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RESULTS OF 2001 SALMON RESEARCH CRUISE OF THE *STR "POLYARNYK"*

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Abstract

The salmon research cruise of the *STR "Polyarnik"* of the KamchatNIRO on the program of researches of salmon marine life period was conducted in the eastern Sea of Okhotsk between 50-58° N and the coast of the Kamchatka and 145°E during September 4 — October 11, 2000 for stock assessment and carrying capacity estimation of the Western Kamchatka salmons. The survey included oceanographic observation, sampling zooplankton, fishing of salmon juveniles and other fishes using the rope trawl of 54.4/192 m. The number of salmon caught by 65 sets of trawl was 7,597 salmon juveniles (age 0+) and 3 immature salmon individuals. The catch of juveniles includes 3,803 pink, 2,957 chum, 311 sockeye, 281 coho and 245 chinook. CPUEs of pink and chum salmon in 2001 were low for the even years generations. The average fish size of pink juveniles was close to that of many years' level, the average of sockeye - somewhat higher and of chum, chinook and coho – lower. All samples and data will be worked and analyzed in the KamchatNIRO (Kamchatka Fishery & Oceanography Inst.)

Introduction

The Central and Eastern Sea of Okhotsk are a monitoring ground of the Western Kamchatka salmon juveniles' feeding conditions. Accounting works are conducted on STR-503 type vessels by the standard stations net in September – early October. They use a pelagic rope trawl of 54.4/192 m with a 25-30 m vertical opening.

The purpose of the researches was the study of distribution, biological state and the number estimation of salmon juveniles in the Kamchatka waters of the Sea of Okhotsk.

The main tasks of the 2001 voyage were:

- sampling the materials specifying the number, species composition, biological indicators, age structure and salmon juveniles' feeding at the feeding period at Kamchatka waters;
- sampling the materials specifying the dynamics of plankton animals eating and energy consumption of salmon juveniles at different stages of migration and feeding;
- sampling the materials, which can be used for identification of salmon populations of different origin in mixed marine catches (samples of scales, muscular tissue, otoliths, composition of parasite-fauna, morphometrical indicators);

- sampling the materials for estimation of natural death rate of salmon juveniles due to diseases and eating out by fishes and birds of prey;
- sampling hydrometeorological and hydrobiological materials specifying the background conditions;
- estimation of pink and chum juveniles' number by the results of the trawl survey for revision of the industrial forecasts.

Methods

1. Period and area of work

The trawl survey on STR "Polyarnik" was done at the period of September 4 – October 11, 2001 between 50-58° N and the coast of the Kamchatka and 145°E (Fig. 1).

2. Oceanographic observations

The temperature and salinity of a 100 m water layer at 65 stations were measured with the help of STD-1000 thermohalinosonde.

3. Hydrobiological researches

Plankton sampling planned by the cruise task was not carried out due to loss of formalin and containers for samples at storm of September 16, 2001.

4. Fishing of salmon juveniles and other fishes

Totally were made 66 stations, 7,597 salmon juveniles and 3 immature salmons were caught, sampled and fixed: 1,012 stomachs, 164 samples of muscular tissue of salmon juveniles for a biochemical analysis, and 139 otoliths for studying the age structure. Was made a full biological analysis of 3,326 juveniles and also measured and weighed 3,693 juveniles. The volume of the sampled data is shown in Table 1.

Table 1

Number and types of data collected during survey STR "Polyarnik" (September-October, 2001)

Species	Specimens	Measured fishes	Weighed fishes	Biochemistry samples	Stomachs	Otoliths	Total catch
Pink	1298	2223	2223	48	393	-	3803
Chum	1557	1253	1253	56	441	-	2957
Sockeye	227	71	71	20	114	85	311
Chinook	128	10	10	23	47	33	245
Coho	116	136	136	16	47	21	281

Results and discussion

1. Oceanographic observations

During October 4 – 11, 2001 at the eastern and central part of the research area the water surface temperature changed from north to south from 6.6 to 12.2 ºC (Fig. 2). The water salinity did not exceed $33^0/_{00}$ (Fig. 3). The analysis of the hydrological conditions at the research area showed that they could be estimated as “cold”.

2. Ichthyologic works

1) Salmon juveniles’ catches

Pink predominated in the species composition of salmon juveniles (age .0+) – 3,803 pieces (50.1%). The chum number was several less – 2,957 pieces (38.9%), and the part of other species was minor: sockeye – 311 pieces (4.1%), coho – 281 pieces (3.7%), chinook – 245 pieces (3.2%).

2) Distribution

Pink juveniles were noted at 50 stations out of 57 (without regard to 9 stations at the 24 hours’ station). Were registered two main stocks of pink (Fig. 4). The first, numerous one, settled between 51 ºN and 54 ºN to the east of 151 ºE and consisted mainly of pink of

the Western Kamchatka origin. In this accumulation was registered maximum catches (more than 500 pcs/hour of trawling). The second stock, more compact, settled between 50-52 ºC N to the west of 151 º E, and was probably represented (substantially) by juveniles of non-Kamchatka origin. Pink catches in this stock reached 200 pcs/hour of trawling. The catches of pink at the rest of the area (without of the registered stocks) did not exceed 50 pcs/hour of trawling; those at the periphery were single instances (Fig. 4).

Chum. Chum juveniles' distribution was noted for (in comparison with pink) a bigger evenness (Fig. 5). This species catches changed from 1 to 675 pcs. The biggest catch was noted in one of the trawls at the 24 hours' station, at the rest area the catches did not exceed 165 pcs. The main accumulations of chum were noted at the periphery of pink accumulations (Fig. 5).

Sockeye. Sockeye juveniles were concentrated next to the Western Kamchatka coast (Fig. 6). Its catches changed from 1 to 144 pcs. The maximum catch was noted in one of the trawls, in other ones it did not exceed 50 pcs.

Chinook. Chinook juveniles were staying at the narrow coastal zone forming the only high-density accumulation in the southeastern part of the research area (Fig. 7).

Coho. Coho juveniles' distribution was the same as that of chinook (Fig. 8).

4. Biological indicators and salmon juveniles' growth

The average body fork length and weight of salmon juveniles are given in Table 2.

Table 2

Fork length, body weight, daily linear and weight growth rate of salmon juveniles in the Sea of Okhotsk in September - October 2001

Species	FL (cm)	BW(g)	Daily linear growth rate (mm)	Daily weight growth rate (g)
Pink	20.2	86.1	1.6	1.9
Chum	21.2	106.5	not determined	not determined
Sockeye	22.8	141.3	not determined	not determined
Coho	27.8	266.8	not determined	not determined
Chinook	22.1	159.8	not determined	not determined

Pink. On the whole in the fall of 2001 the AC length of pink juveniles changed within 12-30 cm, on average– 20.2 cm (Fig. 9), weight– 6-270 g, on average– 86g (Table 2).

Males were bigger than females. The sexes correlation was close to 1:1 with some males' predominance.

Pink juveniles' sizes considerably differed depending on the period and place of fishing. So, the average size of pink of the accumulation at the southwestern part of the research area at 51 ºN, where the works were made on September 10-14, was 17.8 cm and 54.6 g. Afterwards, on September 22-23 salmon fishing in this part of the research area was repeated. Pink juveniles were then much bigger (19.6 cm and 75 g accordingly) in comparison with the previous observation period. We suppose that the available data on the pink juveniles' size change are adequate grounds for calculation of the linear and weight growth rate, which in September 2001 made 0.16 cm/day and 1.9 g/day accordingly.

