Interannual variations in growth trajectories of juvenile jack mackerel *Trachurus japonicus* in the Tsushima Warm Current

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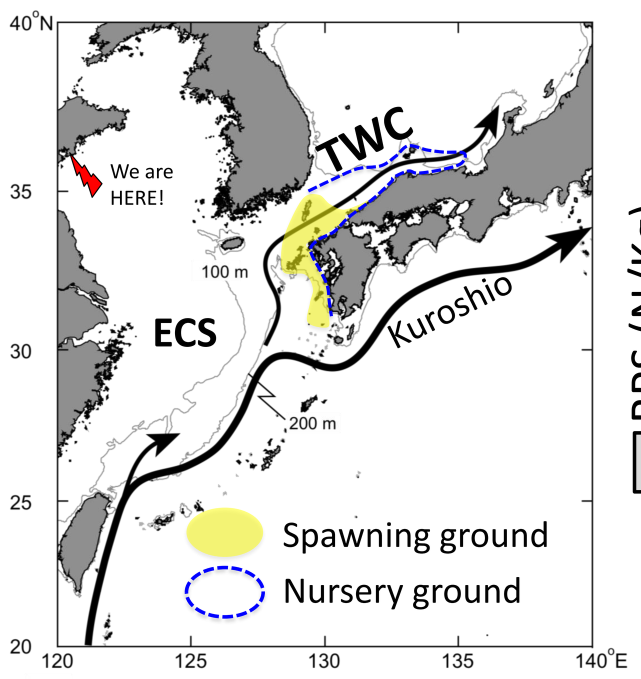
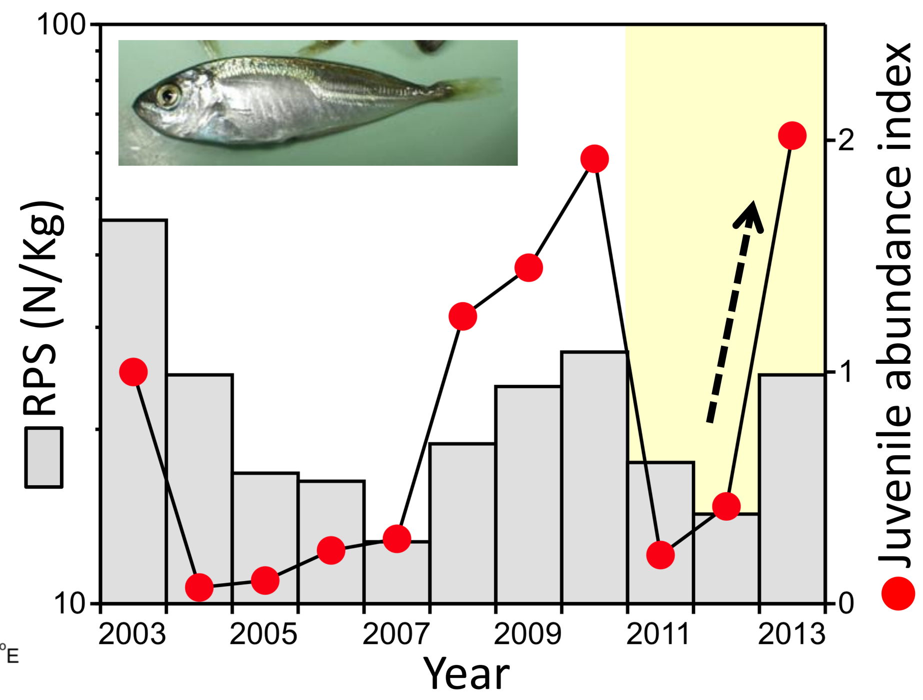
Background

Interannual variations in juvenile abundance of *T. japonicus* have been assessed to forecast recruitment in the Tsushima Warm Current (**TWC**).

