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Results of 2016 Salmon Research in the Eastern Part of Okhotsk Sea by the R/V MRTK-316

by

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Abstract

The analysis brought new information on Pacific salmon biology. One phase of mass migration of pink and chum salmon under-yearlings from the coastal area was revealed in July 21-30, 2016. Surveys in earlier dates in all years before (during the 1st or 2nd decades of July) revealed sporadic representatives of both mentioned species. Additional surveys in the last half of August usually do not demonstrate many pink or chum salmon individuals in the waters between the shore and 155° E and southward from 54°N. Hence, the migration of pink and chum salmon under-yearlings from the shore with their simultaneous drift with geostrophic surface currents northward is shorter, less than one month in mentioned waters, and takes place from mid July to mid August.

Keywords: Pacific salmon, juvenile, early marine life

INTRODUCTION

A mid-water trawl survey of juvenile salmon was carried out in the Okhotsk Sea waters adjacent the coast of West Kamchatka in July 2016 (Figure 1). The survey goal was to estimate stock abundance of Pacific salmon smolts and study smolts growth and migration in the costal zone.

The main objectives of the work were:

— to collect materials, characterizing juvenile salmon abundance, biological characteristics and age structure for the period of feeding at sea;

— to examine composition of species in the forage and to find out the major components in the diet of juvenile salmon in the course of feeding at sea;

— to collect data, characterizing marine fish community and feeding by mass fish species in order to figure out how do the species interact;

— to study the timing when juvenile salmon leave coastal area for open sea waters;

— to sample scales and otoliths for the age and growth rate assessment.

MATERIAL AND METHODS

The trawl survey on the R/V MRTK–316 in the waters of the Okhotsk Sea was carried out in the Kamchatka-Kuril subzone from 21 to 30 July 2016 (Figure 1). There were 53 control trawl hauls provided in the cruise in July.

From the technical side of fishing, the trawl system functioned sustainably in the surface water horizon. The speed that the trawl was towed varied between 3.1-4.4 knots (3.7 knots in average), and the time of a trawl haul was 15 minutes.

The midwater rope trawl used for the survey was 33.6/56 m long (model 529) with the upper panel equipped by a hydrodynamic system with the square 3.12 m^2 and the lower panel – with the sinker-chain of 12.3 kg. The ends of the wings had 15 kg sinking loads, each being a bunch of chains. The trawl was equipped by vertical oval cylinder boards (2.3 m^2).

Dimensions of the juvenile Pacific salmon feeding habitats were estimated from analysis of sea surface temperature graphic distribution in the program *Ocean Data View*.

After trawl operation the catches of all fish species (including juvenile Pacific salmon) were calculated and weighted, and samples up to 50 fishes of mass species each were selected and fixed in 10% formalin or frozen for subsequent laboratory analyses.

RESULTS

Positive temperature anomalies in the Okhotsk Sea were observed in recent five years, in particular on the west coast of Kamchatka. In 2016, positive deviations from the average annual level for many years since 1981 were observed. Near the shore, the temperature was averagely 2-4° C higher (Figure 2). It is important, that the temperature increased shoreward in the contrast to situation in 2012, 2013 or 2014, when the temperature near the shore was lower than the temperature in the open sea.

Total 14 fish species (plus jellyfishes) were identified in the coastal waters on West Kamchatka in July 2016 for the period of survey. Juvenile Pacific salmon (*Oncorchynchus* juv.), juvenile pollock (*Theragra chalcogramma* juv.), sand lance (*Ammodytes hexapterus*) and sandfish (*Trichodon trichodon*) contributed 87% to the total number, but the major part of the catch weight (92%) was contributed by saffron cod (*Eleginus gracilis*), mature pink salmon (*Oncorhynchus gorbuscha* mat.), sandfish, and juvenile Pacific salmon next (Figure 3). It should be noted that juvenile Bering wolffish (*Anarhichas orientalis*) and sculpins (*Cottidae gen.* sp.), observed in the catches first time ever, were frequent (68%) there in July 2016 (Figure 4). Juvenile Pacific salmon contributed 27% to the number and 10% to the biomass of the catches. The total sample in July consisted of 105 mature pink salmon individuals, which made up 26% in the total biomass of the catches.

