

NPAFC  
Doc. 644  
Rev. \_\_\_\_\_

**Spatial Distribution and Abundance of Pacific Salmon in the Southern Okhotsk Sea in  
fall 2001**

**(Results of 2001 Salmon Crouse of R/V “TINRO” )**

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Submitted to the  
NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

RUSSIA

October 2002

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Spatial Distribution and Abundance of Pacific Salmon in the Southern Okhotsk Sea in fall 2001 (Results of 2001 Salmon Crouse of R/V “TINRO”) (NPAFC Doc. 644). 11 pp.  
Pacific Research Fisheries Centre (TINRO-centre), 4, Shevchenko Alley, Vladivostok, 690600, RUSSIA.

## Material and methods

The trawl survey was conducted by r/v "TINRO" from October 21 to November 9 to estimate pacific salmon juveniles abundance and distribution in the southern Okhotsk Sea in autumn 2001. It encompassed an area 477 km<sup>2</sup> and consisted of 50 trawl tows. Trawling hauls were conducted with a midwater trawl RT 80/396. Its mouth dimensions are following: vertical – 35-37 m, horizontal – 31-36 m, cone-end was equipped with 10-mm mesh on the inside. The trawls has being usually towed by the sea surface during one hour, maintaining a speed 4,4-5,0 knots. . The length of warps was 250-300 m.

All catches have been sorted by species whereupon all fishes were counted and weighed. Catch of one hour trawling was accepted as CPUE. Measurement of the fork length, body weight were executed. To calculate salmonids abundance we used a method of squares when an average density of fish distribution (specimen per km<sup>2</sup>), resulted from the averaging of the trawl catches, was extrapolated throughout whole area where salmon occurred. Coefficient of catch efficiency 0.3 has been applied at calculations of salmon abundance.

### Spatial distribution and abundance of pacific salmon in the southern Sea of Okhotsk in autumn 2001

The salmon was one of the most abundant species in fish communities of upper epipelagic deep water part of the southern Okhotsk Sea in October-November 2001. Proportion of salmon in total trawl catches estimated as 58,4 % in 2001 (1998- 2000–23-72%) (Table 1).

The density of salmon concentrations compared for the previous 4 years had its maximum in 2001 (1.035 t/km<sup>2</sup>).

The pink salmon and chum salmon juveniles were the most abundant among salmonids and consisted of 64.3% and 28.0% of total salmon biomass.

Pink salmon. Total abundance and biomass of pink salmon juveniles (abundance –  $2.0 \cdot 10^9$ , biomass 271.4 ths.t) had maximum in 2001 for the period of 1998-2201. Distribution of pink salmon juveniles in 2002 differs from it distribution in previous years (fig.1) . Relatively high abundance of pink salmon juveniles were registered in the southwestern Sea of Okhotsk in 2001 (2773 specimen per 1 hour tow). At the same time the juveniles were not abundant in the northern areas . In 1999, the mean catch of pink salmon juveniles were 466 specimens per 1 hour tow in the area located to north from 50°00N and to east 150°00E and 142 specimens per 1 hour tow in area located to south 50°00N and to west 150°00E.

Acceptable reason of interannual distribution differentiation is variation of oceanological condition. The area with optimum habits temperature (6-8°C) located more to south in autumn 2001.

Maximum catch in the center of survey area was 3584 specimens per 1 hour tow, mean catch was 318.8 specimens per 1 hour tow and 461.3 specimens per 1 hour tow in the main distribution area.

Mean size of mean pink salmon juveniles in 2001 (length – 23.7, weight – 135 gr) comparable with data of 1999 (Table 3). The pink salmon juveniles size of even year classes higher as juveniles size of odd year classes. The largest pink salmon juveniles were observed in the northern part of survey area off the southern Sakhalin island and the smallest juveniles were registered off the southern Kamchatka (fig. 2).

Chum salmon. The chum salmon juveniles abundance is estimated in 881 mln specimens, biomass in 114 ths.t in the southern part of Sea of Okhotsk in October 2001 (Table 1)

Spatial distribution of chum and pink salmon juveniles very similar and just the highest concentration of chum juveniles was located a little more in the northeastern part of the survey area (fig. 3). The maximum catch of chum juveniles was indicated in the center of survey area, mean catch in the southern area is 882 specimens per 1 hour tow and it's comparable with 1999 data (table 2). The chum salmon juveniles abundance is 1,5 times higher in odd years during last years (table 2).

