Abstract №95

The Variability in the Features in Some Wild and Fish Hatchery Populations of Pacific Salmon

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Abstract. **The viability of some Pacific salmon bred at fish hatcheries is known to be considerably lower than that of the natural populations. It is interesting to compare some biological impotent features in several populations of Primorsky Region, Sakhalin Island and Kamchatka .**

The paper presents studies of specimens of natural and fish hatchery populations of chum salmon *Onchorhynchus keta*, chinook salmon *O. tshawytscha* and pink salmon *O. gorbuscha*. The material for exploration was obtained at Barabashevsky fish hatchery (Primorsky Region), Sokolovsky fish hatchery (Sakhalin Island) and Malkinskiy hatchery (Kamchatka), as well as from the Rivers Melkaya and Tym' (Sakhalin Island) in 1988-1991.

As a criterion of ontogenesis stability and significance of heredity for the formation of some characteristic features in the populations it was chosen the rate of fluctuating asymmetry (FA) of different features: number of pores of seismosensory channels, gill rakers, rays in pectoral fins and ventral fins, spots along the side line. The indices of viability, sex ratio, dynamics of change in size and weight were studied too. The rate of FA in wild populations was lower than in fish hatchery populations.

The variability in the above-mentioned features of the observed populations is described. The most degree of variability was estimated at the Sokolovsky fish hatchery. We established that the fish individual of each population was characterized by certain typical indices of the features and FA of the coupled features.

Key words: fluctuating asymmetry, viability, chum salmon, chinook salmon, pink salmon, heredity, features of salmon.

I. INTRODUCTION

It is known that the ability to viability of some Pacific salmon bred at fishery hatcheries are considerably lower than that of the natural populations. This is illustrated by decrease in return of the bred fish. As a criterion of ontogenesis stability [1] of some characteristic features in the studied populations it was chosen the level of fluctuating asymmetry of different features. FA phenomenon is described in a few salmon species. It was observed in Salmo salar and Salmo Trutta, that numbers of fishes having FA signs is equal to 2,5% - 28%. Generally, the wild population fishes have lower numbers than populations from fish hatchery [2]. Connection between FA indicators and rate of genetic variability in population was displayed. Concerning to FA these authors described three features, namely, spots on opercula, rays of pectoral and ventral fins We researched more features than other authors: fluctuating asymmetry of different features: number of pores of seismosensory channels, gill rakers, rays in pectoral fins and ventral fins, spots along the side line. The indices of viability, sex ratio were studied too.

Methods of dry fertilization used at the hatcheries result in the following: low-active sperms can participate in fertilization along with the high-active sperms. Probably, this is one of the causes of the decrease in quality of salmon offspring at the hatcheries.

II. MATERIALS AND METHODS

The paper presents studies of specimens of natural and hatchery populations of chum salmon *Onchorhynchus keta*, pink salmon *O. gorbuscha* and chinook salmon *O. tshawytscha*. The material for studies was obtained at Barabashevskiy hatchery (Primorskiy Region), Sokolovsky hatchery (Sakhalin Island) and Malkinskiy hatchery (Kamchatka), as well as from the Rivers Melkaya and Tym' (Sakhalin Island) in 1988-1994.

At the hatcheries the eggs was fertilized with the help of trivial dry method of fertilization (control). Besides, we received the posterity using the technique of spermal selection (SS) - selection of the most active part of sperms. In this case, before fertilizing the sperms were activated in the absence of eggs in definite conditions, and after that they were mixed with the eggs. Then the less active sperms were loosing their activity and didn't participate in fertilization.

III. RESULTS

. The chum salmon researched in the presented work is characterized by high occurrence of fluctuating asymmetry. Disorder in fry symmetry reflects the state of population and the level of specimen's viability. Generally, FA level was highest in chum salmon fry from the hatchery populations of Sakhalin Island (Sokolovskiy hatchery) and Primorskiy Region (Barabashevskiy hatchery) when dry method of fertilization was applied (Table 1). The fry of natural populations (in the rivers Melkaya and Tym', Sakhalin Island) and that bred after the sperm selection method applied, when most active sperms participated in eggs fertilization, has reduced level of FA.

