The effect of environmental factors on distribution of Walleye pollock (*Theragra chalcogramma*) juveniles in Funka Bay and vicinity, Hokkaido, Japan

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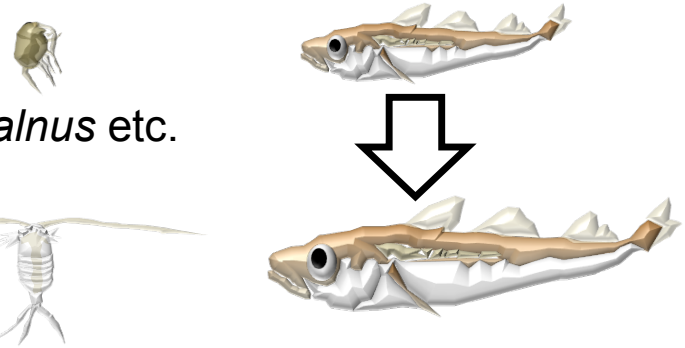
Transition of food organisms for Japanese walleye pollock stock (JPS)

In juvenile stage (3 – 4 months from hatching). . .



Psudocalnus etc.

Neocalanus, Eucalanus etc.

Transition of food organisms

(e.g., Nakatani *et al*. 2003)

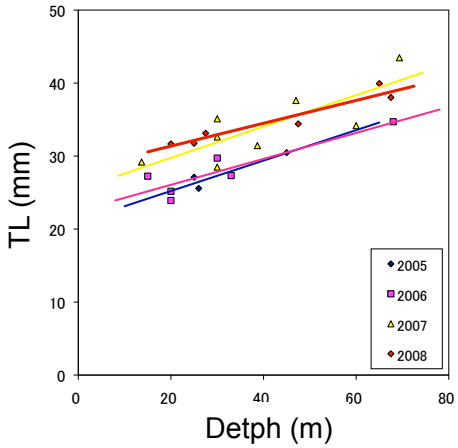
– About 30mm in TL

Spatial/temporal matching between juvenile and plankton body size is important (Kawauchi *et al*. 2011)

Large juv. → Oyashio current water
(Deep, Cold and Salty)

Small juv. → Surface water of coastal Oyashio current
(Shallow, Warm and Sweet)

They can feed foods appropriate for each body size



If juveniles grow and survive in the optimal environment
→ Larger body size in the after life stages & Low prey
→ Improvement of survival potential to recruitment (Yamamura 2012)

Diel vertical migration of JPS

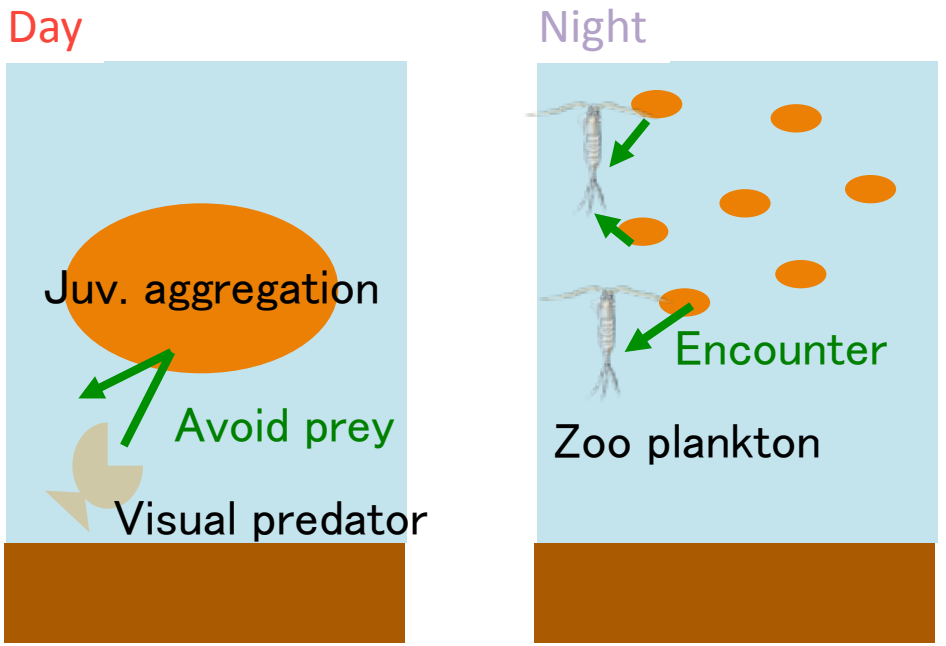
Diel Vertical Migration (DVM) … Changing the distribution vertically during day and night (e.g., Tanaka *et al*. 2009)

Pollock juveniles ...

Day : Large aggregation in mid-water

Night : Scatter or float

(Miyashita *et al*. 2004; Shida *et al*. 2008)



Stay in the suitable environment using DVM is important

But, **not** enough knowledge around **Funka Bay (FB, Main spawning and feeding ground)**

Objectives

- To reveal diel change of juvenile distributions and environments
- To verify the feeding habitat in the transition period

Materials

Period: Mid May 2011

Area: Inside and Outside of FunkaBay

R/V: Ushio-maru & Kinsei-maru (only NORPAC net)

