Abundance and distribution of micronektonic, mesopelagic fish at the 2007 OECOS observation site (Northwest Pacific)

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Diaphus theta


Stenobrachius leucopsarus

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  - Vertical distribution of micronekton and their prey organism
- **Summary**

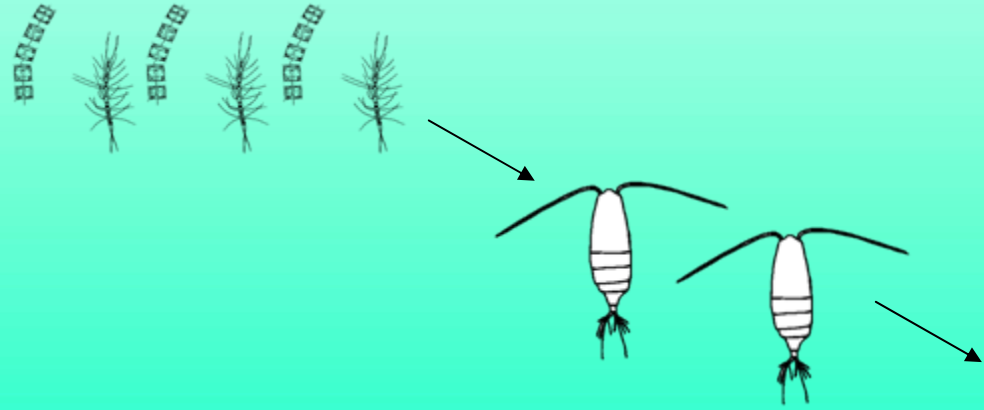
Background and Objective 1

＞Micronektonic mesopelagic fish role in the Marine Ecosystem

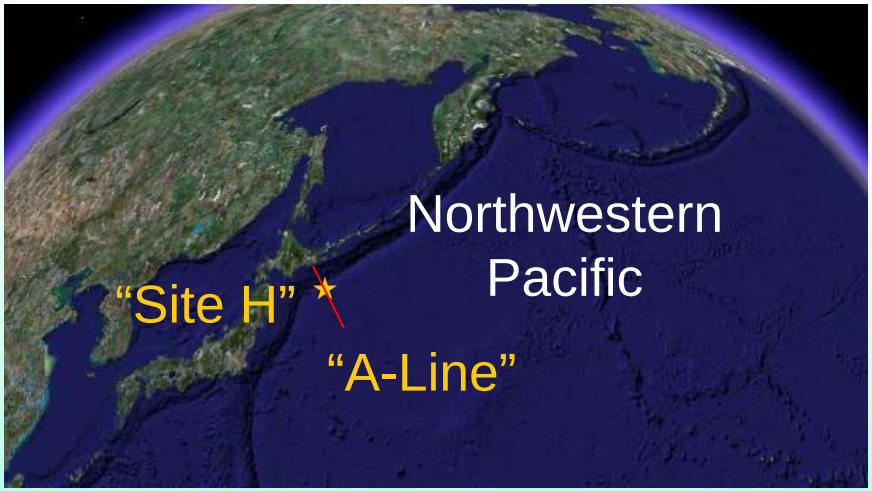
○Zooplankton feeder ○Prey organism for fish, marine mammal
○Huge biomass ○Conduct Diurnal Vertical Migration (DVM)

（Merrett and Roe 1974, Gjosaeter 1984, Hopkins and Gartner 1992, Beamish et al. 1999
Longhurst and Harrison 1988, Hidaka 2001）

→ Important material transporter in the open ocean



Background and Objective 2



~Northwestern Pacific~

Intense study on zooplankton and ocean environment conducted around Site H

(Kobari and Ikeda 1999, 2000, Padmavati et al. 2004, Shoden et al. 2005・・・)

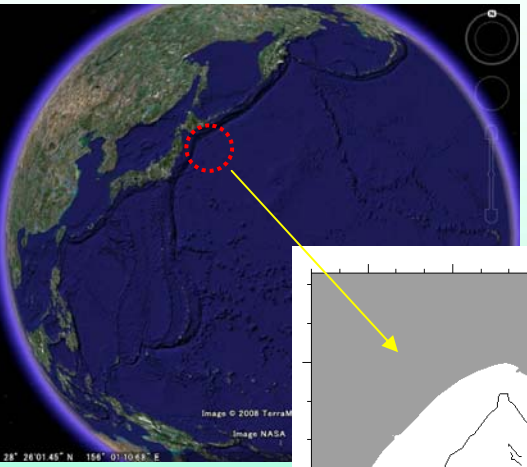
→Information of the next tropic level:
mesopelagic micronekton fish lacking

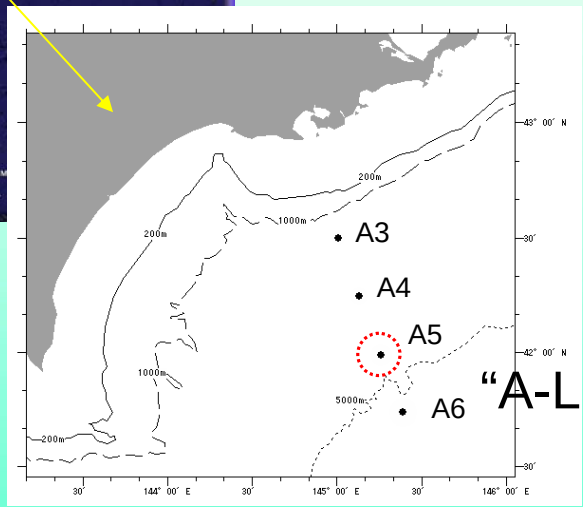
Objective

→Quantify the density and vertical distribution

→Examine their feature of distribution during the blooming

Material and methods - Acoustic survey of the OECOS west

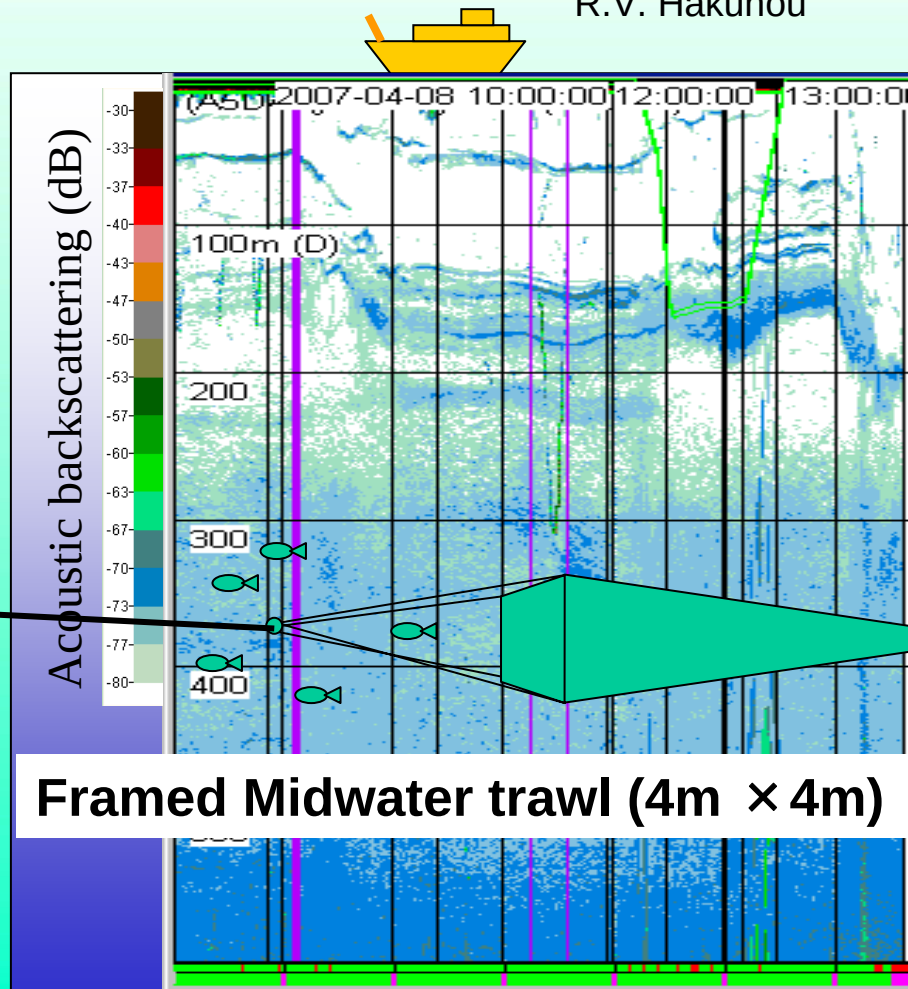




“A-Line”

