Body size variation of juvenile chum salmon among three coastal areas of Hokkaido, northern Japan

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Introduction

Pacific salmon:

Juvenile (fry) migrate from river to sea

Growth in coastal residency is strongly correlated with survival

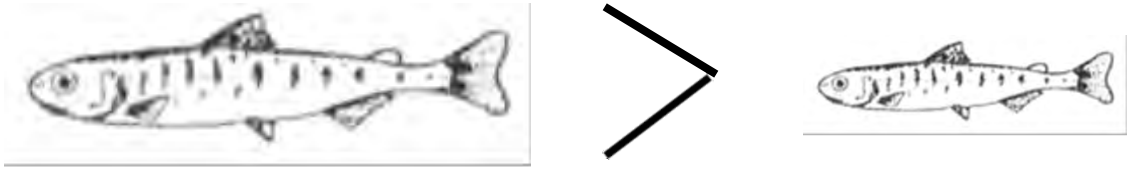
Research on coastal residency is of interest to scientists

Introduction

Estimation of growth rate:

1. Scale and otolith analyses

2. Body size is still used as a simple index
   ⇨when using historical data, body size may be the only available measure



high > low

Introduction

chum salmon:

Migrating from their natal river to the sea shortly after hatching

Juveniles stay in the coastal zone around their natal river

The large juveniles in an area are thought to be
those with the high growth rates

Growth rate positively correlated with prey abundance

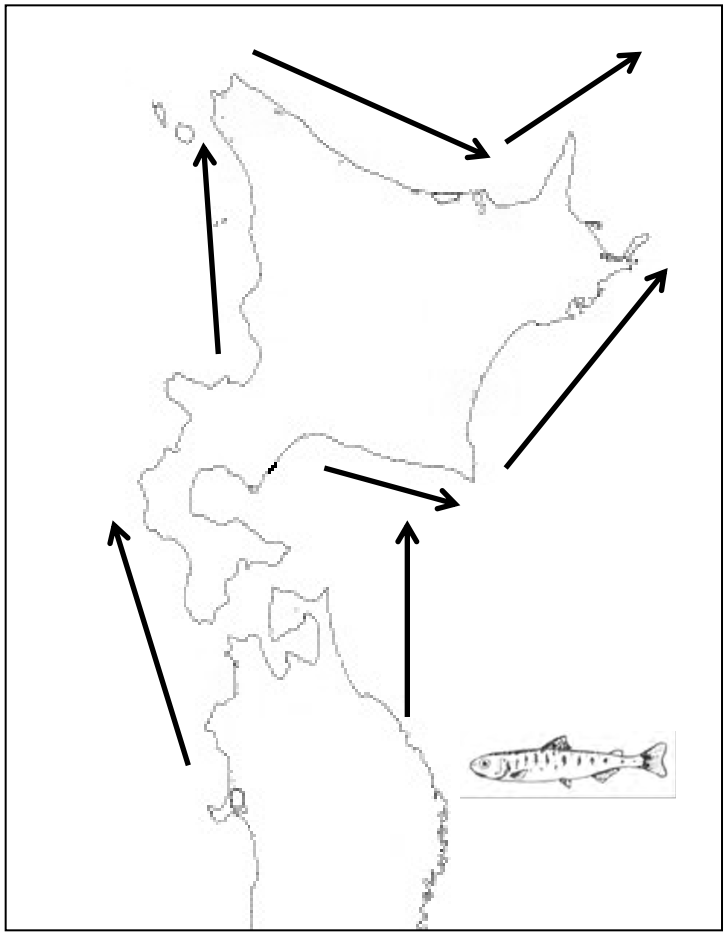
Introduction

Question:

Does the body size of juvenile salmon in a given area truly reflect the growth rate, which is determined by the prey abundance?