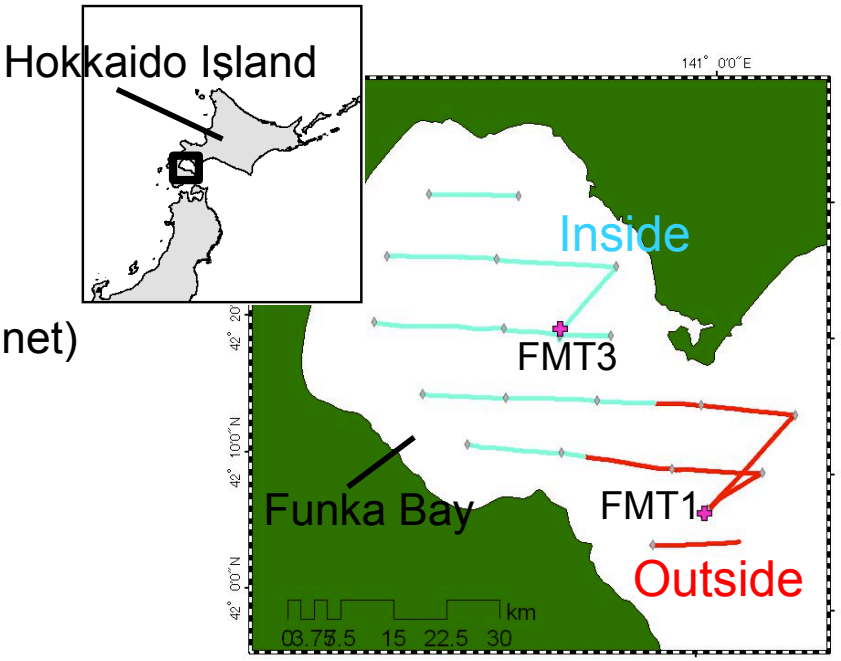
Contents:

- Oceanographic observation by CTD
  - In fixed points & towed points by FMT net

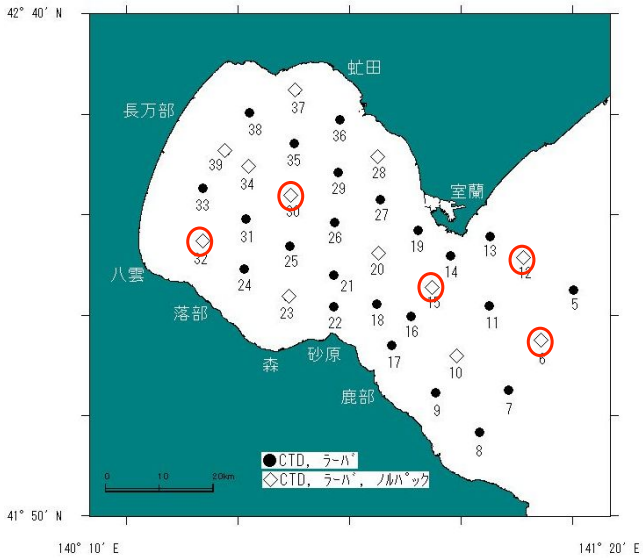
- Acoustic measurement by quantitative echosounder（38kHz, Simrad, in day and night）
  - Assumed that all echo above 100m in depth are juvenile's（Funamoto 2010）

- Collecting juvenile samples in each water-mass by FMT net(in day and Night, above and below 33.0psu)
  - TL mesurement & gastric contentsnalysis

- Collecting zooplankton samples by NORPAC net (day, above 33.0psu and all layer)