- **Quantitative Echosounder -FQ80 38kHz**

R.V. Hakuhou



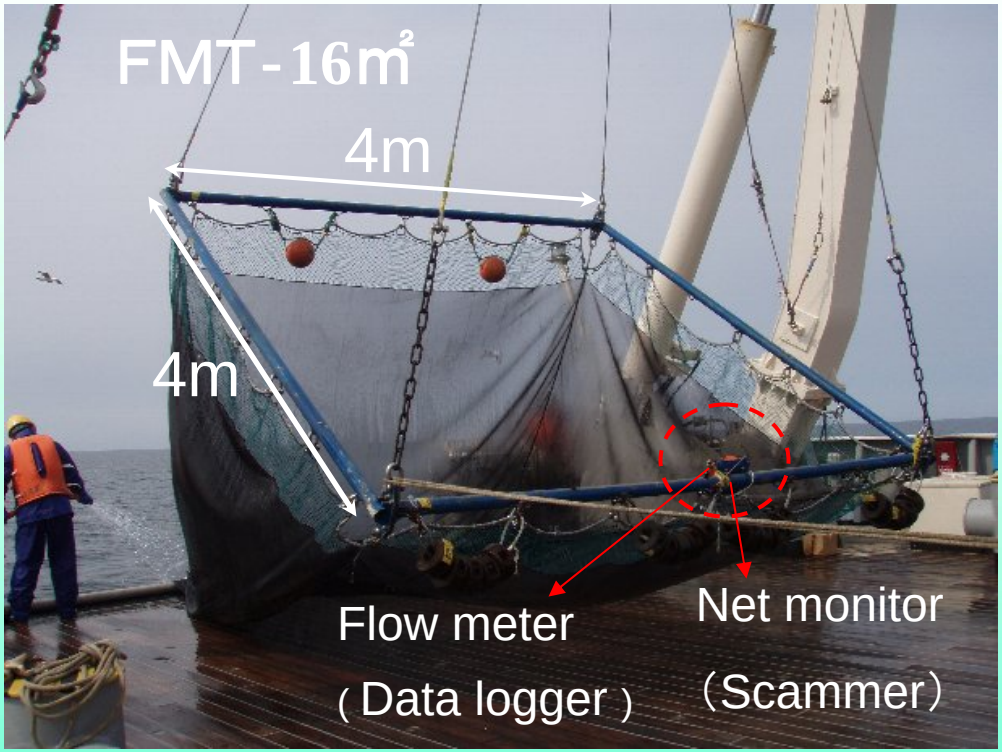
- **Framed Midwater trawl (4m ×4m)**

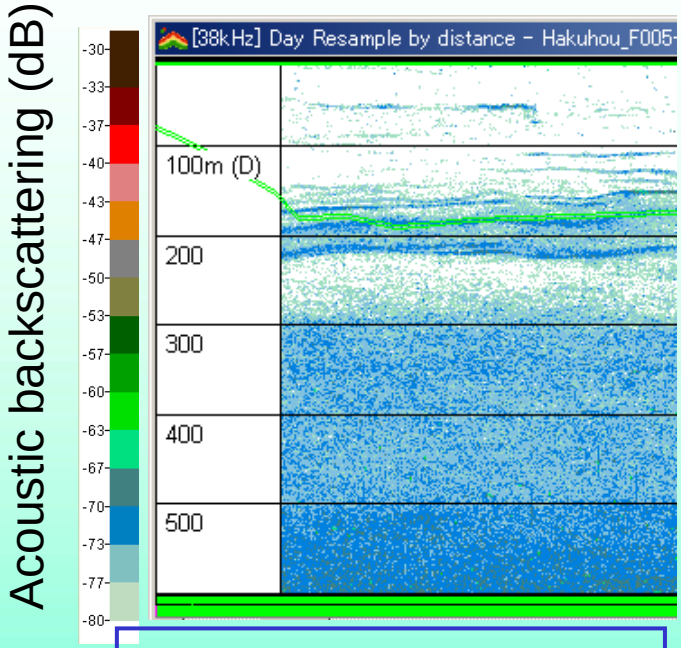
2007/3/9 ~ 3/15

2007/4/5 ~ 5/1

Mar. April. off Kushiro, Hokkaido

Material and methods: Framed Midwater Trawl (FMT) for biological sampling





●Confirm the echo

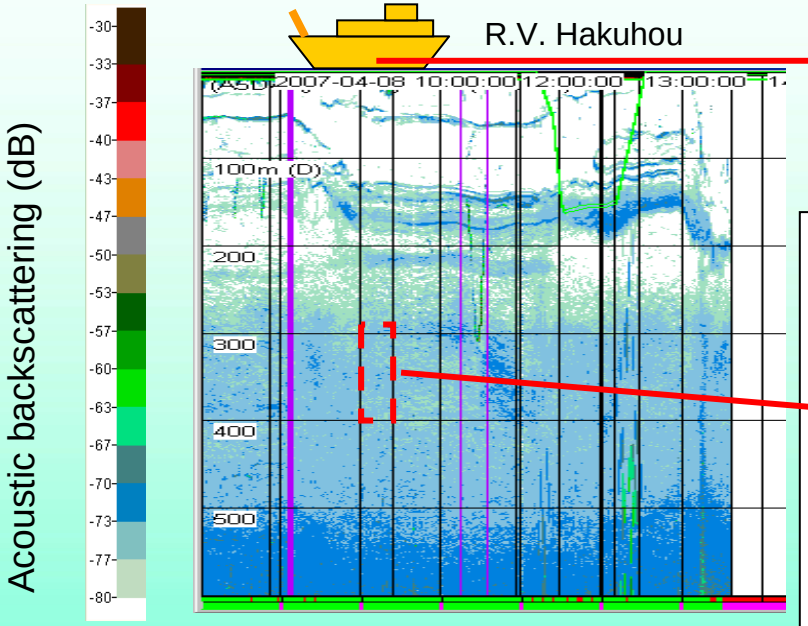
→Tow for 20 min.

Fixed opening. Data logger attached to measure the flow velocity at the mouth.

＊Problem of net avoidance → Under estimation

Acoustic estimation several to several tens higher value (Gjøsæter 1984)

Material and methods: Quantitative echosounder



Quantitative echosounder

FQ80 38kHz

~Basic of density estimation~

$$\frac{\text{Back scattering per cubic meter}}{\text{Back scattering per fish}} = \text{Density of the Target fish}$$

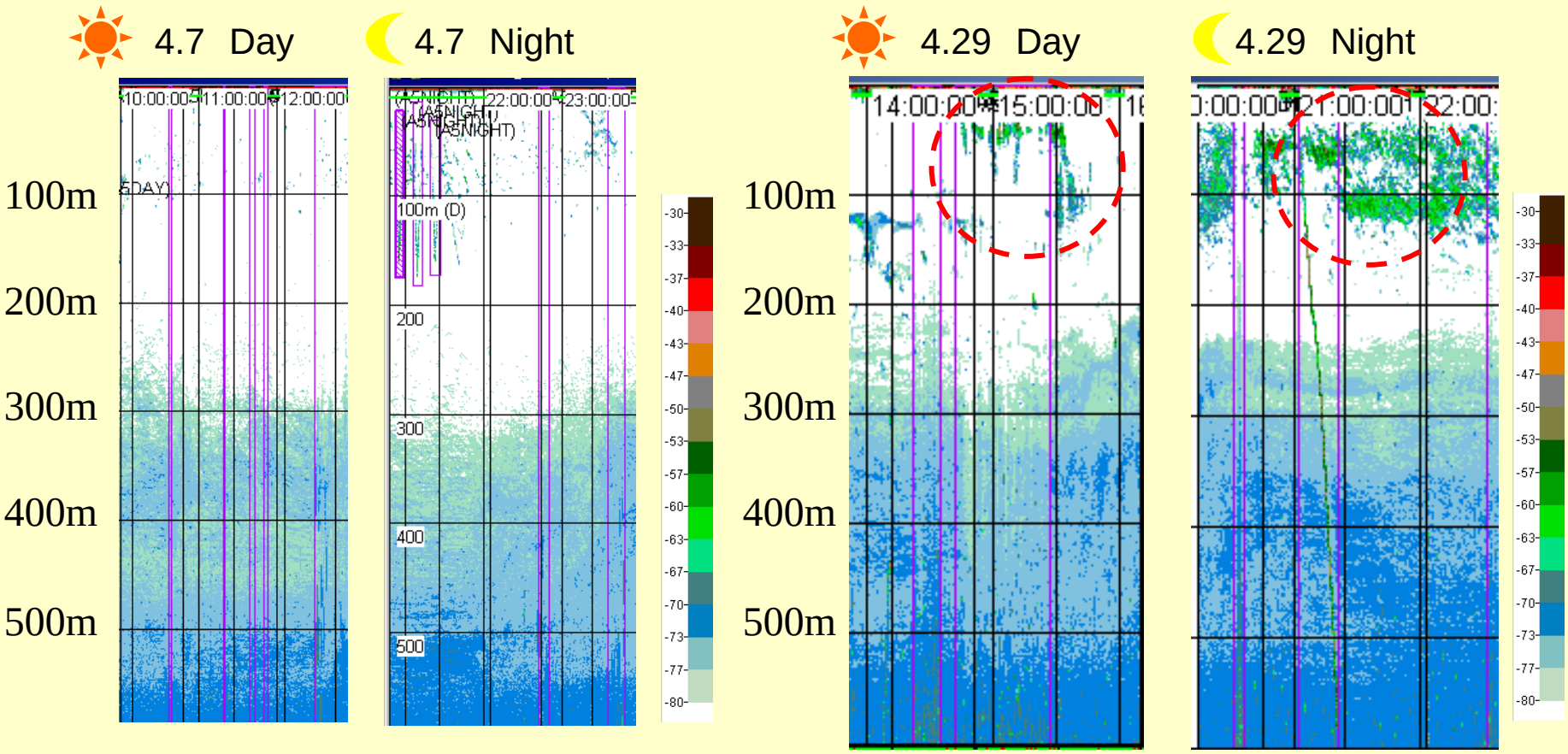
- Obtain continual information of the vertical distribution