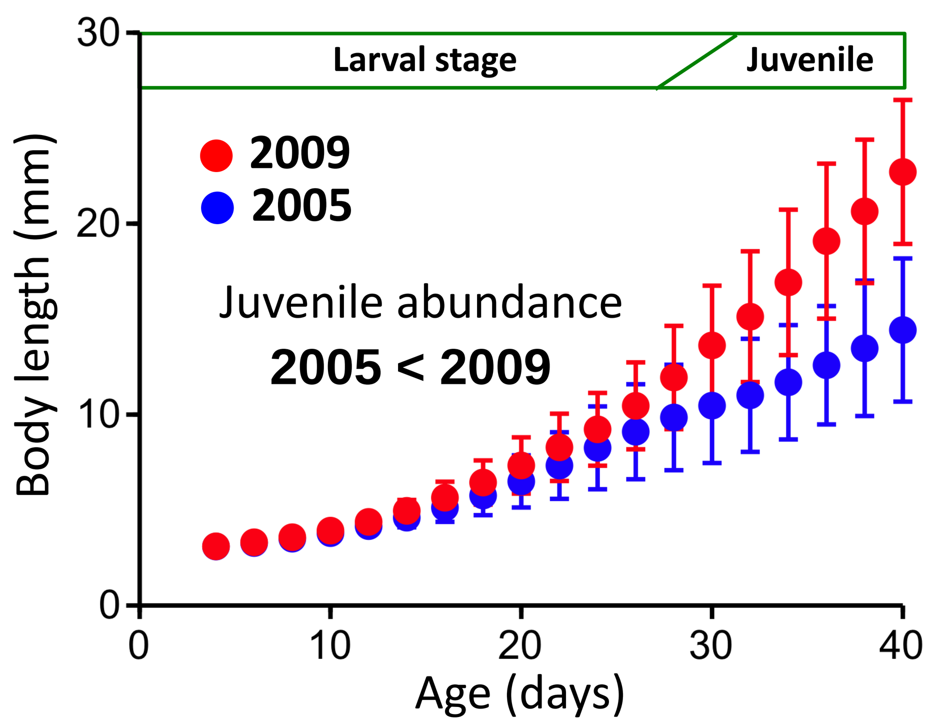




Juvenile abundance index is indicative of recruit per spawner (RPS), yet causes of recruitment variability remain unclear.

In the East China Sea (**ECS**), faster growth rate during larval stage for *T. japonicus* results in higher abundance of juveniles.

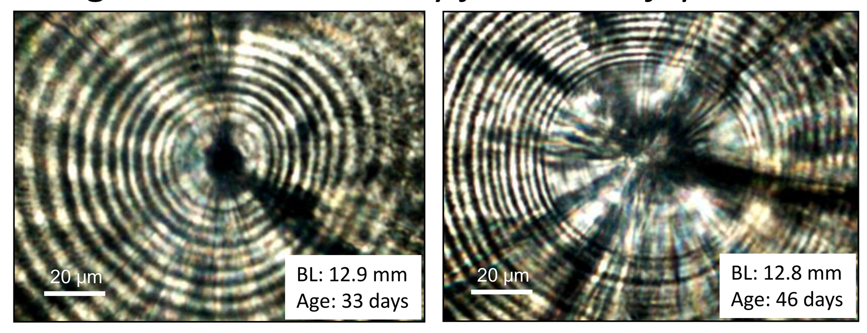
Takahashi et al. (2012)



Focusing on a sharp increase in juvenile abundance index during 2011- 2013 in the TWC, the following questions arise

- Relationship between survival (RPS) and growth trajectories?
- Effects of environmental conditions on growth?

