NPAFC
Doc. 523
Rev.

RESULTS OF 2000 SALMON RESEARCH CRUISE OF THE SRTM-K "KAMCHATSKI LOSOS"

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Submitted to the
NORTH PACIFIC ANADROMOUS FISH COMMISSION
by

RUSSIAN NATIONAL SECTION

March 2001

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Valentina Shershneva and Tatjana Vvedenskaja 2000. Results of 2000 salmon research cruise of the SRTM-K "Kamchatski losos" (NPAFC Doc. 523) 12 p. KamchatNIRO, Kamchatka Fishery & Oceanography Inst., Fisheries State Commit. of Russia, Petropavlovsk-Kamchatski, Naberezhnaja street 18, Russia.

Results of 2000 Salmon Research Cruise of SRTM-K "Kamchatsky Losos"

Abstract

The cruise of SRTM-K "Kamchatsky Losos" was conducted in May – July 2000, for researches of regularity of distribution and interaction of the Pacific salmon local stocks in the areas of fattening and migrations in connection with the number dynamics and environment. The investigations were made in three areas: 1- the Petropavlovsk-Commander subarea (6102.2) limited within 52º39' – 54º18' N, 161º25' – 166º07' E; 2 – the West Bering Sea area (6101) limited within 53º57' – 55º17' N, 170º10' – 170º47' E; 3 – the Karaginskaya subarea (6101.1) limited within 56º50' – 57º58' N, 163º54' – 165º08' E. The researches included oceanographic observations, sampling zooplankton, fishing salmon with gill nets (mesh 55 mm or 110 mm by the Japanese measurement). As a result of setting 39 gill nets 8,665 pieces of salmon were caught, out of them 52 pink, 1,406 sockeye and 16 chinook. The 1,902 pieces of salmon were the subject of the thorough biological analysis.

Introduction

During some period of time KamchatNIRO has carried out researches of adjustment of the short-term forecasting method and intensity of the salmon run to the spawning reservoirs of the Eastern Kamchatka. The main task of the researches is studying regularities of distribution and interaction of the local stocks of the Pacific salmon in the fattening areas and areas of migration in connection with abundance dynamics and environment.

The main tasks of the 2000 cruise provided for:

1 – sampling materials characterizing the abundance, species composition, biological data age structure and salmon feeding in the fattening period and pre-spawning migration;

2 – sampling materials that can be used as criteria for identification of salmon origin areas from the mixed catches (scales samples, otoliths, parasite fauna composition);

3 – sampling hydro-meteorological data characterizing the environment;

4 – sampling histological and biochemical materials characterizing salmon gonads state.

Methods

1. Period and Areas of Researches

SRTM-K "Kamchatsky Losos" cast gill nets in the North-West Pacific Ocean, South-West and West Bering Sea limited within 52º39'– 57º58' N, 161º25 – 170º10 E (Fig. 1)(Tab. 1.).

2. Oceanographic Observations

Prior to casting and hauling gill nets they made 73 measurements of the water temperature and salinity with AST-500P thermohalinosonde at 200 m layer with a 2 m interval. The standard Olyutorskaya hydrological survey (Tab. 2) and Kamchatsky transect at 200 m layer were made.

3. Hydrobiological Researches

During the standard Olyutorskaya hydrological survey, they sampled zooplankton with IKS-80 net (0.55 mm mesh at 0-100 m layer (14 samples) (Tab. 2).

4. Salmon Fishing

For the whole period of researches, they made 39 drifts with gill nets (mesh 55 mm or 110 mm by the Japanese measurement) and fished 8,665 salmon pieces. The biological analysis was made on 1,902 salmon pieces. There were made and fixed: scales samples of 1,902 individuals, 193 stomachs, 128 biochemical samples (muscles and gonads) and 72 histological samples (gonads), 241 otoliths for studying salmon age composition. The number of the sampled materials is shown in Tables 3-5.

5. Biochemical and Histological Samples

Biochemical and histological materials have been sampled for definition of muscles and gonads chemical structure of salmon at different stages of maturity. The biochemical samples of muscles and gonads of pink, chum and sockeye were sampled from the same individuals as those used for sampling gonads histological samples. A piece of muscle tissue (4-5 cm wide) covering a flank and a half of abdomen was cut in front of the dorsal fin. The tissue was cleaned
from the skin (keeping the hypodermal fat), lamina and blood, and then thoroughly grained; the sample (10 g) was fixed with the Folch solution (Folch at al., 1957). The biochemical and histological samples were taken from the second third part of the gonads. After weighting the biochemical sample (up to 5 g) was fixed with the Folch solution, and the histological probe (without weighting) was fixed with the Bouen solution (Persov, 1947).

