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Report

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Scientific research on the issue

Estimation of the Number of Hatchery Salmon Returning to Kurilskiy and Reidovoy Hatcheries.

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Content

INTRODUCTION

Marking salmon from hatcheries of CJSC "Gidrostroy" is a part of the requirements for certification of the fishery. The purpose of this research is to estimate the share of hatchery origin spawners returning to the Kurilskiy and Reidovoy hatcheries in 2011, and the study of the dynamics of their runs.

The main task of the research is the differentiation of wild and hatchery origin species from the marks on the microstructure of otoliths in samples from catches in the district of Kurilskiy and Reidovoy hatcheries, and analysis of the data on the dynamics of correlation, between the wild and hatchery origin component of the return during the spawning run.

MATERIALS AND METHODS

Material to evaluate the origin of salmon returning to spawn in 2011 were collected from the trap net catches in the bays of Kurilskiy and Prostor, the mouths of the basic rivers of Reidovoy and Kurilskiy, in the hatchery sites for collection of roe, and in the hatchery area of Olya Bay (adaptive hatchery pond and Olya Creek). Test samples were collected in the spawning grounds of Kurilka River and the nearby hatchery reservoirs (Lebedinoye Lake, Podoshevka River) (Fig. 1).

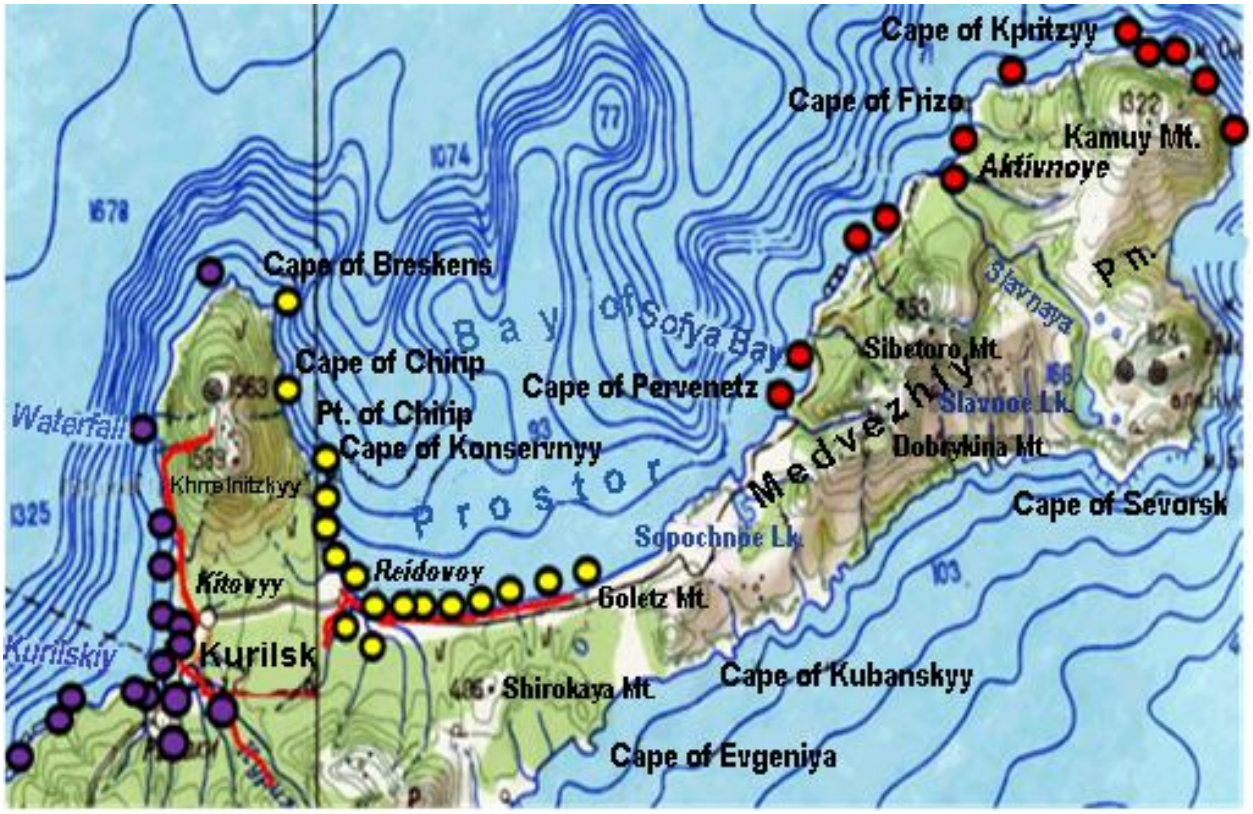

Fig.1. Scheme of the data collection district, for assessing the origin of salmon returning to Iturup Island in 2011.

Total of 1800 specimens of chum salmon were collected for studies of the microstructure of otoliths (Table 1)

Table 1

Characteristics of the material used to assess the origin of chum salmon in the spawning runs to Kurilskiy and Reidovoy hatcheries in 2011.

Date of Collection	Place of Collection	Sample Size
District of Reidovoy Hatchery		
September 28, 2011	Chernye Kamni	100
October 01, 2011	Mouth of Reidovaya River	100
October 05, 2011	Adaptive Pond of Hatchery in Olya Bay	100
October 10, 2011	Mouth of Reidovaya River	100
October 12, 2011	Roe Collection Point of Reidovoy Hatchery	100
October 14, 2011	Kirpichnyi	100
October 14, 2011	Adaptive Pond of Hatchery in Olya Bay	100
October 15, 2011	RUZ of Channel Sopochnaya	100
October 20, 2011	RUZ in the Mouth of Reidovaya River	50
October 22, 2011	Roe Collection Site of Reidovoy Hatchery	50
November 01, 2011	Roe Collection Site of Reidovoy Hatchery	50
November 04, 2011	Olya Bay	50
November 11, 2011	Mouth of Reidovaya River	50
December 05, 2011	Lake Lebedinoye	50
Total		1100
District of Kurilskiy		
September 29, 2011	Staroe and Novoye Lakes	100
October 05, 2011	Mouth of Kurilka River	100
October 12, 2011	Staroye and Novoye Lakes	100
October 15, 2011	Roe Collection Site of Kurilskiy Hatchery	100
October 16, 2011	Mouth of the Kurilka River	100
October 25, 2011	Roe Collection Site of Kurilskiy Hatchery	50
November 04, 2011	Roe Collection Site of Kurilskiy Hatchery	50
November 21, 2011	Podoshevka River	50
November 23, 2011	Spawning Grounds of Kurilka River	50
Total		700

The material used to assess the origin of pink salmon in the return to Reidovoy hatchery was collected from the Roe Collection Site of Reidovoy Hatchery. Moreover, we studied the otoliths microstructure of salmon spawners returning to the Olya Bay Hatchery located slightly off Reidovoy Hatchery. The samples from the mouth of Olya River and adaptive pond of the hatchery were also examined.

