

**NPAFC
Doc. 522
Rev.**

**Distribution and Abundance of Pacific Salmon
in the Southern Okhotsk Sea in Summer-Fall 2000**

by
Lapko V.V. and Glebov I.I.

Pacific Scientific Fisheries Center (TINRO-Center)
4 Shevchenko Alley, Vladivostok, 690950, Russia

Submitted to the
NORTH PACIFIC ANADROMOUS FISH COMMISSION

by
Russia

March 2001

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Lapko V.V. and Glebov I.I. 2001. Distribution and abundance of pacific salmon in the southern Okhotsk sea in summer-fall 2000. (NPAFC Doc. 522) 14 pp. Pacific Scientific Research Fisheries Center (TINRO-Center), Vladivostok, Russia.

DISTRIBUTION AND ABUNDANCE OF PACIFIC SALMON IN THE SOUTHERN OKHOTSK SEA IN SUMMER–FALL 2000

Lapko V.V. and Glebov I.I.

Pacific Scientific Research Fisheries Center (TINRO-center)

Vladivostok, Russia, 690950

MATERIAL AND METHODS

There were two separate trawl surveys carried out by TINRO's research vessels to estimate pacific salmon abundance and distribution in the southern Okhotsk Sea in 2000. The first one was conducted from August 17 to September 1 and directed on assessment of anadromous fish abundance, mainly pink salmon. It encompassed an area 384 000 km² and consisted of 44 trawl tows, 12 of which were made in Pacific waters off Kuril Islands (Fig.1 A). The second survey covered an area 408 000 km² has been undertaken from October 14 to November 5 to observe high sea migration of the salmon juveniles. It consisted of 37 trawl tows (Fig.1 B). The same midwater trawl (RT 80/396) was used in both cases. Its mouth dimensions were the following: vertical – 35-37 m, horizontal – 31-36 m; cone-end was equipped with 10-mm mesh on the inside. The trawl has being usually towed by the sea surface during one hour at the distance (wire length) 250-300 m astern, maintaining a speed 4.4 – 5.0 knots. 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, and gonad weight were executed. To calculate salmonids abundance we used a method of squares when an average density of fish distribution (specimen per km²), resulted from the averaging of the trawl catches, was extrapolated throughout whole area where salmon occurred. We have applied a catch efficiency to be equal 0.4 instead of former standard 0.3 because of substantially less trawl used in 2000 comparing to one used before. Totally 950 sp. of pink, 227 chum, 2 coho, 2 chinook and 7 cherry salmon were caught in summer and 10855 sp.of pink, 4742 chum, 150 sockeye, 2 chinook, 4 coho and 33 cherry – in fall 2000.

RESULTS AND DISCUSSION

Trawl survey in summer

Pink. Pink salmon was the most abundant among salmonids in the southern Okhotsk Sea in summer 2000. It occurred almost everywhere inside of observed area, however very irregularly. There was an obvious trend of CPUE increasing southeastward revealed in the

investigated area during cruise term. The least catches were observed in the waters off eastern Sakhalin (ranged from 0 to 12-14 sp./tr.) while the maximum ones (184 – 293 sp./tr.) obtained from both Pacific and Okhotsk sides of the South Kuril Islands, mostly Iturup – island. The catches of pink salmon acquired over the Okhotsk Sea southern basin could be defined as intermediate-value (32-99 sp./tr.)(Fig. 2). Such type of pink distribution at a point in time of trawl survey was conditioned by the terms of spawning runs in regional spawning grounds. For example, the peak of pink salmon run usually ends by the mid of August in the eastern Sakhalin rivers, so the most part of pink have leaved sea waters near Sakhalin and been in freashwater or may be spawned and died. At the same time pink salmon looked to be very abundant around Kuril Islands because of remarkably later peak of spawning occurred in the local rivers where it's observed in the late August – early September. Thus, the majority of fishes stayed in the sea at a time of trawl survey conducting.

As established and many times confirmed in the previous cruises, the most matured fishes are founded at the head of the pink groups approaching the coast, i.e. the closer to seashore – the more mature fish occur. Such situation happened in 2000 as well. We found that the fishes having high maturity index occurred near both the eastern coast of Sakhalin and Okhotsk coast of Iturup-island, whereas the less matured pink salmon were caught in Pacific Ocean (Fig. 3).

Also as maturity index the sex composition of pink catches indicates a stage of run. In general males are known to predominate at the head of spawning run in freshwaters, the sex ratio becomes almost even at the peak and females prevail in number at the final phase. The same order of pink groups migrating to the separate spawning areas is maintained in the sea too. In summer 2000 the share of females was increasing northeastward from Sakhalin coast and in lesser degree – northward, northeastward from the South Kuril Islands (Fig. 4), determining two major directions of the mature pink movement.

Thus, general situation recorded during trawl survey in summer 2000, characterized a final stage of pink salmon run to the rivers of Sakhalin Island and peak of pink's run belonged to Kurils populations. This was confirmed by the fish distribution as well as biological factors. According our assessment total abundance of pink salmon amounted 25.33 mln.sp. and 37.7 thousand tons in the southern Okhotsk Sea and 1.59 mln.sp. and 3 thousand tons in pacific waters off Kuril Islands. In 2000 pink salmon was slightly larger comparing to ones in 1999. In 1999 average length equaled 48.3 cm, average weight – 1480 g; in 2000 these characteristics were 48.9 and 1502 respectively in the Sea of Okhotsk and 49.8 and 1583 – in

pacific waters. Fishes from length range 46-52 cm composed 79% of the total number in Okhotsk Sea and 74% - in the ocean.