Sagittal otolith of early juvenile *T. japonicus*

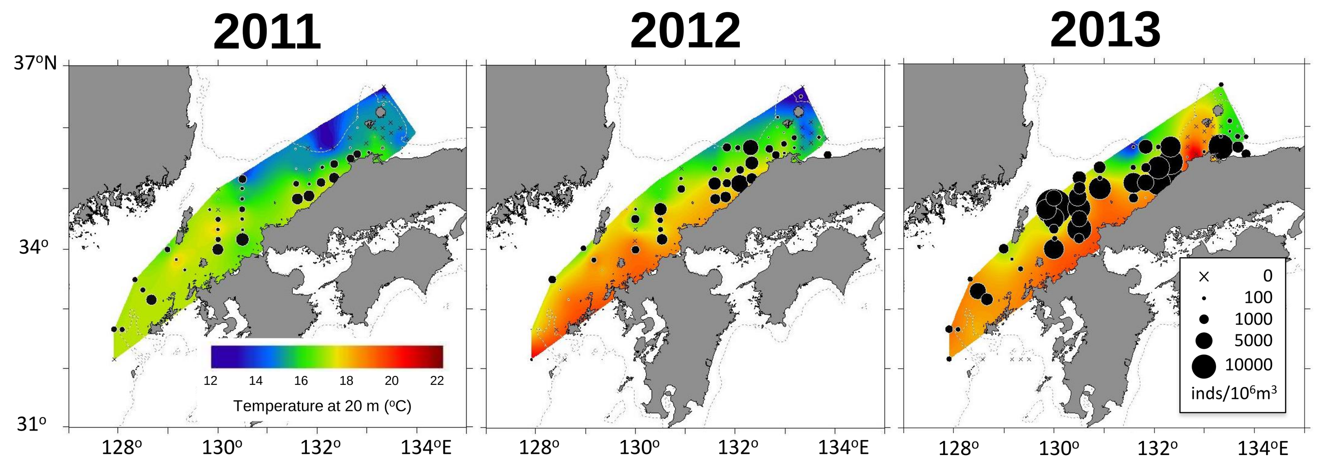


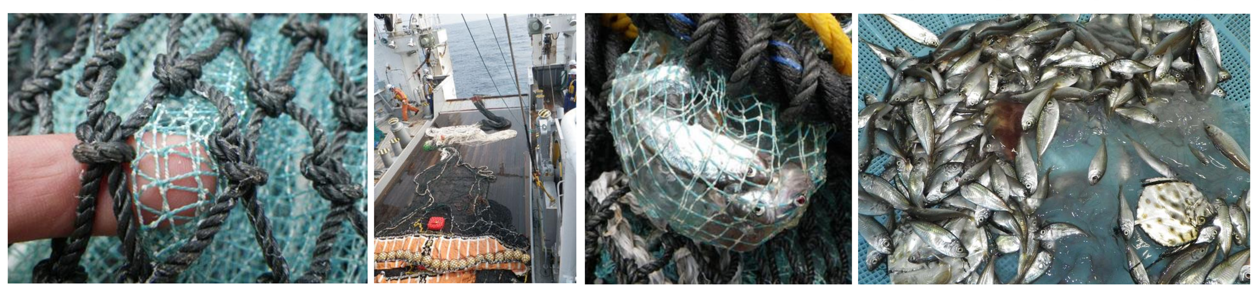
Otolith increments may tell us the answer!

Approach

Growth analysis

1. Early juveniles were collected in the juvenile survey using a mid-water trawl in May-June during 2011-2013.
2. SL at age was back-calculated using otolith daily increments based on the Biological Intercept method (Campana 1990).
3. The growth trajectories were examined among the three survey years.
4. Year-to-year differences in temperature and prey abundances were examined.





Environmental monitoring

Environments **at fish collection** were assessed using CTD and zooplankton net.