The mean size of chum salmon juveniles had minimum in 2001 (length 22,6 sm, weight 129.5 g) for the last 4 years period (table 3). Spatial distribution of chum salmon different size juveniles in 2001 is very similar to the distribution in previous years. For example, the largest juveniles distributed in the southeastern and the smallest in the northern and southwestern parts of survey area (fig.4)

The acceptable explanation of distribution phenomena in the southern Sea of Okhotsk by the end of 1990-s is quite possibly predomination of juveniles from Japanese hatcheries.

Other salmon species. The juveniles of all other salmon species there are in catch and its biomass indicated in Table 1.

The king salmon juveniles distributed of western Kamchatka shelf up to 54o00N and obviously migrated toward to the Pacific ocean through the north Kuril Islands straits (fig. 5a). The sockeye salmon juveniles behavior is very similar usually, but it was distributed more widely in 2001 compare previous years (fig. 5b). Quiet possibly, it is connected with high abundance of sockeye salmon juveniles (Table 1).

Abundance of cherry juveniles is a lot higher in 2001 compared to the previous years (Table 1). Catch of salmon trout juveniles had minimum in the northeastern Sea of Okhotsk and maximum in the southern part (428 specimens per 1 hour tow (Fig. 6a)

The coho salmon juveniles were indicated in catch off Kuril Islands (Fig. 6b) and its catch was increasing from southwestern survey area towards northwestern the area or coastal water western Kamchatka.

The coho salmon juveniles registered in 2001 are western Kamchatka stock.

Feeding of pink and chum salmon juveniles. The amphipods, euphausiids and copepods predominate in feeding of pink and chum salmon at the centre deep water basin in 2001 as well as in 1998 and 2000. Proportion of it in feeding of pink salmon estimated as 94.4% and for chum salmon 86.4%.

The euphausiids (basically *Th.longipes*) consists 46.6% of daily food ratio and hyperiids (basically *Th.pacifica*, *Th.macropa*). Intensity of pink salmon juveniles was relatively high, and the index of stomach estimated as 120.1 o/oo, daily food ratio as 3.9%.

The pteropods, ocyropsids and sagitta take most important part in feeding of chum salmon juveniles (13.6 of chum salmon ratio and just 4.8 of pink salmon ratio).

Feeding intensity of chum salmon juveniles comparing it to pink salmon is higher (table 4). The chum salmon juveniles stomach index estimated as 126.2 o/oo, daily food ratio as 4.7%.

