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Results of marine research on the RMS «Moskam-alfa» in 2001

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Abstract

The expedition of the RMS «Moskam-alfa» has been undertaken in the period from May to August 2001 in order to study the Pacific Salmon distribution and the character of local stock interactions in the area of migration and feeding in relation to stock abundance dynamics and environment conditions. The research has been carried out in the fishery area including Western Bering Sea zone - 6101 in the coordinates 57?21'-59?38' N and 170?20'-172?03' E, Karaginski subzone - 6102.1 in the coordinates 56?13'-60?15' N and 163?55'-169?34' E, Petropavlovsk-Commander subzone - 6102.2 in the coordinates 51?16'-53?22' N and 159?18'-167?18' E and Kamchatka-Kurile subzone - 6104.5 in the coordinates 51?21'-51?32' N and 154?50'-155?33' E. The research consisted of oceanographic observations, zooplankton sampling, salmon sampling by driftnets with the mesh of 55-mm (110-mm according to the system accepted in Japan). Total catch Pacific Salmon (total number of fish - 6382) including: Sockeye salmon – 2622, Chum salmon - 2345, pink salmon - 1395, Chinook salmon – 13, Coho salmon - 7. Biological analysis was carried out on 2083 fish of Pacific salmon.

Introduction

Regular since 1983 marine studies carried out by KamchatNIRO should provide better understanding of the basis factors determining the dynamics of anadromous migration. For the purpose of further improvement of short-term forecast methods and in order to provide fisherman with current information on the strategy of fishery campaign in 2001 there have been marine expeditions organized in the adjacent to Kamchatka fishery zones.

General purpose of the marine expedition work was to study Pacific Salmon distribution, stock abundance dynamics and local stock interactions within the area of migration and feeding.

The expedition work implied:

1. To trace the dynamics of the Pacific Salmon run from the basis analysis of quantitative and qualitative composition of the driftnet (55-mm mesh) catches;
2. To collect the data on the abundance, composition of species, biological parameters, age structure and feeding of salmons in the course of their pre-spawn migration;
3. To collect the data might be useful as identification criteria of origin of salmons from mixed marine catches (scale samples, tissue samples, otoliths, parasites occurring);

4. To make meteorological and hydrobiological observations in order to describe the background conditions.

Material and methods

The expedition of the RMS «Moskam-alfa» was carried out for the period from May 16 to August 8, 2001. The research was made within four fishery zones including Western Bering Sea zone - 6101 in the coordinates 57?21'-59?38' N and 170?20'-172?03' E, Karaginski subzone - 6102.1 in the coordinates 56?13'-60?15' N and 163?55'-169?34' E, Petropavlovsk-Commander subzone - 6102.2 in the coordinates 51?16'-53?22' N and 159?18'-167?18' E, Kamchatka-Kurile subzone - 6104.5 in the coordinates 51?21'-51?32' N and 154?50'-155?33' E (Fig. 1).

1. Ichthiological research

For period expedition have been made 55 driftnet settings (55-mm mesh). The Pacific Salmon catch by fishery zones has been represented in the Table 1. From May 19 to July 12 the research was carried out in Petropavlovsk-Commander subzone - 6102.2, from July 15 to July 19 in Kamchatka-Kurile subzone - 6105.4, and from July 23 to August 3 in Karaginski subzone - 6102.1.

Table 1. Total catch of Pacific Salmon in 2001 (number of fish)

Fishery areas	Period	Pacific salmon					Total
		sockeye	chum	pink	chinook	coho	
6102.2	May-July	2295	1830	801	10	5	819
6105.4	July	158	232	228	3	1	622
6102.1	July-August	169	283	366	-	1	4941
Total areas	May-August	2622	2345	1395	13	7	6382

Biological analysis has been carried out on 2083 fish of Pacific Salmon. The data collected have been represented in the Table 2.

Table 2. Total sampled biological materials in 2001 (number of fish)

Species	Biological analysis	Otoliths	Genetic samples
Sockeye salmon	827	70	150
Chum salmon	710	70	150
Pink salmon	473	-	50
Chinook salmon	35	-	-
Coho salmon	38	-	-
Total	2083	140	350

2. Research methods

The catch of salmons by species has been estimated in number and in mass of specimens in the course of releasing the driftnet. Every day one or more driftnet series with the mesh of 55-(110) mm has been set. Responsible scientific observer should assess the length and the number of the control series. Driftnet (55 or 110-mm mesh) setting time period should be 10 hours and no more than 1 hour extra. Usually for biological analysis every day from catch to collected 50 fish of mass salmon species. In the case if less than 50 fish of one species has been catched – all individuals of the species have been analysed. None mass species, i.e. chinook salmon, coho salmon, masu salmon and steelhead, have been analysed totally in the catches every day.

