DO SQUID FISHING LIGHTS AFFECT THE NITROGEN CYCLE IN THE SEA OF JAPAN?

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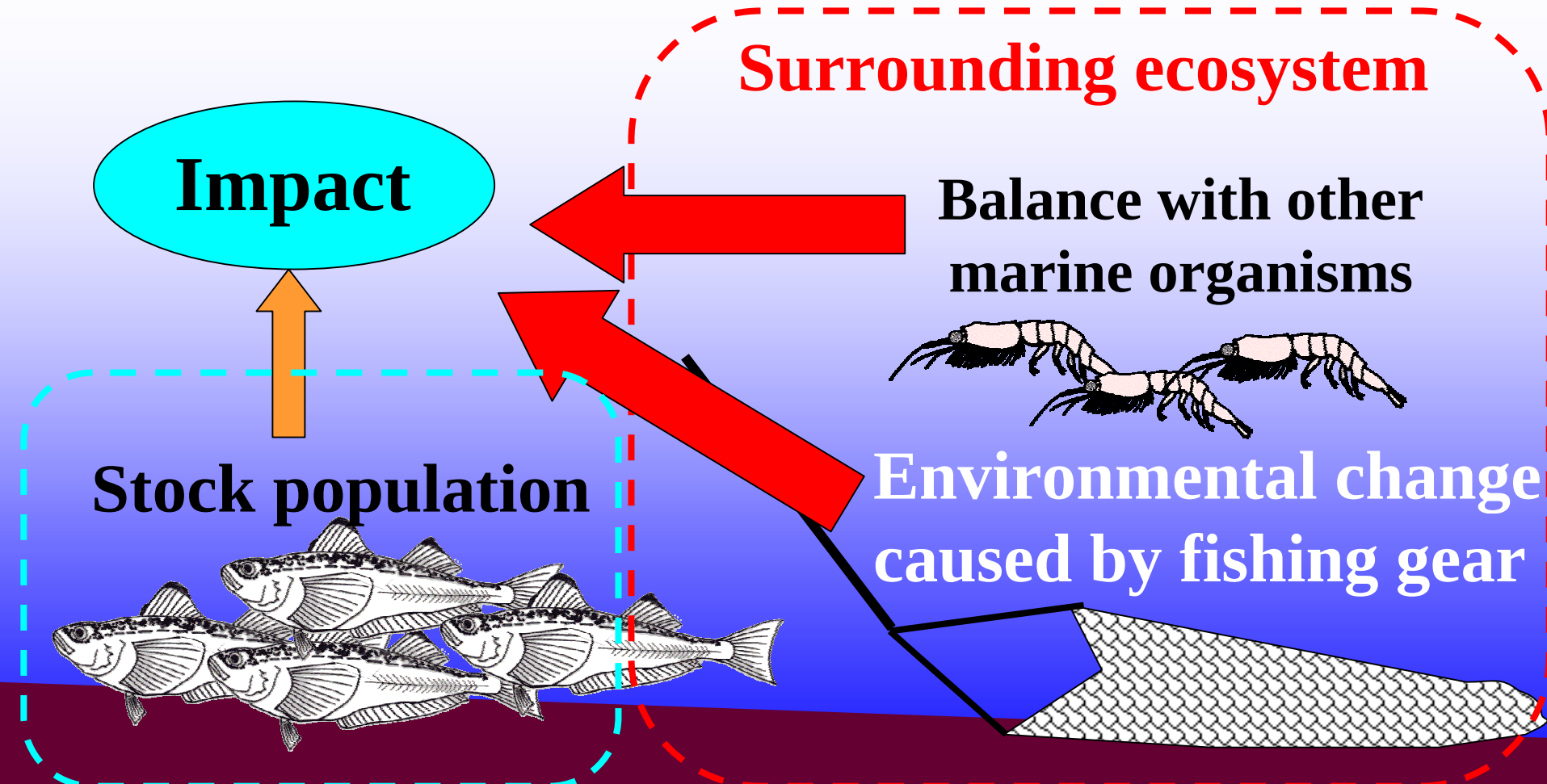
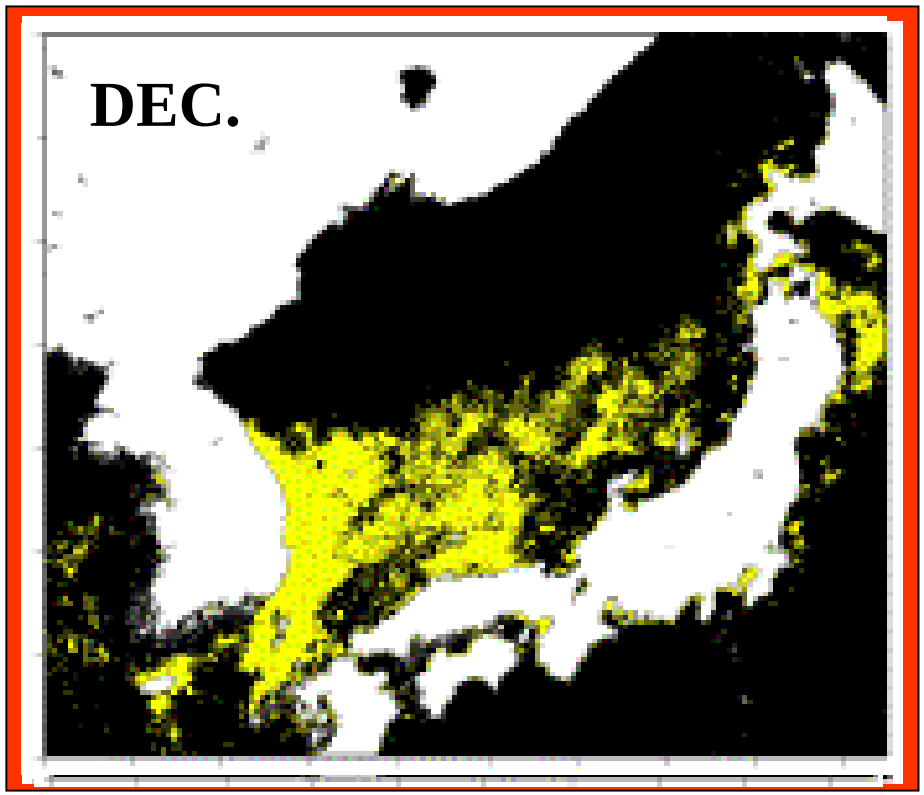
For sustainable fishing in the 21th century