Juvenile Pacific salmon

The catch distribution of juvenile Pacific salmon in the coastal waters of West Kamchatka in July 2016 is presented on Figure 5.

Pink salmon caught during the survey represented the odd-years broodline. However, we captured 89 fishes that is surprisingly high in contrast to the whole period of observations since 2004, when the pink salmon occurred sporadically. All juvenile pink salmon were caught off the 12-mile zone. The body length (AC) of under-yearlings varied from 6.7 to 10.2 cm, the body mass being 2.1-8.9 g. Comparing the maps of horizontal temperature distribution on the sea surface and juvenile distribution during the survey period demonstrates that the catches occurred within the area limited by 12° C.

The catch of juvenile chum salmon was also one of the biggest for the whole research period – 163 individuals. The body length was 4.9-11.6 cm (8.1 cm in average) and the weight – from 1 to 16 g (5.6 g in average).

Juvenile coho and Chinook salmon were evenly distributed throughout the area up to 40 miles from the shore, without any more or less visible aggregations. The body length of coho salmon was 10.7-23.2 cm (15.1 cm in average), and the weight was 13.1-182.4 g (47.8 g in average). The body length of juvenile Chinook salmon varied from 10 to 16.5 cm (13.1 cm in average), and the weight – from 10.3 to 58 g (30.4 g in average).

The catches of juvenile masu salmon were minor (1-4 fish per haul) and distributed evenly in the area examined. The average body length of juvenile fish was 15.6 cm (52 g).

Majority of the catches of juvenile sockeye salmon in July occurred in the area between 53°00’ and 54°00’ N. The body length of the fish varied as 6-16 cm (12 cm in average) and 2-45 g (21 g in average). We think that the major part of sockeye salmon populations was covered by survey. However, it is possible that some fish could escape from the survey area between 52°30’ and 52°00’ N eastward from 156°00’ E. Data on the Ozernaya River sockeye salmon stock, obtained during coastal trawl surveys, play important role in forecasting. The Figure 6 demonstrates that the estimated numbers of juvenile sockeye salmon migrating to the Okhotsk Sea from the Kurilskoye Lake and during the near-coastal survey correlate and demonstrate in-phase fluctuations.

The catches of pink and sockeye salmon were maximal at the point № 27, and one of high chum salmon catches occurred there too (Figure 1). Juvenile chum salmon were observed at

all trawl stations, where juvenile pink salmon were in the catches. The cores of the aggregations of juvenile sockeye and chum salmon were isolated respectively northward and southward from 53°00’ N.

Other species of fish

The distribution of the catches of other species of fish in the coastal waters of West Kamchatka in July of 2016 present on Figure 7. It was first time for the period of surveys when there was many juvenile wolffish (46 ind.) and sculpins (113 ind.) in the catches. The number and the frequency of sandfish, juvenile walleye pollock and sand lance in the catches was similar to the average annual data for many years.