6. Salmon Anomalies

At the process of the biological analysis they paid attention to various deviations from normal development of different species male and female gonads. Anomal mature gonads were taken for biochemical and histological researches.

Results and Discussion

1. Oceanographic Observations

In the Petropavlovsk-Commandor subarea the water temperature in May rose from 3.1ºC (May 17) to 4.1º C (May 20). In June the low water temperature 3.8–4.4º C kept up to the end of the second decade, and beginning the third decade it rose from 5.5° (June 22) to 7.4º C in the end of the month (June 30). On the whole the June temperature of the surface water layer in the Petropavlovsk-Commandor subarea was relatively low (3.8–5.5º C).

The neighbour average water temperature in this area (4.0–5.1º C) was noted the previous year as well, whereas in 1998 it was higher – 7.2–9.2º C. In early July the water temperature changed from 6.7º to 7.4º C.

During June 7-8 the second part of the standard Olyutorskaya hydrological survey was made simultaneously with f/v "Moskam-Alfa" that was making its first part. The 14 hydrological series were totally realized. Besides, the standard Kamchastky hydrological transect was additionally made (July 5) – 6 stations in all.

Ichthyologic Researches

1. Salmon Catches

In the Petropavlovsk-Commandor subarea the base of salmon catches was sockeye: in May – 80-98%, in June – 92-97% of all the salmon fished. In May the CPUE sockeye changed from 2.5 pcs/net (May 20) to 6.1 pcs/net (May 31). In June the biggest catch of sockeye was 8.3 pcs/net (June 15) (Fig. 2).

In May the dynamics of chum catches is generally the same as that of sockeye but at a lower level. The chum catch changed from 0.1 pcs/net (May 20) to 0.8 pcs/net (May 28). In June chum catches changed from 0.3 pcs/net to 1.0 pcs/net (Fig. 3).

Pink individuals (males) appeared in the catches on June 22 (CPUE 0.06 pcs/net). In the end of the third decade of June the CPUE of pink was 0.47 pcs/net (June 29).

Chinook catches were small and made 0.03–0.06 pcs/net.

2. Biological Data

Pink. In the Petropavlovsk-Commandor subarea the first pink individuals (males) were fished on June 22. The average fork length was 48.5 cm (limits 46.0 – 51.0 cm), weight – 1.6 kg (limits 1.35 – 1.75 kg). The gonad somatic index (GSI) of males was 2.11 on average. Up to the end of June only males made up the catches. The biggest individuals were noted on June 30 and July 1: fork length – 50.3 and 51.5 cm, weight – 1.6 and 1.9 kg accordingly. GSI of males increased from 2.11 (June 22) to 4.85 (June 30).

In the Karaginskaya subarea males' length changed from 48.0 to 49.7 cm, weight – from 1.4 to 1.7 kg, GSI – from 5.79 to 6.86. Females in the catches were absent.

Chum. In May and the first half of June males prevailed in the Petropavlovsk-Commandor area making 56-65% and 58-66% accordingly (Table 6). In the latter half of June the sexes correlation became somewhat even. The portion of females slightly increased to 53-59%. The biggest males and females were noted in the second decade of June. The males length reached 60.6 cm, weight – 3.07 kg; the females – 59.4 cm and 2.84 kg accordingly. The average GSI of males increased from 0.31 (mid May) to 2.30 (mid June), then the index went somewhat down to 1.14–1.92 in the latter half of June, that is connected with the increase of immature fish number (up to 28%), whose GSI was very low (0.02–0.08). The females GSI increased from 2.83 (mid May) to 6.89 (late June). The portion of immature females descended from 10% to 0% (the second decade of June), but in the third decade immature females appeared again, their relative number increased to 5%.

