

## Stock Origins of Juvenile Chum Salmon Migrating Along the Eastern Pacific Coast of Hokkaido During Early Summer

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Japanese juvenile chum salmon migrate from their natal river to the Okhotsk Sea during their first summer (Urawa et al. 2001). They remain in the Okhotsk Sea for feeding and growth before moving to the western North Pacific for their first winter. A previous study has suggested coastal migration routes of juvenile chum salmon (Irie 1990), but their stock-specific migration route and timing are unclear. In this study, we estimated stock origins of juvenile chum salmon from the eastern Pacific coast of Hokkaido by analysis of otolith thermal marks and genetic stock identification (GSI) using single nucleotide polymorphism (SNP) markers to collect basic information on the migration route and timing of each regional stock.

Surveys were conducted at the Konbumori coast (42° 57'N, 144° 31'E), eastern Hokkaido, almost weekly from early June to mid-July, 2011 and 2012. Fish samples were collected at four or five stations (0.4-12.0 km from the shore) by a seine net towed by two boats. Otolith and tissue samples were collected from each juvenile chum salmon after recording fork length (FL) and body weight. Otoliths were examined for the presence of thermal marks; marking patterns were detected at the Tokachi and Nemuro Field Stations, Hokkaido National Fisheries Research Institute (HNFRI). DNA was extracted from chum salmon tissue samples at the Sapporo Laboratory of HNFRI. Each sample was assayed for 45 SNP loci using TaqMan chemistry. Five regional stock contributions (Hokkaido: Japan Sea coast, Okhotsk Sea/Nemuro Strait, and Pacific coast; Honshu: Pacific coast and Japan Sea coast) were estimated using a conditional maximum likelihood algorithm and a SNP baseline dataset from 57 Japanese populations.

A total of 622 and 384 juvenile chum salmon was collected in 2011 and 2012, respectively. Juvenile chum salmon were observed when sea surface temperature (SST) was over 8°C at the Konbumori sampling sites. The mean FL of juvenile chum salmon caught in 2011 (7.68±1.55 cm) was significantly smaller than in 2012 (10.26±1.29 cm). In 2011, otolith marks were detected in 68 fish out of 622 juvenile chum salmon. The otolith-marked juveniles (5.6-11.4 cm FL) were found between mid-June and early July, all of which originated from hatcheries located along the Nemuro Strait and Pacific coast of Hokkaido. In 2012, 43 out of 384 samples were otolith-marked fish of which 31 (6.3-11.0 cm FL) were released from hatcheries in Hokkaido and 12 (9.9-12.5 cm FL) were from hatcheries located on the Pacific coast of Honshu.

GSI-estimated stock composition of small juveniles (less than 10 cm FL) caught in 2011 was 96.7% Hokkaido stocks (6.8% Japan Sea coast, 3.0% Nemuro Strait/Okhotsk Sea, and 86.9% Pacific coast) and 3.3% Pacific coast of Honshu stocks. The estimated stock composition of large fish (more than 10 cm FL) caught in 2011 was 55.0% Hokkaido stocks (11.4% Japan Sea coast, 1.2% Nemuro Strait/Okhotsk Sea, and 42.4% Pacific coast), 16.3% Pacific coast of Honshu stocks, and 28.7% Japan Sea coast of Honshu stocks.

In 2012, the estimated stock composition of small fish was 67.5% Hokkaido stocks (5.7% Japan Sea coast, 18.1% Nemuro/Okhotsk Sea, and 43.7% Pacific coast), 25.7% Pacific coast of Honshu stocks, and 6.9% Japan Sea coast of Honshu stocks. The estimated stock composition of large juvenile chum salmon was 30% Hokkaido stocks (4.2% Japan Sea coast, 3.8% Nemuro/Okhotsk Sea, and 22.0% Pacific coast), 67.3% Pacific coast of Honshu stocks, and 2.8% Japan Sea coast of Honshu stocks.

Hasegawa et al. (2013) indicated that the eastern Pacific coast of Hokkaido is a community of juvenile chum salmon originating from rivers on the Pacific coast of Hokkaido and Honshu. Our results indicate that juvenile chum salmon released from hatcheries located on the Pacific coast of Honshu migrate along the eastern Pacific coast of Hokkaido between mid-June and early July, maybe heading for the Okhotsk Sea. Our results also indicate that large juvenile chum salmon (over 10 cm FL) includes a higher percentage of Pacific coast of Honshu stocks than small fish. The mean body size of juvenile chum salmon in 2011 was significantly smaller than in 2012, and the estimated percentage of Honshu stocks in 2011 was lower than in 2012. In addition, otolith marked juveniles from the Pacific coast of Honshu were not recovered in 2011. All results suggest that the 2010 chum salmon brood-year originating from the Pacific coast of Honshu were adversely affected by the big earthquake and tsunami that occurred on March 11, 2011, in Tohoku.

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