Individuals that originate from rivers outside the area of interest may migrate into the area and be captured

Introduction



Juveniles increase in body size throughout their oceanic migration

Individuals that have grown in other areas into an area of interest may result in the overestimation of growth

Objective

In order to evaluate the relationship between
the river of origin, the prey abundance, and body size

Comparison of the body size of juvenile chum salmon
among three coastal areas of Hokkaido, northern Japan

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Predictions

Mean body size of juveniles would be high in areas with
1.abundant food resources

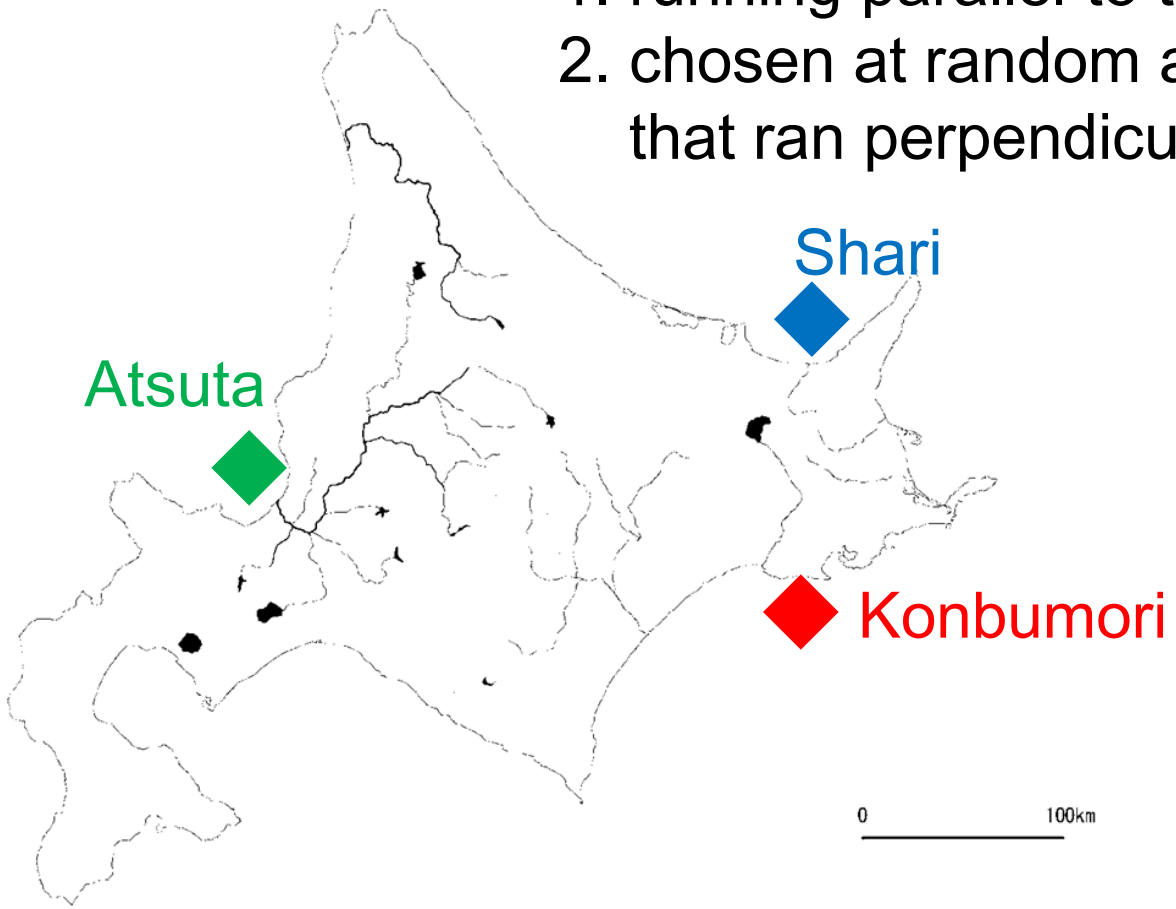
2. containing individuals that originated outside the survey area

Materials & Methods

Long-term monitoring data (1999-2010)