In the West Bering Sea (2) and Karaginsky (3) areas the biological indices of males and females lightly differed. In the second area the males fork length was 59.9 cm, weight – 2.94 kg; females – 59.0 cm and 2.75 kg accordingly. In the third area the males fork length was 60.7 cm, weight – 3.05 kg; females – 59.6 cm and 2.97 kg

accordingly. The GSI of males were close (2.39 and 3.04), whereas that of females in the third subarea was considerably higher and made 9.14 compared to that in the second area – 5.63.

Sockeye. In the Petropavlovsk-Commandor subarea in May a relative number of sockeye males changed from 80% in the second decade to 42% in the end of the month (Table 7). The biggest males were noted in the third decade of May: fork length was 60.5 cm, weight – 3.08 kg. GSI was relatively low – 0.31 in the second decade and increased to 0.61 in the end of May. The number of immature males decreased from 68% in the second decade to 22% in the end of May.

The relative number of males changed from 23-47% in the first decade of June to 51-59% in the third decade. The biggest males – fork length 60.0 cm, weight – 3.12 kg were noted in the first decade of June, the smallest – 58.3 cm and 2.77 kg in the third decade. Males GSI increased from 0.60 in early June to 1.39 in the second decade, and went slightly down to 0.77 in the third decade. The low value of males GSI corresponds to a big number of immature individuals, whose relative number changed from 19% (GSI – 0.60) in early June to 14% (GSI – 0.77) in the third decade. The relative number of sockeye females varied from 71% in the third decade of May to 41% in the third decade of June. The females fork length changed less than that of males: from 55.8 cm in the second decade of June to 56.9 cm in May; but the body weight conditioned by growth and development of gonads at the similar body length changed more noticeably. In May GSI of females grew from 3.42 to 5.11 in the end of the month, and in June – from 4.67 in the beginning of the month to 5.92 in the second decade; then by the end of the month a small decrease of GSI to 4.27 was noted. Immature females were not found in May – June.

In June in area 2 (June 9-10) and in July in area 3 (July 3-4) the relative number of males was almost twice less than that of females and made 23% and 38% accordingly compared to 77% and 62% of females. In area 2 the body size of males and females were close to those in area 3. In area 2 the males fork length was 60.3 cm, weight – 3.12 kg, females – 56.0 cm and 2.45 kg accordingly. In area 3 the males fork length was 59.0 cm, weight – 3.01 kg, females – 56.6 cm and 2.50 kg accordingly. GSI of males in area 3 was higher and made 2.49 (immature 0) compared to 0.85 (immature 8%) in area 2. GSI of females in these areas was about the same; and in area 2 it was 4.81, where no immature females were noted. In area 3 GSI of females was 5.14 and that of immature – 6%.

Chinook. The average chinook males fork length varied from 57.5 to 64.0 cm, weight – from 2.7 to 4.2 kg. The fork length of the only immature female (June 30) was 64.0 cm, weight – 3.4 kg. The average GSI of males changed from 0.81 (end of May) to 3.22 (end of June).

3. Salmon Feeding

Pink fed strongly, the average point of stomachs fullness reached 2-4 points (Russian test) except individuals fished on June 23 (fullness – 1 point). Pink mainly consumed fish juveniles (anchovy) and euphausiids (body length 22-25 mm) whose relative number reached 100% weight of the food bolus. Calanus cristatus, Parathemisto japonica (juveniles 1.5–2.0 mm), Limacina helicina (2-3 mm) and squids were found more seldom.

Chum fed not so strongly than pink, and in May the average point of stomach fullness was 1.0–2.1 (Table 8). In June chum feeding intensity remained small, the average point of stomach fullness changed from 2.4 (beginning of the month) to 1.4 (end of June). In mid May the number of fish with empty stomachs was rather high and made 26%, then decreased to 9-11% in late May. In June the number of fish with empty stomachs increased

from 5% (beginning of the month) to 27% (end of the month). Chum consumed fish food, mainly lanternfishes (Myctophidae) (up to 100% of the food bolus), and at a lesser degree squids and appendicularian. (Table 9).

C. cristatus, euphausiids (spawning individuals, body length over 20 mm), single individuals of P. japonica (body length 6-10 mm), gammaridae (up to 20 mm), Clione limacine, L. helicina and Sagitta (Chaetognatha) were found in chum food.

Sockeye fed strongly, the average point of stomach fullness in May changed from 1.5 to 2.8 (Table 10). In June feeding intensity remained high up to 2.0 points to the third decade, then slightly decreased to 1.4 in the end of the month.