The described populations were distinguished between each other regarding at row of features, such as number of

spots along side line, number of rays in pectoral fins, number of gill rakers, number of pores.

We note that the use of SS increases the sizes and weight of fry. It's power that the level of specimens viability is higher from SS fry (Table 2).

The summarized results indicate that FA level is lower in populations of chum that reproduced in natural conditions than those populations which bred in hatchery ($p<0,01$). It was possible because of the wild specimens fittest survival after natural selection that took place. But better FA indicators were noticed in the experiments with SS that were exercised at Sokolovskiy hatchery. During it the lowermost indicators of FA were observed in number of sports, gill rakes, rays of pectoral fins and pores. Their values were nearer to the indicators of fishes from the rivers Melkaya and Tym' (Table 1). FA indicators of fishes from Barabashevskiy hatchery are 1,5–2,0 times more than of fishes from other researched regions according to such features as pores of seismosensoric channels on preoperculum, rays of pectoral fins, gill rakers. This may be linked with unfavorable water regimen on Barabashevskiy hatchery over period of study. Also, conditions of dry fertilization are the additional unfavorable factor.

It should be stated, when considering various features, that feature of coincidence of spots number doesn't belong to vitally needed one [3,4]. And it is unsure to evidence symmetry of body sides. Probably, it is the reason, why the most variations of values (from 6 to 19 spots) were observed here (Fig. 1). The most feature variability was observed on Sokolovskiy hatchery. In the experiments with SS the variability of feature was reduced. The same picture was observed in pectoral fins and gill rakers. Apparently, selection decreased fish features diversity.

In regard of FA magnitude all studied populations for sure were distinctive from each other (Table 1). The lowermost level of spots FA is characteristic in the experimental (SS) fry of Sokolovskiy hatchery.

The pore feature is conservative. Number of pores is the lowermost figure among other features (Fig. 6). Numbers of the pores are rather similar in fishes from different areas. Fishes from the rivers Melkaya and Tym' were distinguished a little (Table 1) with $p<0,001$. The lowermost level of FA in pores number was specific for fry from the rivers Melkaya and Tym', also for fry in the experiment with SS in Sokolovskiy hatchery (0,16, 0,16, 0,17 respectively, Table 1).

Deviations in number of gill rakers evidence asymmetry of gills. Scatter of the feature values was changing within 9-13 (Fig.4). Fishes from Barabashevskiy hatchery were distinguished according to higher number of gill rakers. Barabashevskiy hatchery population was essentially distinctive from all the rest (0,34) in regard of FA magnitude of gill rakers number ($p<0,001$). We have already pointed to unfavorable water regimen at this hatchery as possible reason of ontogenesis violations. There should be pointed also, that often defective spade-formed pectoral fins (more, than 70% cases) were registered in fry from Barabashevskiy hatchery. They looked like stumps, namely twice as short, compared with usual ones and were like nibbled round edges that were obstacle to count the number of rays. This phenomenon could be linked with unfavorable water regimen and aggressive bacterial medium at the hatchery.

FA distinctions in pectoral fins rays of fishes from hatchery and natural populations proved out to be significant (Table 1). Therefore wild fry are frequent similar experimental (SS). Here, the similar indicators in fishes on one hand were those, that resulted from fertilization by dry method at Barabashevskiy and Sokolovskiy hatchery (0,69 and 0,63), on the other hand they were registered among wild populations from the rivers Melkaya, Tym' and the experimental ones from Sokolovsky hatchery ($p<0,01$).