＊For interpretation ;

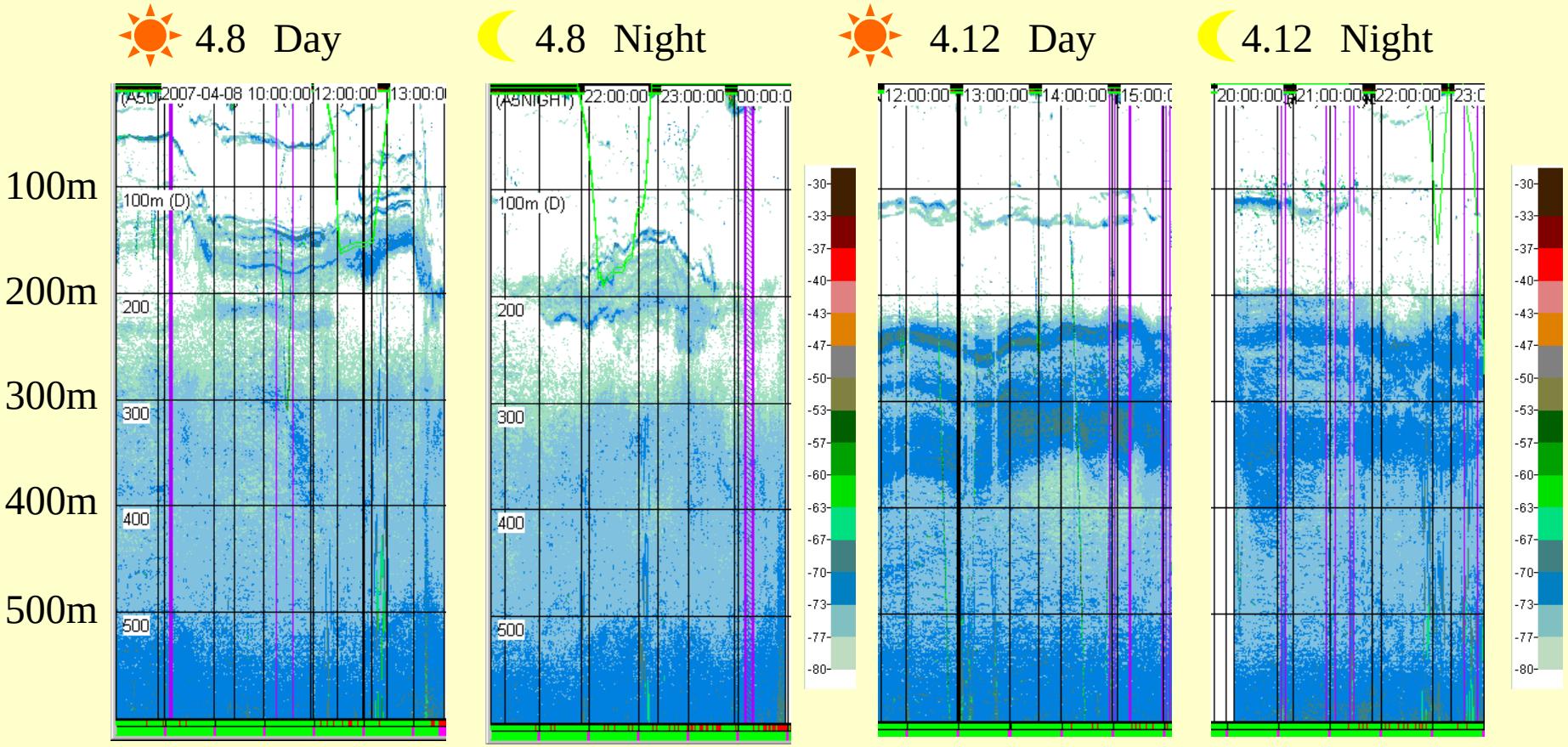
What mainly contributes to the acoustic backscattering ?

How much is the backscattering per fish ?

Results- Vertical distribution pattern observed on the echogram

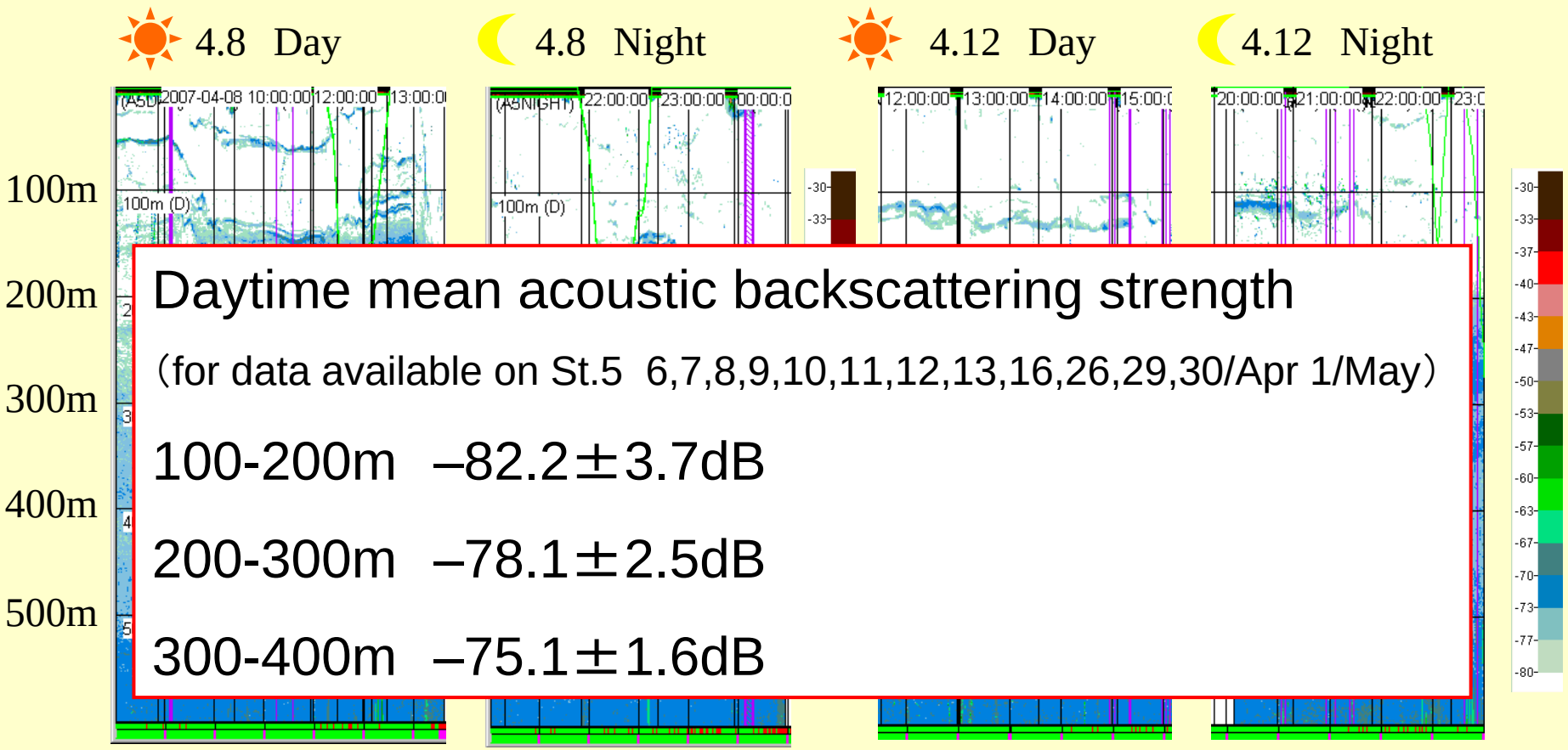


Results- Vertical distribution pattern observed on the echogram



- Echoes observed deeper than 100m.
- Pattern changed, though obvious diurnal pattern was not observed

Results- Vertical distribution pattern observed on the echogram



- Echoes observed deeper than 100m.
- Pattern changed, though obvious diurnal pattern was not observed