Chum. In August 2000 chum salmon were met mainly in the eastern part of the investigated area (Fig. 5). Several relatively high catches have been obtained off the eastern coast of Sakhalin. CPUE of mature chum ranged in the limits 1-28 sp./tr.; maximum catch (28 sp./tr.) occurred in Pacific Ocean while in the Sea of Okhotsk it did not exceed 14 sp./tr. Since the chum spawn later than pink salmon we revealed that chum still stayed mainly in pacific waters approaching to the South Kuril Islands from the northeast.

Total number of chum was estimated as 6.50 mln.sp., biomass – 22.5 thousand tons in the Sea of Okhotsk and 3.92 mln.sp. and 11.61 thousand tons respectively – in pacific waters. Chum of size group 60-68 cm composed 66% of the total number and 70% of the total biomass in the Sea of Okhotsk, while 58-65 cm sized fishes composed 54% and 77% respectively in Pacific Ocean. Average length and weight of chum salmon were recorded to be substantially lesser in 2000 comparing to data collected in 1999. For example, in 2000 averaged length varied from 62.06 cm to 63.88 cm (Pacific waters – Okhotsk Sea), average weight – from 2969 up to 3448 g whereas in 1999 these characteristics were 65.76 cm and 3715 g.

Juvenile chum salmon occurred in the two trawl catches – 7 and 6 specimens per haul. Several immature chum salmon were also caught mainly in pacific waters.

Trawl survey in fall 2000.

Pink. According to already long-term experience, it's very important to choose correct term of marine investigation while planning the trawl survey on pink and chum juveniles. We have found that such optimal time limits for the southern part of the Sea of Okhotsk can be defined as approximately one month from the mid October up to mid November. This period is optimal because the juveniles of the most common salmonid – pink salmon usually did not start to migrate to Pacific Ocean through the Kuril straits rather they accumulate in the southern part of Okhotsk Sea and can be reliably assessed in abundance during 2-3 weeks by research vessel. Of course, an estimation of juvenile number can be also conducted later, up to the end of December, but this work will require much more time because it will be necessary to investigate pacific waters off Kuril Islands too where juveniles distribute by that time. In 2000 also as in two previous years trawl survey on juvenile salmon has been carried out in optimal term. This is affirmed by extraordinarily low catches of pink juveniles in the waters

near Kuril Islands (Fig. 6). Although due to lack of time we could not investigate pacific waters in the fall 2000, the experience of previous two similar survey conducted in the same time period in 1998 and 1999, when only several specimen were caught there, indicates a correctness of our assumption. It consists in that during above-mentioned term almost all pink juveniles originated in the rivers of Okhotsk basin stay inside of Okhotsk Sea.

During our trawl survey pink juveniles were widely and comparatively evenly distributed in the southern Okhotsk Sea. Maximum catches were obtained on the mid of transects, while in vicinity of both Sakhalin and Kuril Islands they decreased (Fig.6). Quite high catches in both the southern and northern transects indicates that pink juveniles spread out southward and in more degree northward of the observed area. Distribution of pink juveniles could be determine as “comfortable” for estimation because there was not empty catches recorded inside of area covered by the stations and catch value variation was not too sharp. Assuming these reasons we have assessed of pink juvenile abundance as 1032 mln.sp., biomass – 150.953 thousand tons. Average individual length accounted 23.94 cm, average individual weight – 146.25 g. Length frequency distribution of pink juvenile catches was unimodal (Fig.7) that is usual for aggregations consisting of one age group. It’s necessary to note that in the fall 2000 average length and weight of juveniles considerably differed from ones of parental fishes as revealed in similar survey conducted in fall 1998. In 1998 average length and weight were recorded to be 26.4 cm and 195.9 g, though the estimated total numbers were very close: 1070 mln.sp. in 1998 and 1032 mln.sp. – in 2000. We’re sure that there was not any food deficit in the southern Okhotsk Sea during feeding period of salmon juveniles and described variation of body length and weight between young fishes in 1998 and 2000 has been resulted from severe environmental conditions observed in fall 2000. In the second half of October numerous cyclones moving over the southern part of the Sea of Okhotsk initiated strong and prolonged storms, which deeply mixed sea surface layer and destructed a seasonal thermocline. As a sequence a homothermy was established in the upper 60-80 m layer with the water temperature being less at 3-6⁰C comparing to average annual value. Most likely that was a reason why pink salmon juveniles fed less intensive, especially in the southern part of surveyed area, determining slightly “lower” growth rate than as usual. However, we presume that juveniles will compensate a delay of growth during subsequent feeding period, but it will be revealed more definitely in salmon survey in summer 2001.

Regarding spatial distribution of the average length we have ascertained that also as in 1998 the largest fishes were met in the waters near Kuril Islands and Kamchatkan coast, the smallest – off the Sakhalin. Besides, in addition to trend of average length increasing in

direction from the west to the east, the same trend was observed from the north southward (Fig. 8). We think that such type of average length distribution is conditioned by the mixing of fishes belonging to different regional stocks in the southern Okhotsk Sea. At the beginning of their high sea life (in August and September) pink juveniles irrespective of the region of originating widely distribute and mix in the northern and mid parts of Okhotsk Sea avoiding too warm waters over the southern deep basin. In October and later they are forced out southward and southeastwards by the water cooling started at the north. Those juveniles that earlier leaved inshore and entered to high sea waters have more prolonged feeding period and being the largest the first reach Kuril straits.