Biological analysis consisted of:

1. Fork length measuring;
2. Gutted and none gutted fish mass measuring and gonad mass measuring. The weight of fish has been assessed with the accuracy up to 10 g, gonad mass – up to 1 g. Gonad-somatic index has been estimated as gonad weight diluted into none gutted fish mass and multiplied in 100;
3. Scale sampling according to standard method (Clutter, Whitesel, 1956; Knudsen, Davis, 1985);
4. Stomach filling estimation on the basis of 5-ball scale and food composition estimation; the percentage of the components represented by large taxons (for example: euphausiids-50%, hyperiids-10%, squids-20%, fish-15%) has been estimated once a five-day period for every Pacific Salmon species;

5. The number of immature fish assessed, i.e. of the fish that wouldn't spawn in current year. Maturity estimation has been carried out from the gonad mass (Ishida et al., 1961; Ito et al., 1974; Takagi, 1961);

6. Sampling the materials for genetic analysis, which includes sampling the tissues of eye, liver, heart and muscle for every particular fish;

7. The number of inquired fishes assessed with notification of the origin of the trauma;

8. The number of deceased fishes assessed with notification of their visible abnormalities, for example tumours, development abnormalities, ulcers, and parasites occurring.

3. Hydrological research

In total 80 measurements of water temperature and salinity in 200-m layer have been carried out before net setting and after net lifting using STD-1000. Standard hydrological survey (36 stations) has been carried out in Bering Sea from 6 to 10 June. The coordinates of these stations have been represented in the Table 3.

Table 3. The coordinates of standard hydrological and hydrobiological surveys in the South-West part of Bering Sea

Number station	Coordinates		Number station	Coordinates	
	N	E		N	E
1	57°37'	163°45'	19	60°15'	168°00'
2	57°30'	164°03'	20	59°52'	168°12'
3	57°13'	164°32'	21	59°25'	168°16'
4	56°55'	165°09'	22	59°00'	168°24'
5	57°24'	166°17'	23	58°37'	168°30'
6	57°42'	165°40'	24	58°41'	169°16'
7	58°05'	164°55'	25	59°07'	169°12'
8	58°27'	164°15'	26	59°33'	169°10'
9	58°45'	165°05'	27	59°55'	169°07'
10	59°05'	165°05'	28	60°10'	168°37'
11	58°50'	165°55'	29	60°12'	169°07'
12	58°27'	166°25'	30	60°00'	169°34'
13	58°02'	167°00'	31	59°38'	170°20'
14	58°23'	167°55'	32	59°28'	170°32'
15	58°53'	167°30'	33	59°09'	170°45'
16	59°26'	167°02'	34	58°30'	171°09'
17	59°44'	166°42'	35	58°00'	171°32'
18	59°55'	167°32'	36	57°21'	172°03'

4. Hydrobiological research

For the period of standard hydrological survey making in Bering Sea from 6 to 10 June the samples of plankton has been carried out within 0-100-m depth layer (36 samples) using IKS-80 net. The coordinates of stations have been represented in the Table 3.

Results and discussion

1. Meteorological conditions

The cyclones from the south and the fronts attended had the most influence on the weather conditions in Petropavlovsk-Commander subzone during the period of the research. Normally the cyclones haven't been rather frequent in June, they being gone mostly to the east or to the west from the area studied. Under general synoptic conditions in the north hemisphere as a whole the cyclone trajectory can differ from an average state what can determine whatever meteorological and hydrological variations in general. This year meteorological conditions in Petropavlovsk-Commander subzone should be characterized as abnormally cold. For the whole period of our research the cloudness was about 10 balls. Cyclone activity affected the weather conditions extensively. Air temperature hasn't been over 5-10?C. East and Southeast winds of 5-15 m/sec were dominating mostly. The storms were of 2.0-3.5 balls in average. Anticyclone activity in early June caused better further weather conditions. Air temperature varied in range 12-15?C. The storms of 2.0-3.0 balls were comparatively heavy. Actually during almost the whole period of fishery the weather within the sub-area had got stormy.

In Kamchatka-Kuril subzone the weather in the second half of June has been more variable. The cloudness in the offshore has been of 0 balls being compared to that (up to 10 balls) in the seaward area. The distribution of the atmosphere front like this was determined by cyclone activity in the southwest of the Sea of Okhotsk. The storms were of 0-1.5 balls. Mostly South and Southwest winds up to 12 m/sec were dominating.

Weather conditions in Karaginski subzone at the end of July and by early August were characteristically stable what was a result of anticyclone activity. As for the state of winds – there was almost a calm. The cloudness in the course of the period of fishery generally was in range of 0-2 balls.

2. Hydrological conditions

Hydrological observations by the RMS “Moscam-alfa” have been carried out during the whole period of the expedition. Hydrological conditions by zones have been mostly determined by synoptic conditions in current and previous seasons in Table 4.

Table 4. Average surface water temperature by five-day periods by zones in 2001, ?C

Month	Pentads					
	1-5	6-10	11-15	16-20	21-25	26-30
Petropavlovsk-Commander subzone – 6102.2						
May	-	-	-	2.8	3.5	3.0
June	3.5	-	4.2	4.5	4.4	4.6
July	5.6	6.1	-	-	-	-
Kamchatka-Kurile subzone – 6105.4						
July	5.0	6.2	-	-	-	-
Karaginski subzone – 6102.1						
July	-	-	-	-	11.5	12.4
August	12.2	12.2	-	-	-	-

For the period from May 16 to June 12 the surface water temperature in Petropavlovsk-Commander subzone varied in range 2.8-6.1?C, being 4.5?C in average. This surface water homogenous layer usually has been 20-m thick. In late June and early July surface water temperature normally has been increasing. The temperature in the surface water homogenous layer of 25-30 m has been increased as well. It should be noted that surface temperature in June has been increasing quite slowly. Temperature background in a whole should be reckoned as relatively cold.