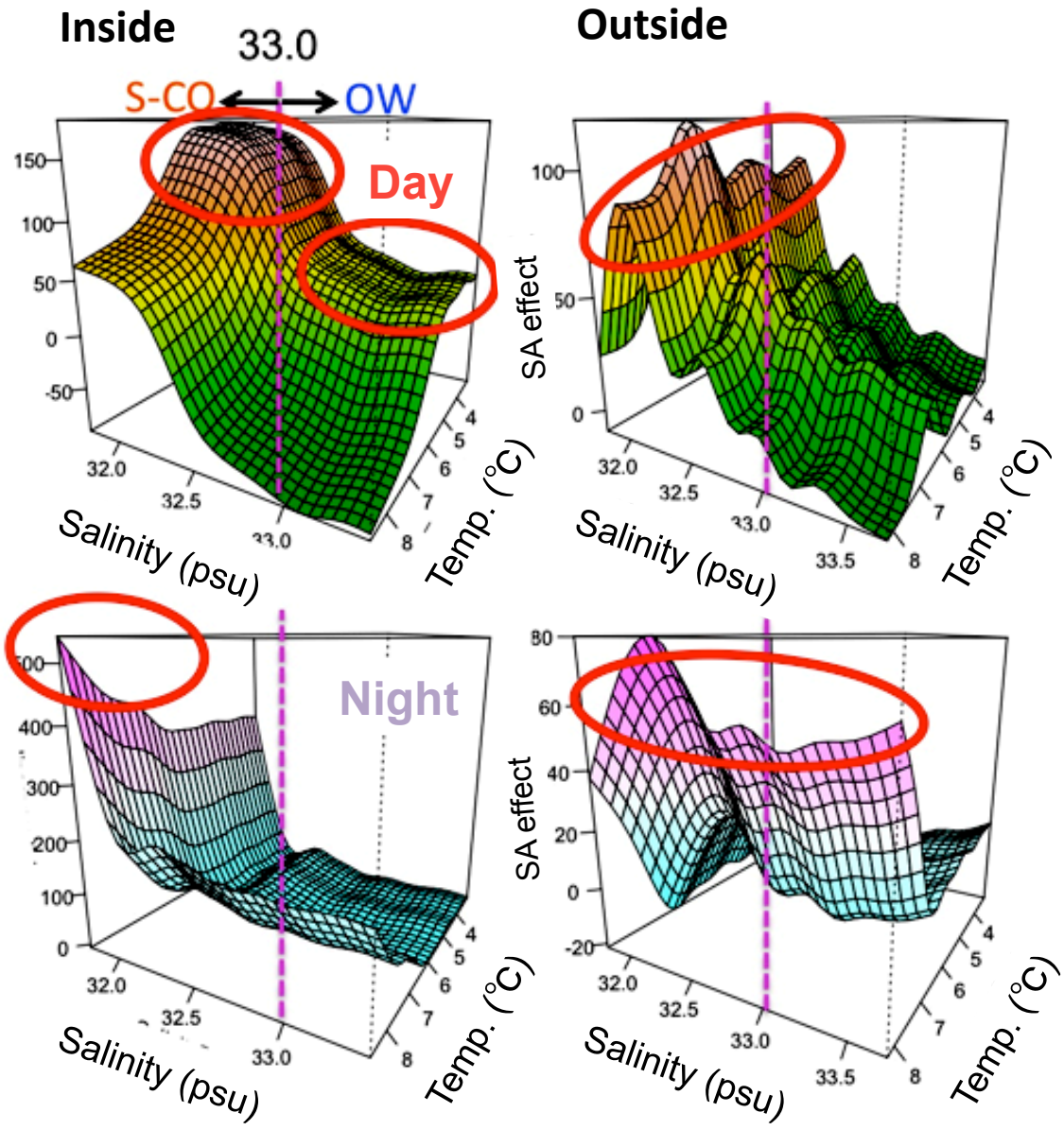
↑ Lines & points by Ushio-maru

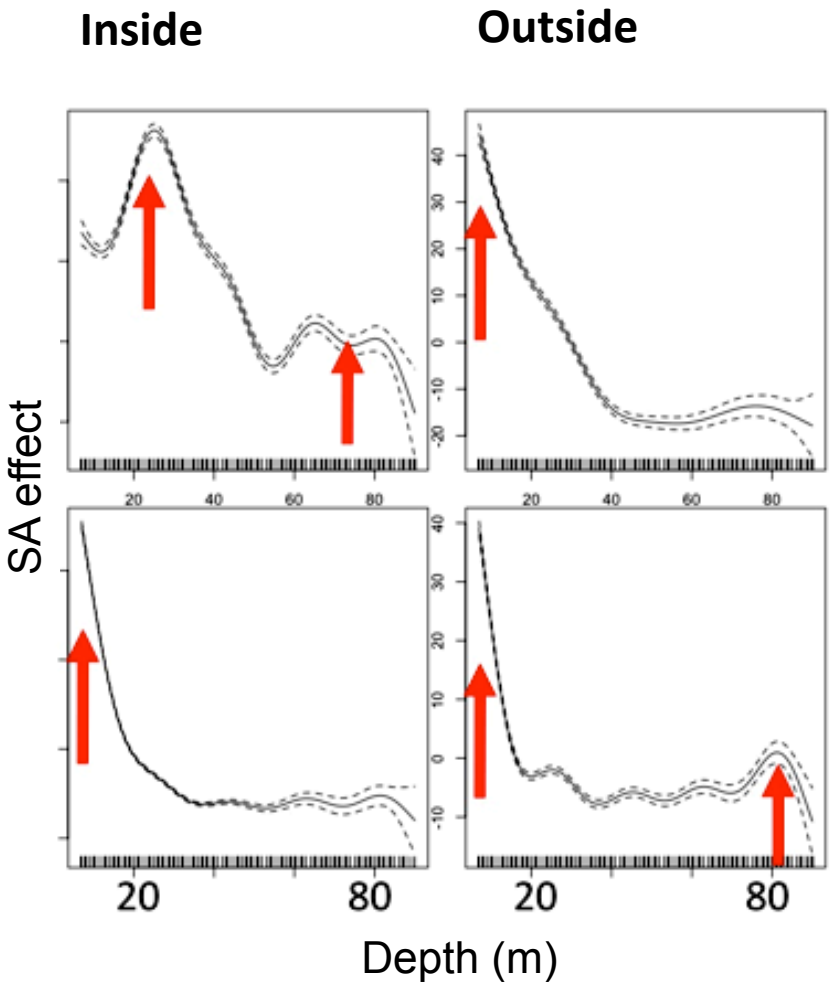


↑ ○ indicates NORPAC point by Kinsei-maru