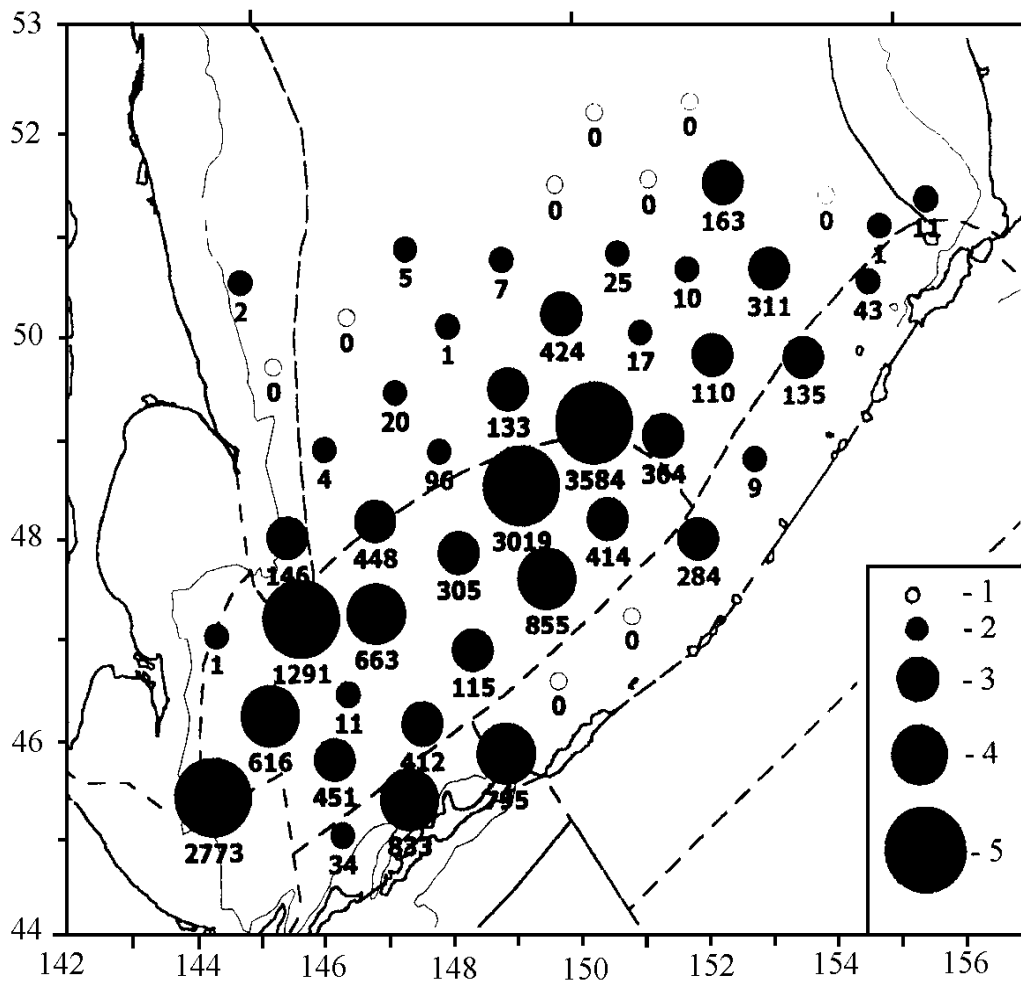


Fig. 1. Catch distribution of pink salmon in autumn 2001. Catches: 1 -0; 2 - less than 100; 3 - 100-500; 4 - 500-1000; 5 - more than 1000 sp./h.

