Another potential factor is the difference in biological productivity between the temperate and subarctic waters in the Sea of Japan and the Sea of Okhotsk. The Tsushima Current is derived from the warm Kuroshio Current and its productivity is considered to be lower than subarctic waters inhabited by the herring. Carrying capacity of the subarctic waters in the Sea of Japan and the Sea of Okhotsk may be sufficiently greater than the total food requirement of the herring population and competition for food may not be realized in these waters.

References

Hanamura, N. 1963. A study on the method of prediction of the Hokkaido spring herring resources. Bull Hokkaido Reg. Fish. Res. Lab. 26: 1-66.

Kitahama, H. 1955. Data on the total length compositions of Hokkaido spring herring. Hokkaido Pref. Fish. Exp. Stn., Yoichi, pp 46.

Morita, S. 1985. History of the herring fishery and review of artificial propagation techniques for herring in Japan. Can. J. Fish. Aquat. Sci. 42 (Suppl 1): 222-229.

Watanabe, Y., Zenitani, H., and Kimura, R. 1995. Population decline of the Japanese sardine *Sardinops melanostictus* owing to recruitment failures. Can. J. Fish. Aquat. Sci. 52: 1609-1616.

Long-term variability in length of walleye pollock in the western Bering Sea and east Kamchatka

Pavel A. Balykin and Alexander V. Buslov
Kamchatka Fisheries and Oceanography Research Institute (KamchatNIRO), 18 Naberezhnaya Street, Petropavlovsk-Kamchatsky, Russia 683600. E-mail: kamniro@mail.kamchatka.ru

The mean body length of walleye pollock yearlings from the western Bering Sea increases when the area of the ice cover is reduced. The average length of 2 to 6-year-old walleye pollock varies in relation to the dynamics of total stock biomass and environment. The biomass of walleye pollock is lower when the area of ice cover in the Bering Sea exceeds 700,000 km^2. When the area of ice cover is reduced, the total stock abundance of walleye pollock increases and the average length of 2 to 6-year-old fish decreases. A reliable relationship has been observed between condition factor and the growth of fish, indicating that the growth of walleye pollock is dependent on the forage base. Currently the biomass of walleye pollock in the western Bering Sea is very poor, therefore the growth in length is not dependent on the environment and total stock biomass.

The average length of 2 to 6-year-old walleye pollock in the Pacific Ocean waters adjacent to Kamchatka has changed in relation to the biomass of total stock and the abundance of generations. When the biomass has been high, the growth has been slow and *vice versa*. The environmental factors do not affect the growth of walleye pollock to the east of Kamchatka.

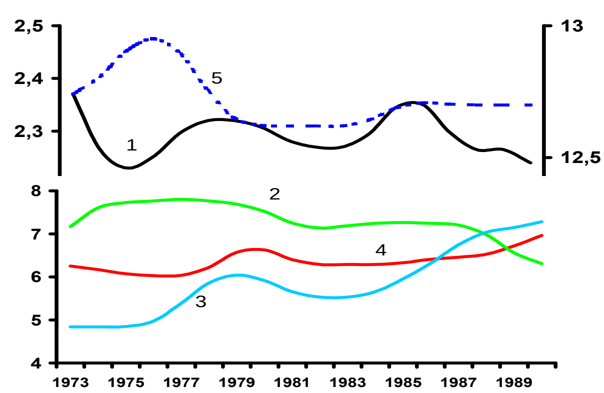

Fig. 56 Variation of natural logarithms of average length of walleye pollock yearlings (1), walleye pollock (2), Pacific herring (3), mesoplankton biomass (4), and area of ice cover (5) in the western Bering Sea.

Figure 56 shows changes in the length of walleye pollock yearlings, the biomass of mesoplankton and ice cover in the Bering Sea for the period from 1973-1990. The reduction of the ice cover area in the Bering Sea leads to the growth of total stock and an increase in average length of fish (Fig. 57).