Small number of fish with empty stomachs corresponded to high degree of sockeye stomachs fullness. So, in May the number of fish with empty stomachs changed from 1% in the second decade to 3-4% in the end of the month. Up to the third decade the number of fish with empty stomachs did not exceed 19-21%, and in the end of the month it increased to 38%. In July the number of fish with empty stomachs made up to 28%. In May the main food of sockeye was fish, predominantly lanternfishes (body length up to 12 cm), squids (body length up to 15 cm), appendicularian (body length 5-7 cm) and copepods (mainly Calanus cristatus) (Table 11).

These groups made up to 100% of the food bolus. In June P. japonica juveniles (2-3 mm), C. limacine – 2,0- 3,0 cm; L. helicina – 2-4 mm, euphausiids (spawning individuals, body length over 20 mm), gammarids (body length about 20 mm). Sockeye consumed shrimp (single cases) and Parasagitta in small quantities.

In the West Bering Sea area (June 8-10) the food base of sockeye was squids (up to 100% of the food bolus) and anchovies (up to 100%). In small quantities (up to 50% of the food bolus) there were found C. cristatus, P. japonica (body length 6-10 mm), L. helicina. Spawning individuals of euphausiids (body length over 20 mm), Parasagitta, shrimps (body length 7-8 cm) and gammarids (body length over 20 mm) were found as single pieces. The number of fish with empty stomachs was about 9%.

In the Karaginskaya subarea Sockeye mainly fed with fish (Myctophidae) and P. japonica juveniles (length up to 2 mm).

5. Salmon Anomalies

Anomalies of development of gonads were found with sockeye and chum. So, the left ovary of sockeye (#357) consisted of to independent parts. The front part of the ovary, compact appearance, was 3 cm long and with the weight of 15 g; whereas the back part was elongated (8 cm and 20 g). The ovocytes in both parts of the left ovary and in the right ovary were at the same stage of development (stage III). The first third of the right testis of sockeye (# 542) looked like a rounded “cookie” sized 3.0 x 3.5 cm, with a thickness up to 2 cm (section) in the center, diminishing to the edges to 0.5 cm, weight 29.8 g, stages of development III–IV. The testicle tissue was very dense and of whity-pinkish color. Approximately from the “cookie” center there came out a bar composing 2/3 of the whole length of the testicle and that was at stage of development II–III, as well as the left testicle (weight 3.7 g). The sockeye testicle was taken by parts for histological and biochemical researches. The abnormal development of testicles was found with two chum individuals. The left testis of chum (# 655) was normally developed (stage III–IV), whity-pinkish with the weight of 105 g; and the right one – weight 18 g, was at stage of development II-III and looked like a brown-vinous bar. The right testicle of chum (# 747) consisted of one third of the left one length, was

very short and thick (length 6 cm, thickness 3 cm across diameter); the right – of a normal length (about 19 cm). Both testicles were at the same stage of development – III–IV.

Such anomalies of salmon gonads had not been found before.

Resume

In 2000 the researches of distribution regularities and interaction of the Pacific salmon local stocks in the areas of fattening and migrations were continued in connection with dynamics of its abundance and environment. As a result of researches of SRTM-K "Kamchatsky Losos" there was received data for adjustment of the salmon catch return, of conditions and terms of its migrations, its biological state and relative number of immature individuals.

Weather conditions in the research area in May – July 2000 were not so favorable for fishing than that in 1999. In the Petropavlovsk-Commandor subarea there was noted a big number of days when the strength of wind exceeded 20 m/s (15%). The number of cloudy days was 81%, and the water surface temperature changed from 3.8º C (early June) to 5.5º C (the end of the second decade of June) and increased to 7.4º C in the end of the month. In June 1999 the water temperature in this area was noted the same low as in June 2000.

The main researches were conducted in the Petropavlovsk-Commandor subarea (90% of all made net drifts) in May – June. The catch base was sockeye, in which connection males prevailed in the second decade of May and the third decade of June; at the first-second decade of June – females prevailed. In June sockeye males and females sizes were 2-3 cm longer than those in June 1999, weight – 200-300 g more. But the number of immature males of sockeye and chum was more in 2000 and made 19% and 28% compared to 10% and 8% in 1999 accordingly.