Chum. Chum juveniles occurred as frequently as pink ones were less abundant. Distribution of chum juveniles was also similar with pink one but there was one exception: maximum catches of chum were obtained slightly northeaster than in case with pink (Fig. 9). We estimated chum juveniles number as 473 mln.sp., biomass – 61.50 thousand tons, average length accounted 23.60 cm, average weight – 130.15 g. Length frequency distribution had also unimodal type (Fig.10) because of presence one age group only. As long as there were substantial catches in the stations of the northern and southern transects, the total abundance of chum juveniles appeared to be underestimated as well as in case with pink juveniles. As revealed in previous surveys the total number of chum juveniles usually varied near 0.5-0.6 bln.sp. in the southern part of the Sea of Okhotsk in fall. Assessment of 2000 was close to these values that in general can be resulted from comparatively stable amount of juveniles released from Japanese hatcheries annually. Our data indicate that like pink juveniles all chum ones from whole Okhotsk region including those originated in Japanese hatcheries migrate and feed inside of Okhotsk Sea up to mid October. Immature chum were also met during trawl survey. Totally 22 specimen were caught mostly near Kuril Islands.

Other salmon. In addition to pink and chum few fishes of other species of pacific salmon were recorded in the trawl catches. Their distribution is presented on figures 11 and 12.

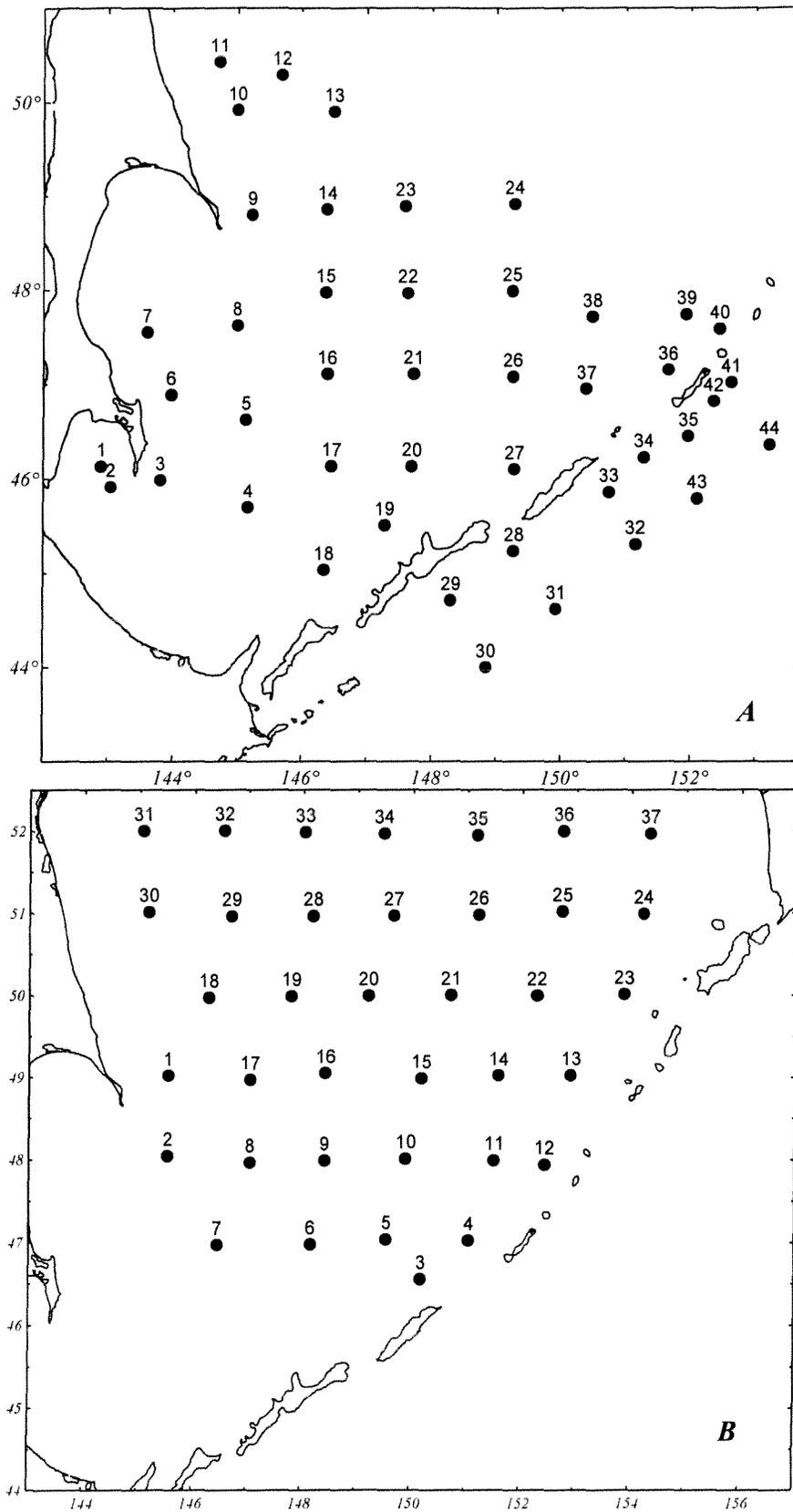


Fig.1 Trawl stations location in the southern Okhotsk Sea in summer (A) and fall (B) 2000

