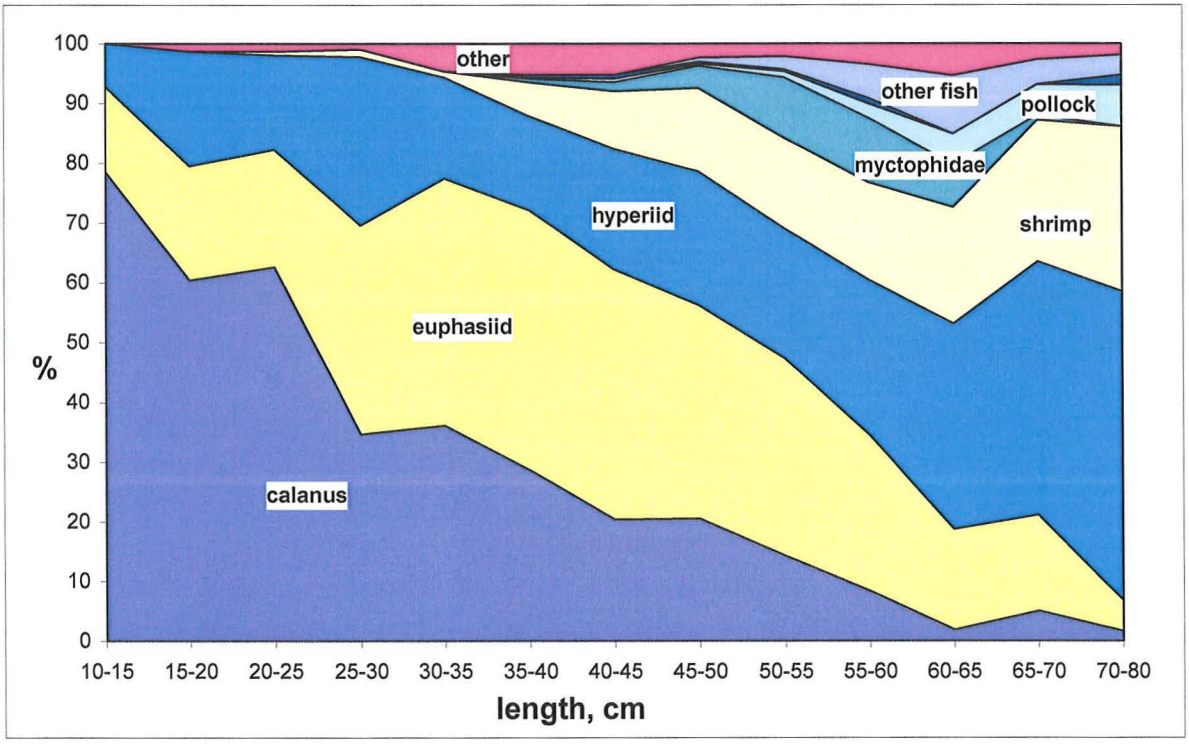

Figure 3. Pollock food composition by length in the Western Bering Sea

Trophic conditions of the area was favorable for young and large pollock. Pollock was feeding actively, so cubic condition index of immature fish

permanently increased and reached its maximum by September-October (0.657-0.663). Cubic condition index of mature fish reached its maximum in October-November (0.638-0.649) because of a spawing. Relative size of the liver increased because of the oil accumulation. Hepatosomatic index of immature fish increased till 11.8-12.0% in October; the same index of mature pollock increased to 10.1-11.1% in November.

During bottom surveys in June and August pollock in catches was presented with the fish body length of 9-76 cm (Fig. 4).

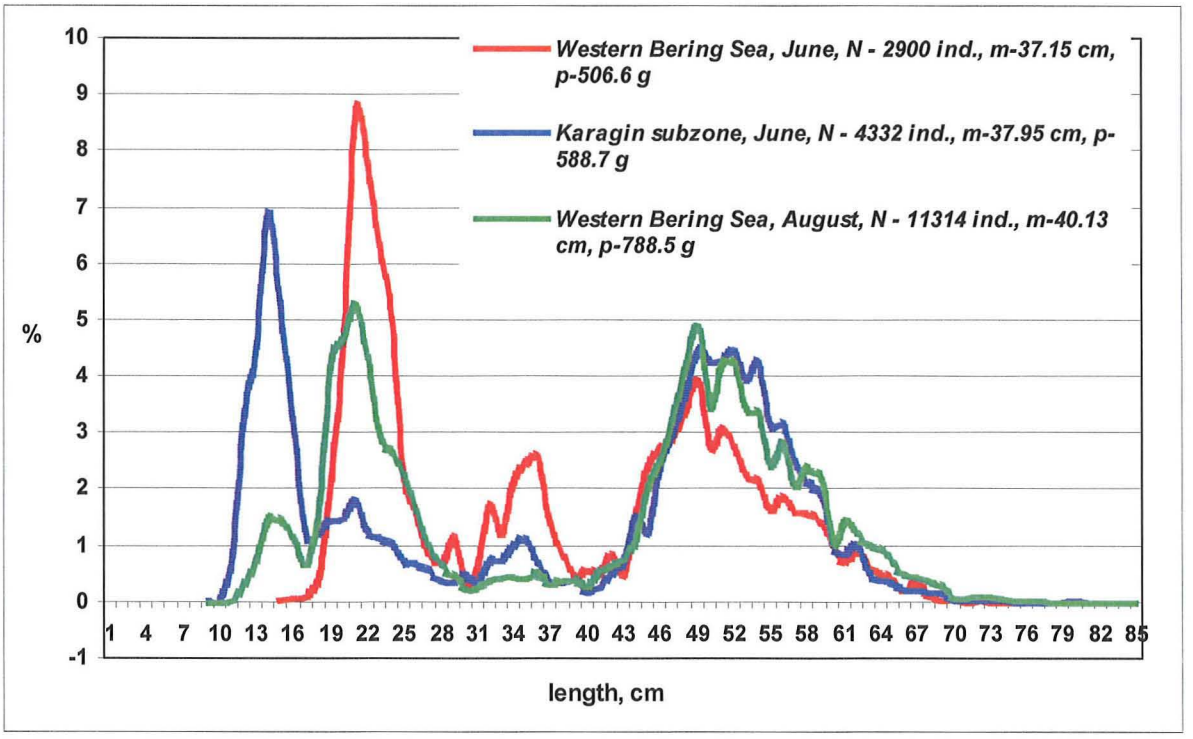

Figure 4. Length composition of pollock catched during bottom surveys in June (Karagin subzone – 19-22.06, Western Bering Sea – 22-30.06) and August (Western Bering Sea – 17-22.08) 2008

Three young age groups (mode – 14, 21 and 35-36 cm) standed out for the length composition of pollock. The youngest from them (the generation of 2007 with body length of 9-18 cm) represented 27.7% of total amount of caught pollock in Karagin subzone. In the Western Bering Sea this group was nealy absent in June

(0.7%) and was weakly present in August (7.5%). The generation of 2006 (19-24 cm) was not numerous in Karagin subzone (8.1%) but in the Western Bering Sea this generation dominated in catches both in June (34.6%) and August (24.2%). The generation of 2005 was not numerous in both areas. The generation of 2004 represented 12.7% of catches in the Western Bering Sea in June. Biological state of yound pollock is shown in Tab. 7.

Table 7. Biological state of pollock generation 2005-2007 from the Navarin region in July-August 2008

generation		2005	2006	2007
average length, cm/number		27.05/2245	21.58/5305	15.68/938
minimum–maximum		25 - 31	19 - 24	10 - 18
mode		25	21	14
average weight, g	females	152.7	72.8	27.7
	males	156.2	69.0	15.9
minimum – maximum	females	94 - 225	41 - 115	17.1 - 44.0
	males	84 - 219	40 - 114	14.7 - 46.5
male portion, %		42.9	44.6	62.6
prevailed maturity stage of gonads, %	females	II – 98.2; II-III – 1.8	I – 1.6 II – 98.4	I – 85.3 II – 14.7
	males	II – 80.9; II-III – 14.3; III – 4.8	II – 98.0; II-III – 2.0	I – 84.2; II – 15.8
stomach filling, units		2.73	2.79	2.66
share of empty stomachs, %		4.1	0	3.3
prevailed food objects, %		calanus – 52.9; euphasiid – 18.7; hyperiid – 23.9	calanus – 63.7; euphasiid – 13.8; hyperiid – 22.5	calanus – 68.0; euphasiid – 16.4; hyperiid – 13.9
cubic condition index		0.621	0.586	0.549
GSI, %	females	0.58	0.47	0.41
	males	0.45	0.19	0.04
HSI, %	females	9.73	8.09	7.95
	males	10.2	8.33	7.52
number		98	112	91

Note: averege length is based on the results of measures, average weight – on the results of bioanalysis

Biomass of near-bottom accumulation of pollock based on the results of trawl survey

The acounting survey occupied area of water in **14658 sq. miles** and consisted of 43 trawling (Fig. 5) Pollock average density concentrations were equaled **1000000 t**. During the survey the main concentration of pollock was marked in the south part of studied area. The concentrations of smaller density were marked on the periphery of quasi-stationary eddy in grounds of the main food items of pollock.

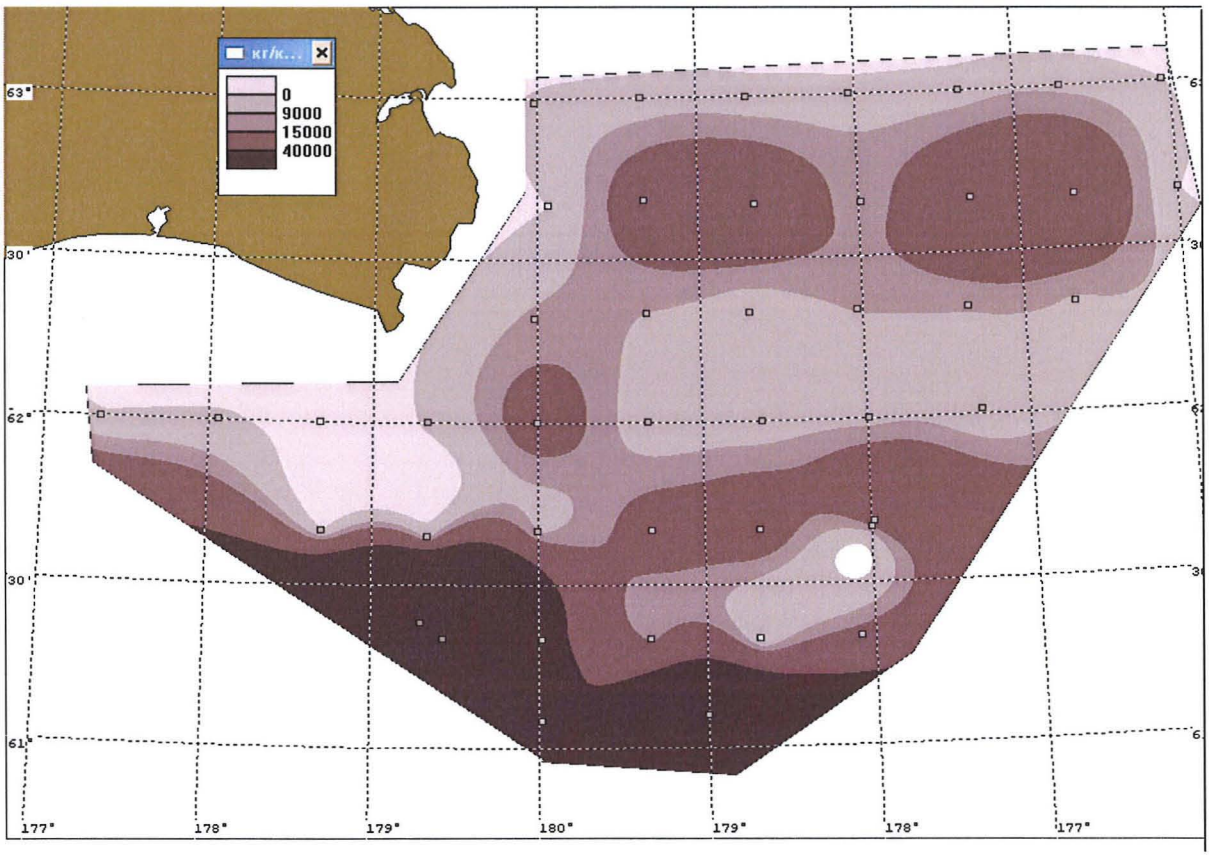

Figure 5. Pollock distribution during the survey (August 2008)

The generation of **2006** standed out for the length composition of pollock and represented **26.6%** of total amount of caught pollock.

Characteristic of cod – Gadus macrocephalus

During surveys in June cod was absent in 7 (15.2%) catches, in August – in 9 (20.5%). The maximum catch of cod per hour trawling was 2756 kg and 950 ind. in the Karagin subzone (59°56'1 N, 167°00'1 E, depth 95 m) in June and 1940 kg and 2576 ind. in the Western Bering Sea (62°00'0 N, 177°18'8 E, depth 92 m) in August. Average weighted catch of cod per hour trawling in the Karagin subzone in June was 76.2 ind. and 171.7 kg, in the Western Bering Sea in August – 90.7 ind. and 139.3 kg.

In the Karagin subzone in ***June*** cod in catches was presented with the fish body length of 14-97 cm; average length was 51cm. Durring the surveys in the Karagin subzone and in the Western Bering Sea two age groups (25-35 cm and 38-45 cm) standed out for the length composition of cod; in fishing catches these groups were weakly present (Fig. 6).

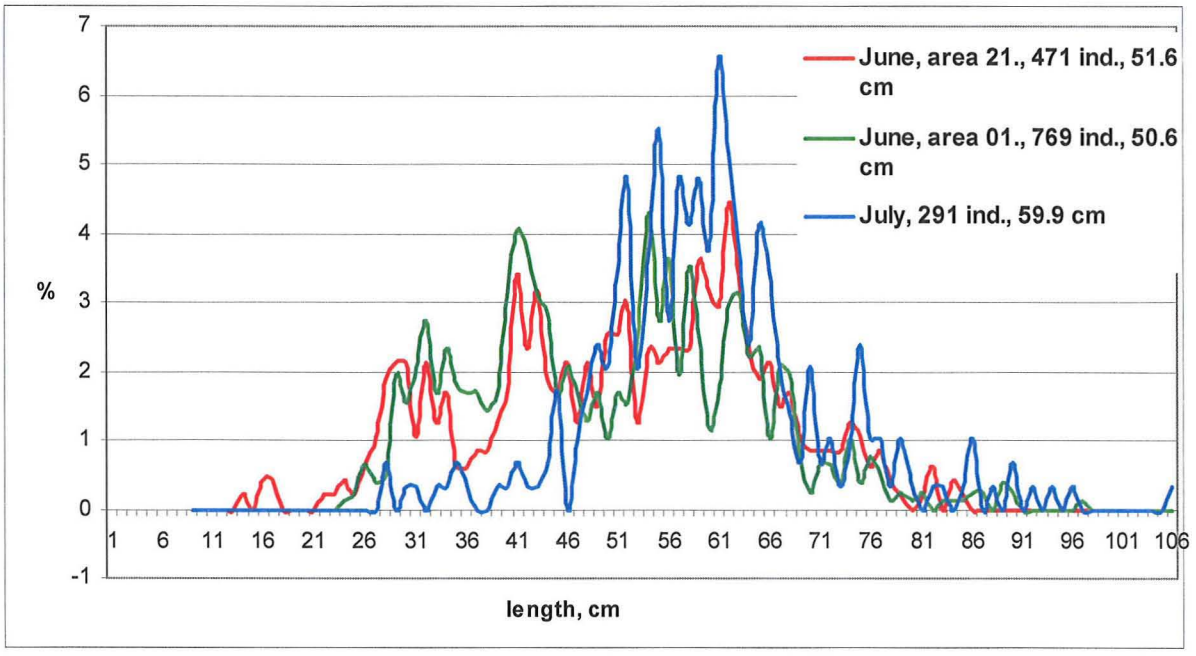

Figure 6. Length composition of cod caught by RTMK-S "Vasilyi Kalenov" during surveys and fishing operations in June-July 2008

77.6% of fish in catches were immature. The main part of mature fish had gonades on stage II-III; the gonades of the half of females and 28,6% of males

were resting. Cod was feeding actively (SFU – 2.3-2.8). Because of the small sizes of cod in June in its food dominated crustacea: shrimps, Diogenes-crabs, crabs and euphasiids. 8% of spectrum of nutrition was fish components (Tab. 8).

Table 8. Biological characteristics of cod from the Bering Sea in June 2008

Measures		
average length, cm/number	51.00/1240	
minimum–maximum	14 - 97	
mode	29, 34, 41, 54, 62	
Bioanalysis		
min.–max. length, cm	35 - 73	
min.–max. weight, g	515 - 5620	
share of immature fish, %	77.6	
Indexes	Females	Males
number, ind.	29	29
average length, cm	50.4	48.3
average weight, g	1761.9	1453.2
prevailed maturity stage of gonads, of mature fish %	II-III – 50; VI-II – 50	II-III – 57.1; IV – 14.3; VI-II – 28.6
stomach filling, units	2.83	2.29
Morphological indexes of immature fish		
cubic condition index	1.014	1.002
GSI, %	1.10	0.98
HSI, %	9.3	-
Morphological indexes of mature fish		
cubic condition index	0.995	1.009
GSI, %	2.03	1.85
HSI, %	4.92	-
prevailed food objects, %	shrimp – 54.0; Diogen-crab – 9.2; crab – 8.0; euphasiid – 8.0; fish components – 8.0, cephalopoda – 6.9	

In ***July*** cod in catches was presented with the fish body length of 28-106 cm (larger, than in June) with average length 59.9 cm. So the share of immature fish was lower (39.1%).

In catches males slightly dominated. The main part of mature fish had gonades on stage II-III and VI-II; some males had gonades at stage III. Cod was feeding actively. As in June, in its food dominated pelagic and near-bottom

crustacea. The role of fish in cod nutrition was higher (35.8%) because there was larger fish in catches. The share of pollock in fish components was 13.2% (Tab. 9).

Table 9. Biological characteristics of cod from the Bering Sea in July 2008

Measures		
average length, cm/number	59.89/291	
minimum–maximum	28 - 106	
mode	55, 61	
Bioanalysis		
min.–max. length, cm	27 - 94	
min.–max. weight, g	185 - 10770	
share of immature fish, %	39.1	
Indexes	Females	Males
number, ind.	110	123
average length, cm	57.9	57.3
average weight, g	2674.2	2558.8
prevailed maturity stage of gonads, of mature fish %	II-III – 53.8; VI-II – 46.2	II-III – 32.5; III – 3.9; VI-II – 63.6
stomach filling, units	2.50	2.55
Morphological indexes of immature fish		
cubic condition index	0.951	0.952
GSI, %	1.02	0.36
HSI, %	2.89	3.09
Morphological indexes of mature fish		
cubic condition index	1.028	0.988
GSI, %	2.27	1.46
HSI, %	4.93	4.56
prevailed food objects, %	shrimp – 38.3; Diogen-crab – 3.0; crab – 9.2; fish components – 35.8 (among them pollock – 13.2, eelpout – 7.6); polyhaete – 3.9; cephalopoda – 3.0.	

Hepatosomatic index of immature fish was 2.9-3.1%, of mature fish was a little bit higher (4.6-4.9%). Cubic condition index was 0.951-0.952 (young fish) and 0.988-1.028 (adult fish).

In the Western Bering Sea in ***August*** cod in catches was presented with the fish body length of 24-97 cm; average length was 52.4 cm. Durring the surveys in August the same two young age groups (25-35 cm and 38-45 cm) standed out for

the length composition of cod that standed out during survey in June. In fishing catches in November-December these groups were weakly (Fig. 7).

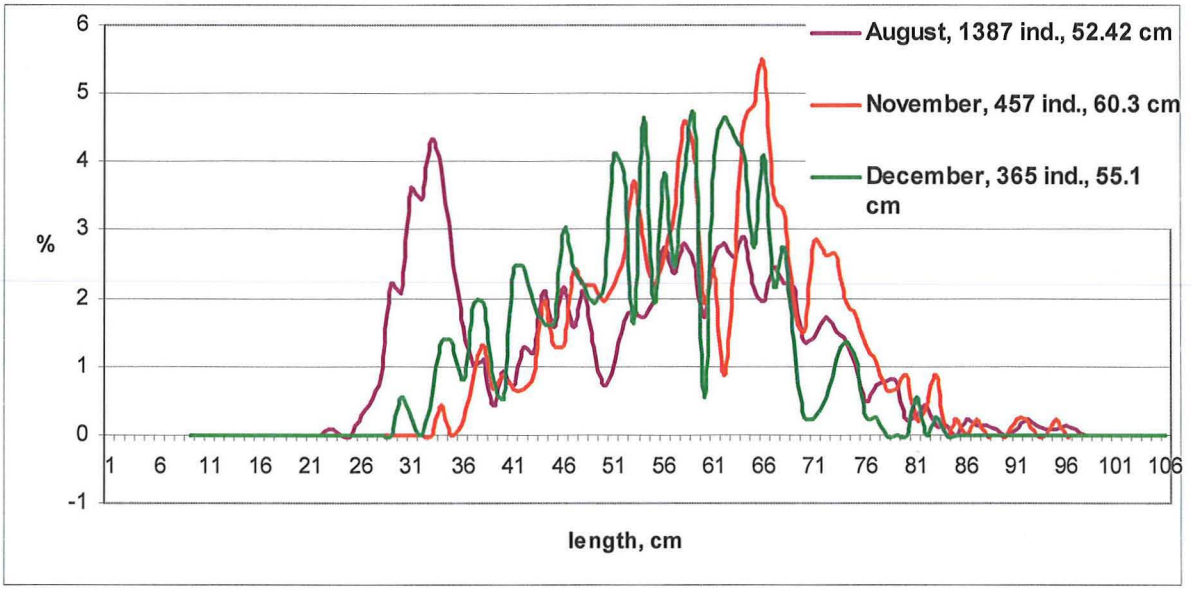

Figure 7. Length composition of cod caught by RTMK-S "Vasilyi Kalenov" during surveys and fishing operations in August-December

In August 32% of analyzed fish was immature. In catches males slightly dominated. The main part of mature fish had gonades on stage II-III and some males (10.5%) had gonades at stage III.

In cod food dominated benthos organisms (26.3%): Diogen-crabs, crabs, polychaete. As before shrimps were the main component of nutrition especially for the small size cod. The share of fish companents (pollock, herring, snakefish, eelpout) was 30.4% (Tab. 10).

In Augus cod fed actively, hepatosomatic index increased till 4.7-5.2% (young fish) and 6.1-6.6% (adult fish). At the area, where fishing took place cod ate fishing wastes.

