Real-time monitoring for mesopelagic fish abundance using J-QUEST integrated system of echosounder and stereo TV cameras.

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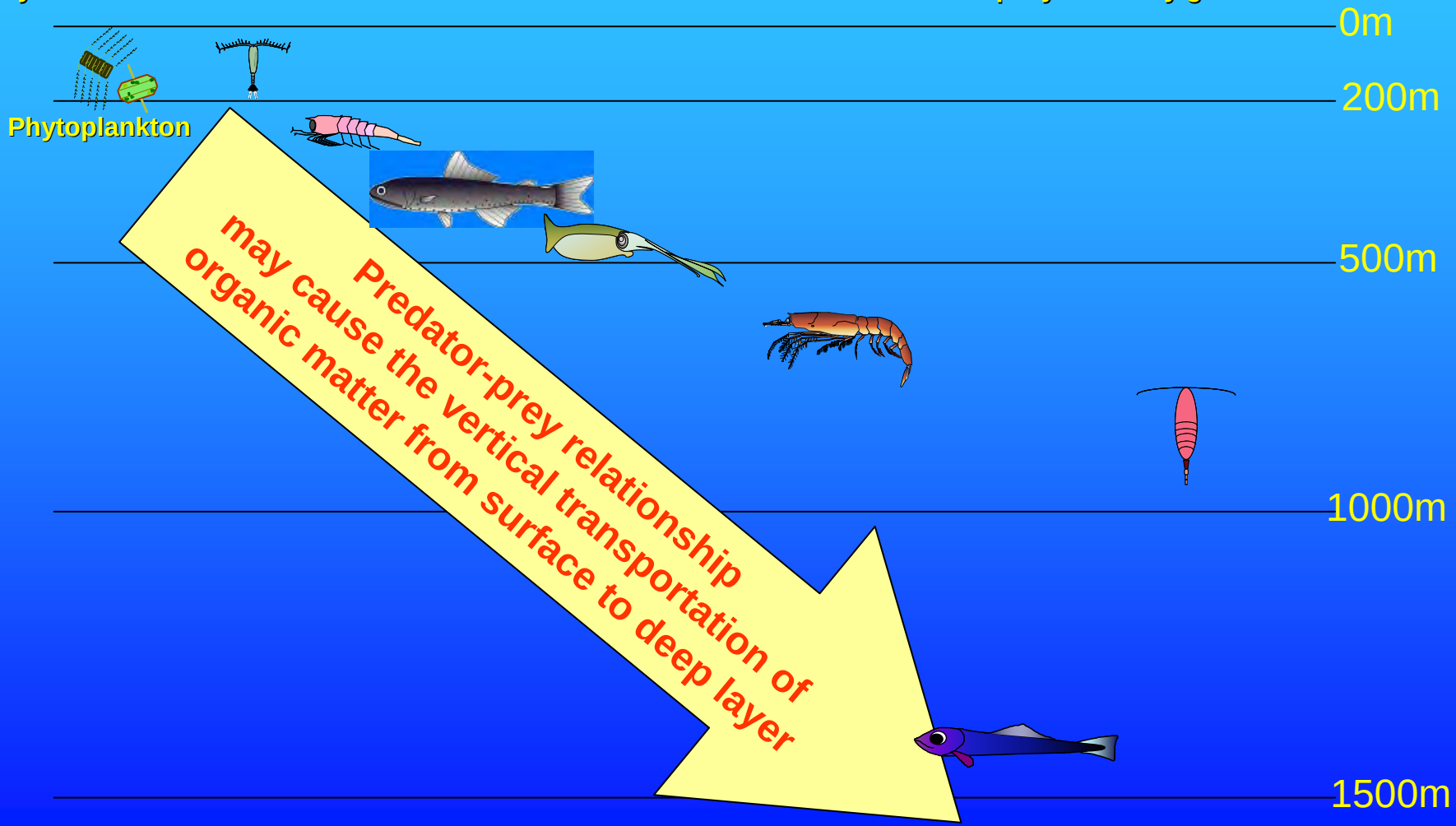
Vertical distribution and migration are The Key Point of research on the ecology of mesopelagic micronekton

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!

Difficulty to evaluate the accuracy of the estimated deep-sea biomass from net sampling data

- There is no continuous recording method for observation in the deep sea
- There are very few data and information on the ecology (e.g. school size, swimming speed etc.) of deep sea creatures

How to solve this problem?

The first approach:
Intensive samplings using different type of gears


Quantitative sampling gear for
Micronekton
4m²MOCNESS

Quantitative sampling gear for micronekton

MOHT frame trawl

(5m^2 mouth area)