The accumulation situated at the east of the investigated area (Fig. 4) may be divided by three isolated enough. Pink juveniles of the western north and the extreme north accumulations weakly differed both in the AC length and body weight. The average fork lengths were equal to 20 cm in both accumulations, the body weights – 85 g and 78 g, accordingly the west and the north. The curve of fork length distribution of the western stock pink was close to the normal; that of the northern shifted to bigger fishes.

The observations in the southern were made on September 19, i.e. minimum a week before the previously considered. In comparison with the latter pink juveniles were somewhat smaller in the fork length (19.4 cm) and body weight (75 g).

The observed differences of the biological indicators well coordinate with V. G. Erokhin's scheme, which describe the routs of pink salmon juveniles' migrating from the Western Kamchatka coast on the big and small turnovers. In accordance with this scheme the fish of the southern stock may be referred to small individuals down-streamed relatively late and going through the minor turnover. The fish of the northern stock – to big individuals down-streamed early and going through the major turnover.

The fish of the western stock are represented by the mixture of the first two stocks feeding here prior to the beginning of the catadramous migration.

Chum. The chum AC length changed from 13 to 30 cm and made on average 21.1 cm, the weight changed from 6 to 270 g, on average – 106.5 g (Table 2, Fig. 10). The sexes correlation was close to 1:1, males were somewhat more in number. Females were bigger than males.

Sockeye. Sockeye juveniles' body size changed: the AC length – from 13.5 cm to 29.3 cm, weight – from 31 g to 280 g, on average 22.8 cm and 141 g accordingly. Bigger

individuals of more than 20 cm (Fig. 11) predominated in the size composition. The part of males was 10% higher. Females were smaller than males.

Chinook. Chinook juveniles' fork length changed from 17 cm to 27 cm, weight – from 70 g to 260 g, on average 22.1 cm and 160 g accordingly. Males were bigger than females and yielded them in number. The curve specifying the size composition of these species juveniles is shown on Fig. 12.

Coho. Coho juveniles' body size changed: the AC length – from 20 cm to 32 cm, weight – from 140 g to 420 g, on average 27.8 cm and 267 g accordingly (Fig 13, Table 2).

The sexes correlation was close to 1:1. Males yielded to females both in weight and fork length.

5. Salmon juveniles' feeding

Pink. Pink juveniles' feeding included 10 components, whose base consisted of hyperiids (frequency 44.2%) and copepods (frequency 40.1%) juveniles; also a considerable part of the food lump consisted of euphausiids (13.9%), pteropods (13.3%) and sagittae (11.1%). Pink salmon juveniles' feeding intensity was high, the number of fish with empty stomachs was 14.8%, and the part of fish with poor filling (1 point) made 14.6%.

Were noted a significant difference in the feeding intensity of different stocks pink salmon juveniles. So, in the first stock the average point of stomachs filling exceeded 2, and in the second – did not make 1.

Chum. Chum and pink juveniles' food included 10 components. The base consisted of 4 components: hyperiids (31.2%), euphausiids (23.5%), copepods (21.9%) and sagittae (20.3%). Meeting of other components did not exceed 7%. Chum feeding intensity for the research period was high as in the case with pink. The part of fish with empty stomachs made 10.6%, and the number of fish with poor filling (1 point) made 18.2%.

Sockeye. Sockeye juveniles' feeding included 9 components. Most often they found pteropods (35.4%) and hyperiids (26.8%) in sockeye stomachs. Also the food contained euphausiids (17.1%), copepods (12.2%) and sagittae (8.5%). Sockeye juveniles' feeding intensity was lower than that of pink and chum; the number of fish with empty stomachs was 27.4%, and the part of fish with poor filling (1 point) made 23.0%.

Coho. Coho juveniles' feeding included 5 components. The feeding base consisted of fish juveniles (80.8%). Also, the food contained euphausiids (14.9%) and crab juveniles (10.6%). Coho feeding intensity as in the case with pink and chum was high. The part of fish

with empty stomachs was 20.3%, and the number of fish with poor filling (1 point) made 6.8%.

Chinook. Chinook juveniles' food as that of coho included 5 components. Most often were found euphausiids (52.2%), launce juveniles (37.7%) and other fish juveniles (33.3%). Chinook feeding intensity was high. The part of fish with empty stomachs was 14.8%, and the number of fish with poor filling (1 point) made 17.3%.

6. Other species

Besides juveniles they fished 3 pcs of immature Pacific salmon: 2 chum and 1 chinook.

Out of other fish species the most mass one in the catches was Atka mackerel (Pleurogrammus monopterigius) – 5645 pcs. In the catches made in the nighttime they found anchovies (fam. Myctophidae) and squid juveniles. Pacific herring (Clupea pallasi) and sandfish (Trichodon trichodon) were found rather seldom (total catch for the research period – 36 pcs and 12 pcs accordingly). In one of the trawls (54°01 N 154°52 E) were fished 10 pcs of Flathead sole juveniles (Hippoglossoides elassodon). In another (54°58 N 154°58 E) were fished 4930 pcs of Arctic smelt 0+ (Osmerus mordax dentex). Spinous lumpfish (Eumicrotremus soldatovi) and lamprey were found as single pieces.