Table 10. Biological characteristics of cod from the Bering Sea in August 2008

Measures		
average length, cm/number	52.42/1381	
minimum–maximum	24 - 97	
mode	30 - 33, 45, 55 - 56, 61 - 63	
Bioanalysis		
min.–max. length, cm	28 - 97	
min.–max. weight, g	214 - 14685	
share of immature fish, %	32.0	
Indexes	Females	Males
number, ind.	44	56
average length, cm	61.5	58.8
average weight, g	3773.4	3077.7
prevailed maturity stage of gonads, of mature fish %	II-III – 83.3; VI-II – 16.7	II-III – 30,0; III – 10.5; VI-II – 39.5
stomach filling, units	2.80	2.62
Morphological indexes of immature fish		
cubic condition index	1.046	1.004
GSI, %	1.06	0.48
HSI, %	5.16	4.71
Morphological indexes of mature fish		
cubic condition index	1.060	1.037
GSI, %	2.80	2.17
HSI, %	6.05	6.56
prevailed food objects, %	shrimp – 35.1; Diogen-crab – 5.7; crab – 13.4; fish companents – 30.4 (among them herring – 5.2, pollock – 2.1, eelpout – 3.1, snakefish – 3.6); polyhaete – 7.2; cephalopoda – 3.1, fishing wastes-6.2	

In ***October*** cod was rarely noted in catches. 30 individuals of cod with the body length of 54-91 cm was analyzed in October (Tab. 11). In September cod was not analysed.

The main part of mature fish in October had gonades on stage III. GSI increased till 3.9% (females) and 9.2% (males). Cod fed actively on gathering of herring and pollock. Fishing wastes dominated in cod food. Level of accumulation of reserve substance was 8.2-9.3%.

Table 11. Biological characteristics of cod from the Bering Sea in October 2008

Measures		
average length, cm/number	67.00/30	
minimum–maximum	54 - 91	
mode		
Bioanalysis		
min.–max. length, cm	54 - 91	
min.–max. weight, g	1965 - 12165	
share of immature fish, %	13.3	
Indexes	Females	Males
number, ind.	16	14
average length, cm	68.4	65.3
average weight, g	4876.3	4153.6
prevailed maturity stage of gonads, of mature fish %	II-III – 33.3; III – 66.7	II-III – 18.2; III – 81.8
stomach filling, units	3.06	2.93
Morphological indexes of immature fish		
cubic condition index	0.980	1.032
GSI, %	1.32	0.40
HSI, %	9.3	-
Morphological indexes of mature fish		
cubic condition index	1.078	1.056
GSI, %	3.92	9.24
HSI, %	8.34	8.15
prevailed food objects, %	shrimp – 16.7; fish components – 68.8 (among them herring – 37.5, pollock – 10.4); gastropoda – 4.2, fishing wastes – 10.4.	

In ***November*** cod had body length of 34-95 cm; average length was 60.34 cm. Analyzed individuals had body length of 34-92 cm and weight 441-10500 g. Females dominated a little bit in catches. 21.95% of cod was immature. The main part of mature fish had gonades on stage III and 27.3% of males had gonades at stage IV (Tab. 12).

Table 12. Biological characteristics of cod from the Bering Sea in November 2008

Measures		
average length, cm/number	60.34/457	
minimum–maximum	34 - 95	
mode	38, 47, 53, 59, 66	
Bioanalysis		
min.–max. length, cm	34 - 92	
min.–max. weight, g	441 - 10500	
share of immature fish, %	29.1	
Indexes	Females	Males
number, ind.	65	62
average length, cm	64.8	62.4
average weight, g	4231.4	3794.1
prevailed maturity stage of gonads, of mature fish %	II-III – 17.4; III – 78.3; VI-II – 4.3	II-III – 2.3; III – 70.4; IV – 27.3
stomach filling, units	2.06	2.11
Morphological indexes of immature fish		
cubic condition index	1.074	1.020
GSI, %	1.24	0.50
HSI, %	7.01	6.72
Morphological indexes of mature fish		
cubic condition index	1.101	1.046
GSI, %	5.11	18.92
HSI, %	9.56	8.71
prevailed food objects, %	shrimp – 30.3; crab – 8.0; fish components – 38.3 (among them herring – 7.4, pollock – 6.9, eelpout – 2.3); polychete – 2.9; fishery wastes – 16.0.	

Feeding activity of cod decreased in November (SFU – 2.1). Hepatosomatic index reached its maximun and after it began to decrease. The share of herring in spectrum of nutrition decreased, and share of fishinf wastes increased.

In ***December*** cod in catches was presented with the fish body length of 30-83 cm; average length was 55.07 cm (Tab. 13).

Table 13. Biological characteristics of cod from the Bering Sea in December 2008

Measures		
average length, cm/number	55.07/365	
minimum–maximum	30 - 83	
mode	37 - 38, 46, 54, 59, 62, 66	
Bioanalysis		
min.–max. length, cm	34 - 81	
min.–max. weight, g	369 - 9050	
share of immature fish, %	50	
Indexes	Females	Males
number, ind.	46	44
average length, cm	54.9	57.9
average weight, g	2457.2	3171.8
prevailed maturity stage of gonads, of mature fish %	III – 55.6; III-IV – 16.7; VI-II – 27.8	III – 37.0; III-IV – 22.2; IV – 29.6; VI-II – 11.1
stomach filling, units	2.35	1.93
Morphological indexes of immature fish		
cubic condition index	1.029	0.988
GSI, %	1.93	0.36
HSI, %	6.87	6.38
Morphological indexes of mature fish		
cubic condition index	1.065	1.050
GSI, %	3.52	26.07
HSI, %	8.11	7.46
prevailed food objects, %	shrimp – 31.9; crab – 11.2; fish components – 36.2 (among them: pollock – 16.4, icelus – 3.4, eelpout – 2.6); fishery wastes – 7.8.	

Because of small body size the half of cod was immature. The main part of mature fish had gonades on stage III, some cod had gonades at stage III-IV and IV. Males took the lead over females in the degree of maturing. Cod continued to feed but its feeding activity decreased (SFU – 1.9-2.4). As in the previous month cod fed on shrimps, crabs, fish (mainly pollock). The high value of hepatosomatic index of fish (6.4-6.9% for young fish, 7.5-7.1% for adult fish) allowed us to speak about favorable conditions for feeding of cod in summer and autumn 2008.

In the spectrum of nutrition of small cod dominated shrimps (Fig. 8). The importance of fish components and benthic crustacea (crabs, Diogen-crabs, ets.) in nutrition increased with the increasing of body size.

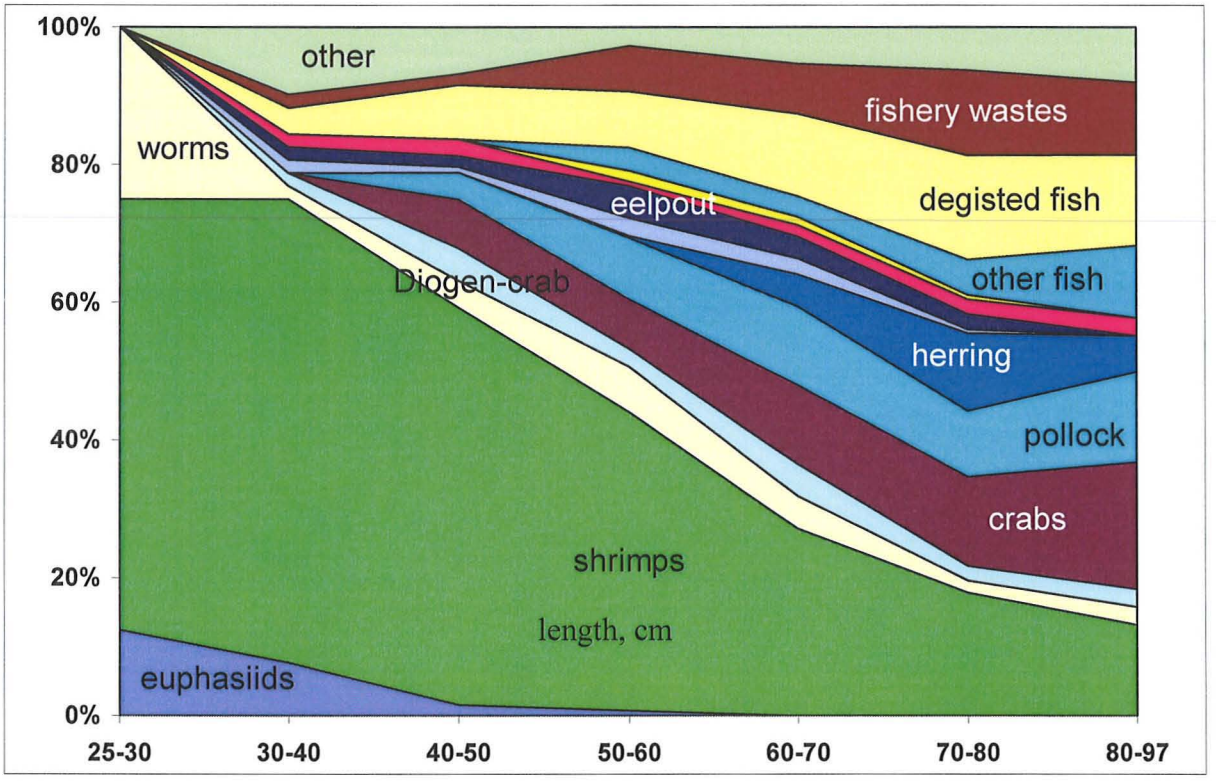

Figure 8. Cod food composition by length

Amoung fish components in nutrition of cod pollock, herring, snakefish and eelpout played the main role. At the area, where fishing took place large cod fed mainly on fishing wastes

Herring Clupea pallasii

Usually herring was caught as a by-catch, but some time its share in catch reached 30-50%. For example on August 15 during the trawling in point with coordinates 61°02' N, 174°03'7 E and depth 120 m there was about 29% (4 t) of herring in catch. In that catch herring was presented with the fish body length of 27-39 cm; average length was 32.6 cm. On August 18 during the trawling in point

with coordinates 62°40'6 N, 179°20'7 W and depth 85 m there was about 85.4% (1.4 t) of herring in catch. During that trawling the fish body length of herring was 27-35 cm; average length – 32.0 cm.

At the end of the cruise there were 4 trawling between 59°31-59°42 N and166°37-170°28 E (100-340 m depth) when herring was fished. 36-50 t of herring were catched for 1-5 hours trawling.

Herring in catches was presented with the fish body length of 23-37 cm with average length 31.3 cm. The of analyzed fish had body length 24.4 cm, weight 139-593 g. Average length was 30.9 cm, weight – 355.6 g. The main part of fish was mature, dominated gonades stage among females was III (68.6%), among males – IV (60.9%).

Herring did not feed practically (SFU 0.03). Cubic condition index was low – 0/965, average unit of internals obesity was 0.82.

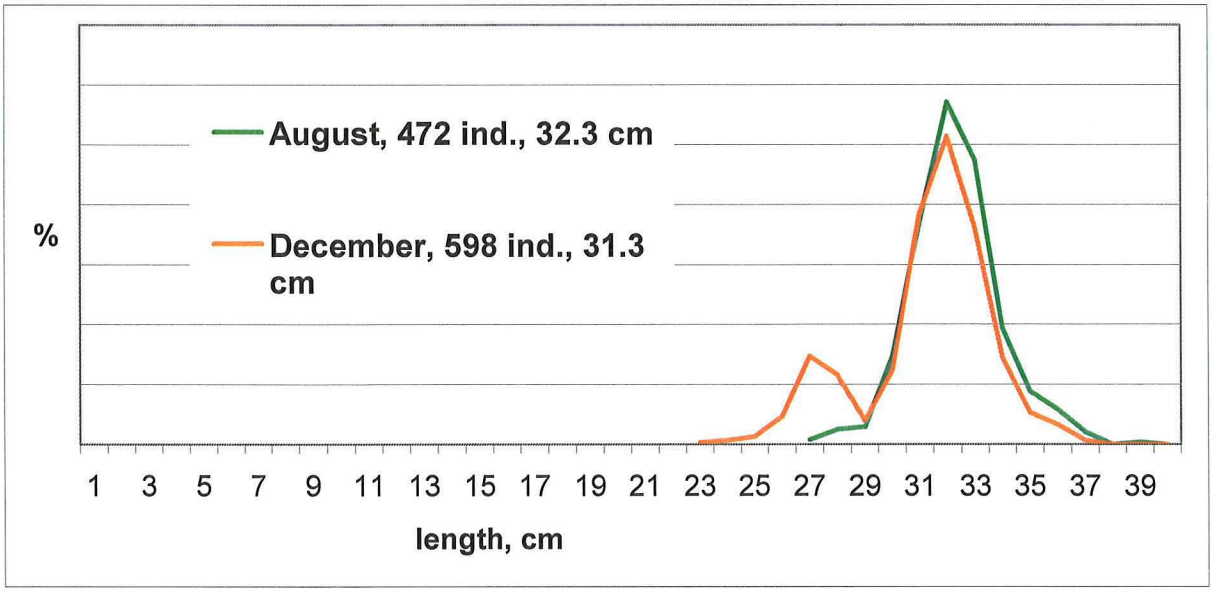

Figure 9. Length composition of herring caught in August-December

Table 14. Biological characteristics of herring from the Navarin region in August-December 2008

average length, cm/number		31.73/1070
minimum–maximum		23 - 39
mode		32
average weight, g		355.6
min.–max. weight, g		139 - 593
male portion, %		56%
prevailed maturity stage of gonads, %	females	II – 20.5; III – 56.5; III-IV – 18.2; IV – 4.5
	males	II – 17.9; III – 8.9; III-IV – 23.2 IV – 50.0
stomach filling, units		0,03
share of empty stomachs, %		97
prevailed food objects, %		calanus – 33.3 hyperiid – 33.3 digested food – 33.3
cubic condition index		0.965
GSI of mature fish, %	females	12.76
	males	22.38
internals obesity, units	females	1.17
	males	0.52
number		100

2.2. Cruise aboard R/V "TINRO" to the Northwestern Bering Sea in July-October 2008

Melnikov I.V.

Pacific Research Fisheries Centre (TINRO-centre)

A cruise abroad R/V "TINRO" was conductedin the Bering Sea in 2008 within the frame work of implementation TINRO-Center programm of research of marine bioresources in Far-Eastern Basin in 2007-2011.

The results of last years cruises confirmed, that considerable reorganizations, expressed in changes of composition and structure of near-bottom and pelagic associations took place in the Bering Sea ecosystems. Climato-oceanological changes in the North-West Pacific were one of the reasonis of these reorganizations. Essential reduction of general fish capacity took place in Bering Sea; also catch composition have changen in same regions of the sea.

Bottom trawl survey was conducted by R/V "TINRO" in the Western Bering Sea and in the Chukchi zone (July 17 – August 25). By area of water and range of depth this survey practically in full corresponded with simular works, which were conducted by TINRO-Center in 2005 with the exception of two moments. First, the research area was broaden in 2008: in addition to Anadyr Gulf and Olutor-Navarin area (Koryak shelf and continental slope) the Chukchi zone was studied. Second, after the introduction of new fishery rules the area of territory waters became closed for studies, so some resources remained not recorded. During the cruise 214 trawling were made at depth from 23 m (on shelf) till 750 (on continetal slope).

In 2008 the Lavrentiev cold lens with near-bottom negative temperature in Anadyr Gulf was developed considerably weaker than in 2005; which did not limit the spread of mass fish species along EEZ of Russia. The intensive advection of transformed oceanic waters into the scope of northern shelf promoted this fact like it was in 2003. By all sing, the development of spring processes happened very

quickly, which may impacted on the intensity of mass species migration and their distribution in area of water in the gulf.

On the results of survey pollock absolutely dominated in near-bottom waters (44.9% of total number and 87.8% of total biomass).

Taking into account the sharp decrease of abundance of generation 1999-2001 during resent years and the fact, that there is only one young abundant year class (2006) we could not expect the considerable increase in the stock of pollock in the nearest years.

The distribution of pollock during feeding in the Bering Sea depend on level of abundance and on background conditions, such as specifics of regimen, condition and distribition of nutritive base.

Research conducted by R/V "TINRO" showed that to the west of 176°E pollock was recorded on shelf and in upper slope at the depth of 43-354 m. The most compact aggregations of pollock (12.2 t per sq. km in average) were recorded at depth of 100-150 m (Fig. 1). Average length of pollock was 45.8 cm. The share of yough pollock did not exceed 5.5% of total number.

To the east of 176° E pollock was recorded at the depth of 22-443 m. The maximum of abundance was recorded at the depth of 100-150 m. The largest aggregations of young pollock of the current year were fixed in the deep stream of the Navarin current.

Average length of pollock from the Navarin region was 35.0 cm. The share of juvenile pollock was 6.5% of total number.

In the Chukchi zone pollock was recorded at the depth of 36-81 m in all region (Fig. 2), but the most dence aggregations were marked in the eastern Anadyr Gulf. Average length of pollock from the Navarin region was 46.6 cm. The share of young pollock was 41.5% of total number (without thecoefficient of fishing efficiency for groups of different size). The total accounted number of pollock in the Chukchi zone was 61.98 mln. ind., total accounted biomass – 54.50 th. t.

From September 9 till October 13 2008 R/V "TINRO" carried out ecosystem trawl survey of the Western Bering Sea with simultaneous echo-integretion. Survey was conducted from the Bering Strait to the south till the Aleutian basin by tacks, perpendicular to the coastline. After transition with trawling along the EEZ of Russia the works were continued in opposite direction from the Commander Islands to the north.

During the survey only near-surface layer was fished by control trawling (with the exception of some trawling based on pollock echo-records). The areas where stratification was realized with the use of results of trawling from the adjacent areas of survey were marked out in the area of water. The type of acoustic image of registered aggregations, type of allocation target strength, typical isobathics allocation and daily behaviour of different pollock groups and the experience of previous works in this area were taken into account.

In September 2008 the main aggregations of pelagic and near-bottom pollock were registered (as in the previous years) on the Navarin shelf and in the adjacent to the Anadyr Gulf areas of water. The most dence aggregations of pollock (more than 300 th. ind./sq. miles) were disposed on the area of water between $179^{0}00$-$177^{0}00$ W.

Active vertical movements of middle and larde sized pollock in dependence of time were to recorded. The aggregations of differnt structure and density disposed mainly in lower pelagial and in near-bottom layer. During the hours of darkness these aggregations were registered mainly as a lighted stratum till 60 m height over bottom. During the daytime pollock was fixed in ecograms as a stratum of variable density in the lower pelagial and in near-bottom layer. The vertical structure of young age pollock aggregations was typical for this time of the year. The young of the current year were distributed mainly in near-surface layers; they did not accomplish considerable vertical movements during twenty-four hours. Only the structure of aggregations changed from school of different detsity in daytime till dispersed distribution at night. Young pollock was registered as a school of high density in lower pelagial at daytime. After the sunset the defined part of the young

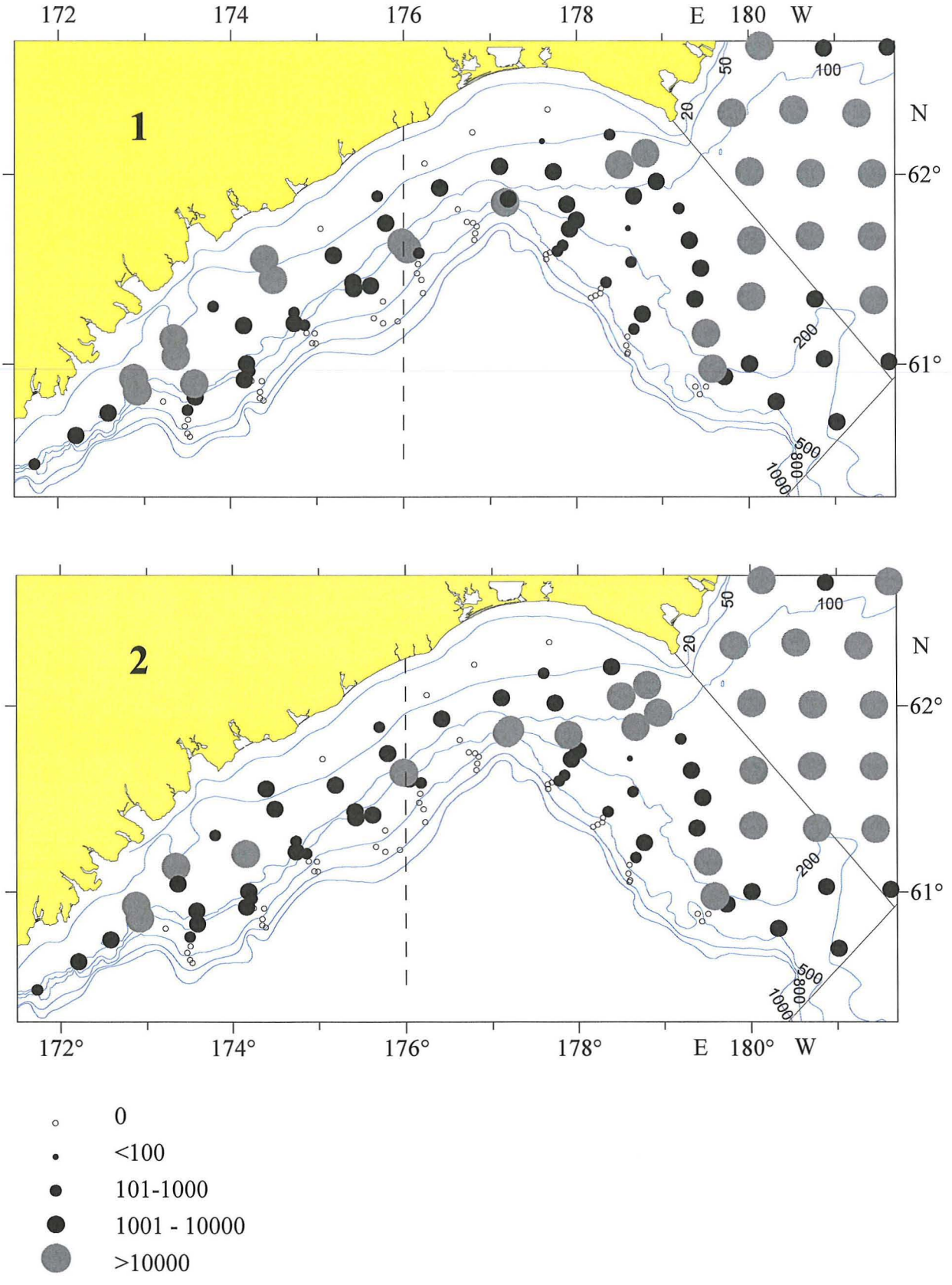

Figure 1. Distribution of biomass (1 – kg/sq. km) and abundance (2 – ind./sq. km) of all pollock age groups in the Olutor-Navarin area (17.07. – 31.07.2008, survey of R/V "TINRO"). Dotted line shows the conditional boundary, which divides the Western Bering Sea and the Northen Bering Sea populations