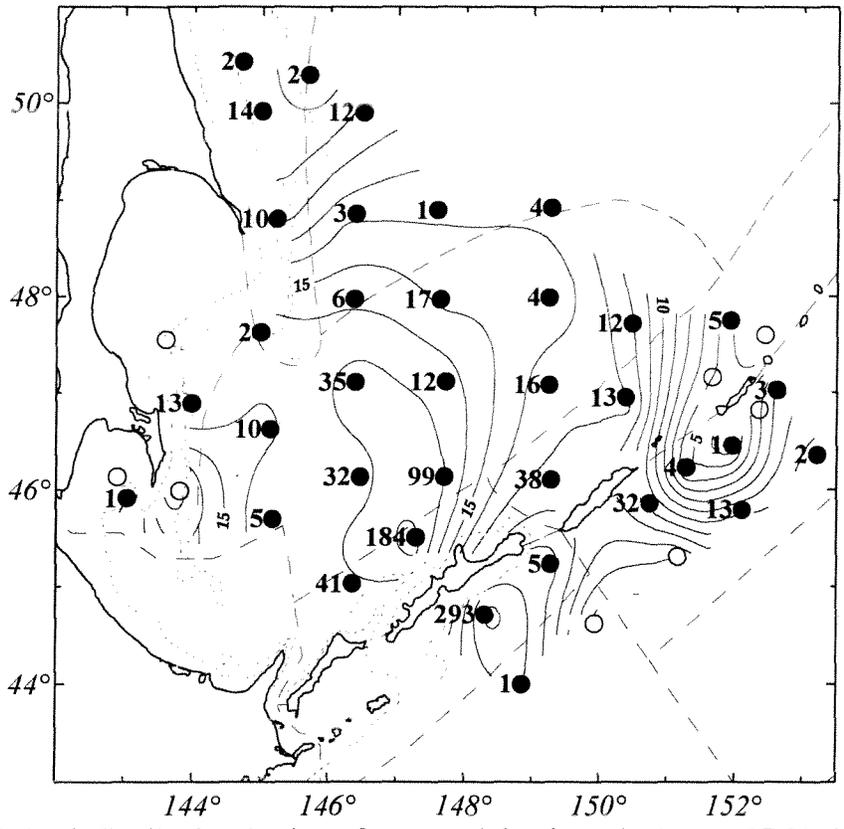


Fig.2 Catch distribution (sp./tr.) of mature pink salmon in August 17-31, 2000. Isolines indicate sea surface temperature.

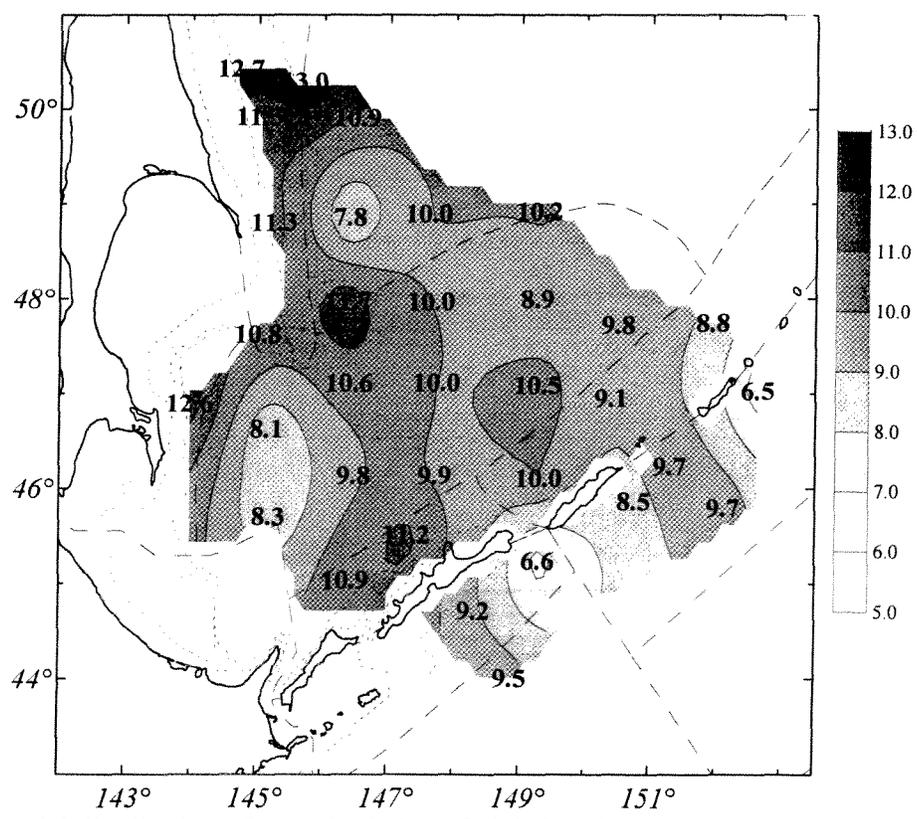


Fig.3 Spatial distribution of maturity index of pink females in August 17-31, 2000