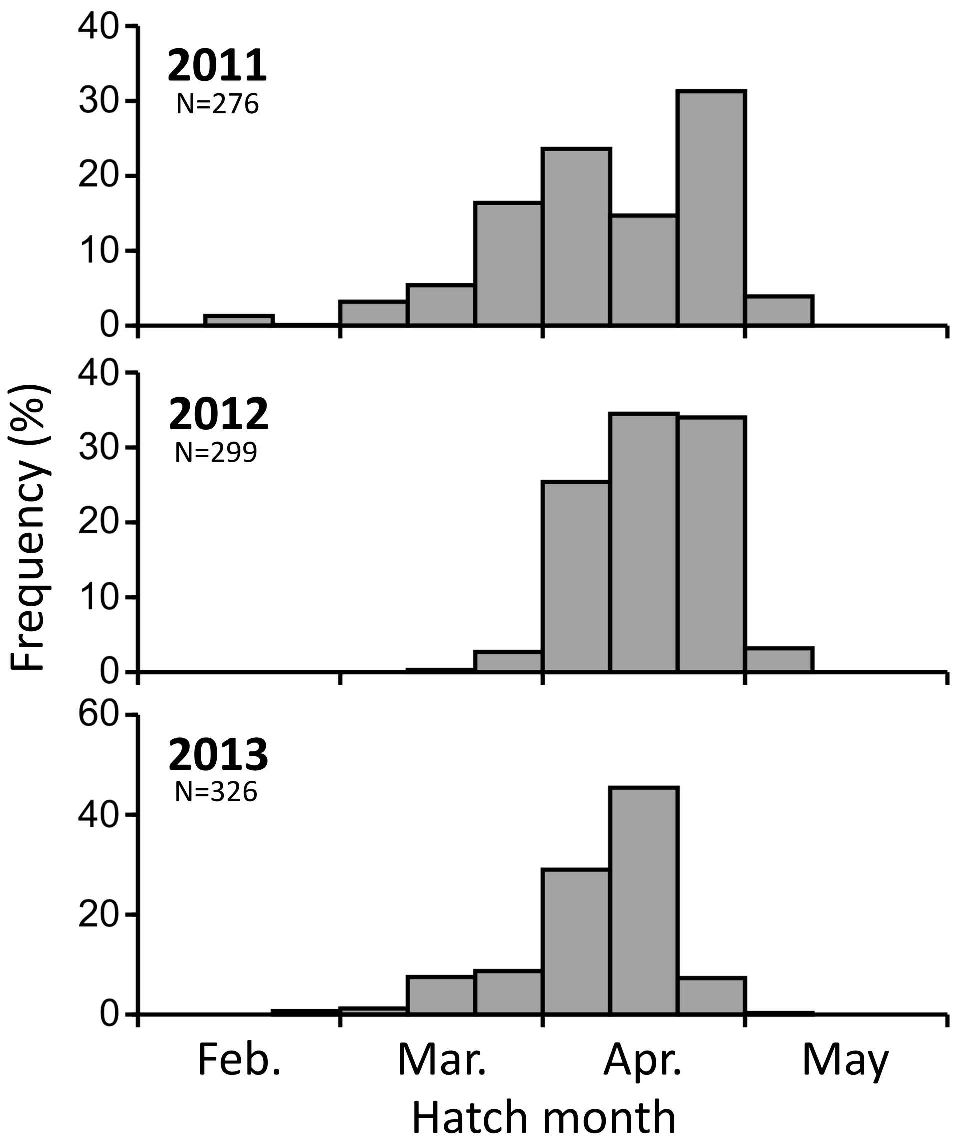
- Temperature at 20 m
- Prey abundance: Sassa *et al.* (2008)
  Paracalanidae (Copepodites + adults)

Environments **from hatching to collection** were examined using satellite data.