Comparison of 2 to 6-year-old walleye pollock from the western Bering Sea and eastern Kamchatka waters indicates that variability in

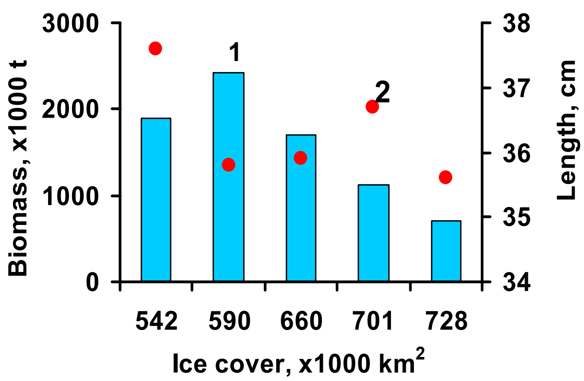

Fig. 57 Relationship between total biomass of walleye pollock (bars) and length of 4-year-old fish (dots) and ice conditions.

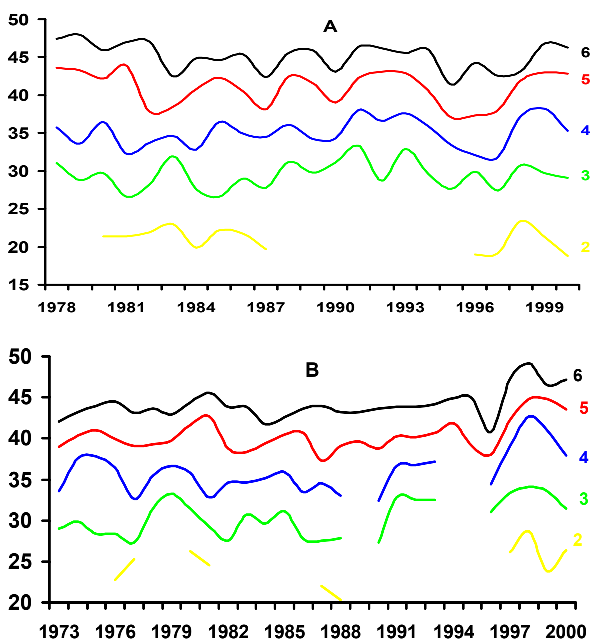

Fig. 58 Long-term dynamics of average length of 2 to 6-year-old walleye pollock: (A) western Bering Sea and (B) eastern Kamchatka.

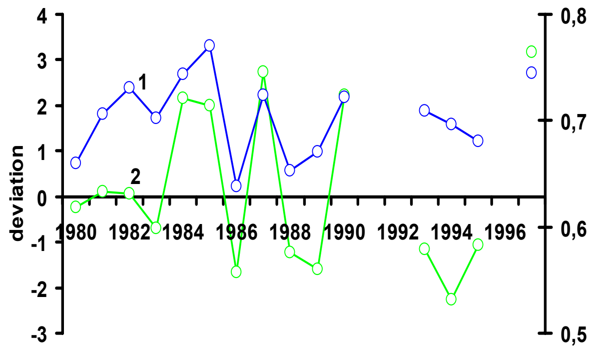

Fig. 59 Long-term dynamics of (1) average condition factor in 3 to 6-year-old walleye pollock and (2) averaged deviations in length from the long-term mean of these age groups.

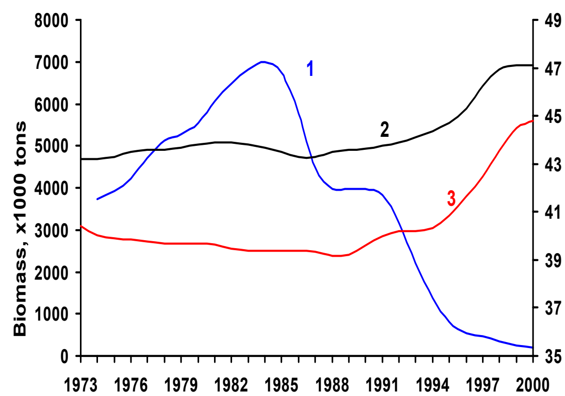

Fig. 60 Long-term dynamics of total biomass of east Kamchatka walleye pollock (1), average length of 6-year-old fish (2) and average length of 5-year-old fish (3).

