Coastal Migration and Survival of Juvenile Chum Salmon Estimated from Laboratory Analysis their Maximum Sustainable Swimming Speed

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Chum and pink salmon migrate to the sea during their early juvenile stages. Previously, it was believed that Japanese chum salmon juveniles migrate east along the sub-arctic boundary (Yonemori 1975). However, recent investigations involving the recapture of otolith marked fish (Ueno 1998; Urawa et al. 2004) and genetic stock identification (Urawa et al. 2001) revealed that Japanese chum salmon juveniles migrate to the Okhotsk Sea.

When migrating to the Okhotsk Sea, the swimming performance of tjuveniles may be important. In this study, water velocity was adjusted in a circulating tank (SOC-10, Japan Aqua Tech Co. Ltd.) and the effect on swimming performance of chum salmon juveniles was observed. The swimming chamber was 600 mm long x 300 mm wide x 330 mm deep (Fig. 1).

Figure 2 shows the relationship between fish size and endurance time. Linear relations with different slopes by each velocity were found. For juveniles ≤ 80 mm in fork length, except for recently emerged fry (36–38 mm), the maximum sustainable speed (Umax) was about 7 FL/s (specific speed based on fork length (FL)).

The value 7 FL/s is higher than others have reported. For example, Brett (1964) showed 2.8 FL/s as a maximum sustainable speed for 10 cm sockeye juveniles. Our results suggest that juvenile chum salmon heading for the Okhotsk Sea have a maximum speed of 50 cm/s, or 1.8 km/h, or 1 knot without any effects from currents. However, the Oyashio Current off Hokkaido in the Pacific side flows primarily southward along the Kuril Islands, in the opposite direction of juvenile chum migrating northward. Current data are available from the Japanese Coast Guard's Oceanographic Data Center (http://www1.kaiho.mlit.go.jp/KANKYO/KAIYO/qboc/index_E.html). From these data, west of the Cape Erimo, a strong westward current is typical during May and June when the juvenile chum salmon migrate to the ocean in this area. Figure 3 shows the results of recovery of otolith thermal marked chum juveniles since 2000. Though almost all fish were caught near the mouth of the river where they were released, a few were caught far to the west, especially those released from the Shizunai and Tokachi rivers.

Considering the swimming ability of young chum salmon, many fish entering the sea in this region might be transported westward by ocean currents. Migrating against the current would take additinal energy and time to travel to the Okhotsk Sea, and may result in fish being transported to areas where they would experience high mortalities. Thus it is important to better understand current patterns in coastal and offshore waters to clarify the mechanism of migration and survival of juveniles.

Fig. 1. SOC-10, a circulating tank for measuring swimming capacity (Japan Aqua Tech Co. Ltd).

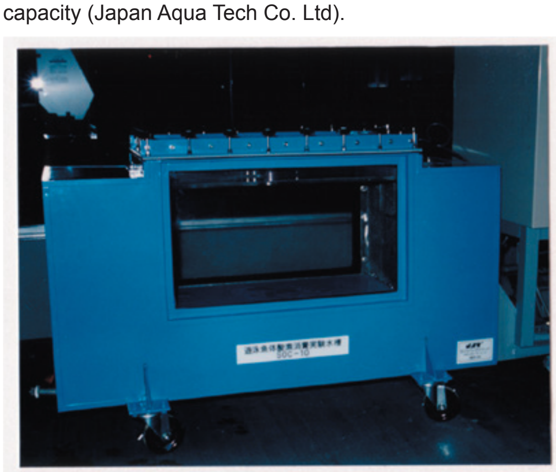

Fig. 2. Swimming capacity of chum salmon (40–80 mm in fork length, FL) expressed in specific flow speed (multiple of FL per second).

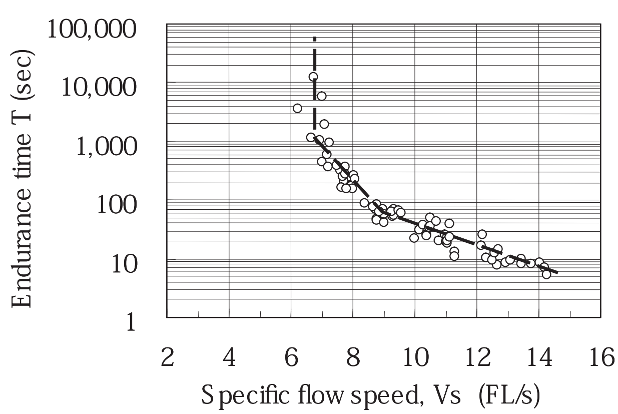

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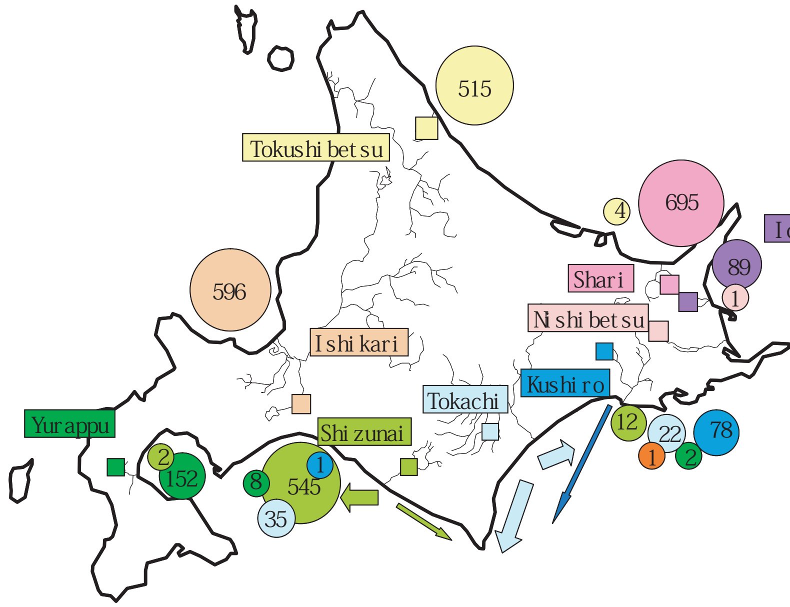
Fig. 3. Distribution of otolith marked juvenile chum salmon caught in coastal waters in 2000–2005. The figure was revised from Nara (2006), adding the results of coastal research in 2000–2004.



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