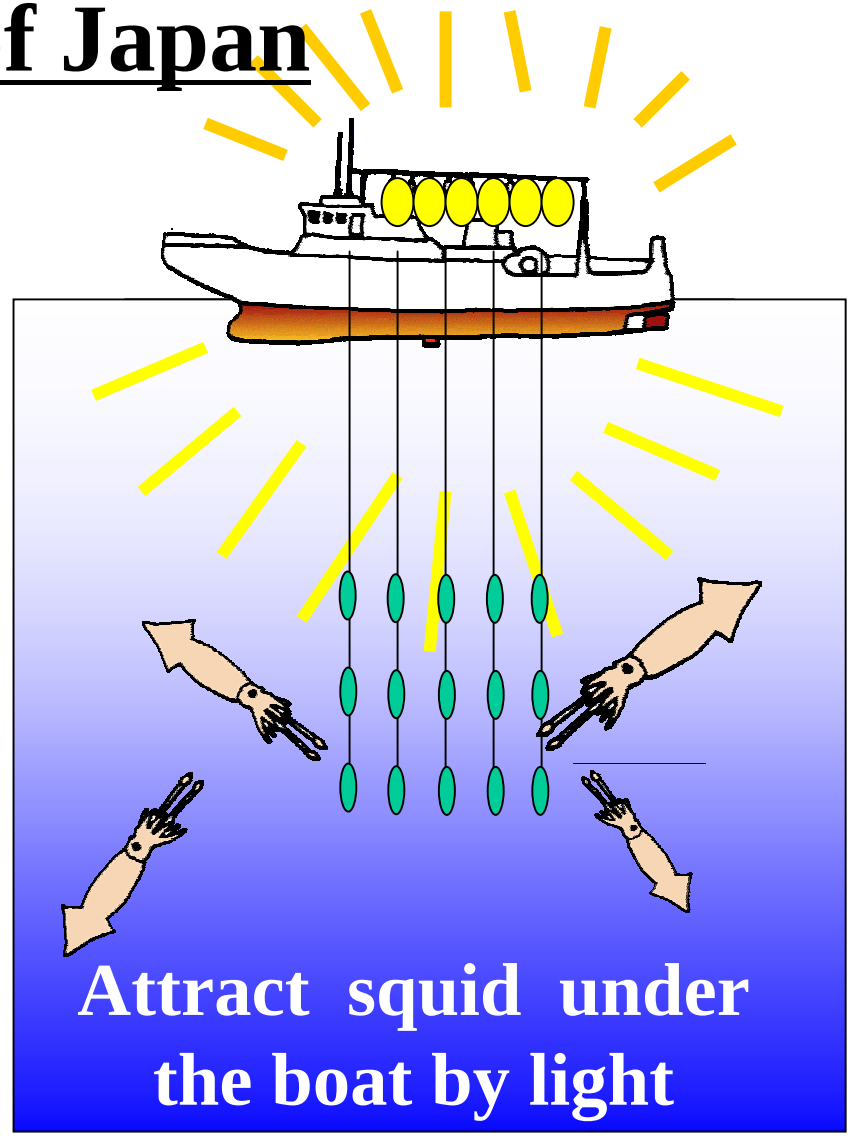
We need to evaluate the impact of fishing on the whole Marine ecosystem



Squid fishery in the Sea of Japan

Satellite images of Squid fishing boats (Kiyofuji 2002)



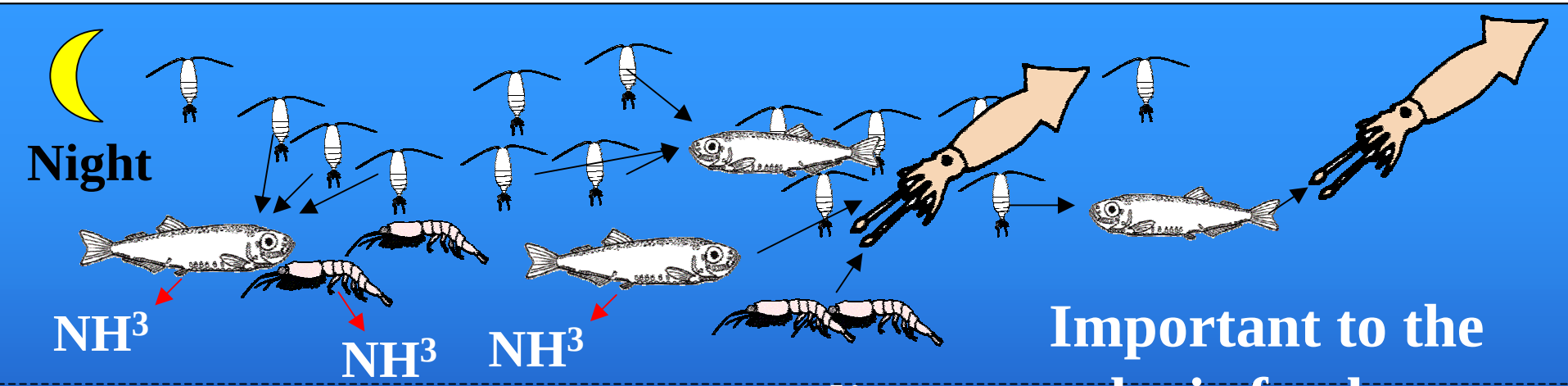


Extensive artificial light in the night sea

Roles of the diurnal migrating mesopelagic organisms

Biological pump

Connecting the pelagic and mesopelagic ecosystem through diurnal vertical migration