During the voyage they continued sampling materials (started in 1999) characterizing the degree of gonads development of Salmon males and females and specifying criteria of defining immature individuals. In all 72 histological and 128 biochemical samples were sampled.

Additionally to the cruise task the standard Kamchatsky hydrological transect (6 stations) was realized on June 5.

The List of Used Literature

Persov G.M. 1947. Testicles of stellate sturgeon during migration, spawning and downstream migration. The researches of Fishing Foundations Laboratory. L. Nauka, vol. 1:34-58.

Folch I., Lees M., Sloan –Stanley G.H. 1957. A simple method for the isolation and purification of total lipids from animal tissues // J. Biol. Chem., vol. 226, No. 1: 497-509.

Table 1. List coordinates drifts of gillnets

Station	Date	N	E	Course (°)	t° C
2	18.05	52°40	164°00	250	3.1
3	19.05	52°39	164°18	250	3.7
4	20.05	52°43	164°04	250	4.1
5	21.05	53°03	163°47	260	3.4
6	22.05	53°10	165°18	40	3.5
7	23.05	53°16	165°30	80	4.0
8	24.05	53°25	166°07	250	3.7
9	25.05	53°29	166°15	260	3.8
10	26.05	53°28	165°57	270	3.8
11	28.05	52°40	165°37	230	3.6
12	29.05	52°40	166°33	50	3.3
13	31.05	53°17	166°12	240	3.5
14	2.06	53°10	166°00	55	3.9
15	03.06	53°09	165°56	60	4.3
16	04.06	53°06	165°53	50	3.7
17	0 5.06	53°07	165°50	30	4.3
18	0 9.06	55°08	170°42	200	4.1
19	10.06	54°04	170°20	220	3.8
20	12.06	54°08	164°04	40	4.2
21	13.06	54°13	164°24	210	4.4
22	14.06	54°15	164°28	230	4.3
23	15.06	54°14	164°28	220	4.2
24	16.06	54°15	164°29	220	4.3
25	17.06	54°09	164°16	45	4.4
26	18.06	54°12	164°28	30	4.4
27	20.06	54°54	163°32	220	4.4
28	21.06	54°14	162°57	240	3.6
29	22.06	53°35	161°59	240	5.5
30	23.06	53°33	161°52	250	5.4
31	24.06	53°32	161°53	250	5.7
32	25.06	53°35	162°10	230	6.1
33	26.06	53°28	161°43	60	6.4
34	27.06	53°37	162°05	210	6.5
35	28.06	53°43	162°12	210	6.9
36	29.06	53°43	162°12	210	7.0
37	30.06	53°15	162°28	270	7.4
38	1.07	53°17	162°01	230	7.4
39	3.07	57°06	164°21	230	7.0
40	4.07	57°52	164°48	240	7.4

Table 2. List coordinates of standart Olyutorski hydrological and hydrobiological survey (7-8.07.2000)

Date	N	E
07.07.00	58°37	168°30
07.07.00	58°41	169°16
07.07.00	59°00	168°24
07.07.00	59°07	169°12
07.07.00	59°25	168°16
07.07.00	59°33	169°10
07.07.00	59°52	168°12
07.07.00	59°53	169°07
07.07.00	59°38	170°20
08.07.00	59°28	170°32
08.07.00	59°09	170°45
08.07.00	58°30	171°09
08.07.00	58°00	171°32
08.07.00	57°21	172°03

Table 3. Number of sampled materials in Petropavlovsk-Commandor subarea (May-June, 2000)

Species	Specimens	Stomachs samples	Stomachs reviewed	Biochemical samples	Histological samples	Otoliths	Total catch
Pink	29	2	27	10	4	-	46
Chum	784	72	712	63	42	99	946
Sockeye	824	73	751	41	17	95	6,433
Chinook	14	-	14	-	-	14	14
Total	1,651	147	1,504	114	63	208	7,439

Table 4. Number of sampled materials in West Bering Sea area (9-10 June, 2000)

Species	Specimens	Stomachs samples	Stomachs reviewed	Biochemical samples	Histological samples	Otoliths	Total catch
Chum	80	11	69	1	1	10	175
Sockeye	45	10	35	1	1	11	465
Total	125	21	104	2	2	21	640

Table 5. Number of sampled materials in Karaginskaya subarea (3-4 July, 2000)