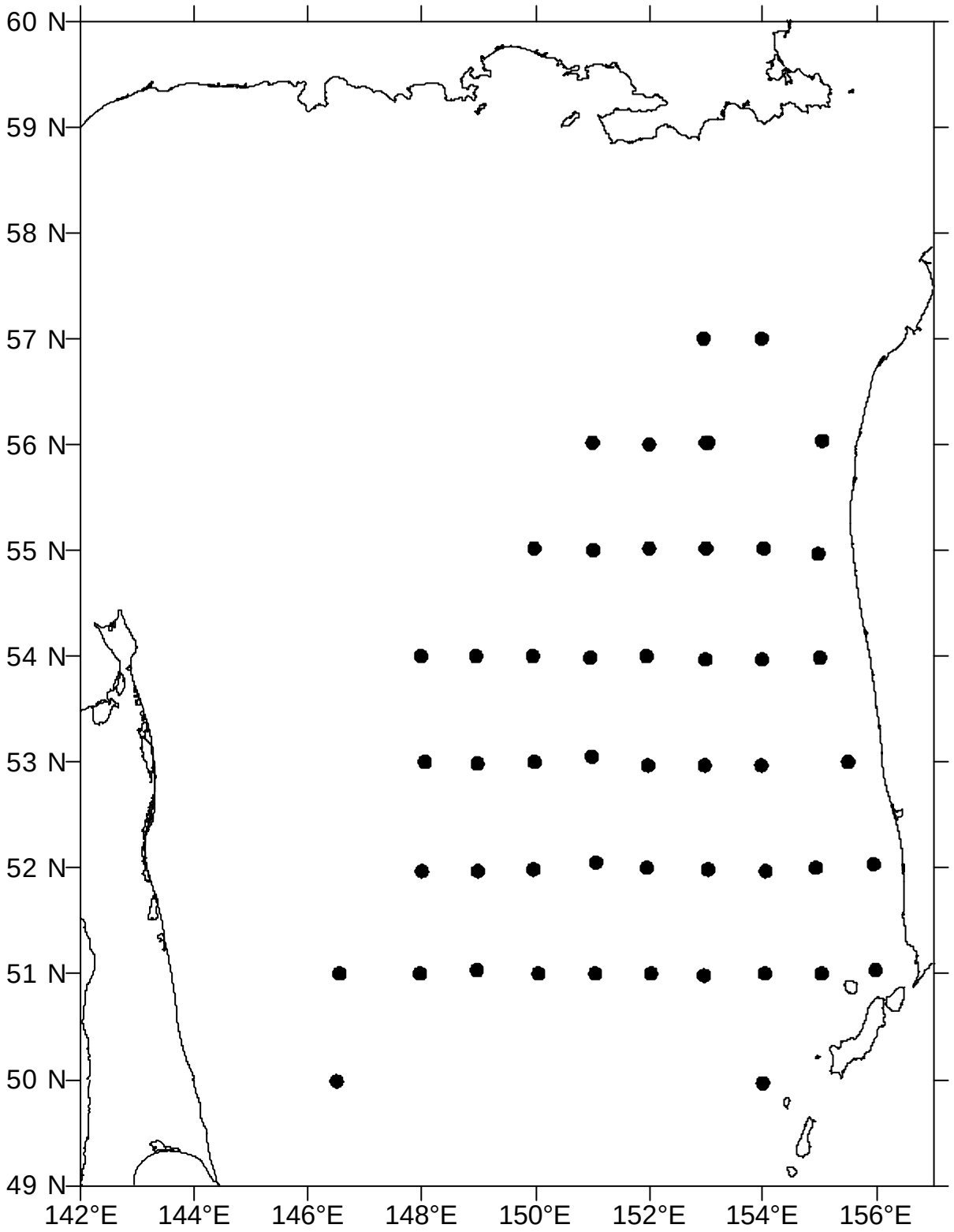

Figure 1. STR "POLYARNIK" SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER 2001, FISHING STATIONS

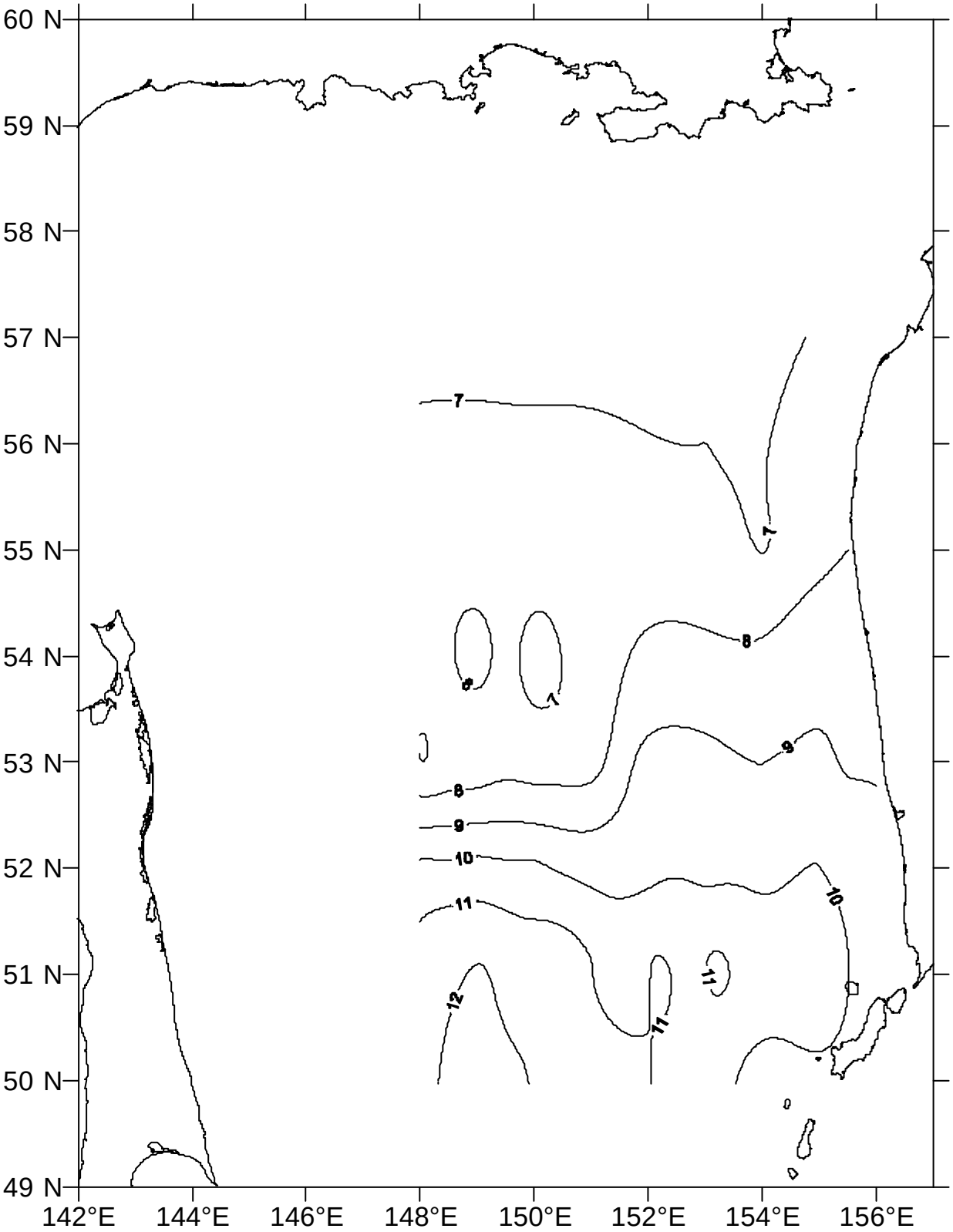

Figure 2. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. SEA SURFACE TEMPERATURE