Representative mesopelagic fish in the western North Pacific

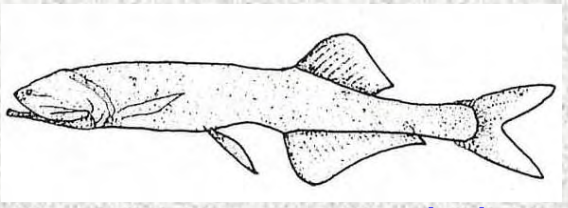
Myctophidae

Diaphus theta

Myctophum asperum

Gonostomatidae

Sigmops gracile



Cyclothone atraria

Microstomatidae

Lipolagus ochotensis

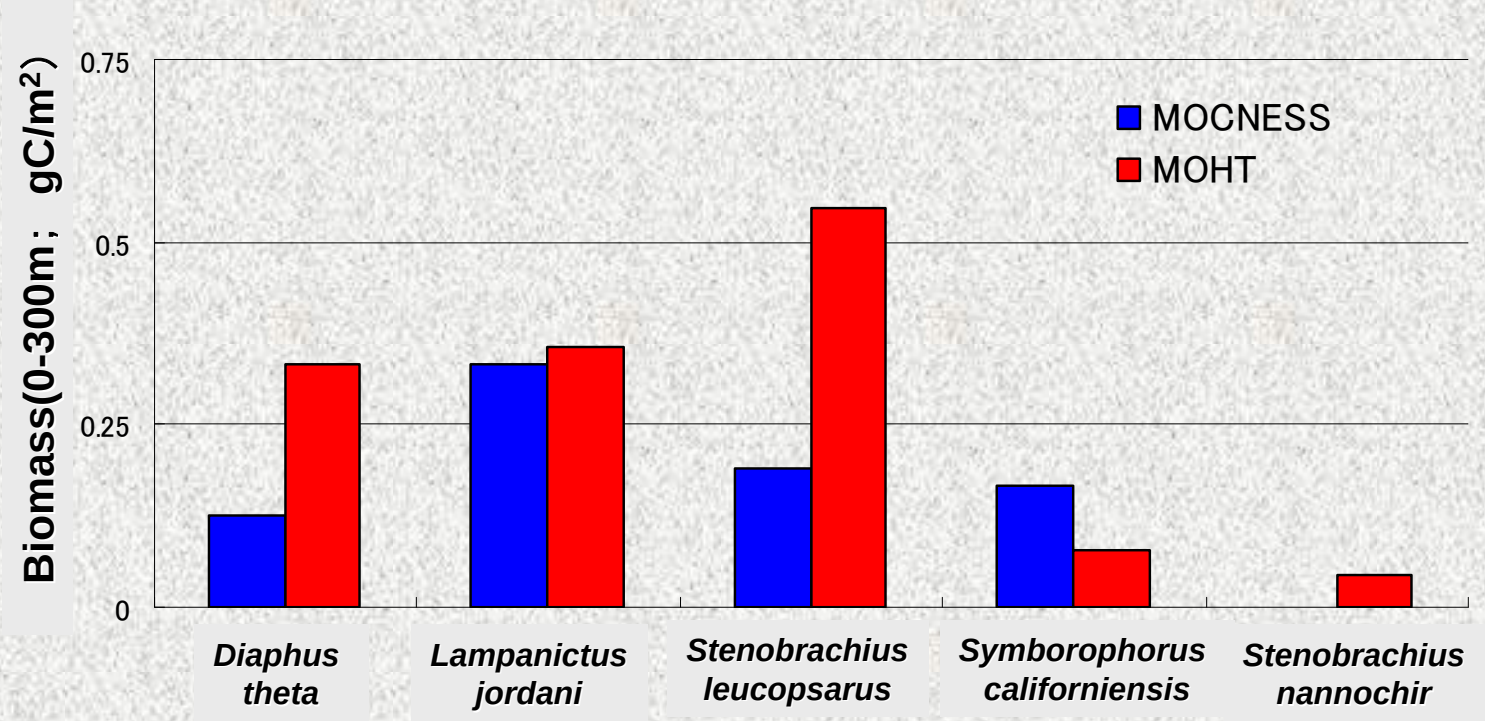
Chauliodontidae

Chauliodus macouni

Nemichthyidae

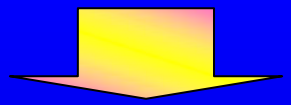
Nemichthys scolopaceus

Differences of estimated biomass between sampling gears

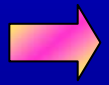


Generally estimated biomasses of MOHT sampling were higher than that of MOCNESS

- **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 because there are high possibility for avoidance from the mouth of net.**

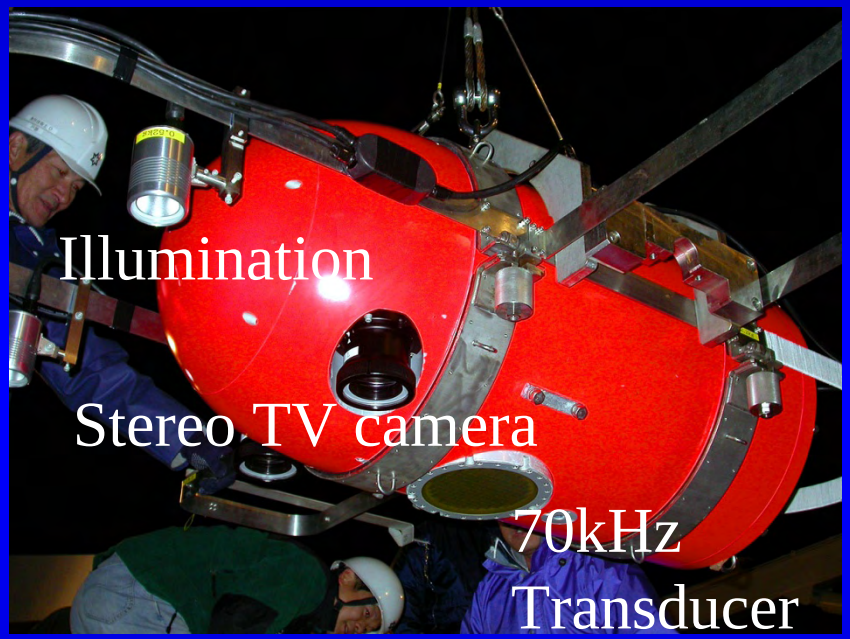


- **Acoustic data should be helpful for quantitative study**



The weak point of acoustics is inability of species identification

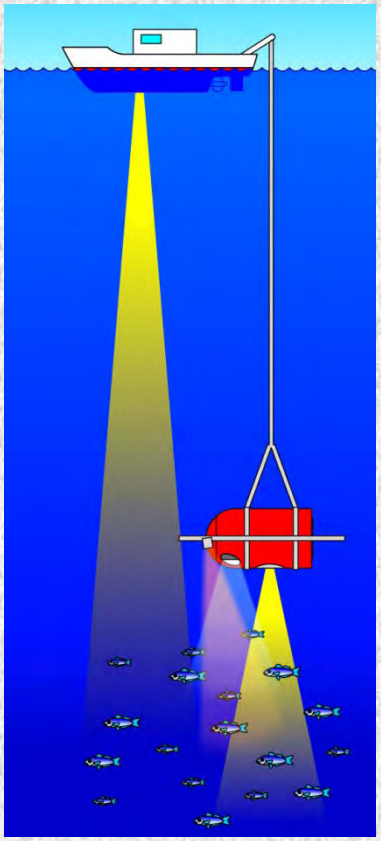
Acoustical-optical system



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)

