Introduction for J-QUEST research project: quantification of micronekton using an integrated system of echo-sounder and stereo TV cameras.

Hiroya Sugisaki and Kouichi Sawada

(National Research Institute of Fisheries Science;
National Research Institute of Fisheries Engineering,
Fisheries Research Agency, Japan)

Micronekton Research in the western North Pacific

- Since 1990s, the information on species composition and horizontal and vertical distribution has been abruptly accumulated
- Newly designed sampling gears have become available (large MOCNESS, MOHT)
- Research project on ecosystem of mesopelagic layer had been executed from 2002 to 2007

http://tnfri.fra.affrc.go.jp/personal/HP_E/index_e.html

MER

Marine Ecosystem Study for Sustainable Utilization of Biological Resources

Site Map ▶ Japanese

funded by ministry of agriculture, forestry and fisheries of Japan

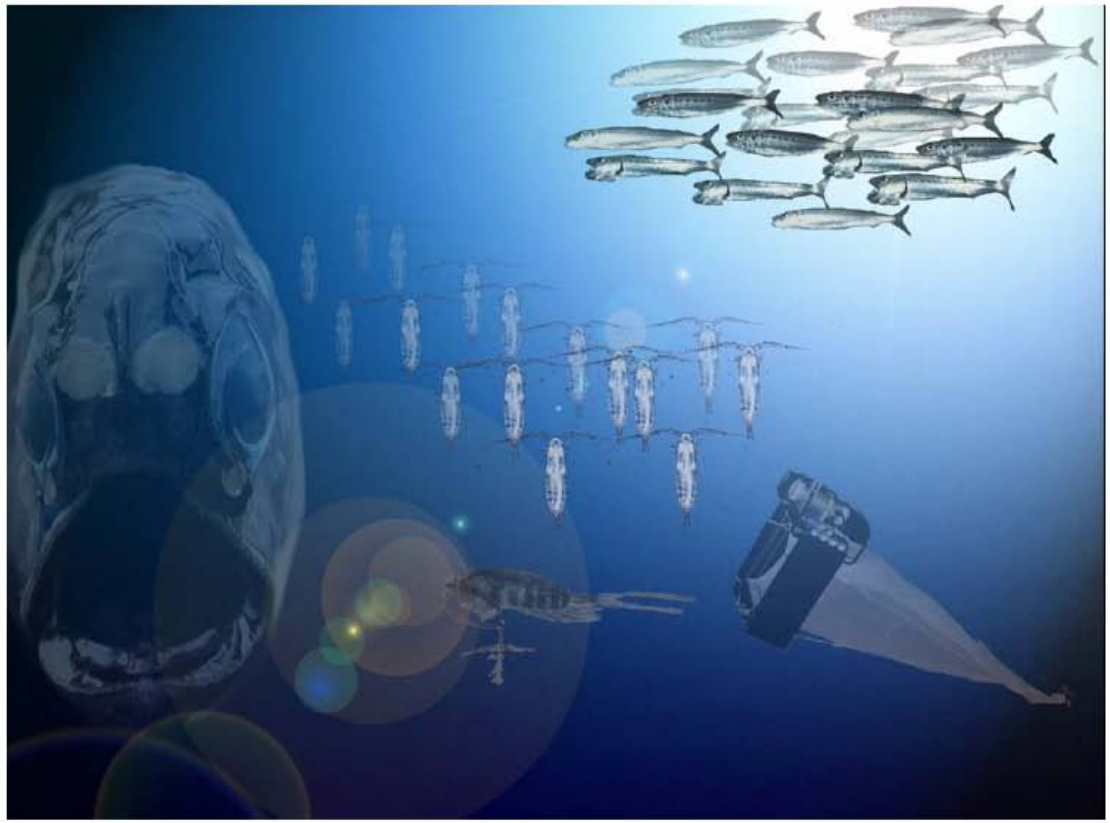
DEEP
(Deep-Sea Ecosystem and Exploitation Programme)

a part of MER project

research on ecosystem of mesopelagic zone

MER

Marine Ecosystem Study for Sustainable Utilization of Biological Resources



Recommended browser of this site inspection is InternetExplorer

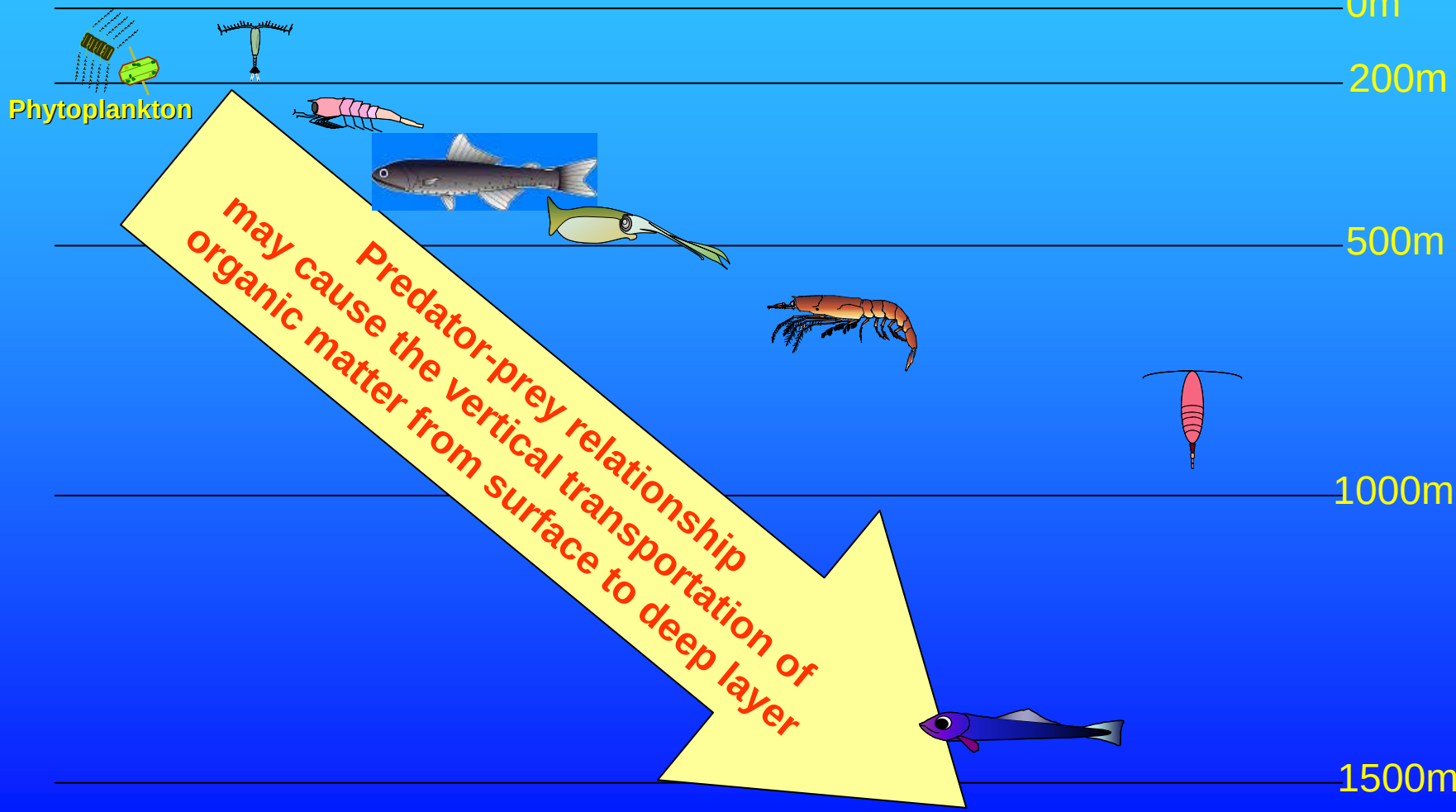
Vertical distribution and migration are The Key Point of research on the ecology of mesopelagic micronekton