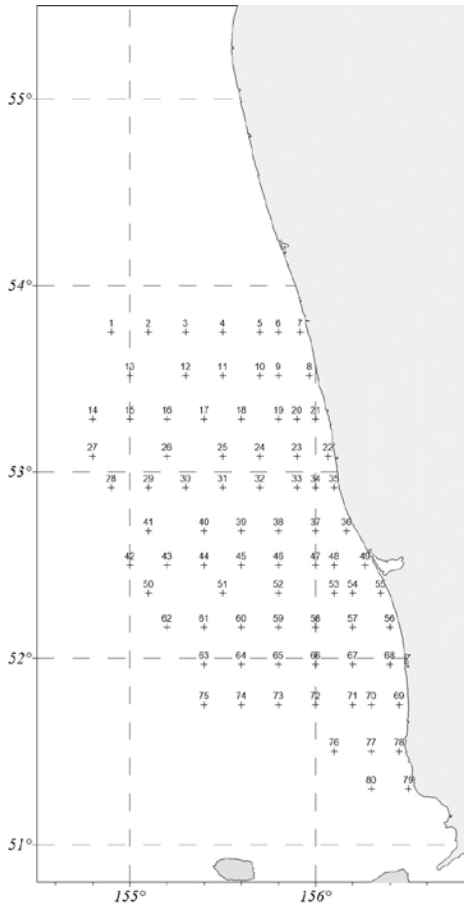


Fig. 1. The survey area on post-catadromous juvenile salmon in Russian EEZ and coastal waters (territorial waters) of the Okhotsk Sea in summer of 2016

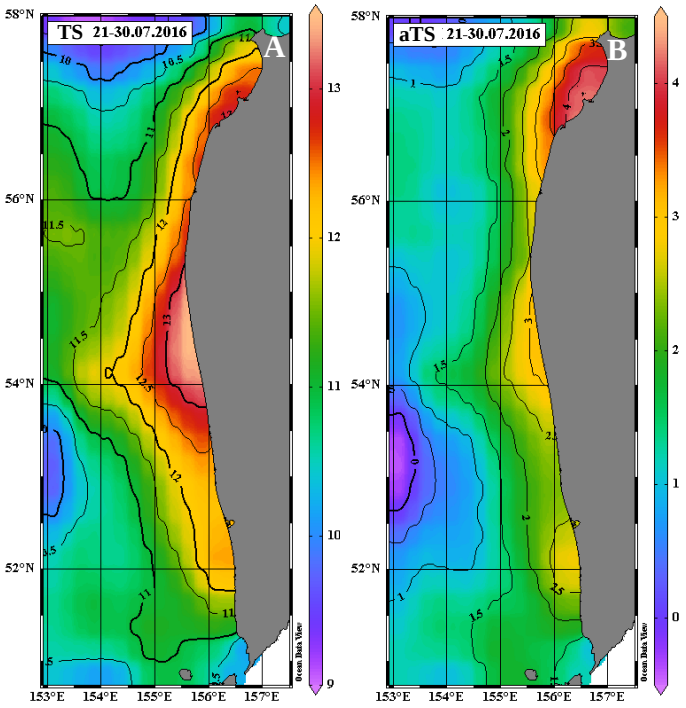
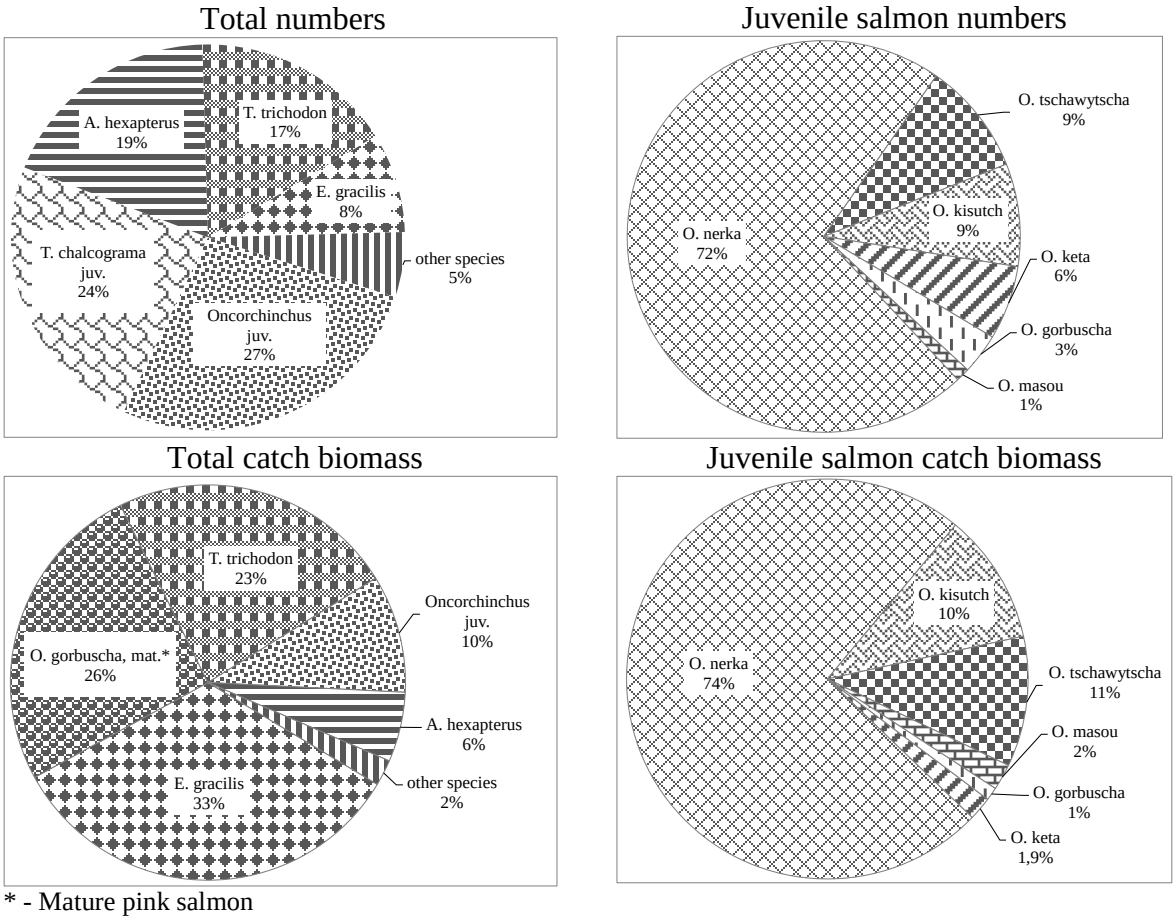