Mean indicators of rays number were equal to 12-13 (Fig. 3). The scatter in magnitude equaled 9-16. Diversity of fishes regarding number of rays (9-15) in pectoral fins of fishes from Sokolovsky hatchery is the widest although the fry was smaller, comparing with others. It was considerable at Barabashevskiy hatchery (10-14). After application of SS the fishes seemed to be less differed. They were similar to fishes from the river Melkaya, because at natural conditions the natural selection of the fittest, including spermatic one ($p<0,001$). The most occurrences of 12-13 rays in fins are displayed clearly. The fry with 9-10 and 11 rays has smaller body parameters. Determining number of the ventral fins rays, we found that this feature is conservative concerning number of rays, as FA. It is mentioned to show its non-significant variability only.

Representative distinctions between numbers of indicators in left and right sides of the fishes were not disclosed, to be precise there were not observed the prevailing increase in a feature indication for one side.

It is described the variability in the above features of the studied populations. It is established that the specimens of each studied population was characterized by certain typical indices of the features and FA of the paired features.

The pink salmon fry had other picture of lower of some indices of FA (Table 1). It had reduced level of FA of rays in pectoral fins and gill rakers and highest level of FA of pores of seismosensory channels.

The chinook salmon had smaller fluctuation of variability regarding such feature as spots and greater one in compliance with rakers number comparing to chum salmon (Fig. 2, 5). At the same time SS influenced the total representation of features distributions quite consistent with digital degree.

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TABLE 1
FLUCTUATING ASYMMETRY INDICATORS IN CHUM SALMON *ONCHORHYNCHUS KETA* AND PINK SALMON *O. GORBUSCHA*.

Number of fishes	Fluctuating asymmetry			
	Spots	Pores	Pectoral fins rays	Gill rakers
O. keta				
Barabashevskiy hatchery(Control)				
60	0.85	0.37	0.69	0.34
Sokolovskiy hatchery (Control)				
99	0.7	0.19	0.63	0.24
Sokolovskiy hatchery (Sperm selection)				
36	0.58	0.17	0.27	0.19
River Melkaya				
52	0.75	0.16	0.33	0.22
River Tym’				
94	0.92	0.16	0.32	0.27
O. gorbuscha (Sokolovskiy hatchery)				
42	-	0.38	0.21	0.22

TABLE 2
WEIGHT AND SIZE OF ONCHORHYNCHUS KETA

Variants	Weight, mg Size, cm	5-th month fry	6-th month fry
Control	mg cm	324.1±10.50 3.3±0.02	403.2±13.50 3.6±0.03
SS	mg cm	383.0±6.20 3.5±0.02	646.1±20.90 4.0±0.04