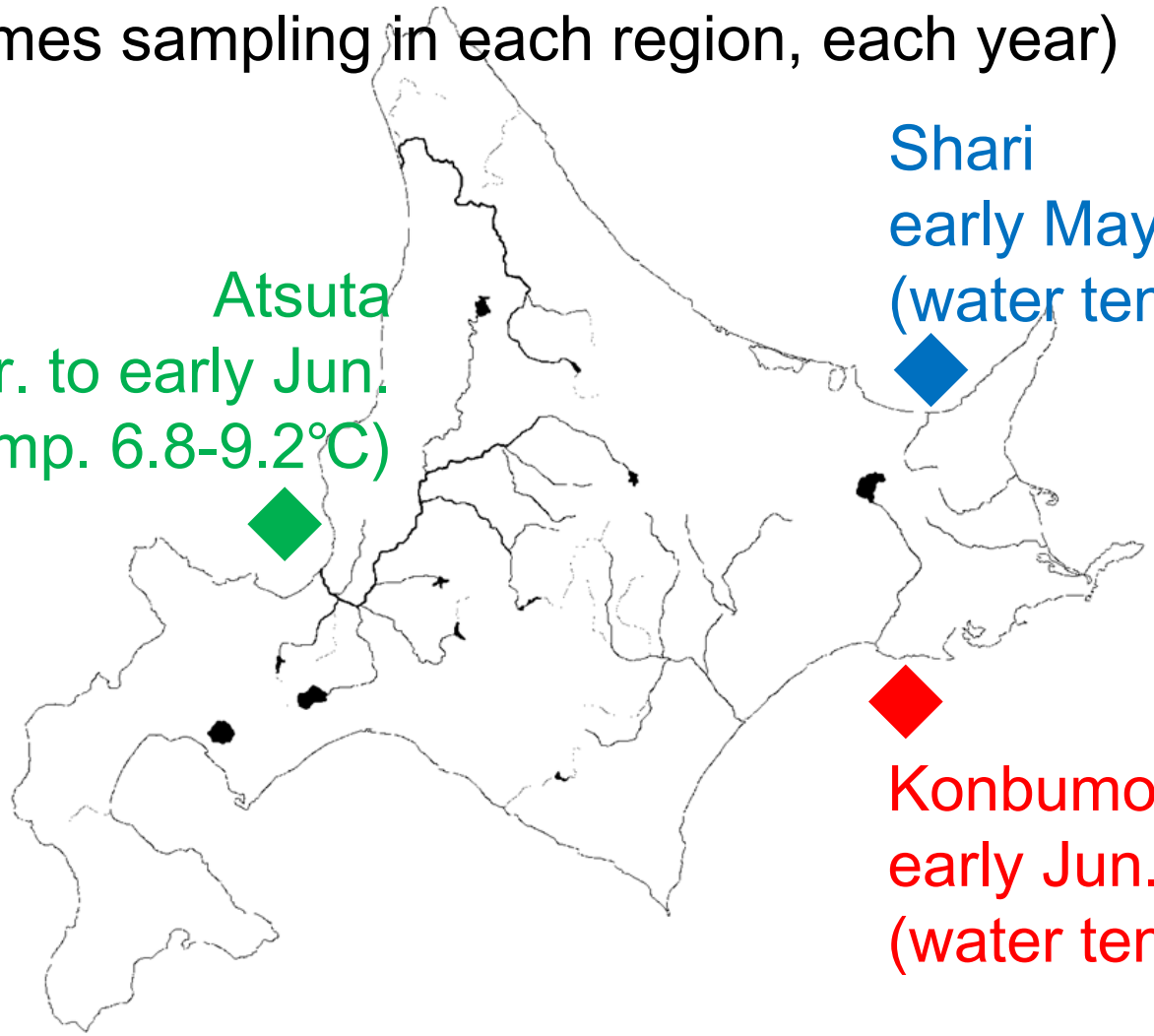
4 sites (length 2km)

1. running parallel to the shoreline
2. chosen at random along a 10 km transect that ran perpendicular from the shoreline



Materials & Methods

The timing of sampling differed among the region due to differences in the timing of juvenile appearance
(4-7 times sampling in each region, each year)



Shari
early May to mid-Jul.
(water temp. 8.8-12.1℃)