The material used for the assessment of the origin of salmon spawners returning to Kurilskiy Hatchery was collected in the roe collection site of the hatchery, from the trap nets located near the mouth of the basic river of the hatchery, and in the bay at some distance from the mouth.

Additionally, there was an identification of hatchery pink salmon among the samples from the trap nets in the Northern part of Iturup Island.

Hatchery individuals were identified by the tags in the microstructure of their otoliths. In assessing the origin of fish we used the image presented in the database NPAFC and the data from the otoliths collection of marked juveniles from different groups of Reidovoy and Kurilskiy Hatcheries.

Inspecting the otoliths of pink salmon we expected to detect 4 different tags used on Reidovoy and Kurilskiy Hatcheries for marking juveniles of the 2009 generation. (Table 1).

Table 2

Release of Pink Salmon Juveniles Marked by Different Tags in Hatcheries of CJSC "Gidrostroy" in 2010.

Name of Hatchery	**Species of Salmon**	**Total Release, Millions Fish**	**Marked Juveniles**		**Kind of Tag**
			Fish in Millions	**%**	
Reidovoy	pink salmon	42.2	11.8	28	1,2,2H1,2,2
Reidovoy	pink salmon	42.2	10.3	24.4	1,2,1H1,2,2
Reidovoy	pink salmon	42.2	20.1	47.6	H1,2,2
Kurilskiy	pink salmon	61.8	52.2	84.6	3,2,2nH
Total		188.4	94.4		

There were three kinds of tags used for marking juvenile pink salmon for the different laying periods of incubation at Reidovoy Hatchery. Juveniles from the Groups #1-7 and #8-11 were marked using both dry and thermal methods; as a result both main and added tags were created. Groups #12-23, making up more than half of the juveniles released from the hatchery in 2010 were marked only by the thermal method after hatching.

Thus, the juveniles of the first seven groups were identifiable by the presence of two tags out of the similar set of lanes formed, both before and after hatching. The otoliths of juveniles from Groups #8-11 had two tags of different configuration located before and after the hatching ring (Fig. 2).

In the otoliths microstructure of juveniles from Groups #12-15, one line was formed by the dry method and then, in connection with the removal of eggs for hatching in the nursery, marking was interrupted and then continued tagging thermally after the hatching of embryos. Juveniles from Groups #16-23 were marked thermally after hatching (Fig. 3).

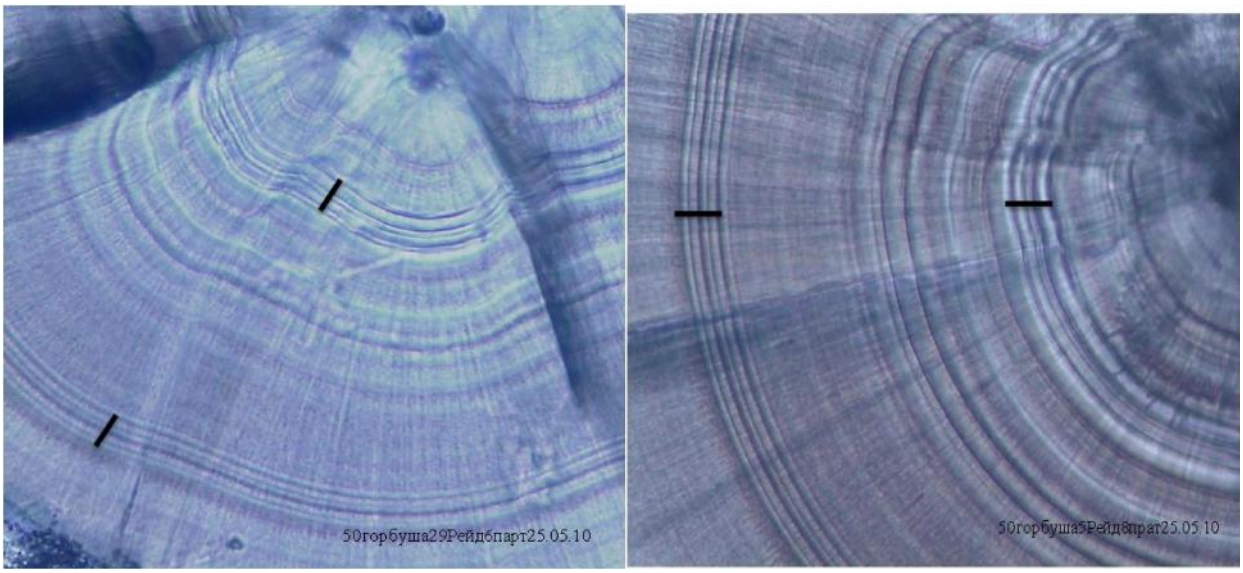

Fig.2. Otoliths of pink salmon juveniles from Groups #6 (left) and #8 (right) for the release from Reidovoy Hatchery in 2010.

The single line on the tags is not a subject for identification, therefore the pink salmon was identified as origin from groups #12-23 by the presence of the tag H1, 2,2.

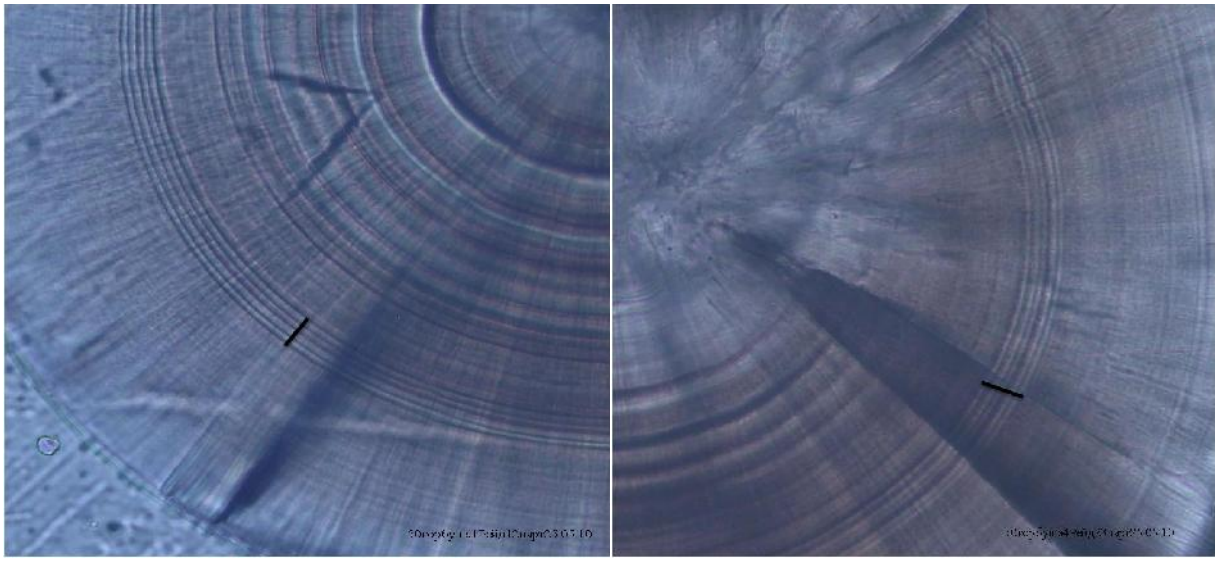

Fig.3. Otoliths of pink salmon juveniles from the Groups #12 (left) and #23 (right) from the release at Reidovoy Hatchery in 2010.