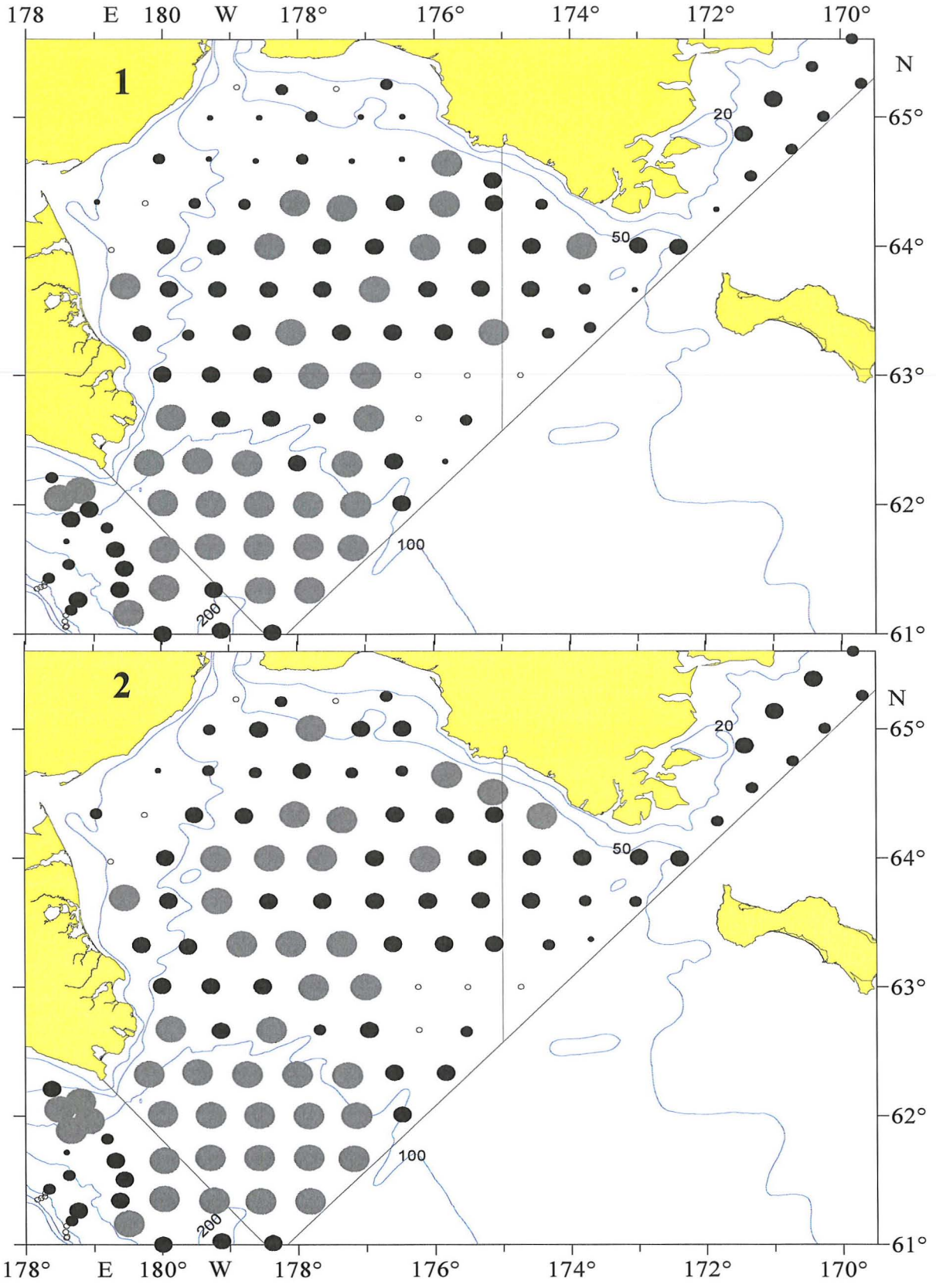

Figure 2. Distribution of biomass (1 – kg/sq. km) and abundance (2 – ind./sq. km) of all pollock age groups in the Anadyr Gulf and in the Chukci zone (4.08. - 25.08.2008, survey of R/V "TINRO"). Key looks like key on Fig. 1

pollock moved to upper pelagial and distributed in near-surface layer with the center of maximum aggregation at the depth of 20-30 m.

The scheme of spatial distribution of pollock in the North-Western Bering Sea is shown on Fig. 3. The most dence aggregations of the young of the current year pollock (more than 300 th. ind./sq. miles) were concentrated between $178^{0}00$-$177^{0}00$ W. Pollock with the body length of 10-19 was sparse. The main aggregations of pollock with the body length of 20-40 cm were fixed in pelagic layer in Navarin region. Pollock with the bogy length of more than 40 cm did not make the independent aggregations and was present enough weakly. In whole, more than 75% of pollock was lockated between 100-150 m.

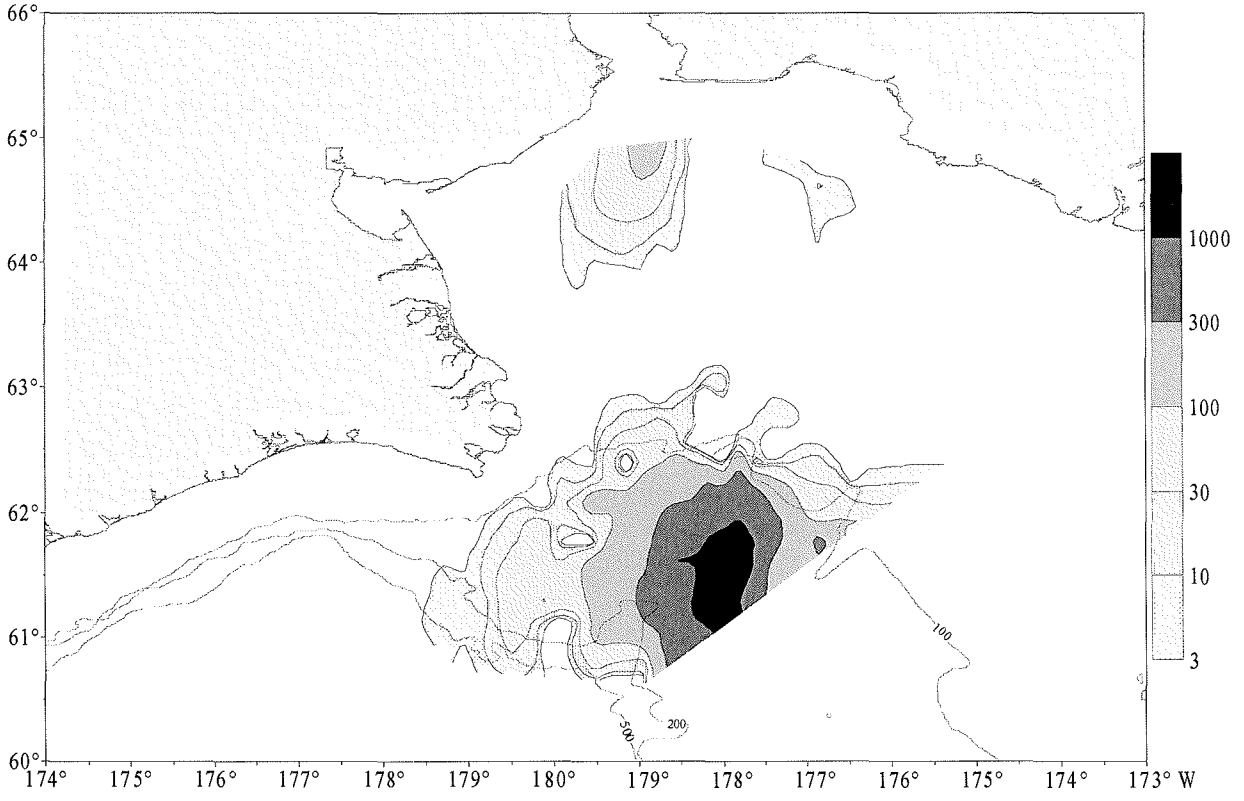

Figure 3. Distribution of pollock abundance (all sized groups, th. ind./sq. miles) in pelagic layer in the North-Western Bering Sea (surveys of R/V "TINRO", september 2008)

According to abundance, the young pollock of the current year and pollock with the body length of 20-29 cm (39 and 42% accordingly) dominated in catches.

There was about 1% of pollock with the body length of 10-19 cm and it did not play at essential role in the forming of total abundance.

According to results of surveyes which were conducted in summer-autumn 2008, in Russian waters of the Bering Sea (to the east of 176° E till the marking line, including Chukchi zone) total abundance and biomass estimated for pollock was 4756.35 mln. ind. and 1466.98 th. t.

2.3. Some results of bottom trawl survey during *SRTM "YUMIR"* cruise to the Western Bering Sea in September 2008

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Since late-1960-s Kamchatka Fisheries and Oceanography Research Institute (KamchatNIRO) regularly conduct bottom trawl surveys in the South-western Bering Sea (Olyutor and Karagin Bays) with main purpose to collect data for commercial marine fish resources assessment, first of all of walleye pollock. In September 2008 KamchatNIRO carried out a bottom trawl survey in this area aboard stern-trawler SRTM "Yumir". Besides research survey, part of time a vessel has operated in commercial fishery regime. The primary objectives of the cruise were:

- to collect information on species composition at research survey and commercial catches on pollock trawl fishery;
- to determine the spatial distribution of walleye pollock and other demersal fish in the South-western Bering Sea;
- to obtain the preliminary assessment of near-bottom walleye pollock biomass in the Karagin and Olyutor Bays by bottom trawl survey;
- to estimate the biomass and density of demersal hydrobionts;
- to collect biological information on walleye pollock and other demersal fish.

Area of cruise, data, and methods

Bottom trawl survey in April 2008 included 26 sampling stations carried out on the shelf and upper slope of the Karagin and Olyutor Bays (Fig. 1). At each station a haul of 30 minutes duration at a vessel speed of 4 knots was made. Additionally to research trawl stations, 14 commercial hauls at the depths 150-300 meters were conducted during F/V "Yumir" operating in commercial fishing

regime in the same area. These stations also were included for calculations of number and biomass of hydrobionts.

The basic fishing gear was bottom trawl Fiska-II with vertical opening of 8 meters and horizontal opening 43 meters.

For each haul catches were identified to species, and the total number and biomass of each species were counted and weighted on board. During vessel operating as a commercial fishing boat, when the catches of fish were much higher compare of survey hauls, the subsample of 300-400 kg was analyzed for species composition identification, and total number and weight of each species were back calculated on the base of processed fish production.

From each catch a subsample of up to 300-500 specimens was selected randomly for length frequency analysis. An additional samples of 50 or 100 specimens were analyzed for fish length, weight, maturity determining. At the same time otoliths were removed for pollock aging.

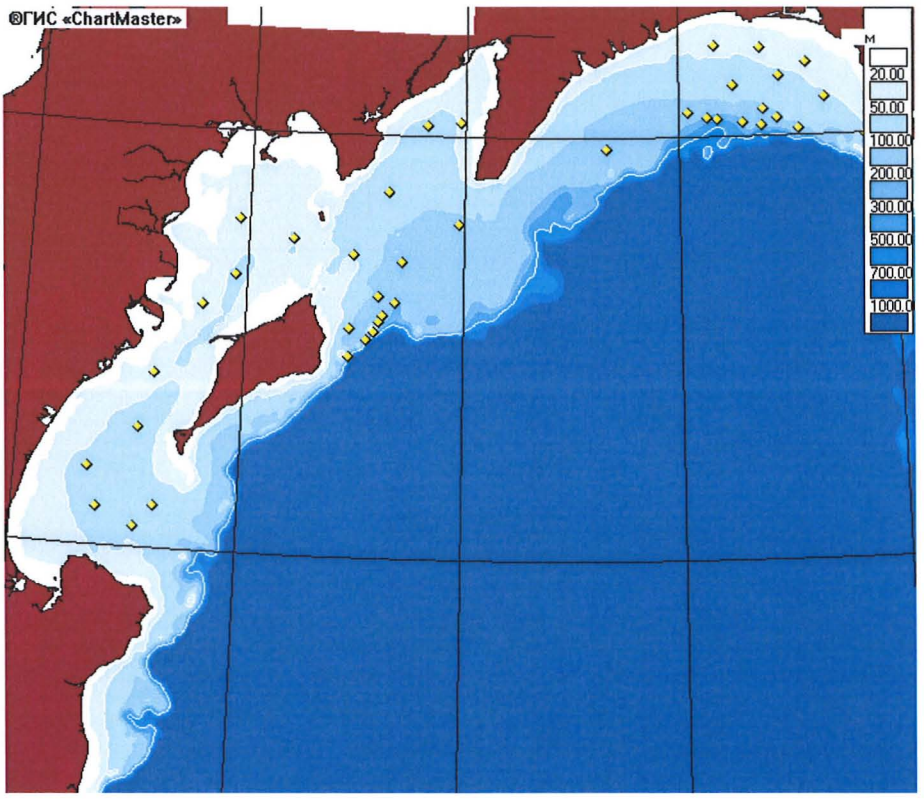

Figure 1. Trawl stations location during F/V"Yumir" cruise in September 2008.

Species composition by trawl surveys data in the Western Bering Sea

Total of 14 families and 42 species of fish were identified in samples collected during bottom trawl survey in the South-western Bering Sea in September 2008 (Table 1). Walleye pollock were absolutely dominating species accounted 88.2% of the total fish number and 80.7% of weight. This species occurred 90% trawl hauls with average catch 2431 specimens/hour and 1605 kg/hour. Proportion of other commercially important fishes of total catch weight was rather negligible: Pacific cod – 3.6%, flathead soles – 2.3%, arrowtooth flounder – 1.5%. Relatively high was proportion of sculpins, especially great sculpin *Myoxocephalus polyacanthocephalus* and Irish lord *Hemilepidotus jordani,* provided in sum 10.6% of the total catch weight.

Fish biomass estimation in the Karagin and Olyutor Bays

Estimates of distribution and biomass of fish were obtained using GIS "ChartMaster" software developed at VNIRO based on spline-approximation method (Ivanov, Stoljarenko, 1988) for next bathymetric zones: <50 m, 51-100 m, 100-200m, >200 m. Calculated biomass of demersal fish including near-bottom walleye pollock in the area of 10554 square miles was 449.7 thousand tons with an average density of distribution 12.4 tons per square kilometer (Table 2). About 78.5% of fish was accounted in the Karagin Bay, 11.5% – in Olyutor Bay. The total biomass estimate forwalleye pollock in the South-western Bering Sea was 385 thousand tons, and fishing stock biomass, calculated using data on pollock size composition, was 310 thousand tons.

Biomass of demersal fish except pollock was 64.7 thousand tons what corresponds to only 14.4% of total estimate, with average density 1.6 and 2.2 tons per sq. kilometer in Karagin and Olyutor Bays respectively. The major component of demersal fish community were sculpins (Cottidae). In the first area two species of them (great sculpin, and Irish lord) provided nearly half of biomass estimate

excluding pollock (27.7 % and 21.2%), what corresponds to biomass 11.1 and 8.5 thousand tons respectively. In Olutorsky Bay biomass and share of sculpins were also rather high, especially of great sculpin – 7.9 thousand tons (32.2%).

Table 1. Species composition of "Yumir" bottom trawl survey in the Karagin and Olyutor Bays, September 1-11, 2008

Species (scientific name)	Catch		Frequency of occurrence, %	Percent of total number
	number/ hour	kg/ hour		
Sqalidae				
Somniosus pacificus	0.03	0.73	3	+
Rajidae				
Bathyraja aleutica	0.62	2,68	10	0.02
Bathyraja maculata	0.28	1.34	8	0.01
Bathyraja parmiphera	1.01	3.77	21	0.19
Bathyraja minispinosa	0.10	0.07	5	+
Clupeidae				
Clupea pallasi	0.54	0.16	3	0.02
Osmeridae				
Mallotus villosus catervarius	5.13	0.05	3	+
Gadidae				
Gadus macrocephalus	49.84	70.85	62	1.81
Theragra chalcogramma	2430.97	1605.23	90	88.22
Eleginus gracilis	1.74	0.88	13	0.06
Hexagrammidae				
Pleurogrammus monopterygius	0.03	0.02	3	+
Sebastidae				
Sebastes alutus	0.03	0.01	3	+
Sebastes borealis	0.28	1.43	3	0.01
Sebastes glaucus	0.33	0.46	5	0.01

Cottidae				
Gymnacanthus detrisus	5.44	2.71	15	0.20
Gymnacanthus galeatus	0.05	0.01	3	+
Hemilepidotus gilberti	2.59	1.74	15	0.09
Hemilepidotus jordani	47.70	94.26	41	1,73
Icelus spiniger	0.29	0.04	5	0.01
Myoxocephalus jaok	3.15	4.95	26	0.11
M. polyacanthocephalus	34.68	106.86	64	1.26
Psychrolutidae				
Dasycottus setiger	1.37	0.80	10	0.05
Malacocottus zonurus	2.03	1.67	10	0.07
Agonidae				
Percis japonicus	1.49	0.24	10	0.05
Sarritor frenatus	0.05	0.01	3	+
Cyclopteridae				
Aptocyclus ventricosus	0.05	0.09	3	+
Liparidae				
Careproctus rastrinus	4.42	2.56	13	0.13
Careproctus sp.	0.28	0.23	3	0.01
Liparis ochotensis	1.19	1.12	28	0.04
Zoarcidae				
Lycodes palearis	0.91	0.24	8	0.03
Lycodes raridens	0.20	0.25	5	0.01
Pleuronectidae				
Atheresthes evermanni	4.26	4.84	15	0.15
Atheresthes stomias	22.38	29.15	36	0.85
Reinchardtius h.matsuurae	3.26	3.95	18	0.12
Hippoglossus stenolepis	1.21	10.46	8	0.04
Hippoglossoides elassodon	4.03	1.39	18	0.15
Hippoglossoides robustus	59.44	18.00	64	2.16
Lepidopsetta polyxystra	0.44	0.12	10	0.02
Limanda aspera	9.17	4.29	44	0.33
Limanda sakhalinensis	47.44	5.83	26	1.72
Pleuronectes quadrituberculatus	5.92	7.18	44	0.21

The most abundant group among commercially valuable fishes were flounders providing 26.0 % (10.4 thousand tons) of bottom fish biomass in Karagin Bay and

31.4% (7.7 thousand tons) in Olyutor Bay. The biomass of Pacific cod was in 2008 rather low – 6.4 and 6.2 thousand tons in Karagin and Olyutor Bays respectively.

Comparing the estimates of demersal fish abundance for three recent years (Table 3), when studies were conducted according the similar bottom trawl survey design and using similar trawl equipment, it can be noticed that in 2008 for the most important commercial fishes (except walleye pollock) they were lower. It appears to be a result of differences in survey terms. Unlike 2005-2006 years, when the surveys were conducted in October, in 2008 all studies were restricted by first half of September, and it seems that such early terms are not optimum. It is quite evident from water temperature distribution by depth (Fig. 2) that in September 2008 the subsurface layer up to depth 30 meters was relatively warm (up to 10-11°C). On the contrary, in mid-water layers the temperature was very low.

Table 2. Biomass (tons) and density (tons/km^2) estimates of demersal fish from bottom trawl survey in the western Bering Sea (F/V "Yumir", September 1-11, 2008)

	Estimated biomass, tons					Average dendity
Depth range, m	<50	50-100	100-200	200-300	Σ	tons/km^2
Total area, km^2	12976	13514	8447	1288	36225	
S. pacificus	9	13	22	48	92	0.003
B. aleutica	45	145	455	20	664	0.018
B. maculata	54	12	34	11	111	0.003
B. minispinosa	5	4			9	+
B. parmifera	99	353	347	7	806	0.022
C. pallasii	8	28	8	2	47	0.001
M. villosus	2	19	2	0	22	0.001
E. gracilis	15	94	36	7	152	0.004
G. macrocephalus	1800	4892	4253	1630	12575	0.347
T. chalcogramma	34502	119903	187278	43330	385012	10.628
S. alutus	+	+	+	+	+	+
S. borealis		90	464	11	565	0.016
S.glaucus	1	40	120	2	164	0.005
P.			1		1	+

monopterygius						
G. detrisus	10	270	180	28	487	0.013
G. galeatus	1	0	0	0	1,46	+
H. gilberti	8	150	69	9	237	0.007
H. jordani	539	2120	4704	1660	9023	0.249
I. spiniger	1	4	9	0	14	+
M. jaok	716	777	123	11	1627	0.045
M. polyacantho-cephalus	1422	6033	10548	993	18997	0.524
D.setiger	6	39	94	26	165	0.005
M. zonurus	2	10	28	23	64	0.002
P. japonicus	1	6	12	8	27	0.001
S. frenatus	0	1	0	0	1	+
A. ventricosus	0	17	55	3	75	0.002
C. rastrinus	2	21	89	52	164	0.005
Careproctus sp.	0	14	73	1	88	0.002
L. ochotensis	55	129	126	9	319	0.009
L. palearis	0	11	19	2	32	0.001
L. raridens	25	63	7	+	95	0.003
A. evermanni	11	257	877	143	1287	0.036
A. stomias	307	1191	2575	1216	5288	0.146
H.elassodon	9	86	186	9	290	0.008
H. robustus	374	2274	1968	242	4859	0.134
H. stenolepis	25	82	1715	106	1928	0.053
L. polyxystra	5	22	7	+	33	0.001
L. aspera	268	268	110	11	657	0.018
L. sakhalinensis	16	659	629	143	1448	0.040
P. quadrituber-culatus	235	749	519	61	1565	0.043
R. hippoglossoides	103	185	174	230	692	0.019
					449	
Total*	40684	141031	217913	50055	684	12.414
Total**	6182	21129	30636	6725	64672	1.785

Note: * - total biomass; ** -total biomass except walleye pollock

Thus, it can be supposed, that in early September 2008 large part of fish stocks, first of all of Pacific cod and flounders, inhabited in warm inshore waters at depths less 30 meters, beyond the surveyed area and depths. Taking unto account that minimum depth of trawl stations during F/V "Yumir" survey was 35 meters

we must conclude that in 2008 resources of some demersal fish were underestimated in comparison with years 2005 and 2006.

Table 3. Abundance and biomass estimates for most important commercial fishes from KamchatNIRO bottom trawl surveys in the western Bering Sea in 2005, 2006, and 2008.