Ⅰ. Juvenile distribution trend for physical environments

Result





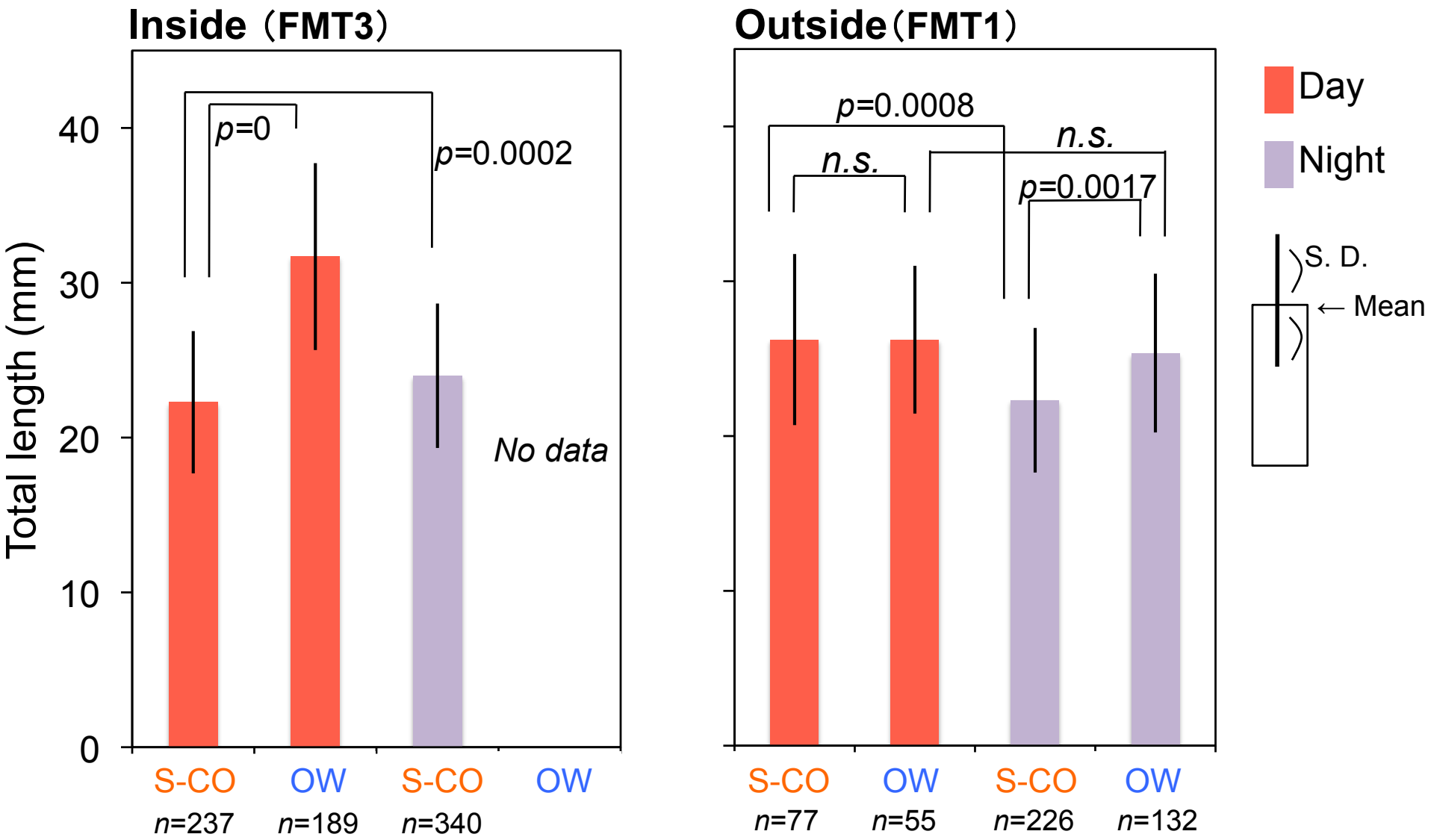
S-CO : Surface water of coastal Oyashio current

