Thermohaline Structures in the Bering Sea Basin in Summer and Autumn

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The Bering Sea is one of the marginal seas of the North Pacific and thought to be a main habitat of chum salmon produced in Japan (Urawa 2000). The oceanographic structures in the Bering Sea, therefore, would influence salmoid migrations and distributions. The flow structures and magnitudes in the basin also probably influence on salmon distributions and migrations (Thomson et al. 1992). The Bering Sea has a cyclonic circulation pattern (Favorite et al. 1976). Roden (1995) reported that the Bering Sea basin in summer is composed of a thin mixed layer, a temperature minimum layer, and a temperature maximum layer. Miura et al. (2002) showed that dichothermal water is formed in winter in the mixed layer in the Bering Sea, because the properties of the dichothermal water in the warming season are almost the same as those in the winter mixed layer. Most of these studies, however, have been derived from observations conducted along one transect line or a composite data. There have been few comprehensive hydrographical observations conducted over large areas, simultaneously in the Western Aleutian Basin. The purpose of this report is to estimate the thermohaline and flow structures in the Aleutian Basin, which influence salmon migrations and distributions.

From 2002 to 2004, hydrographic observations were conducted in the Aleutian Basin and around the Aleutian Islands on board the R/V *Kaiyo maru*. These observations were conducted in late June to mid July (summer), and late August to mid September (autumn), respectively. Vertical profiles of temperature and salinity were obtained with a CTD at each observational point. Surface temperature and salinity were measured by EPCS (Electronic Plankton Counting and Sizing System) in every one minute during the cruise.

In generally, surface temperature in the eastern part was higher than in the western in all observational periods. In the summer of 2002, surface temperature was lower in all areas than in the other years. The higher temperature in the eastern part would be caused by the Pacific Water inflows through the eastern Aleutian Passes. Around the Aleutian Passes, water temperature was significantly lower than in the Bering Sea and Pacific water. This is probably caused by the vertical mixing in the passes. Unlike the temperature distribution, in the salinity in the east was generally lower than in the western basin. In particularly, the eastern continental shelf was characterized by salinity which was less than 32.0 psu. In summer of 2002, however, salinity was about 0.5 higher in the eastern shelf than the other years. A pronounced salinity front was formed along a continental shelf edge and the front was almost stationary during the course of the observational periods. While the annual salinity variation is smaller in the western basin, there was a larger variability in the coastal region. The internal variability of salinity distribution may be associated with an increased ice cover during previous winter.

In the basin, a thin mixed layer about 20–30 m thick was present in summer and autumn. In the strait areas, however, it increased to the equivalent of the deep layer. Below the mixed layer, a temperature minimum was evident around 100–150 m depth in the western basin and not obvious in the eastern basin. The temperature minimum was increasingly lower in 2002. The minimum temperature, however, increased and the density at this layer was reduced in the last two years. This minimum structure formed as a result of winter cooling, probably because the previous two winters were moderate and convection was week.

Dynamic topographies were referred to 1,000 db were calculated to clarify a circulation pattern in the basin (Fig. 1). In the center of the Aleutian Basin, lower values were recognized, compared with the coastal regions and the Aleutian Passes. General circulations over the Aleutian Basin were characterized by a cyclonic loop with some meanders. There were, however, always some eddy-like features in the basin, and the flow patterns were variable with years.

Figure 2a is a result of geostrophic velocity referred to 1,500 db at each observational transect in autumn of 2003. South of the Aleutian Islands, baroclinic structures of the Alaskan stream were well developed to deep layers. In contrast, the velocities were smaller in the Aleutian Basin except for eddy-like structures in the eastern side.
To estimate the Aleutian North slope current accurately, expendable CTD observations were conducted at every 10 nautical miles in the rectangular region shown in Fig. 2a. As a result, very finite and complicated flow structures were evident, faster velocities (> 30 cm/s) were observed and those widths were less than about 20 km just north of the Aleutian Islands (Fig. 2b).

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Fig. 1. Dynamic topography at the surface referred to 1,000db around the Aleutian Basin during the course of observational periods

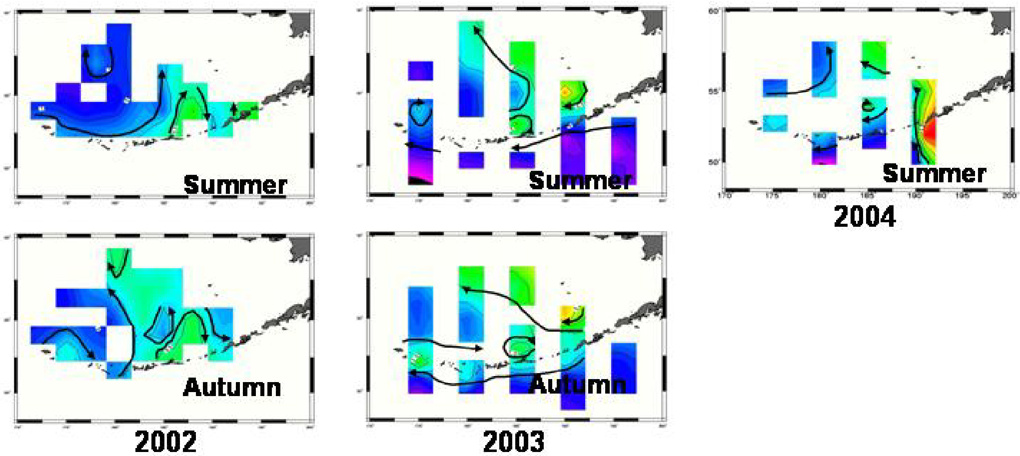
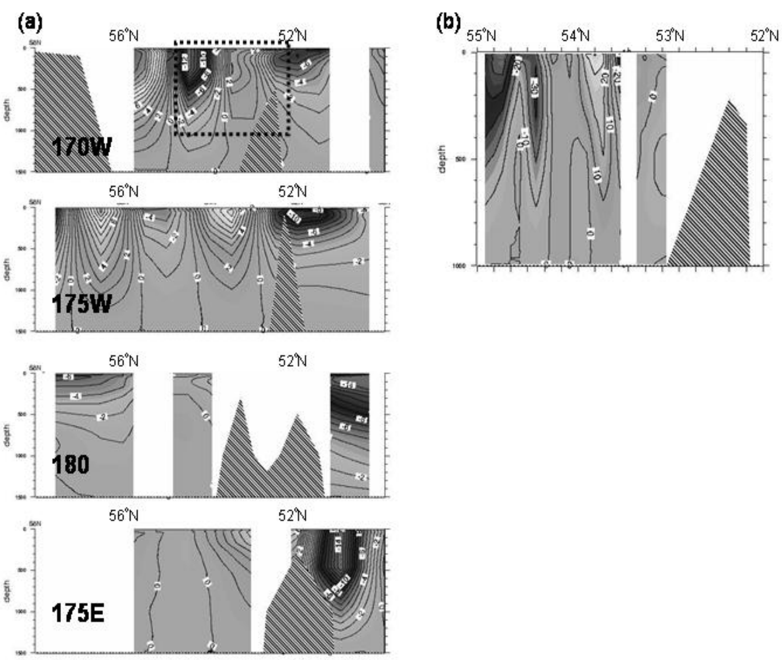


Fig. 2. Vertical cross-sections of geostrophic velocity (cm/s) referred to 1500db in autumn of 2003(a), and a vertical cross-section of geostrophic velocities (cm/s) referred to 1000 db along 170˚W near the eastern Aleutian passes (b), which is associated with a dot's region of Fig.2a.



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