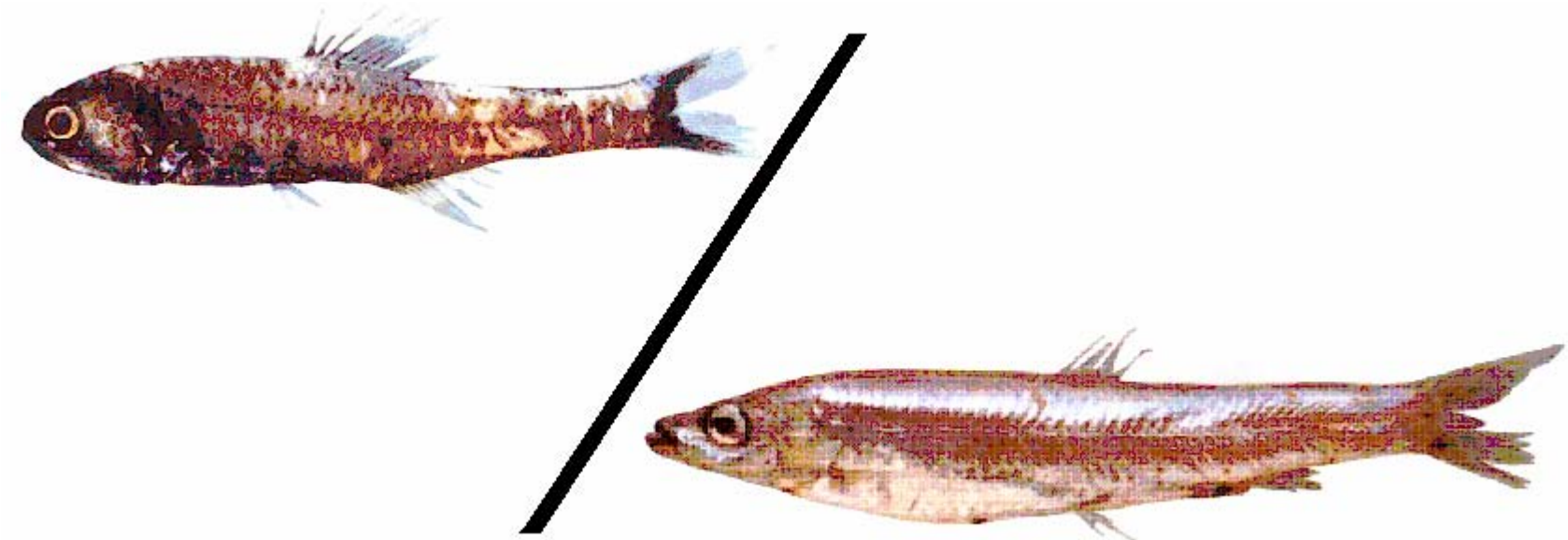
Ratio of myctophid and bathylagid fish biomasses as index of mesopelagic fish community status



= RMB

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Sakhalin Research Institute of Fisheries & Oceanography, 693023, Russia, vlrad@sakhniro.ru

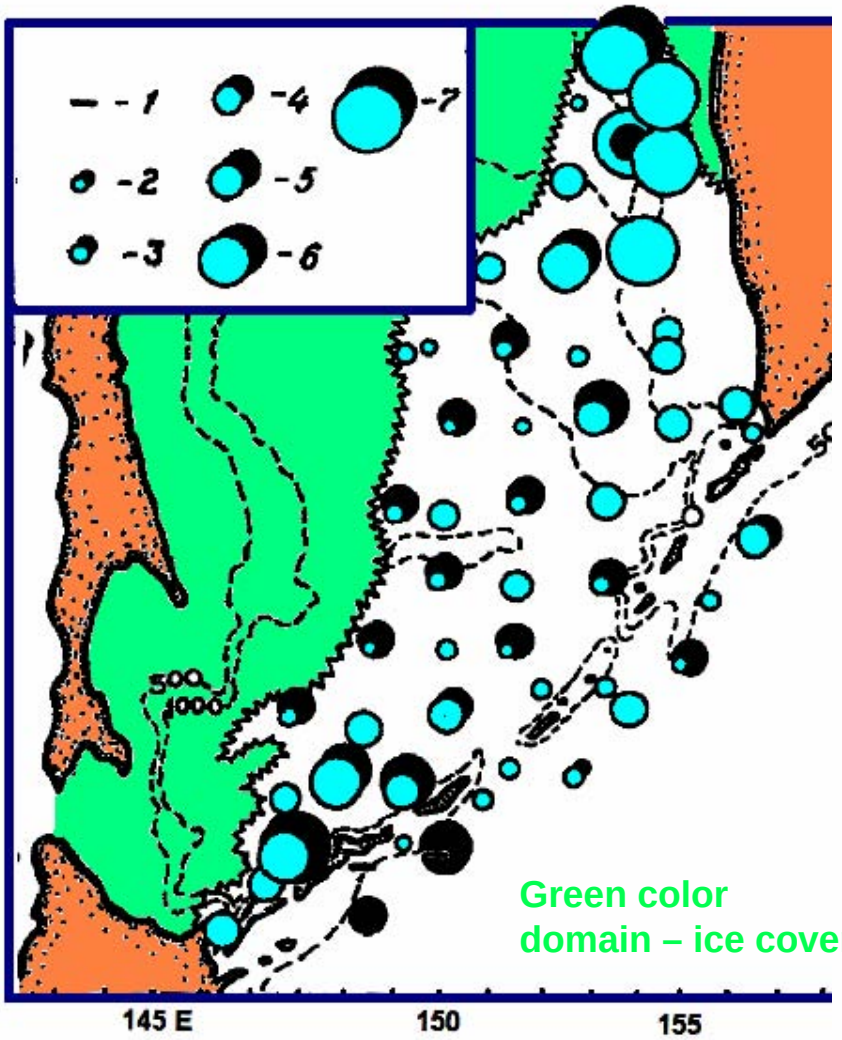
Round-the-year trawl survey conducted in the far-eastern seas mesopelagic layer in February,1990 – January, 1991

