

Status of Hatchery-Origin Chum Salmon in the Bering Sea Deduced From Otolith Mark Recoveries

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Otolith marking is an effective tool for determining the hatchery origin of individual salmon in both high seas and coastal waters. Otolith-marked salmon are annually released from hatcheries in Canada, Japan, Korea, Russia, and the United States under the coordination of the North Pacific Anadromous Fish Commission (NPAFC). The total number of otolith-marked chum salmon released in 2003-2009 was approximately 4.8 billion juveniles (23% of the total hatchery releases in North Pacific Rim countries).

Otolith samples were collected from chum salmon caught in the central North Pacific and Bering Sea by researchers aboard Japanese research vessels (*Wakatake maru* and *Hokko maru*) in the summer of 2006-2010. The samples (n=13,279) were examined to detect otolith marks, and hatchery origins were determined by referring to the NPAFC database of otolith mark releases, which is available at <http://npafc.taglab.org>.

A total of 372 otolith-marked chum salmon was found in the Bering Sea, of which 352 (94.6%) fish were released from 11 hatcheries in northern Japan. The Japanese marked fish showed no hatchery-specific distribution, and most fish were distributed north of 55°N in the Bering Sea during July and early August (Fig. 1). Distribution patterns were slightly different between young fish (ocean age-1) and older fish and between immature and maturing fish that may reflect their specific migration routes (Urawa et al. 2009).

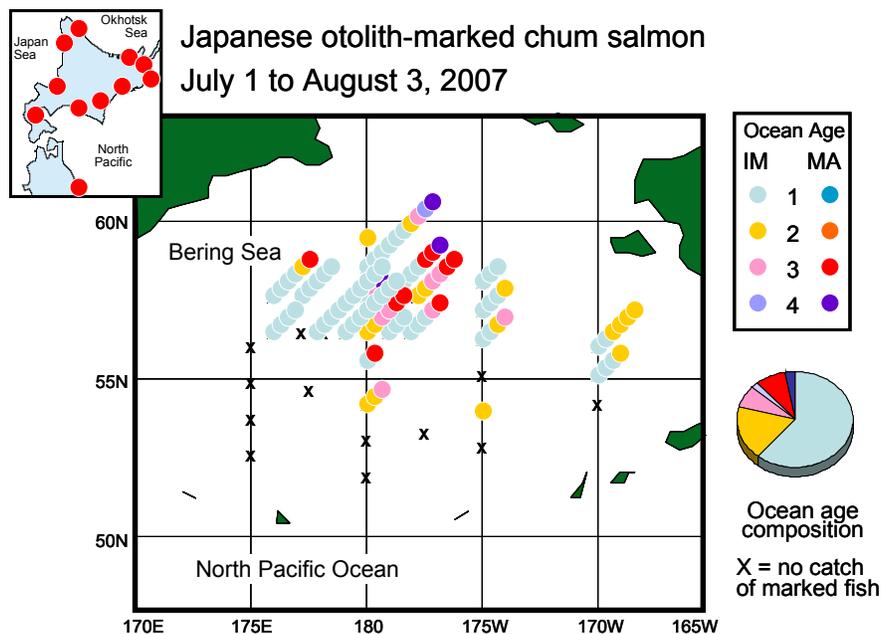


Fig. 1. Ocean distribution of otolith-marked chum salmon released from 11 hatcheries in northern Japan (map, upper left corner). The trawl surveys were conducted from July 1 to August 3, 2007. IM, immature fish; MA, maturing fish.

Alaskan marked chum salmon (n = 7) were found widely distributed in the Bering Sea, and all of them were released from Southeast Alaska and Prince Williams Sound. Russian marked fish (n=5) were recovered in the central Bering Sea, and they originated from the Ketkinsky and Paratunsky Hatcheries located in Eastern Kamchatka. One Korean marked chum salmon released from the Yangyang Hatchery was found in the western area (56°30'N, 176°E) in July 2007, as already reported by Sato et al. (2009).

Can high-seas otolith-mark recovery data be used for the forecast of hatchery chum salmon runs? To test this possibility, the recovery rate of chum salmon otolith marks in the Bering Sea (Bering Sea Catch Index, BSCI) during 2006-2010 surveys and the return rate of adults to the natal river were compared for the 2004-2006 brood years.

BSCI = number of marked fish recovered in the Bering Sea/number of marked fish released in the river
Return rate (%) = number of adults caught in the river/number of fry released in the river

Results differed among regional populations. In rivers on the Okhotsk Sea coast, a high BSCI was followed by a high return rate of chum salmon. By contrast, in rivers on the Japan Sea coast, a low BSCI was followed by a low return rate. There was a positive linear relation between BSCI and return rate for brood year 2004 ($R^2 = 0.803$, $p = 0.001$), 2005 ($R^2 = 0.664$, $p = 0.004$), and 2006 ($R^2 = 0.934$, $p < 0.001$). These results suggest the possibility that high-seas otolith-mark recovery data are useful for forecast of chum salmon runs in specific populations.

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