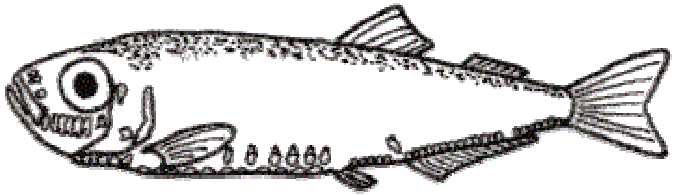


Important to the pelagic food chain at night

Excretion of ammonia
→Important source of nitrogen for primary production

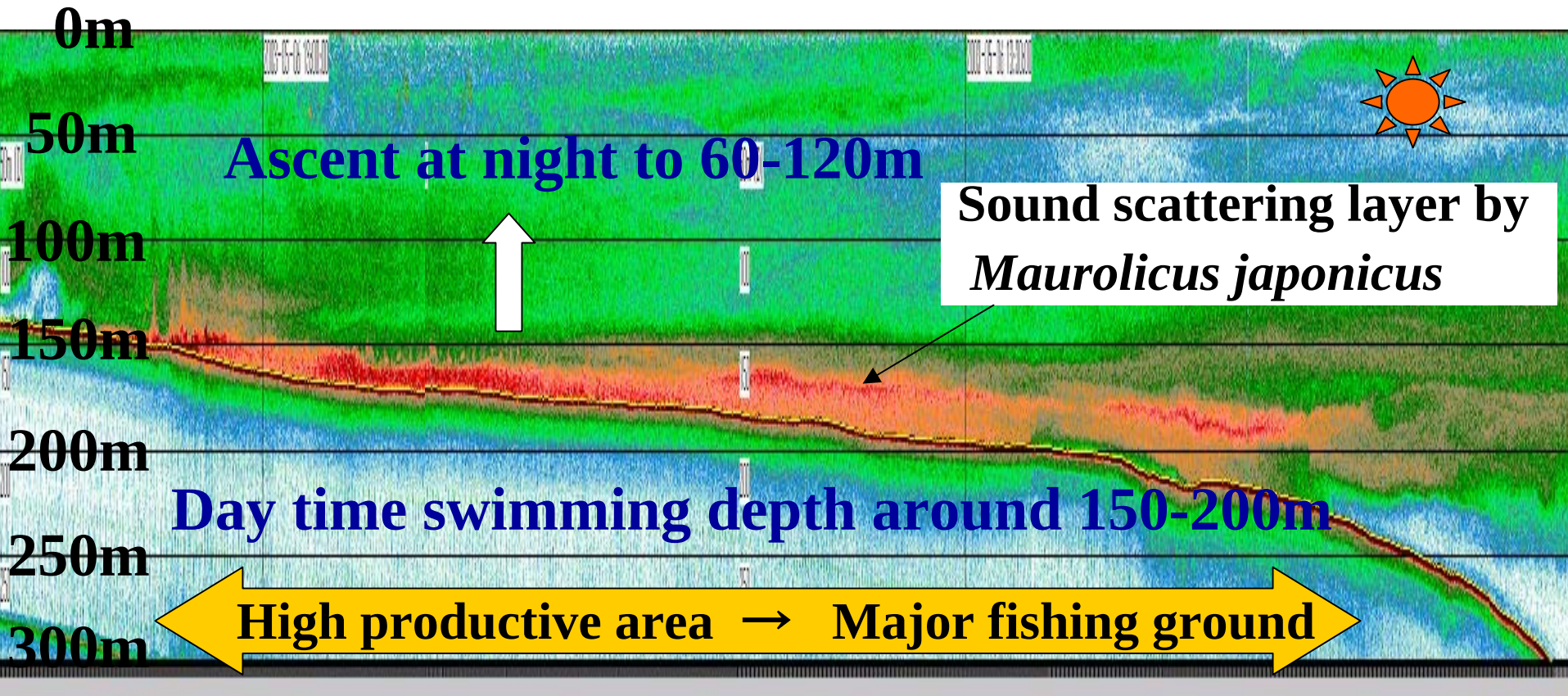
Mesopelagic fish in the Sea of Japan

Maurolicus japonicus



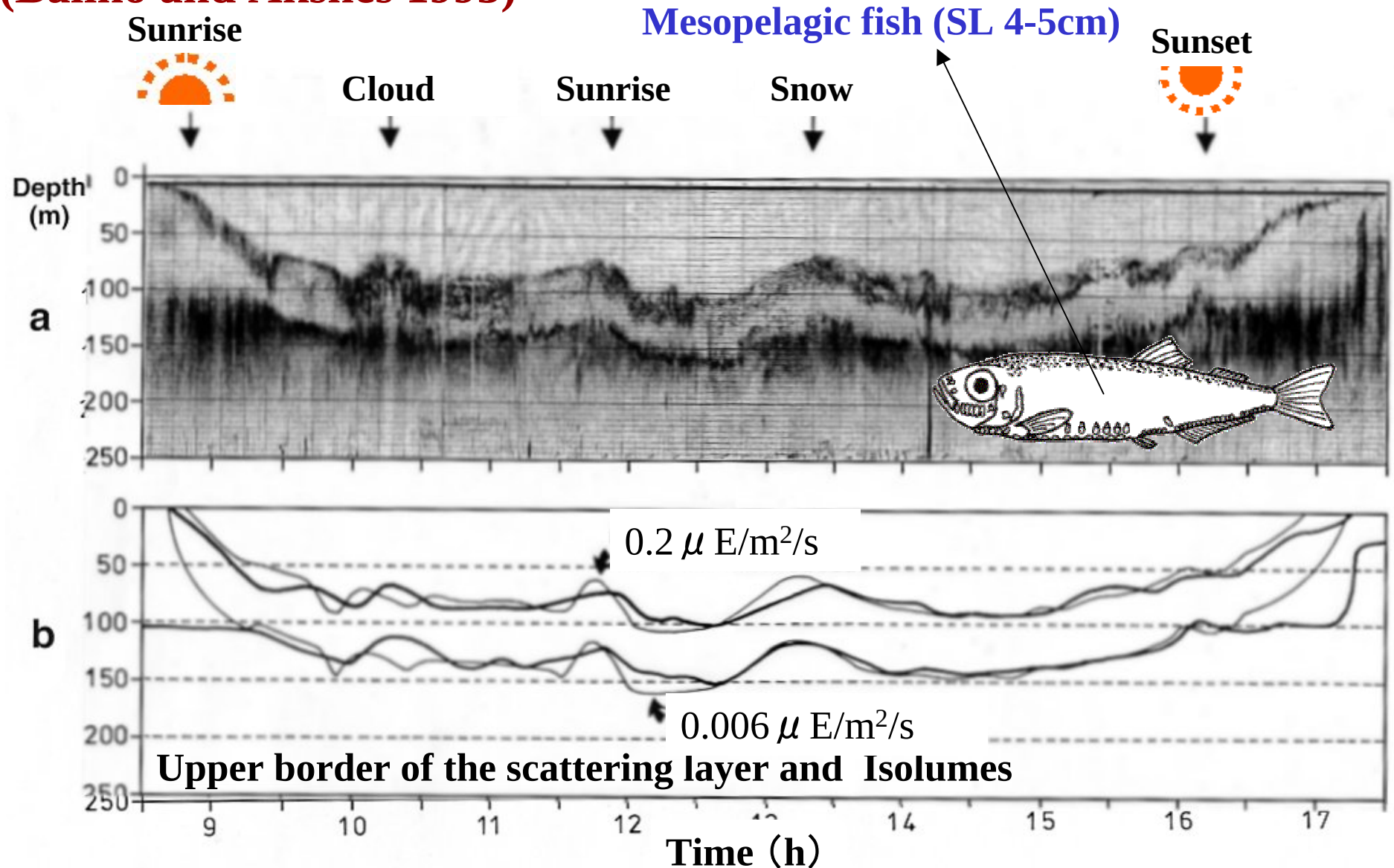
Only mesopelagic fish

Estimated 3.3 million tons



What kind of impact by light?