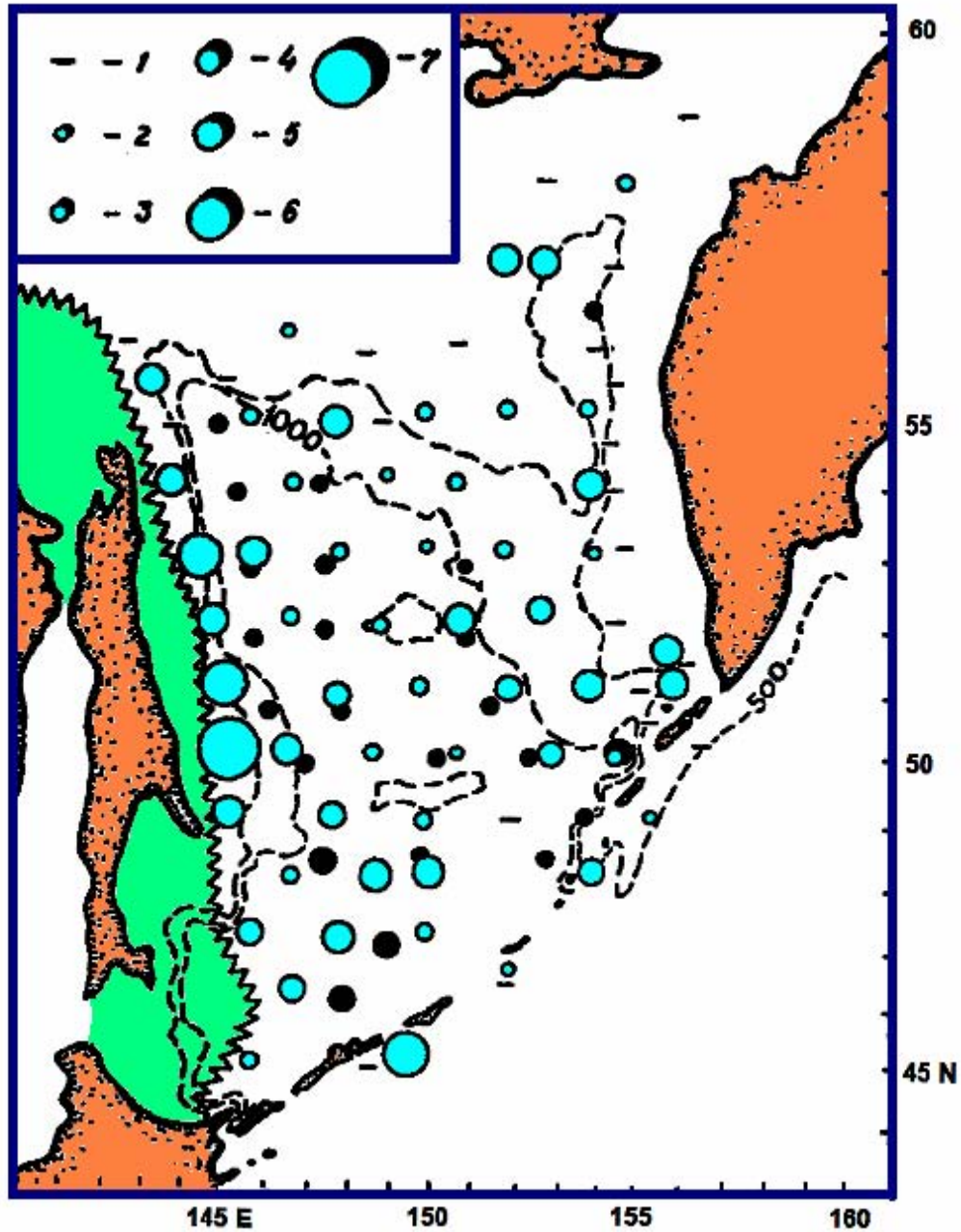
The Bering Sea

Lag number	Name of r/v	Time period	Investigated area, sq. km	Number of trawl hauls
2	Mlechny Put	09.04-26.06.1990	661,2	168
3	Novokotovsk, Professor Soldatov	30.9-18.11.1990	661,2	157

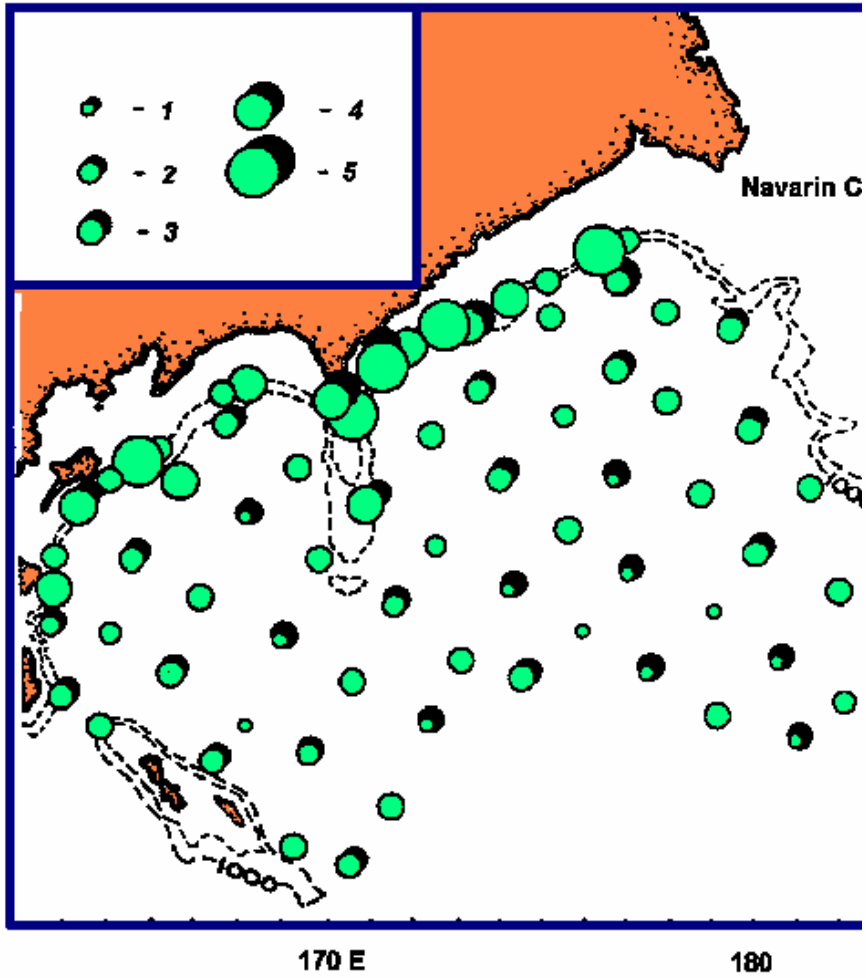
The Sea of Okhotsk

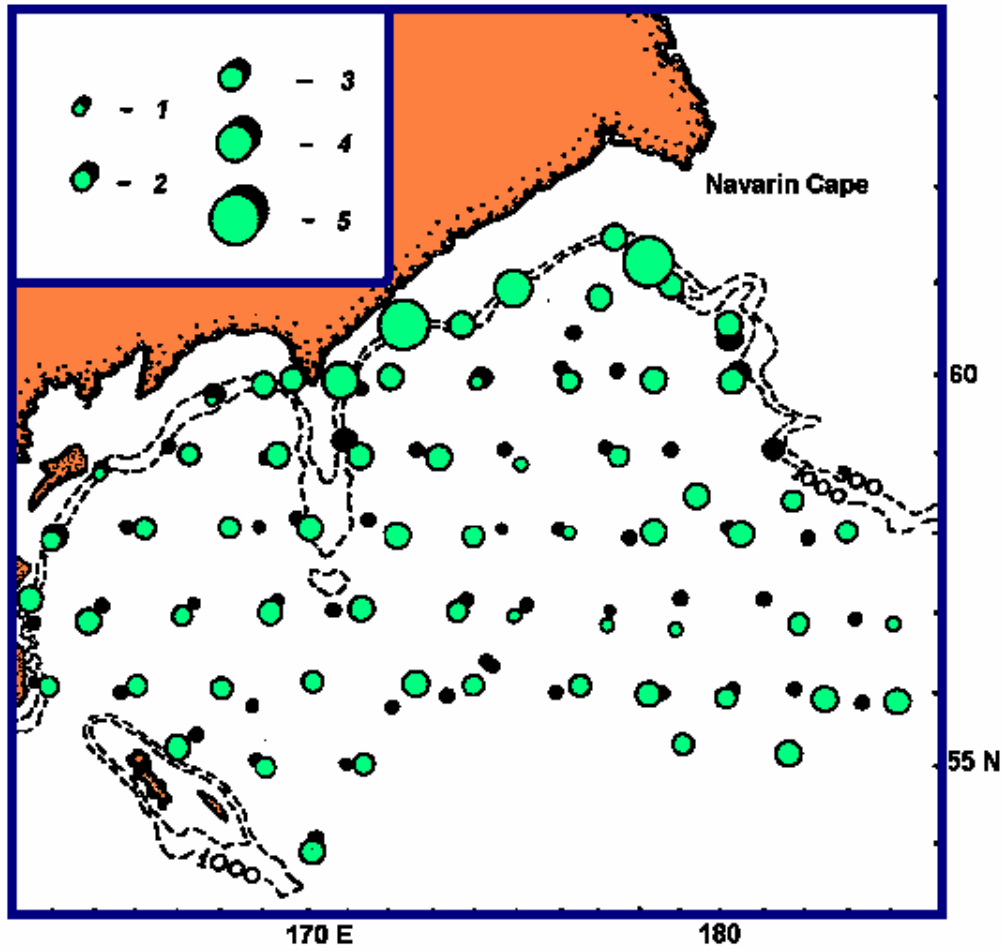
1	Mlechny Put	28.02-6.04.1990	422,5	59
4	Mlechny Put, Professor Soldatov	20.11.1990 – 20.01.1991	771	98





Mesopelagic fish catch distribution in the Sea of Okhotsk in March – April of 1990 (above) and November of 1990 – January of 1991 (right). Blue circles indicate catches in upper mesopelagic layer (200-500 m), Black – in lower (500–1000 m): 1 – no catch; 2 – below 5; 3 – 5-25; 4 – 25-50; 5 – 50-250; 6 – 250-550; 7 – more than 500 kg per hour of trawl haul.