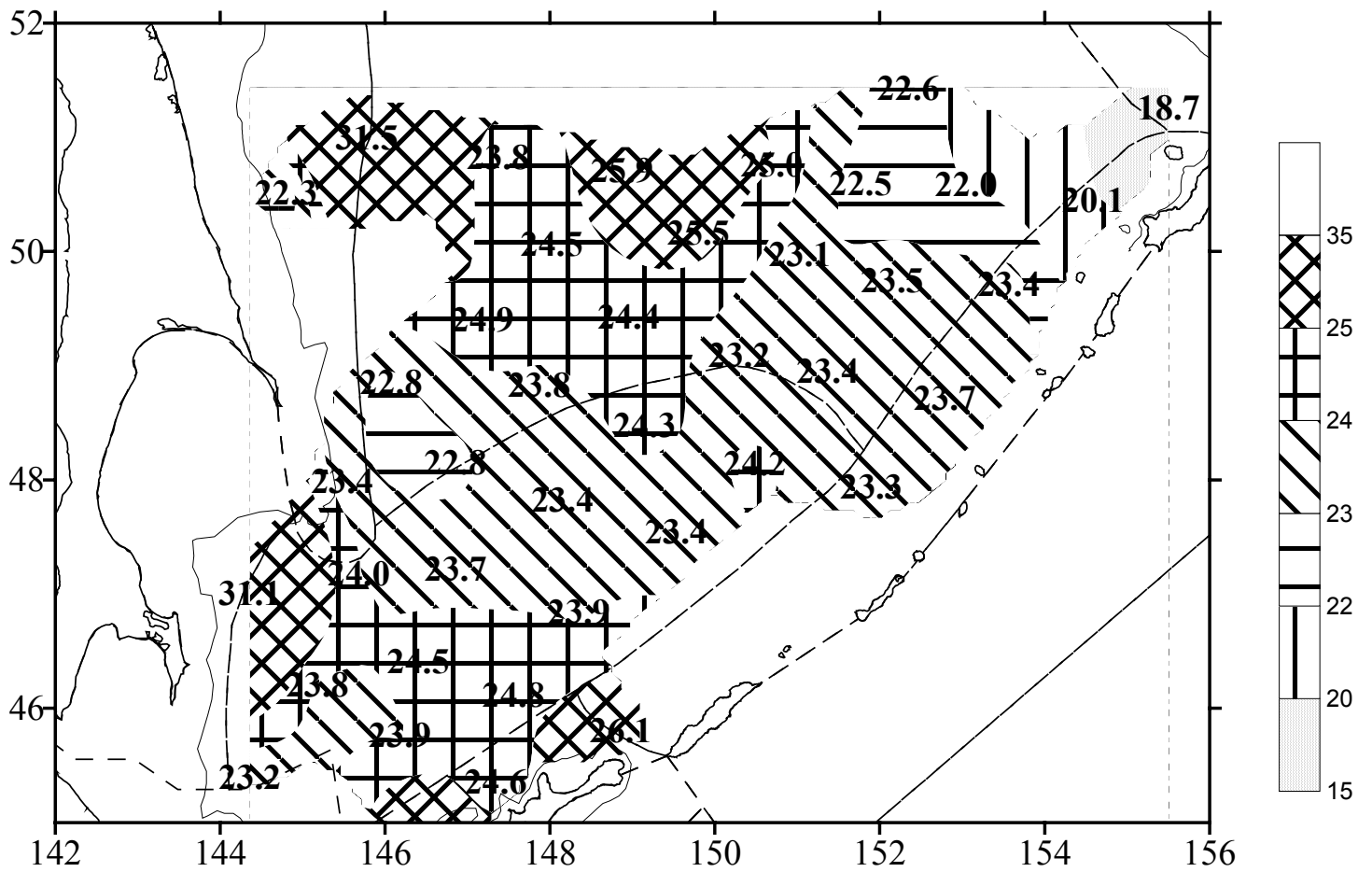


Fig. 2. Distribution of average length (cm) of pink juveniles in fall 2001

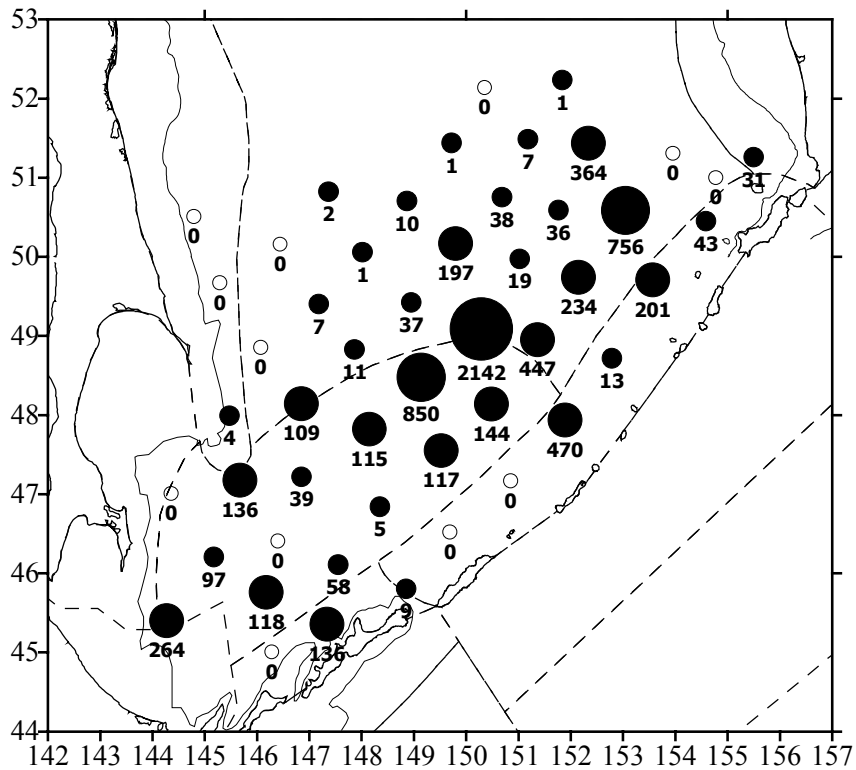


