

Return of adult chum salmon (*Oncorhynchus keta*) to the Tohoku Pacific coast reared immediately prior to the Great East Japan Earthquake and tsunami, March 2011

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Background

Autumn chum salmon is an important fisheries resource along the Tohoku Pacific coast (Aomori to Fukushima), and most of the salmon stock is maintained by artificial propagation and release of fry. In this area, approximately 6.6×10^8 (decadal average before 2011) fry are released from hatcheries during March to May every year. Due to the Great East Japan Earthquake and tsunami disaster of March 11, 2011, with the epicenter off Tohoku, a lot of salmon hatcheries that rear alevin and fry chum salmon (2010 brood) were destroyed (Fig. 1). Therefore, there has been concern that alevin and fry reared at this time did not survive. Because the dominant age at maturity of chum salmon returning to the Tohoku Pacific area is age-4, there was strong concern that the number of returning adult chum salmon in 2014 year would be at a low level.



Fig. 1. The Tsugaruishi Hatchery in Iwate Prefecture on March 28, 2011. Photo credit: FRA (Tohoku National Fisheries Research Institute)

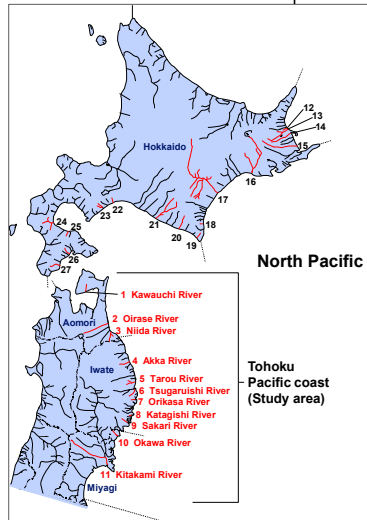


Fig. 2. Study area

Purpose

To assess the number of returning age-4 (2010 brood), we surveyed the age composition of upriver migrating adult chum salmon in 11 representative rivers in 2014 (Fig. 2).

Table. The tsunami damage situation of the hatchery in each investigation river. ★ indicate damage caused by the tsunami was serious.

No	Salmon Hatchery	Tsunami damage of hatchery facilities	Situation of the fry at the time of the earthquake disaster
1	Kawauchi	none	emergency release by a power out
2	Oirase	none	emergency release by a power out
3	Niida	none	
★ 4	Akka	severe	emergency release by a power out
★ 5	Tarou	heavy	emergency release by a power out
★ 6	Tsugaruishi	severe	emergency release by a power out
7	Orikasa	none	emergency release by a power out
★ 8	Katagishi	severe	
★ 9	Sakari	severe	
10	sennumaoka	none	emergency release by a power out
11	Kitakami	none	emergency release by a power out

Number of age-4 salmon in 2014



Scales of adult chum salmon in the 11 rivers were sampled every 10 day during September to December, 2014 (Tsugaruishi River: until January, 2015), and ages were determined.

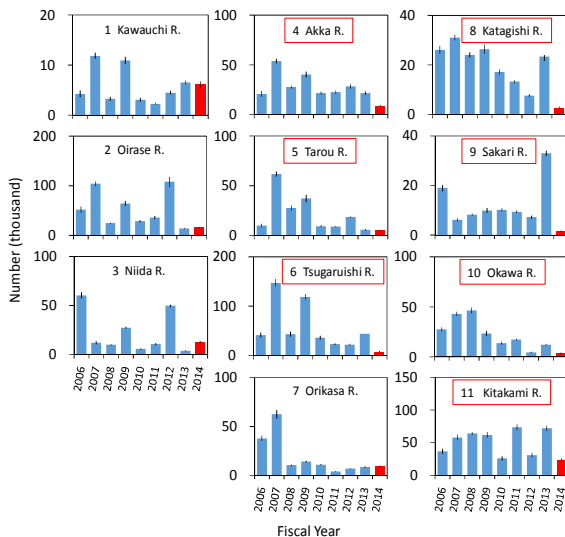


Fig. 3. Number of riverine catch of age-4 chum salmon returning to the 11 representative rivers along the Honshu Pacific region. □ indicates the river that the number of age-4 in 2014 was the least since 2006.

Results indicate a notably reduced harvest compared to previous surveys.

Clustering of return pattern

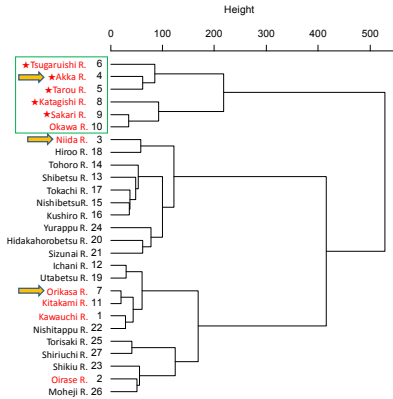


Fig. 4. Dendrogram of rivers surveyed for 10 day appearance pattern of age-4 chum salmon in 2014. ★ indicate damage caused by the tsunami was serious.

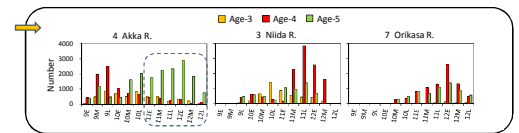


Fig. 5. Example of the riverine catch number of the age-3 ~ 5 salmon every 10 days.

Similarity was extremely high between rivers that the hatchery received direct damage caused by the tsunami (Fig. 4 and Table). In these rivers, age-4 salmon decreased sharply compared to usual peak timing (Fig. 5, e.g. Akka River).

Estimate of 2010 brood

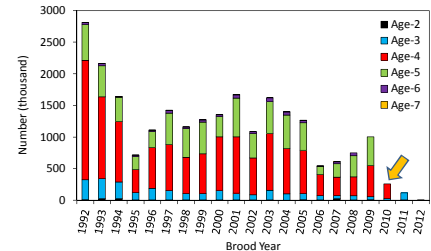


Fig. 6. Number of chum salmon returning to the Tohoku Pacific coast stratified by age in thousands of fish, 1992-2012. Yellow arrow indicates the 2010 brood.

When comparing number of fish returning for ages up to age-4, the number of the 2010 brood is the smallest since the 1992 brood.

Trend of age-5 return

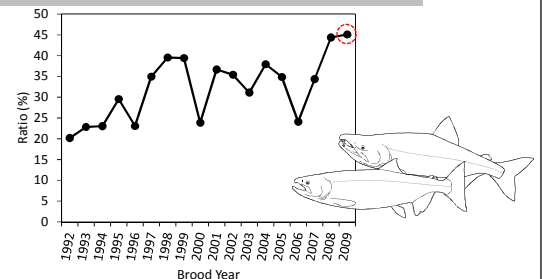


Fig. 7. Annual change in ratio of number of age-5 chum salmon along the Tohoku Pacific coast.

Ratio of the number of age-5 has shown a general tendency to rise since the 1992 brood.

Conclusion

- The influence of the earthquake disaster was actualized in 2014.
- Decrease in age-4 chum salmon was remarkable in the rivers that the hatchery received direct serious damage by the tsunami in 2011.
- Because the possibility that the number of returning chum salmon will further decrease in 2015 season, there is a need to carefully monitor the catch along the Tohoku Pacific coast.