Diurnal vertical migration

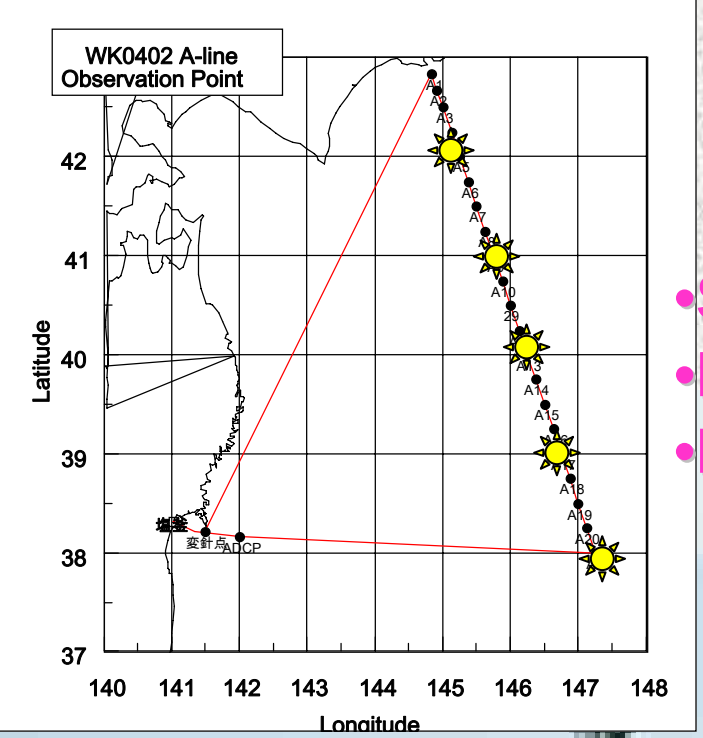
Feeding in shallow layer at night and sink to deep layer during daytime

Ontogenetic vertical migration

distribute shallow layer during young and sink to deep layer as they grow



Thorough quantitative micronekton sampling is essential!



Inclusive micronekton sampling for DEEP project

- Seasonal sampling(4cruises per 1 year)
- Day-Night sampling
- Fixed stations (5 stations)

R/V　Wakataka maru (Tohoku National Fisheries Research Institute)