	2005		2006		2008	
	thousand ind.	tons	thousand ind.	tons	thousand ind.	tons
Sharks	18	1937	0	0	11	92
Skates	2152	12330	845	2249	448	1590
Walleye pollock	1317158	589250	291308	211915	583333	385012
Pacific cod	24040	54947	22140	61485	8850	12575
Sculpins	19641	25002	76121	92818	16263	30616
Rockfishes	2157	1121	309	539	244	729
Halibuts	8288	13894	9895	20312	8546	9195
Flounders	23226	6122	57275	24400	26322	8851

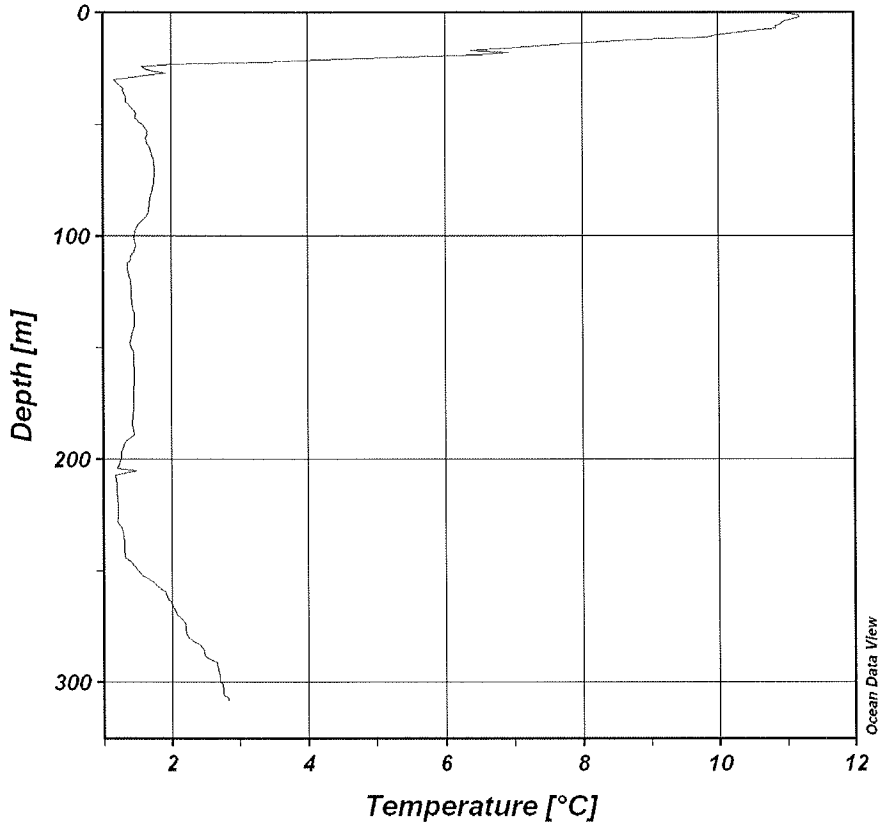

Figure 2. Average water temperature by depth in Olyutor Bay in September 2008.

Distribution, size composition and biological condition of walleye pollock and other demersal commercial fish

Walleye pollock. Only 34.5 thousand tons from total biomass 385.0 thousand tons (or 9.0%) were recorded at the depths less 50 meters (Tab. 2). In September 2008 the maximum aggregations of walleye pollock with density over 18 tons per sq. kilometer were recorded at few sites in upper slope eastward of Karagin Island (Fig. 3).

Pollock length in the Karagin Bay ranged from 20 to 80 cm; length frequency distribution was polymodal with dominating size-groups 26-29, 36-42, and 48-58 cm. The most abundant were fish of length 48-58 cm, compiling 50.6% at the depths less 100 meters, and 46.6% deeper 100 meters (Fig. 4). Second peak of pollock size composition in deep waters belonged to group with length 36-42 cm (30.8% at depths >100 meters). The average length in the area for the whole period of sampling was 50.0 cm at depth <100 meters, and 44.7 cm deeper 100 meters.

In the Olyutor Bay at the depths more than 100 meters large-sized walleye pollock with body length over 60 cm predominated (59.4%) whereas in depth <100 meters modal was size group 36-42 cm (38.0%). The difference in an average length of walleye in the Olyutor Bay pollock by depth in September was very extreme – 54.6 cm at depth <100 meters, and 43.3 cm deeper 100 meters.

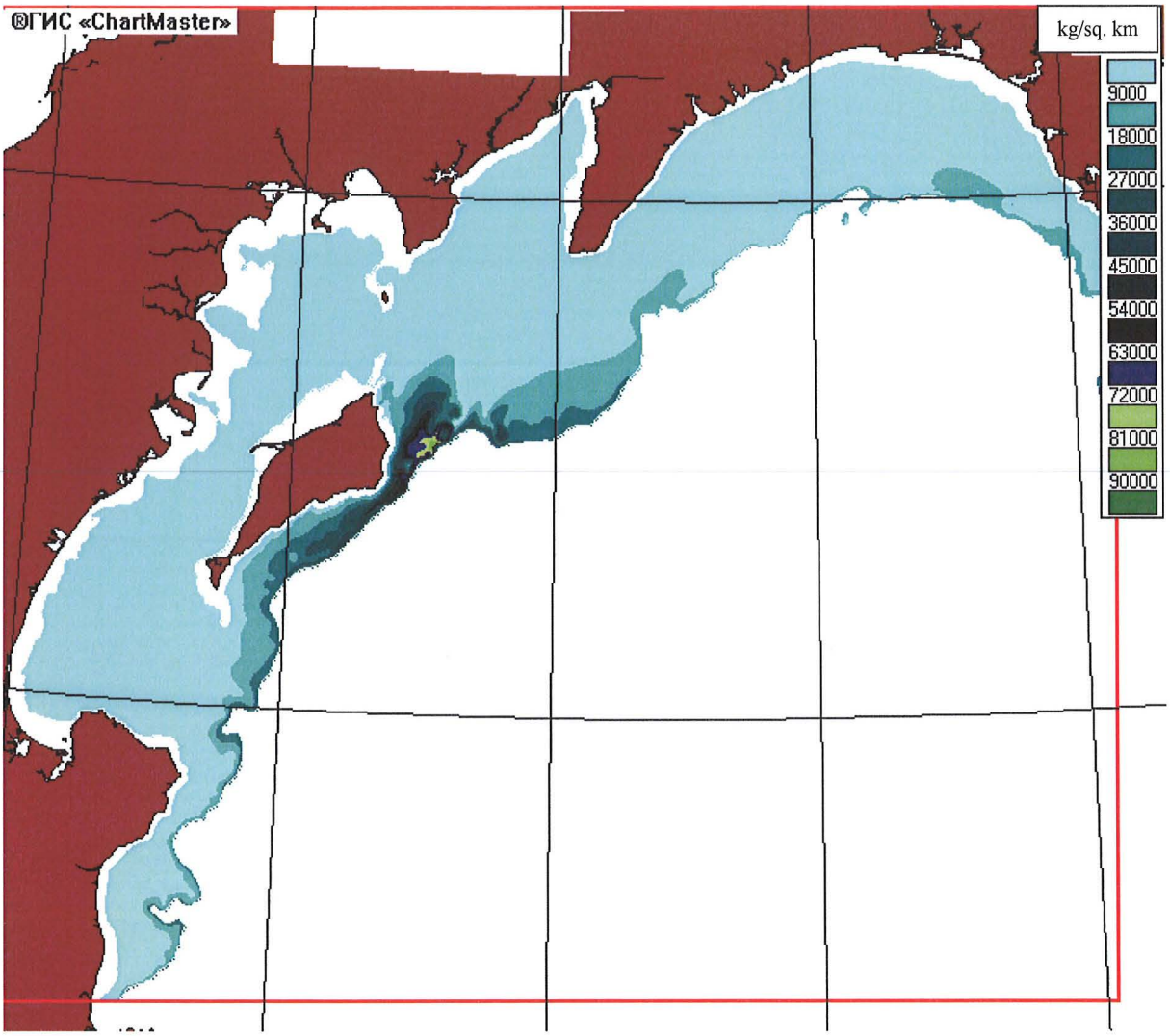

Figure 3. Distribution of walleye pollock biomass (kg/km^2) for the period of bottom trawl survey in the Western Bering Sea (F/V "Yumir", September 1-11, 2008)

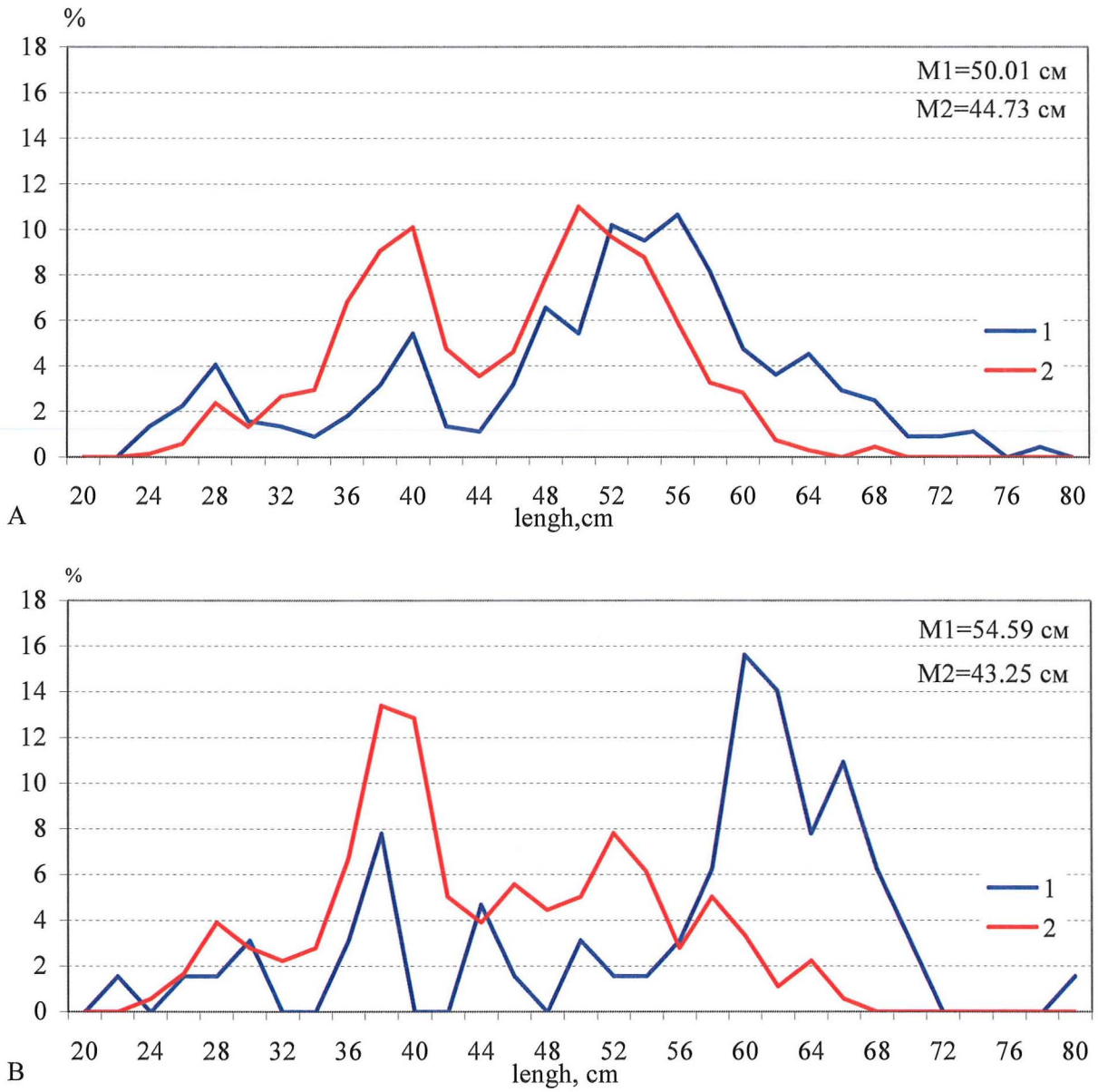

Figure 4. Walleye pollock size composition in the western Bering Sea. F/V "Yumir", September 1-11, 2008. *A* – Karagin Bay, *B* – Olyutor Bay; 1 – < 100 meters, 2 – >100 meters

Kamchatka flounder. This species was widely distributed in the Western Bering Sea. Area of enlarged catches was localized between Karagin Island and Goven Peninsula (Fig. 5) where density of biomass exceeded 0.4 tons/km^2. Outside this area the catches were negligible. The bulk of catches was represented by specimens of length 44-49 cm and weight 0.8-1.0 kg.

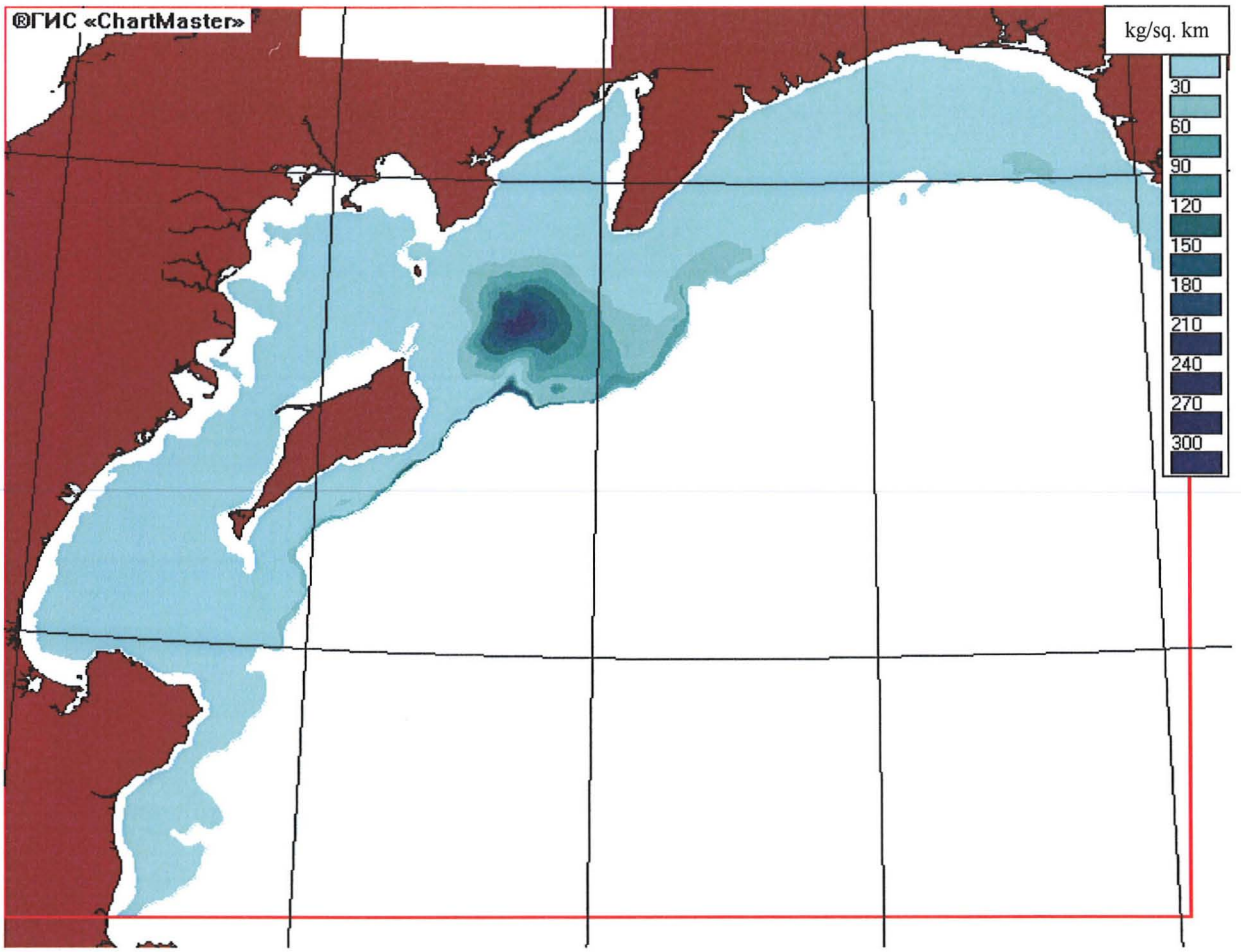

Figure 5. Distribution of Kamchatka flounder biomass (kg/km^2) for the period of bottom trawl survey in the Western Bering Sea (F/V "Yumir", September 1-11, 2008)

Arrowtooth flounder. This flounder was the most abundant representative of Pleuronectidae family during F/V "Yumir" survey in September 2008 and occurred within the area studied everywhere. However the highest density was localized in south-western part of the Olyutor Bay and along the slope of "plateau" between the Karagin Island and Goven Peninsula (Fig. 6) with biomass over 0.5 tons/km^2. Mostly numerous were fish of 44-57 cm length and 0.70-1.777 kg weight.

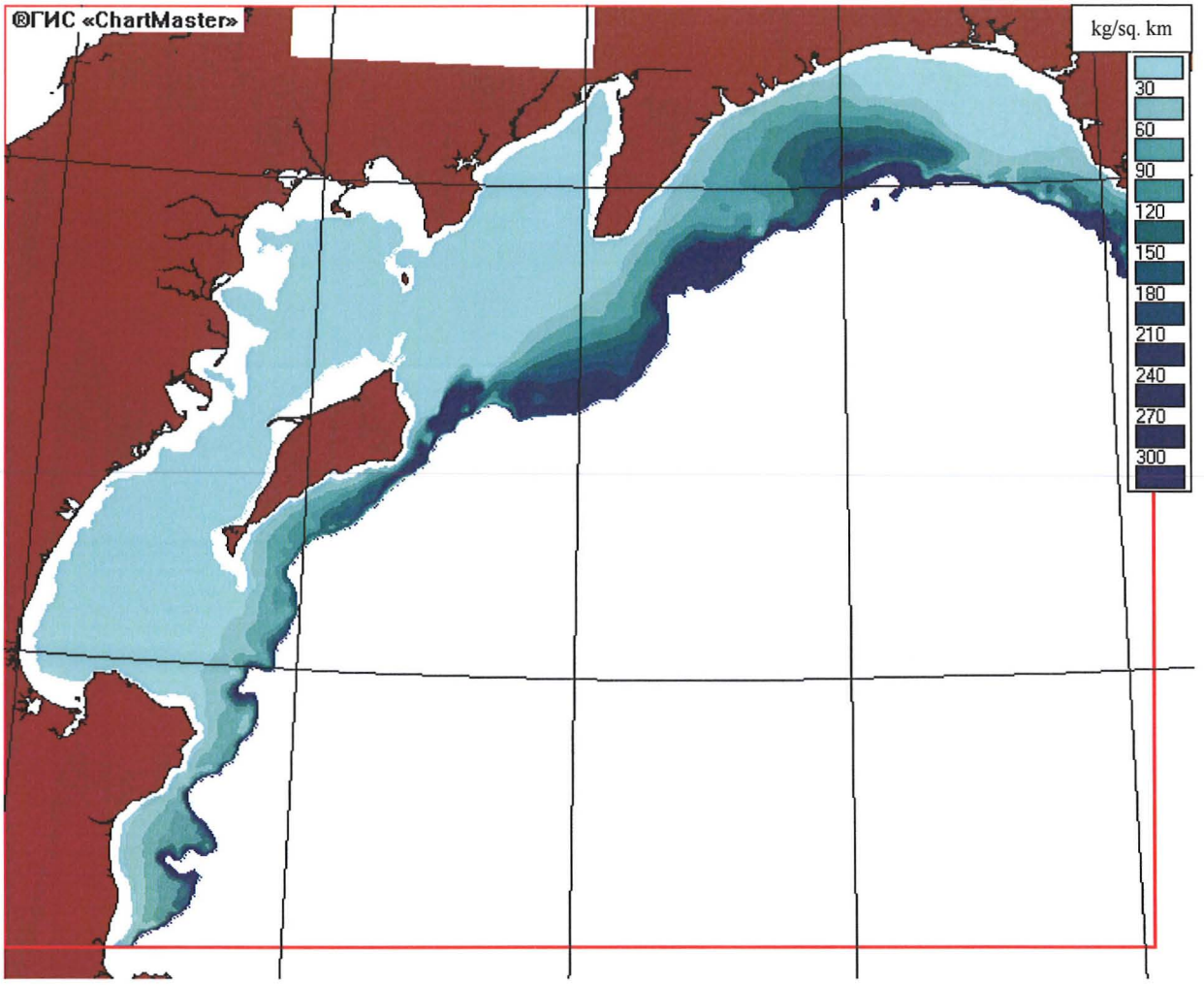

Figure 6. Distribution of arrowtoorh flounder biomass (kg/km^2) for the period of bottom trawl survey in the western Bering Sea (F/V "Yumir", September 1-11, 2008)

Sakhalin sole. Rather usual species with high frequency of occurrence according to survey data. Mostly abundant was in the central zone of the Olyutor Bay at the depths 150-300 meters with maximum biomass at some sites exceeding 0.7 tons/km^2 (Fig. 7). Specimens of 22-24 cm length and 0.04-0.16 kg predominated.