In the release of Kurilskiy Hatchery in 2010 there were about 52 million marked juveniles. Pink salmon embryos from Groups #7-24 were marked by using the one type tag (Fig. 4.) The release of marked juveniles was 48.8661 million with a total release of 57.9808 million, or 84.3%. In general, marking the pink salmon of the 2009 generation was successful. The microstructure of the most otoliths had clear and highly visible tags.

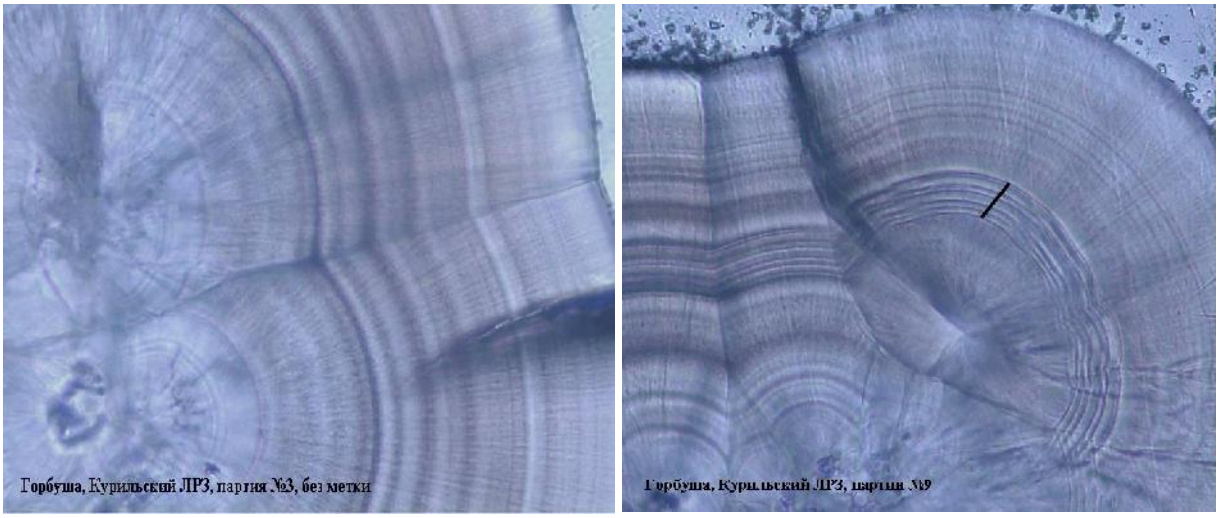

Fig.4. Pink salmon otoliths from Groups #3 (left) and #9 (right) from the release at Kurilskiy Hatchery in 2010

Prior to the release from the hatchery, the otoliths microstructure of juveniles from all groups from both hatcheries was analyzed. Digital photos were taken of all observed deviations of the tag drawings to accurately identify all the tagged fish in the return.

Except for the pink salmon juveniles marked at hatcheries of CJSC Gidrostroy, we did not exclude the possibility of a presence in the spawning return of the fish with tags from hatcheries of other regions located near Iturup Island (Table 2).

For the preparation of otoliths, thermoplastic cement (Buehler, USA) was used. The mounting of the otoliths on glass was accomplished using low magnification from the stereomicroscope Olympus SZ51. The otoliths were polished by the grinding and polishing machine MetaServ-250. For the grinding of the preparations, abrasive discs with an aluminum oxide and silicon-carbide-coated grit 30-40 microns were used (Buehler, USA). For the polishing of saw cuts, the grinding disk FibrMet and diamond grinding paper ultra-prep from 0.1 to 9 microns were used (Buehler, USA). The analysis of the microstructure of the otoliths was accomplished using microscopes Olympus BX51, and Axio Scop A1 at a power of from x200 to x1000.

Table 2

The Tags Used for Marking Pink Salmon Juveniles of Asian Population, for the 2009 Generation.

NPAFC ID	Region	Hatchery Name	Hatch Code of the Tag	Geographical Image of the Tag	
				Before Hatching	After Hatching
JP09-49	Hokkaido	Tokushibetsu Hatchery	2-3H	I I I I I	
JP09-50	Hokkaido	Tokushibetsu Hatchery	2n-2H	II I I	
JP09-51	Hokkaido	Shari Hatchery	2,3nH	I I III	
JP09-52	Hokkaido	Kitami Hatchery	2,3n-2nH	I I III II	
JP09-54	Hokkaido	Nijibetsu Hatchery	2,2nH	I I II	
JP09-55	Hokkaido	Nijibetsu Hatchery	2,2nH	I I II	
JP09-56	Hokkaido	Nijibetsu Hatchery	2,2nH	I I II	
JP09-57	Hokkaido	Ichani Hatchery	2,4H	I I I I I I	
JP09-58	Hokkaido	Ichani Hatchery	2-2-4H	I I I I I I I I	
RU09-50	Sakhalin	Aniva Hatchery	3,2H	I I I I I	
RU09-51	Sakhalin	Sokolovskiy Hatchery	H5,2		I I I I I I I
RU09-52	Sakhalin	Taranaiskiy Hatchery	1,5H	I I I I I I	
RU09-53	Sakhalin	Taranaiskiy Hatchery	H1,5		I I I I I I
RU09-54	Sakhalin	Urozhaynyi Hatchery	3n,3H	III I I I	
RU09-55	Sakhalin	Urozhaynyi Hatchery	3n,2H	III I I	
RU09-56	Iturup	Kurilskiy Hatchery	3,2,2nH	I I I I I II	
RU09-57	Iturup	Reidovoy Hatchery	H1,2,2		I I I I I
RU09-58	Iturup	Reidovoy Hatchery	1,2,2H1,2,2	I I I I I	I I I I I
RU09-59	Iturup	Reidovoy Hatchery	1,2,1H1,2,2	I I I I	I I I I I

RESULTS OF ANALYSIS OF THE MICROSTRUCTURE OF OTOLITHS OF CHUM SALMON

As in the previous years of research, analysis of otoliths microstructure of 1800 pcs of chum showed no marked individuals in the return to Iturup Island in 2011. This is determined, in the first place, by the low amount of chum salmon's junior age group (+2) which comprised the species marked at Kurilskiy and Reidovoy hatcheries.

The absence of chum salmon with tags from other regions among those analyzed in the period from 2007 through 2011 not only in their run to rivers but in catches of fixed nets, is evidence of the low degree of straying for this type of salmon.