•* Japan QUantitative Echo-sounder & Stereo TV-camera system

Mission of J-QUEST



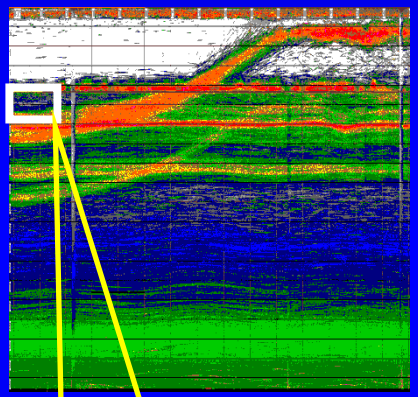
Collect species, TS, length, tilt angle, and swimming speed information in high resolution by approaching an acoustical-optical system to fish school.

Expected income

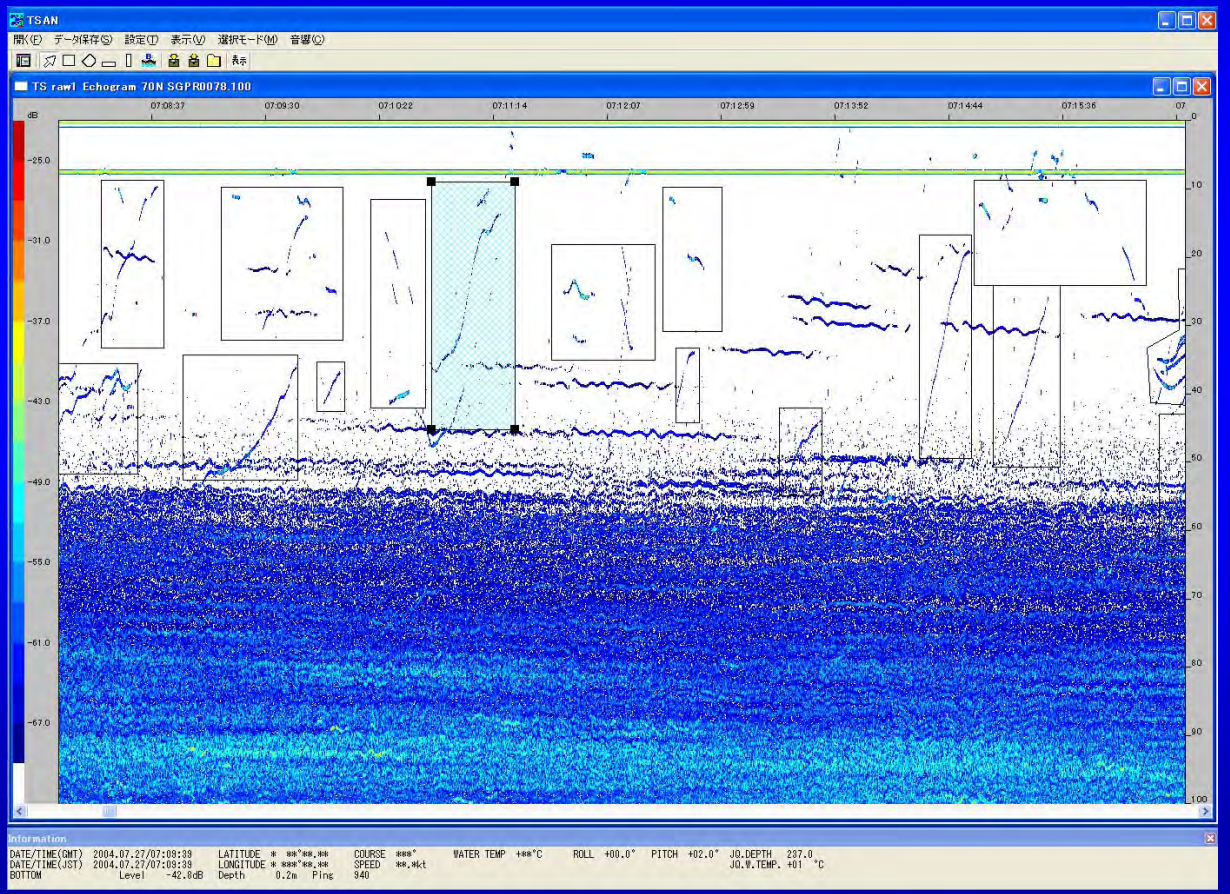
Installed instruments	Available information
Echo sounder (70kHz)	Target strength
Stereo Video Camera	Length, tilt angle, speed

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.