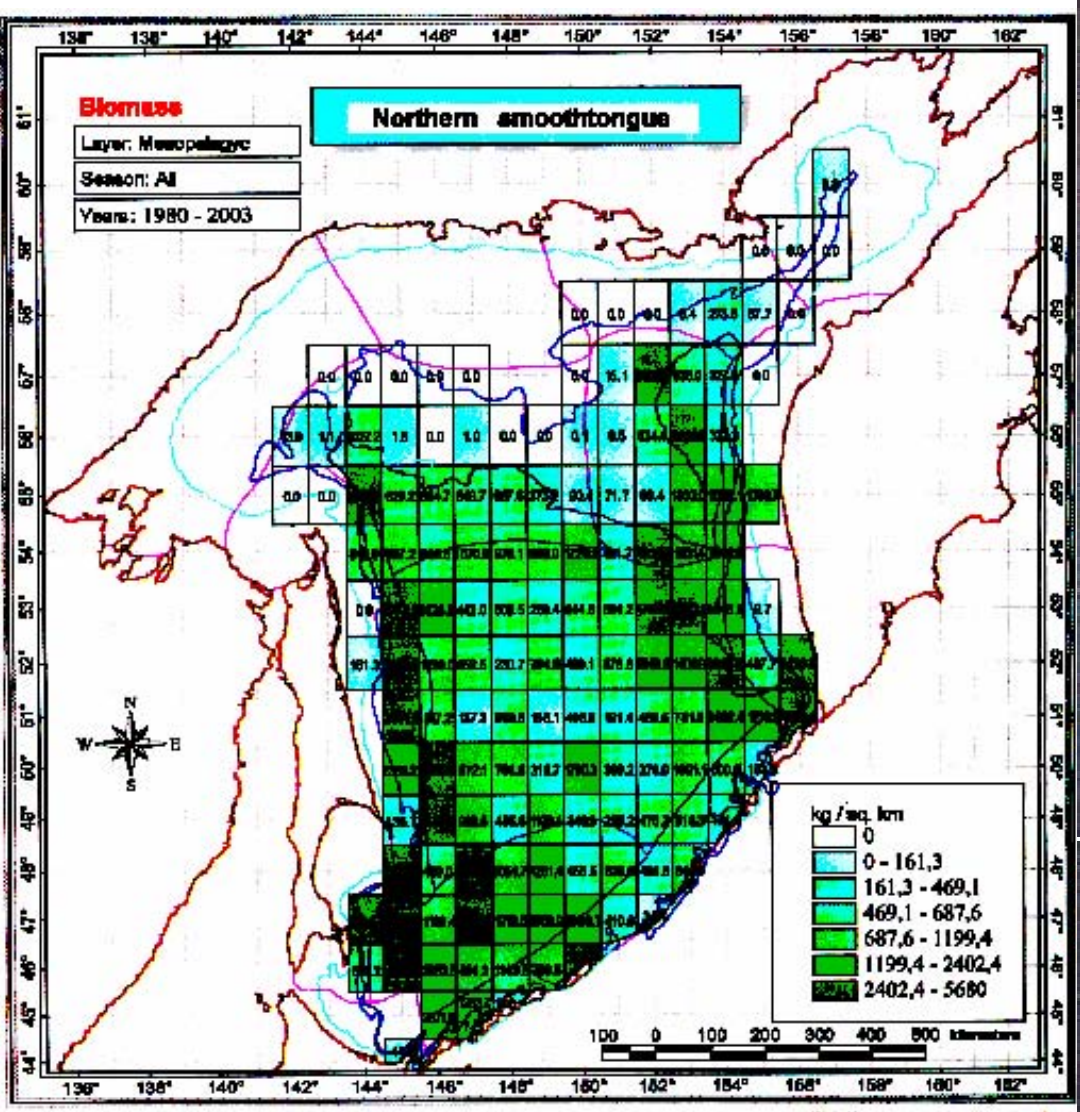
Mesopelagic fish catch distribution in the Bering Sea in April – June of 1990 and October – November of 1990. Greenish circles indicate catches in upper mesopelagic layer (200-500 m), Black – in lower (500–1000 m): 1 – 5-25; 2 – 25-50; 3 – 50-250; 4 – 250-550; 5 – more than 500 kg per hour of trawl haul.

Did radical changes occur?

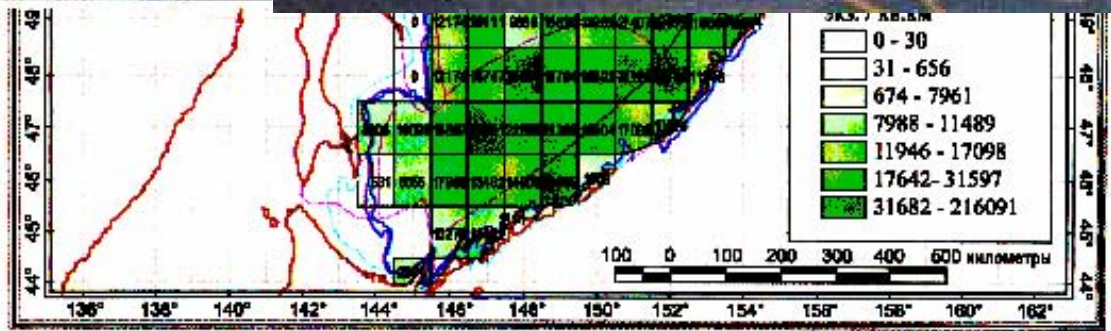
- **“High level of mesopelagic fish biomass was fixed in late 1980s. Midwater fishes abundance reduced in 1990s. Analogous changes of zooplankton biomass were observed in this time. A shift of the dominant species of nekton and plankton communities was recorded.”**

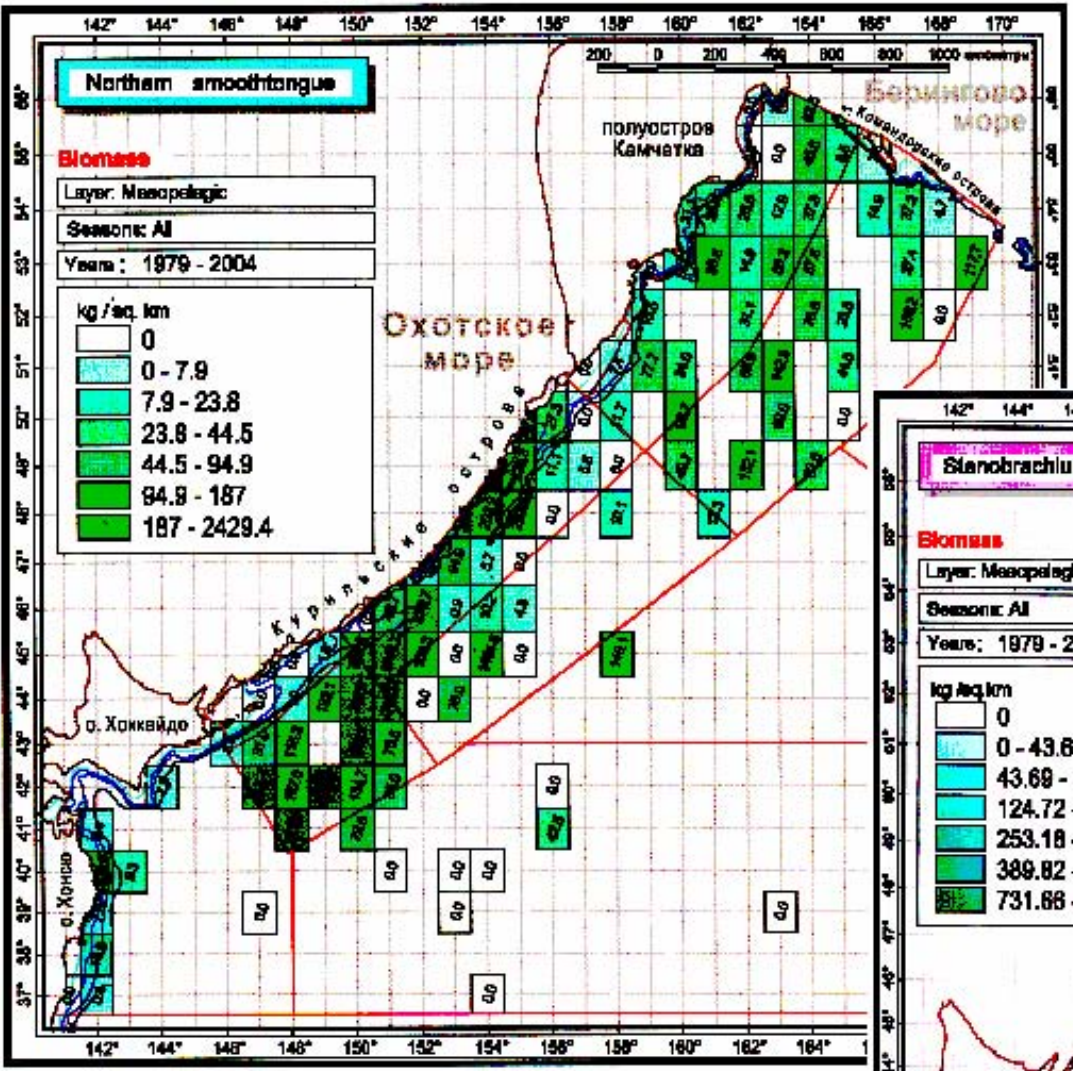
Savinykh V.F., Glebov I.I., Napazakov V.V., and Basyuk E.O. 2001.