- Sea surface temperature (SST)
- Chlorophyll-*a* concentration (Chl-*a*) instead of prey abundance

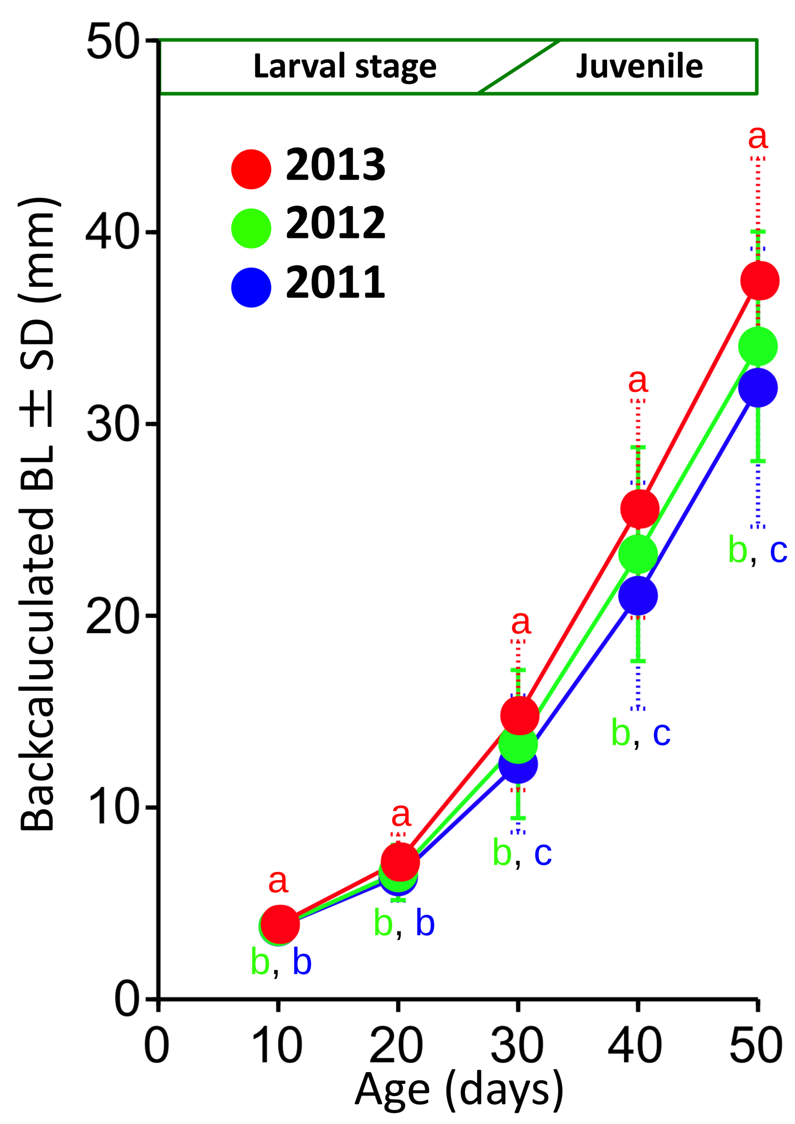
Results

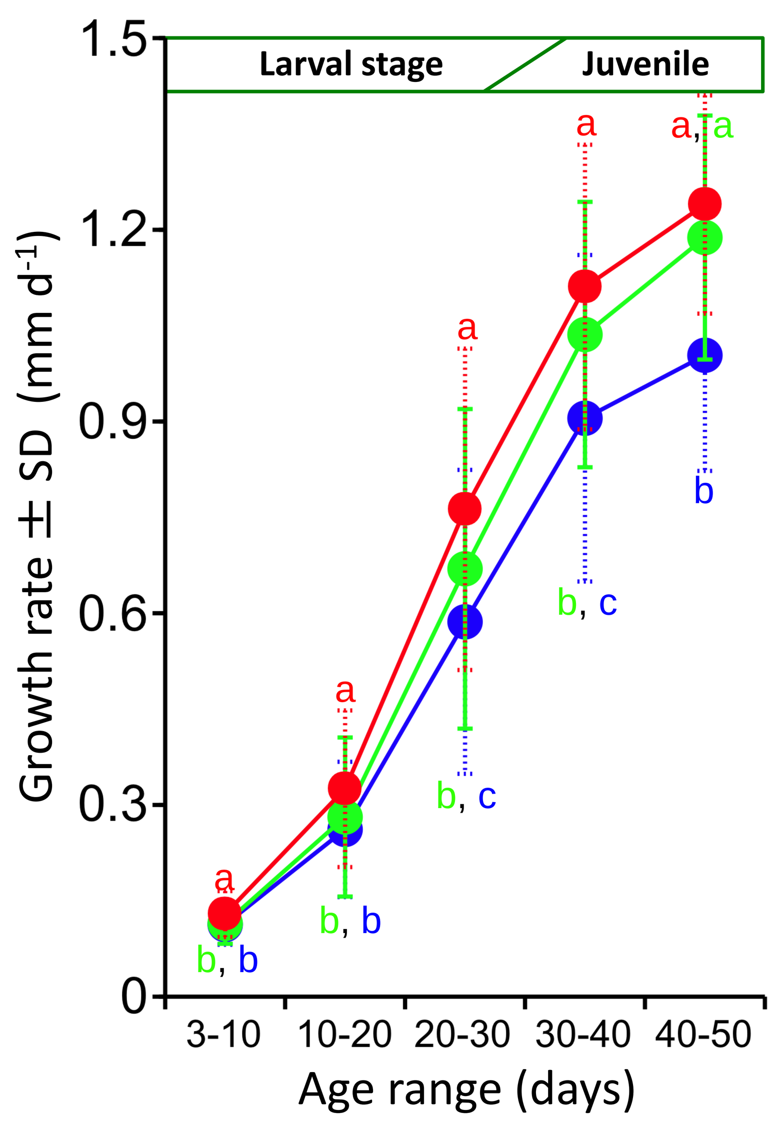
Hatching periods
ANOVA + Tukey-Kramer test