RESULTS OF ANALYSIS OF THE MICROSTRUCTURE OF OTOLITHS OF PINK SALMON

The comparison of pink salmon runs at Kurilskiy and Prostor Bays in 2011. (Fig. 5).

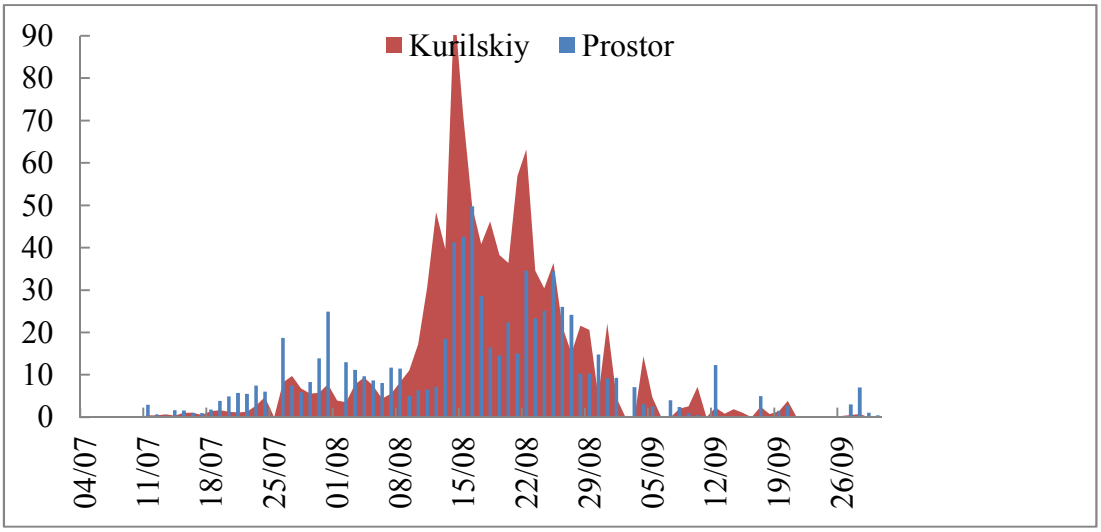

Fig.5. Dynamics of pink salmon fishery in Kurilskiy and Prostor Bays in 2011year.

The catch in the Kurilskiy Bay group of nets accounted for 1017.9 tons, whereas that in Prostor Bay was 747.1 tons over the fishery period. The main catch in Kurilskiy Bay occurred in the second and third ten-day periods of August, while the catch in the remaining fishery period was 20% of the total (Fig.6).

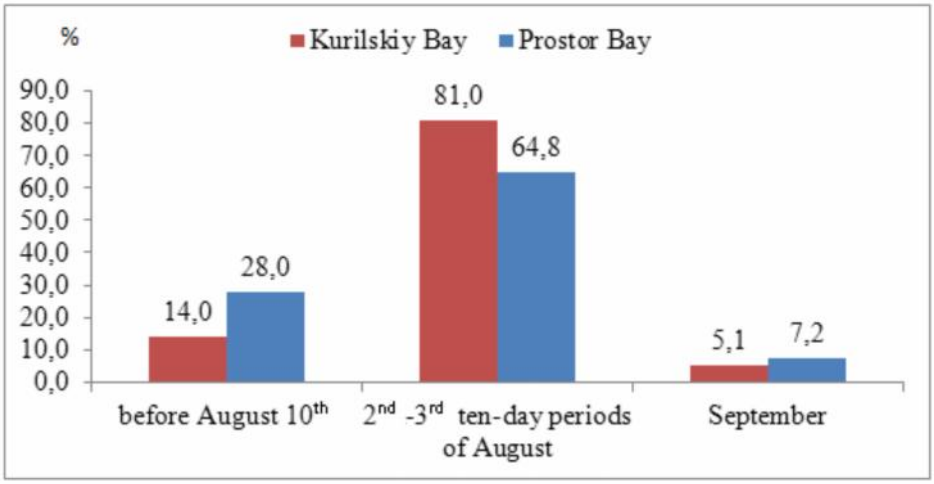

Fig.6. Distribution of pink salmon catches in Kurilskiy and Prostor Bays over the fishery period in 2011.

The dynamics of catch by trap nets in Prostor Bay was similar in nature, with the peak of catches occurring in mid-July; and with an increase of the run in late-July and early August.

To assess the origin of pink salmon in the catches in Kurilskiy Bay, material was selected from mixed catches of nets close to Staroye and Novoye Lakes, as well as Peski and Militia. In Prostor Bay, samples of pink salmon were collected from both mixed catches of all trap nets and the control group. On the whole, the dynamics of pink salmon catches in individual nets was, to a significant degree, similar to the characteristics of catches in all the nets. Thus, the spawn runs and the dynamics of catches in the check nets (Peski, Militia, Staroye and Novoye Lakes), from which samples of pink salmon were selected to identify their origin, did not differ from the general results of the nets in the vicinity of Kurilskiy Bay (Figures 7 and 8).

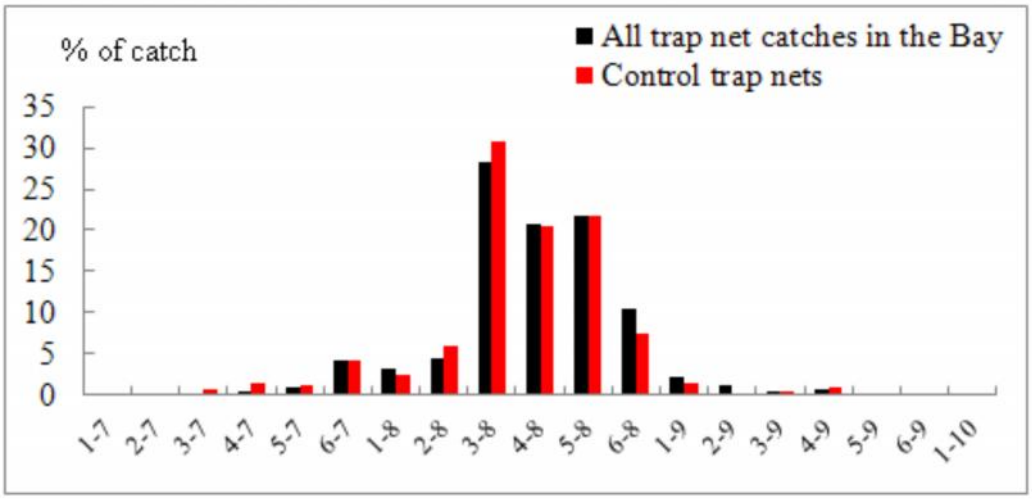

Fig.7. Results of the total catch of pink salmon in Kurilskiy Bay and that of the control nets (Peski, Militia, Staroye and Novoye Lakes).