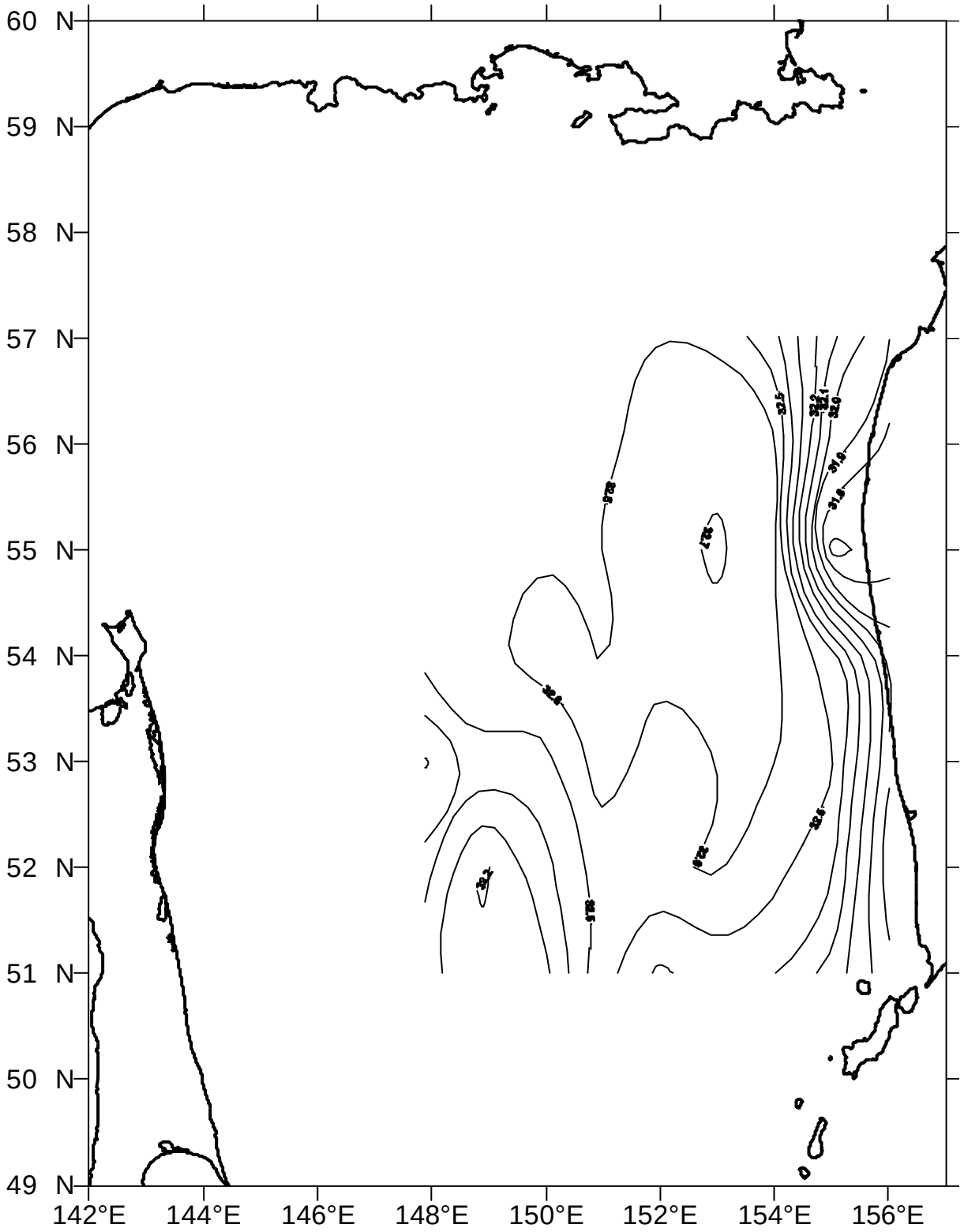

Figure 3. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I.
SEA SURFACE SALINITY

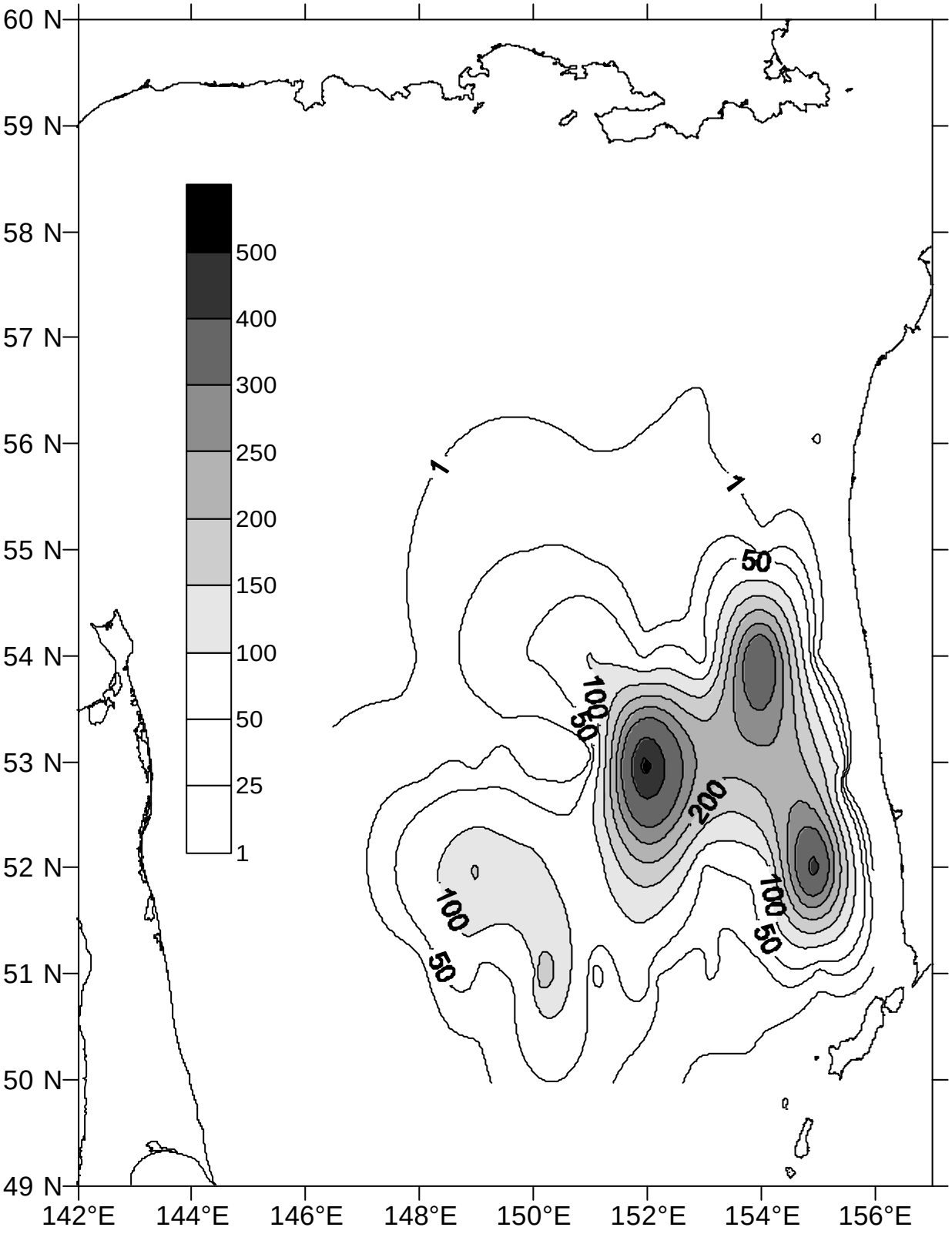

Figure 4. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. CPUE (individuals per 1 hour tow) Pink salmon age .0+.