Species	Specimens	Stomachs samples	Stomachs reviewed	Biochemical samples	Histological samples	Otoliths	Total catch
Pink	5	3	2	-	-	-	6
Chum	86	10	76	10	5	-	285
Sockeye	33	12	21	2	2	10	293
Chinook	2	-	2	-	-	2	2
Total	126	25	101	12	7	12	586

Table 6. Dinamic chum's biological characteristics

Month (area, subarea)	Sex	Number of fish	Sex ratio,%	Immature, %	FL, sm	Weight, kg	GSI	Stomach fullness, points (Russian test)	
								average	empty, %
May									
18 - 20 (6102.2)	male	57	65	49	58.5	2.43	0.31	1.1	24.6
	female	31	35	10	57.8	2.29	2.83	1.0	29.0
21 - 25 (6102.2)	male	58	60	55	58.9	2.65	0.46	1.8	11.1
	female	43	40	7	57.8	2.43	3.38	1.7	8.1
26 - 31 (6102.2)	male	56	57	41	57.8	2.45	0.64	1.9	15.4
	female	44	43	2	57.0	2.32	3.12	2.3	5.1
June									
1 - 5 (6102.2)	male	59	61	19	58.9	2.61	0.92	2.3	7.3
	female	42	39	2	57.4	2.43	3.84	2.5	2.8
9 - 10 (6101)	male	39	51	3	59.9	2.94	2.39	2.1	2.8
	female	41	49	0	59.0	2.75	5.63	1.9	8.8
11 - 15 (6102.2)	male	61	63	5	60.6	3.00	2.21	1.9	13.8
	female	40	37	0	59.2	2.69	5.7	2.0	11.7
16 - 20 (6102.2)	male	24	45	13	60.0	3.07	2.32	2.2	0
	female	35	55	0	59.4	2.84	6.00	1.9	7.4
21 - 25 (6102.2)	male	44	45	28	58.3	2.55	1.14	1.5	20.0
	female	56	55	5	58.4	2.61	6.03	1.4	32.6
26 - 30 (6102.2)	male	72	47	23	59.1	2.80	1.92	1.5	19.1
	female	63	53	2	58.4	2.63	6.89	1.3	32.1
July									
3-4 (6102.1)	male	23	31	9	60.7	3.05	3.04	2.3	0
	female	63	69	0	59.6	2.97	9.14	1.6	33.0

Table 7. Dinamic sockeye's biological characteristics

Month (area, subarea)	Sex	Number of fish	Sex ratio,%	Immature, %	FL, sm	Weight, kg	GSI	Stomach fullness, points (Russian test)	
								average	empty, %
May									
18 - 20 (6102.2)	male	75	80	68	59.7	2.83	0.31	1.5	17.3
	female	19	20	0	56.9	2.44	3.42	1.6	21.0
21 - 25 (6102.2)	male	68	71	34	60.5	3.08	0.54	2.8	5.9
	female	28	29	0	56.7	2.50	4.96	3.0	0
26 - 31 (6102.2)	male	42	42	22	59.2	2.91	0.61	2.8	2.8
	female	58	58	0	56.7	2.58	5.11	2.8	4.1
June									
1 - 5 (6102.2)	male	47	47	19	58.9	2.83	0.60	2.7	4.3
	female	53	53	0	56.0	2.43	4.67	2.8	5.6
9 - 10 (6101)	male	8	23	8	60.3	3.12	0.85	3.4	0
	female	27	77	0	56.0	2.45	4.81	2.8	7.4
11 - 15 (6102.2)	male	43	46	6	59.6	2.91	1.06	2.1	19.2
	female	50	54	0	56.3	2.46	5.22	2.5	12.0
16 - 20 (6102.2)	male	28	43	3	59.9	2.95	1.39	2.1	21.4
	female	37	57	0	55.8	2.42	5.92	3.2	8.1
21 - 25 (6102.2)	male	54	59	14	58.3	2.77	0.77	1.4	31.5
	female	38	41	0	56.0	2.44	4.30	1.4	33.3
26 - 30 (6102.2)	male	64	51	3	58.9	2.86	1.10	1.6	29.7
	female	62	49	0	55.6	2.43	4.27	1.5	38.7
July									
3-4 (6102.1)	male	8	38	0	59.0	3.01	2.49	2.1	12.5
	female	13	62	6	56.6	2.50	5.14	1.7	38.0