Really stable temperature regime has been observed in Kamchatka-Kurile subzone from July 15 to 19. Water surface temperature in the area studied varied in range 5.0-7.0?C, it being of 6.0?C averaged. The distribution of surface water homogenous layer varied from 10 to 25 m. The dynamics of variations in this zone depended, first of all, on the shallow-water character of the zone.

Surface water temperature in Karaginski subzone for the period from July 23 to August 6 has got the highest it being compared to that in the other zones. The variations have been observed in range 11.0-13.5?C, it being the average temperature about 12.0?C. Comparatively extent this warming of surface water layer has been either due to the specifics of this period of fishery and stable meteorological conditions.

3. The dynamics of catch and the results of biological monitoring

Sockeye salmon. Actually sockeye salmon has been dominating in the Pacific Salmon catches for the whole period of the research. The dynamics of sockeye salmon biological parameters in the catches of RMS “Moscam-alfa” has been demonstrated in the Table 5.

In Petropavlovsk-Commander subzone in the second half of May sockeye salmon frequency has been in average 1.2 fish/tan, what agree 32% in the total Pacific Salmon catch. In the first half of June the frequency has been increased up to 6.6 fish/tan what was 61% averaged. In the second part of June the percent has been decreased to 39% (3.7 fish/tan). In early July the frequency has been 7.8 fish/tan or 62%. This dynamics complies with the conformities of migration of East-Kamchatkan and West-Kamchatkan sockeye salmon stocks within this zone. From the results of sockeye salmon local stocks identification on the basis of scale analysis for 1995-2001 the model of pre-spawn migrations of this species within Russian Economic Zone has been suggested (Fig. 2). The variations in sockeye salmon biological parameters depended on the dynamics of migration of these stocks through the zone. Males have been dominating (50-72%) almost until late May. Biological parameters averaged for this period have been as next: male length – 59.5 cm, female length – 55.8 cm, male weight – 2.93 kg, female weight – 2.15 kg, male GSI – 0.84, female GSI – 5.2, immature males – 0%, immature females – 0%. The intensity of sockeye salmon feeding has been high - 1.8 balls in males and 1.69 balls in females averaged. Dominant components in the food have been myctophids, squids, calanuses and euphausiids. In the first half of June the percent of males has been decreased approximately to 40% due to finishing the mass migration of Kamchatka River sockeye salmon stock early race in this zone. Qualitative characteristics of sockeye have been transformed as next: male length – 57.7 cm, female length – 56.2 cm, male weight – 2.85 kg, female weight – 2.65 kg, male GSI – 0.74, female GSI – 3.09, immature males – 0%, immature females – 0%. Slightly changed GSI and size-mass parameters should indicate the mass run of Kamchatka River sockeye salmon stock late race begun in this zone. Feeding intensity in this period for males and females respectively has been 1.84 and 1.2 balls. For this period the myctophids and the squids have been rather dominating components in the food.

For the second half of June the contribution of stocks emerged from rivers West Kamchatka has been increased what has been obvious from the biological parameters changed: male length – 56.2 cm, female length – 55.5 cm, male weight – 2.58 kg, female

weight – 2.46 kg, male GSI – 0.66, female GSI – 3.83, immature males – 5%, immature females – 0%. The parameters have been reduced at the expense of yet maturating also coming in this period Sockeye salmon of West Kamchatka, i.e. of more frequent immature fishes in the control net lines. Feeding intensity decrease to 1.55 balls in males and to 1.54 balls in females has been explained by the contribution of Myctophids and Squids reduced, when intensifying the development of zooplankton.

In early July sockeye salmon has been more and more frequent in the catches at the expense of more intense migration of West Kamchatkan stocks. Biological parameters for this period have been changed extensively: the percent of males – 40-50%, male length – 57.2 cm, female length – 56.1 cm, male weight – 2.95 kg, female weight – 2.74 kg, male GSI – 1.73, female GSI – 3.89, immature males – 6%, immature females – 3%.

Distribution of Sockeye salmon in Kamchatka-Kurile subzone in the second half of July has been characterized as relatively homogenous. Sockeye salmon frequency (CPUE) has been from 2.2 to 4.2 fish/tan. The catches have been generally high and stable what is indication of high abundant the Ozernaya River sockeye salmon mature stock entering the offshore meantime. The percentage of males in the catches has been about 40%, any significant fluctuations of this parameter during the fishery period haven't been observed. Biological parameters have been as next: male length – 54.0 cm, female length – 56.2 cm, male weight – 2.45 kg, female weight – 2.64 kg, male GSI – 3.24, female GSI – 5.41, immature fish in the catches haven't been met. Feeding intensity in average in males and in females has been 2.0 and 1.75 balls respectively. *Euphausiids* and *Hyperiids* have been reliable dominant components in the food.