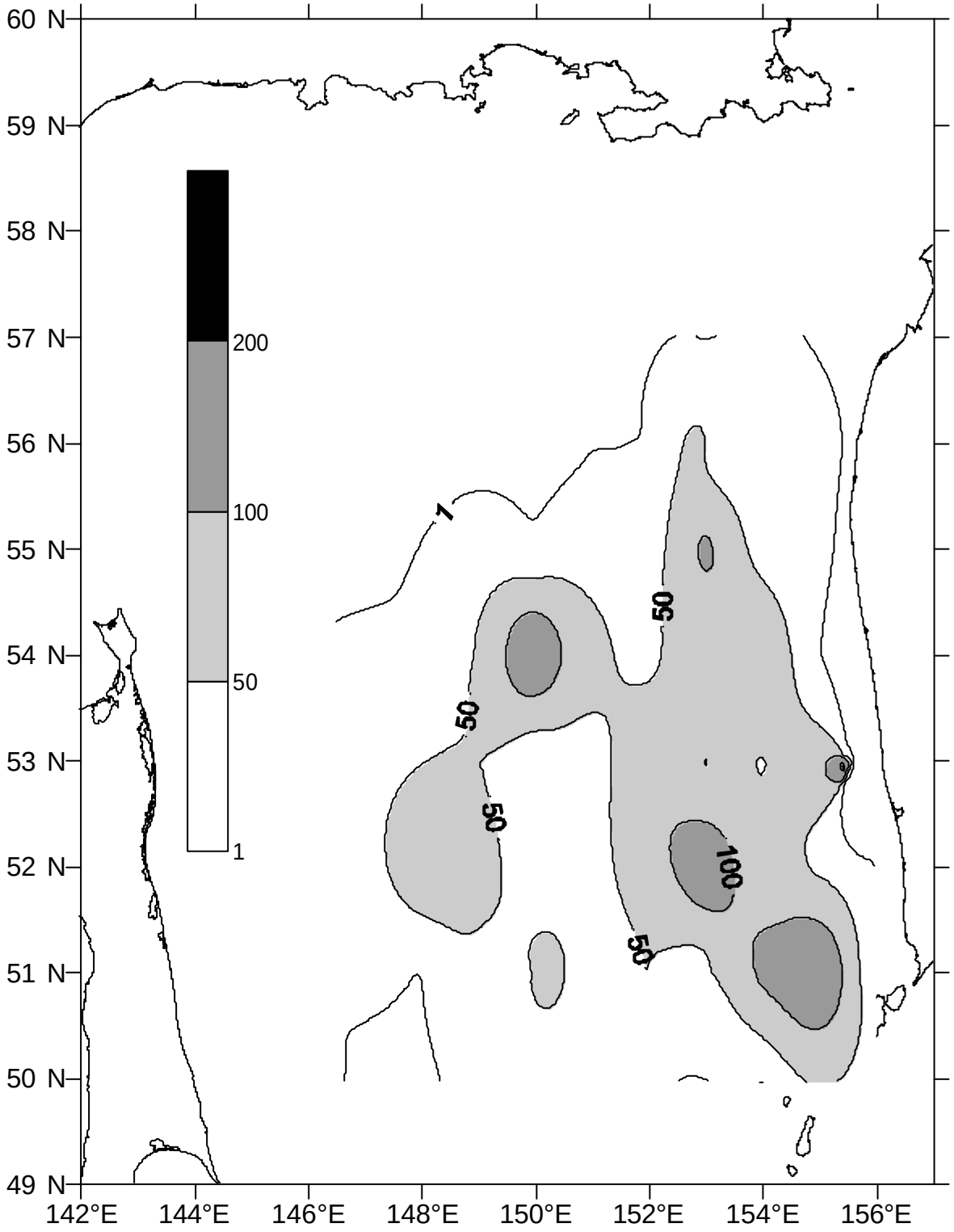

Figure 5. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. CPUE (individuals per 1 hour tow) Chum salmon age .0+.

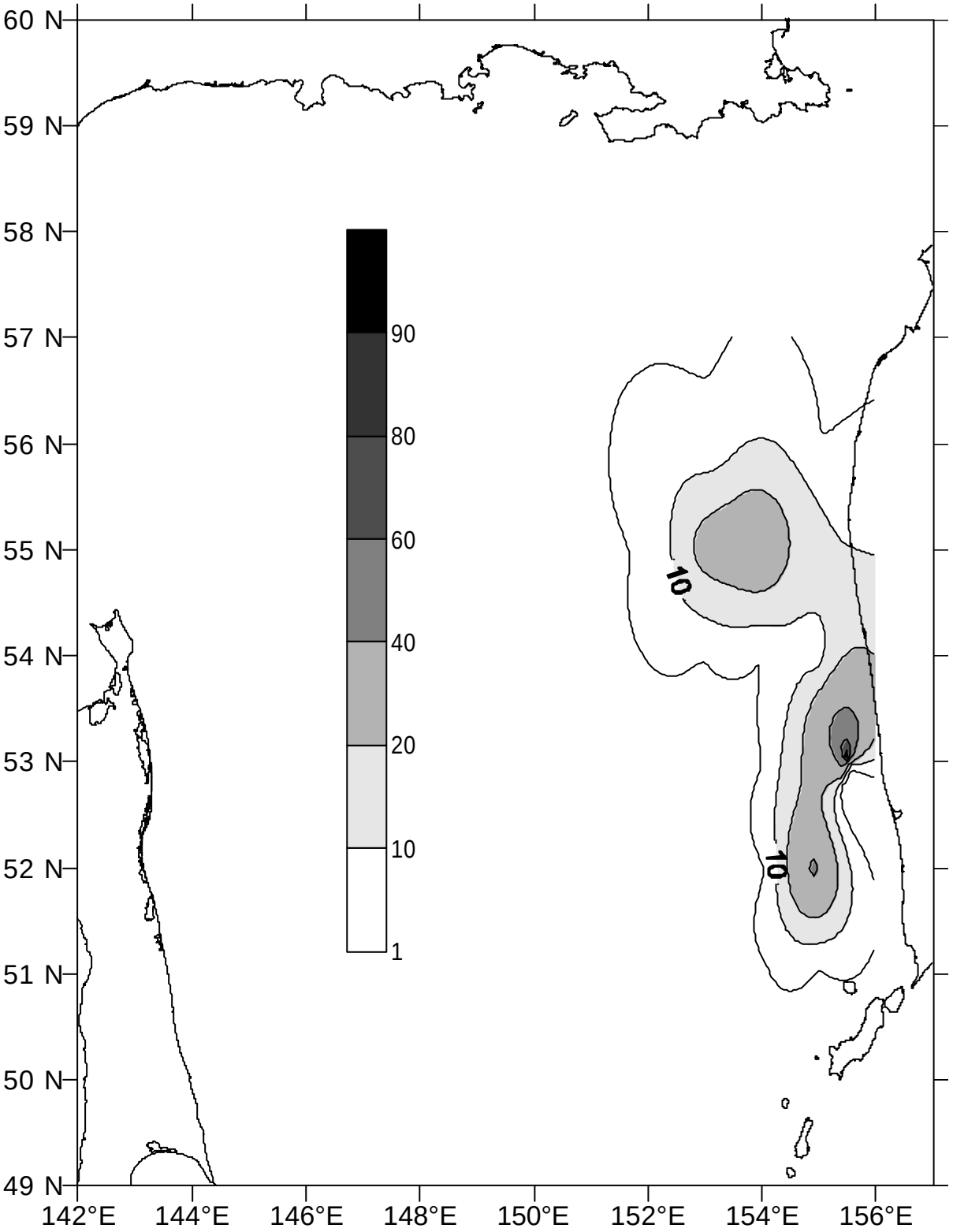

Figure 6. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. CPUE (individuals per 1 hour tow) Sockeye salmon age .0+.