Representative mesopelagic fish in the western North Pacific

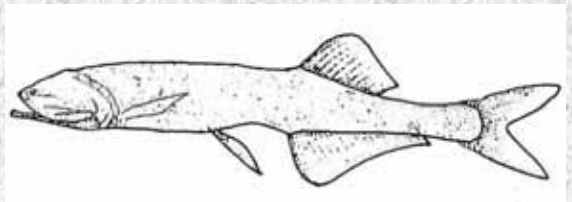
Myctophidae

Diaphus theta

Myctophum asperum

Gonostomatidae

Sigmops gracile



Cyclothone atraria

Microstomatidae

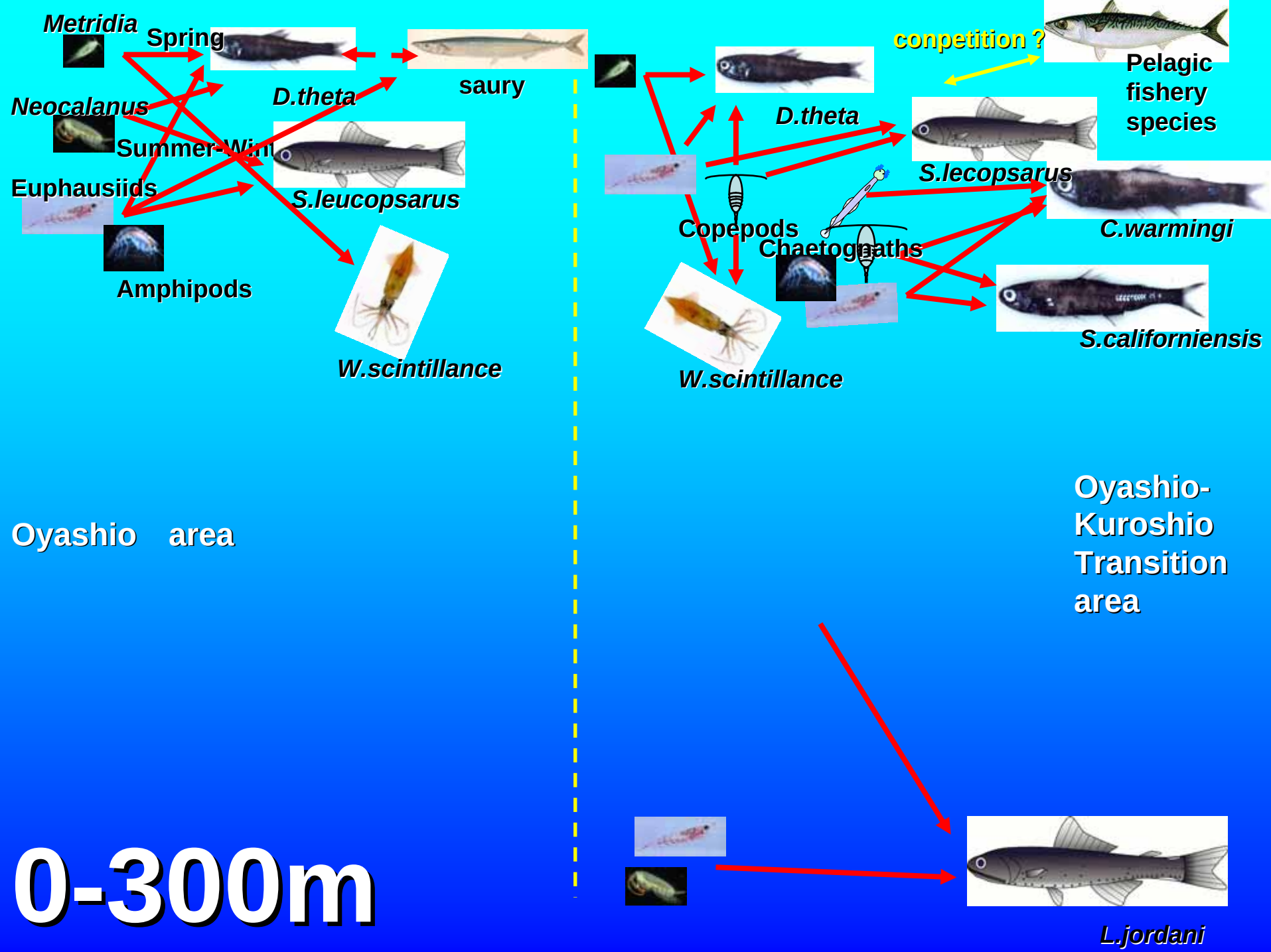
Lipolagus ochotensis

Chauliodontidae

Chauliodus macouni

Nemichthyidae

Nemichthys scolopaceus


Metridia
Spring
Neocalanus
Summer-Winter
Euphausiids
Amphipods
D.theta
saury
S.leucopsarus
W.scintillance
Oyashio area
conpetition ?
Pelagic fishery species
D.theta
S.lecopsarus
C.warmingi
Copepods
Chaetognaths
S.californiensis
W.scintillance
Oyashio-Kuroshio Transition area
L.jordani
0-300m

S.leucopsarus

D.theta

Oyashio

L.jordani

Spring

Summer-Winter *S.nannochir*

S.leucopsarus

Shrimps

D.theta

C.warmingi

S.californiensis

L.jordani

Oyashio-Kuroshio transition

S.nannochir

300-1000m

Importance of mesopelagic fish for ocean ecosystems

- High species diversity

  120 species of meso-pelagic fish were recorded from DEEP research project

- High abundance and High biomass

(from the result of 4m² MOCNESS samplings)

		Spring	Summer	Fall	Winter
Oyashio cold current area	Abundance (ind/m²)	5.6	12.1	10.3	10.5
	Biomass (gWW/m²)	10.8	11.9	14.0	12.3
Kuroshio-Oyashio transition area	Abundance (ind/m²)	18.1	15.8	17.6	16.9
	Biomass (gWW/m²)	10.3	11.6	11.2	10.5

Because micronekton were thought to be important for transportation of organic matters in the ocean ecosystem, it is necessary to reveal the biomass of micronekton precisely

Using various effective sampling gears.


Quantitative sampling gear for
Micronekton
4m²MOCNESS

Quantitative sampling gear for micronekton

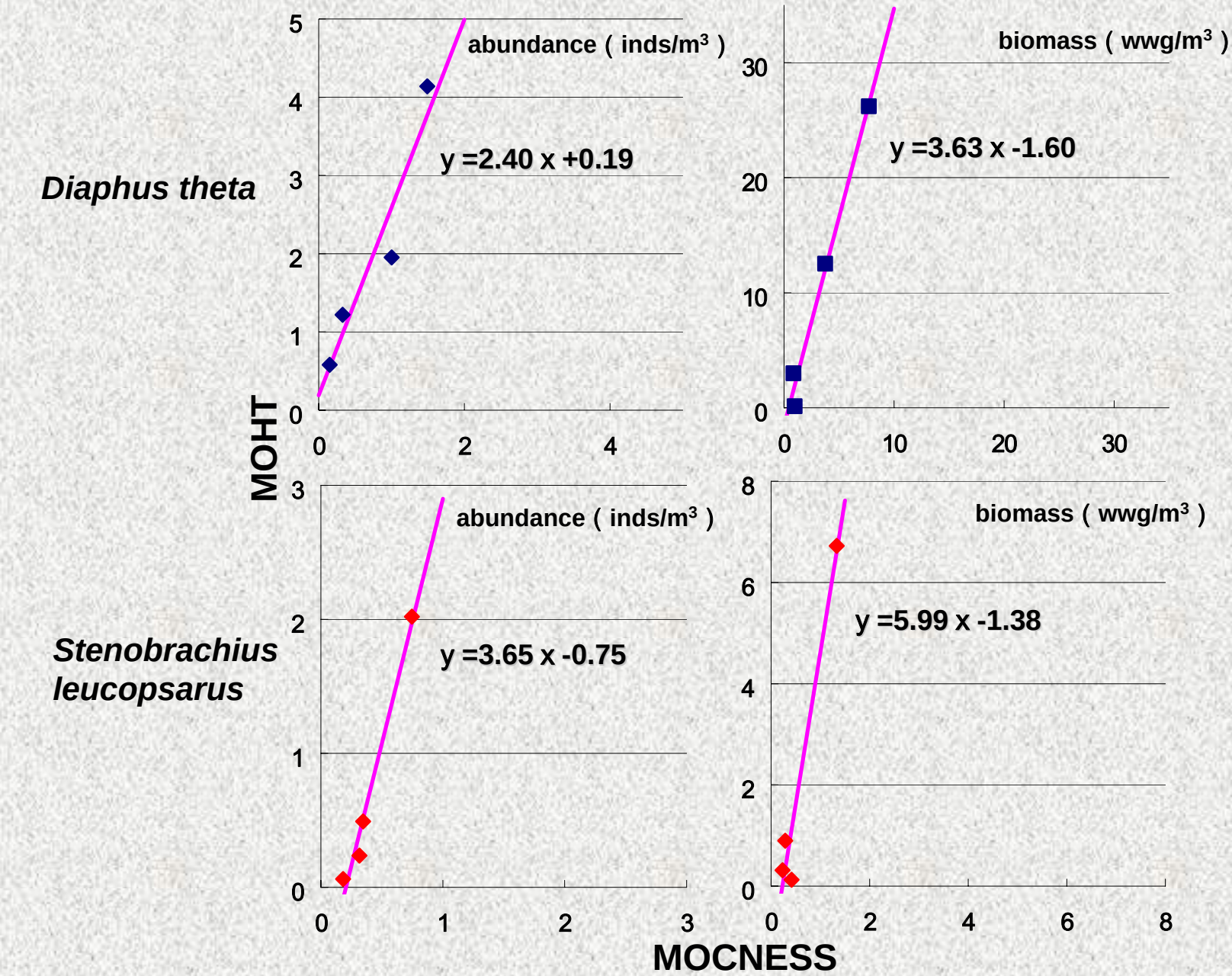
MOHT frame trawl

(5m^2 mouth area)