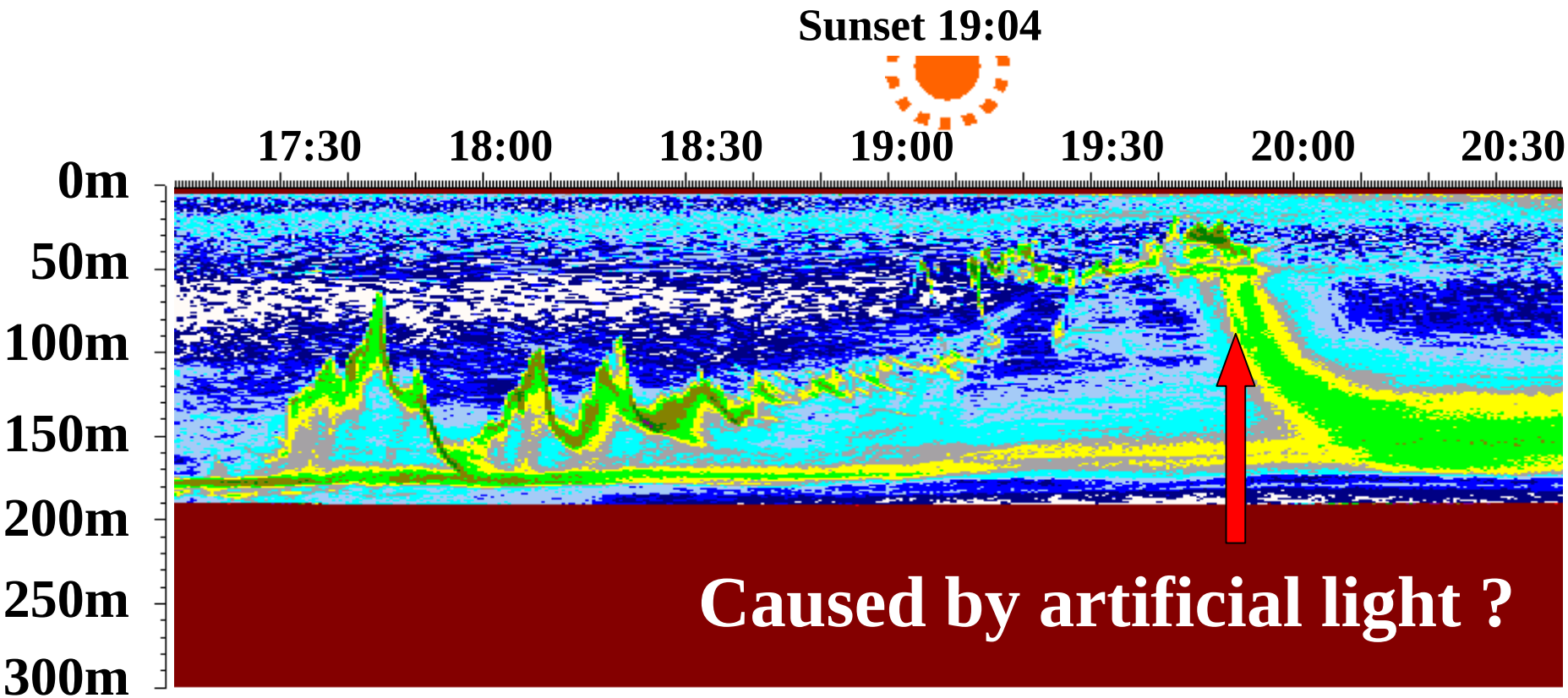
Maurolicus muelleri distribution correlated with Isolumes in Norway (Baliño and Aksnes 1993)



Objective

Do squid fishing lights affect

the biological pump in the Sea of Japan ?



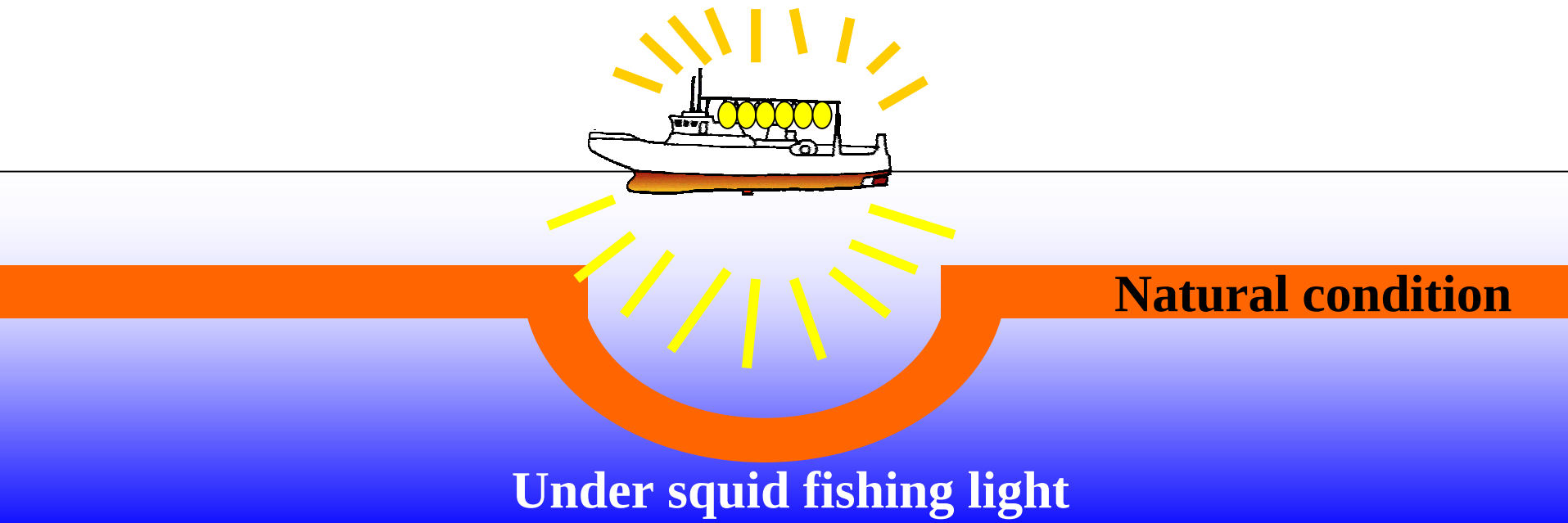
Echogram of *M.japonicus* recorded Aug. 2001