Fig. 3. Catch distribution (sp./tr.) of chum juveniles in fall 2001

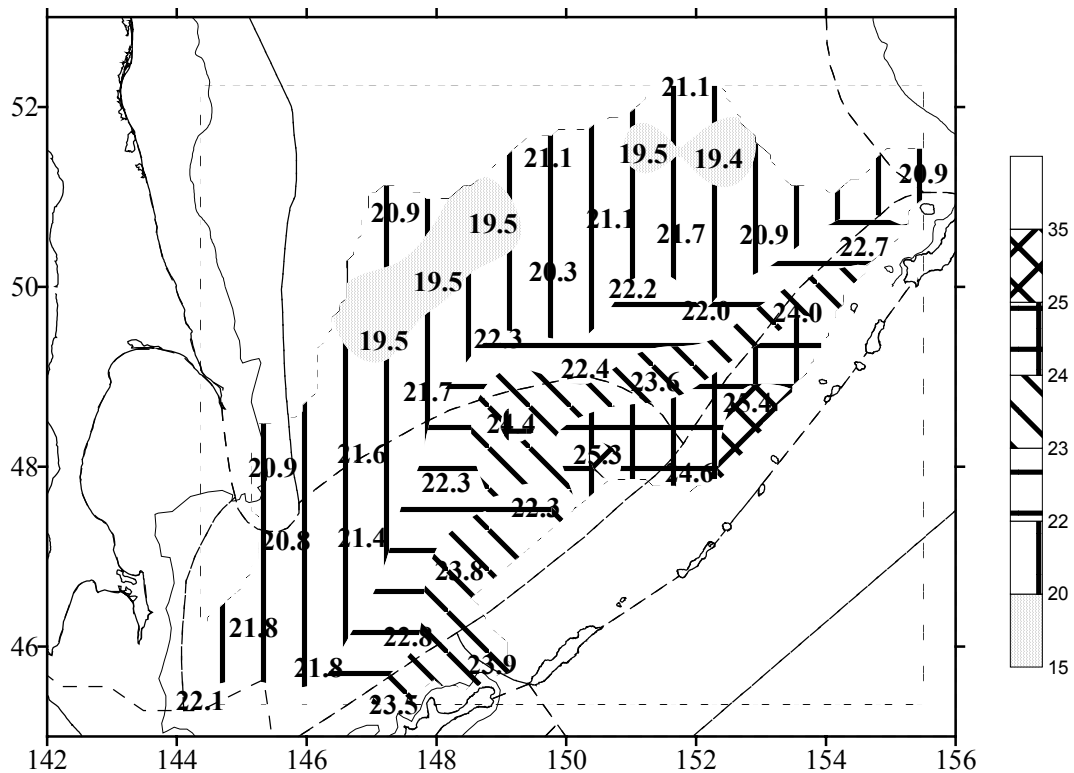