Results - Biological Sampling ①

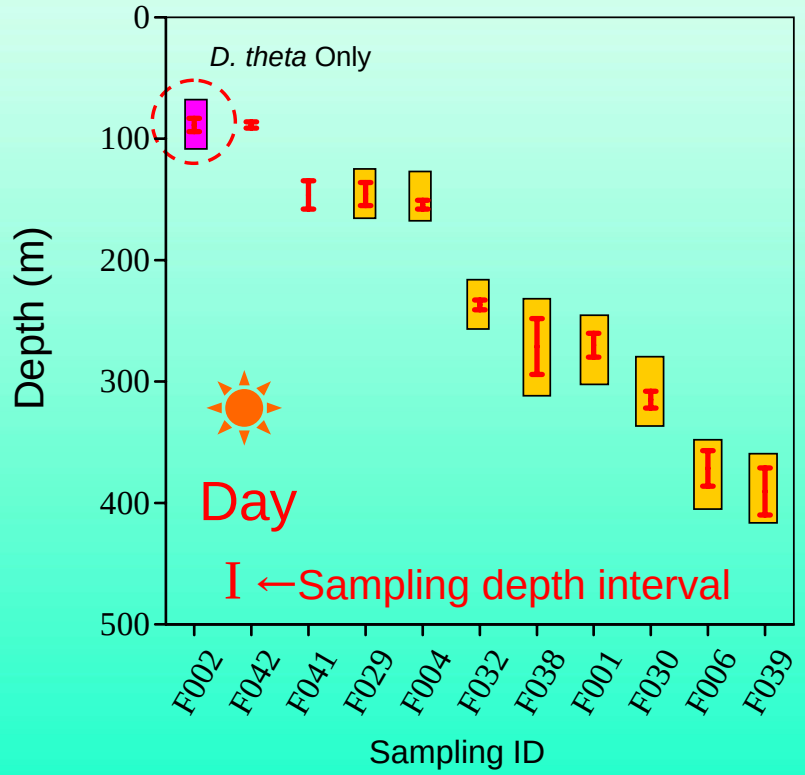
Most dominant species

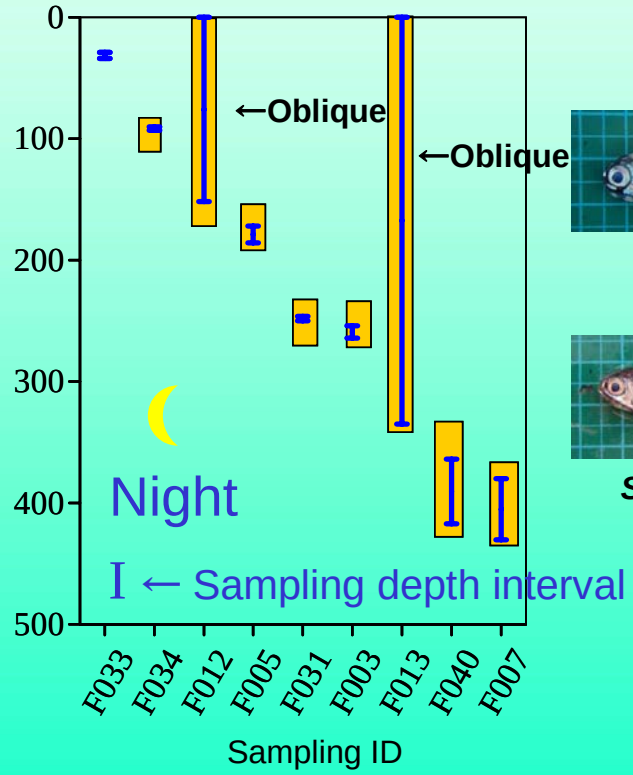
Day 11 tow Depth 136-410m Night 9tow Depth 0-417m

Dominant species: *Diaphus theta, Stenobrachius leucopsarus*

Numercial proportion of *D. theta* and *S. leucopsarus* to the total catch number

Day Mean 71.5% (38.3-100%) Night Mean 57.7% (23.8-81.8%)





D. theta

S. leucopsarus

I ←Depth sampled *Diaphus theta* and *Stenobrachius leucopsarus*

Results-Biological sampling②

Other dominant species

Lipolagus ochotensis, Leuroglossus schmidti, Gonostama gracile

→ Numerical proportion was high in some sampling, however, proportion in weight was small

Ex.) Sampling ID F030 (Day)

Lipolagus ochotensis in number 41.3% → in weight 15.0%

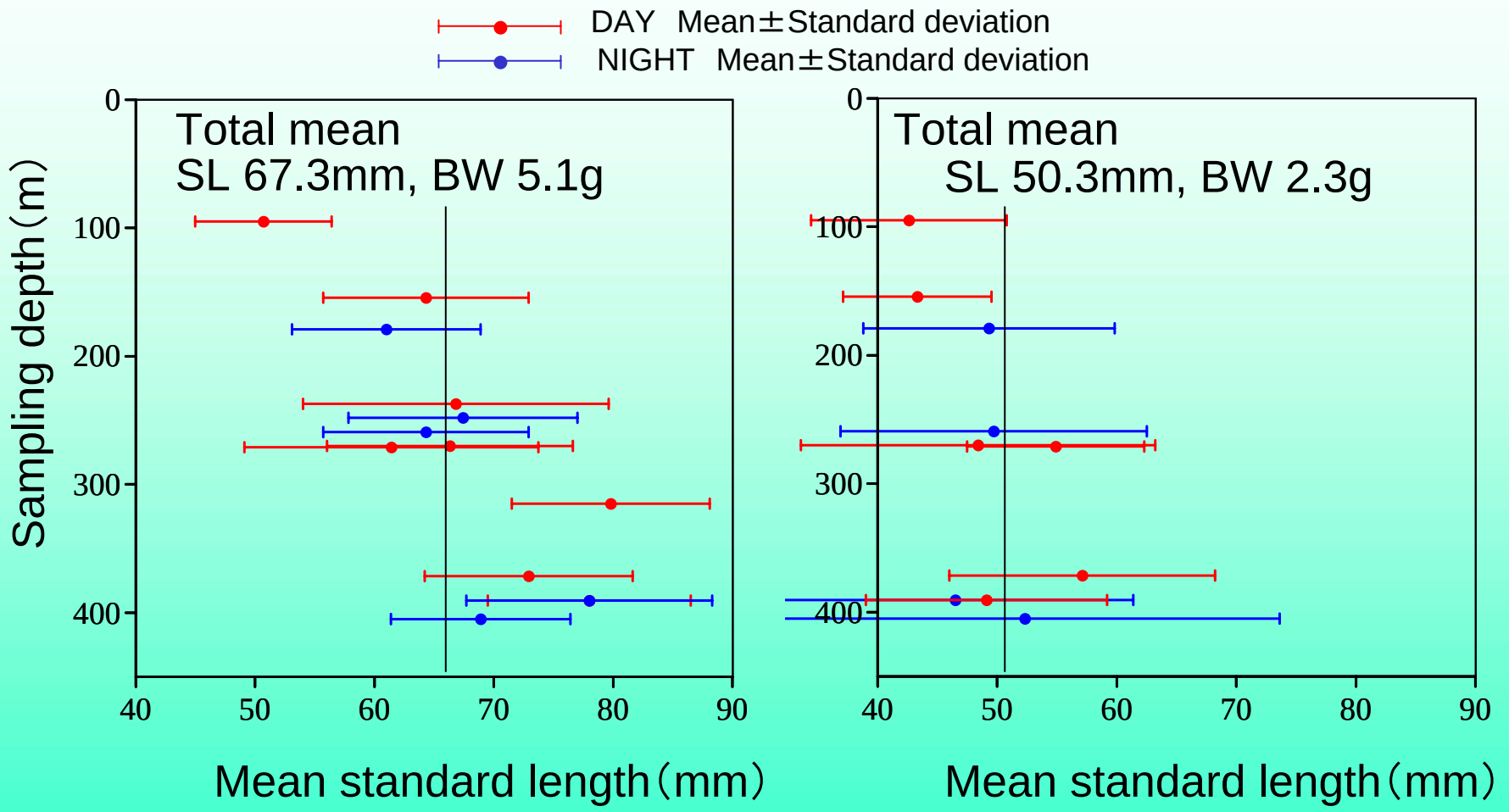
Sampling ID F031 (Night)

Lipolagus ochotensis in number 68.9% → in weight 32.1%

- Number of cephalopod was low

Results-Biological sampling③

Size of the most dominant myctophid species



Diaphus theta

Stenobrachius leucopsarus

Results-Density estimation

From biological sampling;

Diaphus theta, Stenobrachius leucopsarus are the most dominant species.

From acoustic point of view;

・Dominant species in size has must have a great contribution.

・*D. theta* carries swimbladder, which has a large contribution to the acoustic scattering.

