

Long-Term Changes in Climate, Zooplankton Biomass in the Western North Pacific, and Abundance and Size of East Sakhalin Pink Salmon

Kazuya Nagasawa

National Research Institute of Far Seas Fisheries, Fisheries Agency of Japan,
5-7-1 Orido, Shimizu, Shizuoka 424-8633, Japan



Key Words: climate change, pink salmon, zooplankton, regime shift, Oyashio

East Sakhalin pink salmon (*Oncorhynchus gorbusha*) are one of the biggest stocks in Asia. This species is distributed as juveniles in the Okhotsk Sea from summer to autumn and occurs as immature fish in the western North Pacific Ocean in winter and spring. Based on data collected from the late 1950s to the early 1990s, this paper examines what factors contributed to changes in abundance of the stock and also analyzes annual changes in body weight related to stock abundance.

During the period from the mid-1970s to the late-1980s, the Aleutian Low Pressure Index (ALPI) was high (Beamish et al. 1997), but sea surface temperature (SST) and macrozooplankton biomass in the Oyashio region remained low (Odate 1984). As both copepod abundance and ALPI showed similar year-to-year fluctuations in the Gulf of Alaska (Beamish and Bouillon 1993), the observed relationship of ALPI to macrozooplankton biomass in the Oyashio region was opposite to that in the Gulf of Alaska.

The annual catch of pink salmon along the east coast of Sakhalin gradually increased from the 1960s to 1997. However, it declined from 1978 to 1984 despite the decreasing catch by the Japanese high-seas salmon fishery. The annual catch increased again in 1985 and remained at a high level in the late 1980s and 1990s. The catch trend was similar to long-term changes in macrozooplankton biomass in the Oyashio region, suggesting that the east Sakhalin pink salmon production is affected by macrozooplankton production in this region.

In the intense Aleutian Low pressure period from the mid-1970s to the late 1980s, SST was high in the Gulf of Alaska while it was low in the Oyashio region. This may have been caused by differences in wintertime wind direction and stress: the northwest cold wind from Siberia and the southwest warm wind from the subtropical area predominated in these regions, respectively (cf. Yasuda and Hanawa 1997).

From the late 1950s to the late 1980s, there was a clear negative relationship between the body weight and abundance of pink salmon from east Sakhalin. Recently, however, the body weight of pink salmon from this region increased even in the years of high stock levels. Thus, the past body weight and abundance relationship of pink salmon has not been applied to the current year classes, and it is likely that the carrying capacity of the western North Pacific Ocean for east Sakhalin pink salmon has improved.

Because the impact of the Aleutian Low Pressure differs between regions in North America and Asia, research on climate change and ocean production is needed on both regional and whole North-Pacific scales.

REFERENCES

- Beamish, R.J., and D. Bouillon. 1993. Pacific salmon production trends in relation to climate. *Can. J. Fish. Aquat. Sci.* 50:1002-1016.
- Beamish, R.J., G.A. McFarlane, D. Noakes, M. Folkes, V.V. Ivanov, and V. Kurashov. 1997. A comparison of the Aleutian Low Pressure Index and the Atmospheric Circulation Index as indices of Pacific salmon abundance trends. (NPAFC Doc. 289.) 25 p. Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C., Canada.
- Odate, K. 1984. Zooplankton biomass and its long-term variation in the western North Pacific Ocean, Tohoku Sea area. *Japan. Bull. Tohoku Nat. Fish. Res. Inst.* 56:115-173. (In Japanese with English abstract.)
- Yasuda, T., and K. Hanawa. 1997. Decadal changes in the mode waters in the midlatitude North Pacific. *J. Phys. Oceanogr.* 27:858-870.