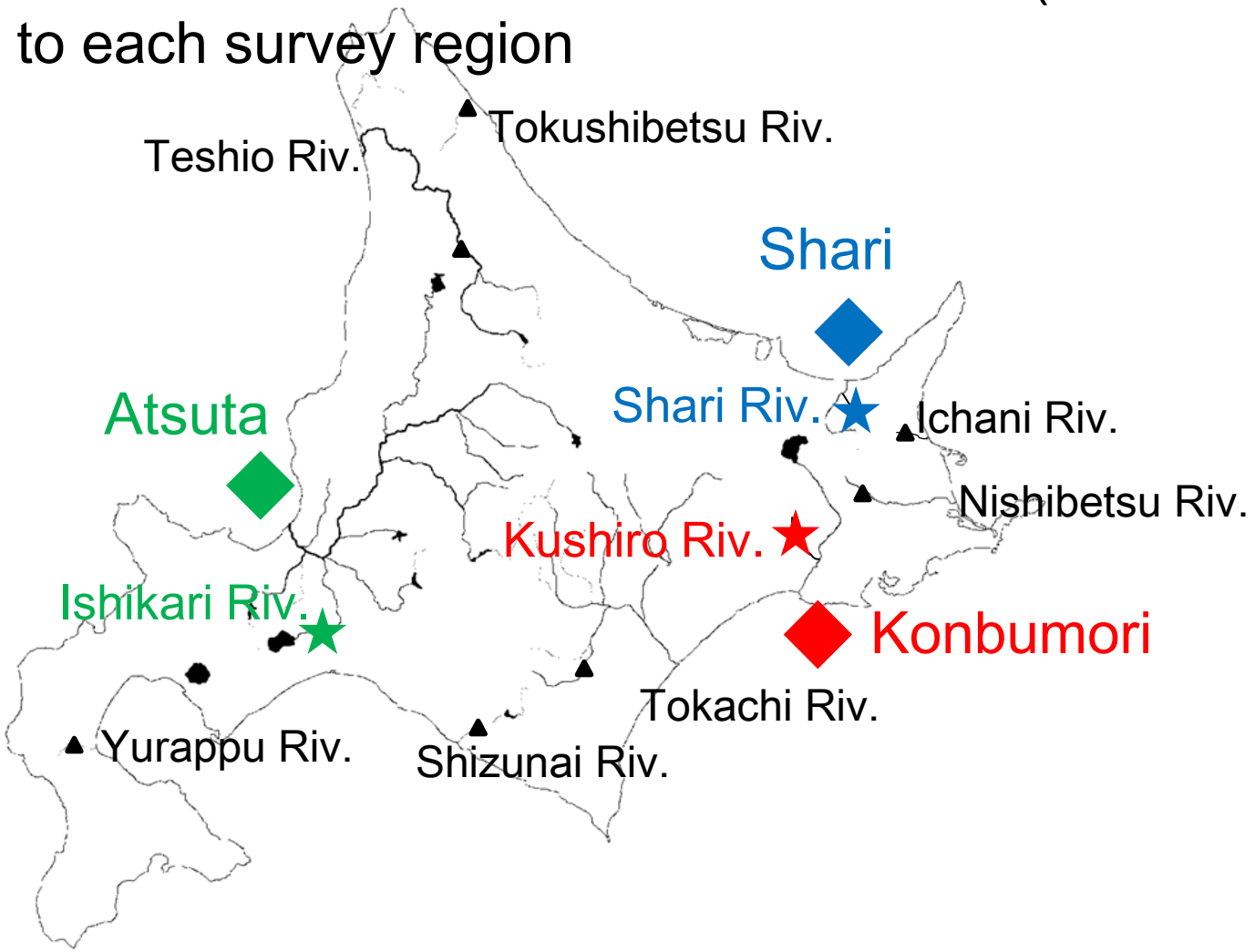
Atsuta
late Mar. to early Jun.
(water temp. 6.8-9.2℃)

Konbumori
early Jun. to mid-Jul.
(water temp. 8.6-10.0℃)

Materials & Methods

10 HNF hatcheries stock salmon fry with thermal otolith marking (since 2003)

★ nearest to each survey region



Materials & Methods

Fish & Zooplankton sampling

Juveniles:

One of five types of seine net

The net was towed by one or two boats (2 knots)

FL measurement

Otolith marking

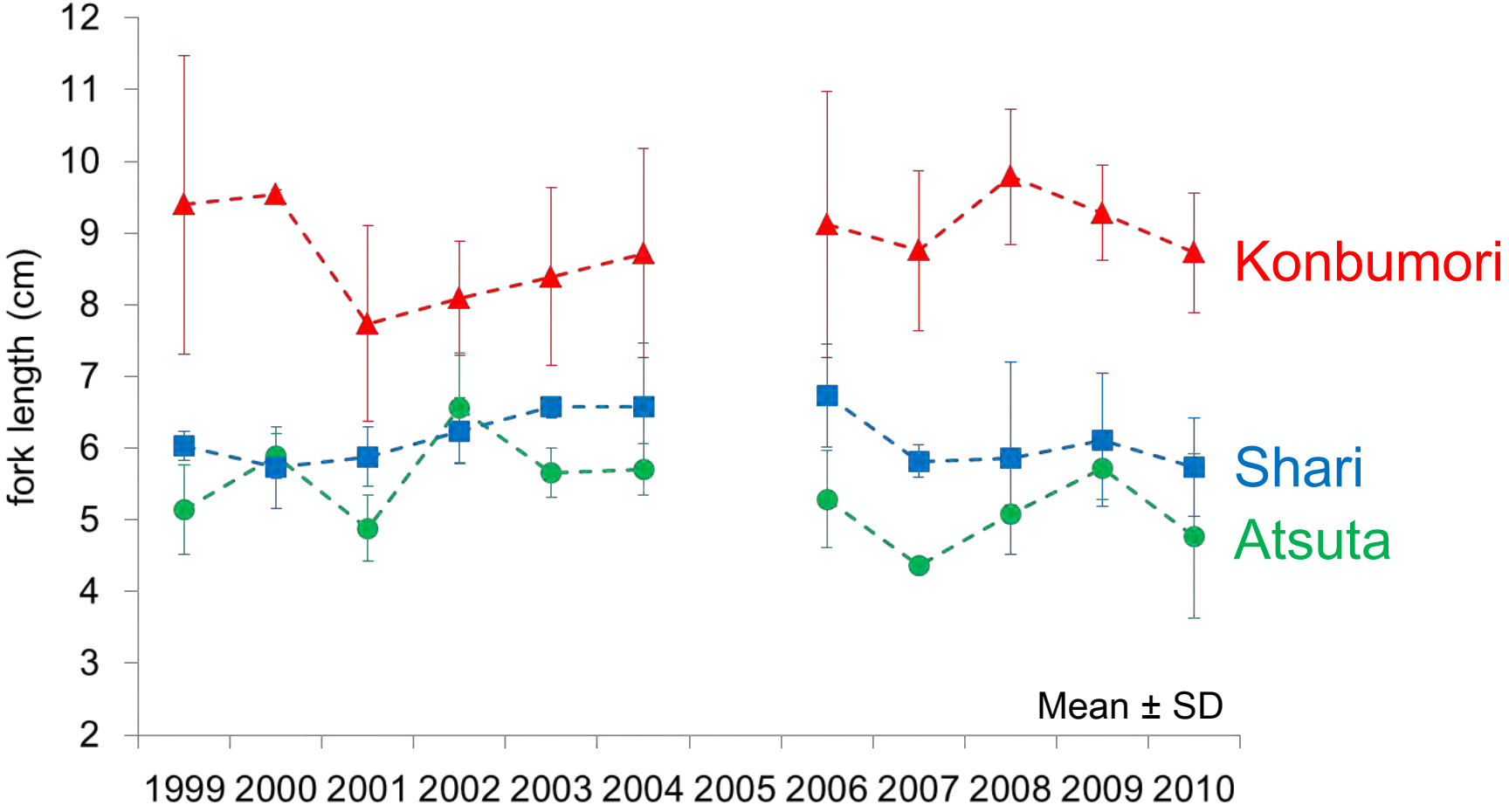
Zooplankton:

NORPAC net

Towed vertically from 20 m to the surface

Wet weight was mesaured

Results (body size)

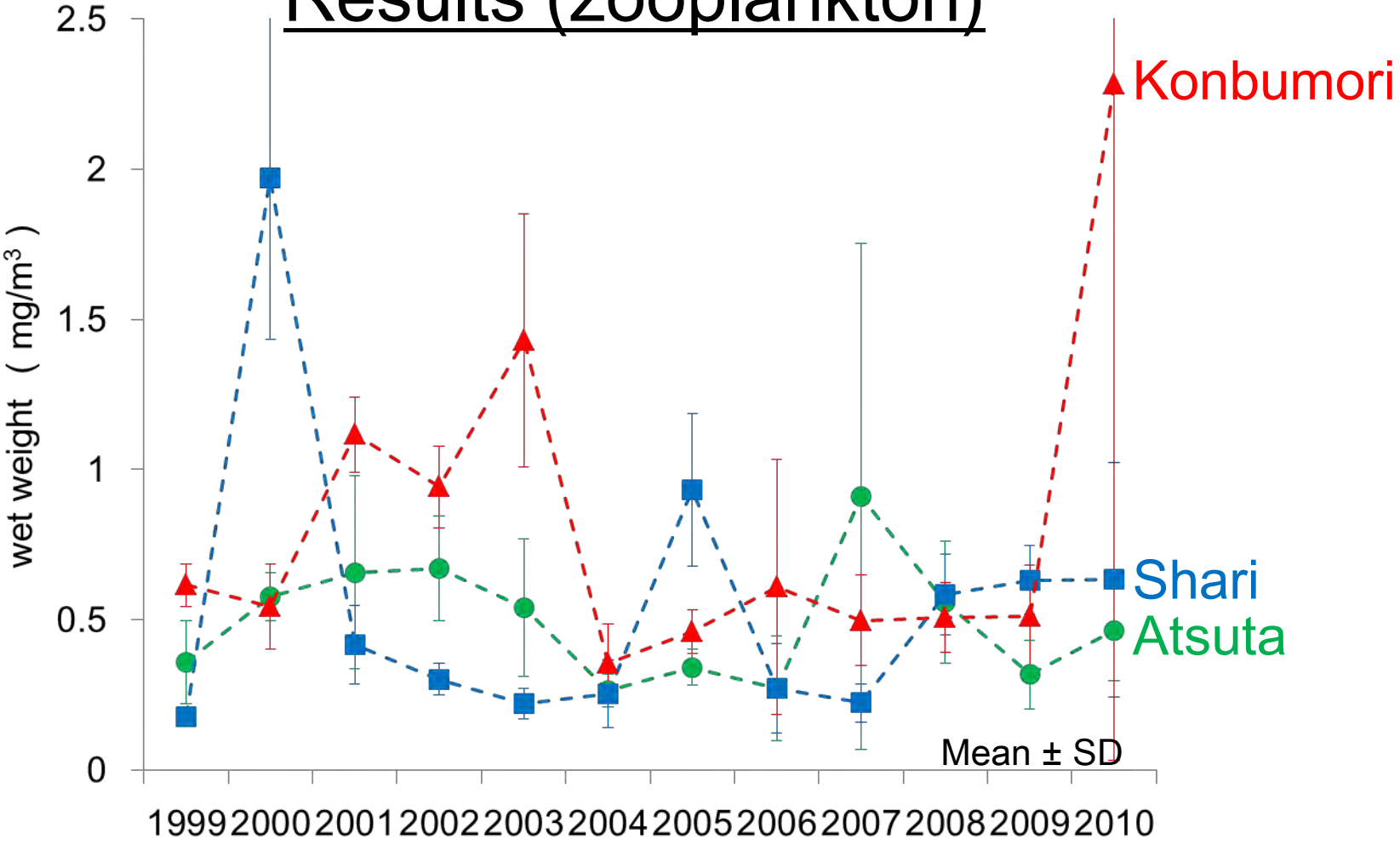


Body size : Konbumori > Atsuta & Shari ($p < 0.05$)

Neither the year nor the year ×the region affected body size

(2-way repeated measures ANOVA)

Results (zooplankton)



Zooplankton abundance was affected by the year, region, and the year × the region

(2-way repeated measure ANOVA)

Zooplankton abundance could not explain body size difference well…..