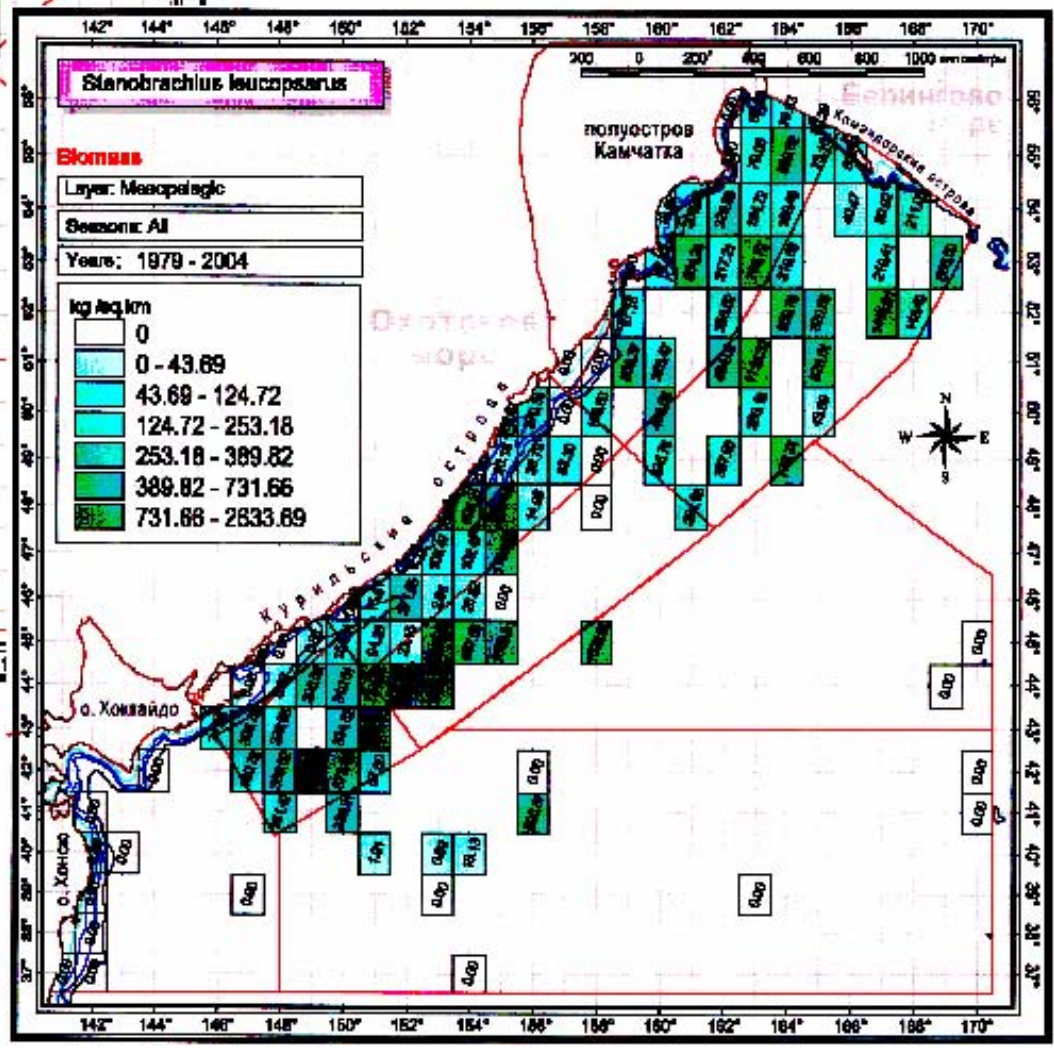
- The decadal changes of the mesopelagic fishes abundance in the western Bering Sea // PICES Program & Abstracts of Tenth Annual Meeting
  - (Victoria, BC, Canada, 5-13 October 2001). P. 128.

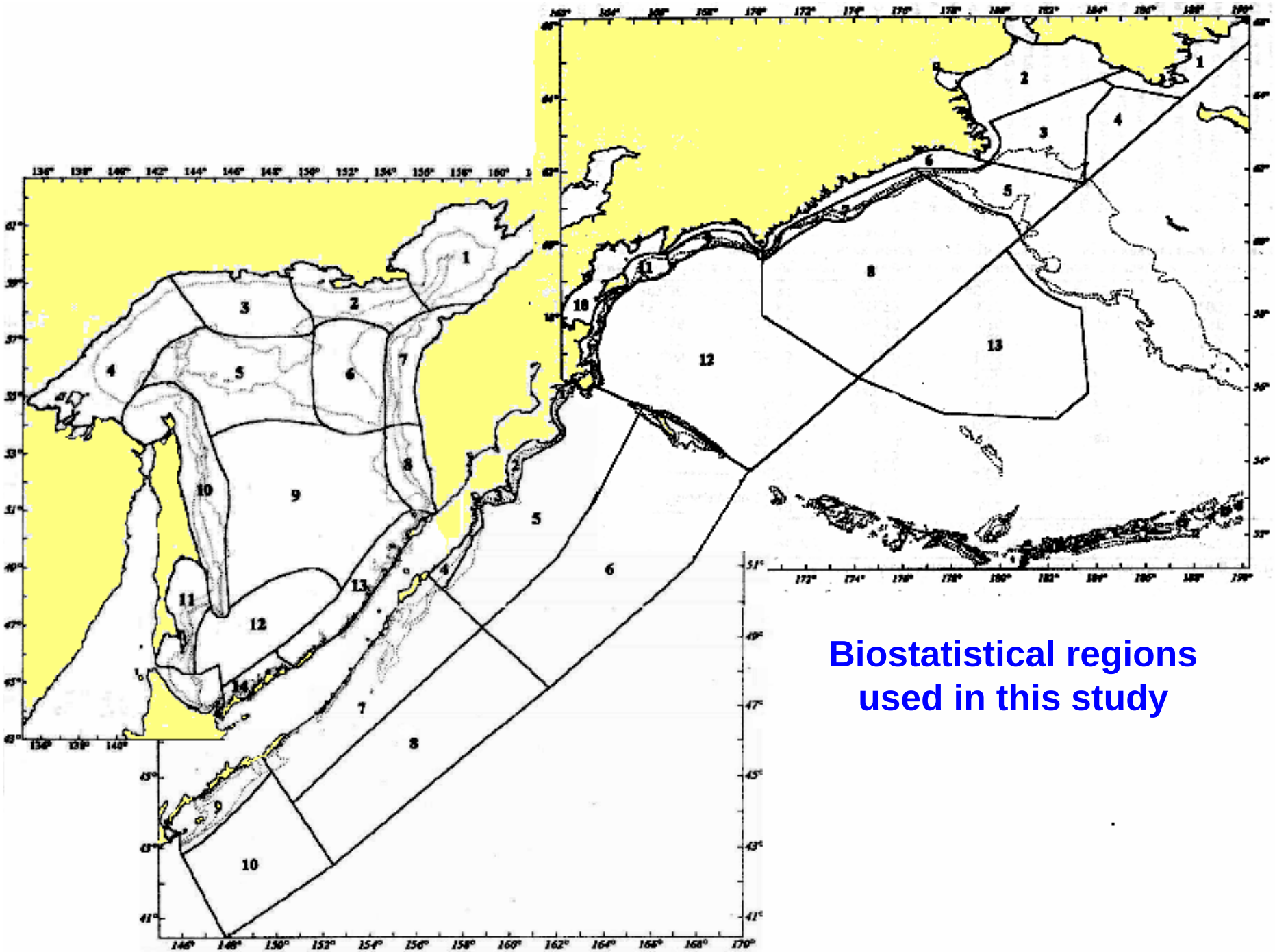

Biomass
Northern smoothtongue
Layer: Mesopelagic
Season: All
Years: 1980 - 2003
kg / sq. km
0
0 - 161,3
161,3 - 469,1
469,1 - 687,6
687,6 - 1199,4
1199,4 - 2402,4
2402,4 - 5680
100 0 100 200 300 400 500 kilometers