Study outline

1.Underwater irradiance from squid fishing lights

2.Light correlated swimming depth change of *M. japonicus*

3.Nitrogen excretion by *M. japonicus*

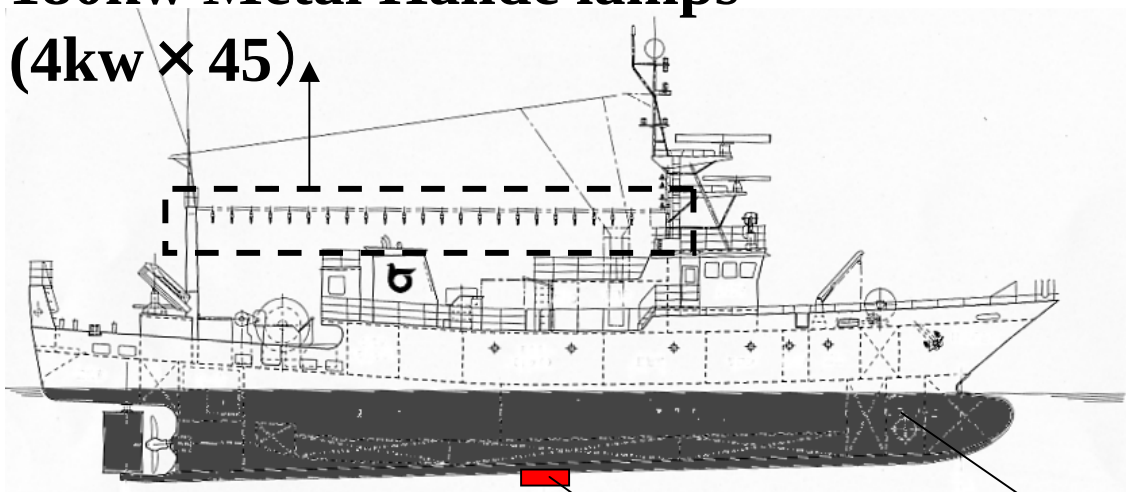


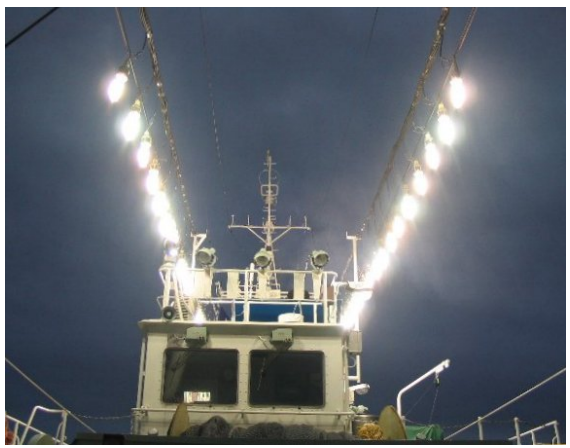
Material and Methods ①

Underwater irradiance from squid fishing lights

MAY, SEP 2003

180kw Metal Halide lamps
(4kw × 45)





KFC3000
Quantitative
echosounder

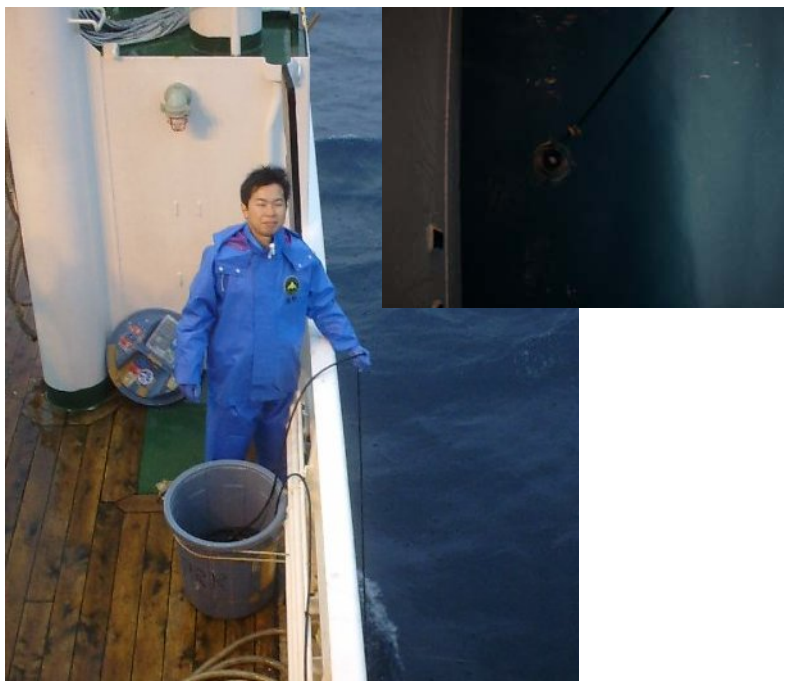
Tottori Prefecture Fisheries
Experimental Station
“Daiichi Tottori Maru”
（199t）

Material and Methods ②

PRR600 Multi-wavelength radiometer

Irradiance for 6 wavelengths (μ W/cm2/nm)

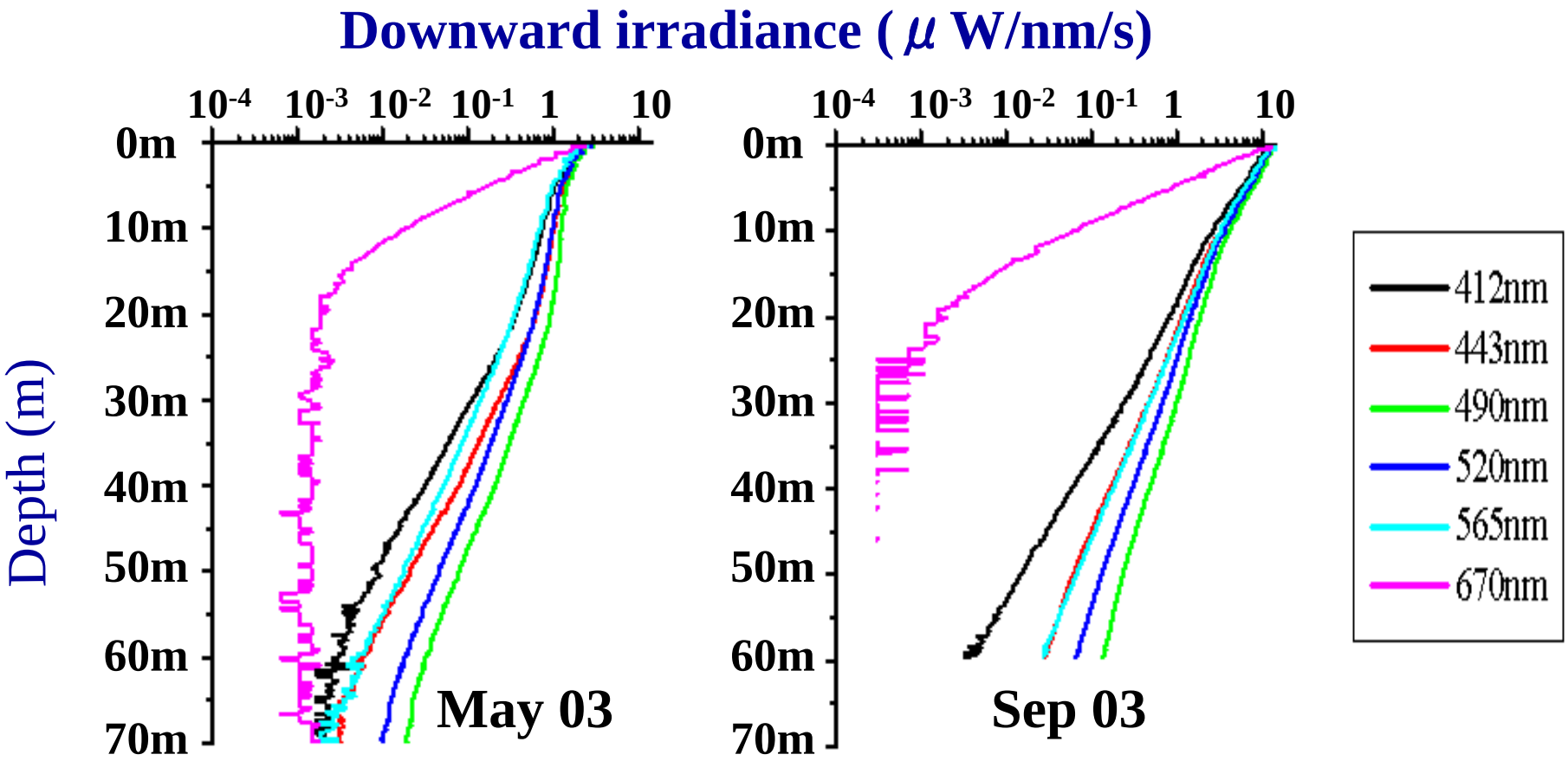
Total photon for 400-700nm (μ mol/ cm2/s)