OW : Oyashio current Water

Day: Cold

Night: Warm

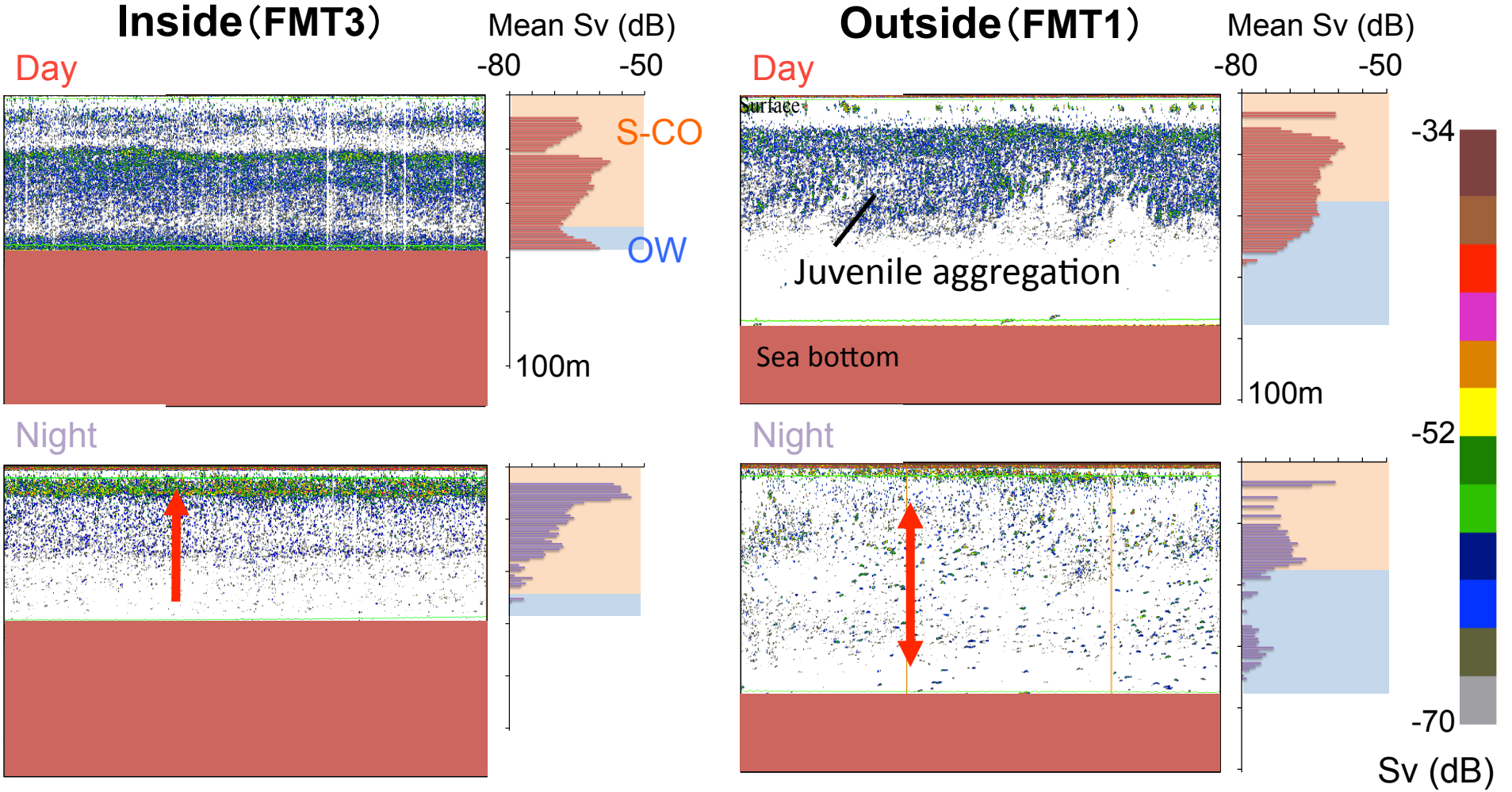
*Generalized Additive Model plot



*P value: Tukey-Crammer multiple comparison

Ⅲ. Vertical distributions of juveniles

Result

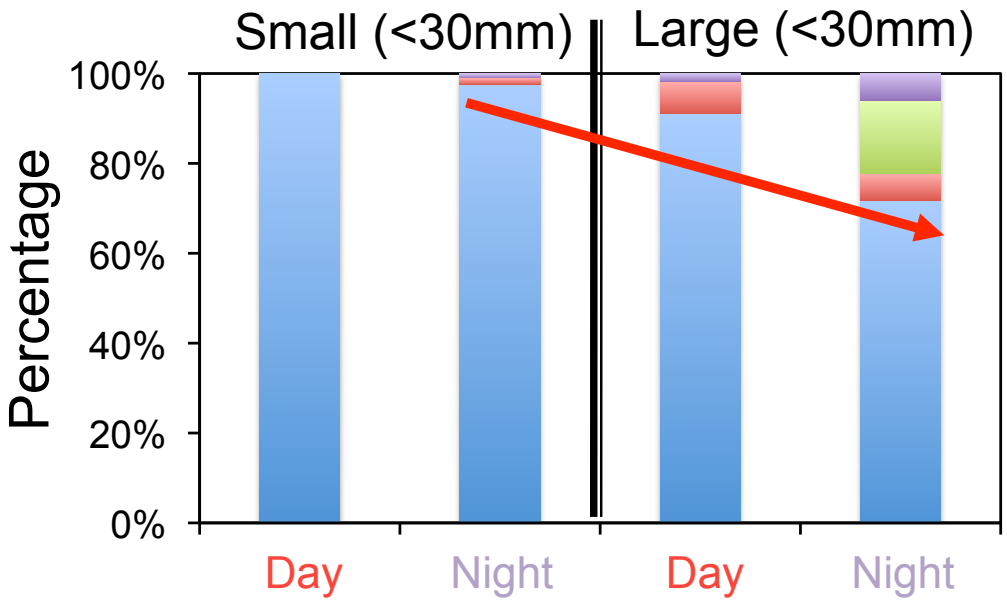


OW: Thin

OW: Thick

Ⅳ. Gastric contents of juveniles

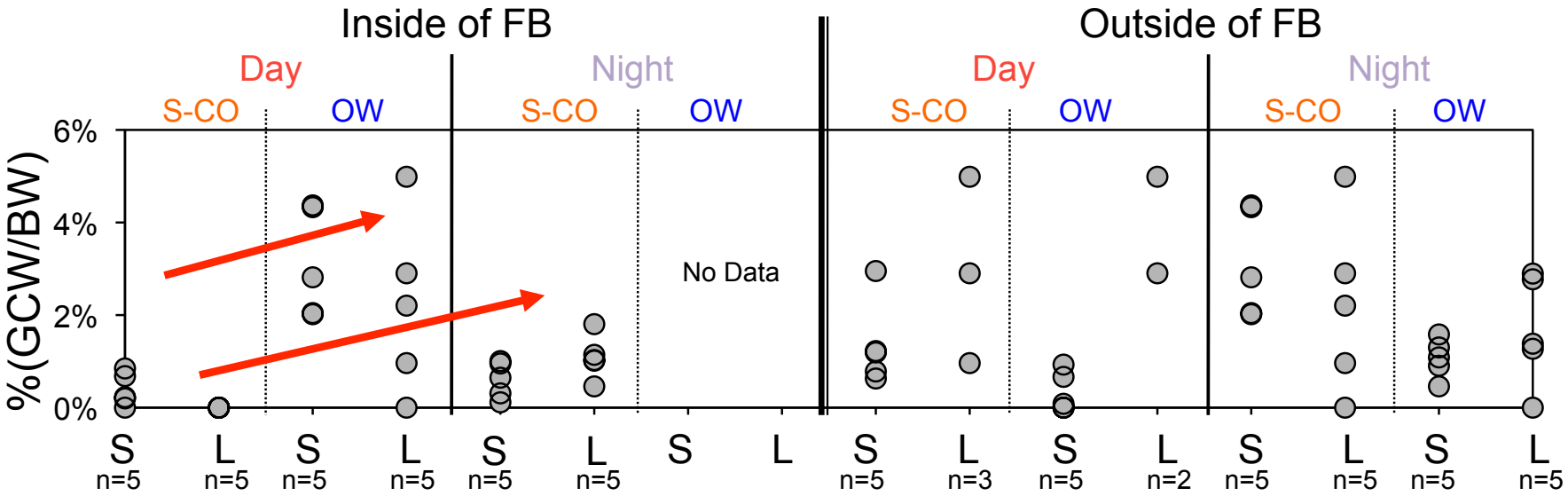
Result



∗ Composition of individual number

- Small copepods (<0.5mm in Body width)
- Large copepods (>0.5mm in Body width)
- Fish egg (0.20 – 0.36mm in diameter)
- Euphausiids