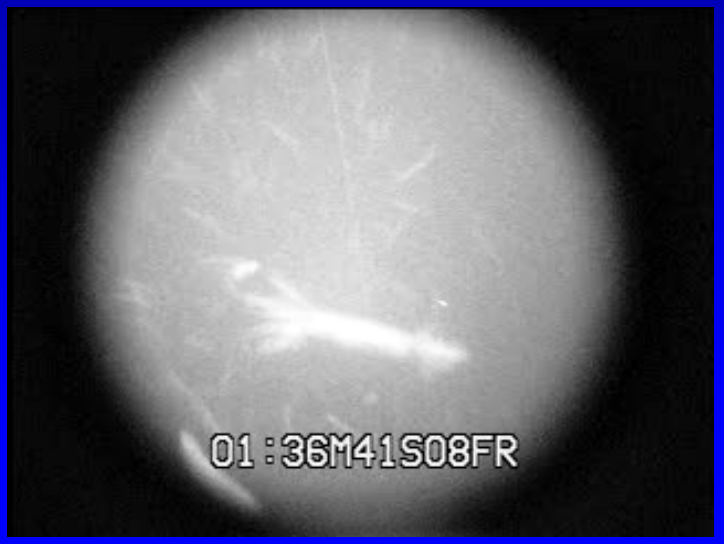


220m

320m

J-QUEST camera view

Left camera



Right camera

Depth: 25m

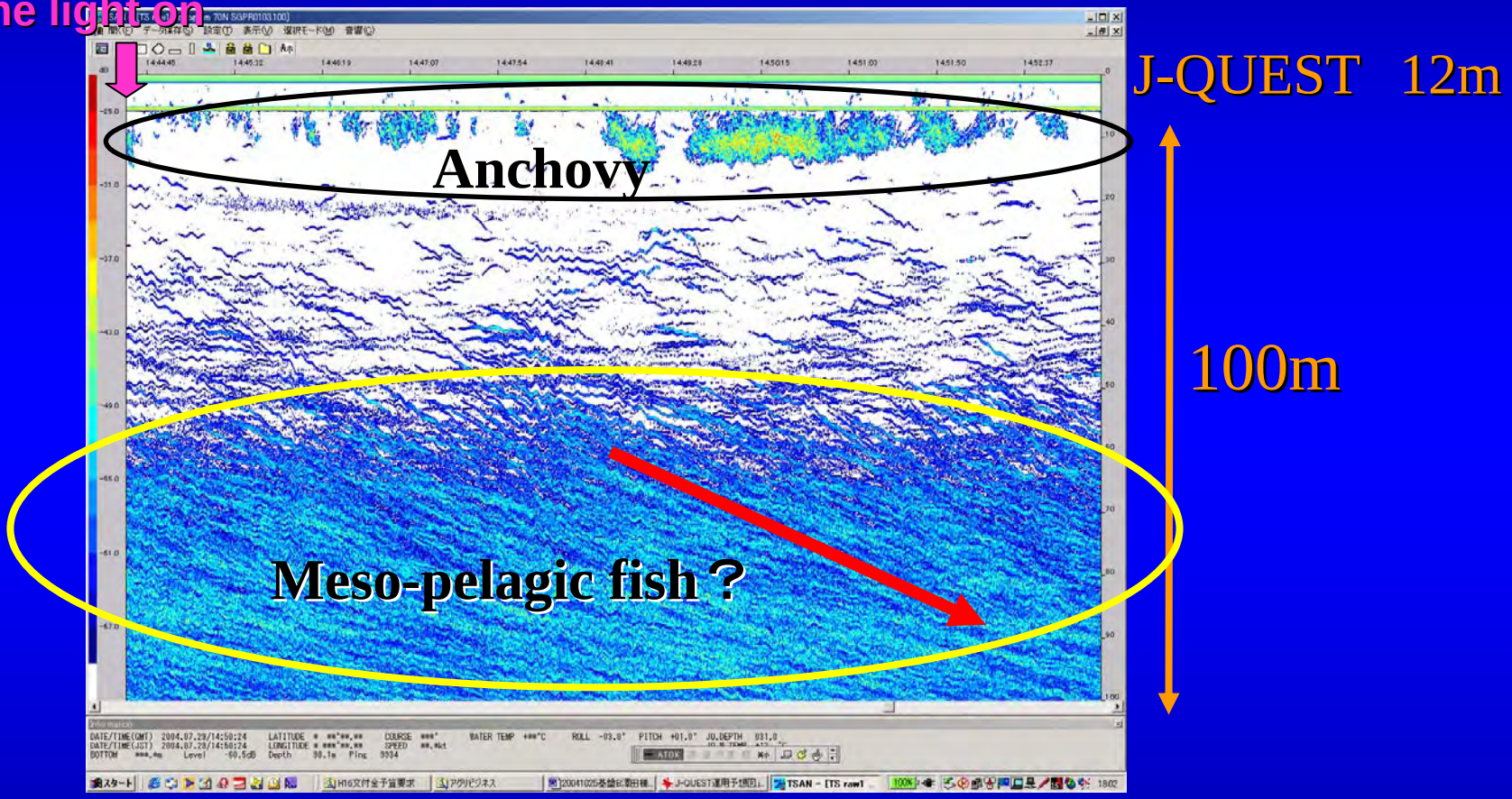
Gonatopsis borealis (squid)

Mantle length 37cm[1]