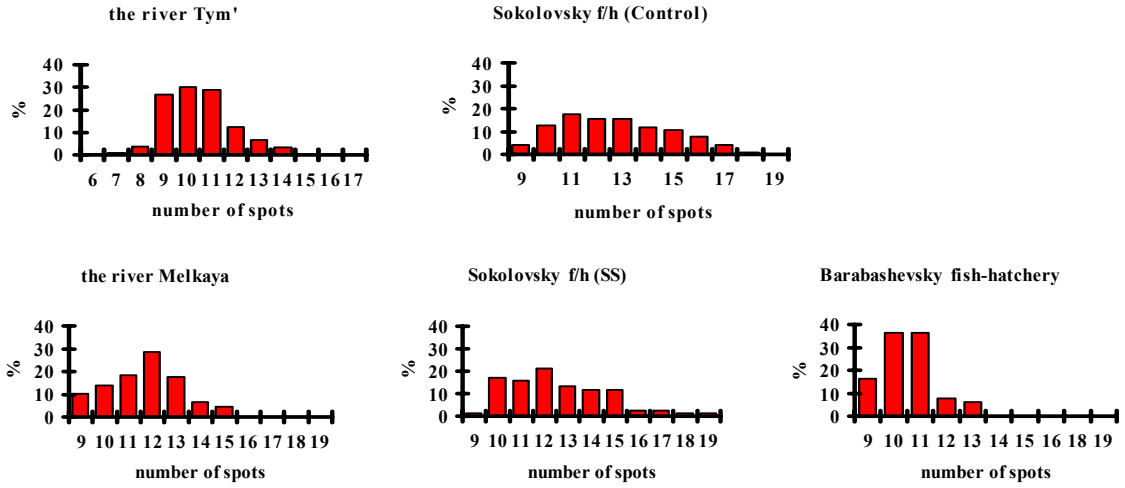

Fig.1.Variability of spots number of O. keta

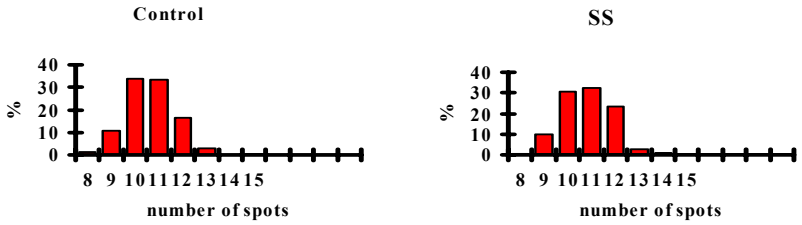

Fig.2.Variability of spots number of O. tshawytscha (Malkinskiy hatchery)

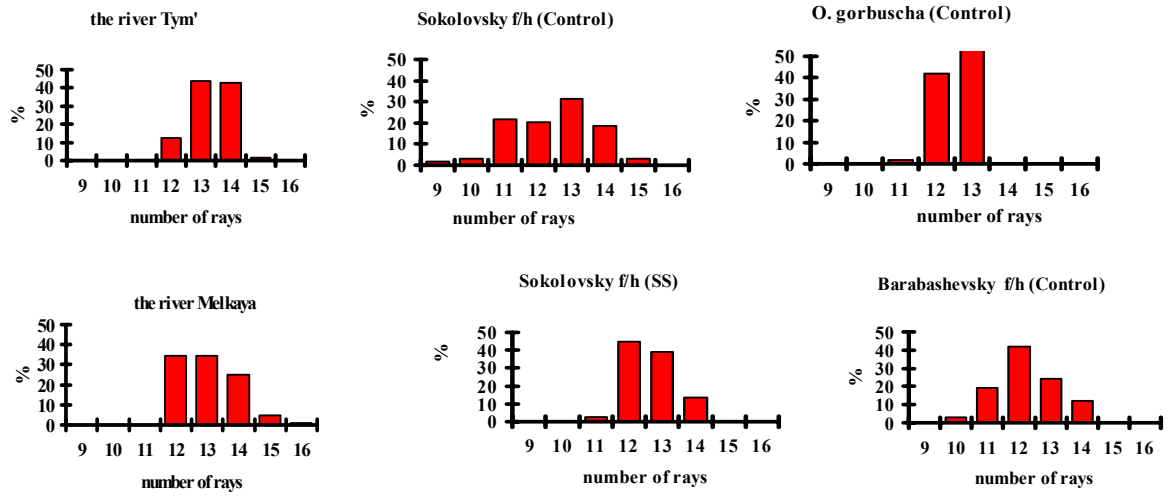

Fig. 3. Variability of rays number of O. keta and O. gorbuscha (Sokolovskiy hatchery)