Food size:
Large juv. > Small juv.
Night > Day



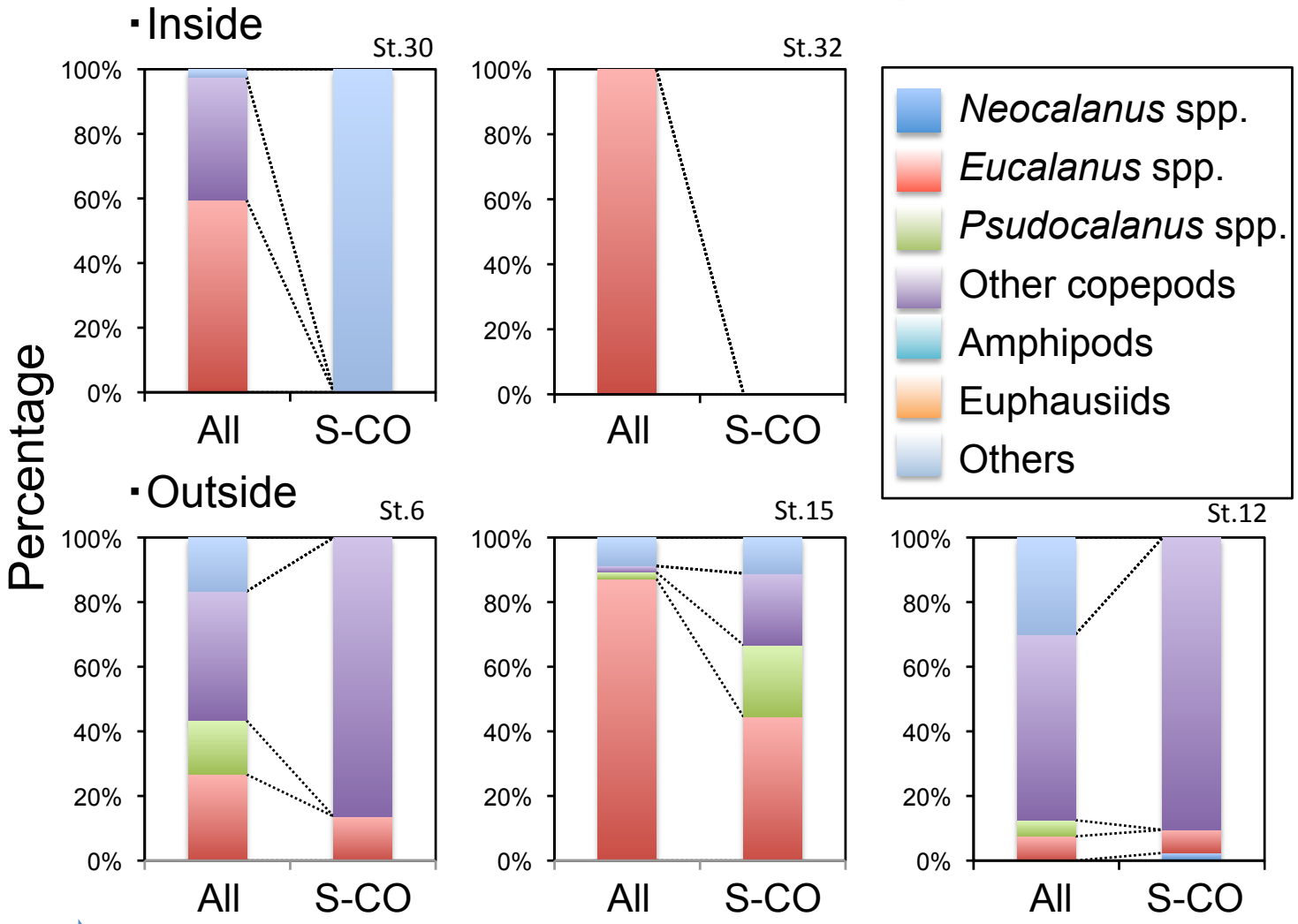
Inside: OW>S-CO & Night>Day

Outside: S-CO≒OW & Day≒Night

*GCW: gastric contents weight, BW: body weight, S: small juvenile , and L: large juvenile

Ⅴ. Zooplankton composition in the vicinity of Funka Bay

Result & Discussion



* Composition of WW
* S-CO : shallower than depth of 33.0psu
* All : from bottom to sea surface