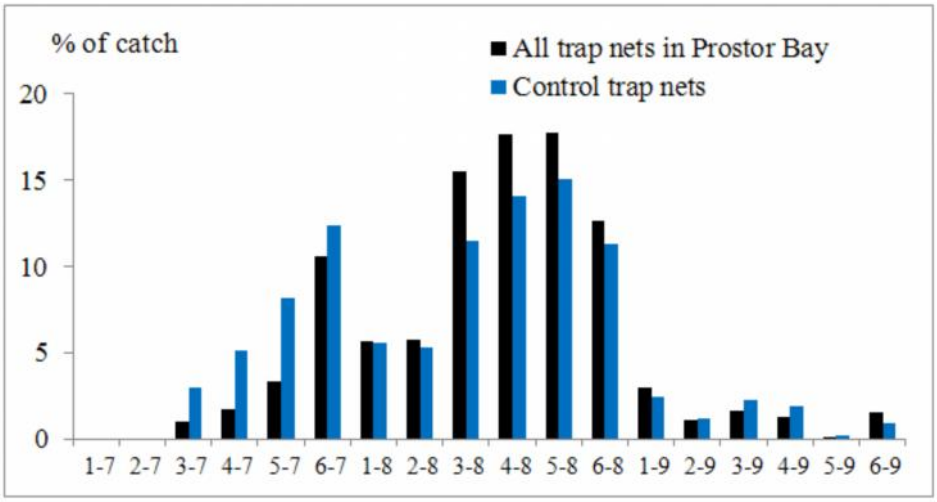

Fig.8. Results of the total catch of pink salmon in Prostor Bay, and that of control net groups (Kirpichnyi, Konservnaya, and 3rd Rechnoy).

Hatchery pink salmon observed in samples from all sampling sites throughout the observation period. Most of the detected hatchery fish origin was from the release of the Kurilskiy Hatchery (Fig. 9).

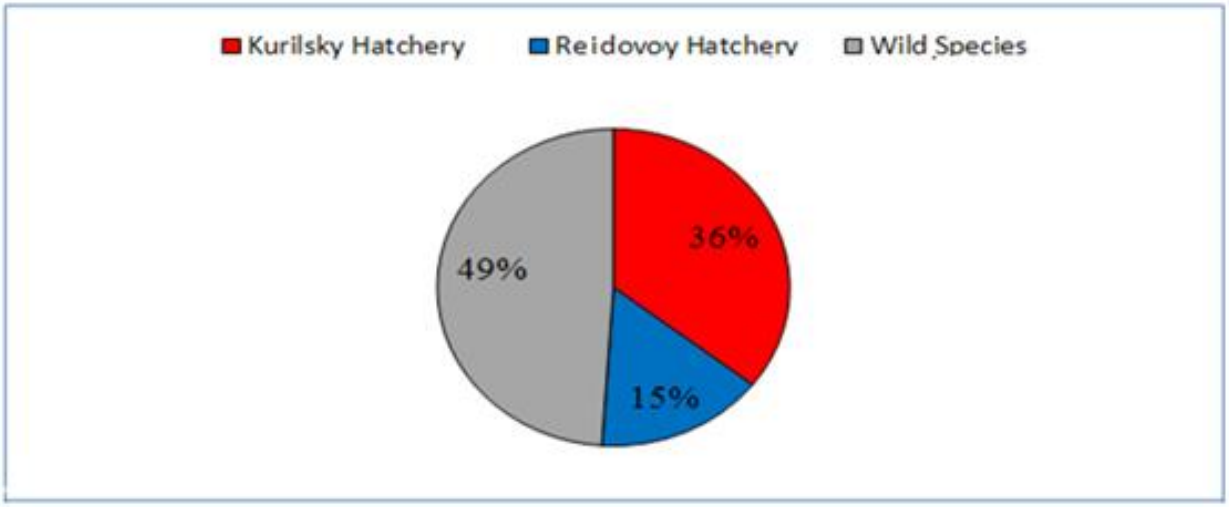

Fig. 9. The proportion of specimens from various origins in the total sample of the pink salmon run at Iturup Island, over the whole period of observation in 2011.

4.1. THE RUN OF HATCHERY PINK SALMON TO THE KURILSKIY HATCHERY.

Material for assessing the origin of pink salmon during their run to the Kurilskiy Hatchery was first collected in the mouth of the Kurilka River, and later on with the spawners moving to the rivers, at the roe collection site of the hatchery (Fig. 10).

In the catches of trap nets located in the Bay, the proportion of marked species increased during the last ten-day period of July, and reached a maximum at the end of August.

The proportion of marked pink salmon in samples from the mouth of Kurilka River accounted for over 50%, and gradually decreased with the spawners' run to the rivers (from 75% to 50.5 %). Accordingly, the amount of hatchery fish in the base river was gradually growing. The maximum number of pink salmon with tags (up to 93.5%) by the end of spawn was observed in samples from the roe collection site of the Kurilskiy hatchery. As follows from the above, the greater part of the catch in Kurilskiy Bay was that of the hatchery pink salmon, while the wild component of its population in 2011 was of minor quantity.

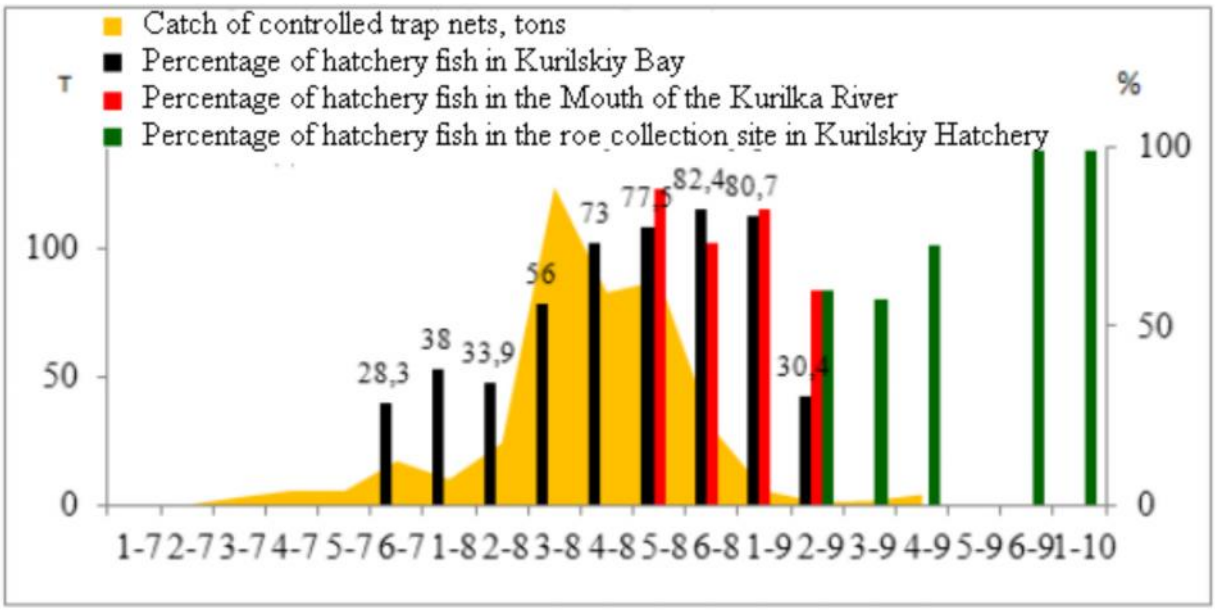

Fig.10. Change in the proportion of hatchery pink salmon in samples from the area of the Kurilskiy Hatchery over the fishery period.