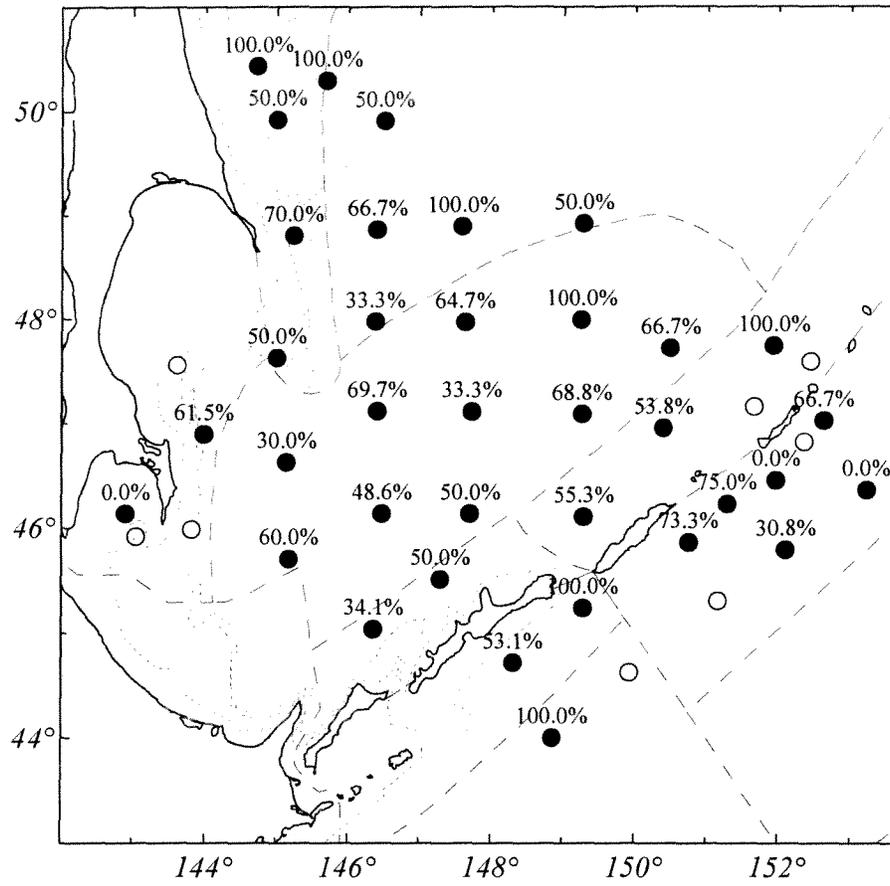


Fig. 4 Share of female in the catches of pink salmon

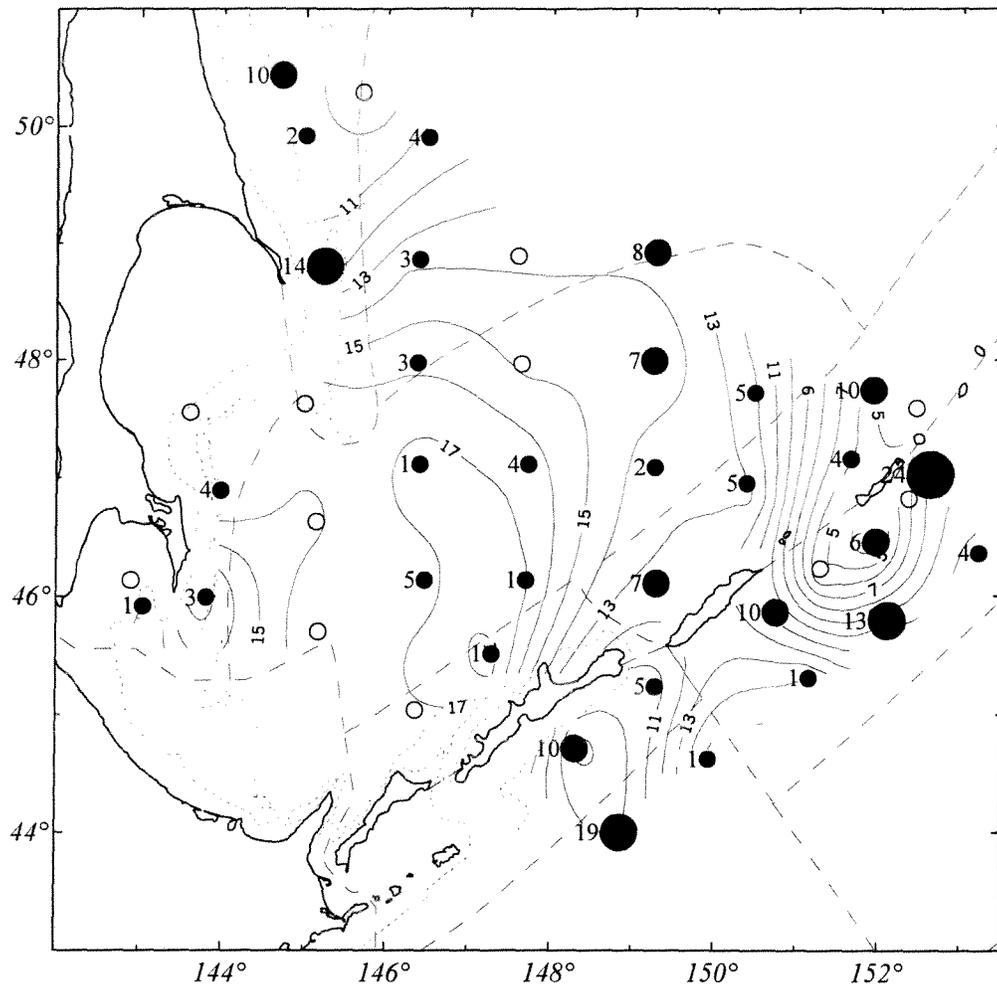


Fig. 5 Catch distribution (sp./tr.) of chum salmon in August 17-31, 2000.
Isotherms indicate sea surface temperature.