Frequency of Sockeye salmon in Karaginski subzone in late July has been 2.26 fish/tan or 19%. In early August the frequency has been reduced to 1.3 fish/tan what is 28% in Pacific Salmon harvest. The catches for this period have been comparatively low because anadromous migration of East Kamchatkan stocks has been almost finished to the time mentioned. The percent of .2 age immature fishes, i. e. of next-year spawners, in the catches has been significant. The rate of males averaged for August has been 40%. Sockeye salmon biological parameters in August have been as next: male length – 53.4 cm, female length – 56.1 cm, male weight – 2.12 kg, female weight – 2.64 kg, male GSI – 0.74, female GSI – 3.89, immature males – 76%, immature females – 42%, intensity of feeding in males and females - 1.43 and 1.2 balls respectively. *Euphausiids, Calanuses* and *Hyperiids* have been reliable dominants in the food.

Chum salmon. During the whole period of the research chum salmon has been

second frequent species in the catches. The dynamics of chum salmon biological parameters in the catches of the RMS “Moscam-alfa” has been represented in the table 6.

Chum salmon frequency in the catches in Petropavlovsk-Commander subzone, similarly to the sockeye salmon frequency, has been quite high. In the second half of May chum salmon has been reliable dominant in the catches, in average its’ rate has been up to 70% what is 2.48 fish/tan. In the first half of June chum salmon frequency in the catches has been increased up to 3.45 fish/tan what is the contribution of 40%. In the second half of June the contribution has been reduced to 28% (the frequency 3.02 fish/tan). In early July chum salmon contribution in the catches has been more reduced to 16% (the frequency 2.03 fish/tan). The analysis of sex ratio revealed no dynamics in the course of anadromous migration what probably related to quite frequent immature fishes in the catches. The percent of both of males and of females varied from 40 to 60%. Biological characteristics averaged for the fishery period in May have been as next: male length – 58.6 cm, female length – 58.1 cm, male weight – 2.72 kg, female weight – 2.68 kg, male GSI – 0.82, female GSI – 3.18, immature males – 0%, immature females – 0%. Feeding intensity for this period has been 1.81 and 1.72 balls in males and females respectively. In June biological parameters have been changed more extensively: male length – 57.3 cm, female length – 57.2 cm, male weight – 2.63 kg, female weight – 2.58 kg, male GSI – 0.85, female GSI – 3.47, immature males – 15%, immature females – 5%. The length-weight characteristics reduced have been, first of all, a result of immature fish frequency increased. The intensity of feeding has been 1.84 balls in males and 1.99 balls in females. High contribution of *Coelenterata* in the food of chum salmon has been notable in the year of the research. Chum salmon biological parameters in early July have been increased being compared to those in June. Biological characteristics have been: male length – 60.17 cm, female length – 58.1 cm, male weight – 3.3 kg, female weight – 2.95 kg, male GSI – 1.97, female GSI – 5.35, immature males – 20%, immature females – 6%, feeding intensity for males and females - 2.11 and 1.97 balls respectively.

Chum salmon frequency in the catch in Kamchatka-Kurile subzone has been in range from 3.6 to 5.33 fish/tan. That is less being compared to last-year frequency for this period. The percent of males in the catches in Kamchatka-Kurile subzone has been highly various from 31 to 53%. Biological parameters have been: male length – 61.7 cm, female length - 58.9 cm, male weight – 3.56 kg, female weight – 3.02 kg, male GSI – 3.53, female GSI – 6.6, immature males – 6%, immature females – 5%, feeding intensity – 1.24 balls for males and 1.38 balls for females. Food dominant has been *Hyperiids*.

Chum salmon frequency in the control net lines in Karaginski subzone has been in range from 3.54 fish/tan in July to 2.87 fish/tan in August. The contribution of chum salmon in total harvest has been 60-80%. The percent of males demonstrated extensive variations throughout the subzone from 37 to 62%. Chum salmon biological parameters for July and for August have been almost the same: male length – 56.9 cm, female length – 58.3 cm, male weight – 2.68 kg, female weight – 2.92 kg, male GSI – 1.35, female GSI – 4.82, immature males – 48%, immature females – 27%, feeding intensity – 1.05 balls for males and 1.17 balls for females. Immature fishes have been rather frequent. *Hyperiids* and *Coelenterata* have been dominant components in the food.

Pink salmon. Pink salmon frequency in the catches has been determined by the dynamics of pink salmon anadromous migration. Actually 90% of total pink salmon to have been caught in July. The dynamics of biological parameters from the catches of the RMS "Moscam-alfa" has been represented in the table 7.

In the catches in Petropavlovsk-Commanders subzone a few pink salmon individuals have been observed in early June. Just in the second half of June pink salmon has been really frequent being 2.35-3.60 fish/tan in average what was 31% in total Pacific Salmon harvest. In early July pink salmon frequency has been a little bit less – 2.98 fish/tan (22%). In June the percent of males has been 50%. Biological parameters for this period have been: male length – 45.2 cm, female length – 44.5 cm, male weight – 1.35 kg, female weight – 1.26 kg, male GSI – 4.29, female GSI – 7.58. The feeding intensity has been 1.75 balls for males and 1.95 balls for females in average. In the food of pink salmon mostly *Myctophids* and large-size zooplankton have been dominating by visual estimation. Biological parameters have been changed in July: male length – 46.2 cm, female length – 45.1 cm, male weight – 1.48 kg, female weight – 1.3 kg, male GSI – 5.51, female GSI – 8.46. The feeding intensity has been slightly lower – 0.58 balls in males and 0.88 balls in females. This reduction depended mostly on the process of gonad maturation.