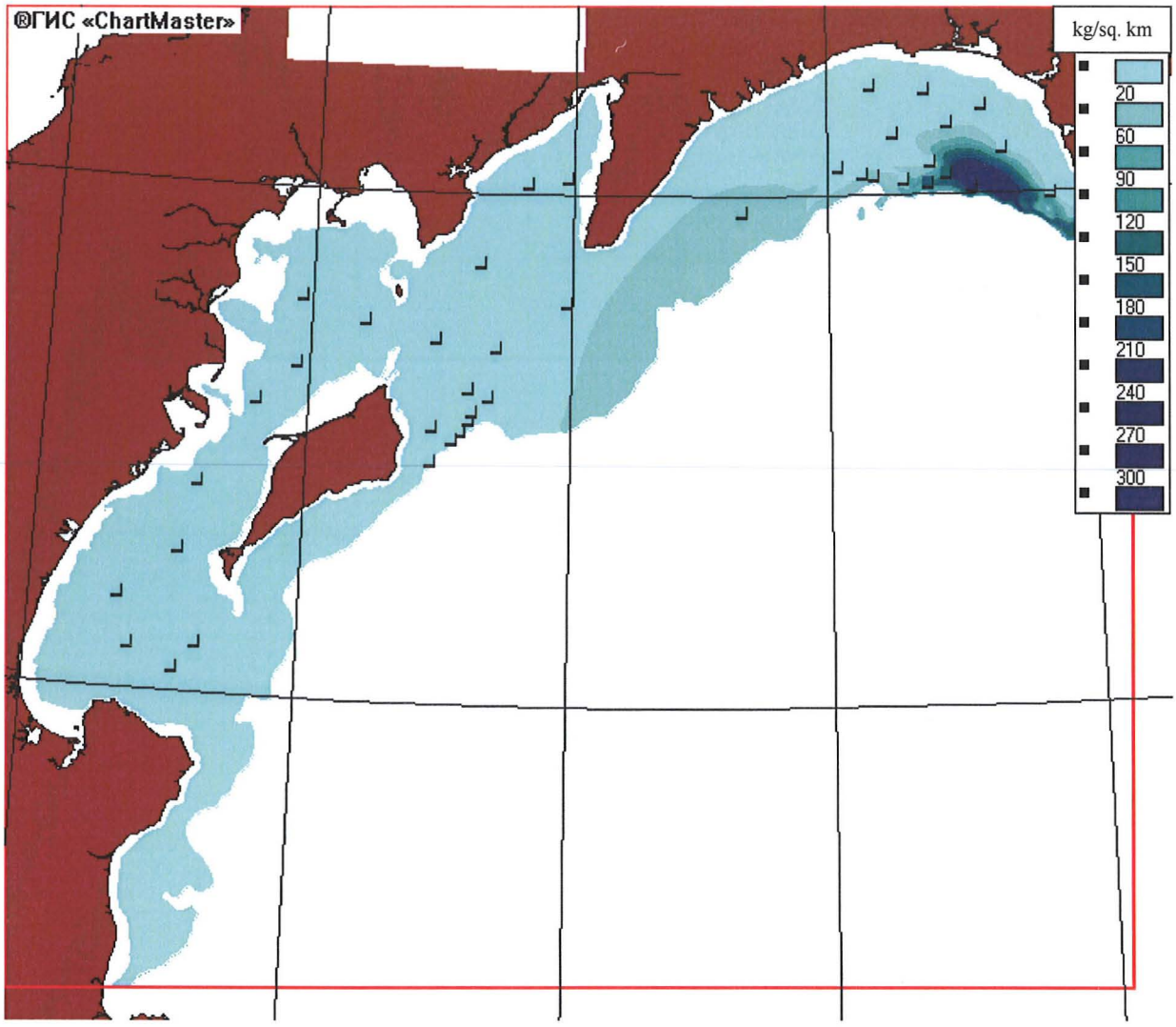

Figure 7. Distribution of sakhalin sole biomass (kg/km^2) for the period of bottom trawl survey in the western Bering Sea (F/V "Yumir", September 1-11, 2008)

Northern flathead sole. Major aggregations of northern flathead sole occurred in Korf Bay, and in western part of Olyutor Bay (Fig. 8). In these places the density of biomass exceeded 0.5 tons/km^2. Predominated fish of 30-40 cm length (32.9 cm on average) and 0.3-0.6 g weight.

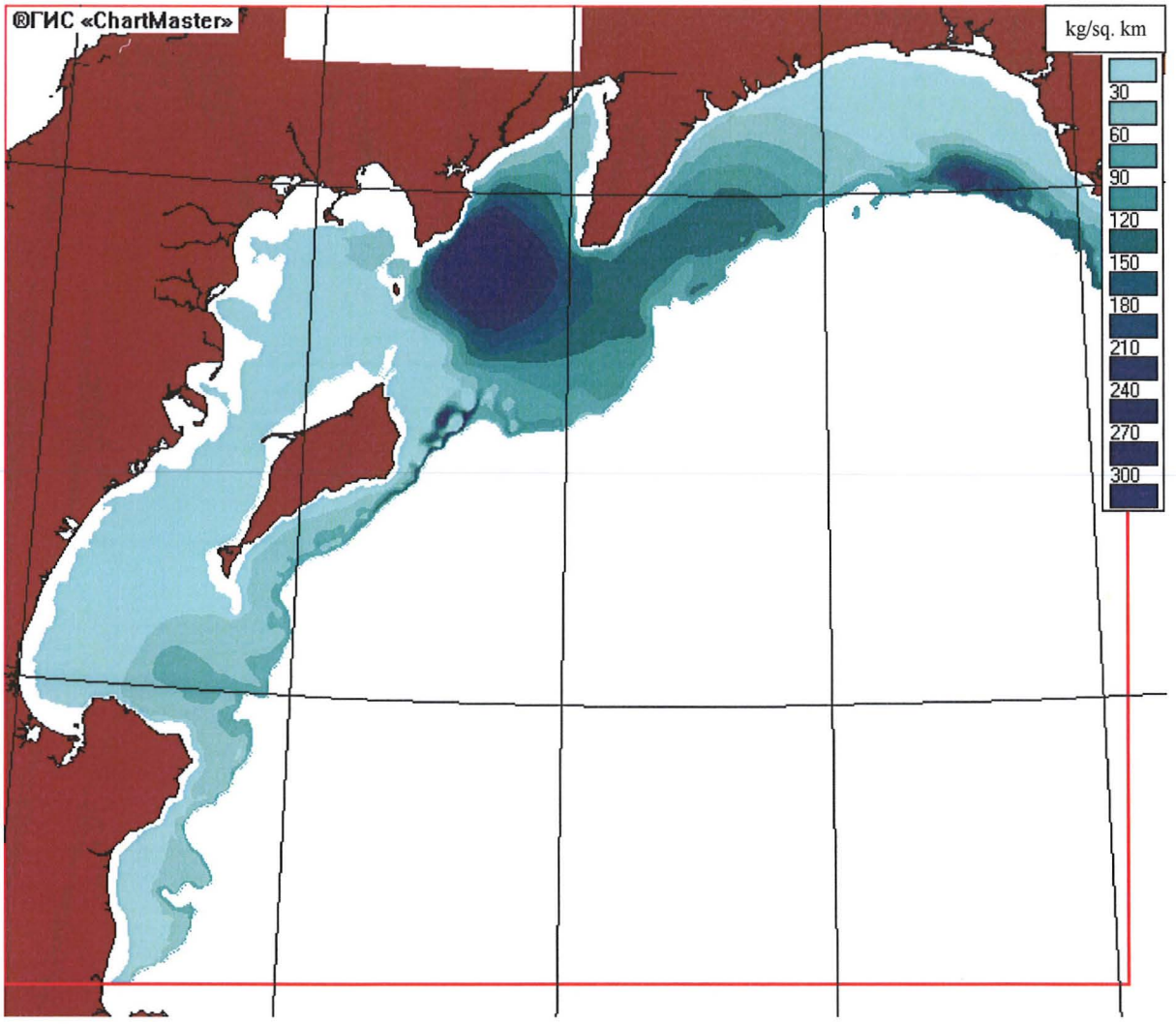

Figure 8. Distribution of northern flathead sole biomass (kg/km^2) for the period of bottom trawl survey in the western Bering Sea (F/V "Yumir", September 1-11, 2008)

2.4. Cruise aboard SRTM "Lebedevo" to the Northwestern Bering Sea in October-December 2008

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This survey was a continuation of researches of the pollock in the Northwestern Bering Sea, which were made before.

The main tasks of the cruise were:

1. Integrated study of pollock population structure, its stock status in the North-Western Bering Sea and the role of pollock in contemporary ecosystem.

2. Study of space-time variability in distribution of Karagin and Navarin pollock gathering.

3. Stock assessment of pollock.

4. Monitoring of size-weight structure and biological state of pollock.

The solution of the above problems was aimed at: obtaining integrated data needed to identify the sources of formation of pollock concentrations in the northwest and central Bering Sea; appreciating pollock biomass, size of recruitment and biological state.

The main engine power of SRTM "Lebedevo" is 1980 kbt. Length 53.1m, width 12m, tonnage 1195 BTR. Disposition of the vessel is determined by the satellite system GPS "Furuno GP-50", electronic-cartographical system "Navi-Fisher-3000". Complex of fish finding and registering equipment is represented by fishing echo sounder "FCV-30" and trawl control of "Furuno TS-331A".

Figure 1. SRTM "Lebedevo".

Trawling operations were conducted with a bottom trawl (type 77/63 m, project 162 which was made in Russia) with vertical net opening 12 m, horizontal one - 55 m. Mesh size in the codend was 100 mm. During surveys was used a bottom trawl (type 46/72, project 82 which was made in Russia) with the vertical net opening 12 m and horizontal 24 m with small mesh inset in the codend with distance between knots 10 mm. The length of small mesh inset was 10 m. The mouth of inset was 2 m width.

The duration of the trawling during cruise varies from 30 to 280 min. 44105 measures, 5917 full bioanalisis, 102 length-weight measures were made during the cruise. Also were collected 928 samples for age determination and 202 samples for genetic studies.

The following variables and coefficients were used in the calculations:

horizontal opening during the surveys 24 m;

coefficient of fishing efficiency	1.0;
spline smoothing	0;
depth coefficient	1000.

The bottom trawl survey which consisted of 36 trawling took place in the Navarin region (**14658 sq. miles**) from 9 till 20 of November in day time. The duration of each trawling was 30 minutes.

The bottom trawl survey which consisted of 15 trawling took place in the Karagin subzone (**2152 sq. miles**) from 9 of October till 4 of November in day time. The duration of each trawling was 30 minutes.

178 trawling on the depth 55-610 m were made during the working period.

Biological conditions of pollock in the Karagin subzone

Pollock in catches was presented with the fish body length of 11-74 cm when average size was 41.03 cm (Fig. 2). Group of 41-53 cm was the greatest while its proportion in total catches was 48.54%.

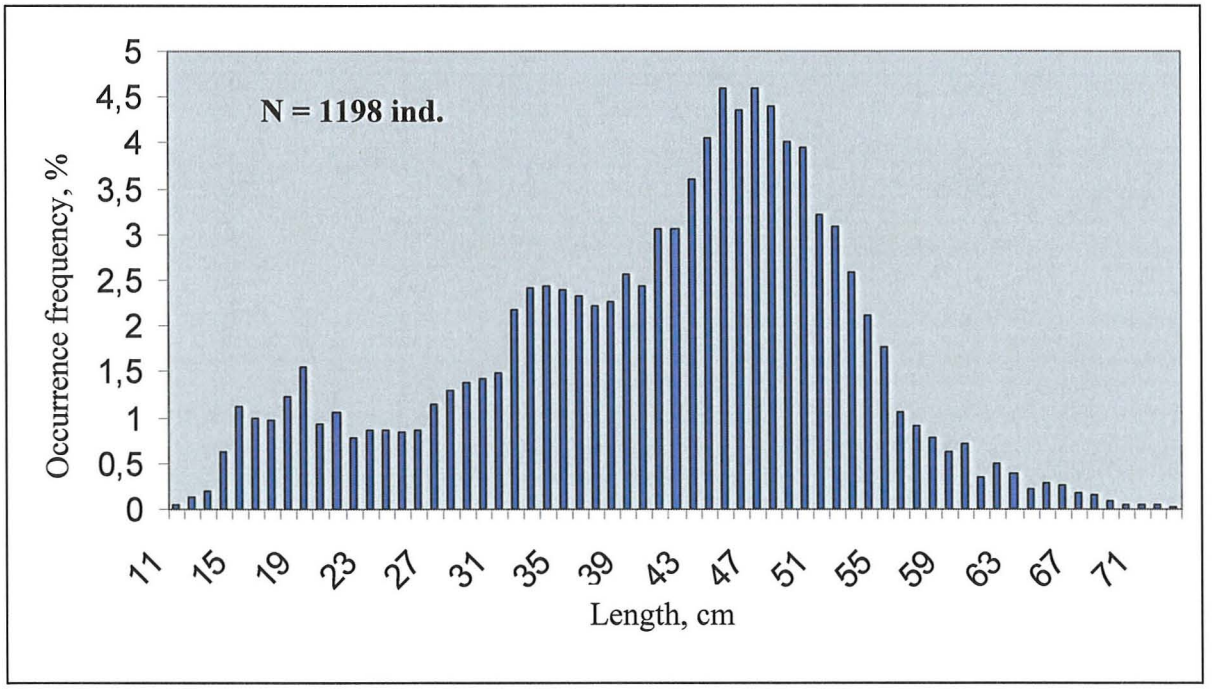


Figure 2. Length composition of pollock in the Karagin subzone in October-December.

Proportion of females and males was equal to 57.0 / 43.0. In catches immature fish was 20.2% (Fig. 3). Females were a little bit larger than males. Females' length was within 12.8-73.6 cm in average 43.4 cm. Males' length was from 13.7 till 66.4 cm average length 40.6 cm. The differences in body weight even more pronounced: 18.2-3258 g (in average 729.7 g), 17.8-3200 g (in average 591.7 g) females and males accordingly.

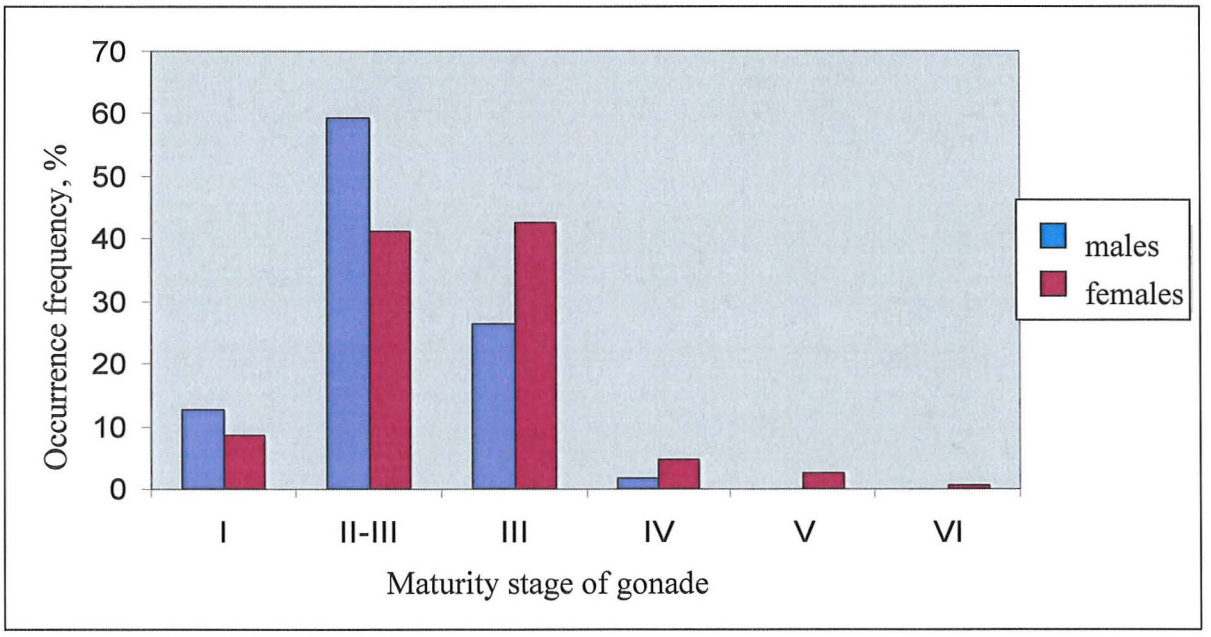


Figure 3. Proportion (%) of pollock males (N=509) and females (N=564) with gonad at different stage of maturity in the Karagin subzone in October-December.

Length-weight relationship was well structured by power function (Fig. 4) with a high measure of confidence of approximation of both sexes (R^2=0.98-0.97). Males and females dependence values of linear and degree coefficients turned out to be very close.

Males gonadosomatic index (GSI) (0.03–8.32% while average was 1.75%) was lower than that one of females (0.04-16.19% while average was 2.86%). Females hepatosomatic index (HSI) also was higher: 2.06-25.18% (average 9.80%)

while males was 2.43-23.82% (average 9.38%). High value of HSI (9.38-9.80%) allows us to say about favorable conditions for pollock's feeding in Karagin subzone in autumn 2008. Dependence between GSI and pollock length and between HSI and pollock length is presented at Figures 5 and 6 in accordance.

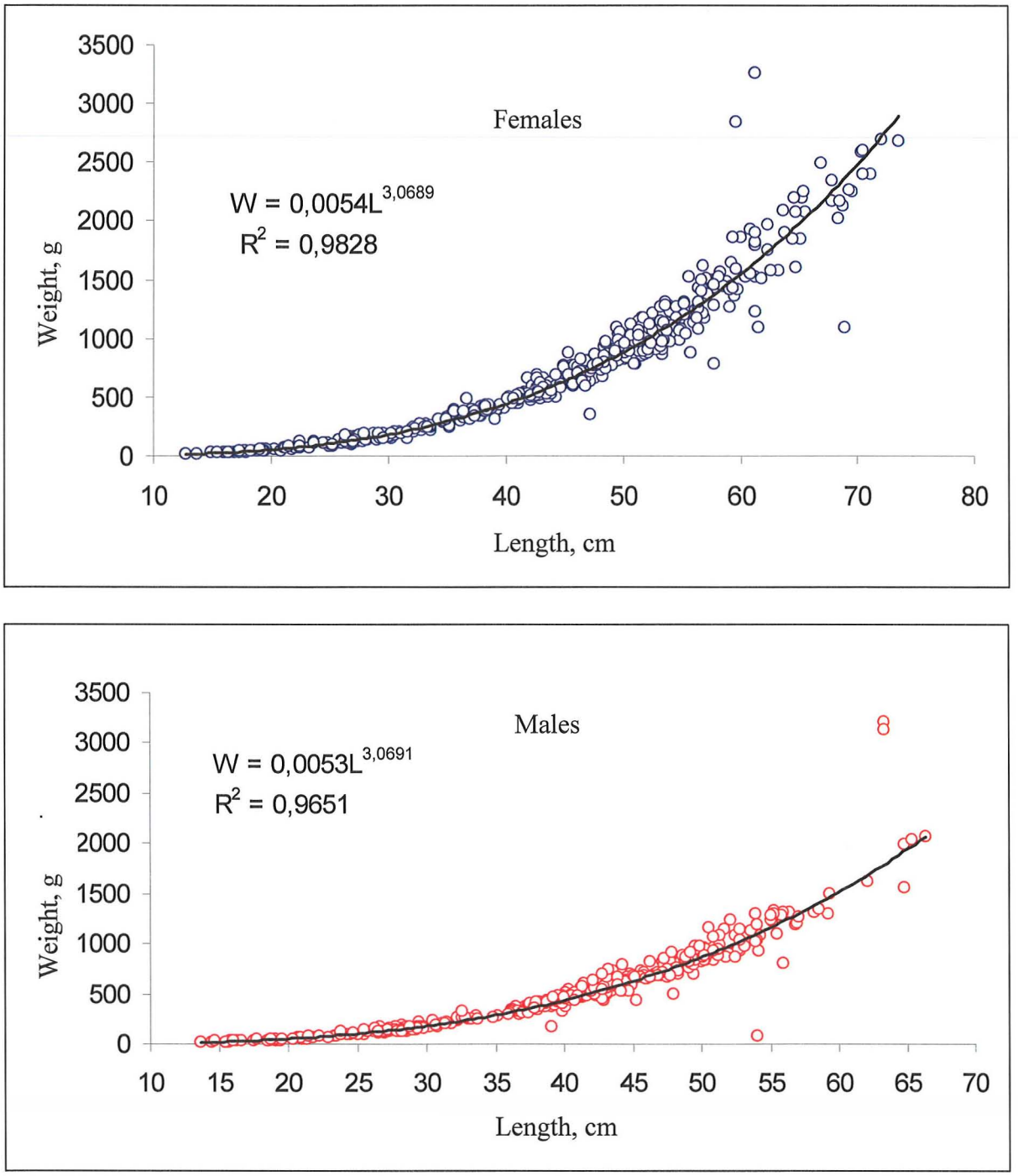
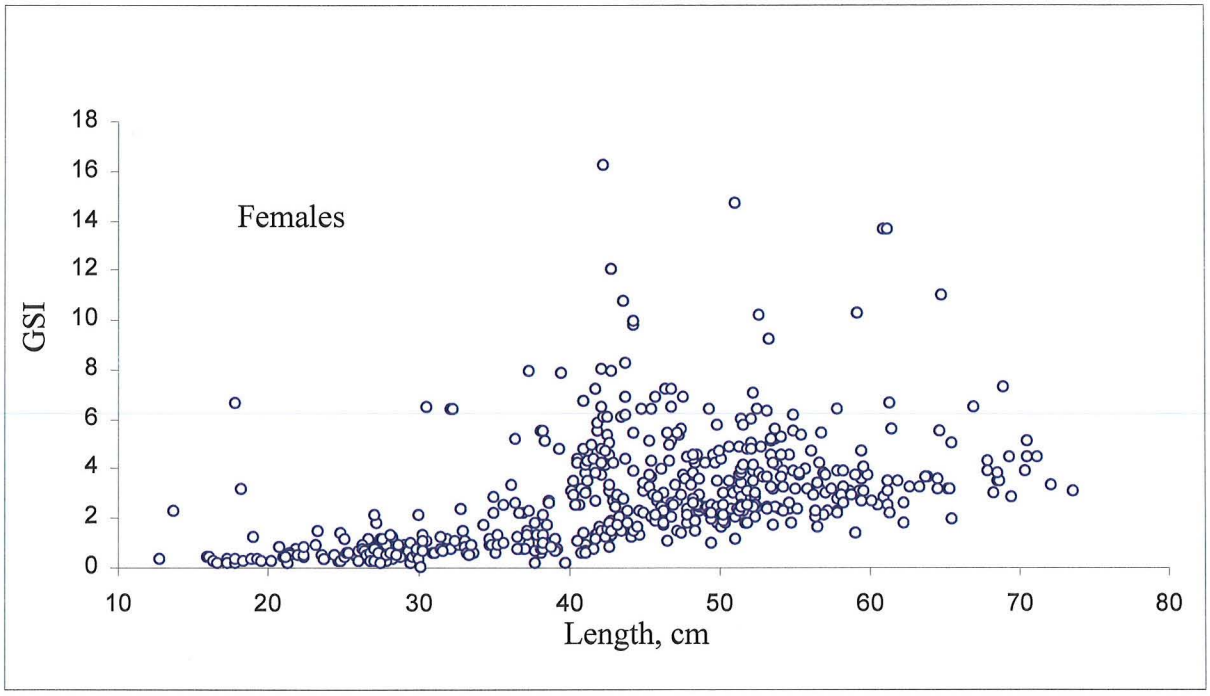


Figure 4. Length-weight relationship for pollock from the Karagin subzone in October-December.