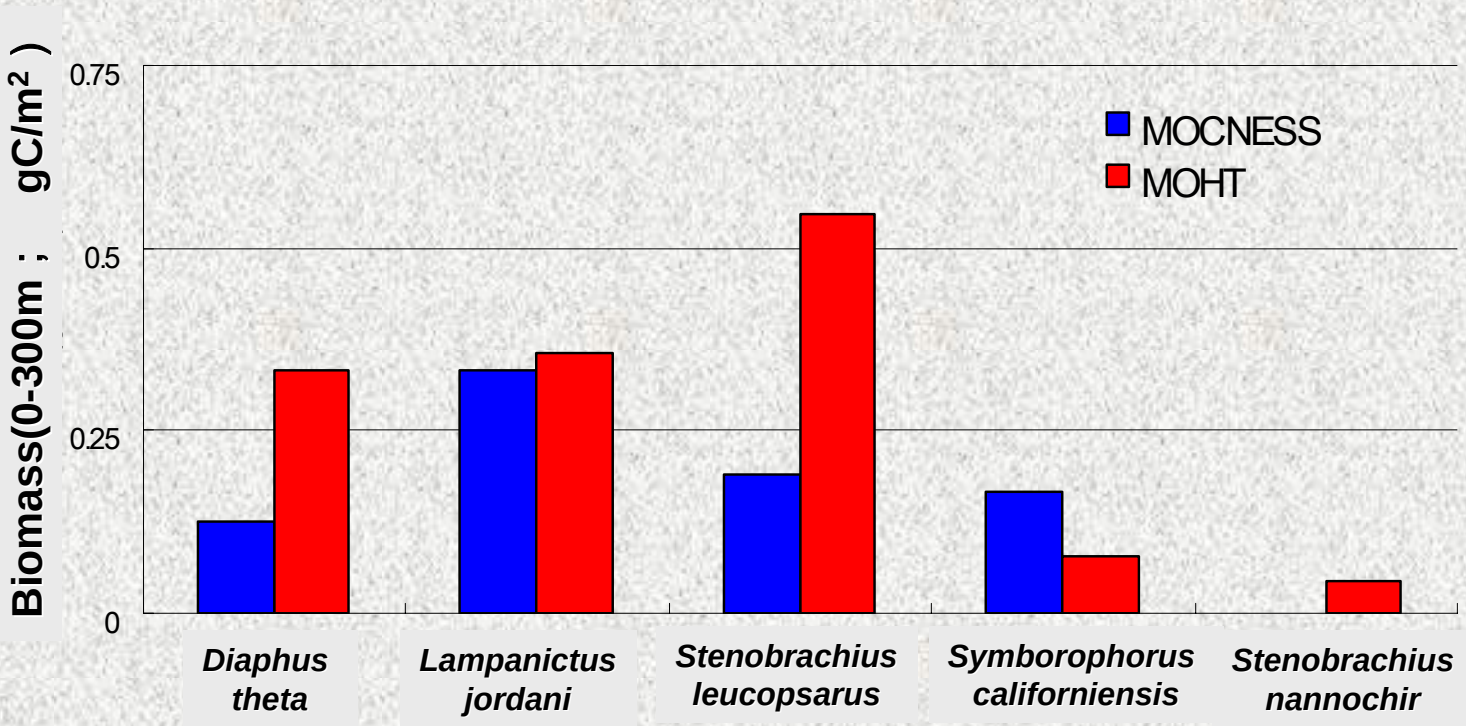
Quantitative sampling gear for micronekton

Mid water otter trawl With multiple sampler

Comparison of estimated abundance and biomass of mesopelagic fish collected at the same station and same day



Differences of estimated biomass between sampling gears



Generally estimated biomasses of MOHT sampling were higher than that of MOCNESS

Difficulty for researching their quantity

- **Estimated biomasses and abundances varied highly between different sampling gears, and catchablity of each gears also varied for species.**
- **Net sampling data of estimated abundance must be underestimated compared to acoustic data.**
- **Acoustic data should be helpful for quantitative study**

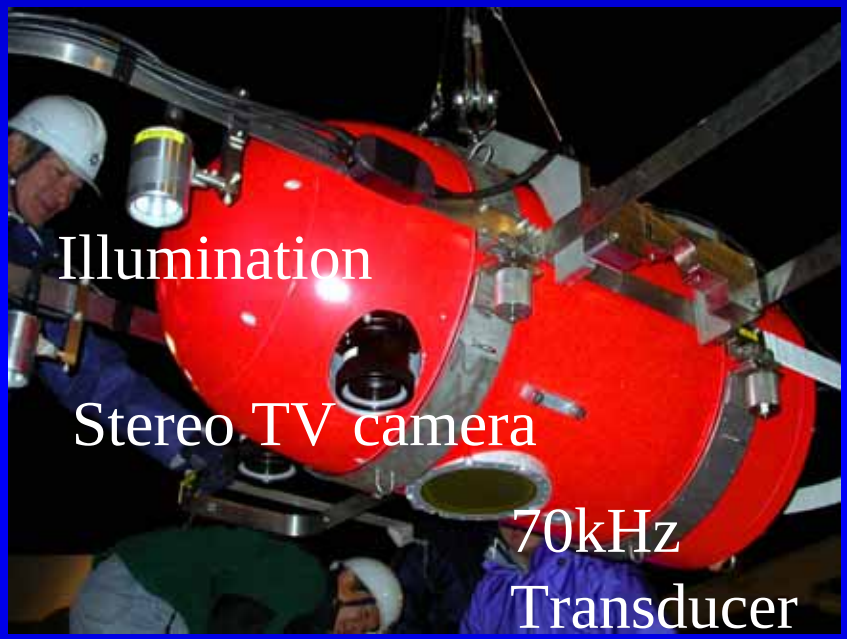
→ **However acoustics cannot detect the species easily.**

J-QUEST

- **Acoustic and visual data are able to be gained simultaneously**
- **Species composition, behavior, and abundance were analyzed from in situ research**