АТЛАС
Охотском море


0 - 30
31 - 656
674 - 7961
7988 - 11489
11946 - 17098
17642 - 31597
31682 - 216091
100 0 100 200 300 400 600 километры


Northern smoothtongue
Biomass
Layer: Mesopelagic
Season: All
Years: 1979 - 2004
kg / sq. km
0
0 - 7.9
7.9 - 23.8
23.8 - 44.5
44.5 - 94.9
94.9 - 187
187 - 2429.4
Охотское море
Берингово море
полуостров Камчатка
Курильские острова
о. Хоккайдо
о. Хонсю

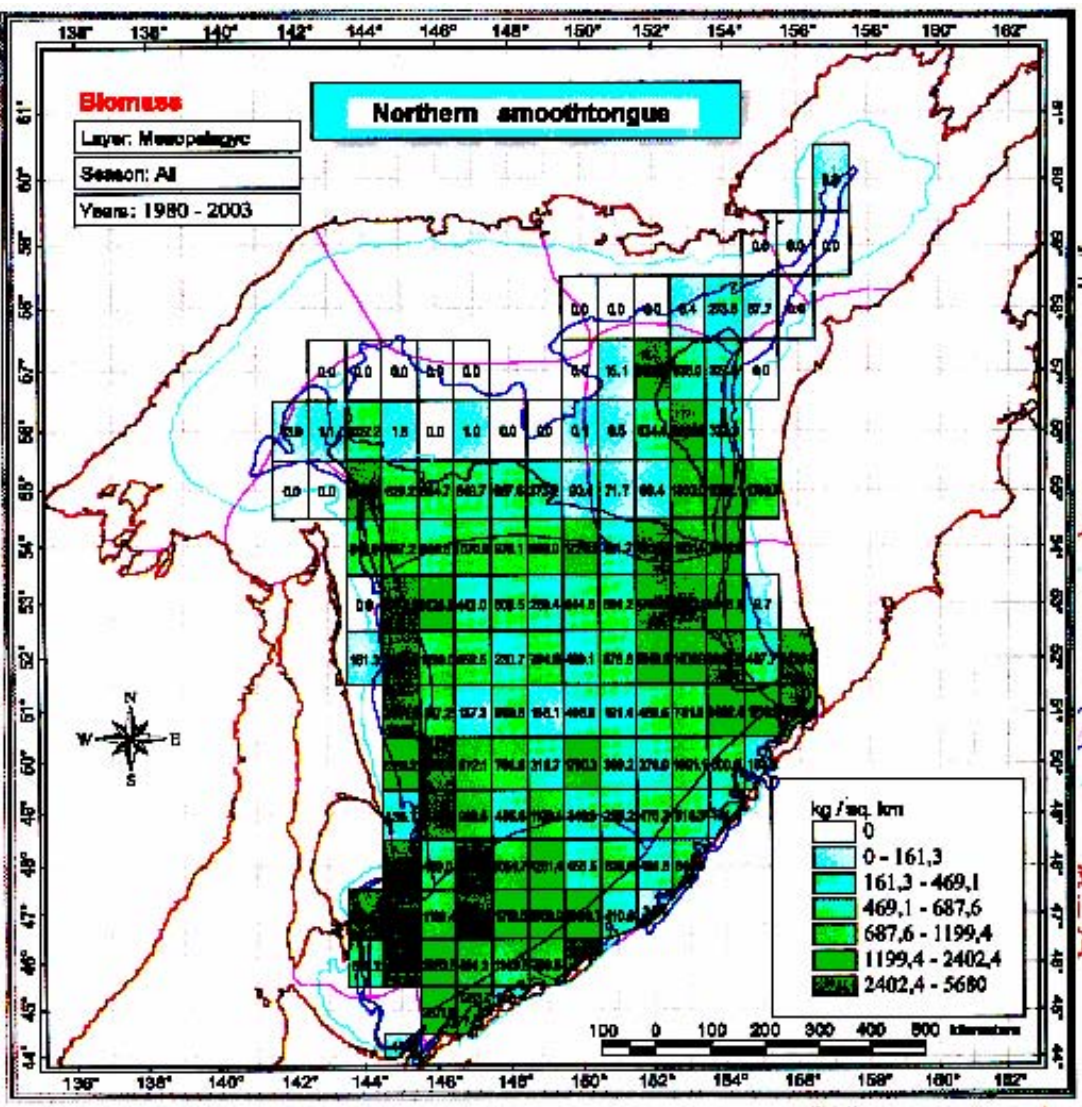

Stenobrachius leucopsarus
Biomass
Layer: Mesopelagic
Season: All
Years: 1979 - 2004
kg/sq.km
0
0 - 43.69
43.69 - 124.72
124.72 - 253.18
253.18 - 389.82
389.82 - 731.66
731.66 - 2833.69
полуостров Камчатка
Курильские острова
о. Хоккайдо
о. Хонсю