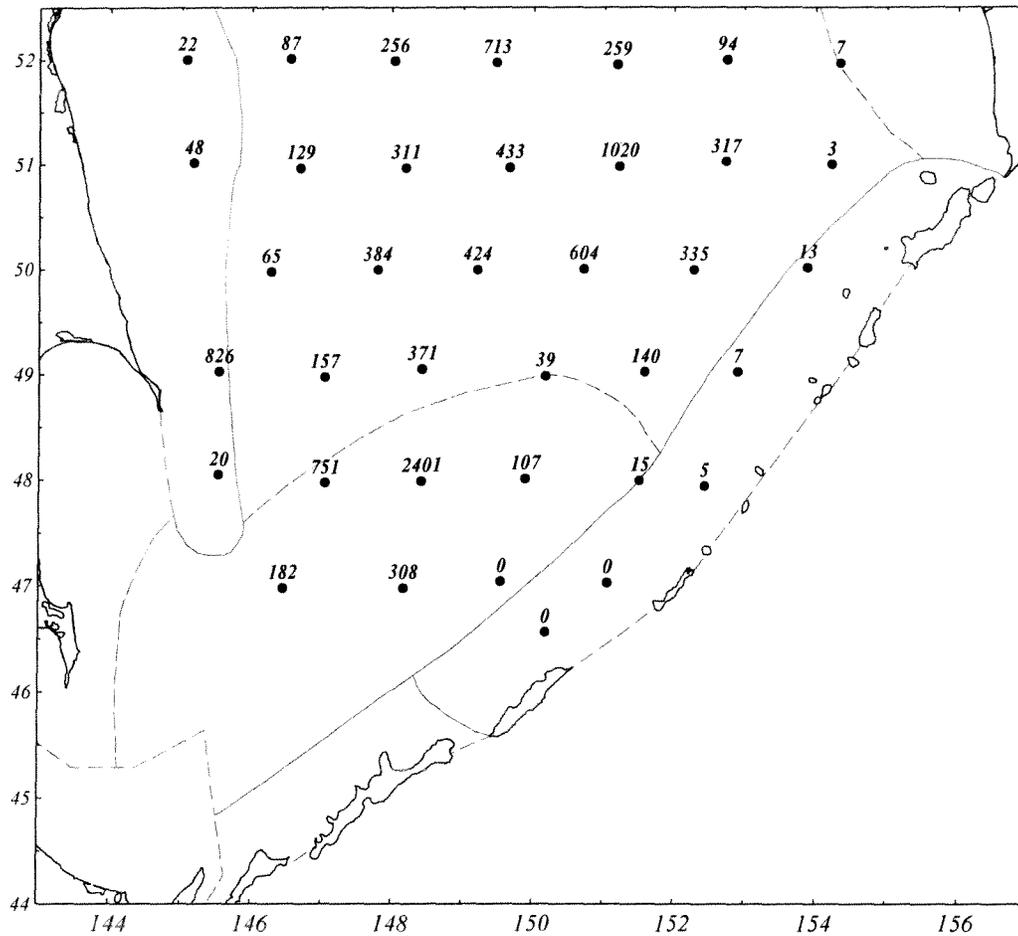


Fig. 6 Catch distribution (sp./tr.) of pink juveniles in fall 2000.