In Kamchatka-Kurile subzone catches of pink salmon have been most variable. The frequency in the catches has been in range 1.0-11.6 fish/tan or 5.72 fish/tan averaged. The percent of males for the period of observation varied from 52 to 64%. Biological parameters have been as next: male length – 46.7 cm, female length – 46.3 cm, male weight – 1.51 kg, female weight – 1.4 kg, male GSI – 4.68, female GSI – 9.6. The feeding intensity for males has been 2.21 balls, for females – 1.63 balls. The contribution of plankton organisms in the food has been 100%. Mostly *Hyperiids* have been dominating.

Pink salmon frequency in the catches in Karaginski subzone has been in range 0.3-

6.1 fish/tan or 3.33 fish/tan in average. The percent of males, it being equal to 50%, was almost stable during the period of observation. Biological parameters have been as next: male length – 47.6 cm, female length – 47.2 cm, male weight – 1.51 kg, female weight – 1.4 kg, male GSI – 8.5, female GSI – 12.1. The feeding intensity in males has been 0.7 balls, in females – 0.8 balls. The contribution of plankton in the food has been up to 100%. Mostly *Hyperiids* and *Calanuses* have been dominating. Quite low frequency of pink salmon in the catches has been typical for this subzone in general.

Chinook salmon and coho salmon. These species are less frequent in Asian region being compared to sockeye, chum and pink salmons. In the course of the expedition of the RMS "Moscam-alfa" chinook and coho salmons have been met in a scare number therefore the dynamics of biological parameters of these species hasn't been analysed in this report.

Bycatch. None fishery species as lancetfishes, zaprores, pharaons and salmon sharks have been observed in the bycatch in Petropavlovsk-Comander subzone by single exemplars.

Walleye pollock, lancetfishes and chars have been bycatched in Kamchatka-Kurile subzone.

Lancetfishes, chars, salmon sharks and squids have been met in the bycatch in Karaginski subzone.

Conclusions

Fishery campaign 2001 was quite similar to the fishery campaign 2000 in the dynamics of sockeye and chum salmons migration – major fishery species. The dynamics of Kamchatkan pink salmon in this year, similar to that in previous year, complied with stock abundance dynamics of even and odd years. Therefore general pink salmon migration was along the Northeast coast of Kamchatka. This year has been reckoned as "cold" on the hydrometeorological characteristics what hardly could cause no effects to the time periods of the pre-spawn migrations.

During the whole period of the research by the RMS "Moscam-alfa" in Petropavlovsk-Commander subzone the catch of Pacific Salmon were stable. Sockeye and chum salmon were most frequent in the catches, chum salmon being dominant in May. Sockeye salmon contribution was 70-90% what was typical for the years when this species has been high abundant. Another evidence of this fact should be high average frequency of 3-

5 fish/tan what is similar to average for 1994-1999 meaning. It should be noted that sockeye salmon distribution in the second half of May, i. e. during the mass migration of Kamchatka River stock sockeye salmon, hasn't been regular. Chum salmon frequency in the control lines was 2-4 fish/tan. Migrating in late May chum salmon, as always in this area, was comparatively poor – 2-3 fish/tan. Hydrological conditions in this area were stable. Surface water layer has been warmed quite homogeneously although slowly. The layer was 15m thick in average.

The fishery in Kamchatka-Kurile subzone has been carried out during 5 days in the second half of July what wasn't enough to make any conclusions. Pink salmon was dominating in the catches, in average 6 fish/tan, the frequency being highly variable from 1.0 to 11.6 fish/tan. Sockeye and chum salmon frequencies were variable as well, in average about 2-4 and 3-8 fish/tan respectively. These variations obviously should relate to variable hydrological conditions in this area, for example 5-20 m water temperature gradient in the surface water homogenous layer.

The fishery within Karaginski subzone has been carried out during two 5-day periods in late July and early August when the anadromous migration has been almost finished. Therefore neither the period of observation itself nor the sample sizes what were limited, similar to those in Kamchatka-Kurile subzone, could provide any reliable statistics. Chum salmon and pink salmon dominated in the catches, frequency ranges were large - 0.5-5.1 and 0.3-6.2 fish/tan respectively. Sockeye salmon frequency was comparatively temperate from 0.5 to 3.6 fish/tan, 1.5 fish/tan in average. For the research period within the area mentioned the percent of immature fishes has been the most high what can be explained by finishing the pre-spawn migration and by the feeding migration began. Hydrological and synoptic conditions in this area were stable during the period of the research.

Instant analysis of the Pacific Salmon pre-spawn migration dynamics within Russian economic zone from the results of the research by the RMS "Moscam-alfa" expedition was a part of general monitoring of anadromous migration to the rivers of Western and Eastern Kamchatka. Every day data on the dynamics of fishery, biological and hydrological parameters sent from several vessels working in the off-shore to KamchatNIRO provided an assessment of the run of valuable Pacific Salmon species and rational regulation of the shore fishery press to local stocks.