Among the marked spawners, a substantial amount was of hatchery origin (67%), and was the predominate species recorded at the Kurilskiy Hatchery.

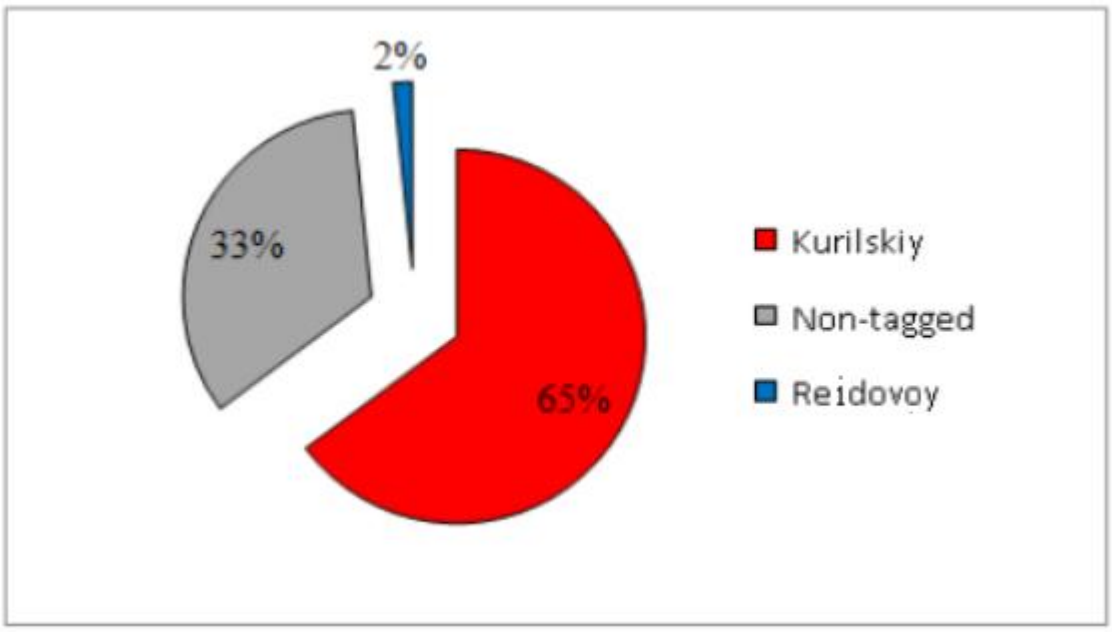

Fig.11. Ratio of pink salmon of different origins observed in the area of Kurilskiy Hatchery over the period of observation.

Marked pink salmon from Reidovoy Hatchery was sporadically found in samples from the area of Kurilskiy Bay. Fish with the tag of Sakhalin and adjacent regions were not observed (Fig. 12.)

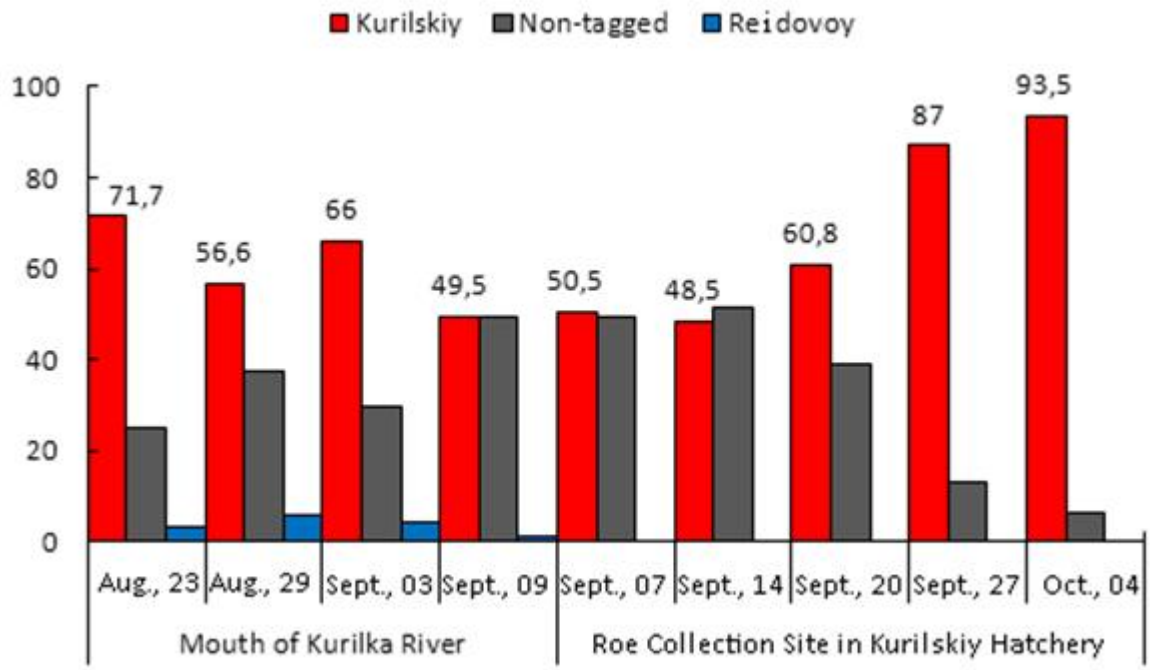

Fig.12. The ratio of pink salmon spawners of different origins in the samples from the run at the Kurilskiy Hatchery in 2011.

Species marked at the Reidovoy Hatchery were recorded in all the samples from the mouth of the Kurilka River; however they were not in the run to the roe collection site of the hatchery. Their proportion in the samples ranged from 1 to 6%.

Evidence of spawners coming from the Reidovoy hatchery and collected in the samples from the mouth of the Kurilka River, and their absence at the roe collection site of the Kurilskiy hatchery, suggests the possibility of a pink salmon simultaneous migration to Island Iturup in 2011, both from the North via Friz Strait and from the South via Catherine Strait. The major part of the return is likely to have migrated via Friz Strait due to the fact that samplings with tags of the hatchery Kurilskiy account for a substantial part (up to 30%) of the run of pink salmon to the rivers of Prostor Bay.

Marking of pink salmon juveniles from Reidovoy hatchery by three different tags allowed the identity of returning spawners originating from the groups of eggs with different incubation times. As in samples from the run to the Reidovoy hatchery, samples collected in the mouth of the Kurilka River, indicated that pink salmon from the latest groups also prevailed. (Fig. 13).