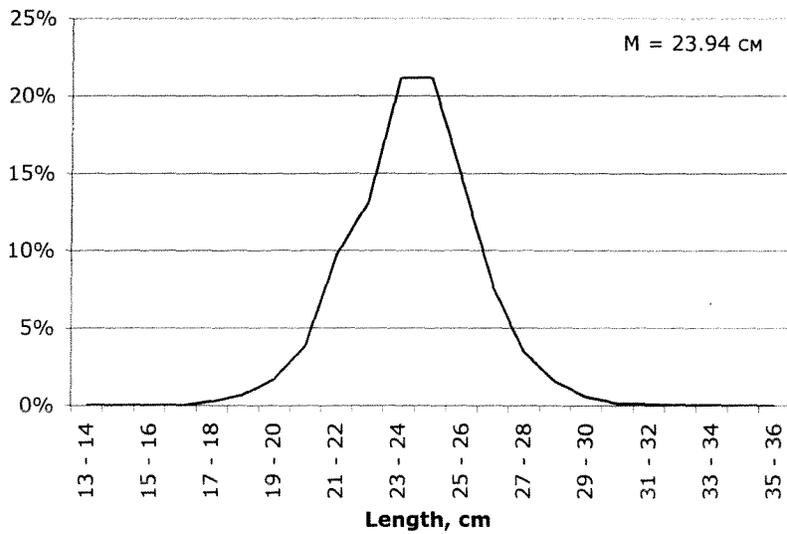


Fig. 7 Length frequency distribution of pink juveniles

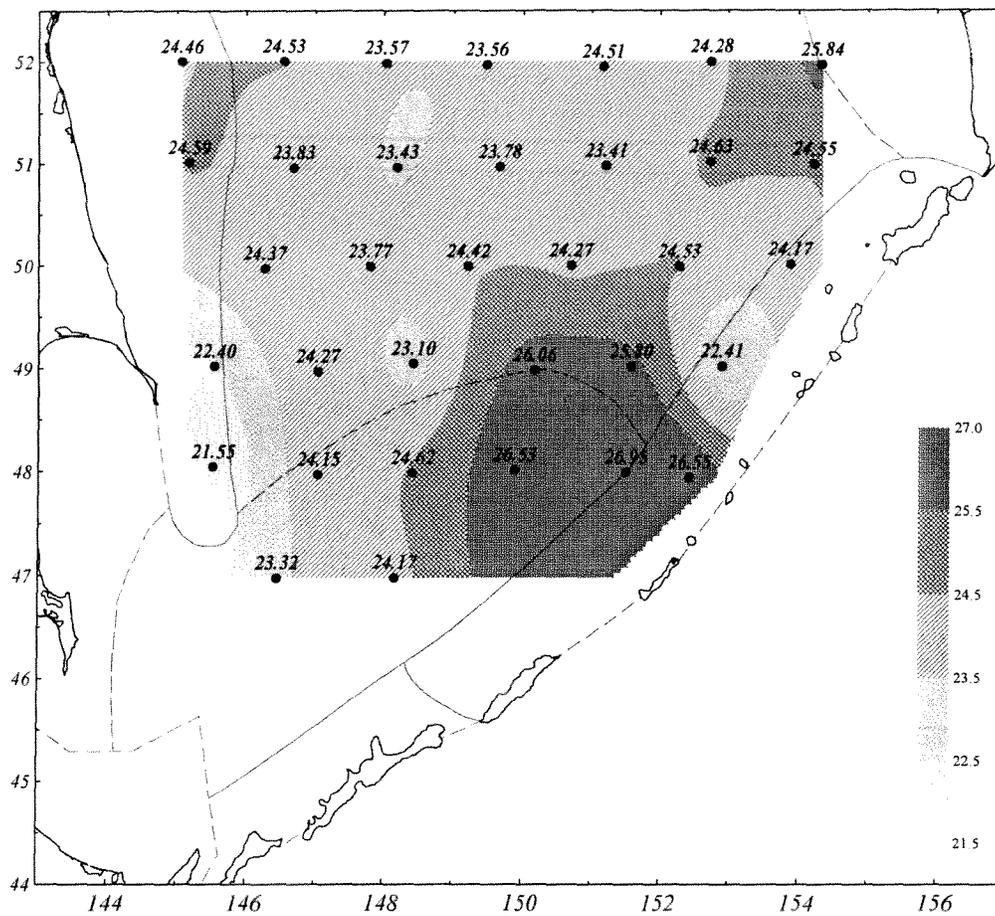


Fig. 8 Distribution of the average length (cm) of pink juveniles in fall 2000

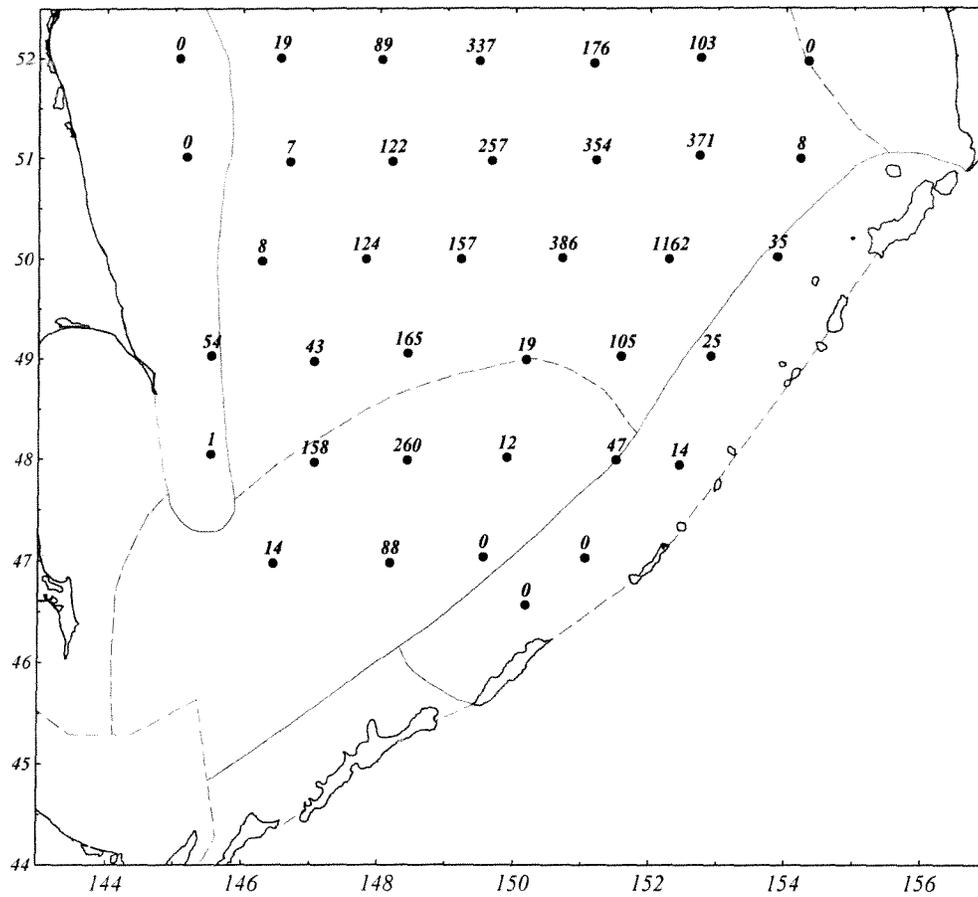


Fig. 9 Catch distribution (sp./tr.) of chum juveniles in fall 2000.