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Appendix tables

Table 5. Dynamics biological characteristics of sockeye salmon in 2001

Month	CPUE, fish/tan	Sex	N	Male, %	Immature, %	Length, cm	Weight, kg	GSI	Feeding intensity	
									Mean	Empty, %
Petropavlovsk-Kommander subzone - 6102.2										
May 17 - 20	0.64	Male	35	70	0.0	60.5	3.36	0.64	1.80	2.6
		Female	15		0.0	55.8	2.63	3.90	1.07	26.6
May 21 - 25	1.45	Male	43	75	0.0	58.6	2.84	0.86	1.79	11.6
		Female	24		0.0	56.3	2.36	4.60	1.92	4.2
May 26 - 31	2.10	Male	24	32	0.0	59.5	2.48	1.12	1.83	3.9
		Female	51		0.0	55.3	2.15	5.86	1.76	29.2
June 11 - 15	7.20	Male	25	49	4.0	57.7	2.85	0.74	1.84	12.0
		Female	26		0.0	56.2	2.65	3.09	1.90	19.2
June 16 - 20	4.88	Male	44	45	4.5	57.3	2.83	0.90	1.57	15.9
		Female	53		0.0	55.5	2.49	3.85	1.91	11.3
June 21 - 25	5.06	Male	51	46	0.0	57.3	2.86	1.16	1.55	27.5
		Female	59		0.0	57.0	2.77	4.20	1.54	25.4
June 26 - 30	2.50	Male	17	34	5.9	56.5	2.83	1.96	1.65	17.6
		Female	33		0.0	56.3	2.70	4.32	1.61	18.2
July 1 - 5	8.98	Male	24	48	0.0	54.3	2.40	1.81	1.54	16.7
		Female	26		0.0	55.9	2.59	3.85	1.62	26.9
July 6 - 10	6.75	Male	36	36	5.6	57.2	2.95	1.73	1.06	38.9
		Female	64		3.1	56.1	2.74	3.89	1.17	28.1
Kamchatka-Kurie subzone - 6105.4										
July 11 - 15	3.50	Male	12	34	0.0	54.7	2.47	2.93	1.58	33.3
		Female	23		0.0	56.9	2.75	4.75	0.70	47.8
July 16 - 20	3.35	Male	41	48	0.0	54.0	2.45	3.24	2.00	7.3
		Female	44		0.0	56.2	2.64	5.41	1.75	9.1
Karaginski subzone - 6102.1										
July 26 - 31	2.26	Male	15	39	66.7	52.9	2.09	1.09	1.00	40.0
		Female	23		43.5	55.6	2.51	3.84	0.83	52.2
August 1 - 5	1.30	Male	7	37	85.7	53.8	2.15	0.39	1.86	14.3
		Female	12		41.6	56.6	2.77	3.95	1.58	0.0

Table 6. Dynamics biological characteristics of chum salmon in 2001

Month	CPUE, fish/tan	Sex	N	Male, %	Immature, %	Length, cm	Weight, kg	GSI	Feeding intensity	
									Mean	Empty, %
Petropavlovsk-Kommander subzone - 6102.2										
May 17 - 20	2.26	Male	36	36	0.0	58.6	2.72	0.82	1.81	8.3
		Female	64		0.0	58.1	2.68	3.18	1.72	3.1
May 21 - 25	2.40	Male	24	37	4.2	57.1	2.31	0.57	1.50	16.7
		Female	41		0.0	56.5	2.22	3.81	1.71	17.1
May 26 - 31	3.23	Male	30	35	0.0	58.3	2.28	0.70	2.07	16.7
		Female	55		0.0	58.3	2.26	4.45	1.95	12.7
June 11 - 15	4.05	Male	16	32	6.3	57.3	2.76	0.83	1.75	6.3
		Female	34		0.0	57.6	2.70	3.73	1.71	8.8
June 16 - 20	3.70	Male	27	45	0.0	58.6	2.81	1.04	2.11	18.5
		Female	33		0.0	57.0	2.52	3.43	1.91	15.2
June 21 - 25	3.48	Male	18	33	22.2	55.8	2.28	0.71	1.39	27.8
		Female	37		8.1	56.6	2.46	3.28	2.11	21.6
June 26 - 30	1.70	Male	8	33	37.5	56.6	2.53	0.52	2.13	0.0
		Female	16		6.3	58.0	2.74	3.44	2.50	12.5
July 1 - 5	1.60	Male	5	45	40.0	56.2	2.85	1.17	2.80	0.0
		Female	6		0.0	57.8	2.85	5.21	2.17	0.0
July 6 - 10	2.80	Male	19	35	0.0	60.1	3.30	1.97	2.11	5.3
		Female	35		5.7	58.1	2.95	5.35	1.97	17.1
Kamchatka-Kurile subzone - 6105.4										
July 11 - 15	3.60	Male	19	53	5.3	59.0	2.92	2.20	1.26	26.3
		Female	17		0.0	57.8	2.69	5.72	1.06	35.3
July 16 - 20	5.33	Male	18	31	5.6	61.17	3.56	3.53	1.50	22.2
		Female	41		4.9	58.96	3.02	6.60	1.29	22.0
Karaginski subzone - 6102.1										
July 26 - 31	3.54	Male	15	37	44.4	55.40	2.49	1.38	0.93	46.7
		Female	26		15.4	58.23	2.89	5.95	0.96	46.2
August 1 - 5	2.87	Male	21	62	52.4	58.4	2.86	1.31	1.24	33.3
		Female	13		38.5	58.5	2.94	3.68	1.38	15.4

