The First NPAFC-IYS Work shop (2018) on Pacific Salmon Production in a Changing Climate

Migration and homing behavior of chum salmon tagged in the Okhotsk Sea, eastern Hokkaido

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Introduction

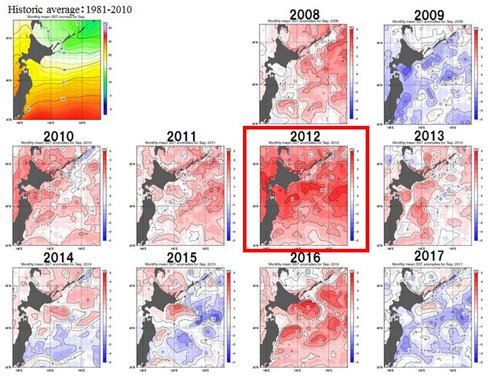


Fig.1 Anomaly of sea surface temperature in September around Hokkaido.
(from Home page of Japan Meteorological Agency)

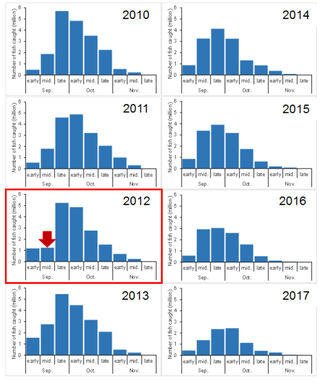
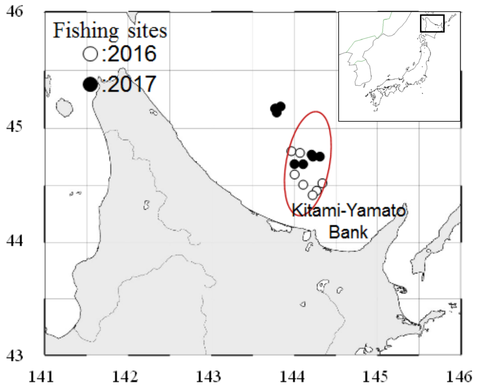


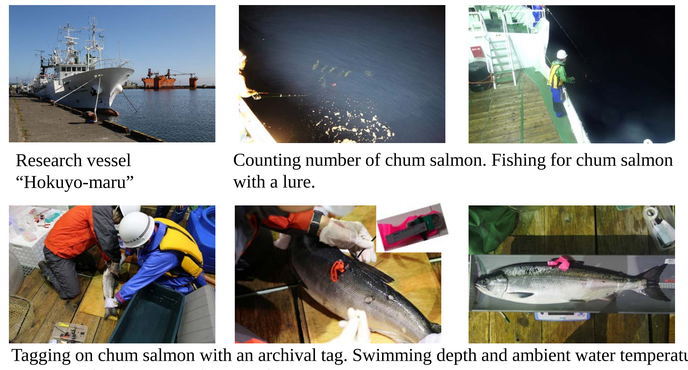
Fig.2 Number of chum salmon landed by set-net fishery on the Okhotsk coast.

Set-net salmon fishery in Hokkaido.

- Chum salmon return to Hokkaido from September, but recent sea water temperatures were often higher than the historic average .
- In 2012, the year of extreme high SST, the number of chum salmon landed in mid-September was too low compared to other years, but in late September, the number of landings quickly increased.
- To determine the effects of sea water temperature on commercial landings, the responses of migrating chum salmon to sea water temperature need to be elucidated.

Method ◆ Tagging experiment in the Okhotsk Sea





Research vessel "Hokuyo-maru"

Counting number of chum salmon. Fishing for chum salmon with a lure.

Tagging on chum salmon with an archival tag. Swimming depth and ambient water temperature were recorded at 30seconds intervals.

Fig.3 Fishing sites in the Okhotsk Sea in eastern Hokkaido in 2016 and 2017. Photographs show steps of tagging and release of chum salmon.

- The tagging experiment was conducted in the Okhotsk Sea in early September of 2016 and late August of 2017 by a research vessel "Hokuyo-maru" of the Wakkanai Fisheries Research Institute.
- Fishing chum salmon was conducted at night with fishing light. Chum salmon that appeared were counted the number and fished with a lure with raw bait on the hook. The captured fish were tagged with an archival tag (Bio-logging Data-logger, AI technology Inc., Tokyo, Japan) on the base of dorsal fin and released.
- The tagged fish were recaptured in the coastal areas or rivers.
- At the fishing sites, the vertical distributions of the sea water temperature and salinity were measured using CTD (Seabird SBE9plus, Sea-Bird Electronics, Inc., Bellevue, WA, USA).

Results ◆ Tagged chum salmon released and recaptured

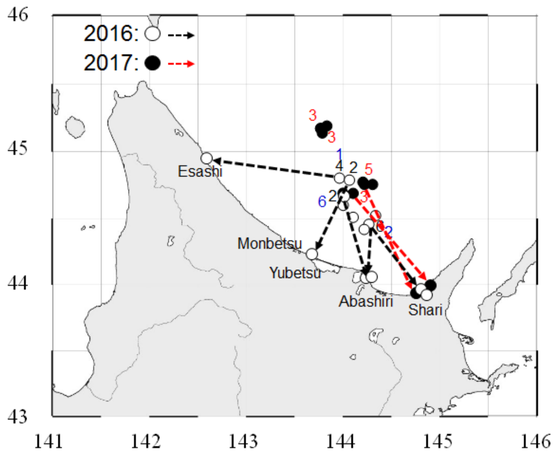


Fig.4 Map of sites where released and recaptured in 2016 (○) and 2017 (●). The number of released chum salmon are shown in 2016 by black letters and in 2017 by red and released pink salmon by blue.