J-QUEST will become a useful gear for mesopelagic research

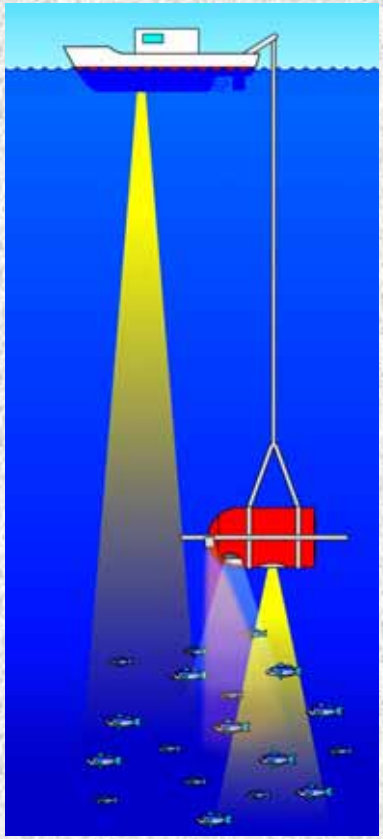
Acoustical-optical system



J-QUEST*	
Size (Length×Dia.)	1.07m×0.53m
Weight	Approx. 300kg
Max. depth	250 m
Echosounder	
Freq.	70 kHz
Method	Split-Beam
Beam width	11.8°
Pulse width	0.6/1.2/2.4ms
Stereo-Video Camera	
Image tube	B/W HARP
Min. Illum. Level	0.015Lux
Focal length	23 mm
F.O.V.	15° (= wide angle lens)

•* **J**apan **QU**antitative **E**cho-sounder & **S**tereo **T**V-camera system

Mission of J-QUEST

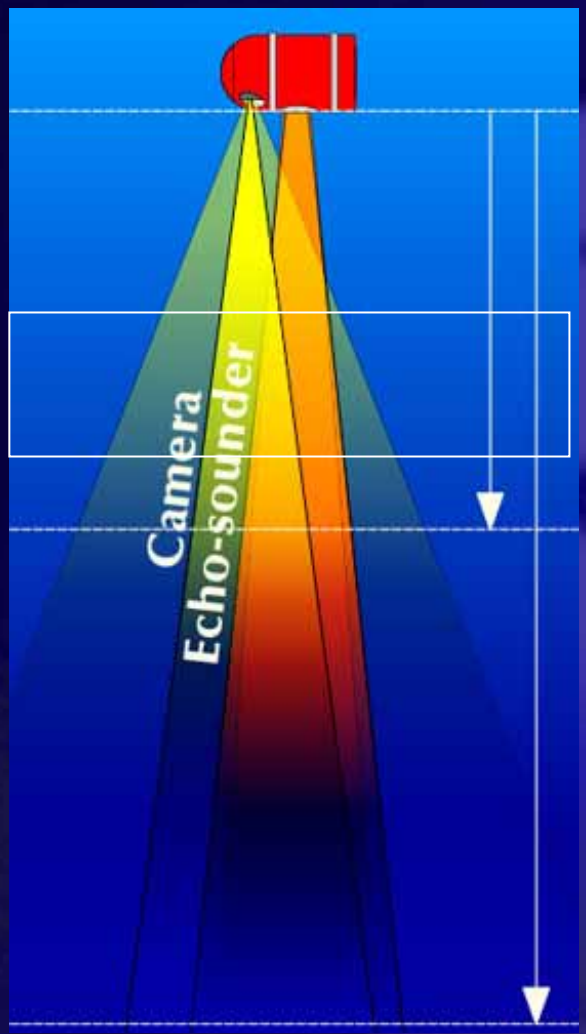


Collect species, TS, length, tilt angle, and swimming speed information in high resolution by approaching an acoustical-optical system to fish school.

Expected income

Installed instruments	Available information
Echo sounder (70kHz)	Target strength
Stereo Video Camera	Length, tilt angle, speed