→Acoustic data most likely reflects the density of the dominant myctophid species

・Acoustic back scattering strength of *D. theta* and *S. leucopsarus* is investigated by Yasuma et al. (2006) and Yasuma et al. (2003).

Results-Density estimation

Considering *D. theta, S. leucopsarus* contributes most of the acoustic scattering,

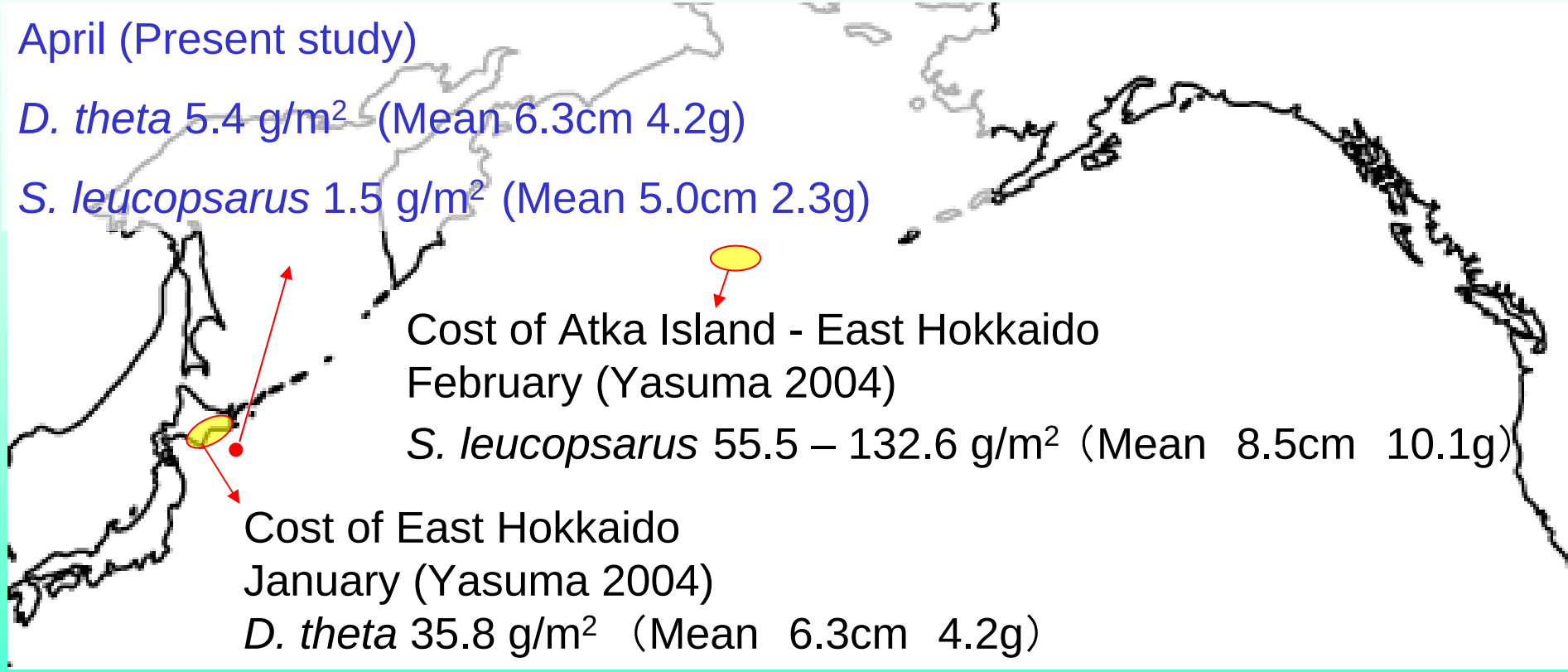
Daytime100-400m depth interval
Mean backscattering strength per 1 square meter= -52.8dB
D. theta Mean target strength= -56.6 dB (SL 67.3mm)
S. leucopsarus Mean target strength= -75.4 dB (SL 50.3mm)

Mean density per 1 square meter (100-400m) ;

D. theta 5.4 g/m^2 *S. leucopsarus* 1.5 g/m^2

Discussion - Comparison of density with other reports①

~Other reports of density derived from Acoustic Methods~



>Relatively low abundance at the OECOS west survey point

Discussion - Comparison of density with other reports②

Possible reason of the relatively low abundance

- Regional difference between the shelf slope and open ocean
- Effect of the Spawning migration (Subarctic → Transition region)

＜Spawning season＞

D. theta : Late March ~ Early September, Peek in May ~ July

Moku et al. (2003)

S. leucopsarus : February ~ March

Tanimata (2008)

Discussion - Comparison of density with other reports②

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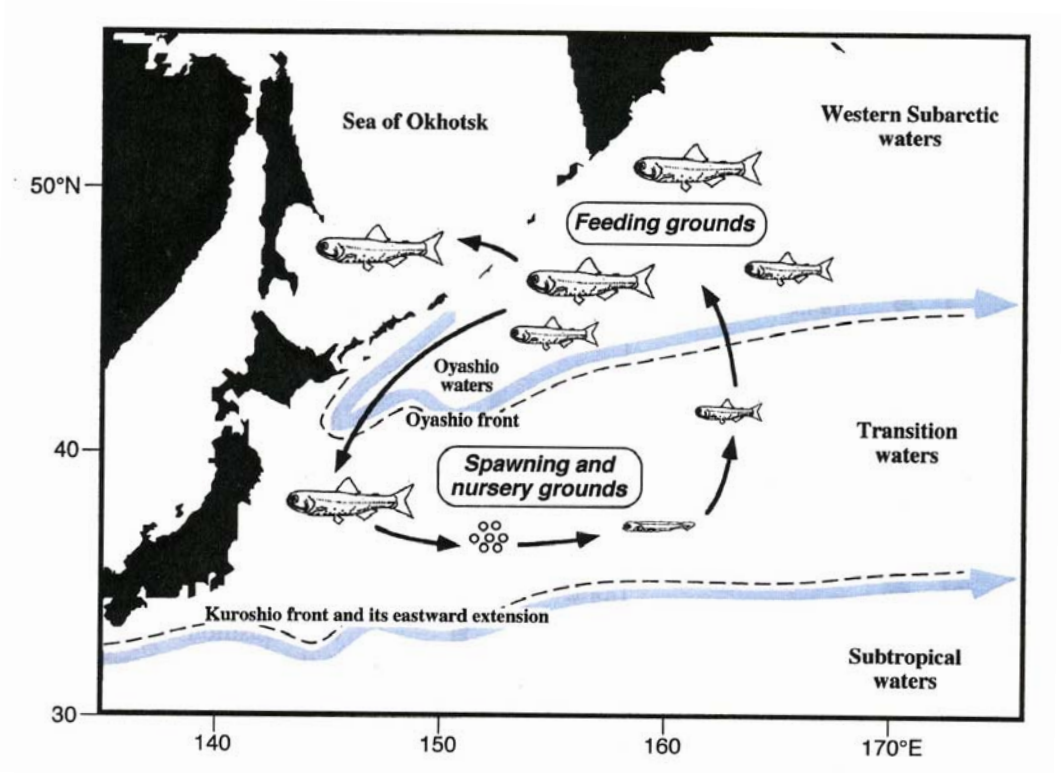


Schematic of migration of *D. theta* by Moku et al. (2002)

Discussion - Vertical distribution①

Watanabe et al. 1999 off Tohoku (Northwestern Pacific) in July

D. theta

Daytime 300-500m, Nighttime 20-100m (Midwater migrants)

S. Leucopsarus

Daytime 400-700m, Nighttime 20-200m / 400-700m (Semi-migrants)