Japanese anchovy

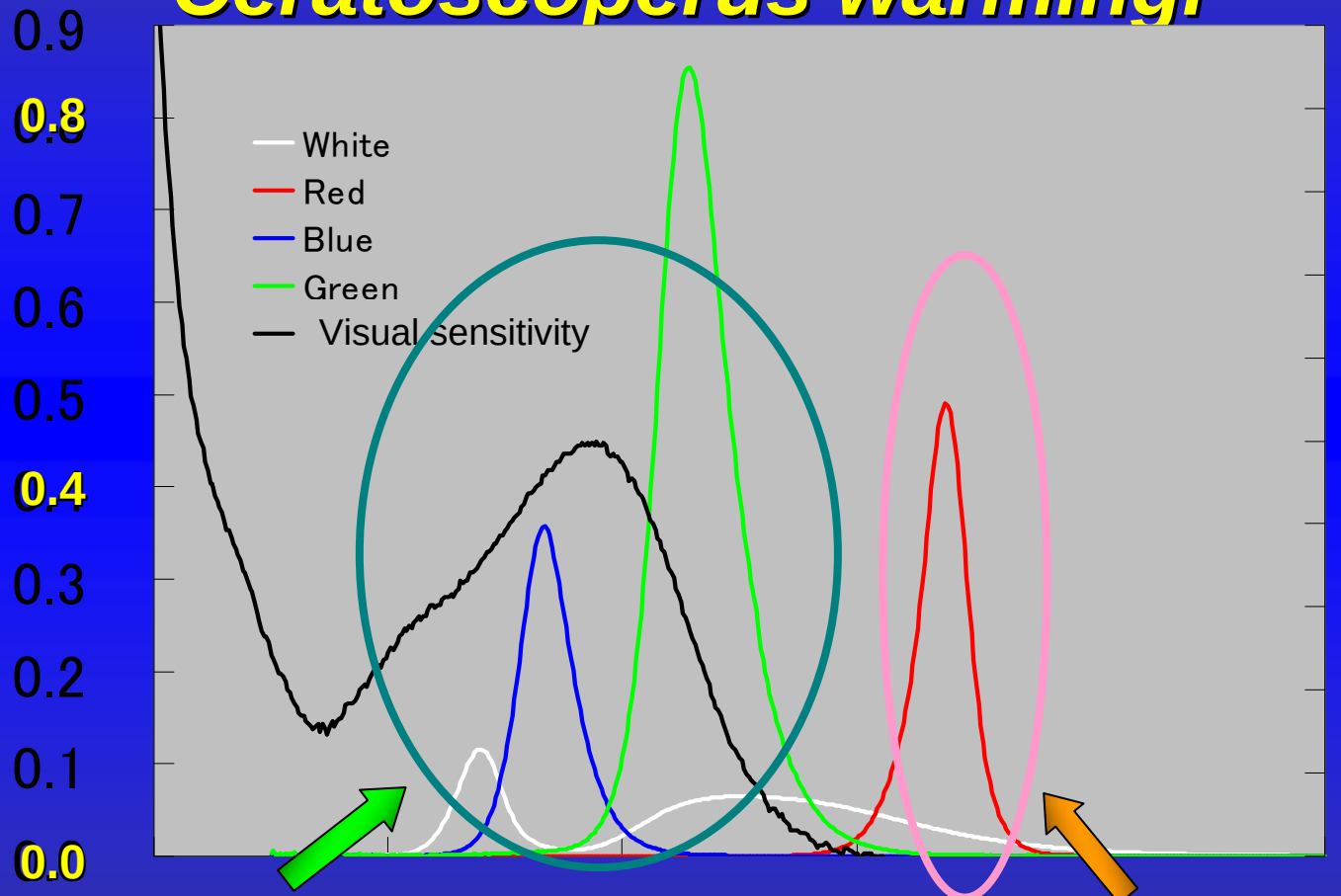
<L>= 12.2cm, S.D.=1.3cm(n=24)

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*



Photon flux density (μ mol/m^2/s/nm)

Relative absorbance for *C.warmingi*

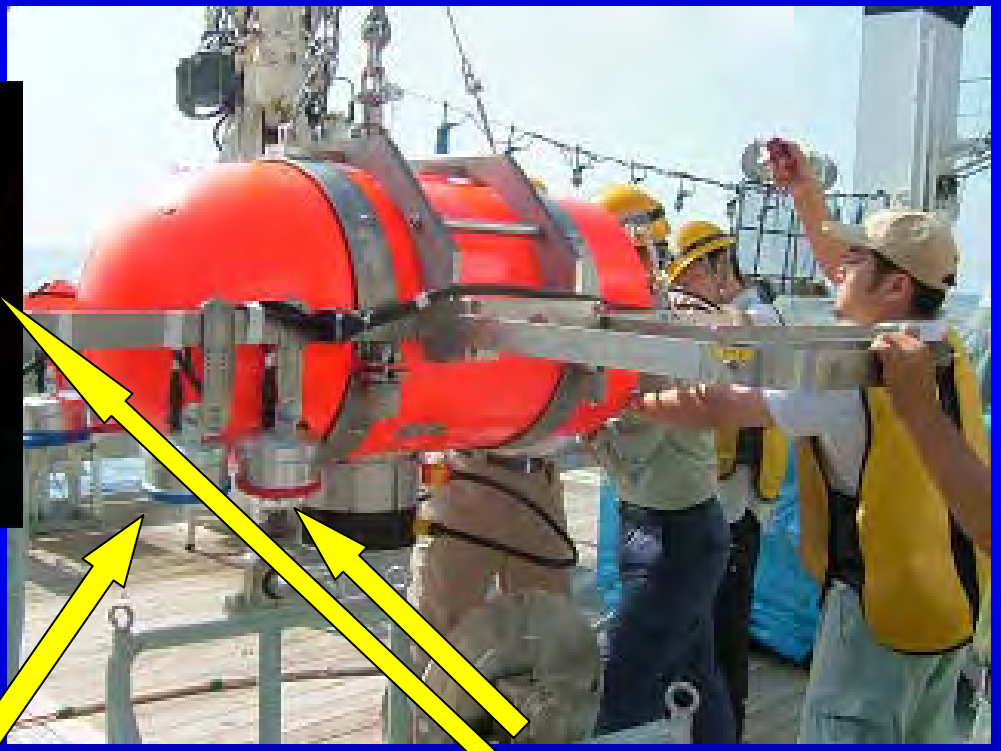
C.warmingi should be sensitive for white, blue and green light

C.warmingi should NOT be sensitive for red light

Wave length (nm)

J-QUEST χ(改)

invisible light system is equipped for mesopelagic fish
the direction is adjustable