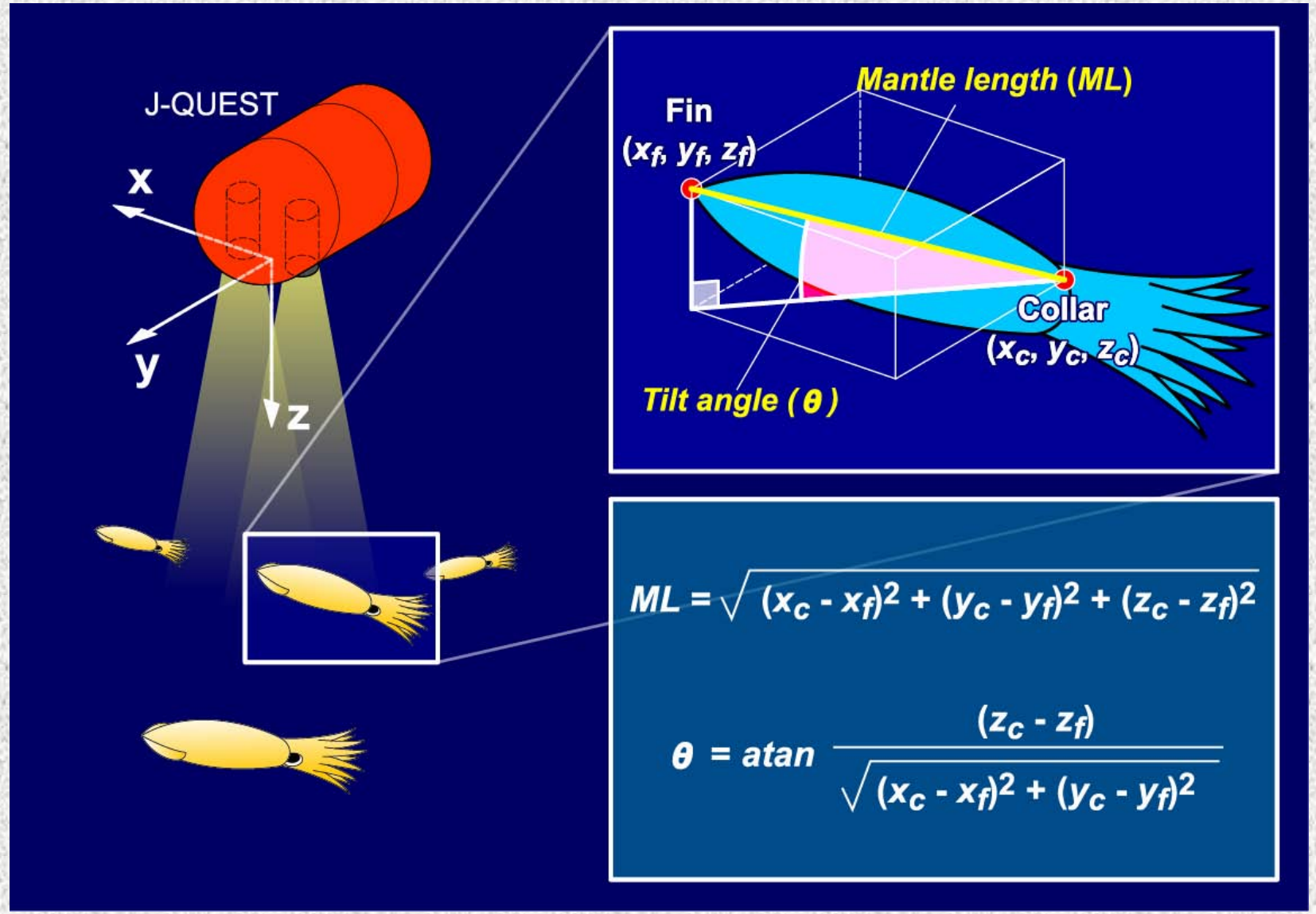
Design of optical system



Sampling volume	
Field of view	15degrees
Distance	1.5-2.5m

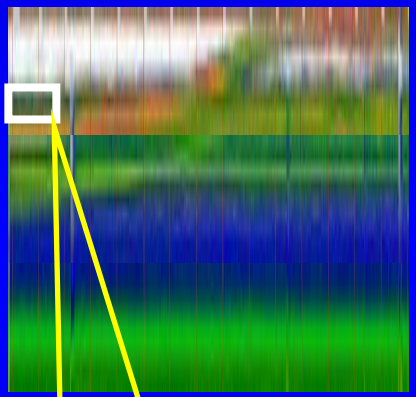
RMS measurement error	
1.5m	0.43±0.34cm
2.5m	1.35±0.95cm

3D measurement by the stereo-method

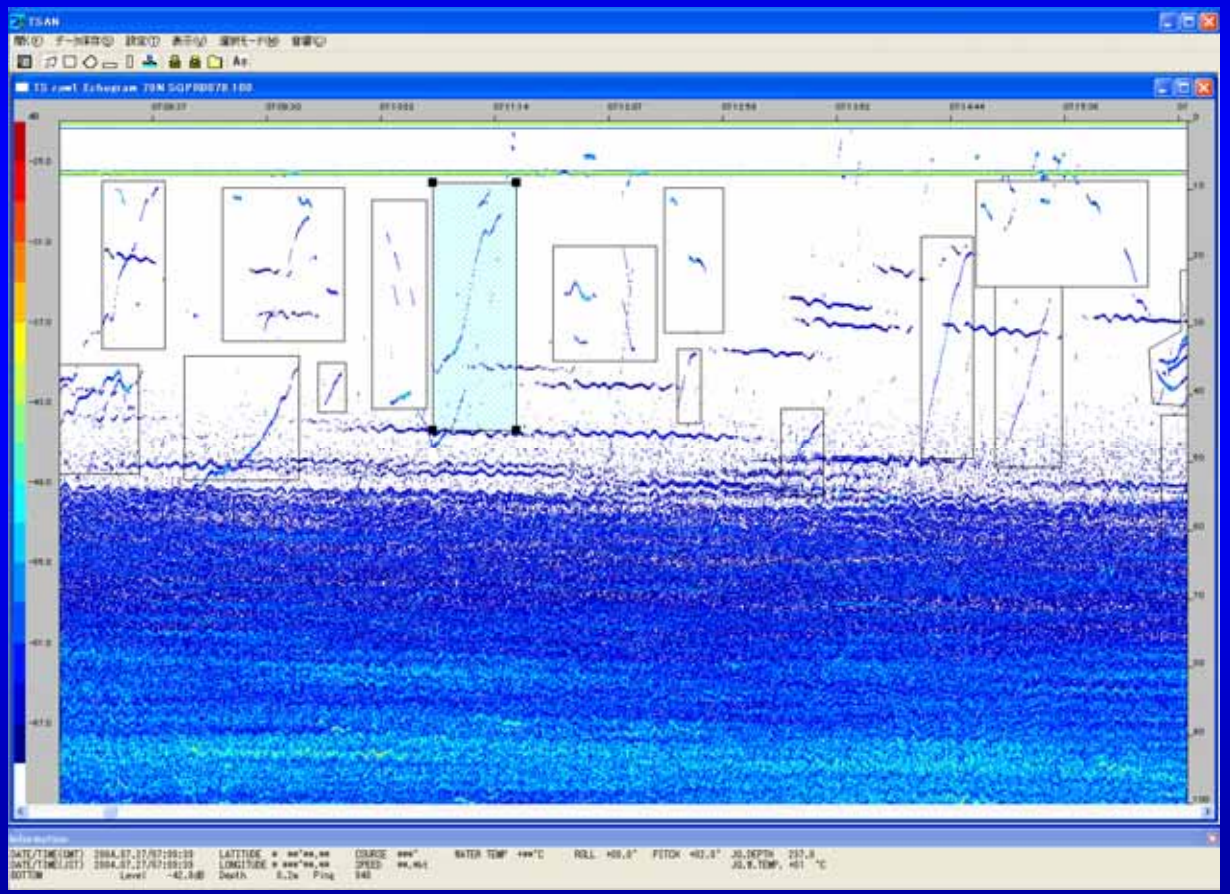


J-QUEST Echogram

Echogram (70kHz) recorded at the depth of J-QUEST 220m. Swimming speeds and TS were estimated from acoustic data.



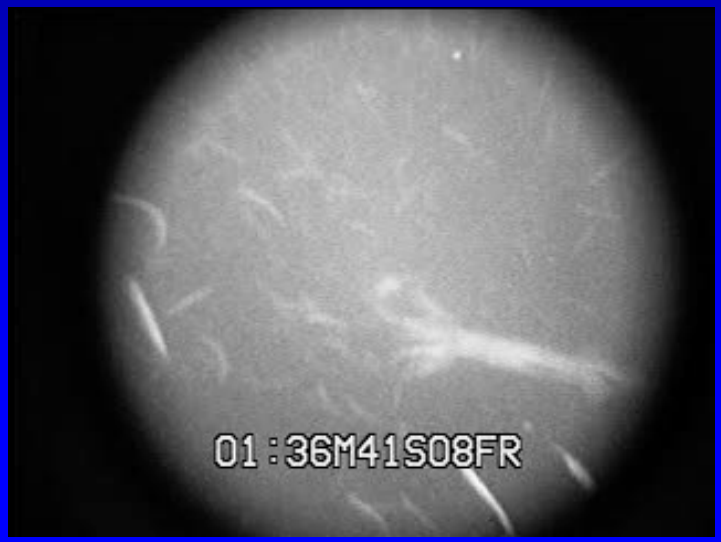
J-QUEST was deployed at 220m depth.