Fig. 4. Distribution of average length (cm) of chum juveniles in fall 2001

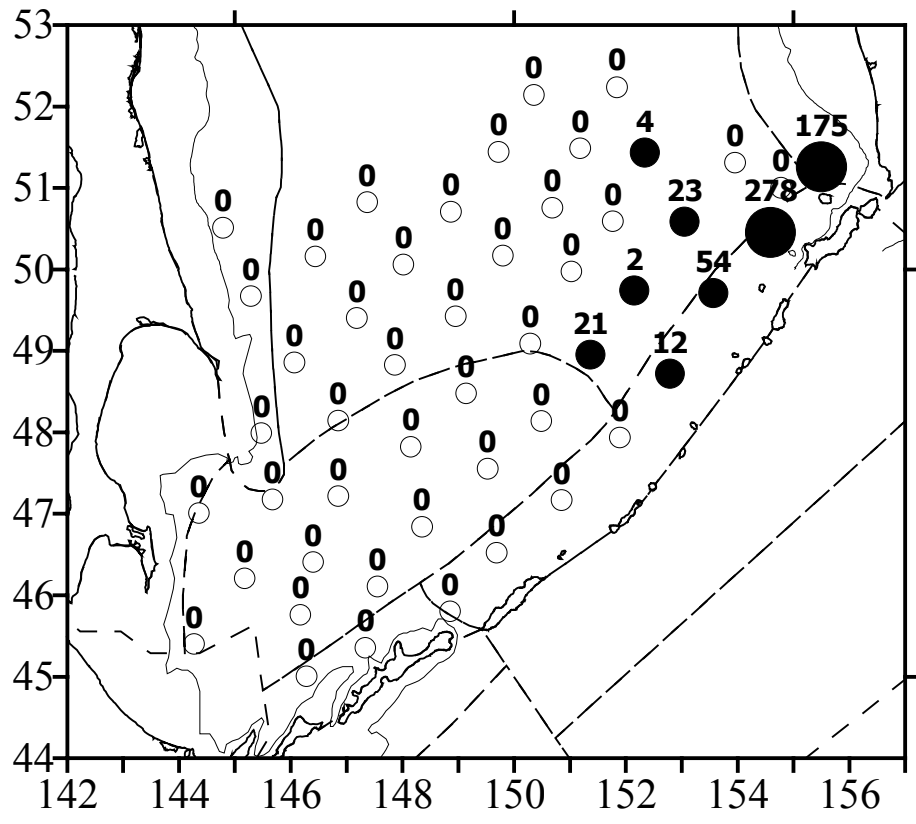
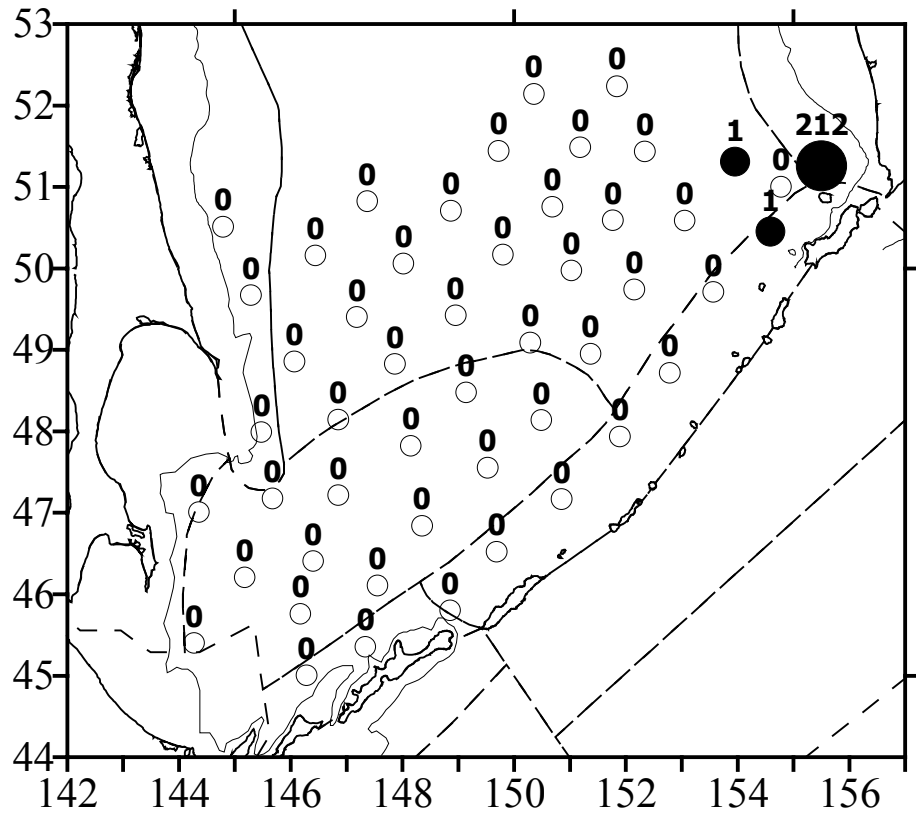