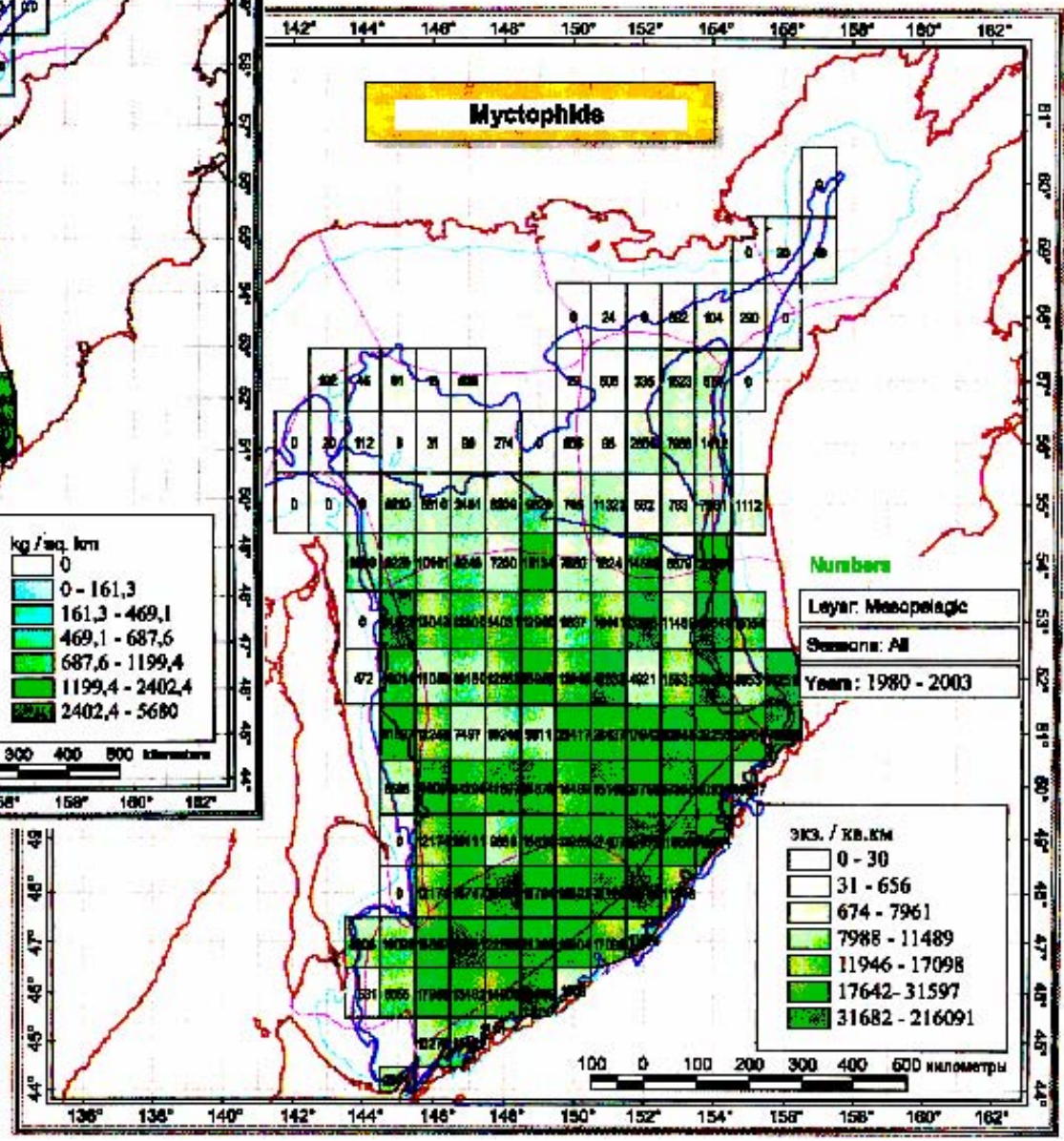


Biostatistical regions used in this study

Mesopelagic fish biomasses in the Sea of Okhotsk mesopelagic layer (kg/sq. km), 1984-2003

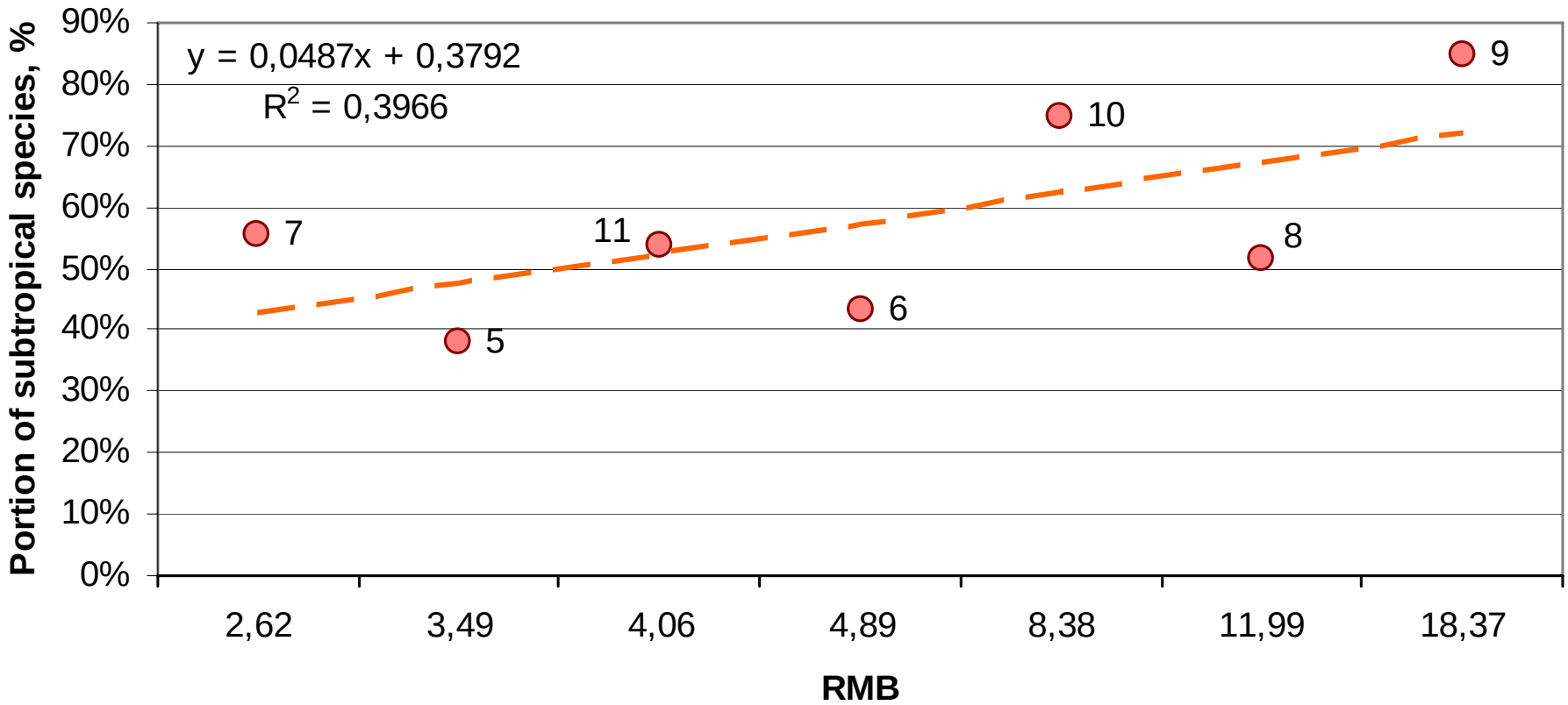
	Biostatistical regions					
Myctophids:	**5**	**6**	**9**	**12**	**13**	**14**
Stenobrachius nannochir	11,839	22,959	143,701	175,317	195,023	224,049
S. leucopsarus	0,638	11,617	42,728	30,776	63,302	11,596
Lampanyctus jordani	0,093	0,107	1,261	4,196	11,722	12,341
L. regalis	0,014	0,15	0,19	2,324	7,911	21,364
Protomyctiphum thompsoni	0,007	-	0,134	0,227	0,903	0,057
Diaphus spp. (Myctophidae gen. sp.)	-	+	0,377	-	0,11	191,908
Total	12,591	34,833	188,391	212,84	278,971	461,315
Bathylagids:						
Leuroglossus schmidti	517,425	1570,337	1536,874	2214,496	941,441	2955,492
Lipolagus ochotensis	59,531	0,81	155,774	230,804	107,3	389,627
Bathylagus pacificus	0,436	-	6,638	34,134	23,725	114,405
Pseudobathylagus milleri	1,179	0,123	6,634	16,336	22,241	26,268
Total	578,571	1571,27	1705,92	2495,77	1094,707	3485,792
RMB	**0,02**	**0,02**	**0,11**	**0,09**	**0,25**	**0,13**

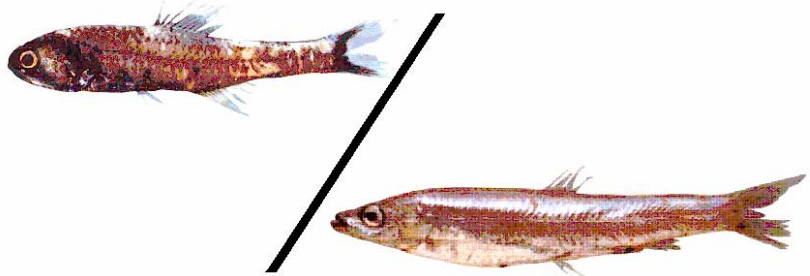

Biomass
Northern smoothtongue
Layer: Mesopelagic
Season: All
Years: 1980 - 2003
kg / sq. km
0
0 - 161,3
161,3 - 469,1
469,1 - 687,6
687,6 - 1199,4
1199,4 - 2402,4
2402,4 - 5680
100 0 100 200 300 400 500 kilometers

