Distribution and Growth of Juvenile Pink Salmon in the Coastal Waters of Eastern Hokkaido Determined with Otolith-Marking

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In Hokkaido, northern Japan, although relatively constant numbers (approximately 140 million fish) of hatchery pink salmon juveniles have been released annually since the 1990s, even and odd year catches of pink salmon in coastal fisheries consistently differ. The reason(s) for this interannual pattern is unknown. There is little consistently gathered information on the ecology and status of pink salmon in Hokkaido although Morita et al. (2005) documented their population structure. It has been suggested that ocean conditions can limit salmon production and high mortality occurs during their early sea life (Parker, 1968; Mortensen et al. 2000). Consequently, we wished to improve our understanding of the early marine ecology of juvenile pink salmon with respect to their offshore movement and growth. We monitored the distribution and growth of juvenile pink salmon and environmental conditions off the Abashiri coast of the Okhotsk Sea beginning in 2002 (Ando et al. 2005).

Four transects were established (A–D; Fig. 1), each with three sampling sites 1 km, 4 km, and 7 km from the shore. Sampling occurred every ten days from late April to early July, 2002–2005. In coastal waters, we captured juvenile pink salmon using a surface trawl net pulled by two boats. We also beach seined littoral waters (St. E; Fig. 1) starting in 2003. Because juvenile pink salmon captured in the coastal or littoral waters of the Abashiri coast might include hatchery-origin fish released from several sites as well as naturally spawned fish, we designed an otolith-marking experiment in 2005 to survey the distribution and growth of juveniles of known origin. Of the 17.2 million juveniles stocked along the Abashiri coast, 2.6 million were otolith-marked in 200 ppm alizarin complexone (ALC) solution before hatching, and were stocked in the Abashiri River in late April 2005.

Distribution of juvenile pink salmon along the Abashiri coast was strongly affected by sea surface tempurature (SST). In May 2003 and 2005 when SST was low (< 8°C), many juveniles were captured by the beach seine (< 100 m from the shore), but not by trawl net in the coastal waters. In May 2002 and 2004 when SST was high (> 8°C), many juveniles were captured by the trawl net in the coastal waters (> 1 km from the shore). In May 2005 when SST was the lowest in four years (Fig. 2), most marked juveniles were captured in the littoral waters, not in coastal waters (Fig. 3). The number of juvenile pink salmon captured 1 km off the shore rapidly increased in early June

Fig.1. Map showing the study sites of littoral area(E),1 km, 4 km, and 7 km off the Abashiri coast (A–D). The arrow indicates release site of ALC marked juveniles.

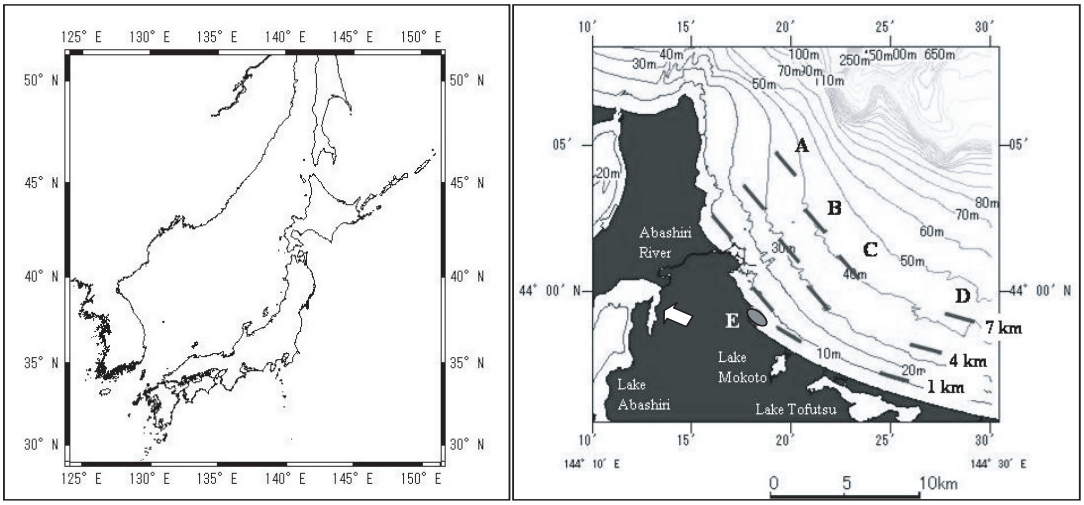

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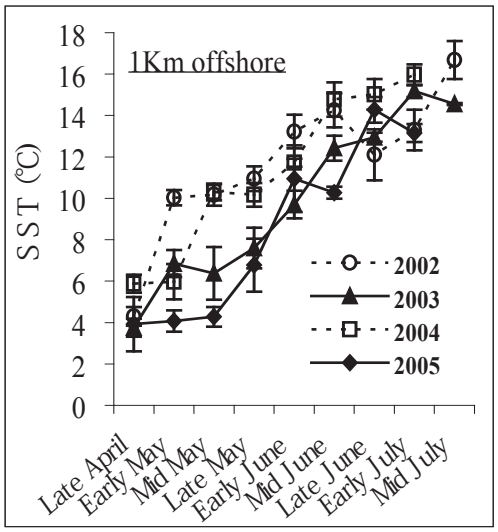
Fig.2. Changes in mean values with SD of SST in the 1 km offshore in the Abashiri coast of the Okhotsk Sea from 2002 to 2005.



when SST exceeded 10°C. Marked and unmarked juveniles showed a similar distribution pattern. In summary, the thermally dependent migration pattern that we found for unmarked pink salmon (including unknown origin fish) in 2002–2005 was consistent with that of marked juveniles released from the Abashiri River .