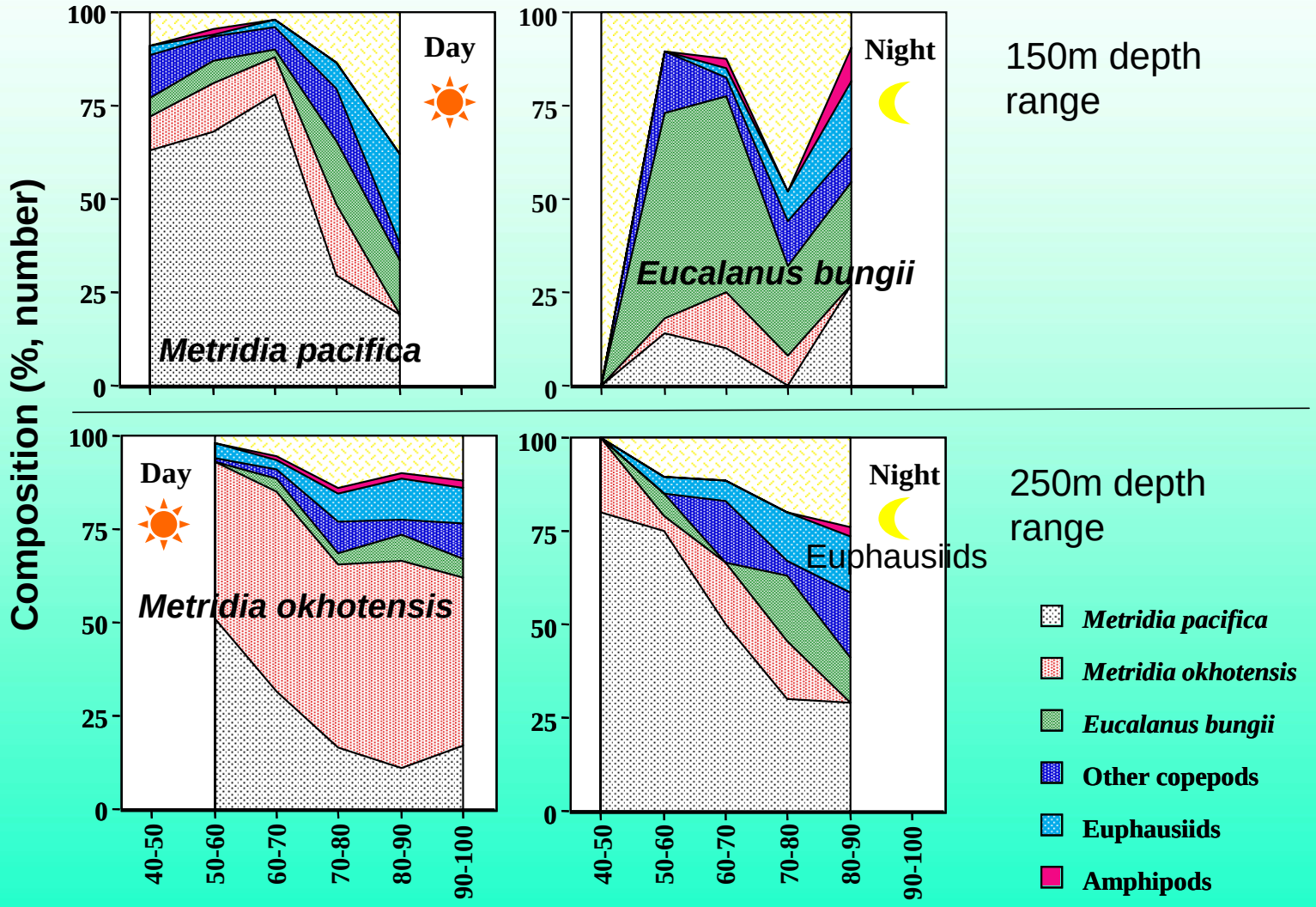
In this study; *D. theta* and *S. Leucopsarus was caught*

Daytime 136-410m, Nighttime 0-417m

- Shallower Swimming depth
- No obvious diurnal vertical migration

Discussion - Vertical distribution②

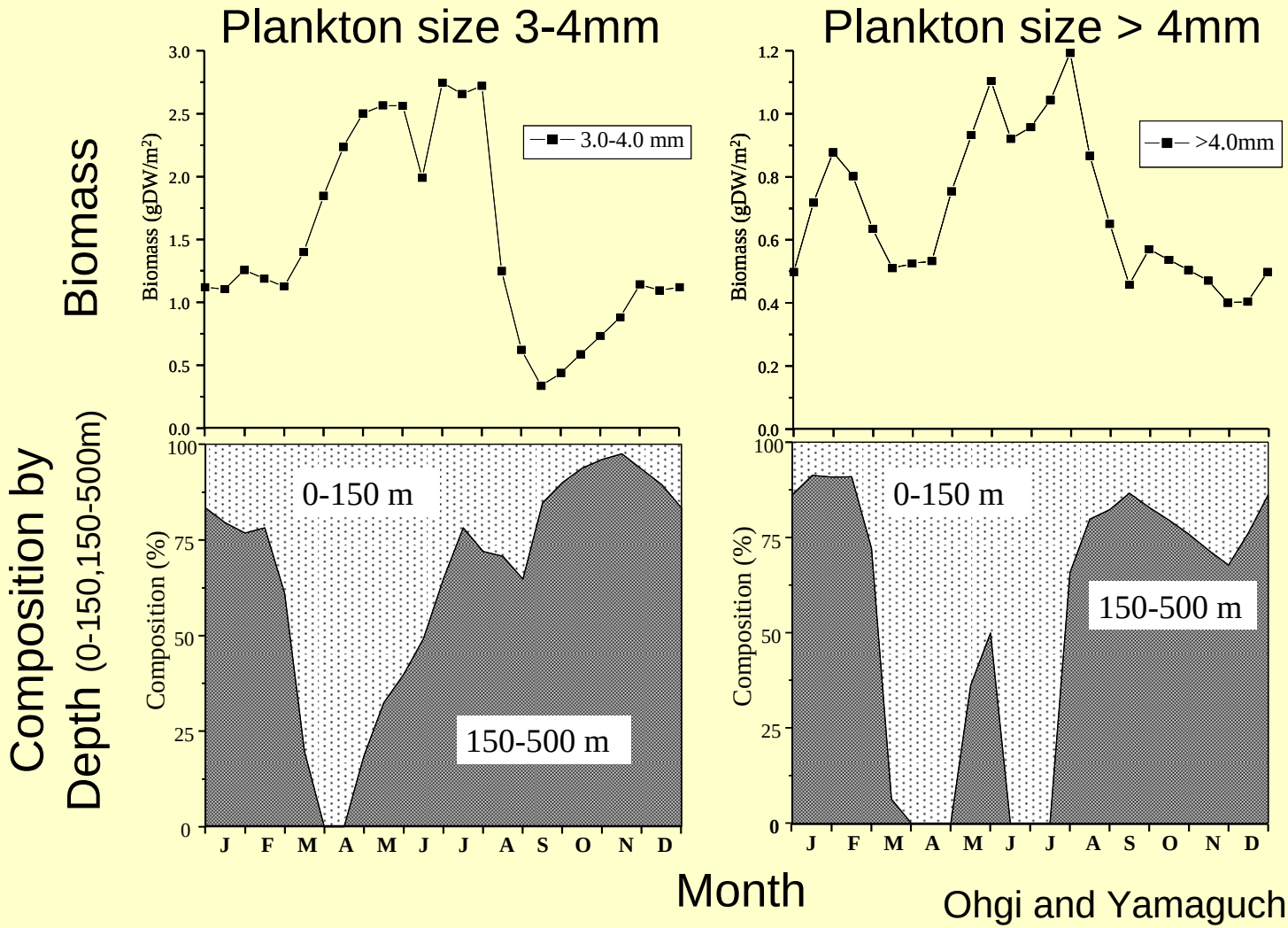
Stomach Content – *D. theta* (Sampling range 150m / 250m)



Yamaguchi (in prep.)

Discussion - Vertical distribution③

Stomach Content

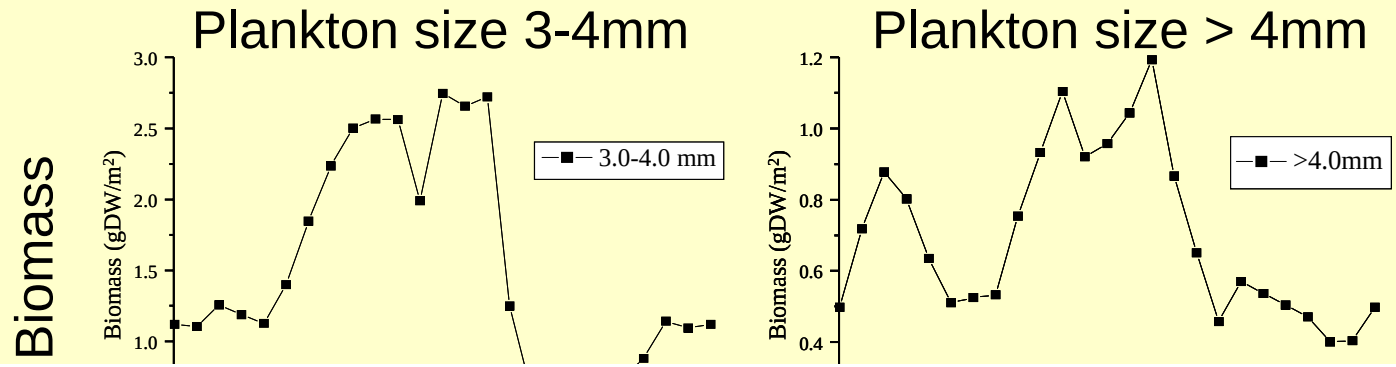


Ohgi and Yamaguchi (in prep.)