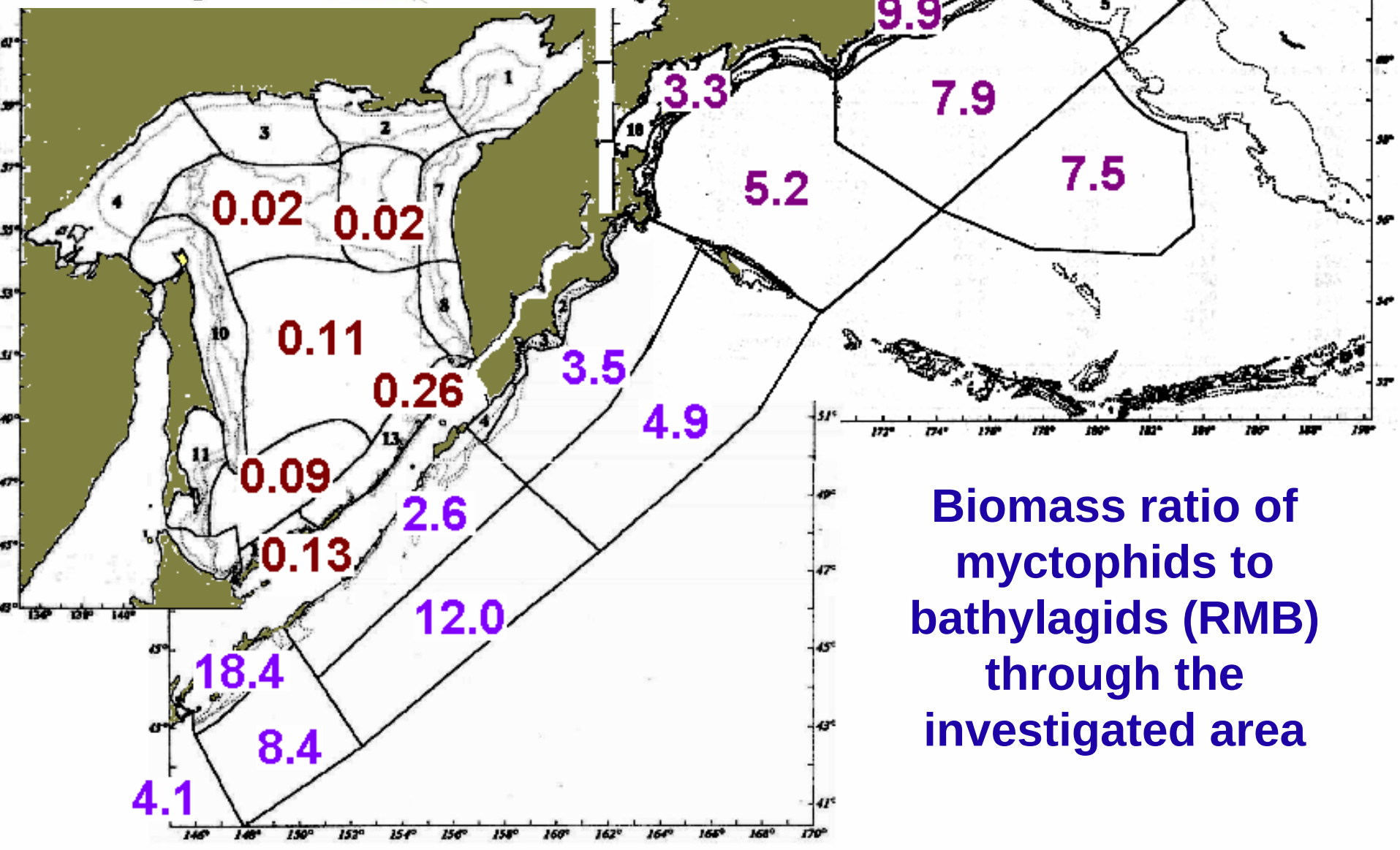

Myctophids
Numbers
Layer: Mesopelagic
Seasons: All
Years: 1980 - 2003
экз. / кв.км
0 - 30
31 - 656
674 - 7961
7988 - 11489
11946 - 17098
17642 - 31597
31682 - 216091
100 0 100 200 300 400 600 километры

RMB value relation to a portion of subtropical species in the total myctophid biomass.

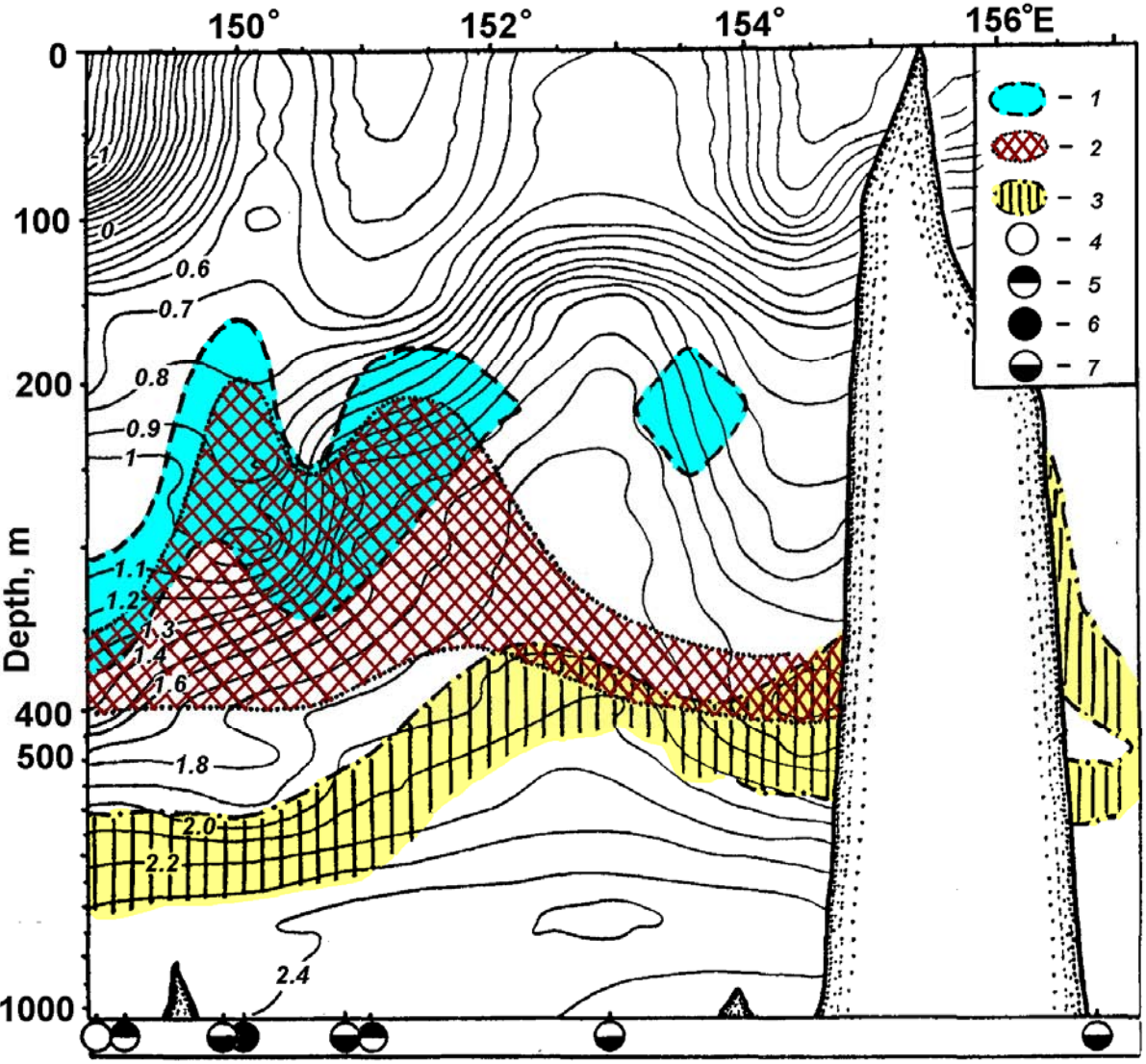
Numbers of statistical regions are indicated