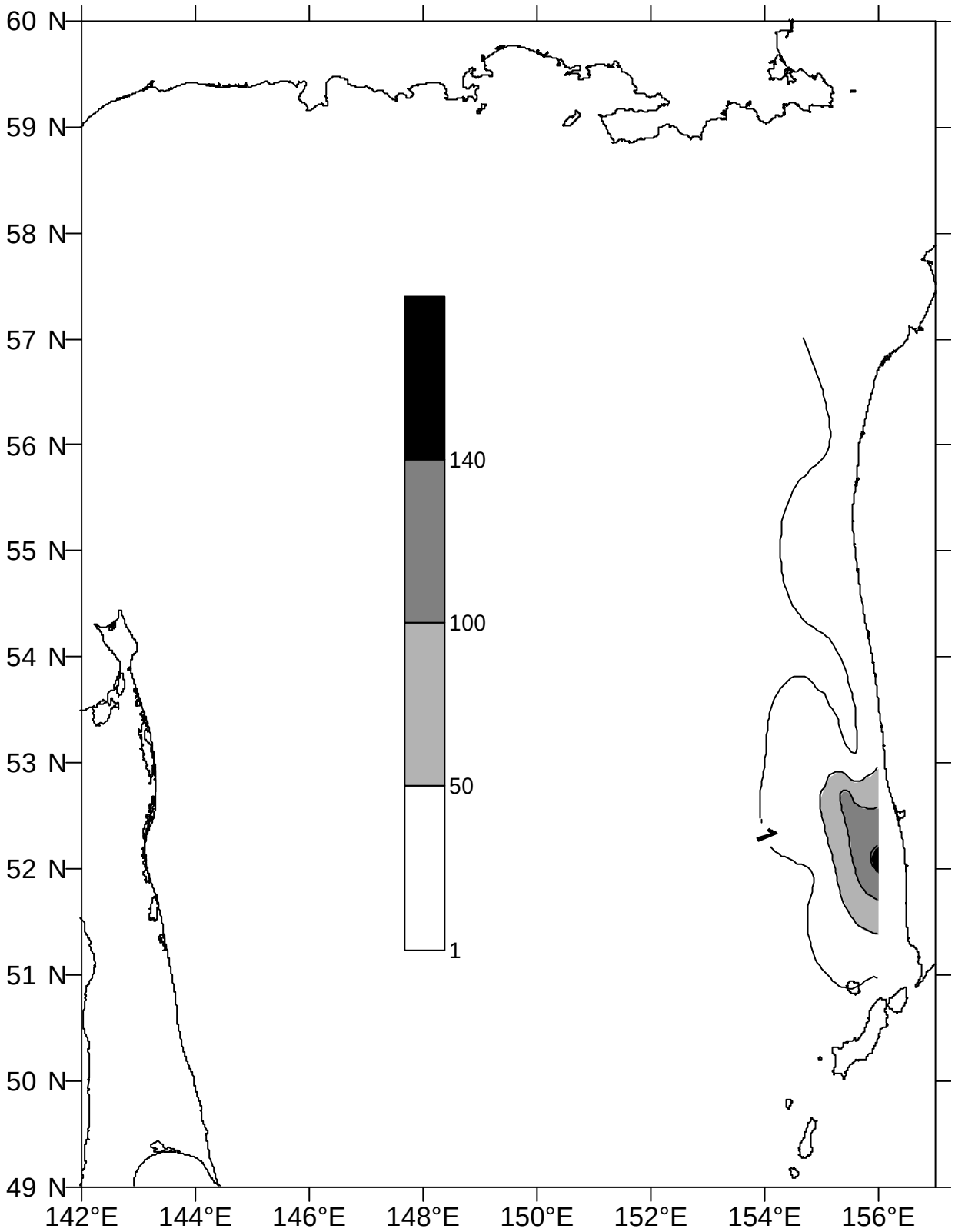

Figure 7. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. CPUE (individuals per 1 hour tow) Chinook salmon age .0+.

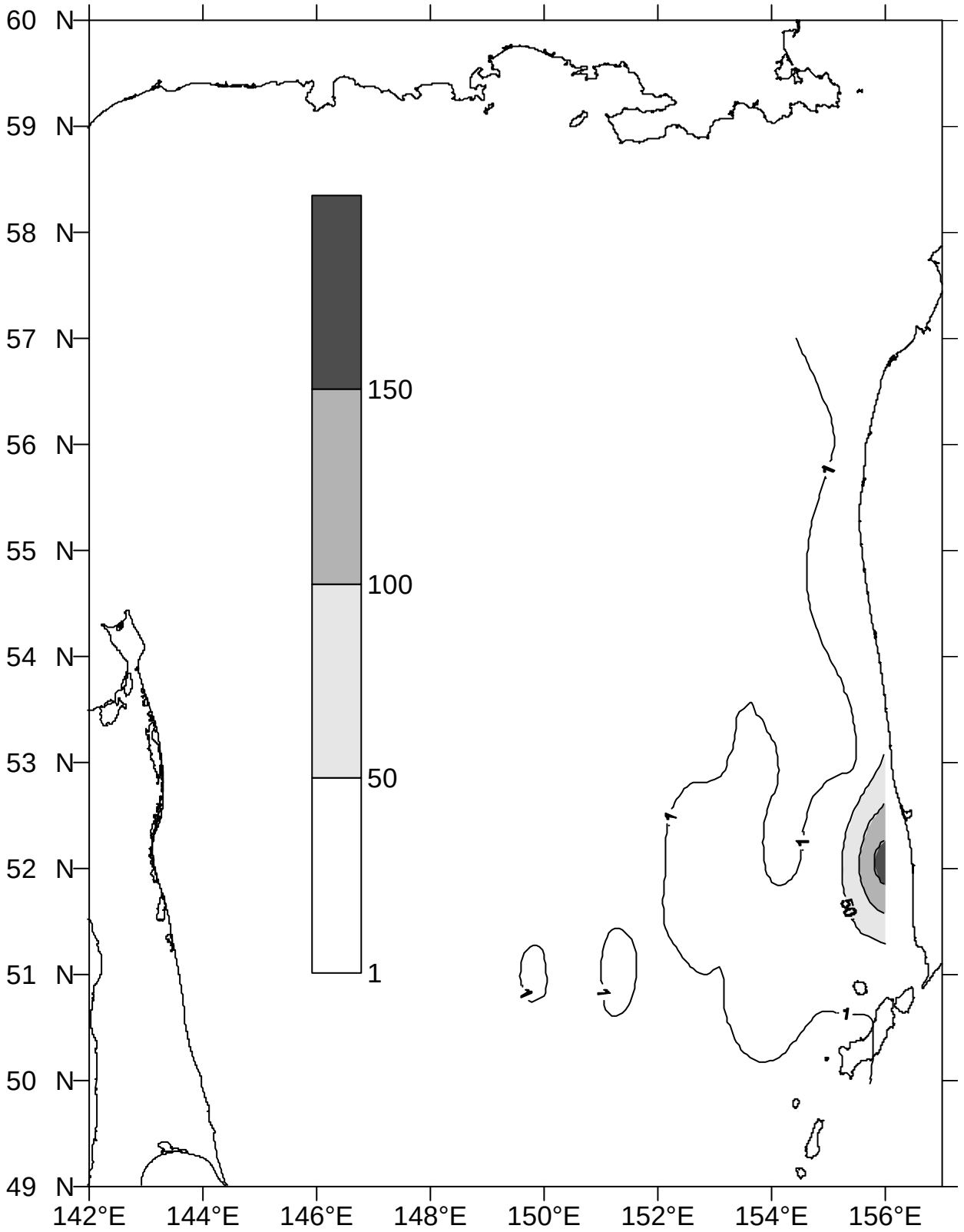

Figure 8. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. CPUE (individuals per 1 hour tow) Coho salmon age .0+.