Fig. Monthly plankton biomass on Site H by depth (0-150m, 150-500m)

Discussion - Vertical distribution③

Stomach Content



Shift of the biomass to shallower depth in April (to 0-150m)

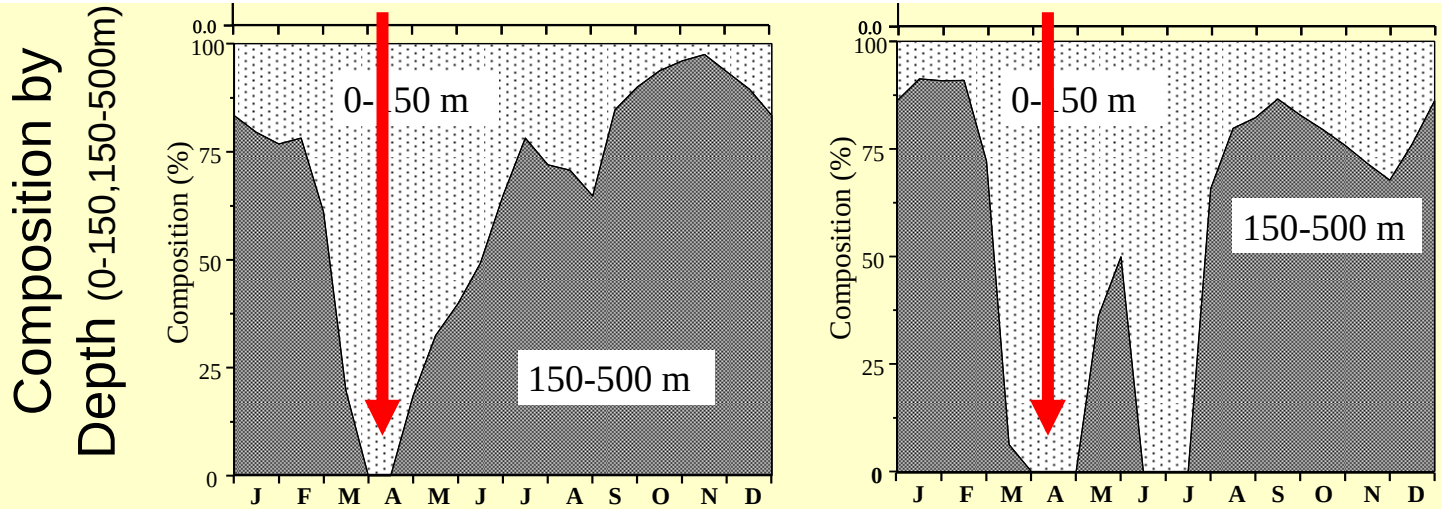


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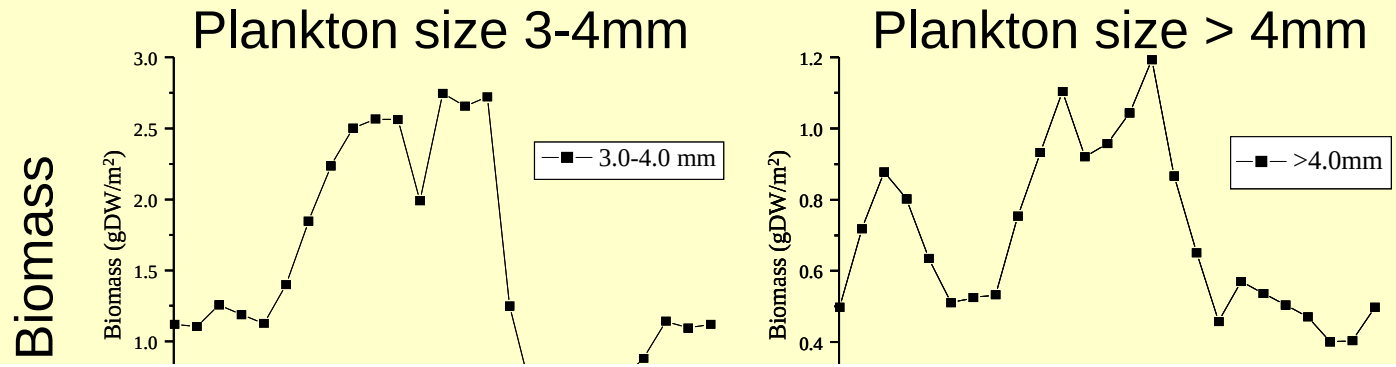
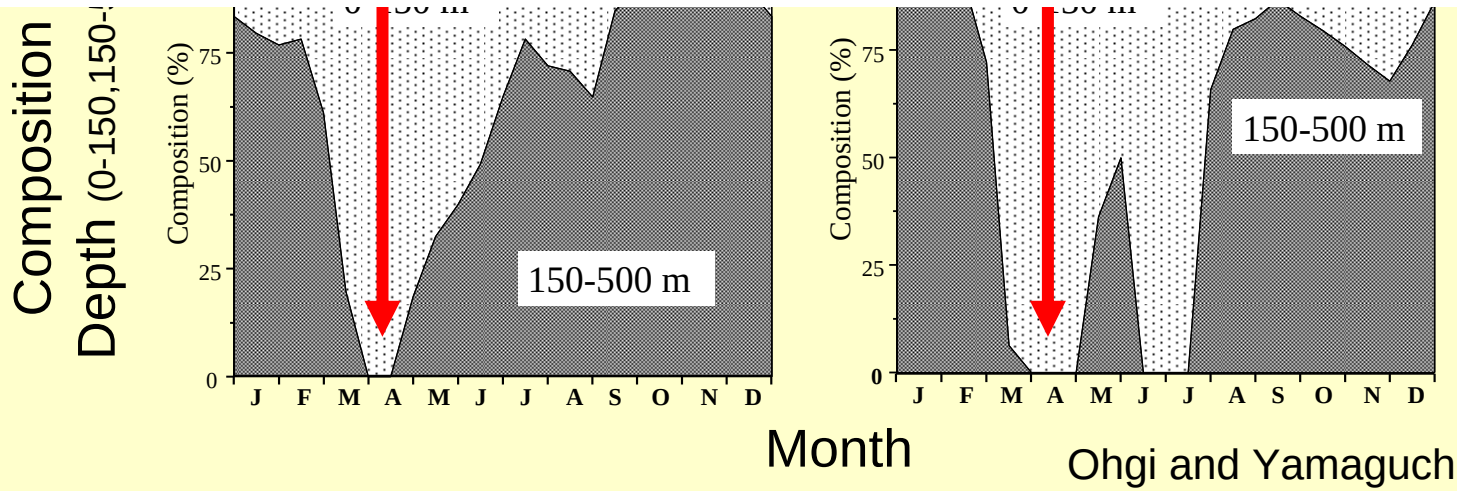
Fig. Monthly plankton biomass on Site H by depth (0-150m, 150-500m)

Discussion - Vertical distribution③

Stomach Content



Mesopelagic fish may have followed the characteristic vertical distribution of their prey.



Ohgi and Yamaguchi (in prep.)

Fig. Monthly plankton biomass on Site H by depth (0-150m, 150-500m)

Summary: Mesopelagic micronekton on the Northwestern pacific (open ocean) at the Blooming season

- Most dominant species: *D. theta* / *S. leucopsarus*

- Density estimation (100-400m Day) by acoustic method:
  D. theta 5.4 g/m^2 (Mean 6.3cm 4.2g)
  S. leucopsarus 1.5 g/m^2 (Mean 5.0cm 2.3g)

→reasonable value considering the location (open ocean) and possible effect of the spawning migration to the subarctic transition zone.

- Relatively shallow swimming depth,
  no obvious diurnal vertical migration

→Effected by the zooplankton (prey organism) which has a shallow swimming depth at the blooming season (Obvious effect from the lower tropic level)

Acknowledgement

We thank all the crew and people cooperated to our survey. Also we are grateful to Dr. Y. Tain and H. Kidokoro (Japan Sea Fisheries Research Institute) for assistance to attend this meeting.

Information !

Mesopelagic fish “SASHIMI”

EATABLE ! Try once!

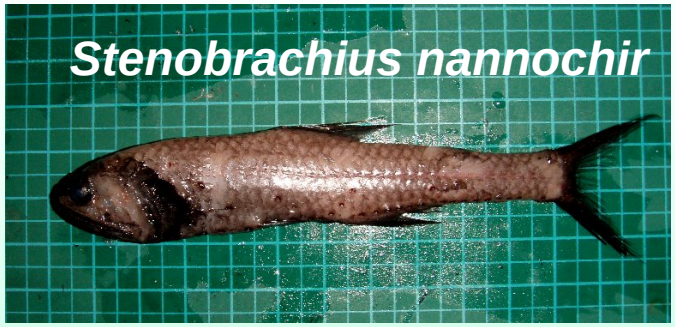
1. Select a large fresh *D. theta*

2. Dress with great care !

3. Serve on a dish and pour some Soysauce !

Soft texture, but tastes not so different from a pelagic fish!