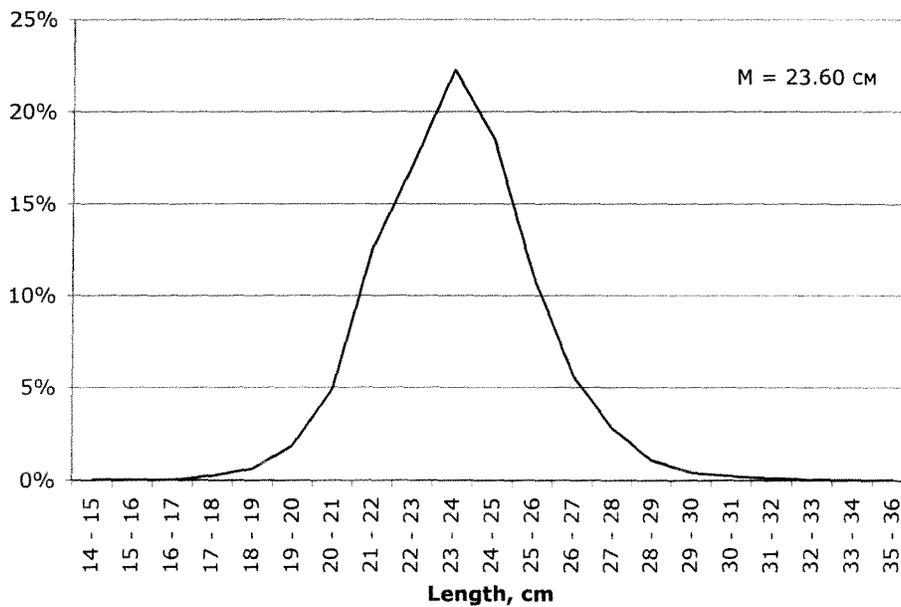


Fig.10 Length frequency distribution of chum juveniles

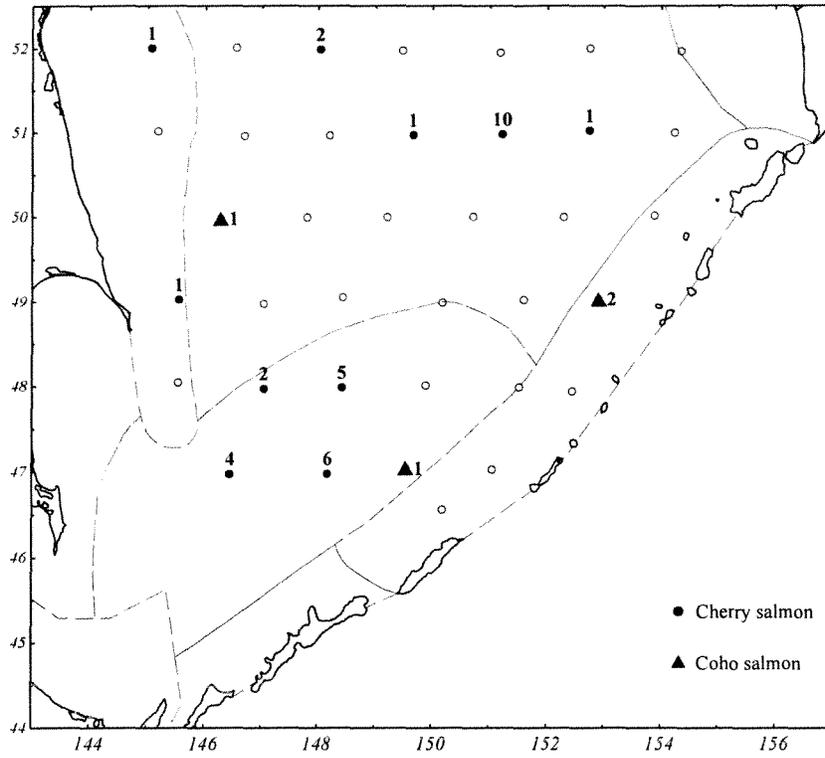


Fig. 11 Catch distribution (sp./tr.) of cherry and coho in fall 2000.

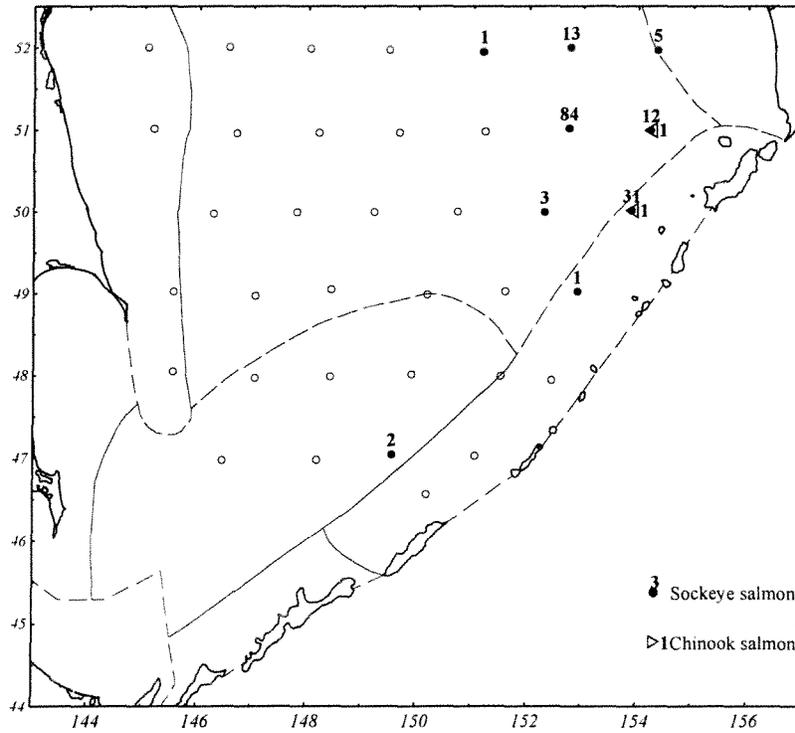


Fig.12 Catch distribution (sp./tr.) of sockeye and chinook in fall 2000.