Primorye Pink Salmon Growth at High and Low Abundance

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Pink salmon from the northern Primorye coast stock are characterized by having the largest size of all Asian stocks and by certain peculiarities in their size structure:

- Odd-year pink salmon from high-abundance generations are generally larger than even-year fish. Over the whole period of observations (1940-1996) the average length of odd-year pink salmon was 50.6 cm and even-year pink salmon were 47.8 cm.
- There is a negative correlation between the average size and stock abundance in most pink salmon populations (Bigler et al. 1996), except for the pink salmon from Primorye. Correlation coefficients between pink size and catches in Primorye were insignificant $r = 0.17$ ($P>0.05$).

A scale structure analysis showed that beginning from 1970s there were essential changes in the growth rate of pink salmon. The number of circuli within the first annual zone has increased and the number of circuli within the second year of life zone has decreased in fish caught during 1971-1990. The analysis of scale radii showed similar results (Fig. 1). The size of the first annual zone increased primarily due to an increase in the winter zone, which is indicative of a prolonged period of growth retardation in winter. The second-year sea growth was more highly correlated with fork length than the first year of growth. Correlation coefficients between the number of circuli in the second-year zone and fish size equaled 0.56 ($P<0.05$) and 0.42 ($P<0.05$) for even- and odd-year pink salmon, respectively. Consequently, average pink salmon size reduction observed in the 1970-1990s was due to the reduction of growth rate mainly during second summer periods at sea.

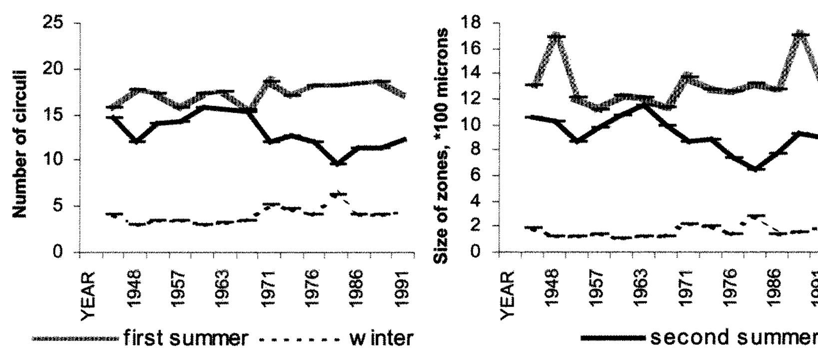

Fig. 1. Interannual variability of Primorye pink salmon scale growth.

Similar decreases in the average body size were observed for all three stocks of pink salmon (Amur, western Sakhalin, Primorye), which forage together in the Japan Sea (Fig. 2). I speculate that starting from the beginning of 1970s feeding conditions in the Japan Sea were less favorable for pink salmon, which resulted in peculiarities of growth of pink salmon from all three regional stocks.

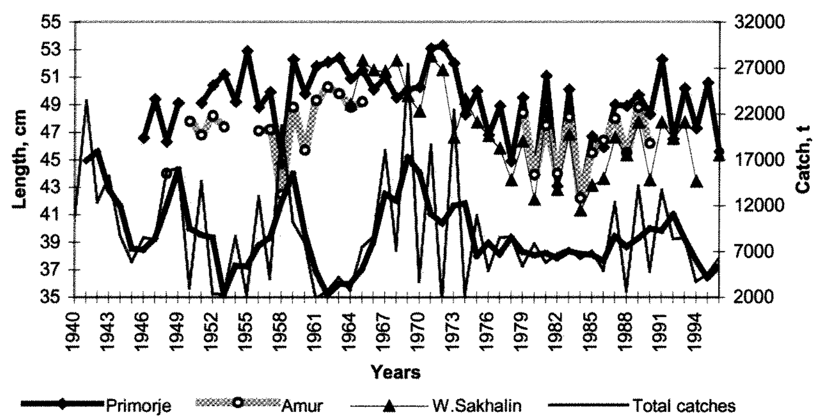

Fig. 2. Dynamics of total catches of Japan Sea pink salmon and average fish size for the main stocks.

Some peculiarities in the dynamics of Japan Sea pink salmon stock abundance were observed starting from the 1970s. Regular cyclic changes in abundance dynamics were characteristic for the Japan Sea pink salmon stocks. There were 10-11 year cycles associated with 11-year solar cycles, and long-term (40-60 year) fluctuations of abundance determined by changes in forms of atmospheric circulation (Birman 1985, Gavrilov and Pushkareva 1996). There was a rise in solar activity in 1979. At this time there also was a change in atmospheric circulation from the meridional into the zonal circulation form, although it was not accompanied by an increase in pink salmon abundance in the Japan Sea (Fig. 2).

There was a rapid rise in abundance of the Japanese sardine in the early 1970s. This may have caused stress in the food relationships of fish in the Japan Sea (Kun 1990, Belayev and Zhigalin 1996). It may be possible that during increased sardine abundance in the 1970-1980s there was increased pressure on the planktonic communities, which led to changes in their structure. This could have served as one of the reasons for increase of feeding competition between different pink salmon stocks. In this regard, the role of the Amur pink salmon with respect to the other Japan Sea stocks is of particular interest. There is a significant decrease in average size of pink salmon in Primorye, coupled with an increase in the percentage of Amur stock in the total pink salmon catch in the Japan Sea (Fig. 3). The correlation between Primorye pink salmon body size and the catches of Amur pink salmon (r = - 0.55) was stronger than that between Primorye pink salmon size and its stock abundance. During 1970-1980s the Amur pink salmon stock dominated in the Japan Sea in odd and even years. It was then that the size of pink salmon from the Japan Sea stocks decreased. This period was characterized by the strongest negative correlation between Primorye pink salmon length and catches in the Amur river (r =-0.92, P=0.00).

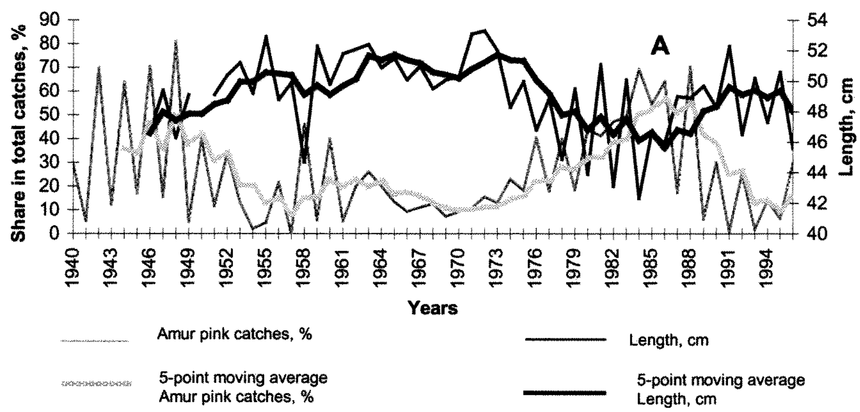

Fig. 3. Share of Amur pink salmon stock in total catches and average Primorye pink salmon length.

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