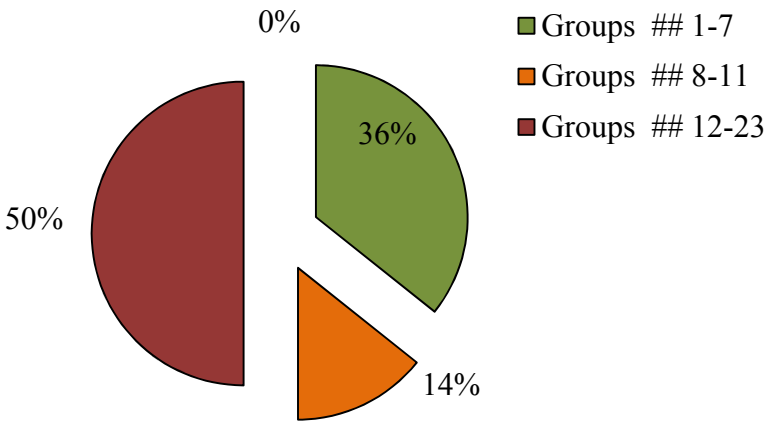

Fig.13. The ratio of Reidovoy pink salmon from different incubation periods, were observed in samples from the spawning run to Kurilskiy hatchery in 2011 (percentage of the total amount of the observed spawners in the region with the tags of the Reidovoy Hatchery).

The proportion of samplings from the first groups amounted to 36 %, and those from groups 8 -11 accounted for 14%. This ratio corresponds to the amount of the release of juveniles from different groups.

4.2. THE RUN OF HATCHERY PINK SALMON TO THE REIDOVOY HATCHERY.

A considerable part of spawners selected for the analysis was of hatchery origin. Among the marked specimens of pink salmon in 2011, there was found a considerable amount of species with the tags from the Kurilskiy hatchery (Fig. 14). There were no fish with tags from the hatcheries of Sakhalin and adjacent regions.

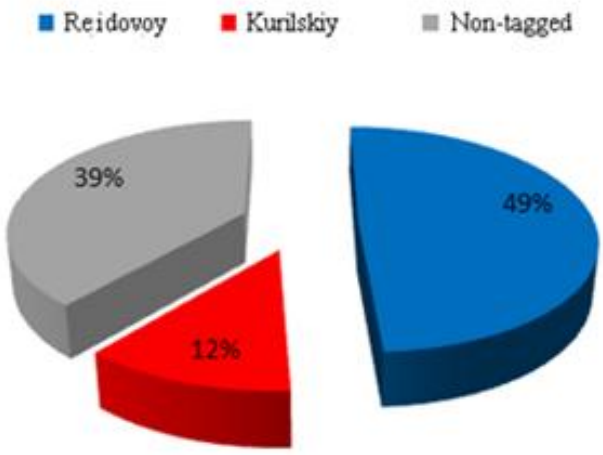

Fig.14. Ratio of pink salmon of different origins observed in the area of the Reidovoy Hatchery and Olya Bay over the observation period.

The proportion of marked species varies during the spawning run both in samples from the roe collection site and from the mouths of rivers (Fig.15). In most samples, there were found samplings with the tags of both hatcheries which released marked juveniles in 2010. The spawners from Kurilskiy hatchery were absent in the first sample from the roe collection site of Reidovoy hatchery and the spawners from Reidovoy hatchery are not recorded in the sample from the mouth of Olya River in late August.

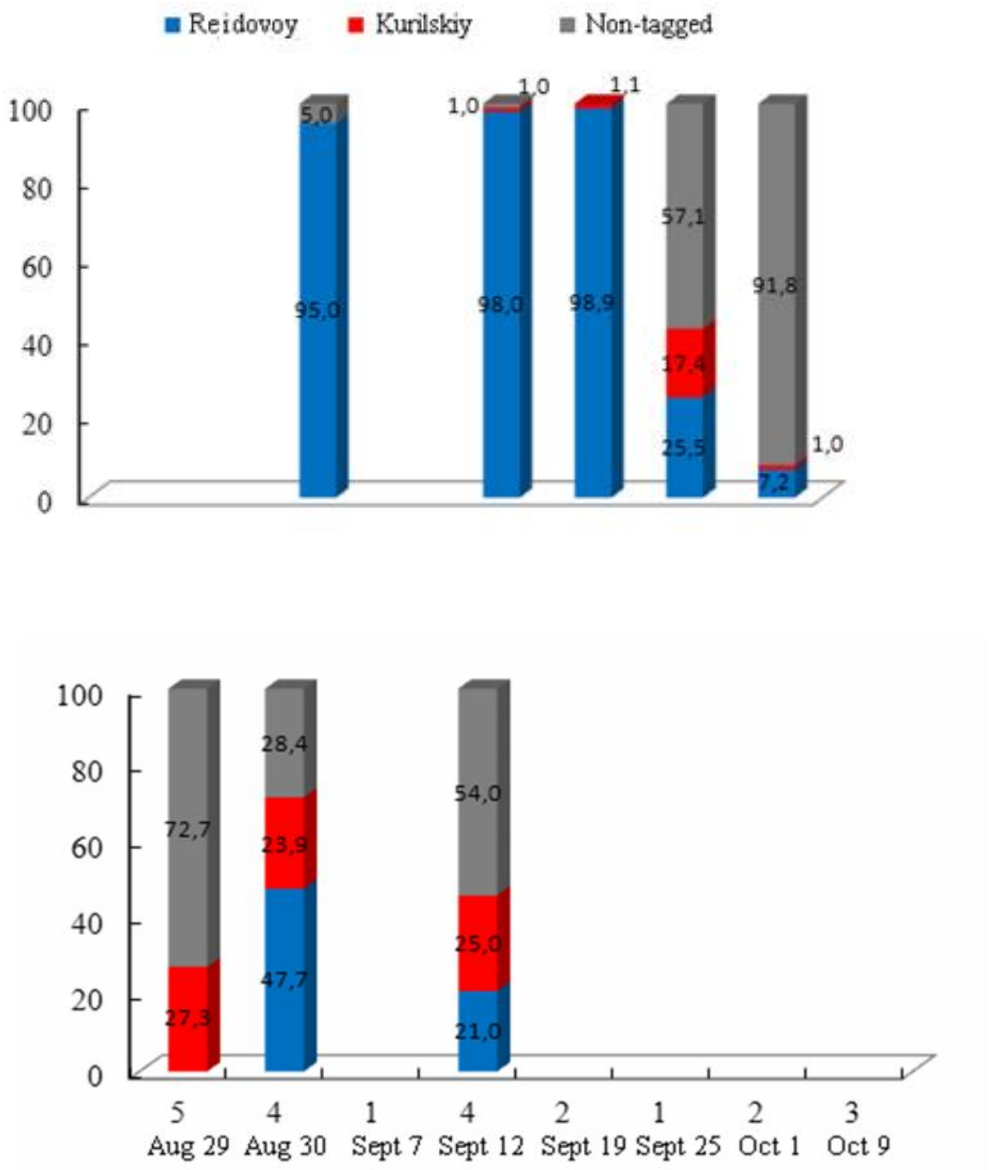

Fig.15. The ratio of pink salmon spawners of different origins in the samples from the area of Reidovoy hatchery in 2011: 1 – Malaya Roe Collection Site of Reidovoy Hatchery; 2 – Bolshaya Roe Collection Site of the Reidovoy Hatchery ; 3 – Adaptation Pond of the Olya Bay Hatchery; 4 - Mouth of Reidovaya River; 5 – Mouth of Olya River.

