Feeding interactions of juvenile Pacific salmon and other fish species in the coastal epipelagic zone of Kamchatka

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Euphausiids in the catch R/V MRTK-316 (July, 2005)

Fig. 1. Schematic distribution of the trawl stations, used by R/V MRTK-316 in the coastal waters of West and East Kamchatka in July and August for 2005-2007 and in 2010.

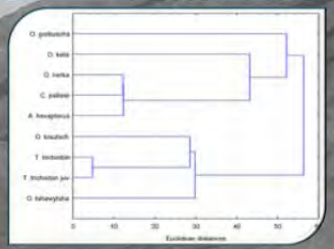

Fig. 2. Food similarity among juvenile salmon and the other mass fish species on West Kamchatka in June-July for 2005-2007 and in 2010 (averaged data).

Fig. 3. The composition of the food of piscivorous fish species in the coastal waters of West Kamchatka in June-July for 2005-2007 and in 2010 (averaged data).

MATERIAL AND METHODS

The data to provide the research were collected during trawl surveys, carried out by specialists from KamchatNIRO in June and July in 2005-2011 in the coastal waters of Southwest Kamchatka and in August in 2007 and 2010 in Kamchatsky Gulf (East Kamchatka). (Fig. 1).

RESULTS AND DISCUSSION

Pacific salmon and up to 25 other fish species were recorded in the summer trawl catches for the period 2004-2011 in the coastal waters on West Kamchatka as permanent inhabitants of pelagic zone and members of coastal biocenotic communities. Pacific sand lance, capelin and sandfish, yellowfin sole, starry flounder and juvenile greenlings were met all over the area surveyed. High abundance is typical for Pacific sand lance, capelin and sandfish. The most frequent species met in the waters of Kamchatsky Gulf was Pacific herring.

As known, there are two principal mechanisms, allowing to use forage base within the area of feeding maximally and to minimize competition between species: spatial divergence and divergence in spectrum of forage organisms (in view of their size and species composition). Our analysis has revealed that since very early marine period of Pacific salmon both mechanisms were operating.

The maximum similarity of food in the waters of West Kamchatka was observed in the group of predators, including juvenile coho, Chinook and masu salmon and adult Pacific sandfish (Fig. 2). Their ration, nevertheless, was different (Fig 3, 4). Moreover, as for coho salmon, it used to migrate during summer and autumn to external shelf zone to feed on juvenile walleye Pollock aggregations - the most preferable forage for coho salmon (the preference is general for coho salmon from the west and east coasts of Kamchatka). Chinook salmon and Pacific sandfish used to stay on the internal part of shelf (spatial divergence).

In the most abundant group of plankton eating fish species included juvenile chum, pink and sockeye salmon, Pacific sandlance and capelin, juvenile Pacific sandfish and walleye Pollock; the similarity of food was low. The ration generally consisted of the organisms from the neritic complex. Pink and chum salmon, comparatively minor in their size, were feeding on larval fish and small-sized fraction of zooplankton. The forage of the major consumer - large sockeye salmon – consisted of big crustaceans and juvenile fish. The spectra were different in the size of consumed organisms. By the end of summer exploiting the trophic net in the biotope gets less intense, because pink and chum salmon leave the coastal waters (spatial divergence).

One of specific traits of juvenile salmon feeding on the shelf of West Kamchatka is the fact that even such typical plankton eaters as pink, chum and sockeye salmon often have in their ration (>50 % of the food weight) juvenile and larval fish (Fig. 5), what can be explained by mass emergence of fish of a number of species of the neritic complex and their early juvenile feeding in mentioned period.

Observation on the east coast of Kamchatka also has demonstrated two groups mentioned: predators and plankton eaters (Fig. 6).

In Kamchatsky Gulf, where the shelf is narrow, the ration of salmon food included not only neritic organisms, but a number of plankton organisms brought from the ocean. In this connection the ration of all fish, including typical predators, can consist mostly of zooplankton (Fig.7).

An important part of stomach content of plankton eating salmon species was provided by *E. bungii* (Fig. 8). That obviously relates to the character of the shelf – it is narrow, - and earlier exploring the waters of the external part of the shelf and the depth slope, sometime beginning in the northern part of the gulf in 5-10 miles from the shore line. All that indicate of less stable conditions for the feeding in the waters of East Kamchatka, comparing to conditions in the Okhotsk Sea.