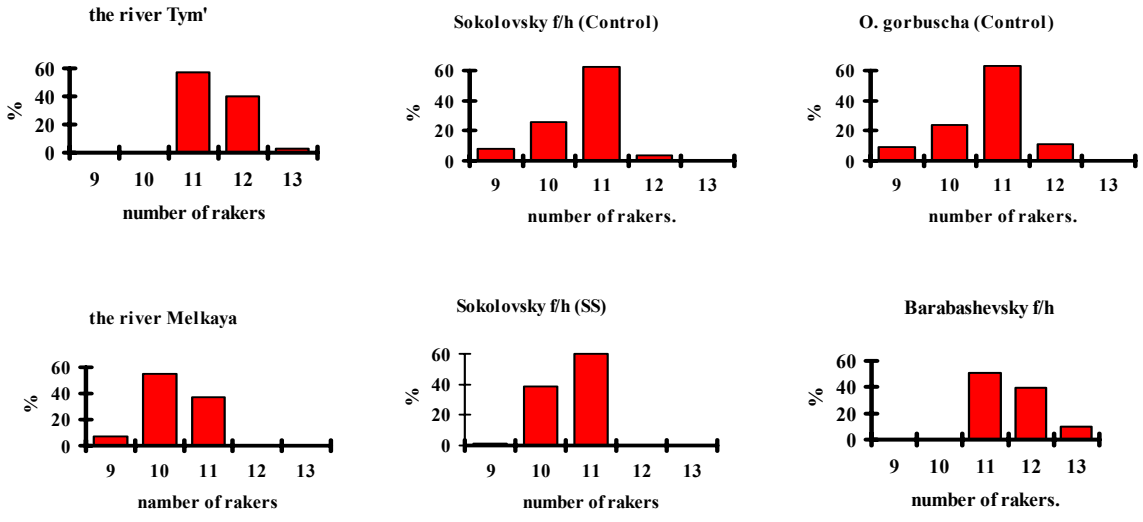

Fig. 4. Variability of gill rakers number of O. keta and O. gorbuscha (Sokolovskiy hatchery)

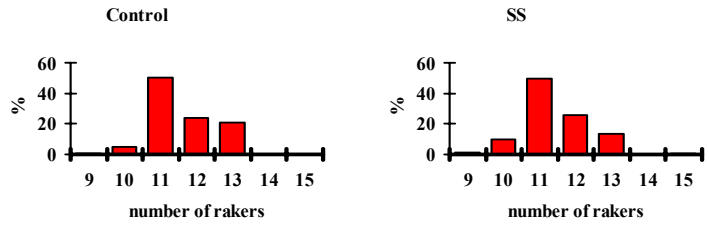

Fig. 5. Variability of gill rakers number of O. tshawytscha (Malkinskiy hatchery)

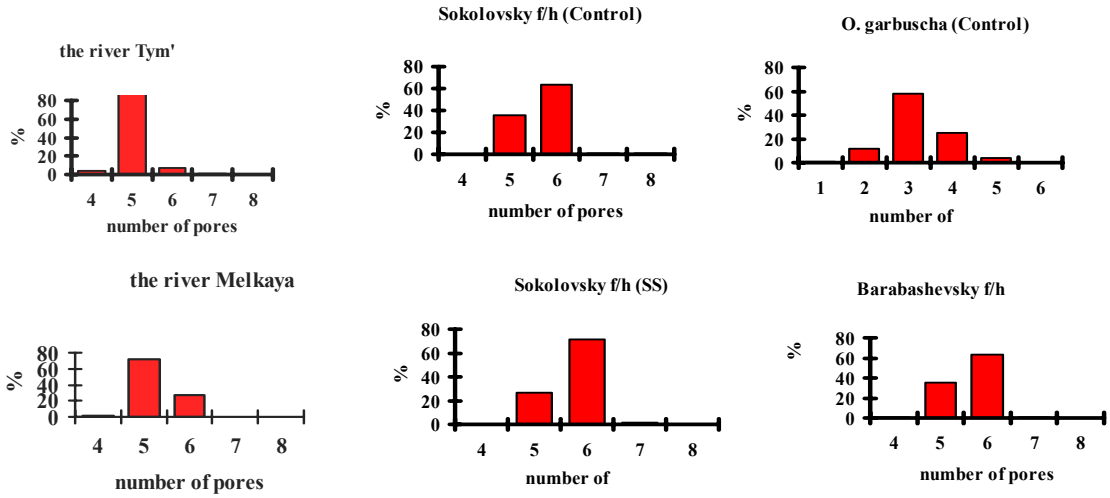

Fig. 6. Variability of pores number of O. keta and O. gorbuscha (Sokolovskiy hatchery)