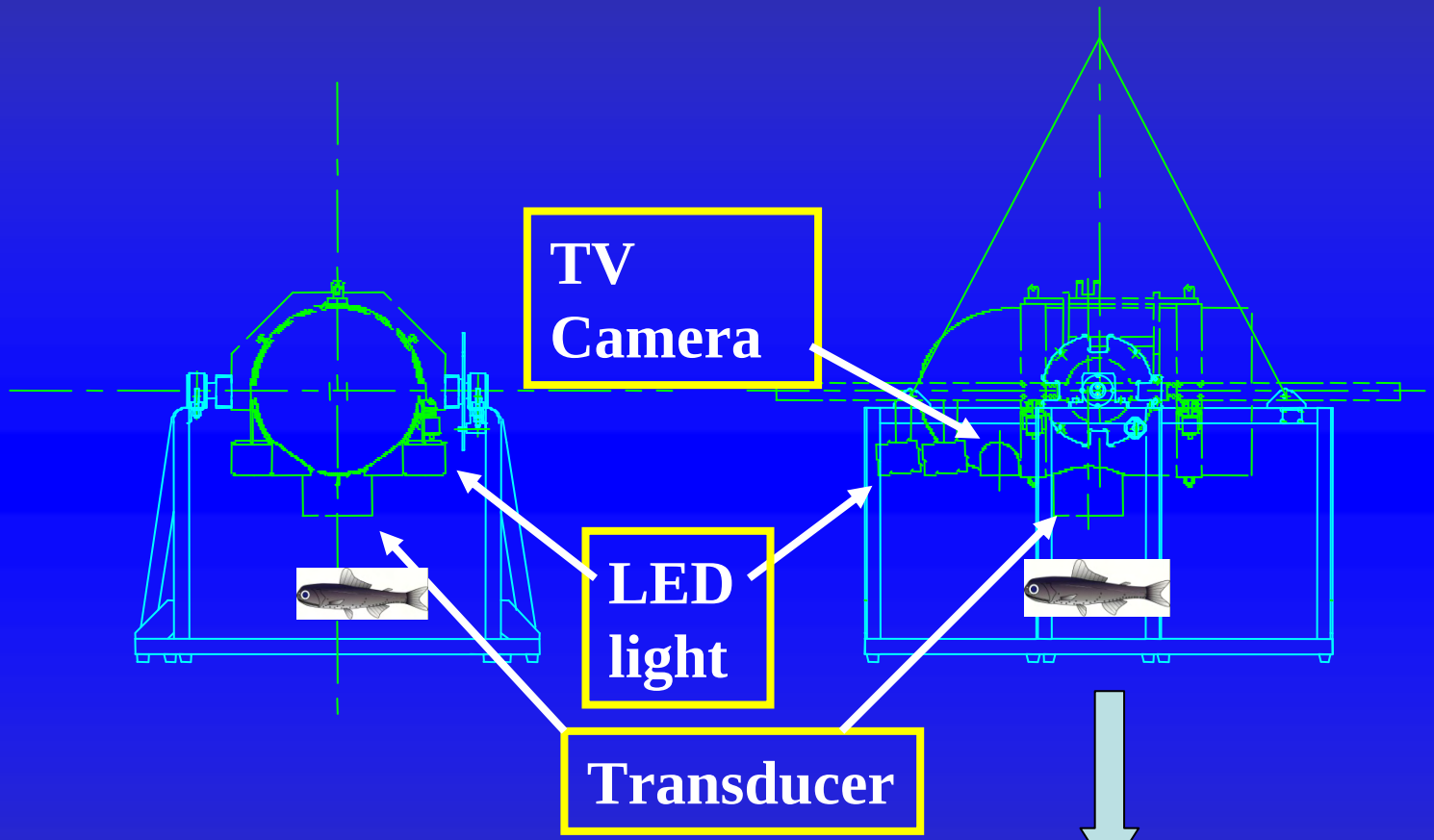
Blue LED

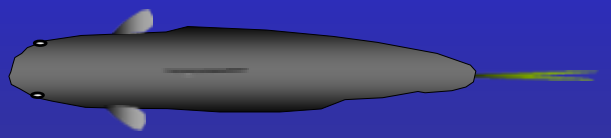
sensitive for mesopelagic fish
but clear images for CCD video camera