Fig. 2. The horizontal distribution of the surface water temperature (A) and temperature anomalies (B) comparing the average annual dynamics (1981-2016) in July



* - Mature pink salmon

Fig. 3. The ratio of main fish species in the catches by the R/V MRTK-316 in July 2016

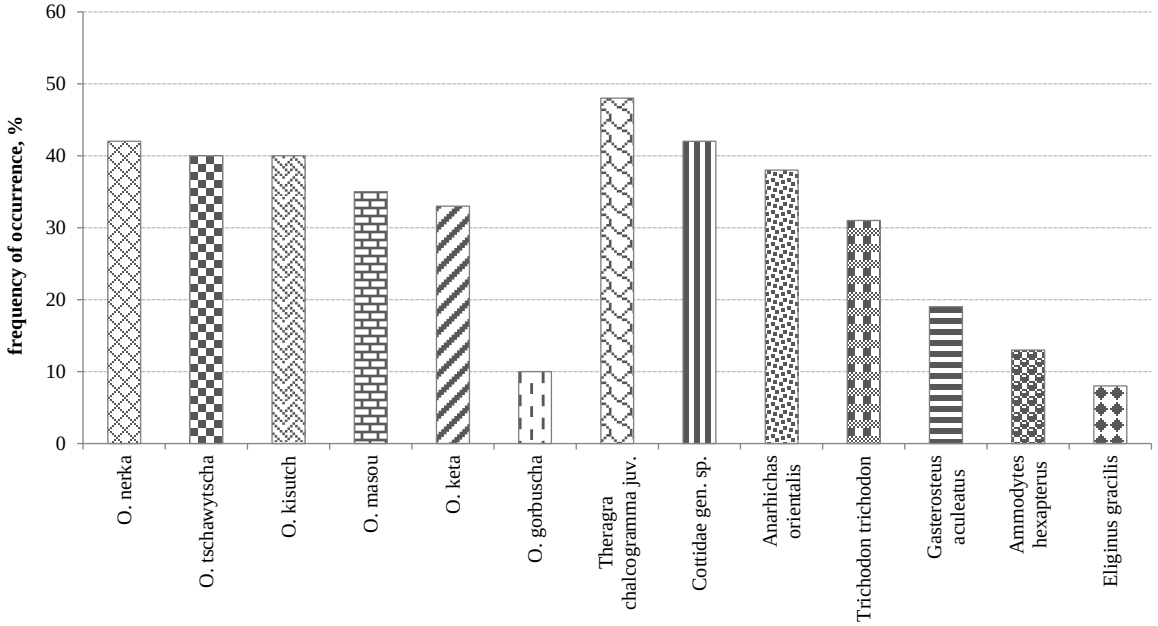


Fig. 4. The frequency of occurrence of main fish species in the catches by the R/V MRTK-316 in July 2016