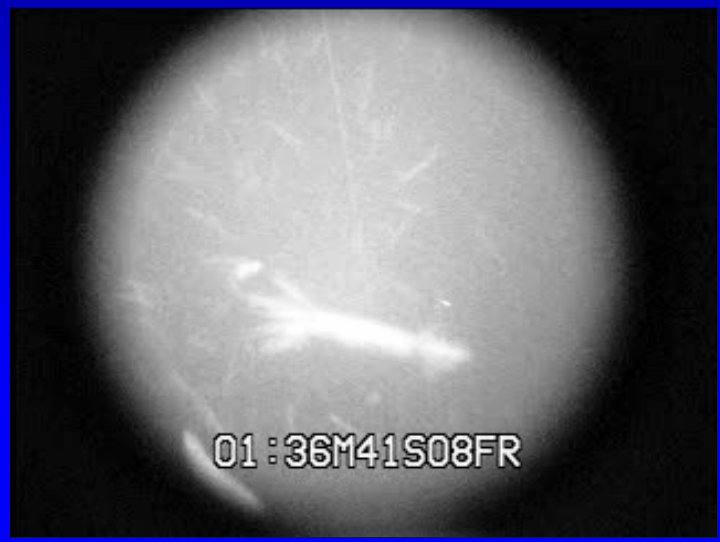
220 m

320 m

J-QUEST camera view



Left camera



Right camera

Depth: 25m

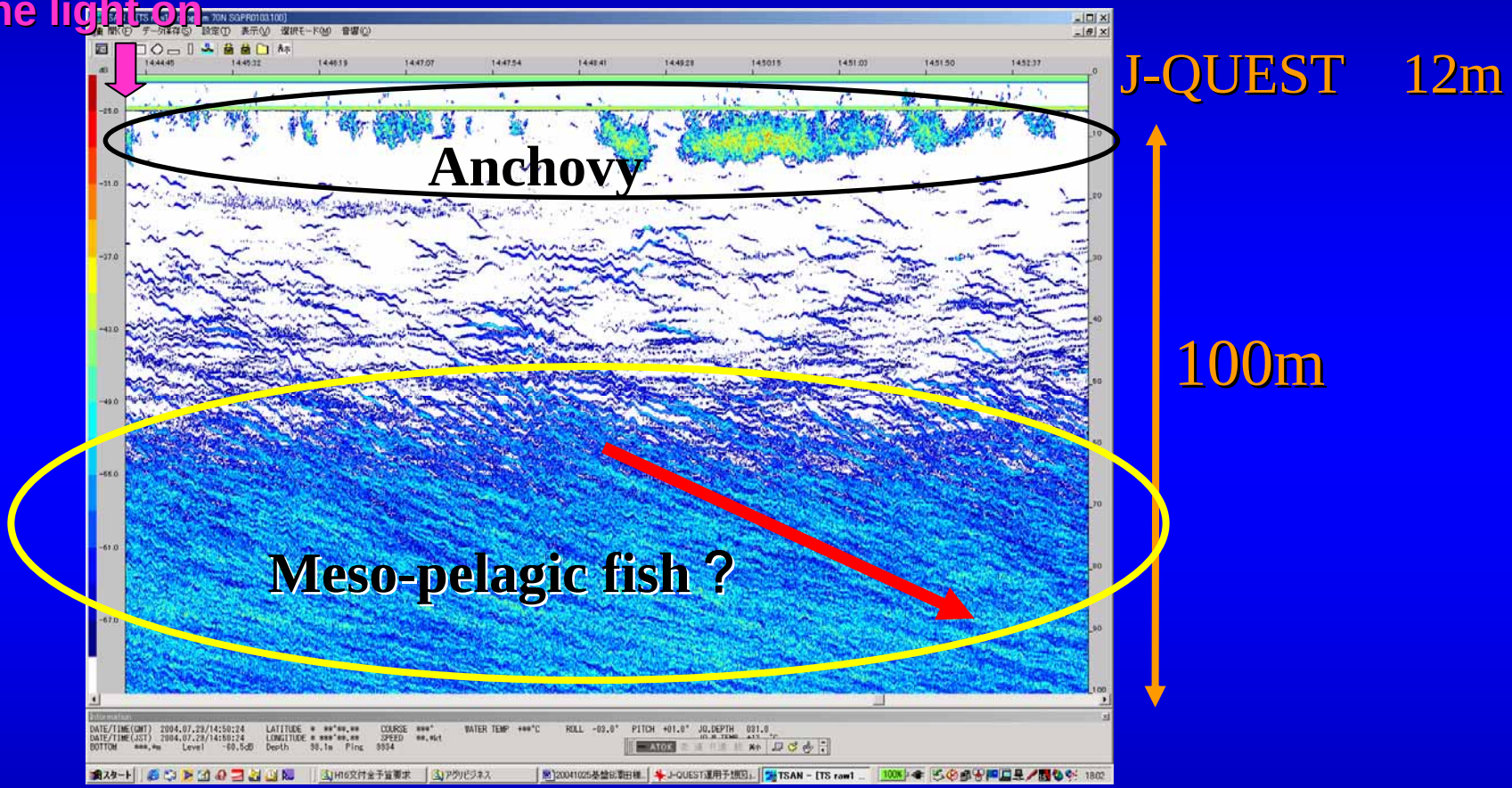
Gonatopsis borealis (squid)

Mantle length 37cm[1]