➡ In OW, large juv. could feed large planktons

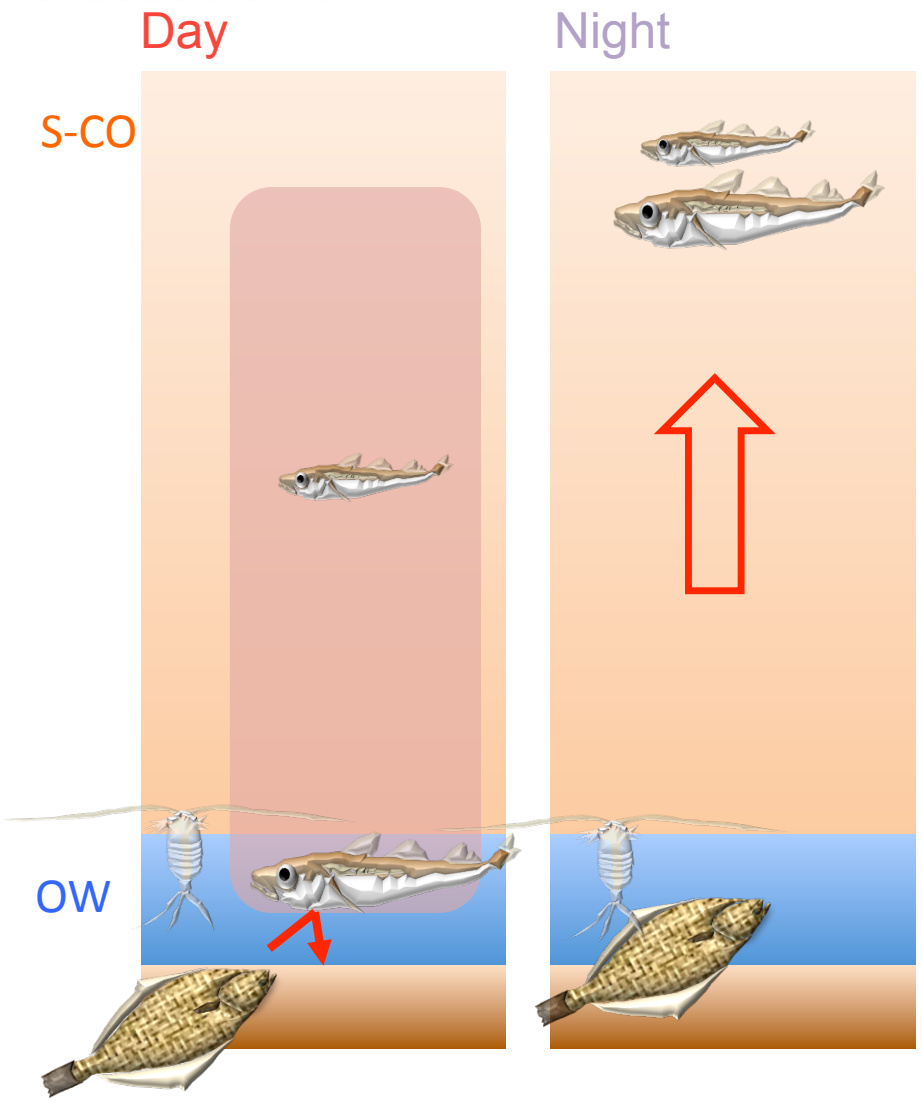
-*E. bungii* do not performs the significant DVM (Schabetsberger et al. 2000)

➡ Outside of FB, juv. could feed small foods in both water-mass

-*Psudocalanus* spp. matches chl. a maximum layer (Yamaguchi 1999)

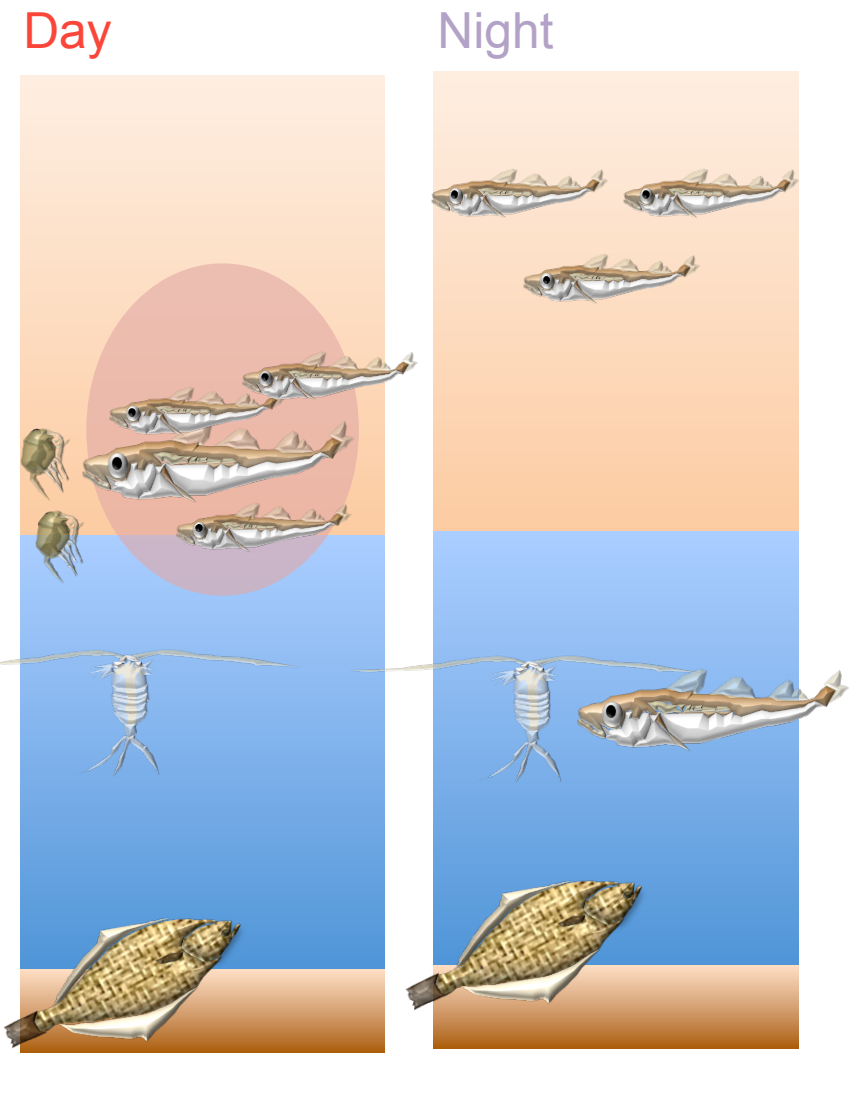
Discussion I

Inside of FB



- Day: Low metabolism in cold water
  Fish aggregation for low prey
- Night: Feeding in warm, bright water
  Large one escape from predator