An important specific trait of the gulf is the run of Pacific herring into the coastal waters of the northwest part in the last half of August. That is probably one of the most important drivers of the early emigration of juvenile salmon from Kamchatsky Gulf. The run is highly important for juvenile sockeye, chum and pink salmon, because their food is very similar to the food of herring, what makes competition for the food growing.

CONCLUSIONS

In this way we can say about regional specifics of the early marine feeding by juvenile salmon: the difference is in duration. In the waters of West Kamchatka the species as sockeye, Chinook and coho salmon stay in the coastal waters until autumn (sockeye and Chinook salmon up to 5-7 months, coho salmon - about 2 months). The duration of the feeding in Kamchatsky Gulf is 2,5-3 months. Juvenile salmon leave the rivers in June and July (the ice period in long) and the gulf – in late August.

The waters on the west coast of Kamchatka are highly productive, and the shelf is extensively developed there. This nursery and rearing area provides mass emergence of and early feeding for various fish species in summer what explains presence of the fish component in juvenile ration of all Pacific salmon species. Long period of feeding makes using the forage resources on this area more effective.

The shelf in Kamchatsky Gulf is not that wide and productive. Moreover, in the last half of August the gulf receives a huge number of Pacific herring, feeding together with juvenile Pacific salmon on a very similar spectrum of food. In this connection juvenile salmon have to undertake earlier exploration of the oceanic forage resources and leave the gulf for effective oceanic ranching very soon.

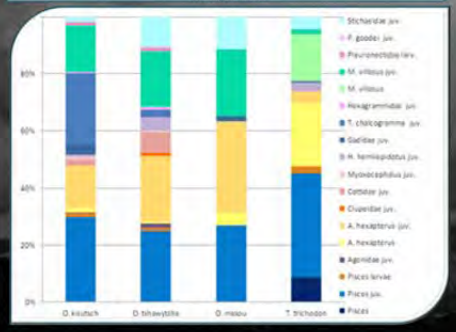

Fig. 4. The difference in the composition of the nektonic part of the food of piscivorous fish species in the coastal waters of West Kamchatka in June-July for 2005-2007 and in 2010 (averaged data).

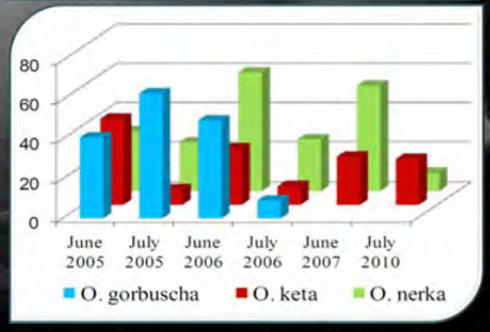

Fig. 5. The part of the fish component in the food of juvenile pink, chum and sockeye salmon in the coastal waters of West Kamchatka in June-July for 2005-2007 and in 2010 (% in the total food weight)

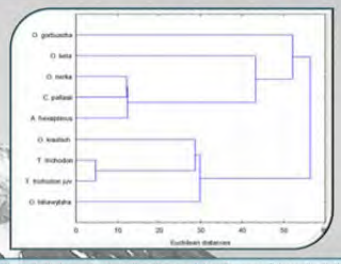

Fig. 6. Food similarity among juvenile salmon and the other mass fish species in the waters of Kamchatsky Gulf in August of 2007 and 2010 (averaged data).

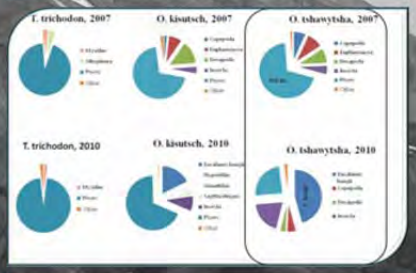

Fig. 7. The difference in the composition of the food of Pacific sandfish, juvenile coho and Chinook salmon in the waters of Kamchatsky Gulf in August of 2007 and 2010 (% in the total food weight).

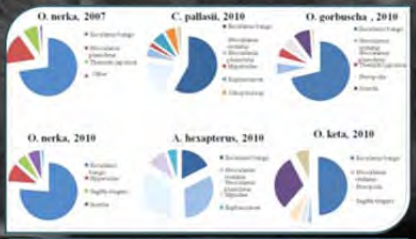

Fig. 8. The composition of the food zooplankton eating fish species in the waters of Kamchatsky Gulf in August of 2007 and 2010 (% in the total food weight).