Japanese anchovy

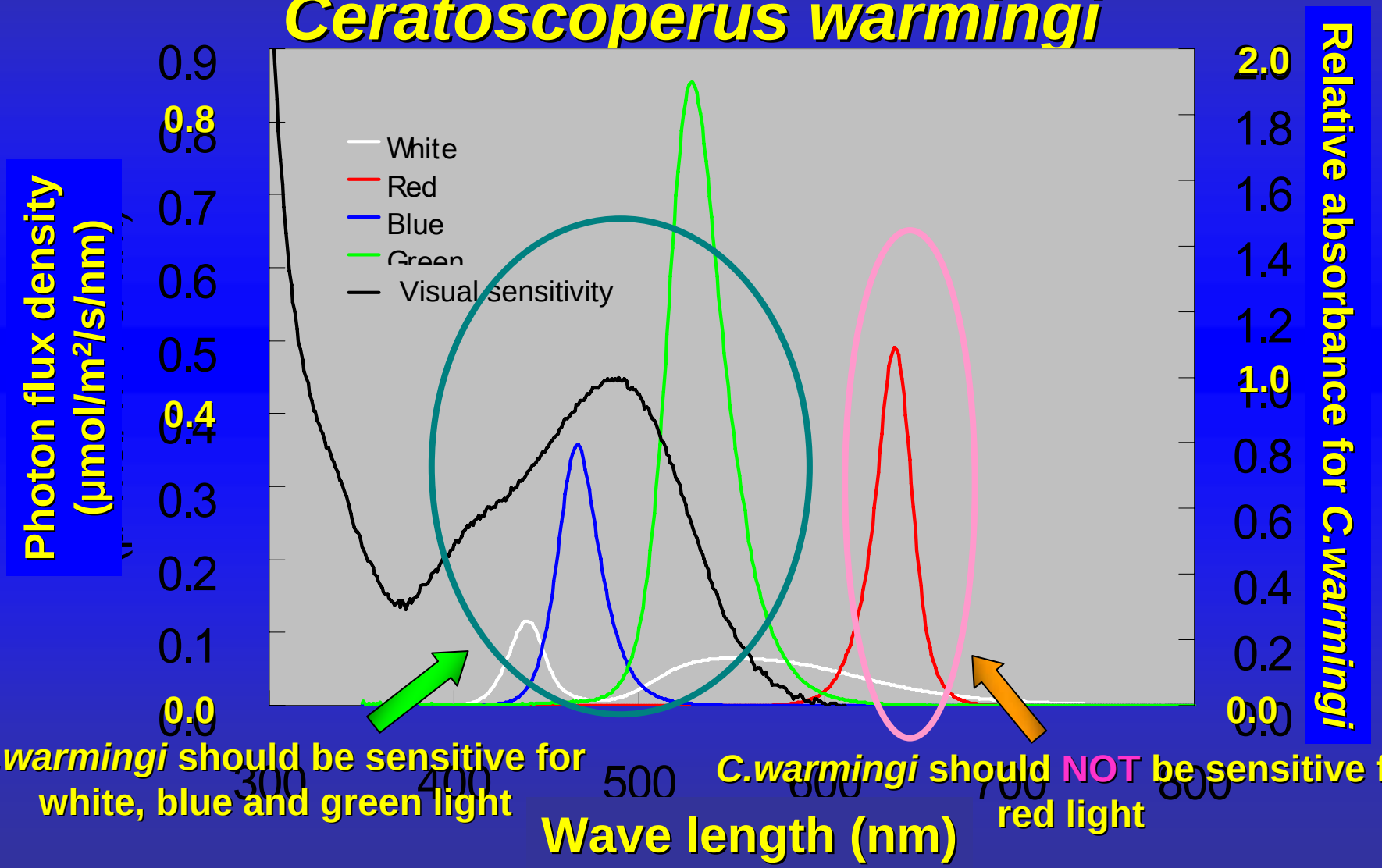
<L>= 12.2cm, S.D.=1.3cm(n=24)

Does meso-pelagic fish dislike the light of J-QUEST ?



The invisible light system for mesopelagic fish is necessary!!

Spectrum of LED of J-QUEST and visual sensitivity of *Ceratoscoperus warmingi*



J-QUEST χ

improvement for invisible light system for mesopelagic fish

Blue LED

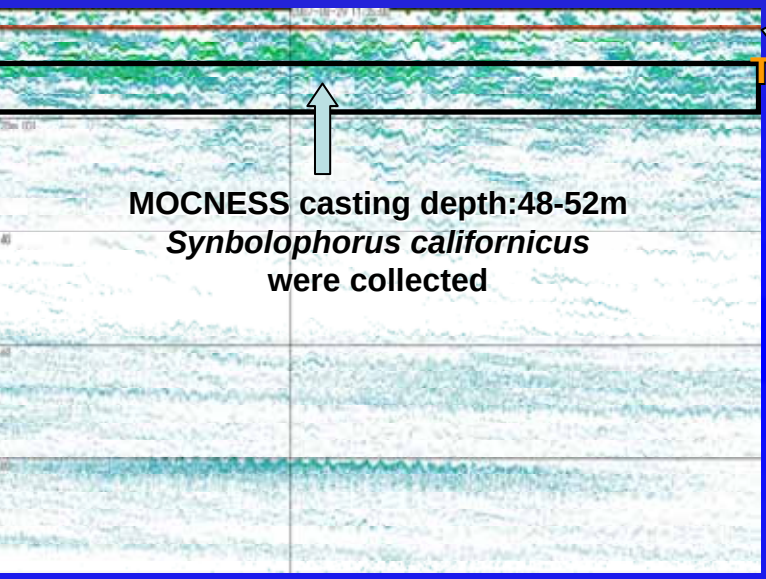
sensitive for mesopelagic fish
but clear images for CCD video camera

Red LED

not or less sensitive
for mesopelagic fish

Preliminary report of J-QUESTχ cruise during Aug. 2007

J-QUEST Echogram

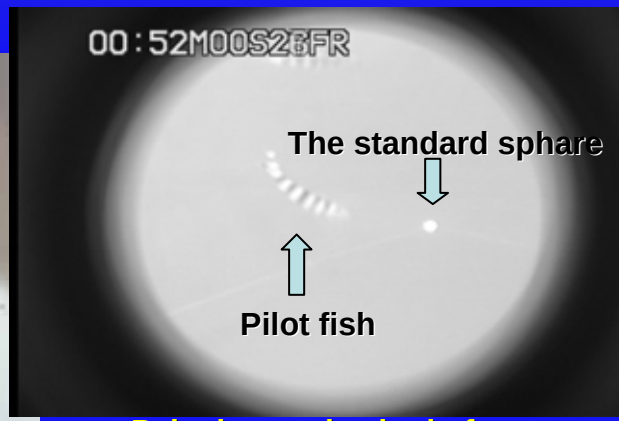


J-Quest casting depth:40m

The standard sphare depth: 45m
=Video view area

MOCNESS casting depth:48-52m
Synbolophorus californicus
were collected

Meso-pelagic fish were well collected by net at every study areas during the cruise



Pelagic species had often been observed by J-QUEST Video

- Meso-pelagic fish were observed by echo-sounder and collected by net sampling.
- Although they were not clearly observed in video images.

Current problem

- Difficulty for mesopelagic fish to be imaged on video camera

Low density in the study field?
Escape from J-QUEST shadow?
Inconvenient of overhead view?

Improvements of cruise plan and method of J-QUEST casting are necessary

- Suspecting the INVISIBLE light system

Improvement of unaffected light system for fish behavior is necessary


Thank you!
Dr. Koichi Sawada
The inventor of J-QUEST