Table 8. Feeding intensity of chum, %

Month (area, subarea)	Stomach fullness, points (Russian test)					Average point	Number of fish
	0	1	2	3	4		
May							
18 - 20 (6102.2)	26.1	52.3	15.9	5.7	0	1.0	88
21 - 25 (6102.2)	9.9	27.5	42.8	16.5	3.3	1.8	91
26 - 31 (6102.2)	11.2	16.8	32.6	33.8	5.6	2.1	89
June							
1 - 5 (6102.2)	5.5	6.6	40.6	39.6	7.7	2.4	91
6 – 10 (6101)	5.8	15.9	53.7	21.7	2.9	2.0	69
11 - 15 (6102.2)	13.2	17.6	42.8	19.8	6.6	1.9	91
16 - 20 (6102.2)	4.2	18.8	49.9	27.1	0	2.0	48
21 - 25 (6102.2)	26.9	17.9	38.4	15.7	1.1	1.6	89
26 - 30 (6102.2)	27.0	23.0	40.0	7.0	3.0	1.4	100
July							
1 (6102.2)	20.0	4.0	48.0	28.0	0	1.8	25
3 - 4 (6102.1)	15.8	6.6	47.4	28.9	1.3	1.9	76

Table 9. Frequency of food item of chum (case) in Petropavlovsk-Commandor subarea (May-June) and Karaginskaya subarea (July)

Components	May			June			July		
	to 50%	50-90%	> 90%	to 50%	50-90%	> 90%	to 50%	50-90%	> 90%
Copepoda	44	1	2	3	1	—	—	—	—
Euphausiid	43	8	3	9	5	4	1	—	1
Hyperiid	3	—	—	5	1	—	1	—	—
Gammarid	6	—	—	—	—	—	1	—	—
Pteropoda	11	—	—	19	12	24	1	3	6
Chaetognatha	—	—	—	2	—	—	—	—	—
Appendicularian	9	1	6	45	11	43	4	1	7
Shrimp	3	—	—	2	—	—	—	—	—
Squid	19	11	5	4	1	3	—	—	—
Fish	22	42	74	23	27	54	1	2	1

Table 10. Feeding intensity of Sockeye, %

Month (area, subarea)	Stomach fullness, points (Russian test)					Average point	Number of fish
	0	1	2	3	4		
May							
18 - 20 (6102.2)	18.1	36.2	28.7	15.9	1.1	1.5	94
21 - 25 (6102.2)	4.2	7.3	22.9	32.3	33.3	2.8	96
26 - 31 (6102.2)	3.5	3.5	9.4	41.3	42.3	3.2	85
June							
1 - 5 (6102.2)	5.0	6.0	25.0	36.0	28.0	2.8	100
6 – 10 (6101)	5.7	0	22.9	31.4	40.0	3.0	35
11 - 15 (6102.2)	12.9	10.8	32.2	22.6	21.5	1.8	93
16 - 20 (6102.2)	13.8	1.5	26.1	13.8	44.8	2.7	65
21 - 25 (6102.2)	31.5	18.5	28.3	14.1	7.6	1.5	92
26 - 30 (6102.2)	37.9	12.6	20.0	26.3	3.2	1.4	95
July							
1 (6102.2)	19.3	9.7	42.0	29.0	0	1.8	31
3 - 4 (6102.1)	28.5	9.5	23.8	23.8	14.5	2.4	21

Table 11. Frequency of food item of sockeye (case) in Petropavlovsk-Commandor subarea (May-June) and Karaginskaya subarea (July)

Components	May			June			July		
	to 50%	50-90%	> 90%	to 50%	50-90%	> 90%	to 50%	50-90%	> 90%
Copepoda	11	1	2	37	7	6	—	—	—
Euphausiid	9	5	5	25	15	11	—	—	—
Hyperiid	7	2	—	4	2	2	2	—	4
Gammarid	8	—	—	13	—	—	—	—	—
Pteropoda	2	3	2	17	3	25	—	—	—
Chaetognatha	—	—	—	1	—	—	—	—	—
Appendicularian	19	3	15	—	—	—	—	—	—
Shrimp	1	—	—	5	—	—	—	—	—
Squid	40	9	17	30	23	58	—	—	—
Fishe	36	49	110	38	15	52	—	2	5

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Figs. 1-3 not available on electronic version.