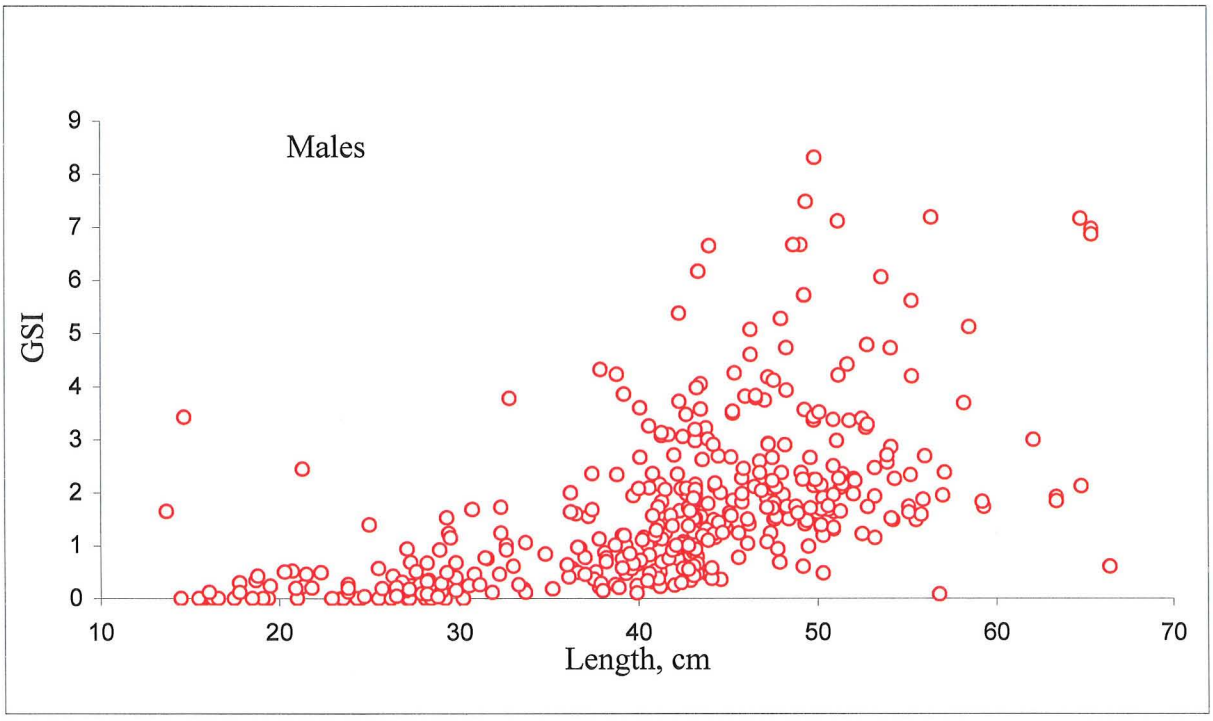
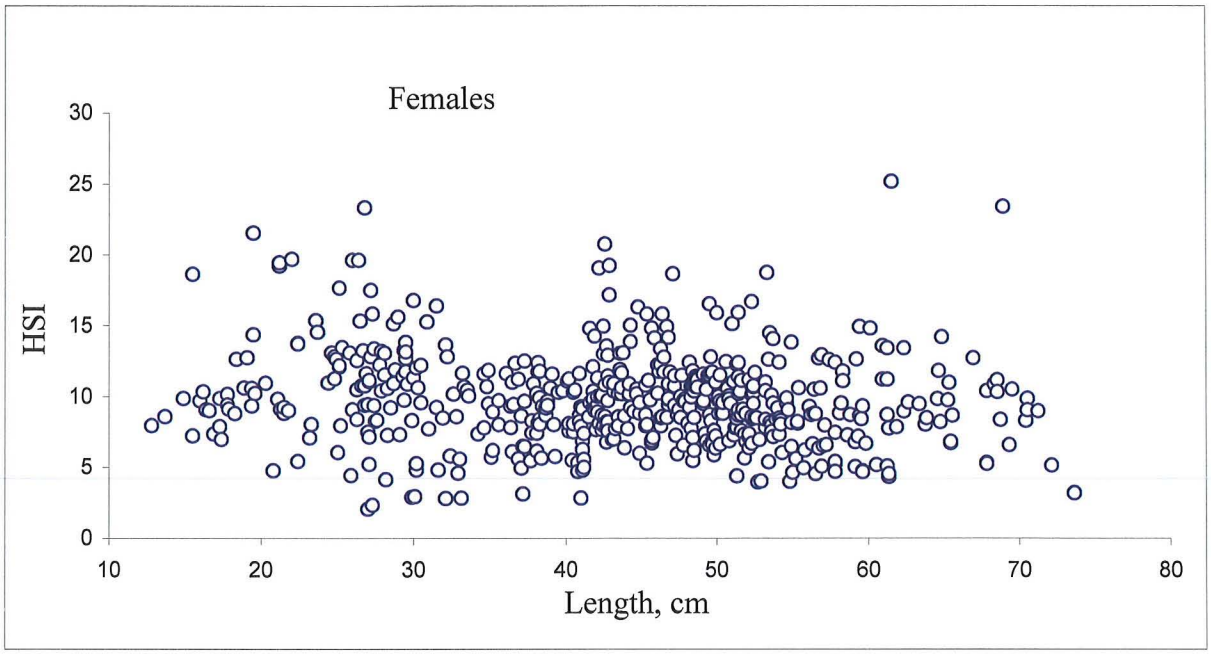


Figure 5. Changes of GSI in relationship with length of pollock from the Karagin subzone in October-December.



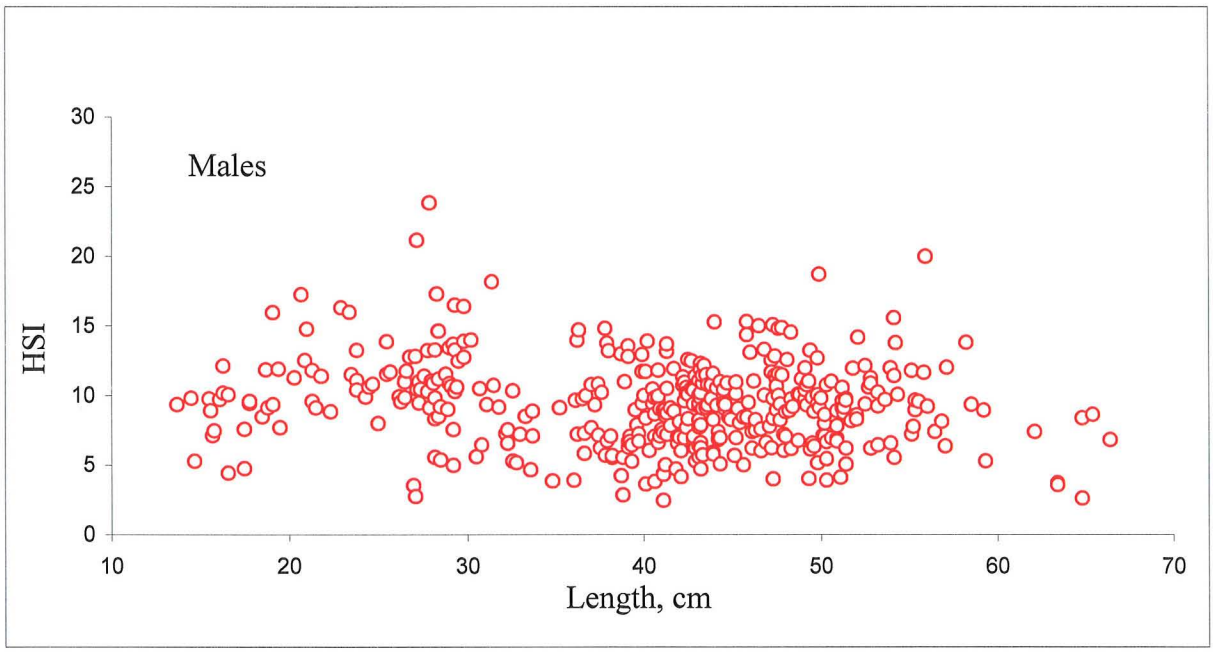


Figure 6. Changes of HSI in relationship with length of pollock from the Karagin subzone in October-December.

Pollock intensity feeding during studied period was high. Average stomach filling units was 1.74. The share of empty stomachs was 19.31%. Cubic condition index was 0.580%.

In stomachs of all age fish more frequently noted were euphausiids and calanus (Fig. 7). Intensive cannibalism (9.2%) was recorded among elder fish. For the first time cannibalism was recorded in 33.2 cm predators and was more frequently in 42.1 cm individuals.

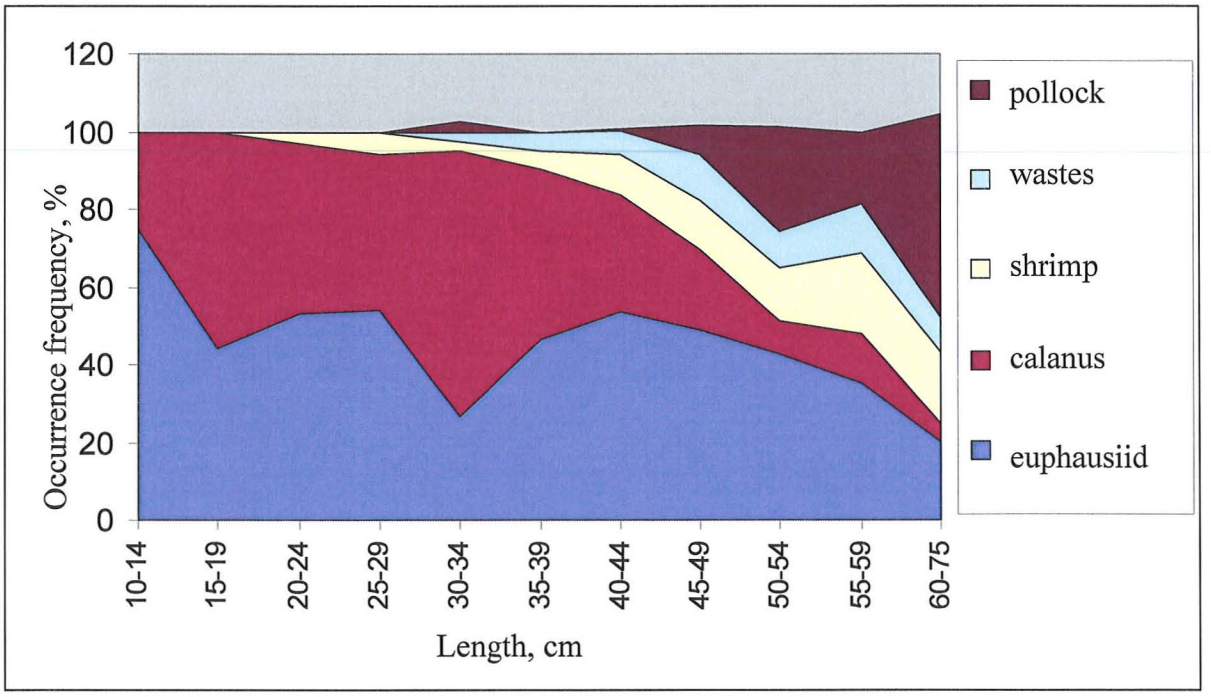


Figure 7. Pollock food composition by length in the Karagin subzone in October-December.

During survey period in the Karagin subsone in size range of pollock the most numerous (38.7%) were fish of 2006 year generation with length 19-25 cm. 2005 and 2007 year class fish had smaller abundance and formed 30.6% at length 26-31 cm and 30.7% at length 11-18 cm in accordance.

Biological conditions of pollock in the Navarin region

Pollock in catches was presented with the fish body length of 10-73 cm when average size was 36.6 cm (Fig. 8). Group of 42-52 cm was the greatest while its proportion in total catches was more then 39%.

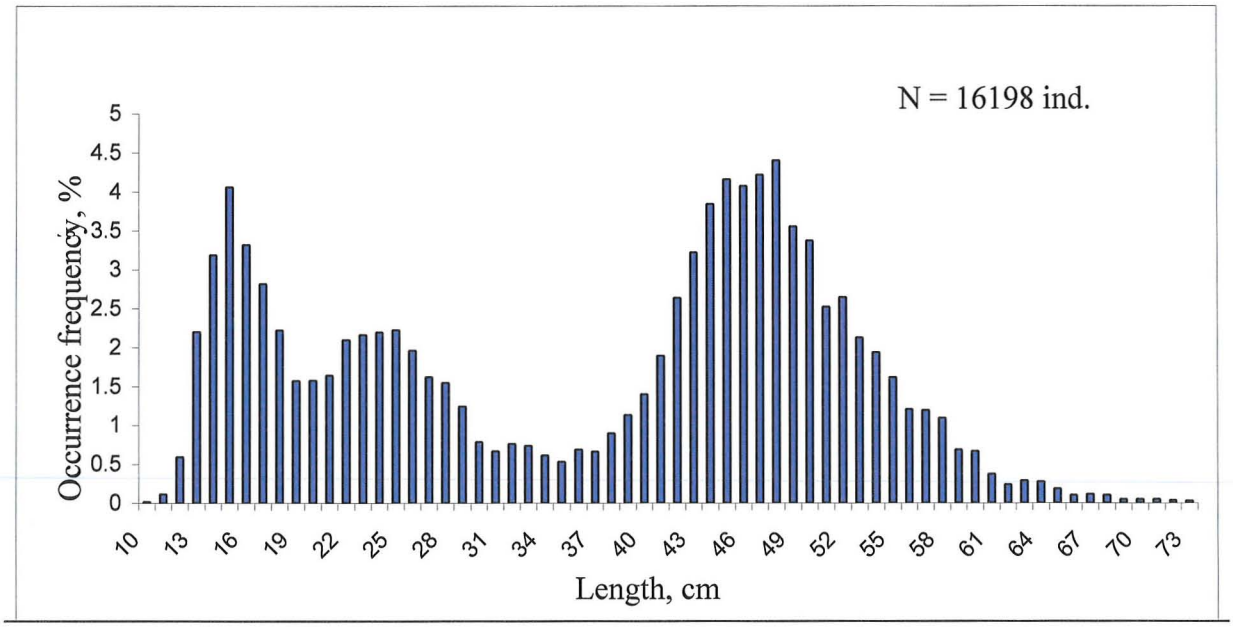


Figure 8. Length composition of pollock in the Navarin region in November..

Females dominated in catches. Proportion of females and males was 66.4% to 33.6%. In catches the portion of immature fish was 26.5% of the total. The most frequent stages of maturity were II and II-III (Fig. 9).

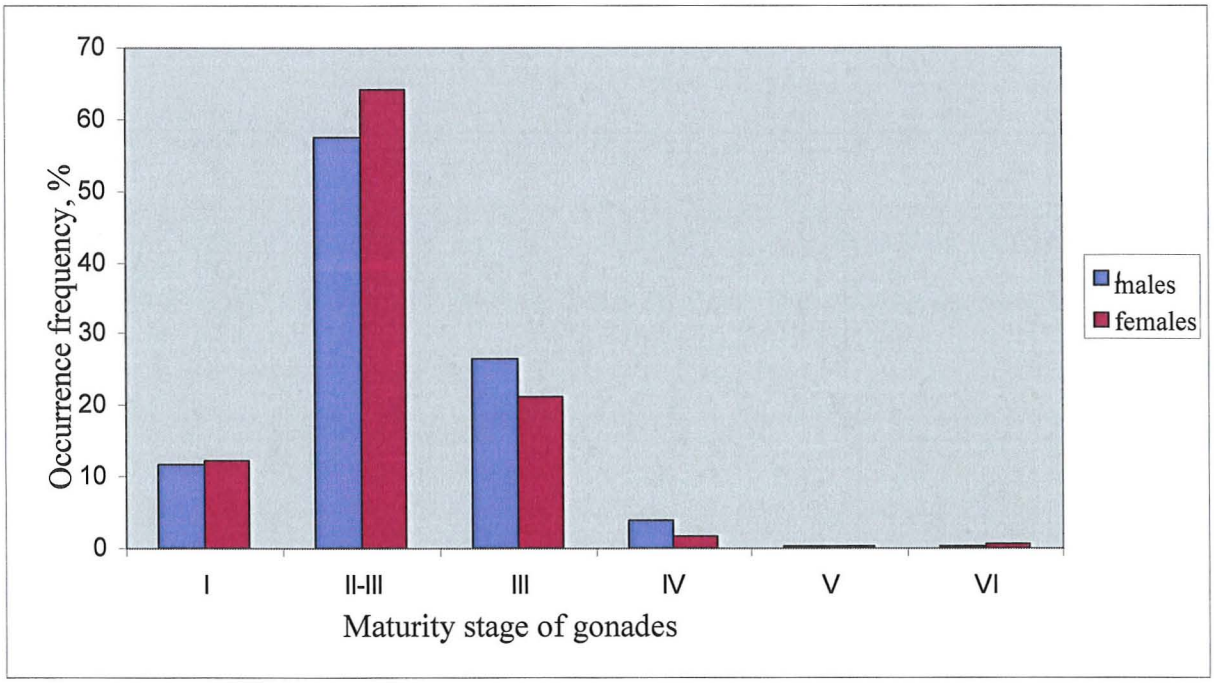


Figure 9. Proportion (%) of pollock males (N=628) and females (N=1241) with gonad at different stage of maturity in the Navarin region in November.

Length-weight relationship was well structured by power function (Fig. 10) with a high measure of confidence of approximation of both sexes (R^2=0.97).

Males gonadosomatic index (0.04–14.39 while average was 2.06) was higher than that one of females (0.04-19.70 while average was 1.97). Females hepatosomatic index was higher: 2.38-12.95 (average 8.51) while males was 1.43-11.13 (average 7.57). Dependence between GSI and pollock length was and HSI and pollock length is presented at Figures 11 and 12 in accordance.

Pollock intensity feeding during studied period was high. Average stomach filling units was 1.71. The share of empty stomachs was 29.1%. Cubic condition index was 0.616%.

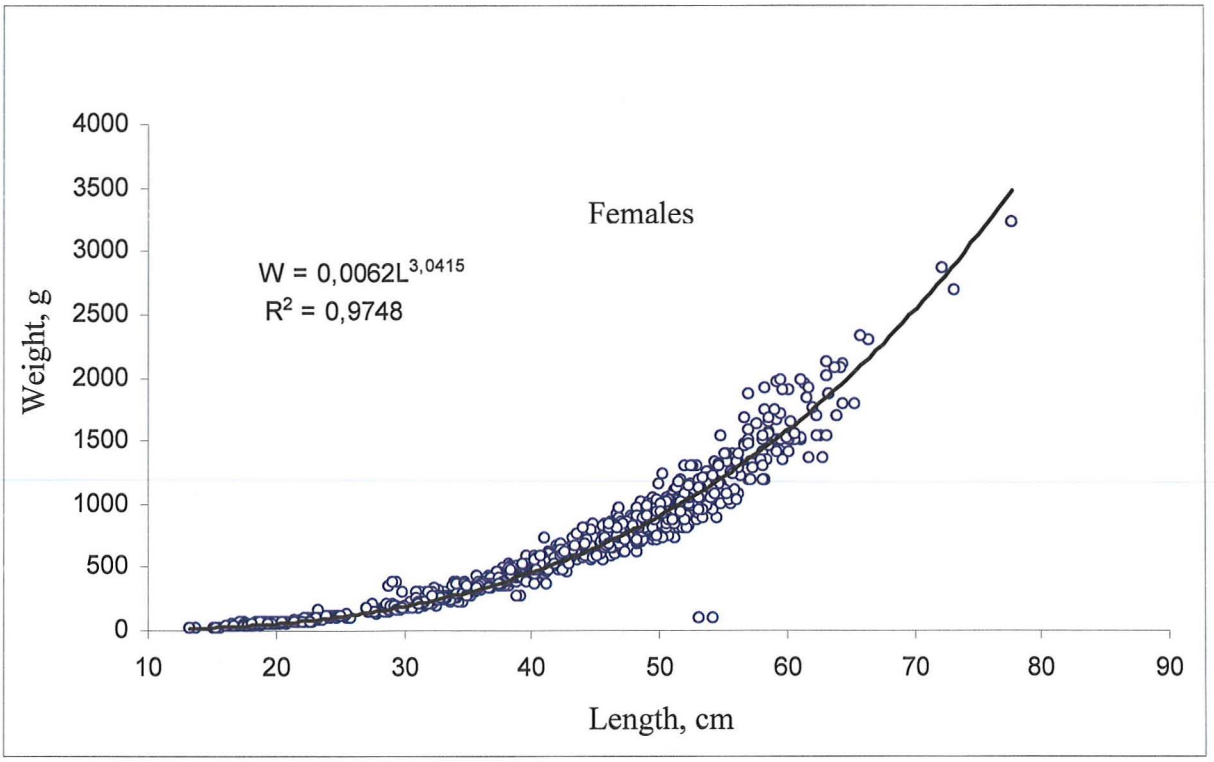
In stomachs of all age fish more frequently noted were euphausiids and calanus (Fig. 13).

Cannibalism was noted in 1.7% stomachs of examined fish. For the first time cannibalism was recorded in 27.1 cm pollock and more frequently in individuals which length were longer then 44.1 cm.

During survey period in the Navarin region in size range of pollock the most numerous (50.1%) were fish of 2007 year generation with length 10-19. 2005 year class fish formed 44.2% (20-30 cm) of all examined young fish. The less numerous (5.7%) were pollock of 2005 year generation (31-36 cm).

The main concentration of the Navarin pollock in western Bering Sea was formed in the area of quasi-stationary eddy to the south off Navarin cape (Fig. 14). Which is related to the favourable hydrologic conditions for developing and concentration in there fishing grounds of the main food items of pollock (euphausiids, hyperiids, shrimps, copepods).

Pollock average density concentrations were equaled **419000 t** (area of water was **14658 sq. miles**). In these calculations the coefficient of fishing efficiency was 1.0.