Results (otolith marking)

the percentage of juveniles with otolith marks
in total captured juveniles

Atsuta	53.7% (2640 ind.)
Shari	10.9% (4835 ind.)
Konbumori	5.0% (357 ind.)

Since 2003

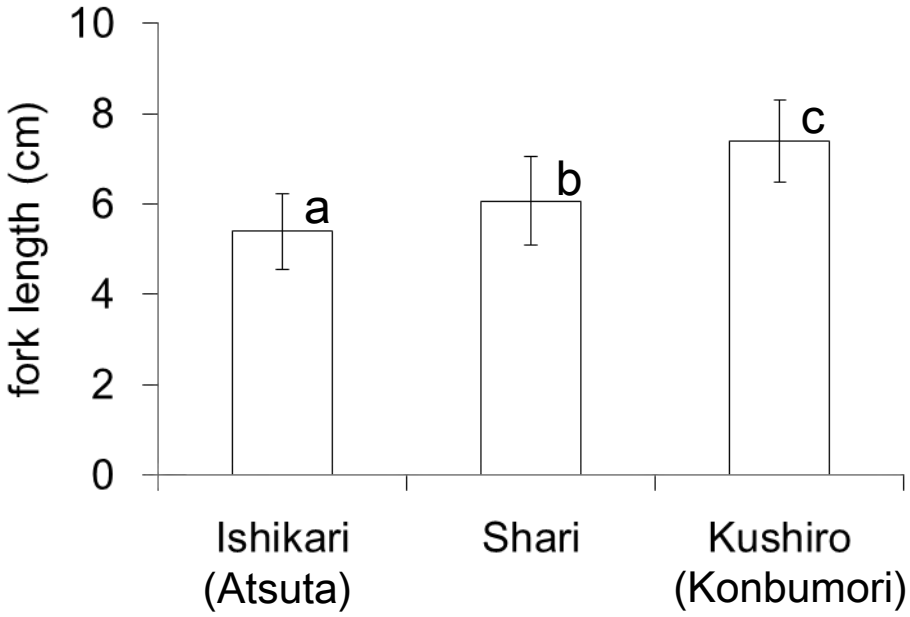
Results (otolith marking)

Breakdown of otolith marking (%)

	Ishikari	Shari	Kushiro	Tokachi	Yu-rappu	Shizu-nai
Atsuta	100					
Shari		99.7				
Konbumori			24.6	42.9	11.2	10.6

Atsuta & Shari ⇨ from the nearest rivers stocked with salmon
Konbumori ⇨ from the nearest and also other rivers

Results (otolith marking)

