Coastal residence of juvenile chum salmon and their adult returns to the Ishikari River, Hokkaido

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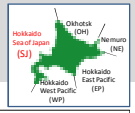
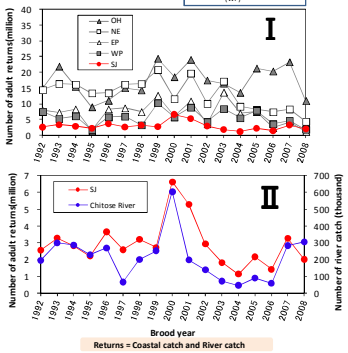
Introduction



・Recent numbers of chum salmon returning to the Sea of Japan (SJ) region of Hokkaido fluctuate at low levels, as compared with those in other regions of Hokkaido (**Ⅰ**).

・The Ishikari River stock is one of the largest stocks in the SJ region.
The Chitose hatchery is the only hatchery producing chum fry in the Ishikari River system.
So, the fluctuation of Chitose River (tributary of Ishikari river) stock is similar to that of SJ region (**Ⅱ**).

・Approximately 30 million chum salmon are annually released from Chitose Hatchery, but fluctuation is large.



To improve adult returns in the SJ region, an effective strategy is needed for recovering salmon stocks in the region.

Early marine residence is considered a critical period for juvenile salmon survival.

Objective

- Investigating quantitative correlation between early marine juvenile and their adult
- Identifying factors that affect fluctuation of salmon stocks

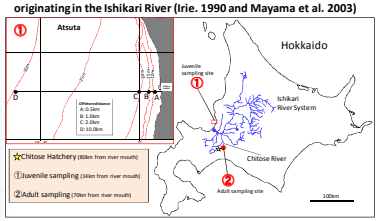
Methods

Survey area

We conducted surface trawl surveys of juvenile chum salmon at Atsuta (①), in the coastal area of the Ishikari River, during the years 2003-2009.

Recovery surveys: Upriver adults were collected at a fishtrap near the hatchery (②).

Atsuta is on the main northward migration route of juveniles originating in the Ishikari River (Irie. 1990 and Mayama et al. 2003)



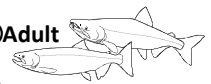
CPUE vs Return rate

①Juvenile

Identified Chitose River origin by otolith thermal marking.

Calculated Catch Per Unit Effort (CPUE)

②Adult



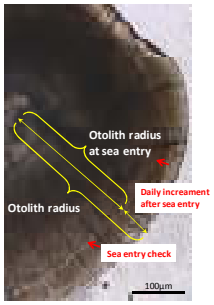
Determined the age and brood year class from scales

Identified Chitose River origin by otolith thermal marking.

Hatchery origin CPUE VS Hatchery origin Return rate

Correlation analysis

Otolith analysis



Otolith microstructure of juvenile chum salmon

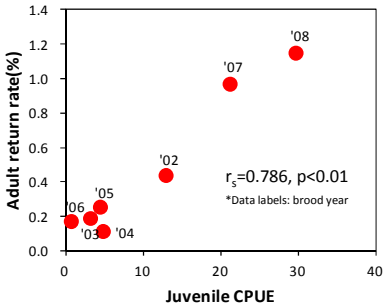
Analysis of juvenile otolith to estimate the following items:

- Size and date at the sea entry
- Daily growth after sea entry
- Days of residence in the river and the sea.

We determined the sea entry check (red arrow in the left panel) according to the method of *Saito et al. 2007*, measured otolith radius, distance from the core to sea entry check (radius at sea entry) and counted daily growth increments after sea entry.

Results

Relation between CPUE and Return rate



▶ CPUE of otolith-marked juveniles was positively correlated with those of adults return rate.

Key hypothesis

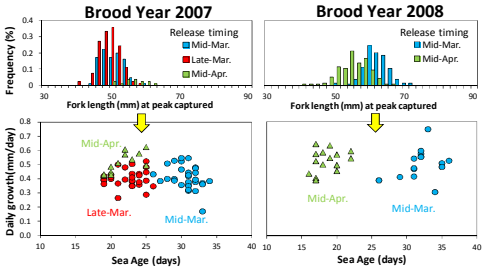
The abundance of marked fish recaptured at Atsuta is an indicator of survival during their early marine residence and that of the adult return fluctuation.

Size and date at the sea entry

	Brood year 2007			Brood year 2008	
Hatchery release date	3/14	3/26	4/18	3/19	4/20
10-day interval	Mid-Mar.	Late-Mar.	Mid-Apr.	Mid-Mar.	Mid-Apr.
Hatchery release size (mean)	43mm	44mm	47mm	47mm	46mm
Estimated sea entry date (mean)	3/24	4/1	4/22	3/30	4/23
Estimated sea entry size (mean)	37mm	40mm	44mm	42mm	43mm
Peak recaptured date (mean)	4/23	4/23	5/13	4/30	5/11
Recaptured fish size (mean)	49mm	49mm	55mm	59mm	53mm

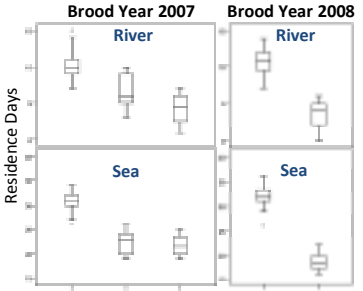
▶ The earlier the fish were released, the earlier they entered the sea.

Daily growth after sea entry



▶ Although the release timing was different, the daily growth after sea entry was similar.

Days of residence in the river and the sea

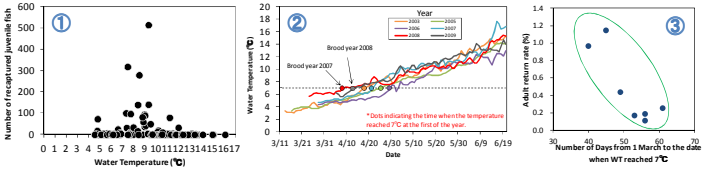


▶ In both 2007 and 2008 brood years, the earlier the fish were released, the longer they tended to stay in the river (upper left and right panels).
The days of sea residence was longer in "Mid-Mar." group than in "Late-Mar." and "Mid-Apr." groups (lower left and right panels).

▶ Return rate of "Mid-Mar." group was higher than that of "Mid-Apr." group. In the 2007 brood year, return rate of "Late-Mar." group was the highest.

Return rate → 0.80 0.95 0.35 1.14 0.67

Water temperature



▶ In the coastal waters off Atsuta, the water temperature at 3-m depth during the peak period of juvenile appearance ranged from 7 to 10℃ (①).
The date when water temperatures first reached 7℃ following the winter period varied by about 20 days from 2003 through 2009 (②).
The adult return rate was negatively related to the number of days after March 1 when water temperatures ware below 7℃ off Atsuta (③).

Conclusions

Intra-brood year difference: Migration timing is one of the important factor affecting the marine survival of juvenile.

Inter-brood year difference: The combined effects of the timing of seaward migration and temperature conditions in the ocean likely have strong influences on the survival of juvenile chum salmon of Ishikari Rive origin.