Most juveniles hatched in **April**, although hatch dates in 2012 was significantly later than 2011 and 2013 ($P < 0.05$).

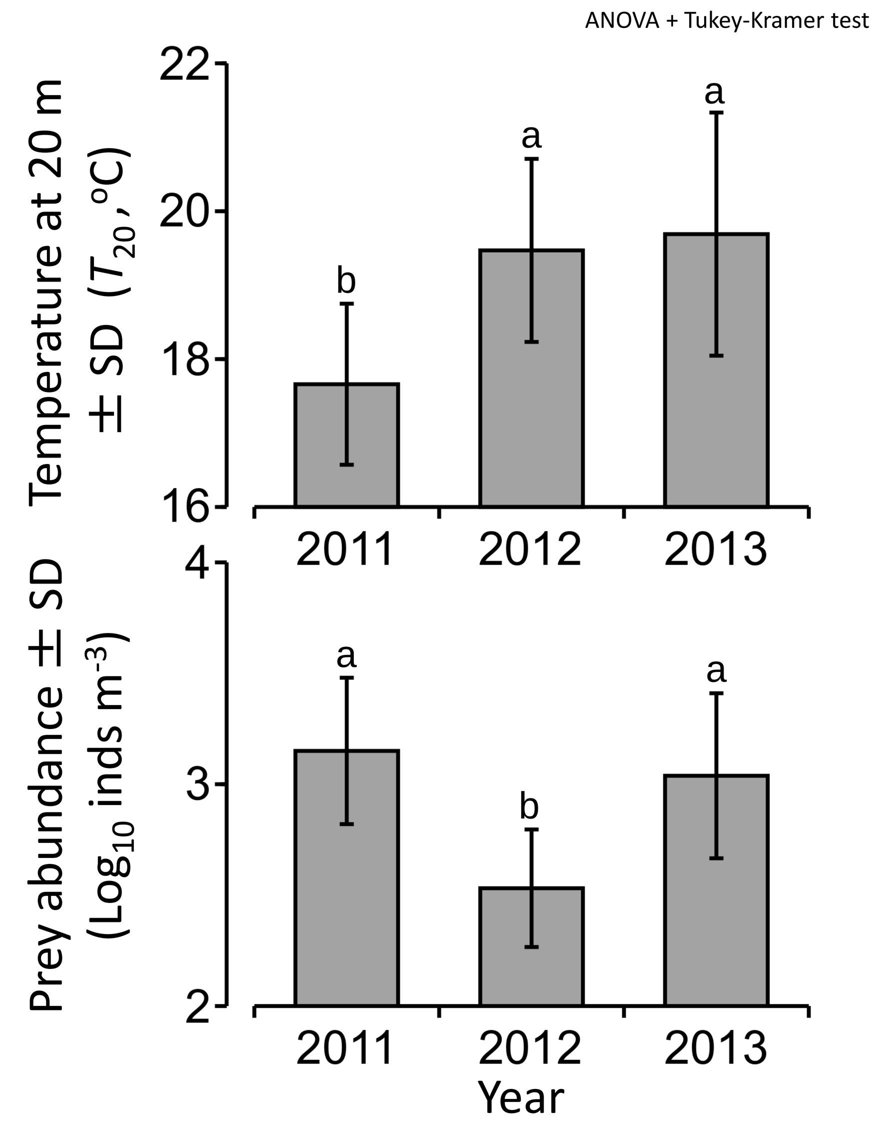
Growth trajectories
Repeated MANOVA + post hoc F test