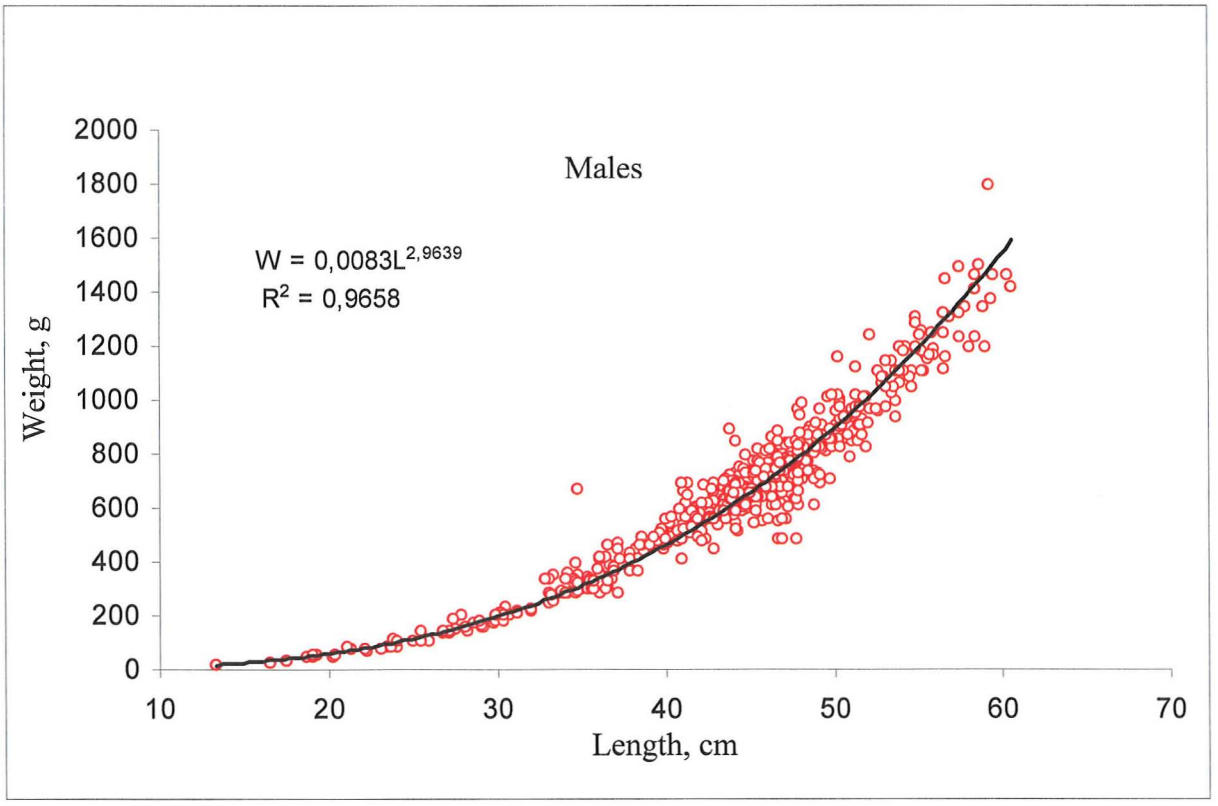
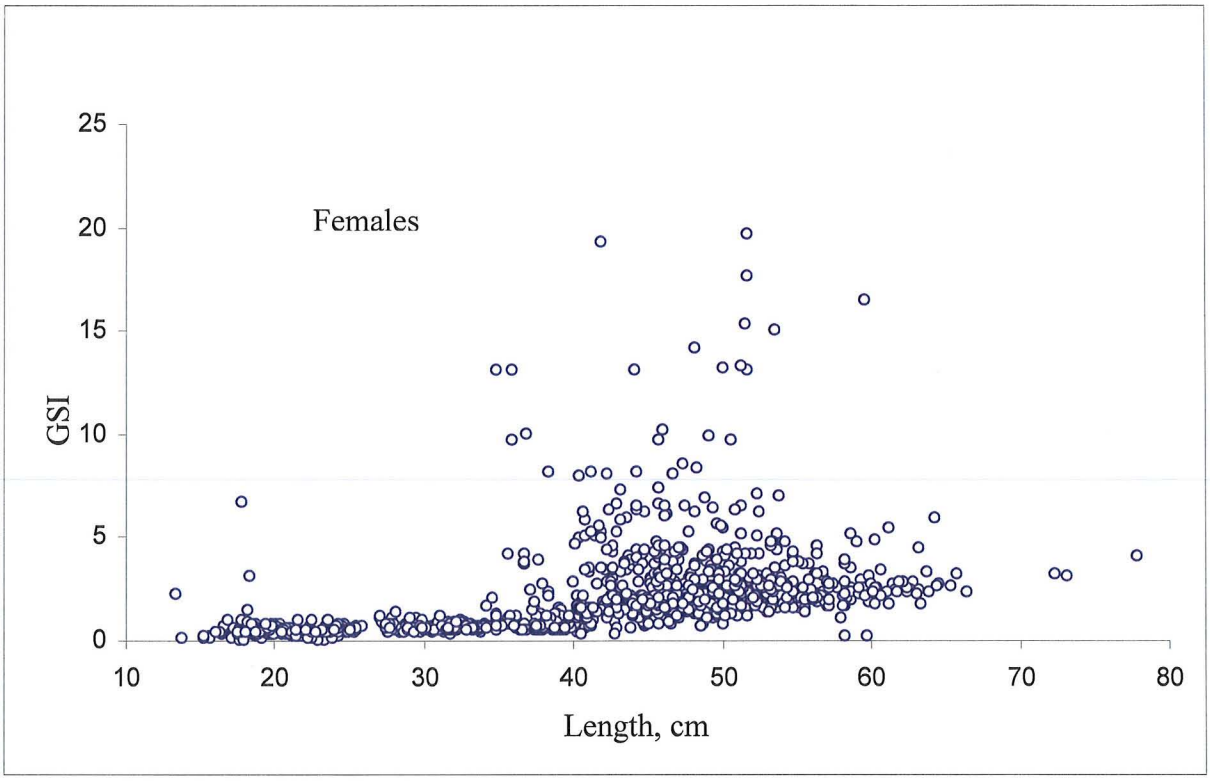


Figure 10. Length-weight relationship for pollock from the Navarin region in November.



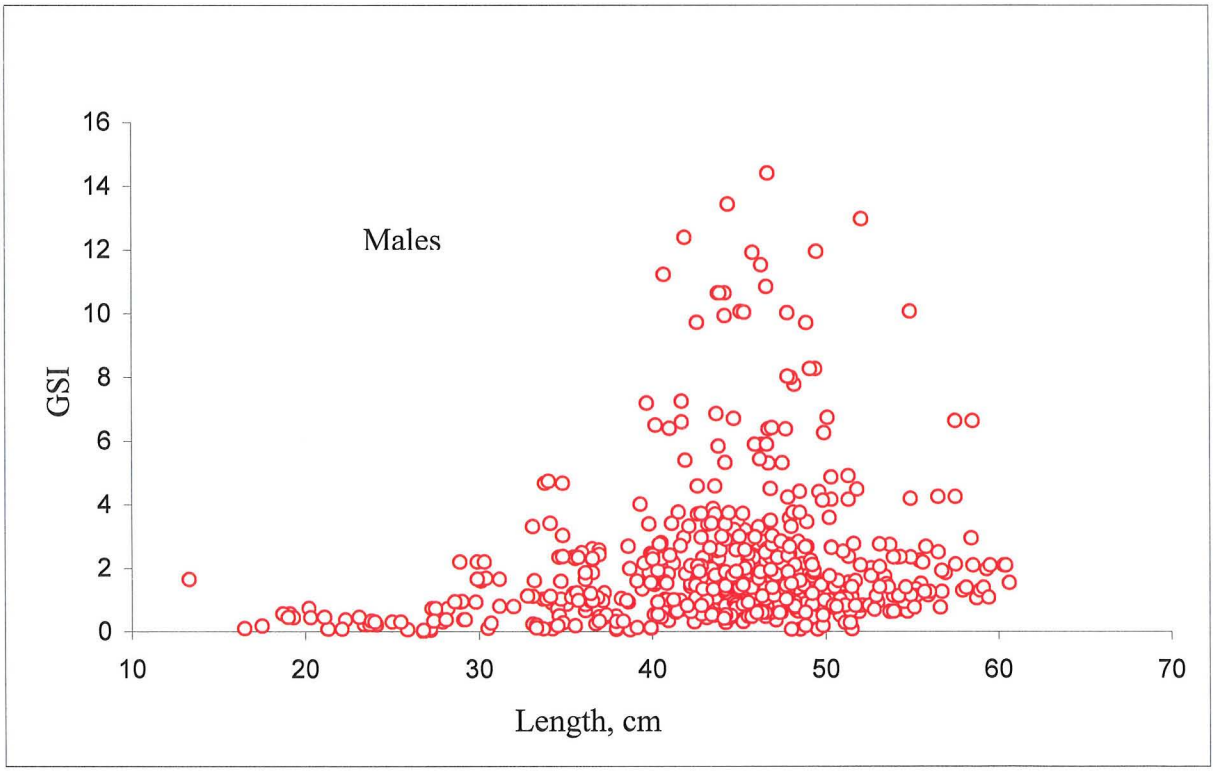


Figure 11. Changes of GSI in relationship with length of pollock from the Navarin region in November.

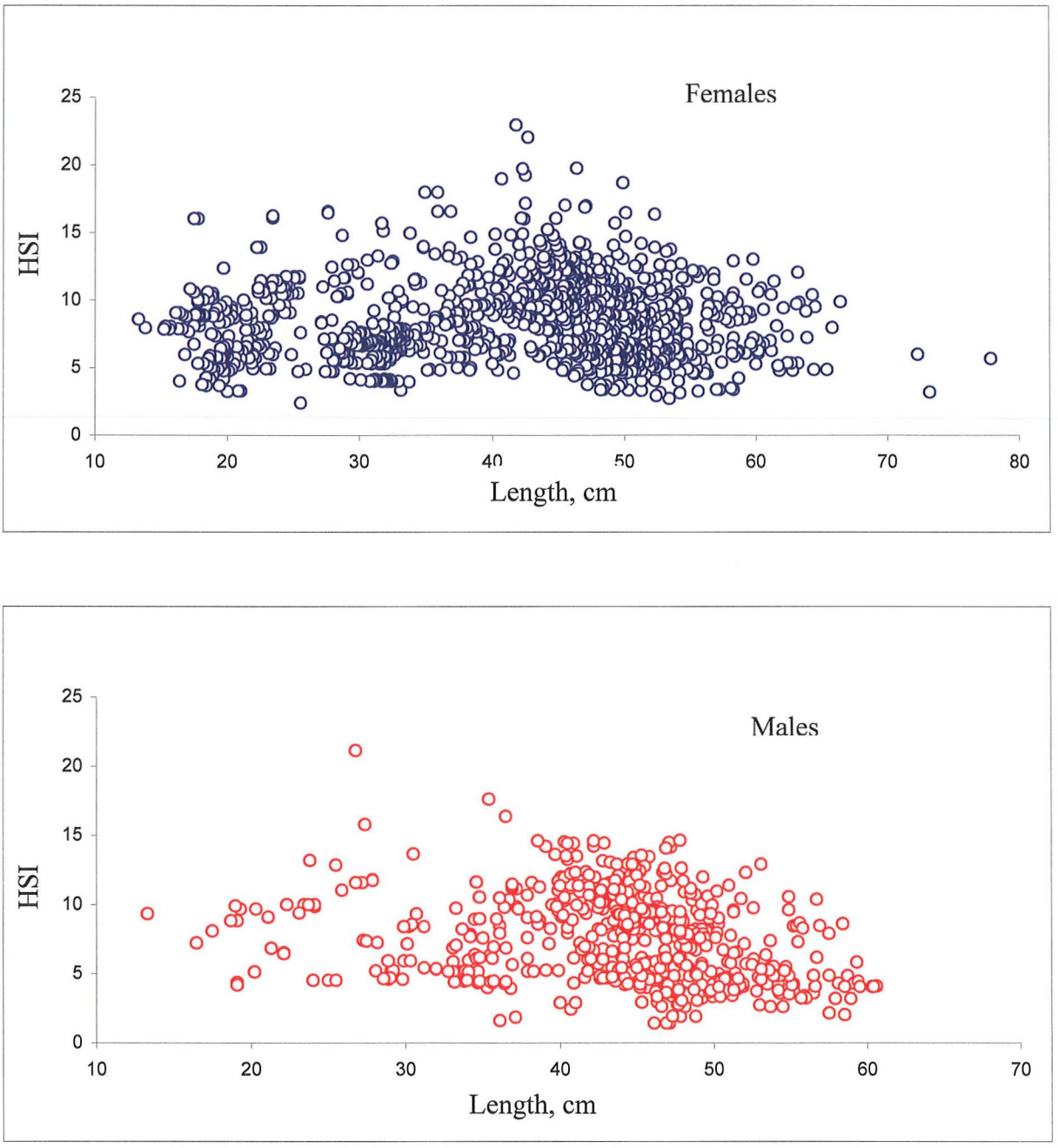


Figure 12. Changes of HSI in relationship with length of pollock from the Navarin region in November.

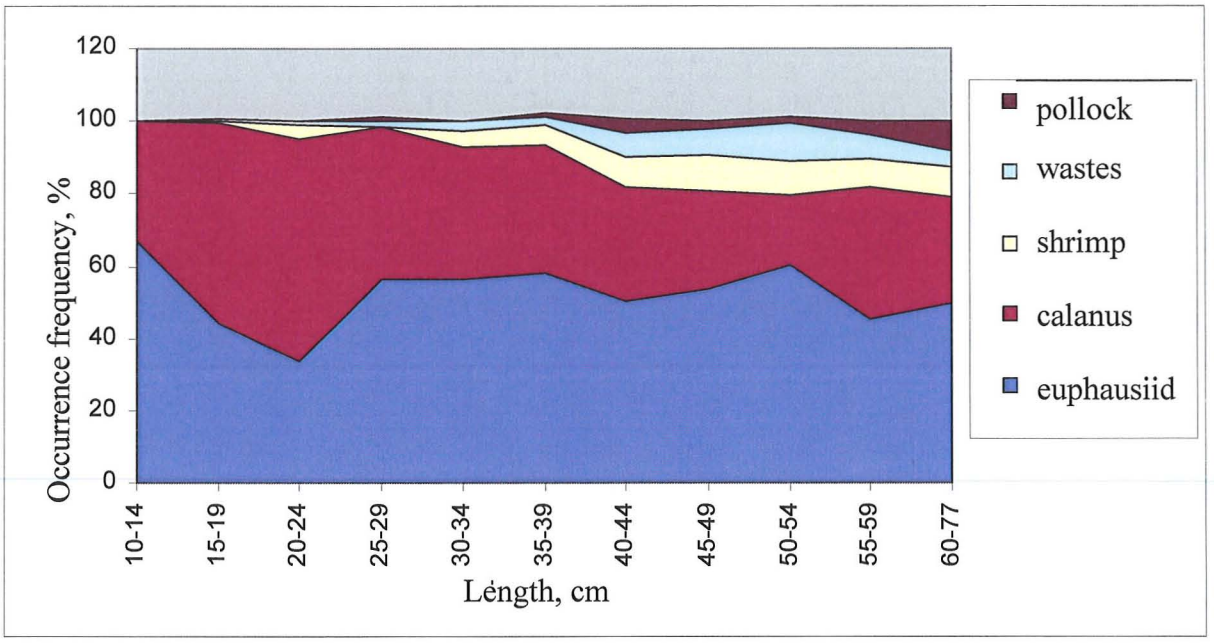


Figure 13. Pollock food composition by length in the Navarin region in November

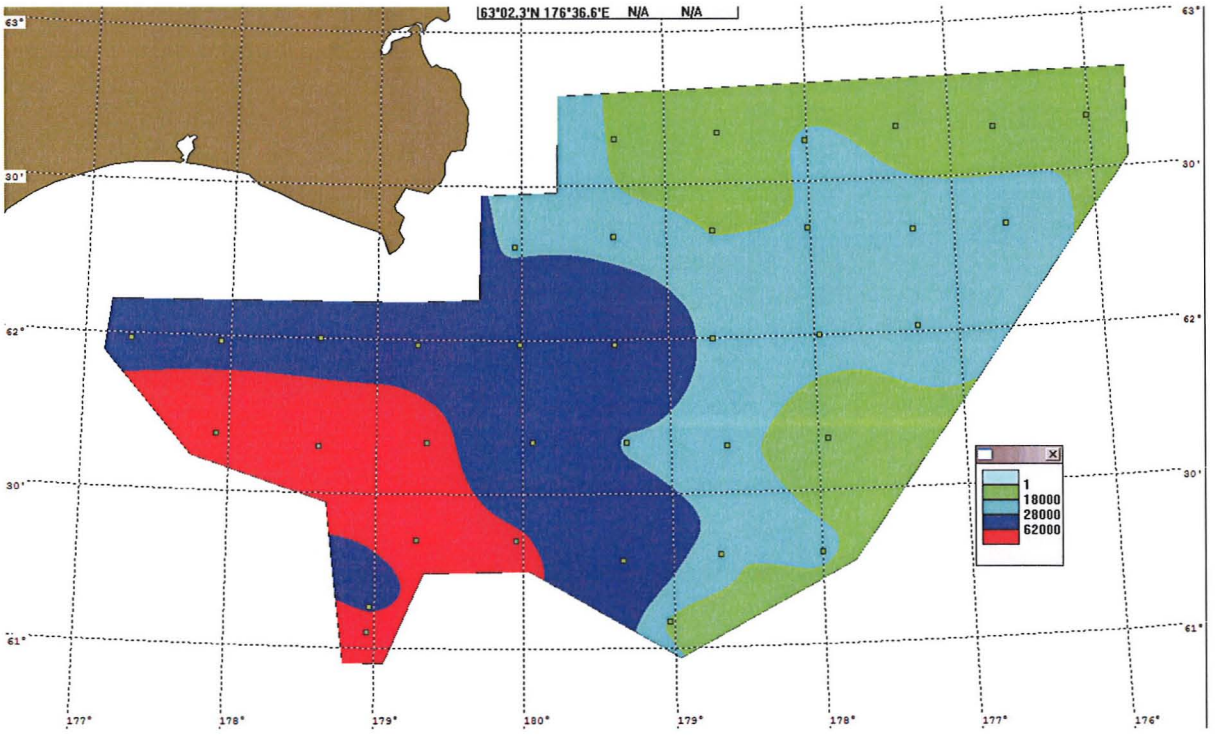


Figure 14. Pollock distribution in the Navarin region based on the results of bottom trawl survey in November.

In Karagin subzone pollock average density concentrations were equaled **355259 t** (area of water was **13141 sq. miles**). During the surveys the densest concentrations of pollock were recorded in western and eastern parts of examined area (Fig. 15).

Cod *Gadus macrocephalus*

Cod in catches was presented with the fish body length of 25.3-91.6 cm, weight 49-11879 g, when average size and weight was 52.9 cm and 2442.9 g. In catches immaturity fish's portion was 14.8% of the total. The most frequent stage of maturity was II and III (Tab. 1).

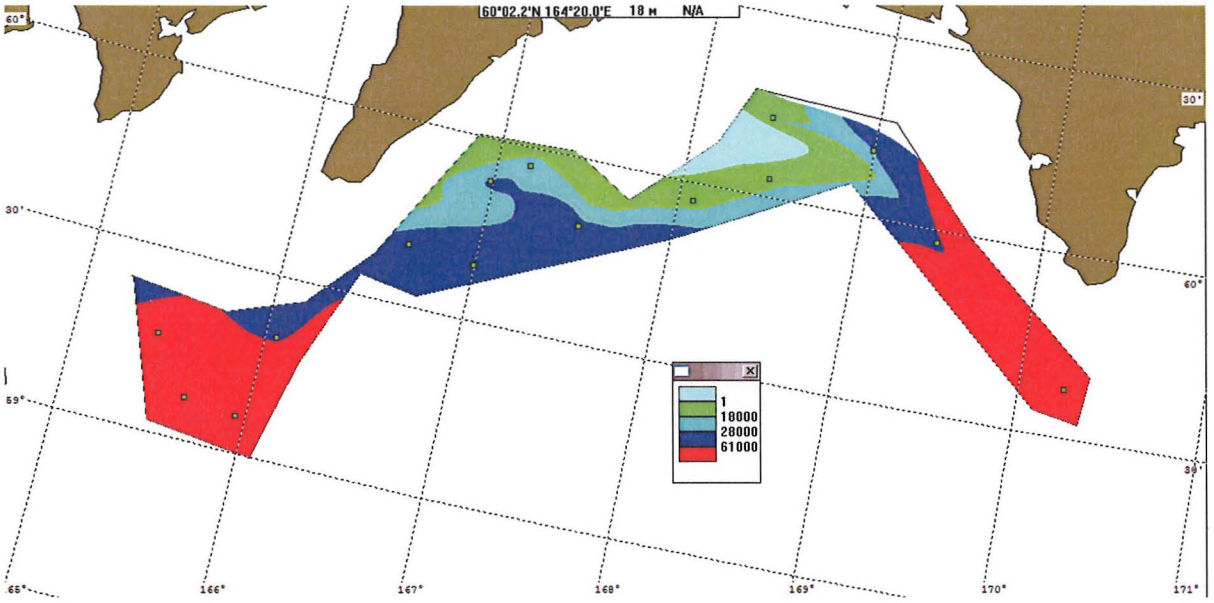


Figure 15. Pollock distribution in the Karagin subzone based on the results of bottom trawl survey in October-December.

Cod intensity feeding during studied period was high. Average stomach filling units was 2.3. Pollock (41.9%) and crustaceans (shrimp – 52.1%, crabs – 3.7%) were the basis of cod's food.

Table 1. Biological characteristics of cod from the Western part of the Bering Sea in October-November

average length, cm/number		52.88/297
min.–max. length, cm		25.3 – 91.6
mode		37-38, 49, 61, 77
average weight, g		2442.85
min.–max. weight, g		49 – 11879
male portion, %		63.7
prevailed maturity stage of gonads, %	females	II – 62.2; III – 37.8
	males	II – 54.4; III – 45.6
stomach filling, units		2.3
share of empty stomachs, %		7.1
prevailed food objects, %		euphausiid – 2.3; shrimp – 52.1; pollock – 41.9; crabs – 3.7
cubic condition index		1,006
GSI, %	females	1,93
	males	2,68
HSI, %	females	5,10
	males	5,27
number		297

2.5. Recent research of walleye pollock spawning in waters off the Commander islands

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In the Bering Sea walleye pollock are distributed not only in traditional fishing areas in the southeastern, northern and southwestern parts of the sea, but also alongside the chain of the Aleutian-Commander Islands. In waters off Aleutian Islands walleye pollock is considered to be a distinct stock inhabiting the region from 170° W to the U.S.-Russia line. The history of Aleutian pollock fishery started in late 1970-s and ended in 1999 when the area was closed for directed pollock fishing due to problem of Steller sea lion recovery. During all the period of fishery most of pollock was caught in the eastern edge of Aleutian shelf, whereas in the western part of region in vicinity of Commander Islands pollock catches were negligible.

No specialized trawl fishery has ever been in waters off Commander Islands neither for pollock nor for any other ground-fish due to prohibition of commercial activities inside the 30-mile zone around the Archipelago. The prohibition of fishery was targeted to protect "Commander" fur seal population and included using trawls for scientific purposes as well. Only one research trawl survey and two ichthyoplankton surveys have been conducted in near-shore waters off Bering and Medny Islands for the last twenty five years. In 1988 aboard of R/V "Gissar" of Pacific Fisheries Research Centre (TINRO-Centre) a trawl and ichthyoplankton surveys were carried out. In 2001, the scientists of Kamchatka Fisheries and Oceanography Research Institute (KamchatNIRO) conducted walleye pollock planktonic egg and larvae sampling aboard F/V "Bagration". As a result of very limited scientific data for previous period very few are known about "Commander" pollock population status, resources and biology. The results of ichthyoplanknon surveys confirmed only a fact of pollock intensive spawning in the area off

Commander Islands and showed significant increase in stock abundance for the period between two expeditions.

In April 2009 after a gap of 8 years an ichthyoplankton sampling in waters off Commander Archipelago was resumed aboard of small transport-processing vessel "Moroz". The main purposes of the expedition were:

- to find out a species composition and abundance of zoo- and ichthyoplankton in waters off Bering and Mednyi Islands;
- to determine the terms and areas of walleye pollock spawning;
- to collect data on an environmental conditions during pollock spawning period.