Table 1 Date of release, number of chum and pink salmon released and recaptured and the elapsed days from release to recapture.

Date of release	Species	No. of fish released	No. of fish recaptured	Elapsed days from release	Range of recapture
5-7 Sep. 2016	chum	14	6	3 - 13	Esashi - Shari
	pink	9	0	-	-
28-30 Aug. 2017	chum	14	2	9 - 21	Shari

- In both 2016 and 2017, 14 chum salmon were tagged and released from the research vessel. In 2016, 9 pink salmon also were tagged and released.
- Many chum salmon were counted and caught at sites west of the Kitami-Yamato Bank.
- Of the tagged chum salmon that were released, 6 and 2 fish were recaptured in 2016 and 2017, respectively.
- All of the tagged fish were recaptured on the Okhotsk coast.

◆ Distribution of chum salmon and water temperature

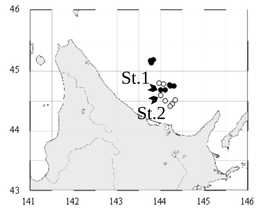


Table 2 The number of chum salmon counted by visually and fished with a lure on 5 September 2016 (St.1 and 2 in map).

	No. of fish counted per 5 minutes	No. of fish fished per hour
St.1	5.6	1.7
St.2	0.7	0.0

- At the sites where many chum salmon were counted or fished, the sea water temperatures were between 15 to 18 °C at the surface layer, 5–15 °C at a depth of 15 m and < 2 °C at depths > 50 m.

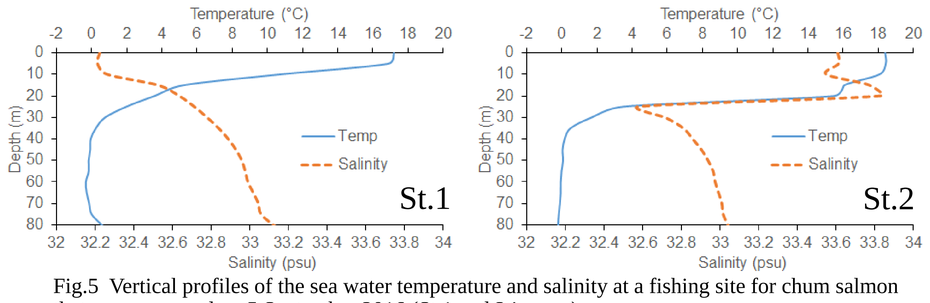


Fig.5 Vertical profiles of the sea water temperature and salinity at a fishing site for chum salmon that was measured on 5 September 2016 (St.1 and 2 in map).

◆ Swimming depth and water temperature by the tagged chum salmon

- Tag: No.17
- Fork length: 680 mm
- Body weight: 4.2 kg
- Age: 6
- Sex: female

Fig.6 Chum salmon tagged with No.17, released and recaptured in 2017.

- Chum salmon tagged with No.17 was released at 22:28 on 28 August and recaptured on 6 September 2017 by set-net in Shari.
- This tagged fish migrated about 100km in 9days.
- This tagged fish migrated diurnally between the surface layer and a depth of over 200 m.
- During day time this fish preferred sea water temperatures of 1 °C at a depth of over 200 m.
- Mean water temperature experienced in day time and night time were 4.5 °C and 8.8 °C, respectively.
- Mean swimming depth in day time and night time were 164.5m and 85.8m, respectively.

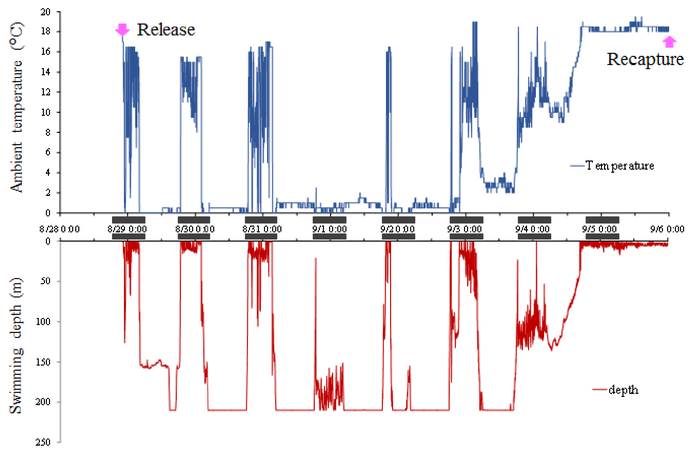


Fig.7 The swimming depth and sea water temperature experienced by the chum salmon tagged with No.17. Black bars indicate night time.
(The archival tag can only measure the depth to about 200m.)

Summary

- Chum salmon were tagged with archival tags and released in the Okhotsk Sea, eastern Hokkaido in early September 2016 and late August 2017.
- All of the tagged chum salmon were recaptured on the Okhotsk coast.
- Most of chum salmon were counted and caught around the Kitami Yamato Bank where SST were 16-18°C , 5-15°C at a depth of 15m, and <2°C at a depth > 50m.
- During day time some of the tagged fish preferred sea water temperatures of 1°C at a depth of over 200m.
- Our study suggests that sea water temperatures are affecting salmon behavior in the coastal areas.
- Because the sea water temperature around Hokkaido in the fall have been higher in recent years, the monitoring of chum salmon behavior relative to the climate changes is important.