Mean backcalculated BL during the larval and early juvenile stages in 2013 was significantly larger than the other years. Similar year-to-year difference was found in growth rates.

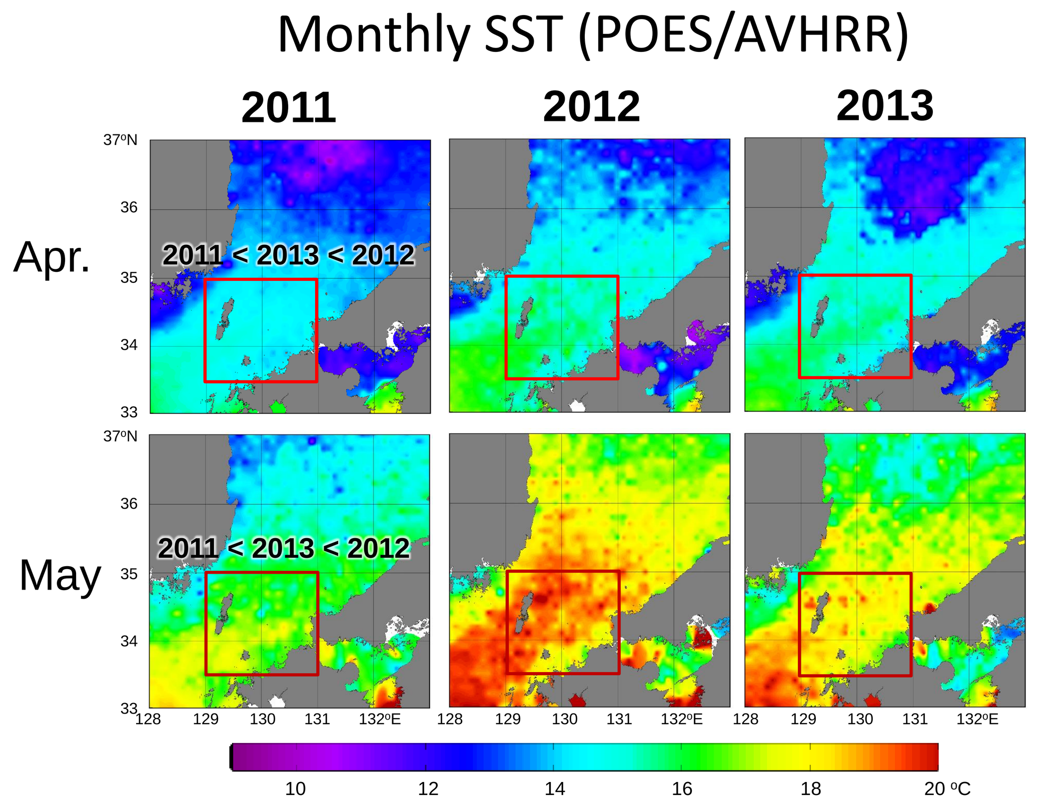
Environments at fish collection
ANOVA + Tukey-Kramer test