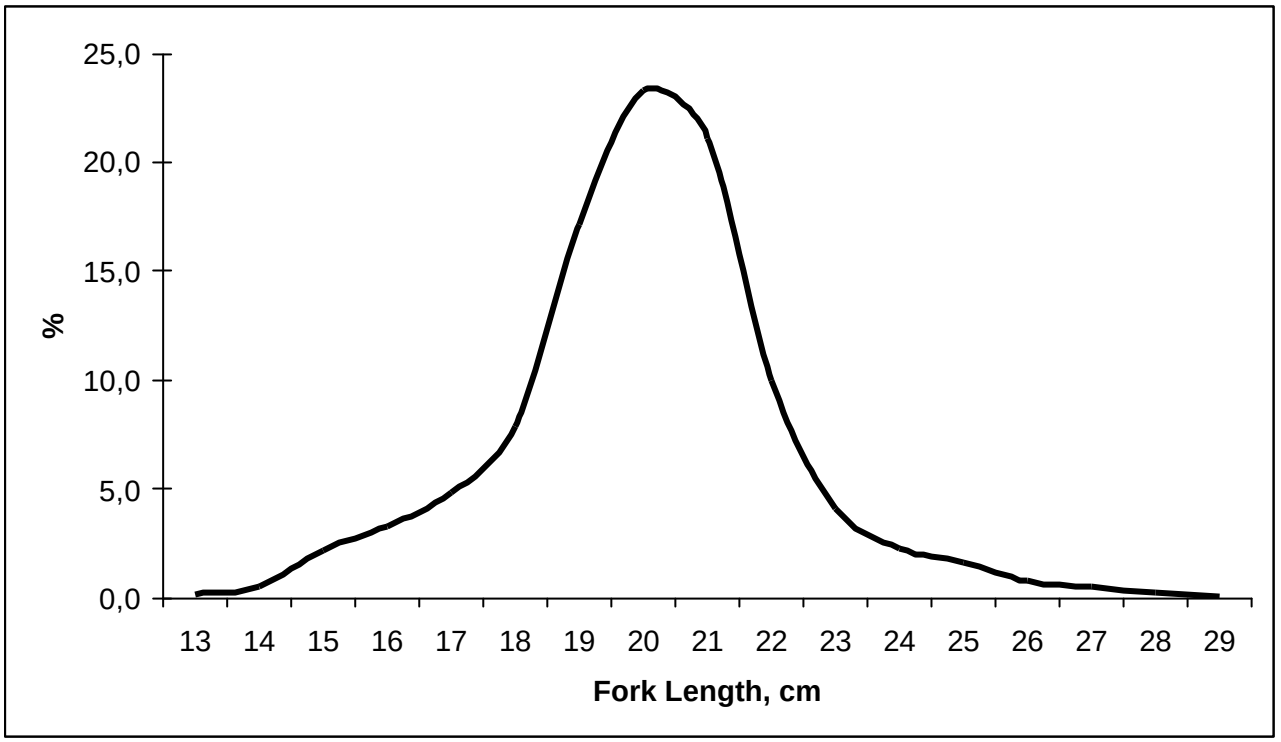

Figure 9. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. Length frequency of pink juveniles.

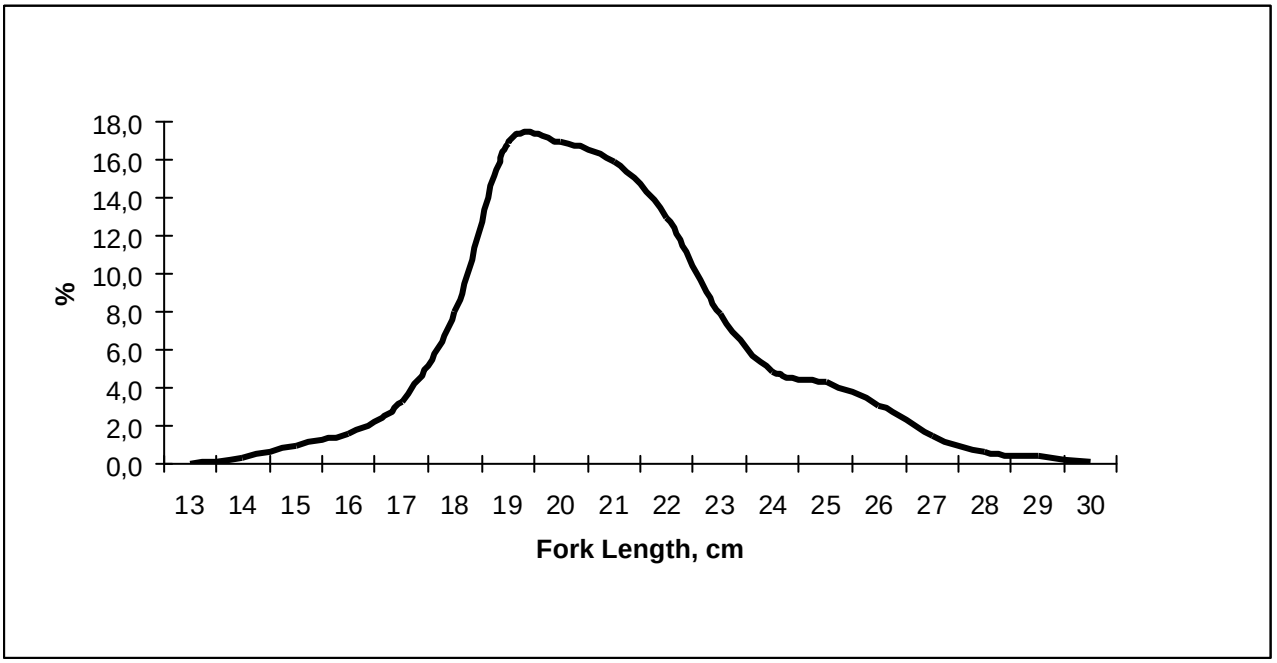

Figure 10. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. Length frequency of chum juveniles.

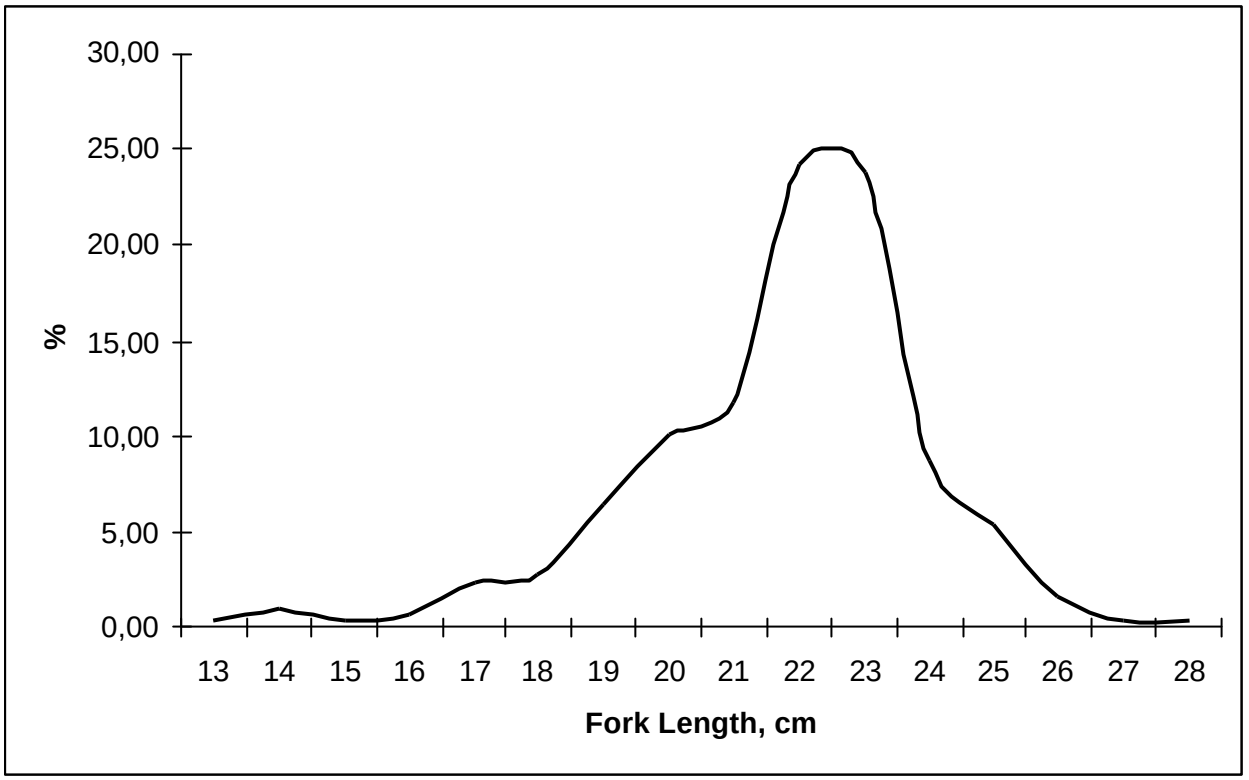

Figure 11. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. Length frequency of sockeye juveniles.