Fig. 5. Catch distribution (sp./tr.) of chinook (a) and sockeye (b) in fall 2001



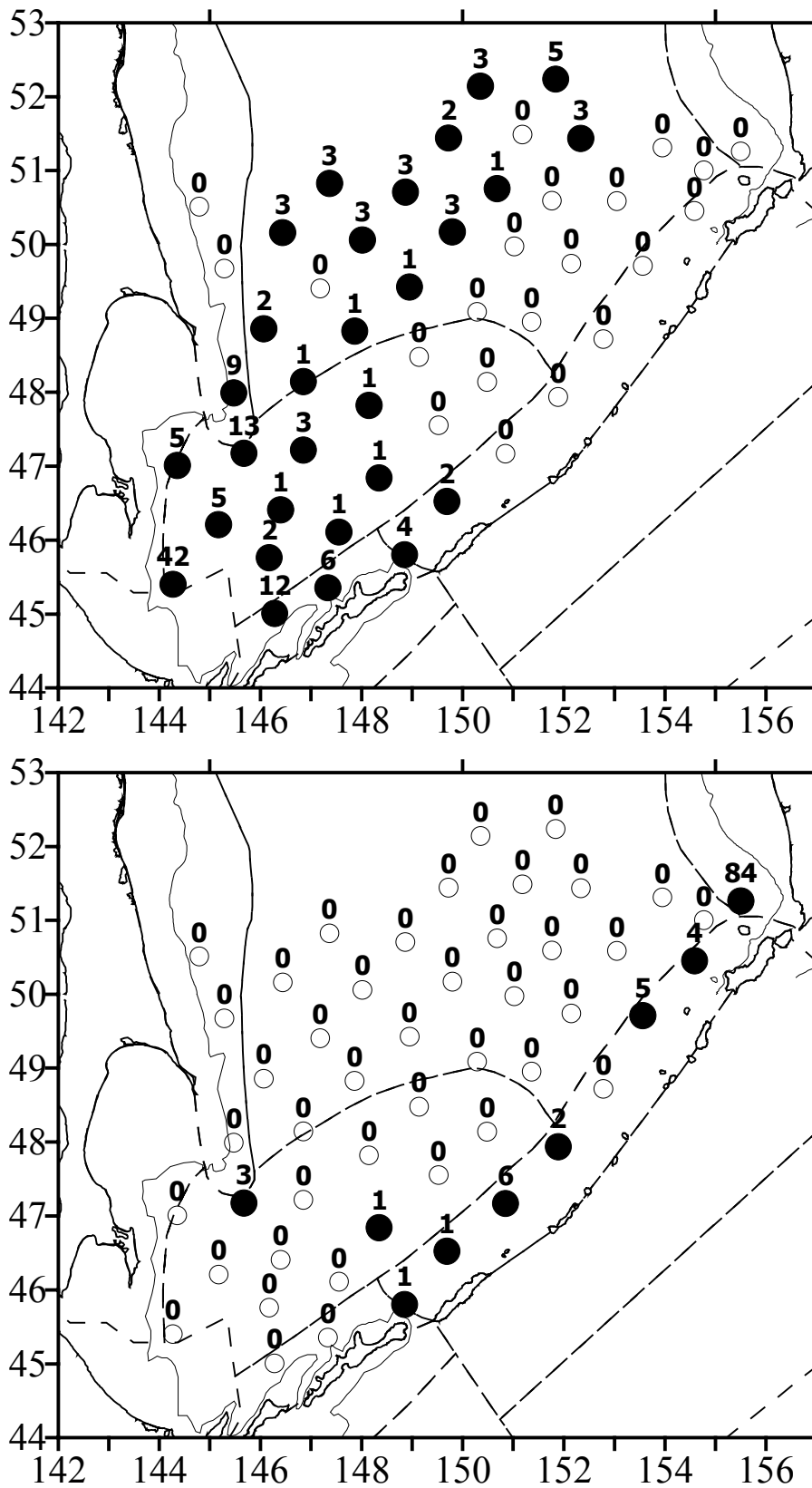


Fig. 6. Catch distribution (sp./tr.) of cherry(a) and coho (b) in fall 2001

Table 1. Species composition and biomass (ths. t) of common fish in the southern Sea of Okhotsk in autumn 1998-2001