Table 7. Dynamics biological characteristics of pink salmon in 2001

Month	CPUE, fish/tan	Sex	N	Male, %	Immature, %	Length, cm	Weight, kg	GSI	Feeding intensity	
									Mean	Empty, %
Petropavlovsk-Kommander subzone - 6102.2										
June 18 - 20	2.35	Male	62	78	0.0	44.7	1.26	3.11	2.44	9.7
		Female	17		0.0	44.4	1.18	7.46	2.06	11.8
June 21 - 25	3.15	Male	40	68	0.0	45.2	1.35	4.29	1.75	25.0
		Female	19		0.0	44.5	1.26	7.58	1.95	10.5
June 26 - 30	3.60	Male	40	63	0.0	45.0	1.29	5.25	1.68	32.5
		Female	24		0.0	44.3	1.23	8.86	1.50	37.5
July 1 - 5	3.44	Male	18	69	0.0	46.2	1.48	5.51	0.58	63.0
		Female	8		0.0	45.1	1.30	8.46	0.88	50.0
July 6 - 10	2.53	Male	14	30	0.0	45.0	1.36	5.36	0.43	71.4
		Female	32		0.0	45.0	1.37	8.72	1.38	34.4
Kamchatka-Kurile subzone - 6105.4										
July 11 - 15	4.40	Male	23	52	0.0	45.4	1.35	4.94	1.65	43.5
		Female	21		0.0	46.4	1.36	8.08	1.62	42.9
July 16 - 20	6.03	Male	14	64	0.0	46.70	1.51	4.68	2.21	7.1
		Female	8		0.0	46.30	1.40	9.60	1.63	25.0
Karaginski subzone - 6102.1										
July 21 - 25	4.80	Male	23	50	0.0	47.0	1.46	8.27	0.61	65.2
		Female	23		0.0	47.1	1.36	10.98	0.57	69.6
July 26 - 31	3.88	Male	29	46	0.0	48.28	1.57	8.83	0.83	55.2
		Female	34		0.0	47.28	1.41	12.16	1.12	38.2