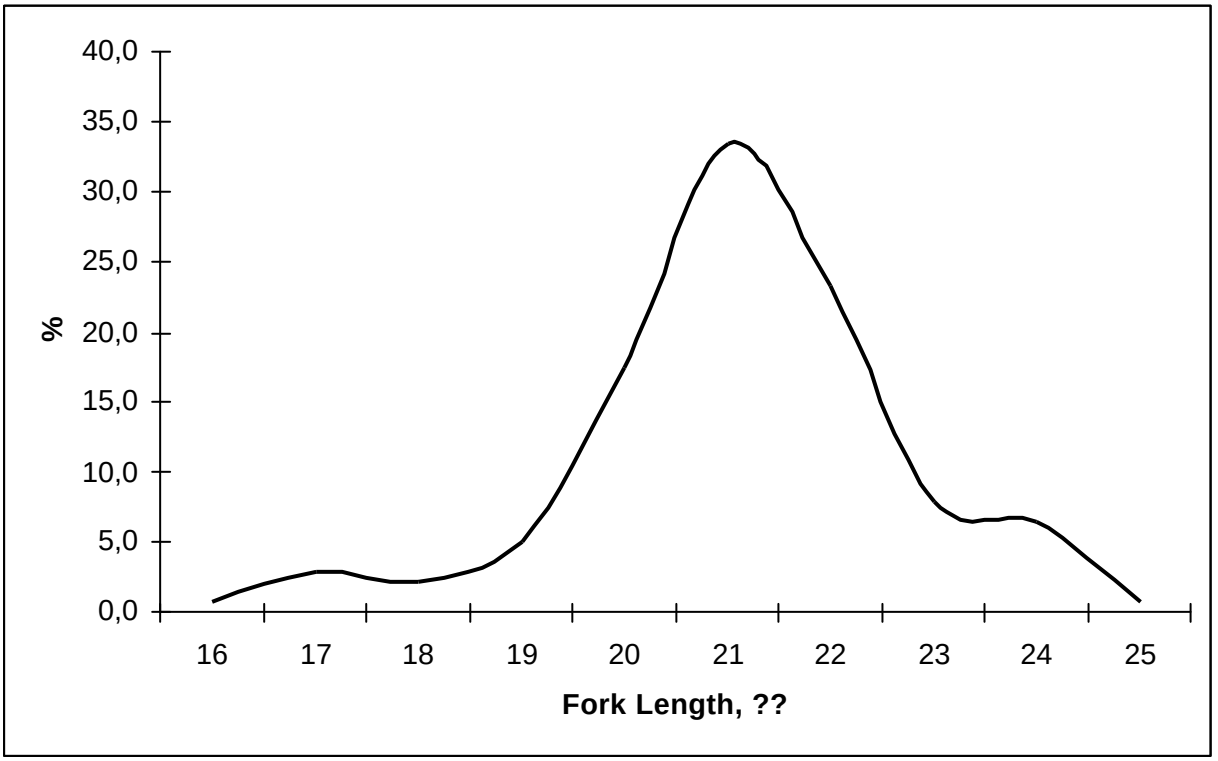

Figure 12. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. Length frequency of chinook juveniles.

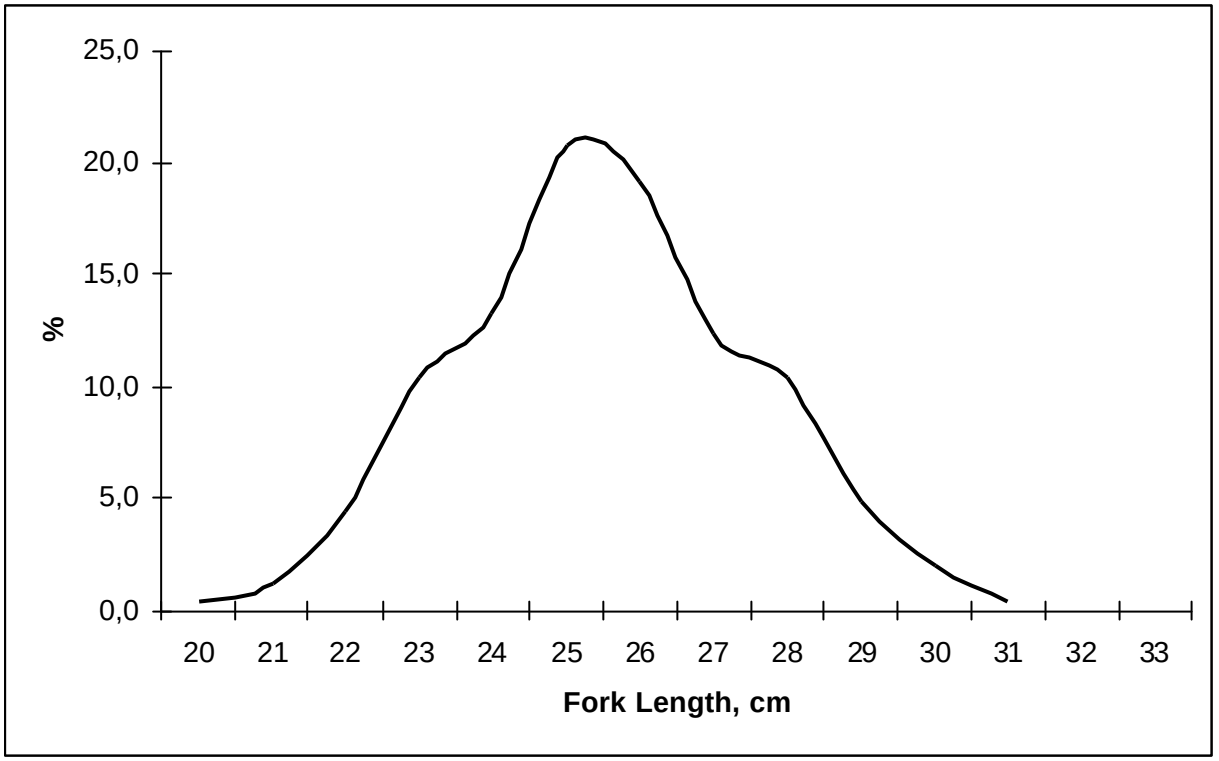

Figure 13. STR " POLYARNIK " SURVEY, SEA OF OKHOTSK, SEPTEMBER-OCTOBER, 200I. Length frequency of coho juveniles.