May 2003: Right beside the ship

Sep 2003: 3m away from the ship

Downward irradiance of sunlight

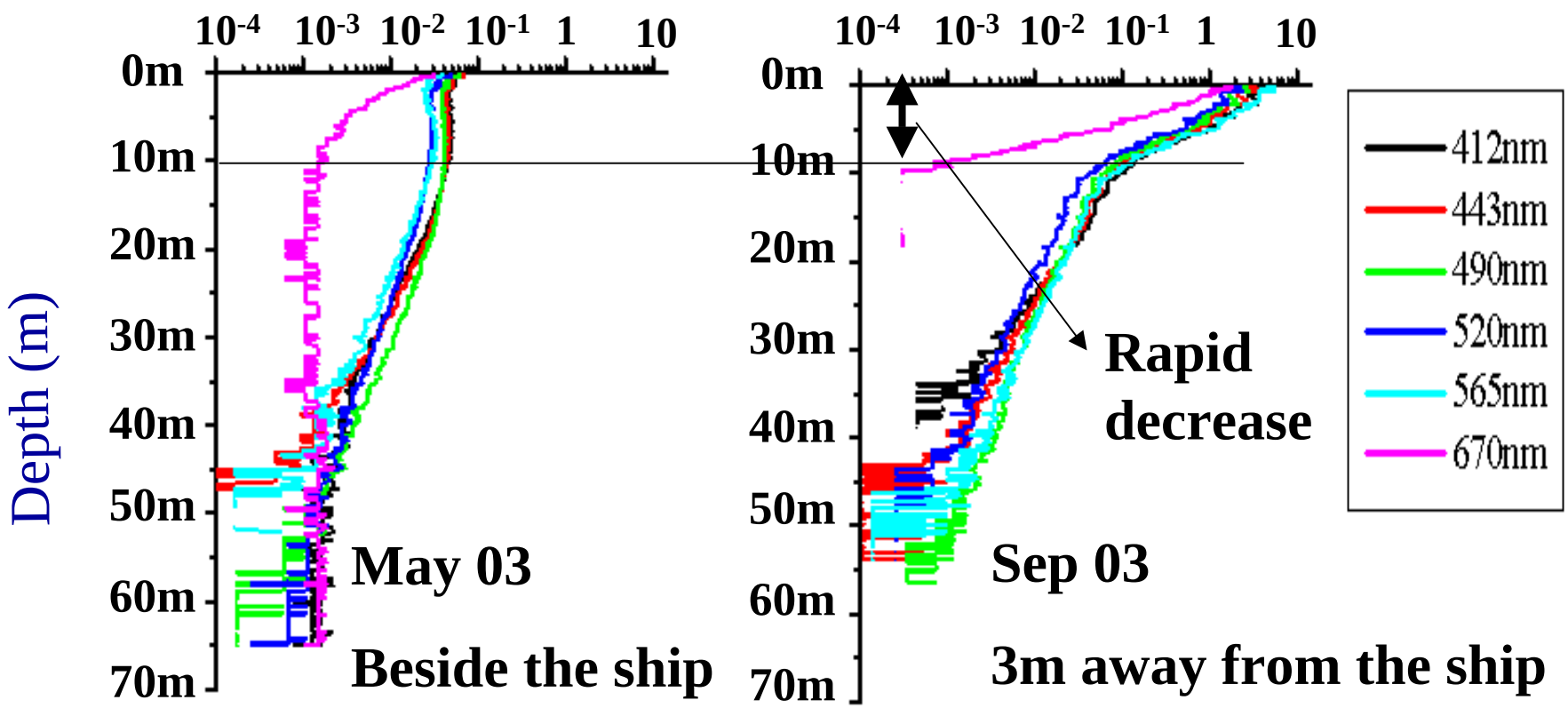


Wavelength 490-520nm penetrates well

Sunlight 490→520 →443 →565 → 412 →670

Kd (Attenuation coefficient) at 490nm; May 0.074 , Sep 0.075