Other species



Density estimation by acoustics and FMT

Acoustic estimation is larger than FMT estimated density for

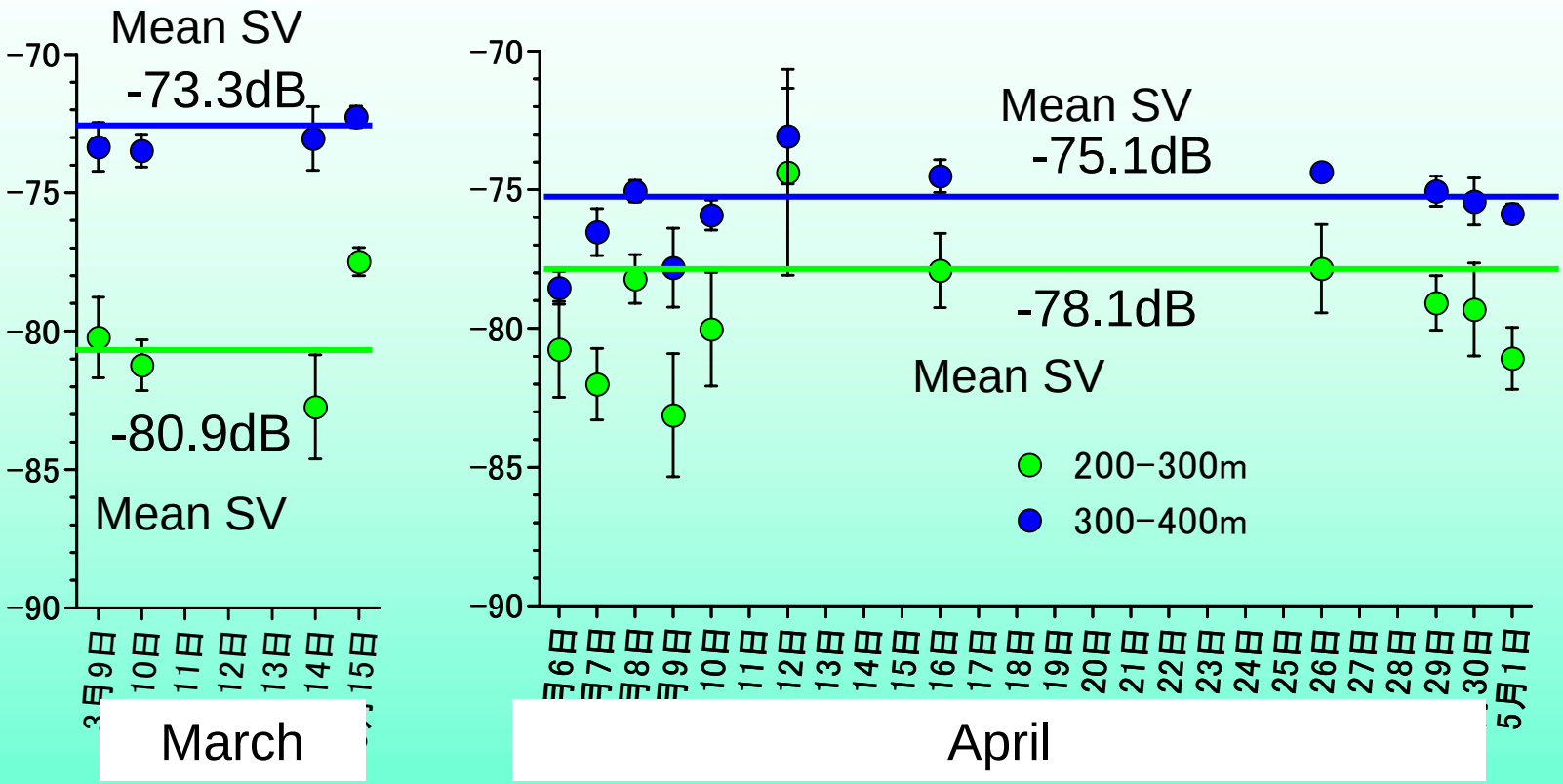
D. Theta 4.3±3.3

0.7
1.6
3.6
8.1
0.6
5.9
3.1
11.3
2.7
3.2
7.9
3.6

S. leucopsarus 4.6±3.7

0.7
1.5
3.6
7.1
0.6
5.8
3.2
13.9
4.5
3.2
7.9
3.6

Fluctuations of the backscattering

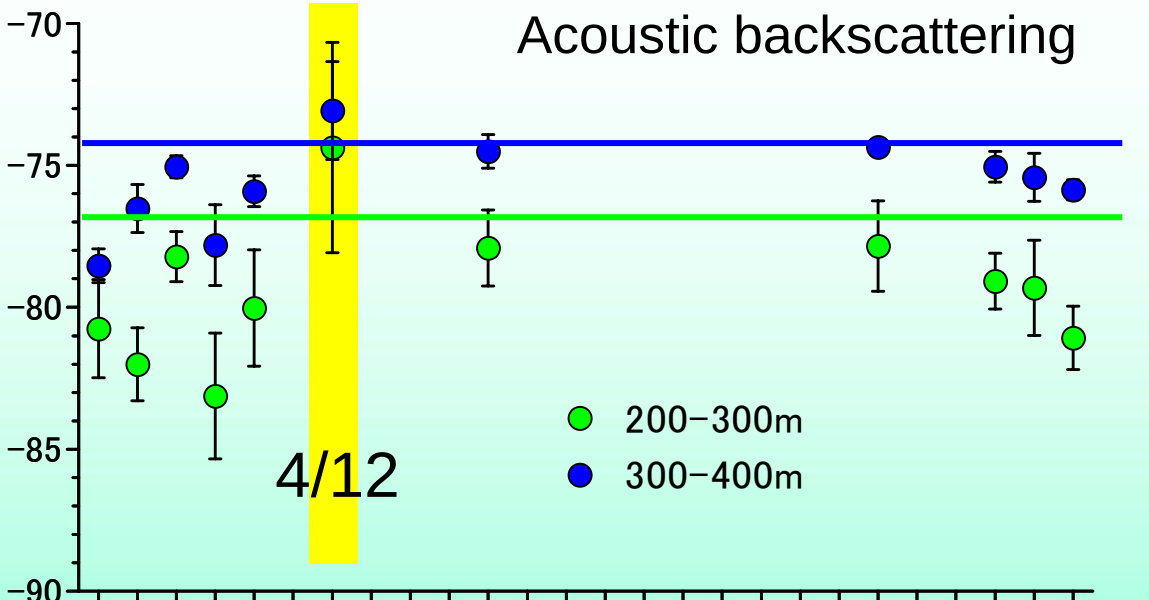


200-300m March ≒ April

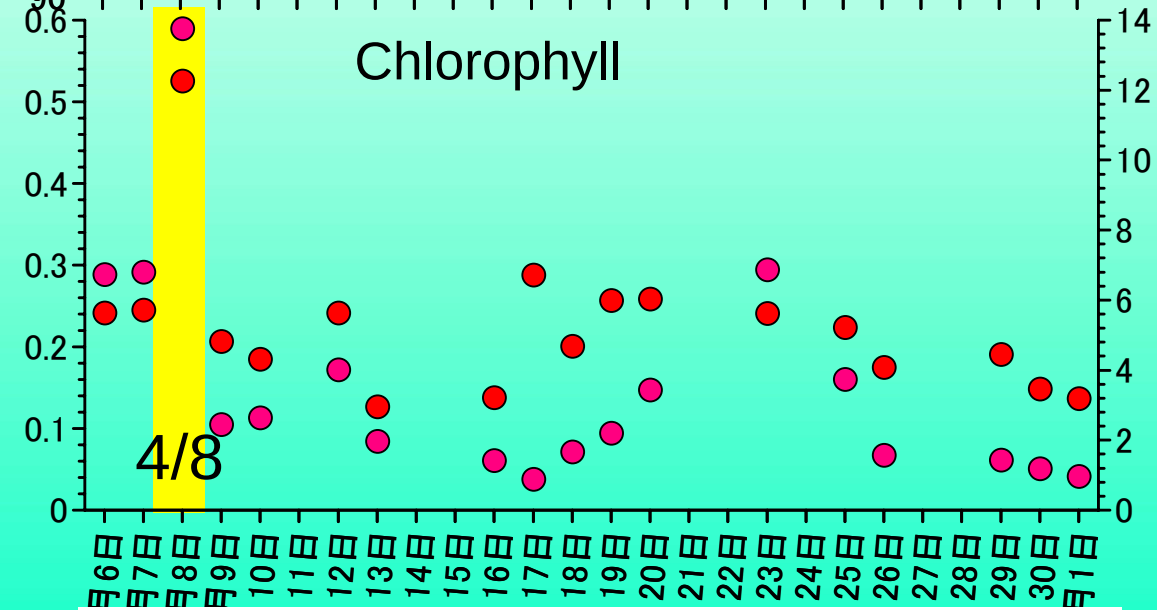
300-400m March ＞ April

MannWhitney U test

Relationship with the blooming



200−300m
300−400m



CHL (2 μm, μg/l)
CHL (20 μm, μg/l)

Mean density of depth
0, 5, 10, 20, 30, 40, 50, 75, 100, 150m