Species	1998		1999		2000		2001	
	ths.t	%	ths.t	%	ths.t	%	ths.t	%
O. gorbusha (juv)	198,6	13,7	193,4	41,0	200,7	43,7	271,3	37,6
O. keta (juv)	87,7	6,1	127,2	26,9	81,8	17,8	114,1	15,8
O. keta mature	7,97	0,6	16,7	3,5	0,0	0,0	2,3	0,0
O. keta immature	24,1	1,7		0,0	2,2	0,5	4,2	0,0
O. nerka	0,4	0,0	0,19	0,0	3,2	0,7	11,9	1,6
O. tschawytcha	0,2	0,0	0,66	0,1	0,4	0,1	6,5	0,9
O. kisutch	4,6	0,3	0,19	0,0	0,2	0,0	3,9	0,5
O. masu	3,1	0,2	1,77	0,4	2,5	0,5	7,4	1,0
Total salmon	<b>326,7</b>	<b>22,6</b>	<b>340,1</b>	<b>72,1</b>	<b>291,0</b>	<b>63,4</b>	<b>422,3</b>	<b>58,4</b>
Leuroglossus schmidti	338,5	23,4	49,7	10,5	68	14,8	175,8	24,3
Pleurogrammus azonus	1	0,1	6,4	1,4	0,5	0,1	1	0,1
Engraulis japonicus	617,1	42,7	23,8	5,0	1	0,2	0,3	0,0
Other	32,3	2,2	14,7	3,1	42,2	9,2	71,5	9,9
Total fishes	<b>1315,6</b>	<b>91,0</b>	<b>434,7</b>	<b>92,1</b>	<b>402,7</b>	<b>87,8</b>	<b>670,9</b>	<b>92,9</b>
Squids	129,6	9,0	36,9	7,8	56,2	12,2	51,6	7,1
Total nekton	<b>1445,7</b>	<b>100,0</b>	<b>472</b>	<b>100,0</b>	<b>458,9</b>	<b>100,0</b>	<b>722,5</b>	<b>100,0</b>
Square, km <sup>2</sup>	402,9		513,5		408		477	

Table 2. Abundance (N, mln.sp.) and mean catch (CPUE, sp/trawl) of pink and chum salmon juveniles in the southern Sea of Okhotsk in fall 1998-2001

Year	Survey duration	Pink		Chum	
		N	CPUE	N	CPUE
1998	14.10-1.11	1070	175,9	573	92,9
1999	7.10-27.10	1513	363,9	913	144,1
2000	25.10-8.11	1376	292,9	631	126,9
2001	21.10-9.11	2009	318,8	882	150,3

Table 3. Abundance (N, mln.sp.) and mean size of pink and chum salmon juveniles in the southern Sea of Okhotsk in fall 1998-2001

Год	Survey duration	Pink			Chum		
		N, mln.sp.	L, cm	W, g	N, mln.sp.	L, cm	W, g
1998	14.10-1.11	1070	26,4	196	573	24,5	168,5
1999	7.10-27.10	1513	23,3	132	913	23,3	140,4
2000	25.10-8.11	1376	23,9	146,3	630,6	23,6	130,1
2001	17.10-9.11	2009	23,7	135	881	22,6	129,5

Table 4. Feeding of pink and chum salmon juveniles in fall 1998-2001

	Food components, %	1998	1999	2000	2001
O. gorbusha	Euphasiidae	11,9	21,8	46	46,4
	Amphipoda	38,7	36,9	39,7	31
	Copepoda	14,5	35,7	7,4	17
	Decapoda	0,1	-	1,2	0,5
	Pteropoda	17,5	-	1,1	0,2
	Oikopleura	-	-	2,1	0,6
	Sagitta	12,9	2	1,3	4
	Coelenterata	0,4	0,9	0,6	-
	Fishes	0,6	-	0,3	0,3
	Other	3,4	2,7	0,3	-
	Stomach index ‰	110,7	169,1	155,7	120,1
O. keta	Euphasiidae	5,2	14,9	17	30,3
	Amphipoda	43,9	33,7	37,9	39,7
	Copepoda	17,1	29,7	6,3	16,4
	Decapoda	0,4	-	0,8	-
	Pteropoda	10,9	-		2,6
	Oikopleura	3,4	6,3	23,2	4,5
	Sagitta	16,5	8,8	7,1	6,5
	Coelenterata	-	5,7	4,7	-
	Fishes	0,1	0,6	-	-
	Other	2,5	0,3	3	-
	Stomach index ‰	98,1	137	135,4	126,2