Most of the pink salmon from the release of the Reidovoy hatchery was found at the roe collection sites of the hatcheries (from 95 to 98.9%). In the mouth of Reidovaya River the maximum amount detected on August 30th (47.7%). By mid-September, its proportion had decreased to 21%. About

7.2% of them were observed at the end of the spawning run in the adaptation pond of the Bukhta Olya Hatchery.

Pink salmon with the tags of the Kurilskiy hatchery were found in almost all samples, except one sample from early September that was collected at the roe collection site of the Reidovoy Hatchery. Its proportion varied from 1 to 27.3%. Unmarked species were found not only at the roe collection site remote from the hatchery, where other anadromous fish were present, but also at the roe collection site located directly at the Reidovoy hatchery (17.4%).

Marking of pink salmon juveniles from Reidovoy hatchery with three different tags allowed the identity of returning spawners originating from the groups of eggs with different incubation times. In most samples, among the spawners of the Reidovoy hatchery, there is a high proportion returning from the latest groups, and somewhat lower is the proportion of samplings from the first groups (Fig. 16). Thus, the ratio of the return of marked pink salmon with different tags and different incubating periods corresponds to the volume of release (Table 2).

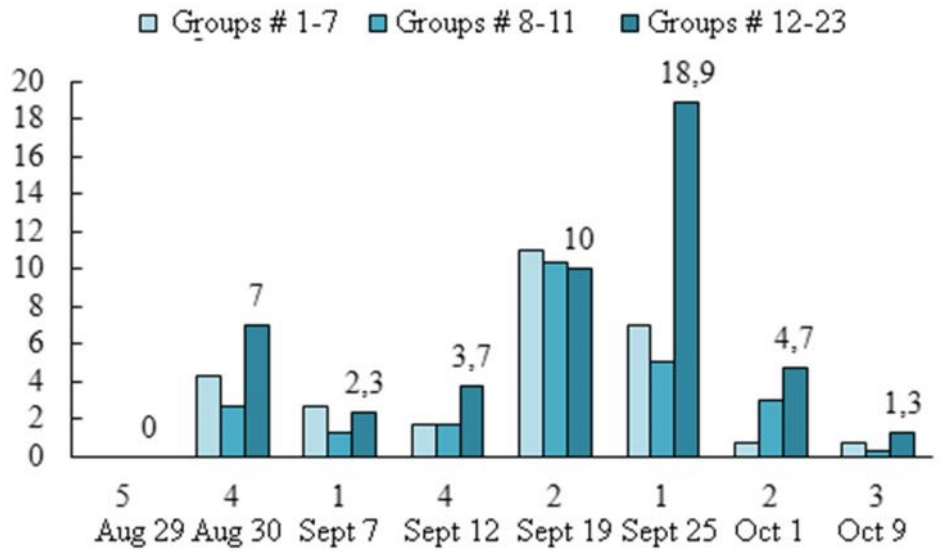

Fig.16. Ratio of species from different incubating periods in samples from the spawn run to the Reidovoy and Bukhta Olya hatcheries in 2011 (percentage from the total amount of spawners with the tag of the Reidovoy Hatchery).

It should be noted that, given the amount of the juveniles marked with different tags, one could have expected a greater amount of pink salmon from groups #12-23 (Fig.17). However, the proportion of specimens from groups #1-7 and #8-11 exceeded the expected amount in the first period of the spawn run and was lower than expected by the time of its completion.

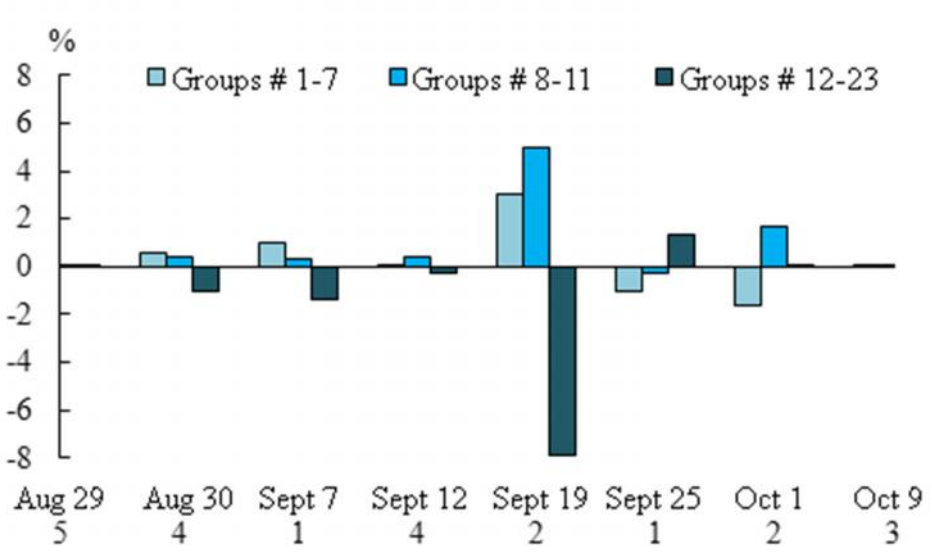

Fig.17. Deviation from the expected pink salmon ratio from different groups of origin in samples of their return to the Reidovoy and Bukhta Olya hatcheries, given the absence of dependence between the timing of incubation and the timing of the spawning migration.

The obtained data may be the result of a connection between the timing of incubation and the timing of the spawning run. At the same time, one could assume that pink salmon of different incubation periods differ in various degrees of survival and straying. Further study of this issue may be quite relevant both for fish agriculture and forecast of the amount of runs.

CONCLUSION

In the process of research at the initial stage, the first data was obtained for the assessment of the amount of return, and for studies of the direction of the pre-spawn migration of pink salmon released from the hatcheries Reidovoy and Kurilskiy in 2010.

In addition, the first data was obtained for the comparative assessment of the amount of pink salmon return, given different terms of incubating periods.

In the spawn returning to the Kurilskiy hatchery in 2011, there were no registered spawners of the Reidovoy hatchery, whereas a high degree of straying was registered for the pink salmon originating from the Kurilskiy hatchery.

The run of pink salmon to Iturup Island in 2011 was to a considerable degree provided by the spawners from that hatchery.