Red LED

not or less sensitive
for mesopelagic fish

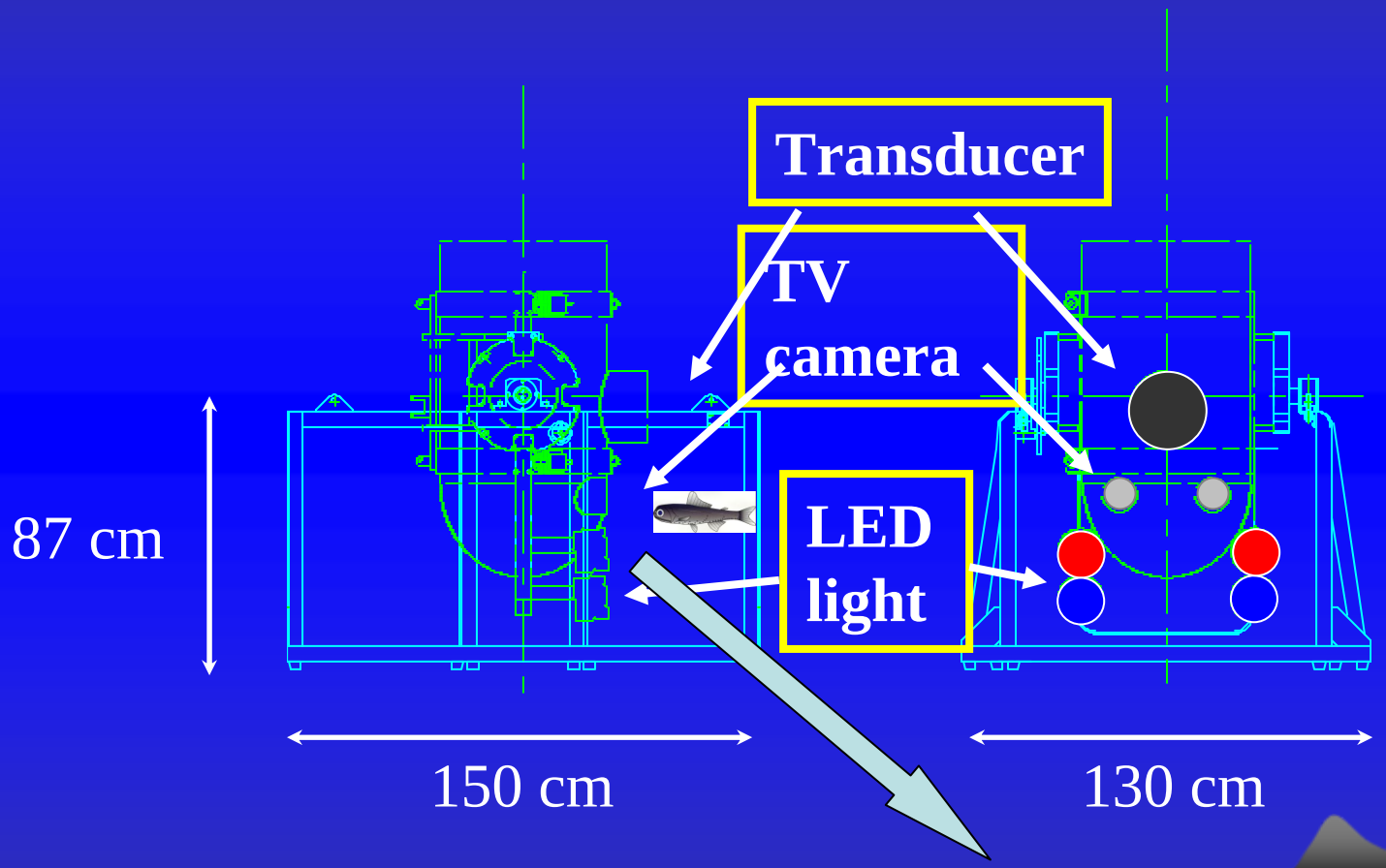
Downward direction of TV camera

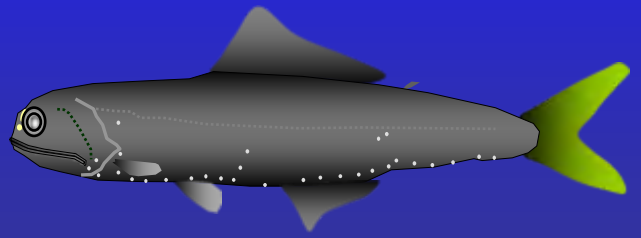




Bird's view of the fish is observed

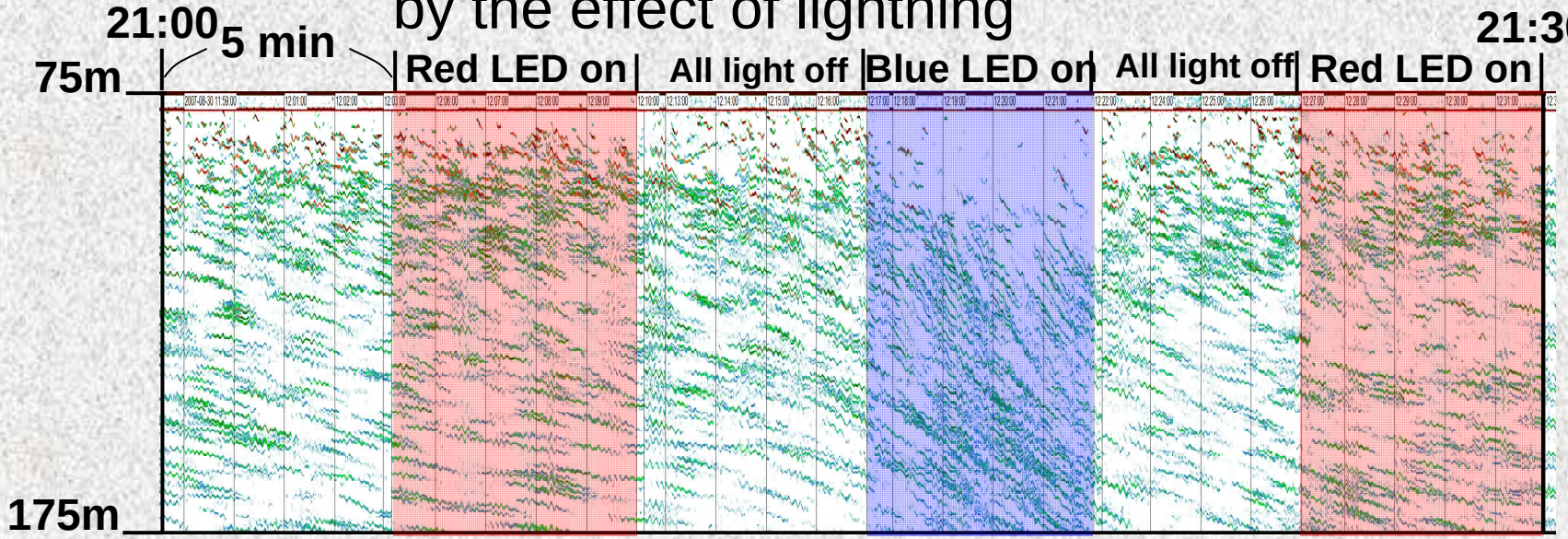
Sidewise direction of TV camera



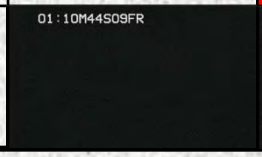
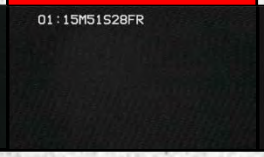
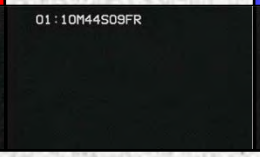
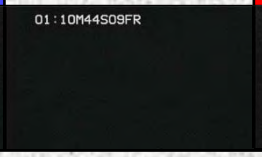
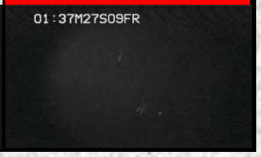