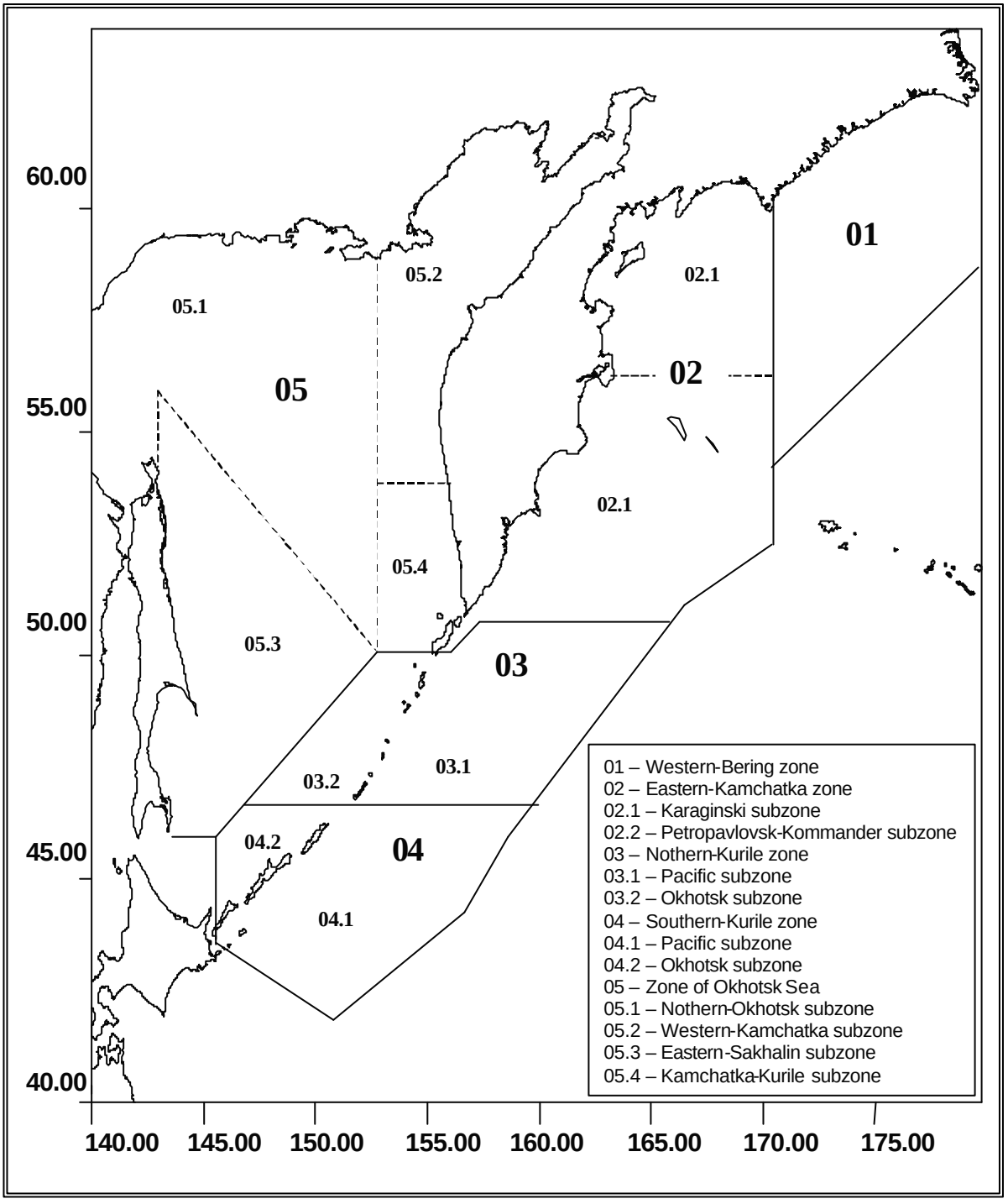

Fig. 1. Scheme fisheries areas within economic zone of Russia in Far Eastern Region

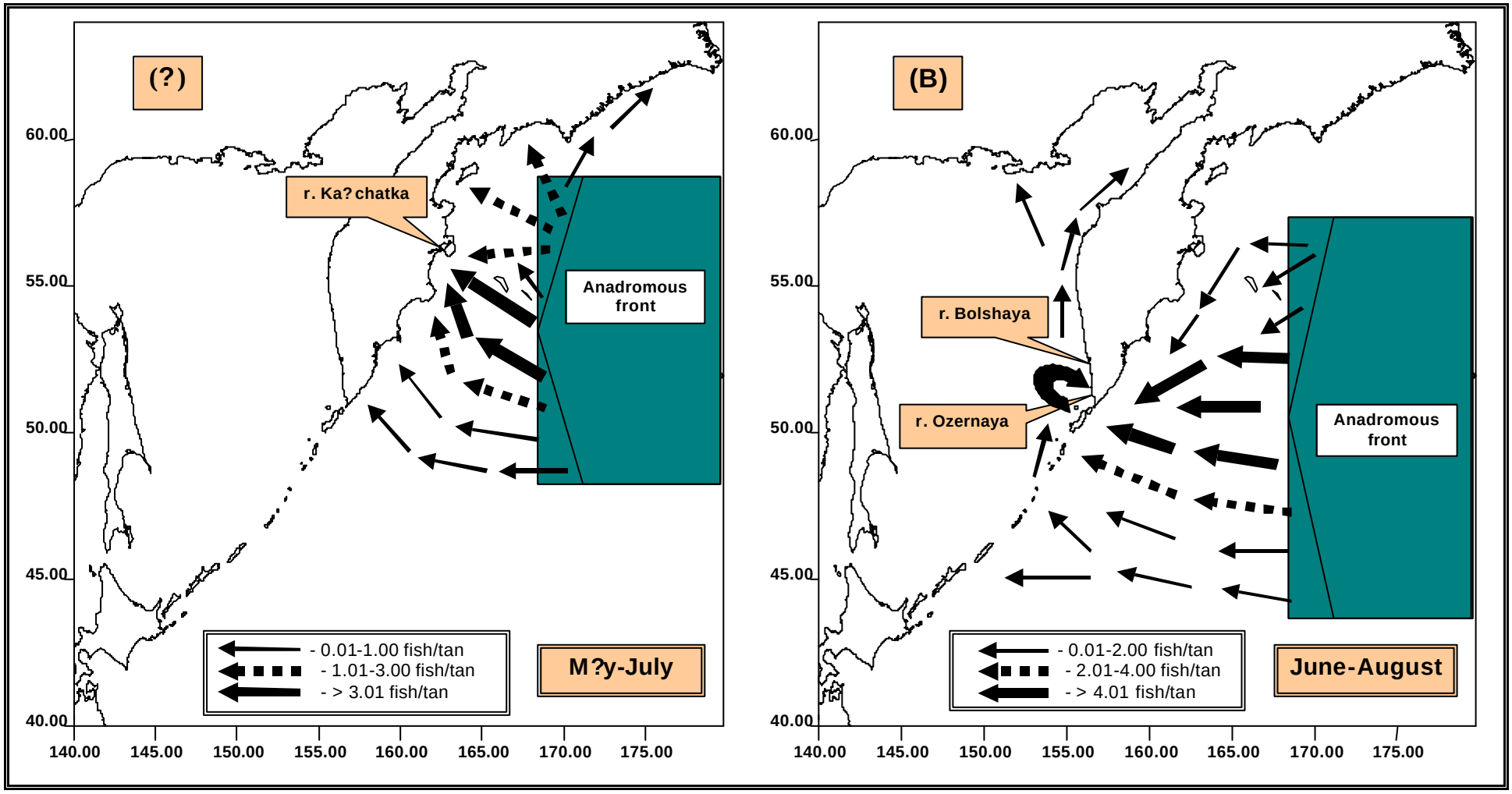

Fig. 2. Generalized model of anadromous migration of Asian sockeye salmon in economic zone of Russia for all age groups: A – stocks of Eastern Kamchatka; B – stocks of Western Kamchatka (from A.V. Bugaev, research 1995-2001).