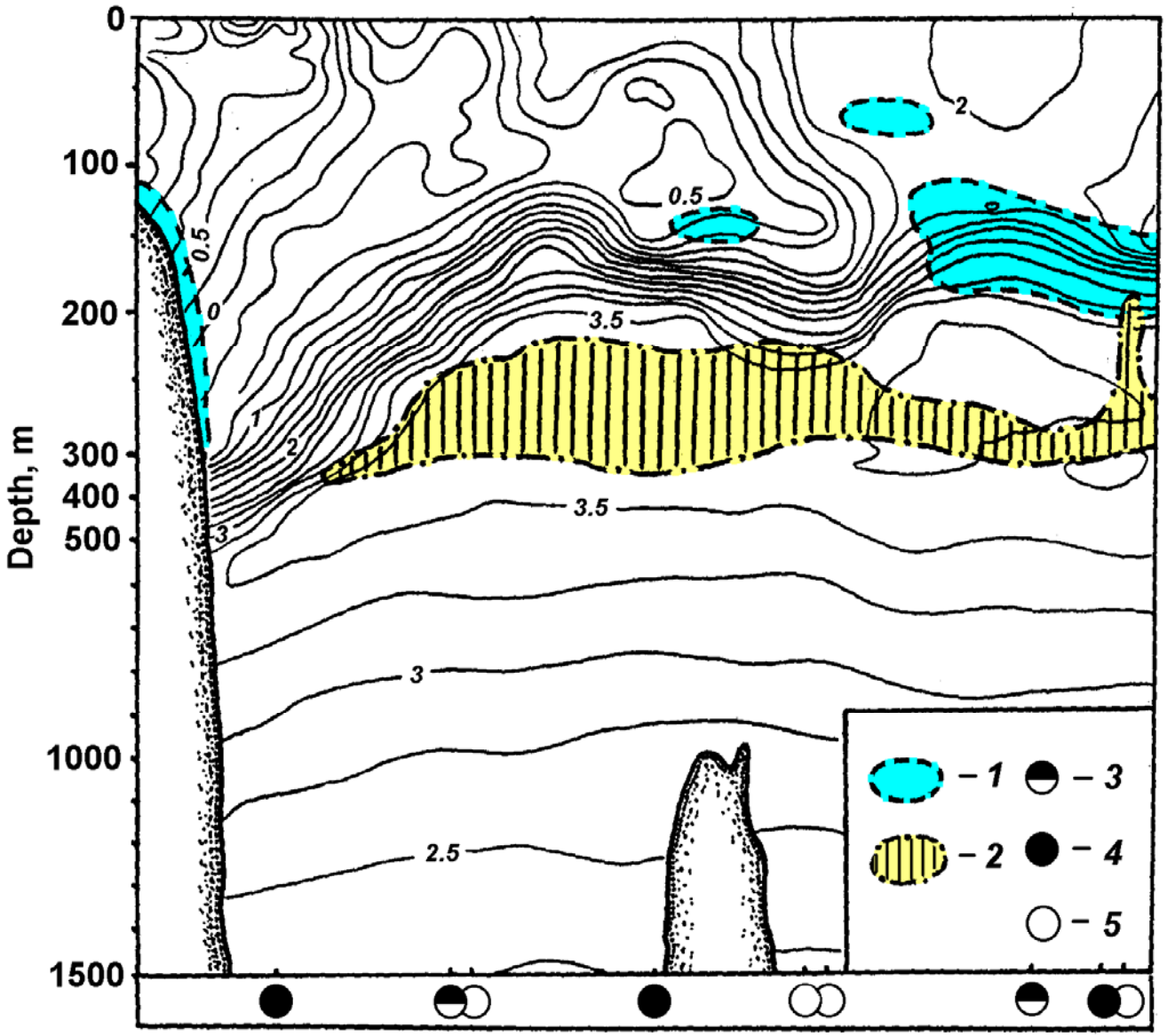


Biomass ratio of myctophids to bathylagids (RMB) through the investigated area



Vertical distribution of the common mesopelagic fish aggregations in the offshore Sea of Okhotsk on the water temperature field:

1 – Theragra chalcogramma;
2 – Leuroglossus schmidti
3 - Stenobrachius spp.
Time of trawl hauls:
4 – daytime (8 a.m. – 4 p.m.)
5 – evening (4 – 8 p.m.)
6 – night (8 p.m. – 4 a.m.)
7 – morning (4 – 8 a.m.)



Vertical distribution of the common mesopelagic fish aggregations in the offshore Bering Sea on the water temperature field:

1 – Theragra chalcogramma;

2 – Stenobrachius leucopsarus

Time of trawl hauls:

3 – evening (4 – 8 p.m.)

4 – night (8 p.m. – 4 a.m.)

5 – daytime (8 a.m. – 4 p.m.)

Variability of RMB index in the Sea of Okhotsk biostatistical regions by three selected time periods

Second line for each region – number of trawl stations in the database

Regions	RMB Index			
	1984-1990	1991-1995	1996-2003	Whole period
5	0,02	n/a	0,01	0,02
	31	9	72	112
6	0,02	0,01	0,02	0,02
	35	33	143	211
9	0,16	0,18	0,05	0,11
	188	45	114	347
12	0,09	0,09	n/a	0,09
	87	11	3	101
13	0,30	0,33	n/a	0,26
	49	10	7	66
14	0,08	n/a	n/a	0,13
	21	3	3	27

Variability of RMB index in the Bering Sea biostatistical regions by three selected time periods

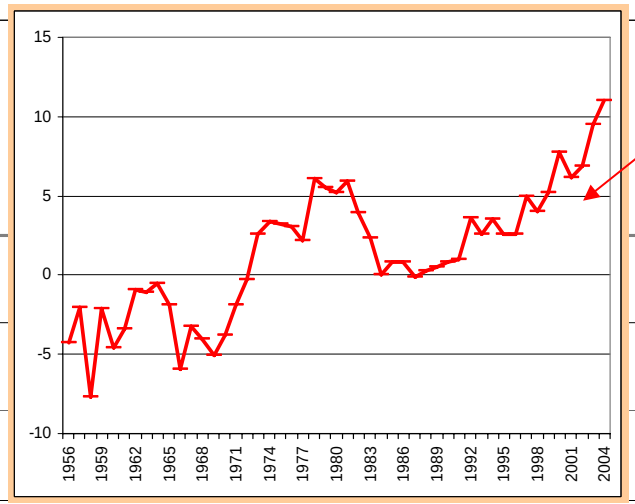
Second line for each region – number of trawl stations in the database

Regions		RMB		
	1982-1990	1991-1995	1996-2004	Whole period
7	9,4	n/a	n/a	9,9
	28	0	6	34
8	8,2	8,7	3,9	7,9
	141	43	26	210
11	3,3	n/a	n/a	3,3
	11	4	0	15
12	5,3	4,1	n/a	5,2
	252	21	0	273
13	7,50	n/a	n/a	7,5
	131	5	0	136

Variability of RMB index in the Pacific ocean biostatistical regions

Regions	RMB Index			
	1979-1990	1991-1995	1996-2004	Whole period
5	3,5	3,5	n/a	3,5
	41	21	0	62
6	2,3	6,2	n/a	4,9
	26	25	0	51
7	3,8	5	1,6	2,6
	135	16	10	161
8	12	n/a	n/a	12
	14	0	0	14
9	3,80	47,2	32,7	18,4
	410	17	52	479
10	n/a	7,1	n/a	8,4
	7	22	4	33
11	4	n/a	n/a	4,1
	168	4	0	173

Changes in the RBM index value between three selected time periods



Time series of yearly ocean heat content for the 0-700 m, after Levitus et al., 2005. (10^{22} J)

PICES XV ***S9-2798 Poster***

Basic factors determinative phytoplankton bloom in the western subarctic Pacific and the adjacent deep area of the Bering Sea in spring of 2005

Boris M. **Borisov**

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In spring of 2005, a plankton survey was carried out in the western subarctic Pacific Ocean and in the adjacent deep area of the Bering Sea. During the survey, an intense algal bloom occurred in the study area; the highest biomass of net-collected phytoplankton at the upper 50m layer was 2900mg m^{-3}. Mesozooplankton samples were represented mainly by fragments of large body-size species - salps and heteropods, typical inhabitants of the south boundary of the Western Subarctic Gyre. The composition of the remainder of zooplankton samples included typical warm water species: *Pleuromamma gracilis, P. abdominalis, Tessarobrachion oculatum,* and spawning stage of *Euphausia pacifica*. The species composition of mesozooplankton at the study area during the spring of 2005 suggests that the water supporting the intense algal bloom was observed penetrated from Western Subarctic Gyre. It is possible that during this time, the large amount of dead salps and heteropods provided a strong input of nutrients to the euphotic zone, which resulted in the observed algal bloom in the study area, although such a phenomena has not been detected previously in this area.

Mesozooplankton samples were represented mainly by fragments of large body-size species - salps and heteropods, typical inhabitants of the south boundary of the Western Subarctic Gyre. The composition of the remainder of zooplankton samples included typical warm water species: …

Conclusions:

1. - RMB characterizes a mesopelagic fish community as rather stable in the long-term aspect, and gradually changing in spatial scale.

2. - Recent conclusions on sharp changes in the mesopelagic fish abundance were likely based on the incomplete data and related to cessation of the regular large-scale pelagic trawl surveys in the mesopelagic layer since 1990s.

3. - Further monitoring of the RBM variability could reveal early evidences of global warming effect on the pelagic ecosystems in mesopelagic layer.