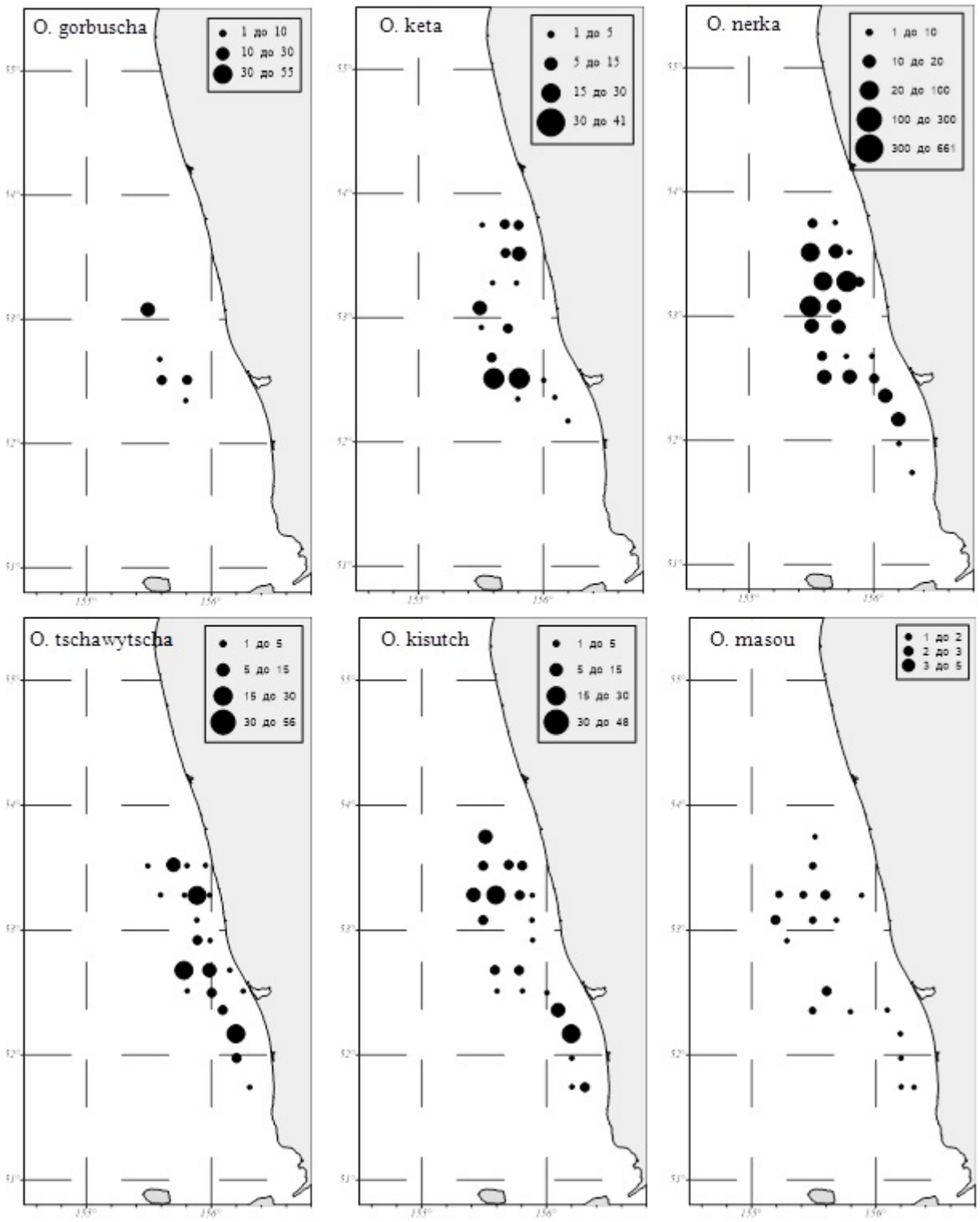


Fig. 5. The catch distribution of juvenile Pacific salmon (fish per trawl haul) in the coastal waters of the Western Kamchatka in July 2016

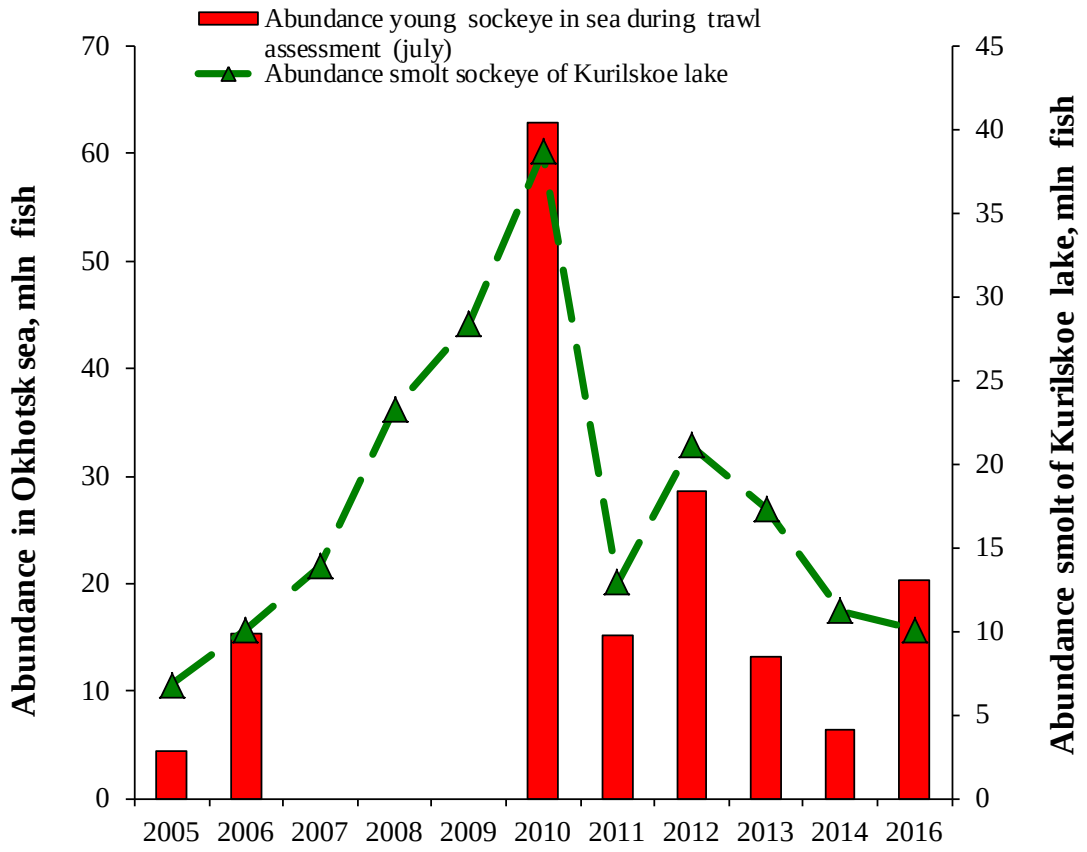


Fig. 6. The correlation between the juvenile sockeye salmon abundance estimated in the coastal waters of the Western Kamchatka and the abundance of smolts from the Kurilskoye Lake (Ozernaya River)

Fig. 7. The distribution of the catches of other species of fish (ind./trawl) in the coastal waters of West Kamchatka in July of 2016