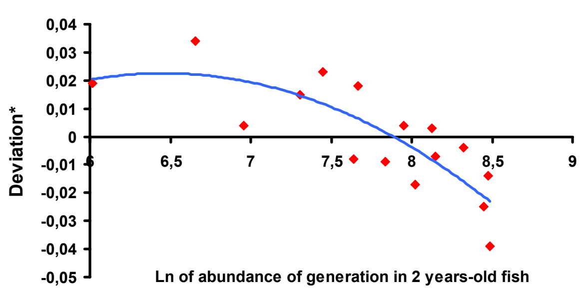

Fig. 61 Relationship between generation growth rate and abundance in the periods of high and intermediate stock abundance of the east Kamchatka walleye pollock, shown as the deviation from the average specific growth rate.

body length among nearby age groups is similar (Fig. 58). For the period 1980-1997, the condition factor is related to linear growth of fish (Fig. 59). For the east Kamchatka stock, changes in growth of 5-6-year-old walleye pollock are inversely related to the total biomass of species (Fig. 60). For the periods of high and intermediate stocks the growth rate of the east Kamchatka walleye pollock depends inversely on cohort abundance (Fig. 61).

Effect of population abundance increase on herring distribution in the western Bering Sea

Alexander A. Bonk
Kamchatka Fisheries and Oceanography Research Institute (KamchatNIRO), 18 Naberezhnaya Street, Petropavlovsk-Kamchatsky, Russia. 683600. E-mail: kamniro@mail.kamchatka.ru

The last two decades have been important for the development of the Korf-Karaginsky Pacific herring population. After a long period of low abundance in the 1980s, the population has been growing dynamically since 1990, reaching a maximum in 1997, and then started to decline again (Fig. 62).

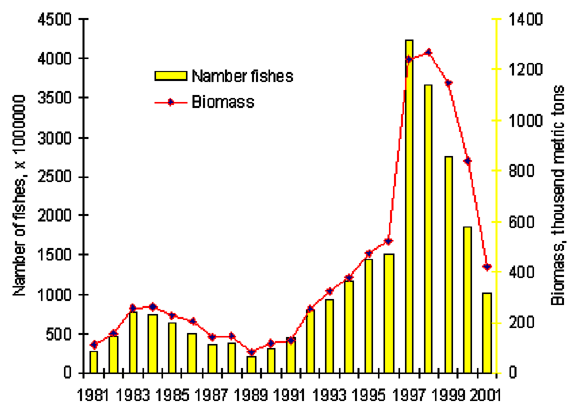

Fig. 62 The stock abundance dynamics of the Korf-Karaginsky herring in the western Bering Sea.

The annual distribution and migratory behavior of the Pacific herring during are determined by hydrology and the stock abundance fluctuations. The time period and the distance of the Pacific herring feeding migration are now significantly different from those when stock abundance was low.

During periods of low abundance, the feeding migration of the mature part of the stock occurred in Anastasiya and Dezhneva bays (Fig. 63A). Herring returned to Olytorsky Bay for winter before October 10th. This period was characterized by relatively stable conditions providing sufficient feeding for the Korf-Karaginsky herring. From the 1980s until the mid-1990s positive changes were observed in the Bering Sea. These included: 1) warming of the upper 200 m which resulted in an increase of the forage zooplankton abundance, and 2) decrease in the stock abundance of walleye pollock, the nearest competitor of herring for food. Thus during the 1980s and early 1990s, when the herring abundance was low, the feeding conditions for the Pacific herring became favorable. In 1993, conditions were optimal for the production of an abundant generation (Fig. 64). In 1997, the

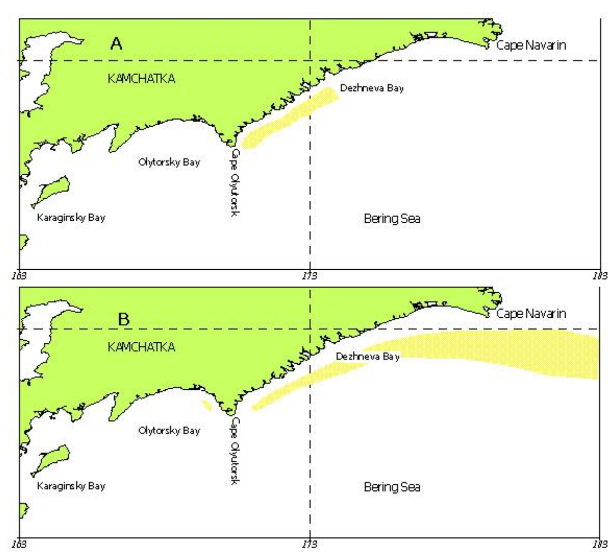

Fig. 63 The Korf-Kagarinsky herring distribution during the feeding migration: (A) low stock abundance and (B) high abundance.