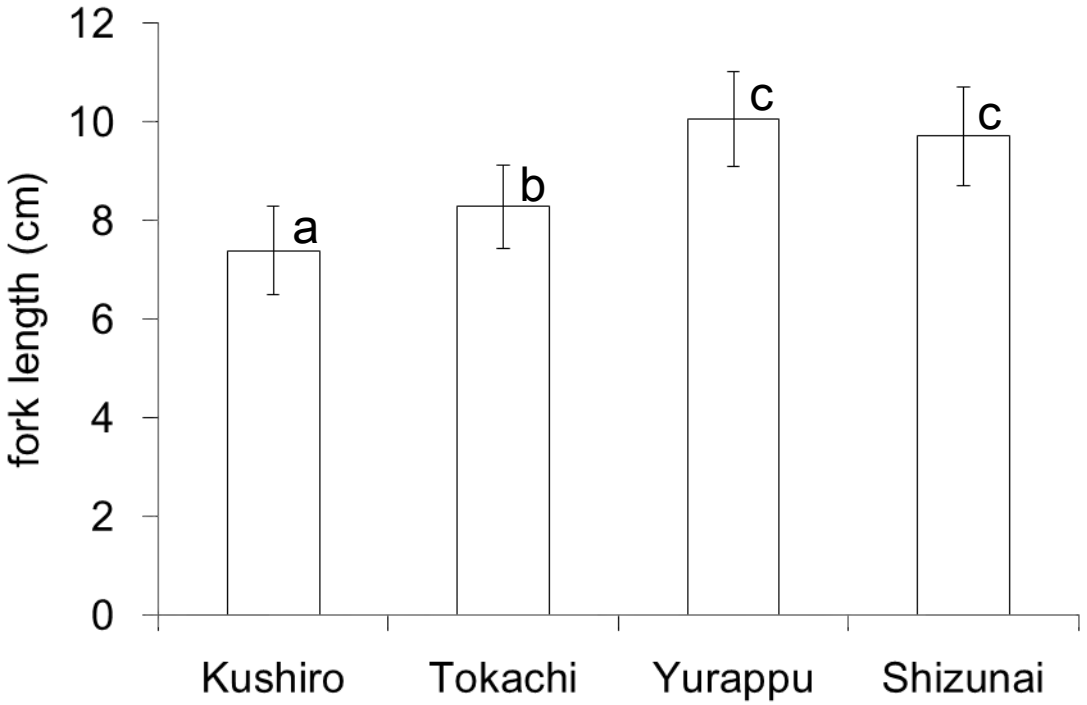


(One-way ANOVA; Mean ± SD)

Juveniles from Kushiro River were larger than others

Results (otolith marking)

Breakdown of captured juveniles in Konbumori



(One-way ANOVA; Mean ± SD)

Tokachi, Yurappu and Shizunai were larger than Kushiro

Discussion

Juveniles collected in Konbumori was larger than juveniles in the other regions during the period of survey

This difference could not be explained by prey abundance
(Yearly fluctuations of the abundance were not consistent with the body size difference)

the effects of density on growth should be considered.
Unfortunately our data set were unsuitable to compare the density due to differences in the method and net size among regions and years.

Discussion

Juveniles collected in Konbumori was larger than juveniles in the other regions during the period of survey

the largeness is a most likely a function of the river of origin

Juveniles from Kushiro River were larger than Ishikari (Atsuta) and Shari

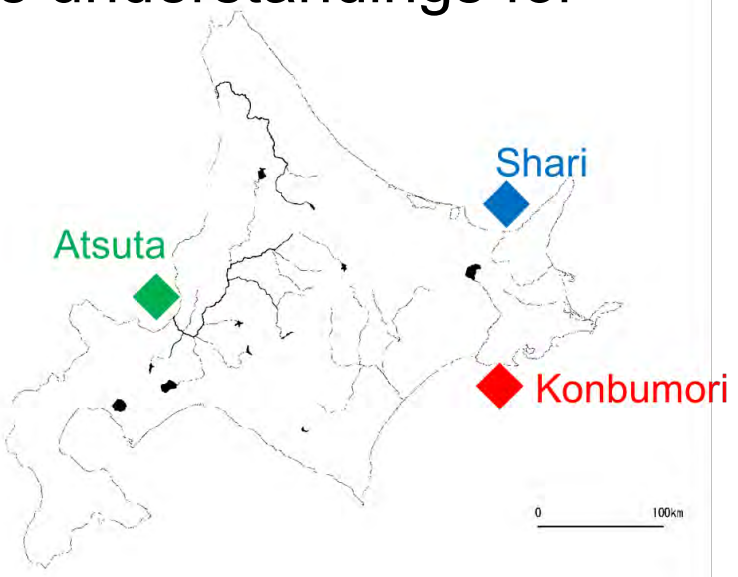
Juveniles from distant rivers (Tokachi, Yurappu, and Shizunai Rivers) were larger than from Kushiro River

Discussion

Additional Question

Why migratory juveniles stopover only in Konbumori?
1.Marine current?
2.Geography?

This further study will contribute on the understandings for migratory of juvenile chum salmon



Conclusion

Body size is not always a useful index of growth rate

Researchers using body size as a surrogate for growth rate should consider the origin of individual juveniles, particularly for migratory species or life-stages.