Downward irradiance of squid fishing light



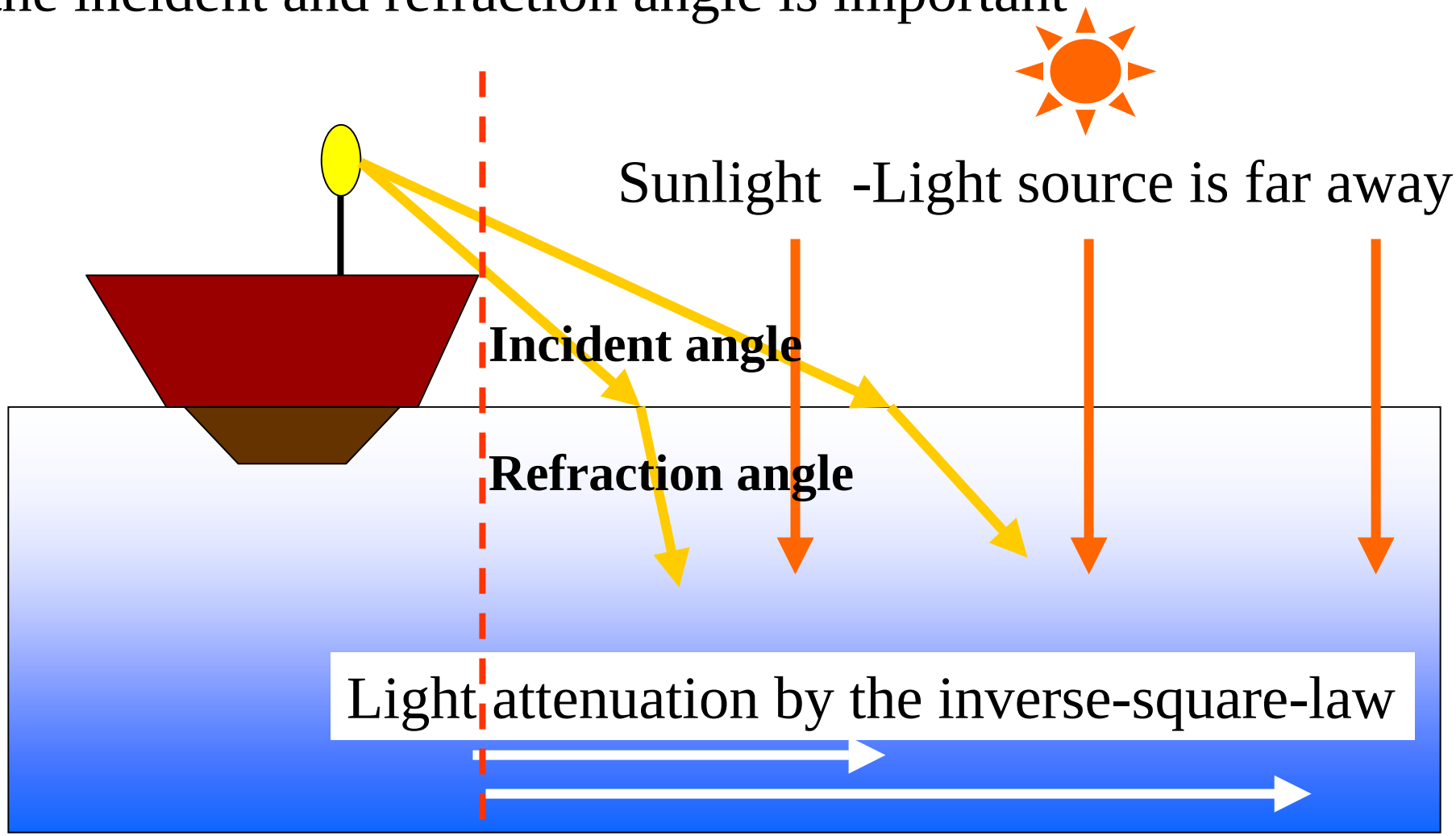
0-20m : 565 → 412→443→490→520→670nm

>30m : 490nm penetrates best

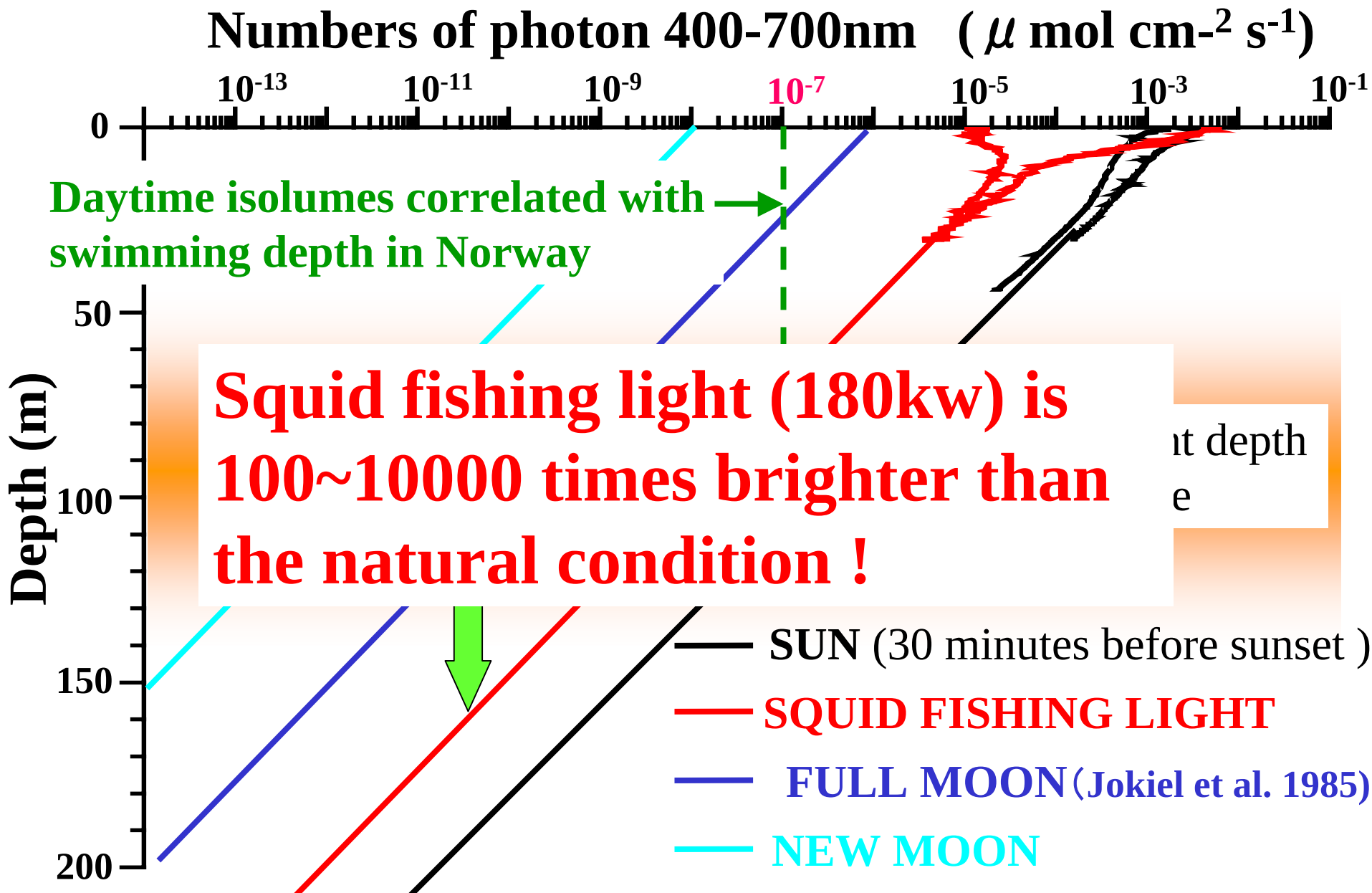
Kd (Attenuation coefficient) at 490nm; May 0.097 , Sep 0.087