Mean fork lengths of pink juveniles captured in the coastal waters in cool years (2003 and 2005) were significantly smaller than those in milder years (2002 and 2004) (Fig. 4). This suggests that juvenile pink salmon in 2002 and 2004 utilized larger nursery areas and grew faster than juveniles in cool water years who tended to stay in littoral waters for longer periods. Annual variations in numbers of juvenile pink salmon captured in the coastal waters were greater than numbers of juvenile chum salmon (pink; 21,867 (in 2002)—3,870 (in 2005), chum; 72,024 (in 2002)—38,523 (in 2005)). The peak timing (late April) of stocking of pink salmon was about one month earlier than that (late May) of chum salmon, whereas the timing of disappearance of pink and chum salmon juveniles from the coastal waters was similar. In conslusion, since juvenile pink salmon stay in the littoral or coastal waters for a longer time than chum salmon, they may be more susceptible to ocean conditions, particularly low water temperatures after ocean entry. Interestingly, there was a clear correlation between the total number of juvenile pink salmon captured in the coastal waters and number of adults captured in the coastal fisheries the following year. These results suggest that cold coastal conditions would strongly affect the growth and survival of juvenile pink

Fig.3. Changes in CPUE (catch per unit of effort, number of juveniles per 2 km towing or per beach seine) of unmarked and ALC marked juveniles pink salmon captured in the littoral waters and 1 km, 4 km, 7 km offshore in 2005.

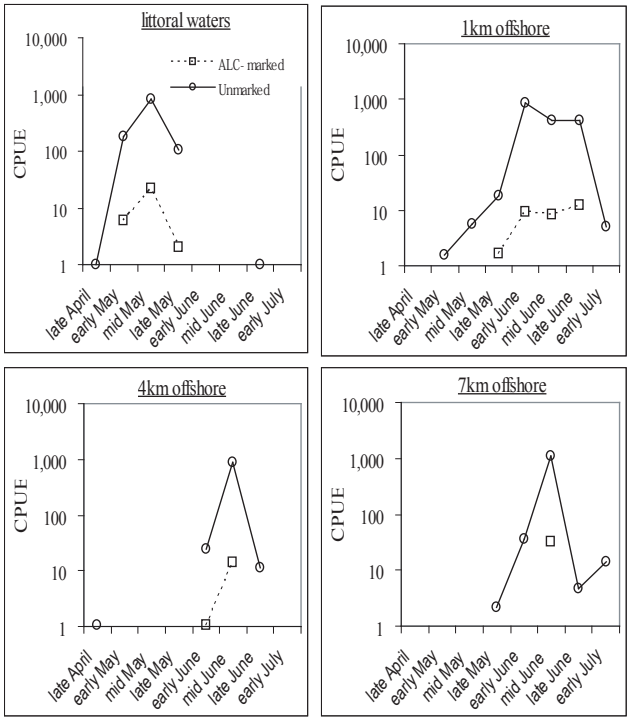


Fig.4. Mean fork length of unmarked juvenile pink salmon captured in the littoral waters and 1 km offshore from 2002 to 2005.

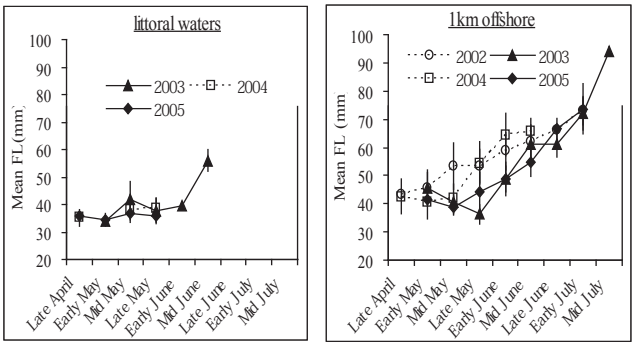
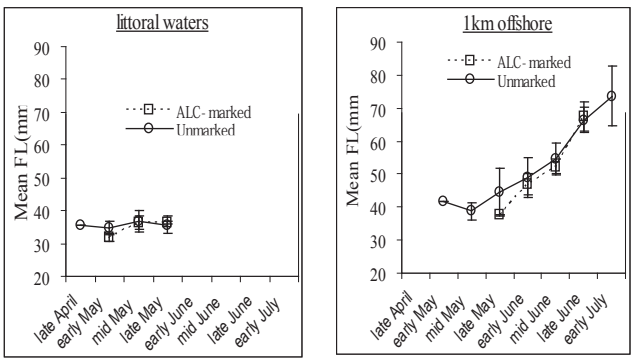


Fig.5. Mean fork length of unmarked and ALC-marked juvenile pink salmon captured in the littoral waters and 1 km offshore in 2005.



salmon in their early marine life, although inter-annual variations in numbers of naturally spawned fish may account for the variation of commercial catches. We plan to monitor the relationship between the early marine ecology and survival of pink salmon along the Abashiri coast with future marking experiments.

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