Plankton samples were collected at the survey stations around the Commander Islands from April 17th through 27th . The depth in the survey area ranged from 25 to 1000 m, at each station a vertical tow was done. An 80-cm diameter cone-shaped net (3.5 m long, 0.66 mm mesh) without a flowmeter was used as a sampler (IKS-80 net). Towing was made from 5 m off the bottom up to surface or from maximum depth 200 m up to surface with speed about 0,4 m/s. CTD-sonde attached below the ichthyoplankton net was used to collect hydrological data. After the ichthyoplankton net and CTD removing a hydrobiolocical samples were collected at the same station by means of vertical tows with standard 37-cm diameter zooplankton net in the upper layer at depths 0-50 meters. Samples were fixed in 4-5% formalin buffered in seawater.

The icthyoplankton samples primarily were examined on board of vessel. Walleye pollock eggs from each tow were classified into four developmental stages according to the method generally accepted in Russia (Rass, Kasanova, 1966) and counted:

Stage I – from fertilization up to the appearance of germ ring near an equatorial position;

Stage II – from the end of Stage I until the tip of a tail beginning apart of the yolk (appearance of a tail bud);

Stage III – from the end of Stage III until the tip of a tail was reaching (or could reach) the snout;

Stage IV – from the end of Stage III until hatching.

When more than 100 eggs were present in a sample, a subsample of 100 eggs was staged. Dead eggs were also counted. Eggs and larvae of fish except pollock were identified from preserved samples and examined later at the laboratory.

After a survey was over, at two stations – # 26-27 with large catches of pollock eggs a horizontal tows of subsurface layer (at depths up to 2 meters) with IKS-80 net as a sampler were carried out in course of circulation made by vessel with average speed about 3 knots.

Ichthyoplankton counting on-site made possible to estimate the total number of spawned eggs in the area using next procedure. At first actual number of eggs per 1 square meter of sea surface by each developmental stage was calculated depending on the net-cable slope angle. The next equation was used:

$N_{act} = (N_{sam} * H_{act}/L)/S$,

were N_{act} – actual number of ichthyoplankton per 1 m^2

N_{sam} – number of ichthyoplankton in sample,

H_{act} - actual depth of net sinking determined by STD-sonde

L – length of net-cable at a sampling station

S – square of net opening (for IKS-80 S= 0,5 m^2)

The total number of pollock eggs of each stage was assessed using software GIS "ChartMaster 3.1". For purpose of comparison obtained results with data of eggs number estimated in 2001 aboard F/V "Bagration" the same polygon of survey in the Strait between Bering and Mednyi Islands was chosen for stock assessment.

Walleye pollock eggs occurred at 23 stations from 32 (Fig. 2, 3). No eggs occurred at stations on oceanic (southern) side of Medny Island and the pass between islands. Single occurrences of eggs were typical for oceanic waters of

Bering Island and north-western part of archipelago. Enlarged number was encountered in the northern part of the pass mentioned and near the Kitolovnaya Bank, and maximal number (25.5 thousand eggs per 1 m^2) was recorded for the most seaward station north-eastwards of Bering Island over a depth 400 meters. In appears that future surveys planning must provide more detailed investigations of the area between islands, and the marginal stations should be located more seawards.

The same area between the islands was determined as a centre of pollock aggregations according to hydroacoustic observations (Fig. 4). Thus, our data confirm previously made assumption regarding an inter-island pass at depths about 100 meters be the principal place of pollock reproduction in the Commander Islands region. It should be noted that at the station with the highest catch of eggs (at the depth 400 m) no pollock echograms have been occurred. It seems that either pollock have already left this place after spawning, or the eggs were drifted here from shelf waters with currents.

Results of embryos developmental stages determination showed that in the main reproductive area – the inter-island pass – the peak of spawning was already over; the eggs of II stage predominated (Tab. 1).

Table 1. Proportion of eggs at different developmental stages at the polygon in the pass between Bering and Medny Islands in April 21-24, 2009

Stage of development	Total number of eggs,$\times 10^{12}$	Average catch per 1 m^2	Proportion, %
I	4.861852515	1375	32.0
II	9.745365547	2757	64.1
III	0.559969991	158	3.7
IV	0.032022449	9	0.2
Total	**15.199210502**	**4299**	**100**

Duration of pollock embryos development depends on water temperature. In our case a mean temperature of upper water column 0-50 meters at different stations varied from 0.77°C to 2.17°C, with average value 0.99°C. This corresponds

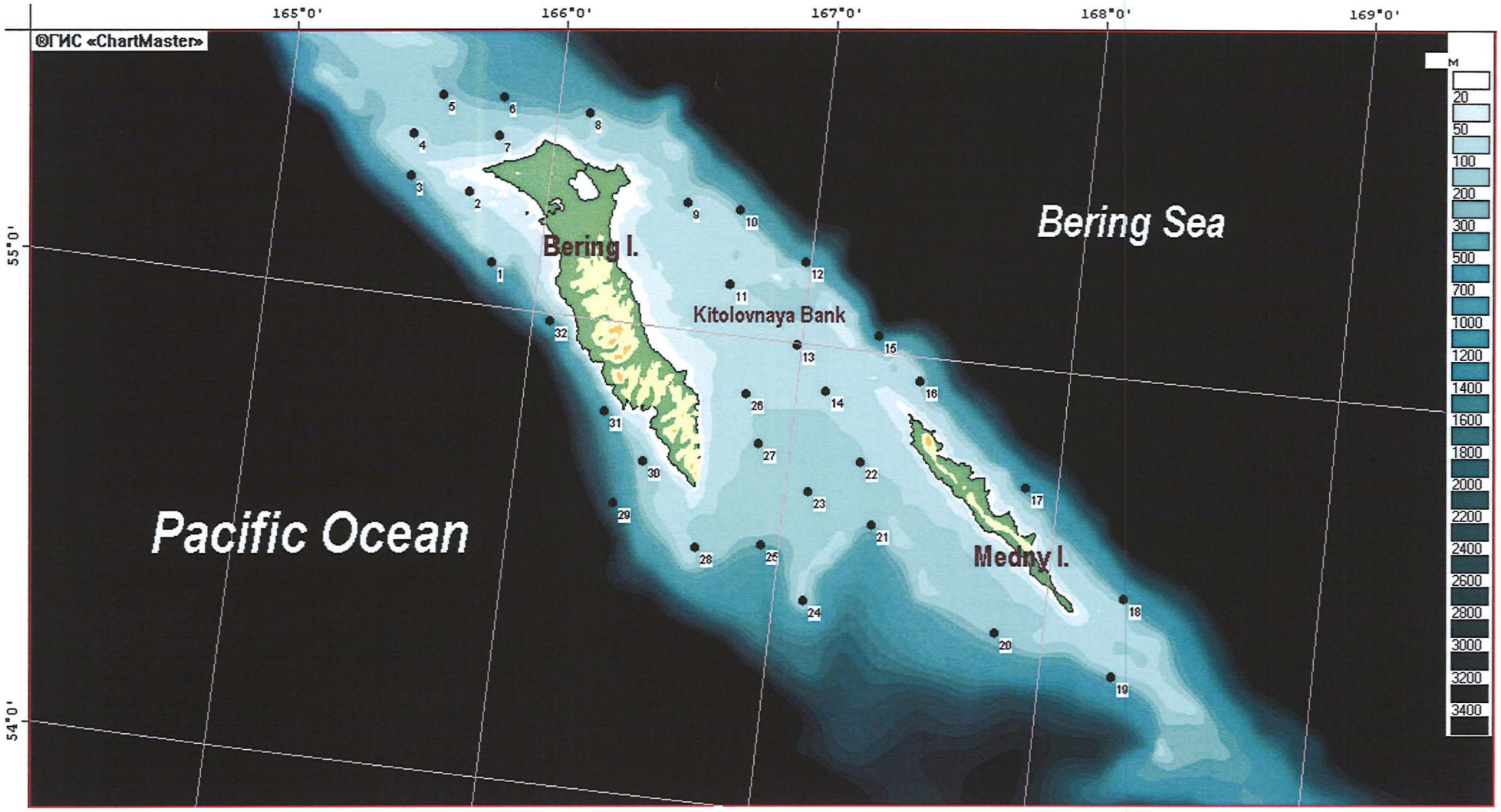

Fig. 1.Ichthyoplancton survey stations locations around the Commander Islands. April 20-24, 2009.

to duration of eggs development from 28 to 34 days. Taking into account a presence of old-aged eggs (IV stage) in the samples, it can be assumed that pollock spawning season in waters off the Commander Islands in 2009 started in the end of March and peaked in mid-April. This is about ten days earlier than in 2001.

Total number of eggs recorded in 2009 was approximately three times more than in 2001: $18.94*10^{12}$ versus $4.89*10^{12}$ (Tab. 2). Absence of any data on the biological characteristics of walleye pollock in the area studied does not allow to estimate pollock spawning biomass using standard methods of stock assessment. Nevertheless, some suppositions can be expressed. In 2001 spawning stock biomass was roughly estimated at level 100 thousand tons. Taking into consideration a large increase in total number of spawned eggs in the area, we suppose that walleye pollock spawning stock after 8 years grew at least 3 times and can exceed 300 thousand tons. This could be linked not only with natural-dependent fluctuations of stock abundance under the influence of environmental factors, but obviously with the nature-protection status of Commander State Nature Reserve.

Table 2. Estimates of walleye pollock spawning intensity in waters off Commander Islands

Year	Vessel	Average number, eggs per tow	Maximum density, eggs/m^2	Total number of estimated eggs at the studied area eggs*10^{12}
1988	R/V «Gissar»	30	236	0.10
2001	RTMS «Bagration»	318	5212	4.89
2009	PTR «Moroz»	2150	25544	15.20

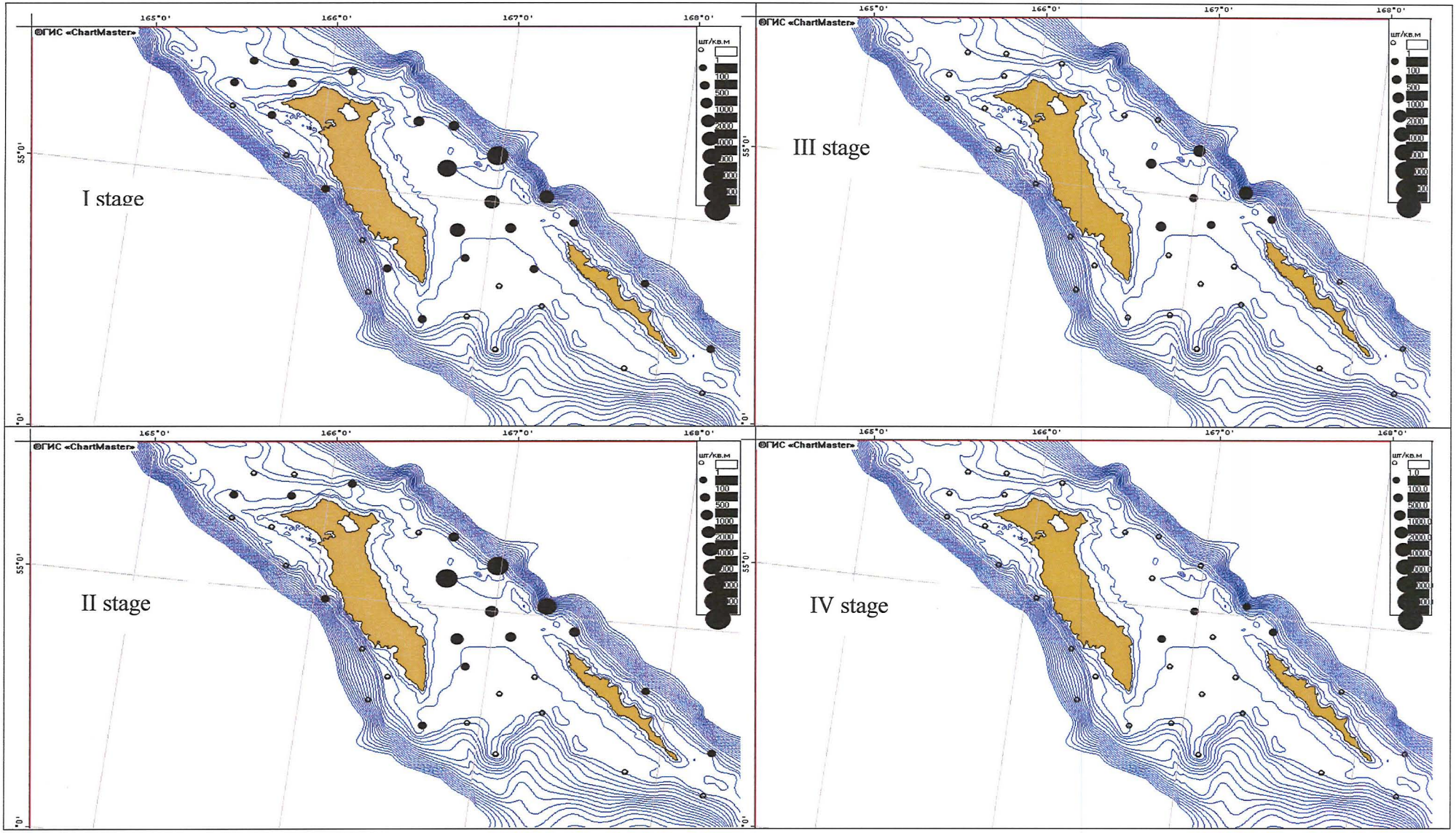

Figure 2. Spatial distribution of walleye pollock eggs of different developmental stages in waters off Bering and Mednyi Islands. 20-24.04.2009 г.

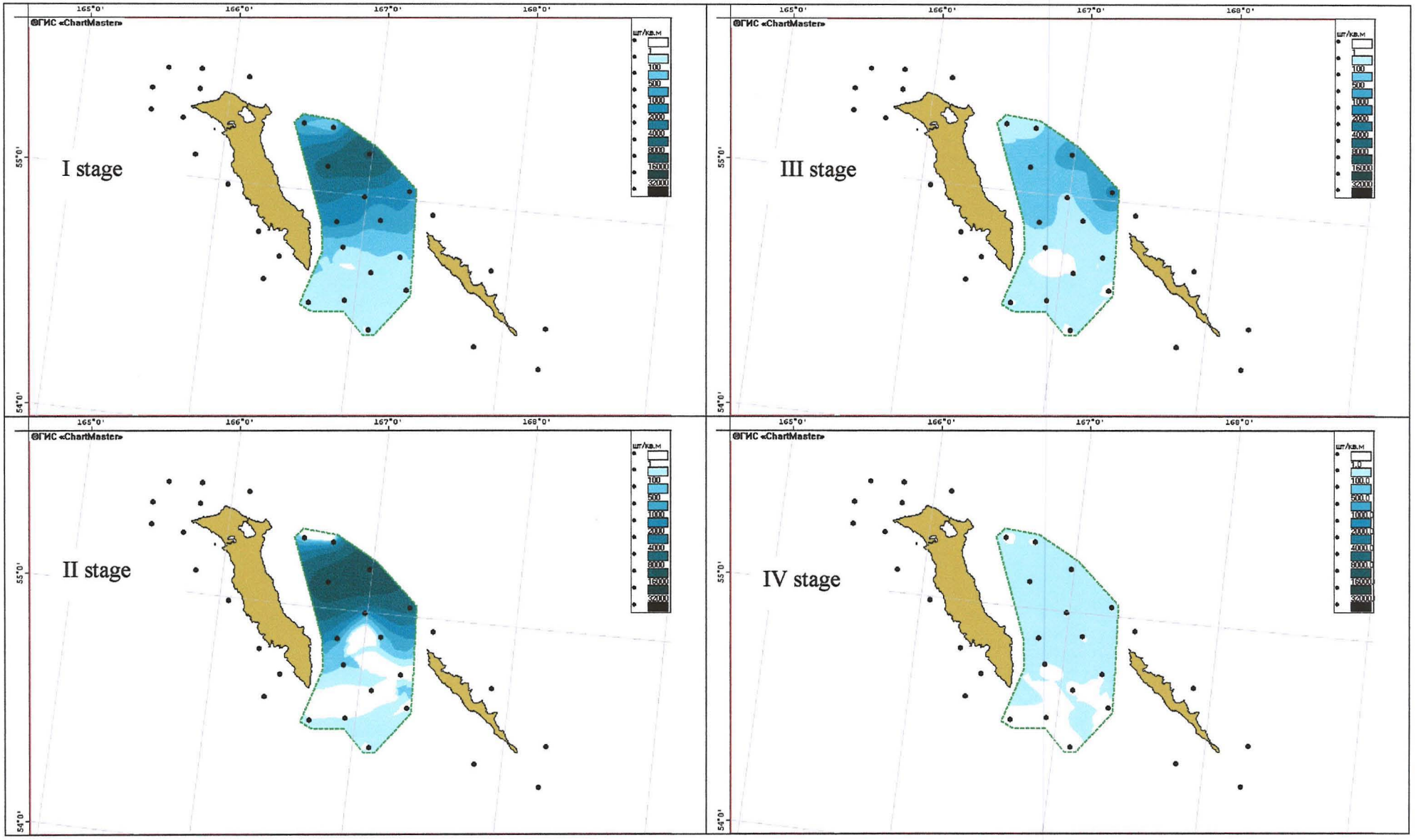

Figure 3. Distribution of walleye pollock eggs of different developmental stages on the polygon between Islands Bering and Mednyi

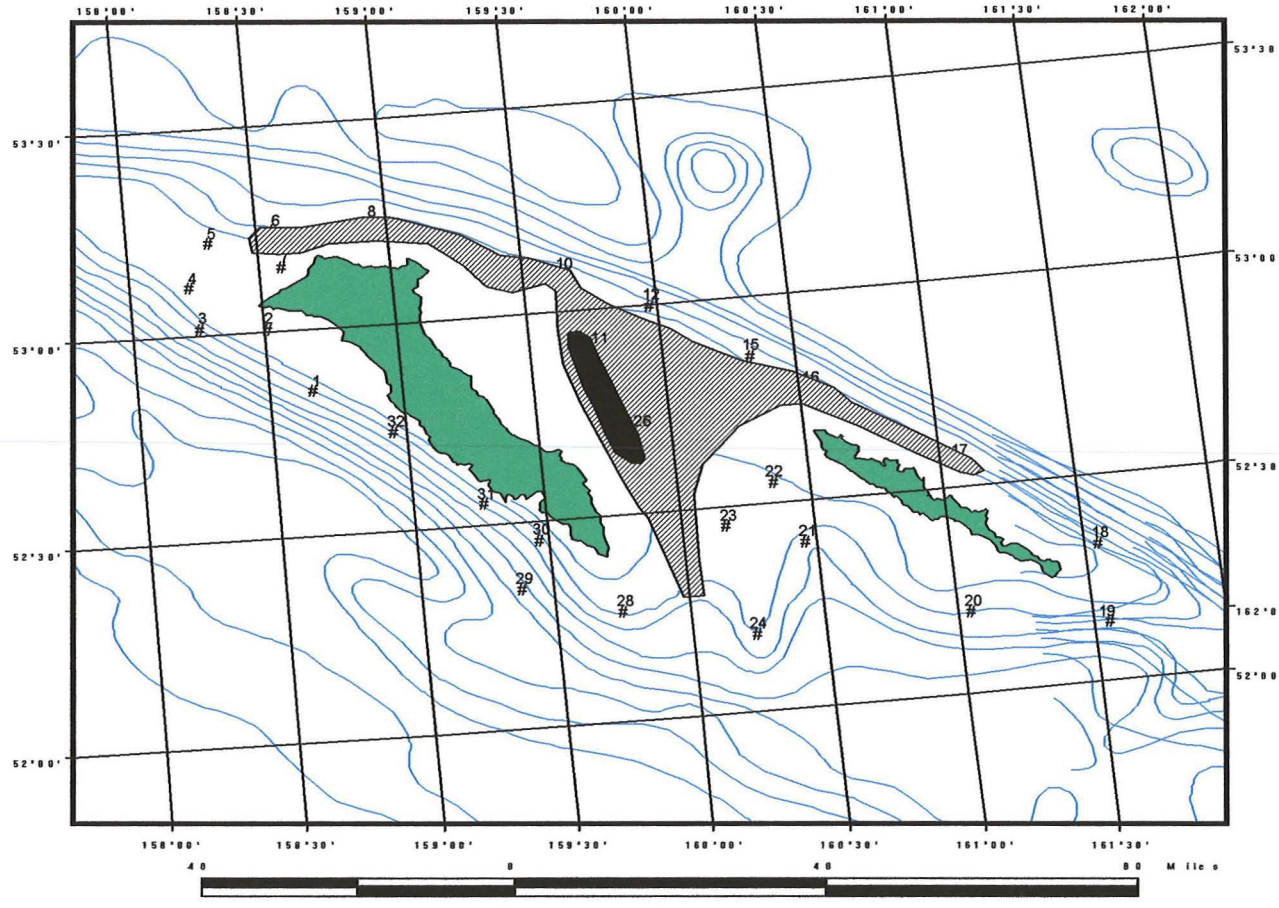

Figure 4. Location of walleye pollock spawning aggregations determined by hydroacoustic data.

Concludion

According to bottom trawl data of SRTM "Lebedevo" the increase in pollock biomass was noted in the Navarin region (14658 sq. miles) from 875 till 1047.5 thousand tons (in October-November).

According to surveyes which were conducted by R/V "TINRO" in summer-autumn 2008, in Russian waters of the Bering Sea (to the east of 176° E till the marking line, including Chukchi zone) total abundance and biomass estimated for pollock was 4756.35 million individuals and 1466.98 thousand tons.

In the Karagin subzone the total biomass estimated for walleye pollock was 385 thousand tons.

In Navarin region the 2007 and 2006 year-classes of pollock are of the mean annual abundance; the 2005 year-class might be regarded as poor.

In Karagin subsone all three generations of recruits (2005, 2006 and 2007) have mean abundance, as shown by the survey data.

Results of assessment of walleye pollock planktonic eggs in waters around the Commander Islands in 2009 confirmed earlier expressed opinion, that the principal reproductive area of pollock is localized in the pass between the Bering and Medny Islands and near Kitolovnaya Bank over the depths about 100 meters. Due to very uneven bottom relief, mixing of water masses of different origin, this area is characterized by complicated water dynamics and enlarged biological productivity providing favorable environmental conditions for walleye pollock reproduction and eggs development.

Spawning season of walleye pollock in 2009 started approximately in the end of March, and peaked in mid-April, what is about ten days earlier than in 2001.

According to preliminary estimates for the years 2001 and 2009 walleye pollock spawning stock increased at least three times and can exceed 300 thousand tons. It could be linked not only with natural-dependent fluctuations of stock abundance under the influence of environmental factors, but obviously with the nature-protection status of Commander Islands State Nature Reserve which excludes any fishing activities inside 30-mile zone around it.

The contemporary abundance of pollock in Russian zone will not allow it to extend into enclave.