Effect of the different light sources

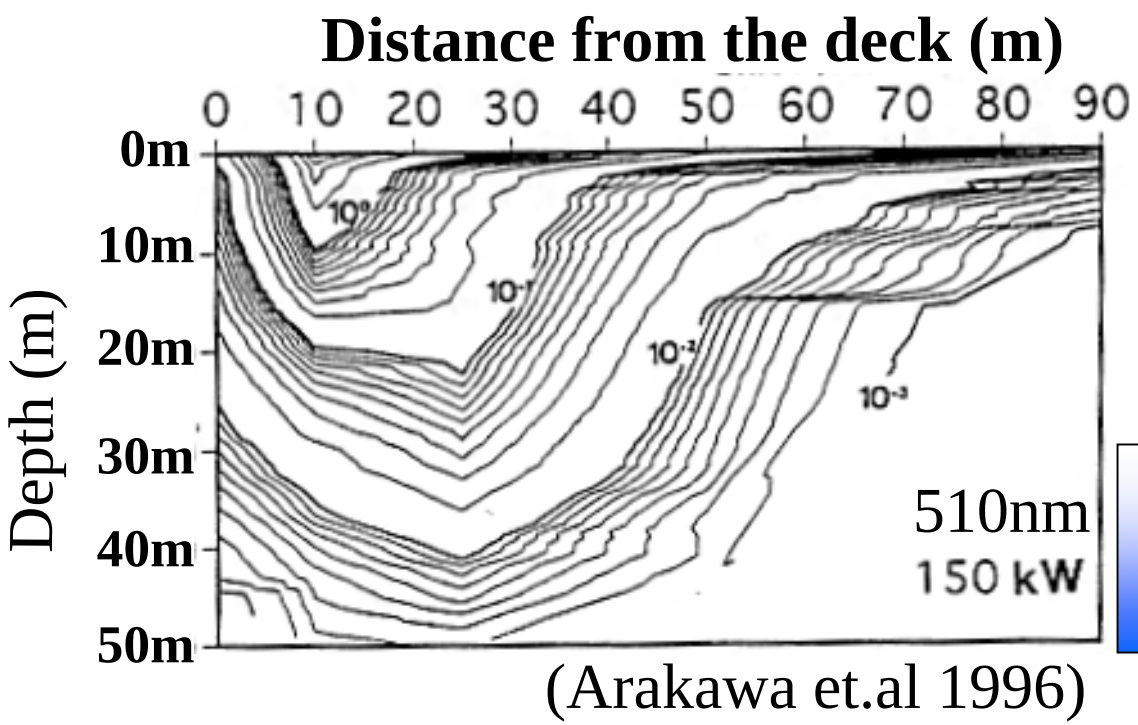
Squid fishing light -Light source is close, effect of angle of the incident and refraction angle is important



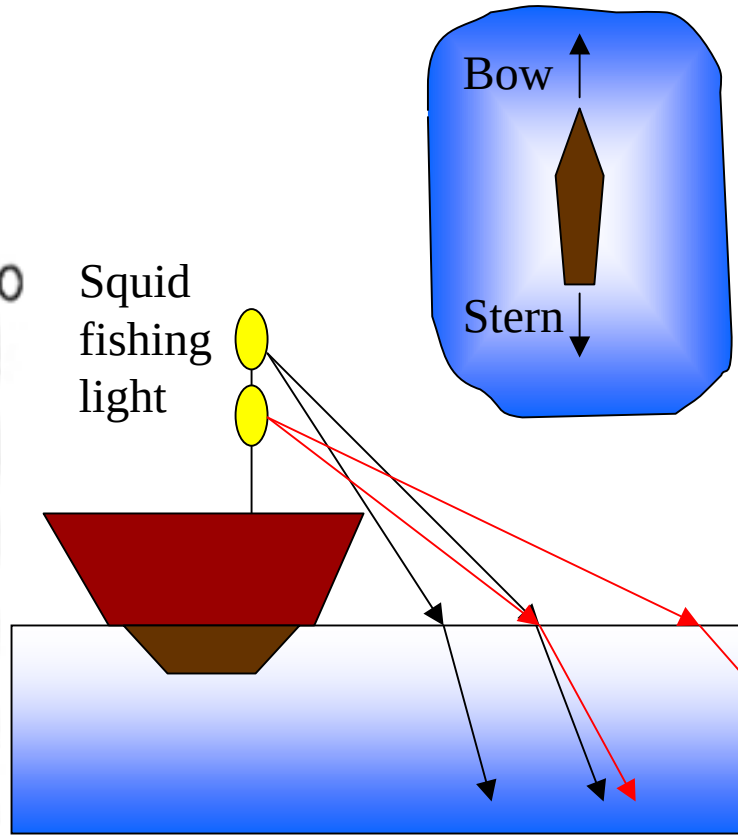
How bright are squid fishing lights?



Next step of our study



(Arakawa et.al 1996)



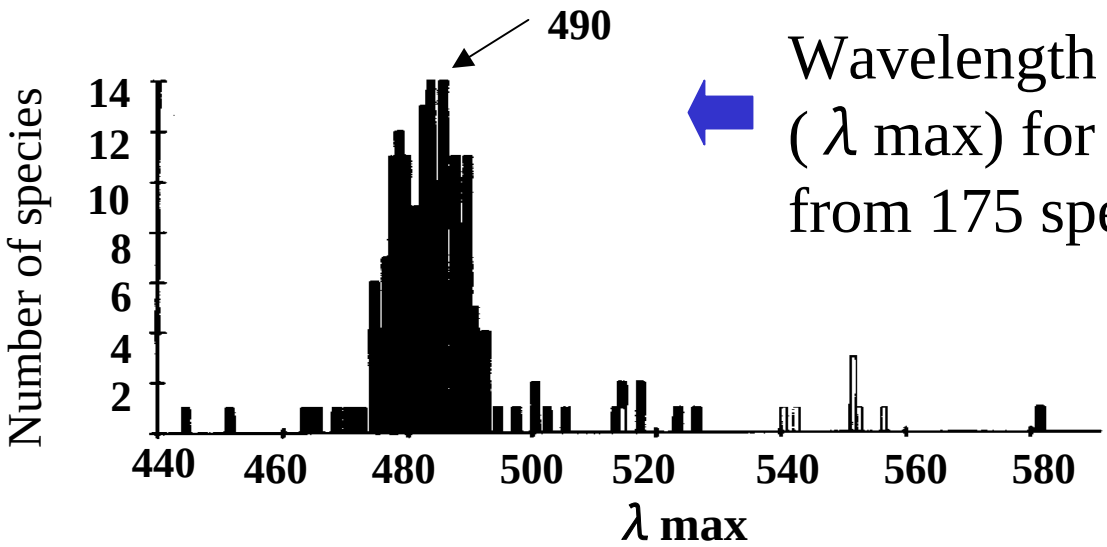
Simulation of isolume distribution according to ship size

- Length and width of ship → Total area of the isolume

Future work

Correlation between swimming depth and underwater irradiance of *M. japonicus*.

Use 490nm wavelength



Wavelength of maximum absorption (λ max) for 195 visual pigments isolated from 175 species of deep-sea fishes.

(Douglas et al. 1998)