Side view of the fish is observed

Change of behavior of school of mesopelagic fish by the effect of lightning



Interval : 1/60[s]

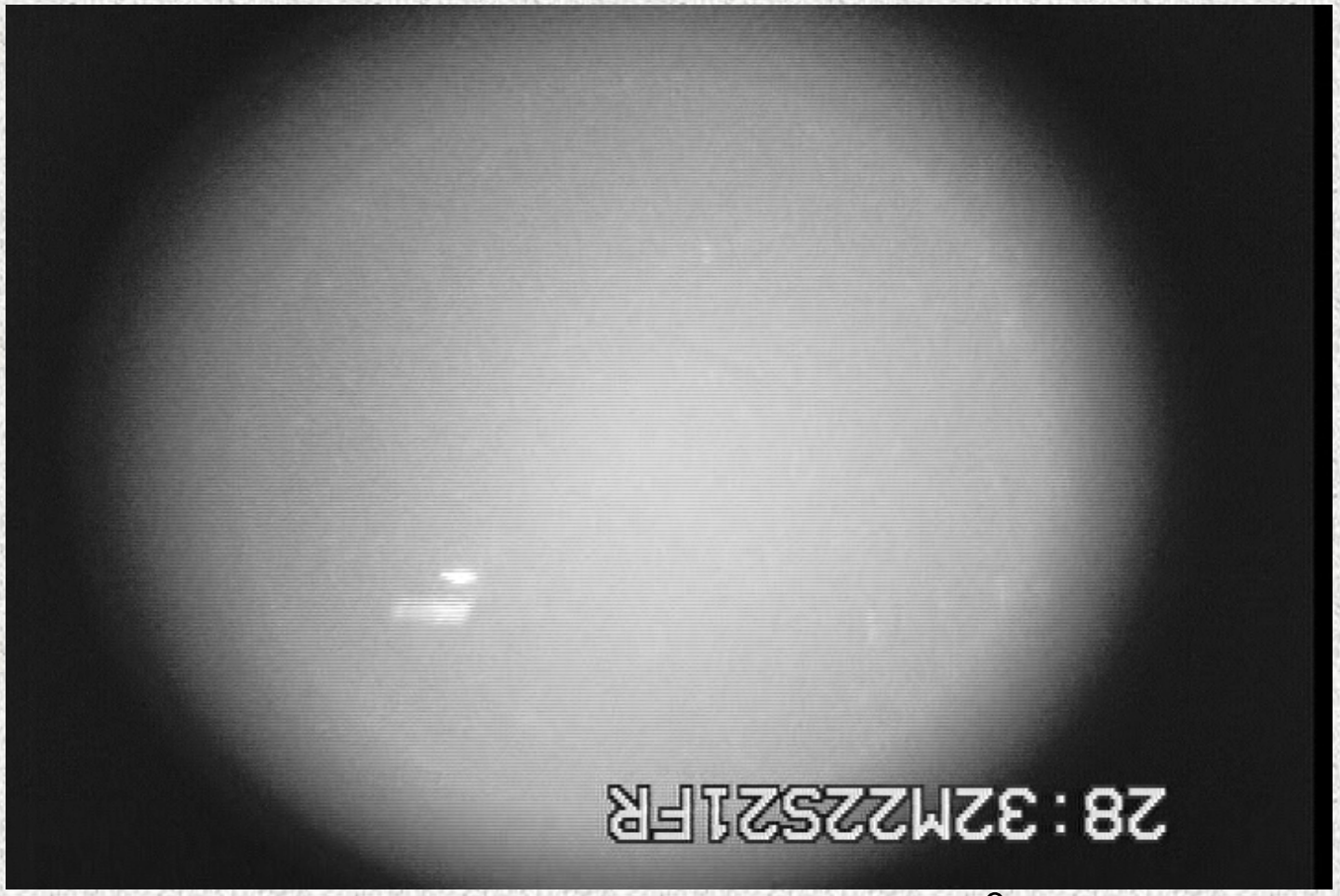
Light	Off 1	Red 1	Off 2	Blue	Off 3	Red 2
Level [mA]		600		600		920
Pulse width[μs]		500		500		1023
Average SA[dB]	-52.5	-52.4	-52.2	-55.0	-52.4	-53.5
Video						

Diaphus +Walleye pollock

8/26 11:56 J-QUEST Depth:191 m Temp: 2.06 ℃

Sal: 33.39 PSU Sideway Blue level 255, Interval 1/60 s, PW 1023 us

Diaphus theta



8/26 18:07 J-QUEST Depth: 151 m Temp: 2.95 ℃

Sal: 33.36 PSU Sideway Blue level 255, Interval 1/60 s, PW 1023 us

Many *Diaphus theta* were observed by the video camera of J-QUEST in the Oyashio area at the sideways posture

J-QUEST can be obtain the visual and acoustic data of deep-sea creatures simultaneously

- **Still leaving problem**

Unclear camera view especially in Red LED condition.
Escape from J-QUEST especially in Blue LED condition.

It is necessary to improve both lighting and camera

J-QUSET could be a useful gear for quantitative analysis of the biomass of oceanic creatures near future