Outside of FB



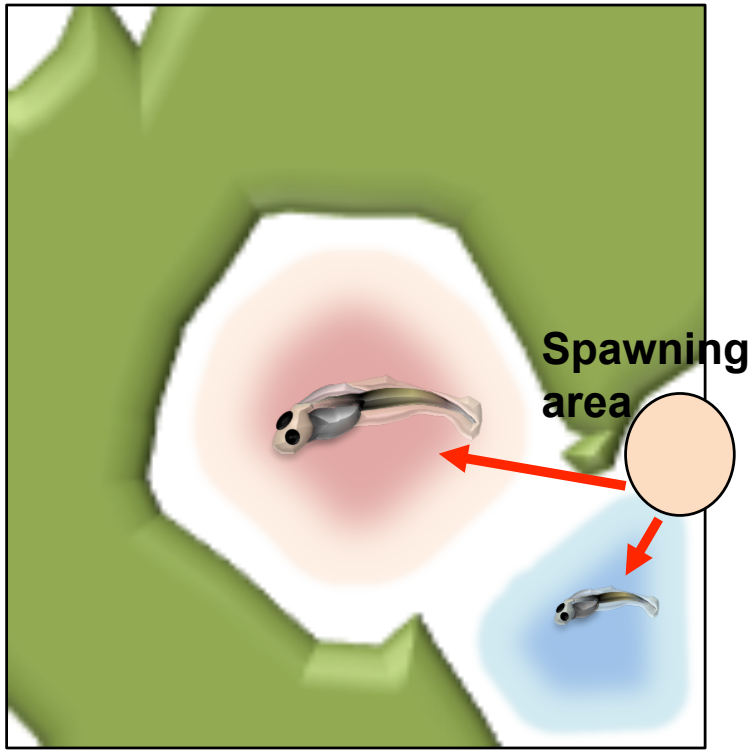
- Day: Fish aggregation in mid-water
  Small copepods were fed
- Night: Feeding in warm, bright water
  Large one descend for large food

Discussion Ⅱ

In the present study,

Inside of FB: Large Juveniles

Outside of FB: Small juveniles



In winter,

Inside of FB: Warm → High growth

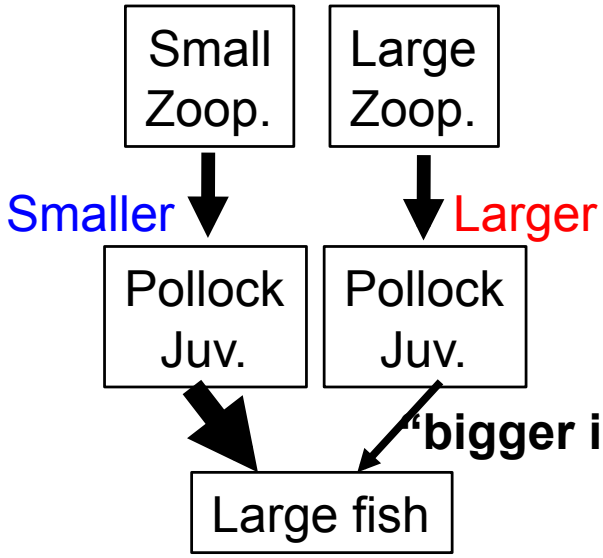
Outside of FB: Cold → Low growth

If pollock can be carried into FB, the growth and survival will be good
(Nakatani and Maeda 1988)

Juveniles outside of FB may not grow and survive well

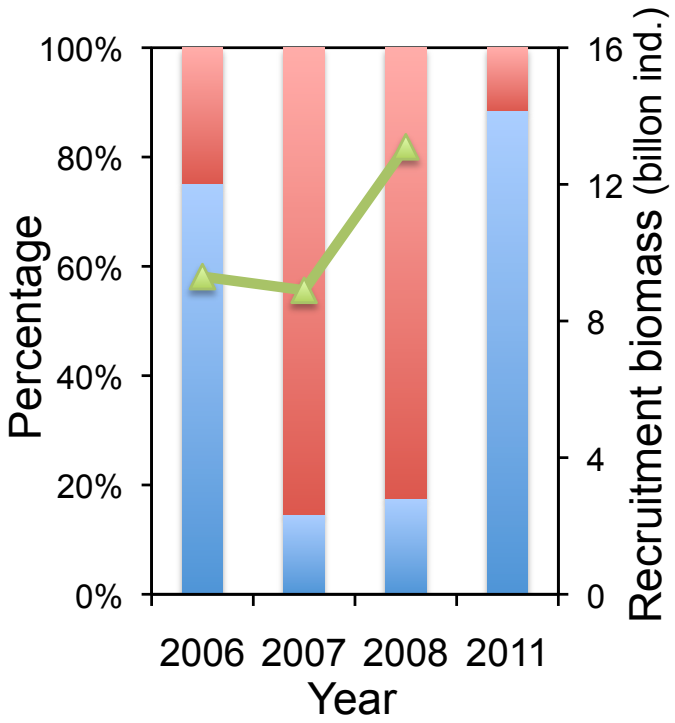
-In late May or June, *Psudocalanus* spp. reduces in FB (Nakatani and Maeda 1987)

Discussion Ⅲ



"bigger is better"

(Modified from Coyle *et al*. 2011)



Large juv. fed large zoop. more than small one

If juvenile feeds large foods, prey by predator in next life-stage may be fewer (coyle *et al*. 2011)

-In 00's, large copepods have incrased (Tadokoro 2012)

But

In 2011, the ratio of large juv. was fewer than recent other years

They might not feed large foods well

- They could not survive well in after life-stage?

As the future works,

Interannual difference of survival will be estimated by analyzing each nutritional status

Acknowledgements

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