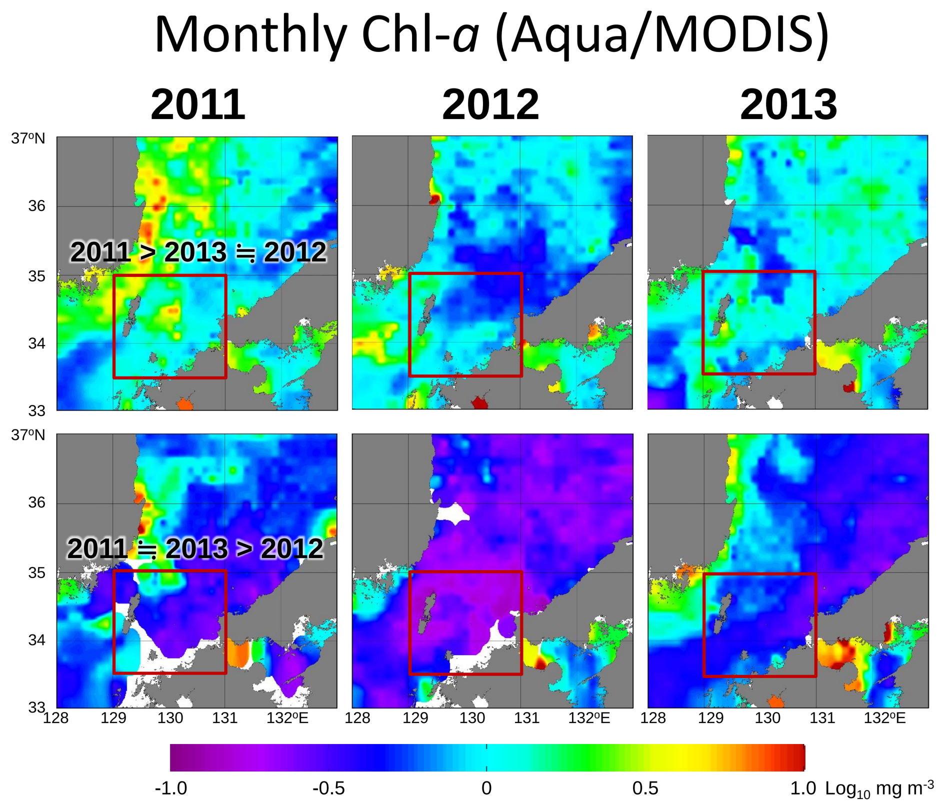
Mean T_{20} in 2011 was 1-2°C lower than the other years. Mean prey abundance in 2012 was lowest among the other years.

Environments from hatching to collection
ANOVA + Tukey-Kramer test

Monthly SST (POES/AVHRR)



Monthly Chl-*a* (Aqua/MODIS)



Mean SST in April and May 2011 at the main spawning area (squares) was significantly lower than that in 2012 and 2013.

Mean Chl-*a* in May 2012 was lower than that in 2011 and 2013, suggesting that food availability for larvae in 2012 was lowest among the survey years.

Conclusion

	2011	2012	2013
Survival (RPS)	Low	Low	High
Growth rate	Slow	Intermediate	Fast
Temperature	Low	High	High
Food availability	High	Low	High

Growth rates during larval stage in 2013 were faster due to higher temperature and prey concentrations than those in 2011 with suboptimum temperature and 2012 with low food availability, and hence resulting in higher survival rates (RPS).

Acknowledgement

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