ROV-Based investigations of mesopelagic micronekton and zooplankton

Bruce Robison

MBARI


Monterey Bay and the Monterey Submarine Canyon

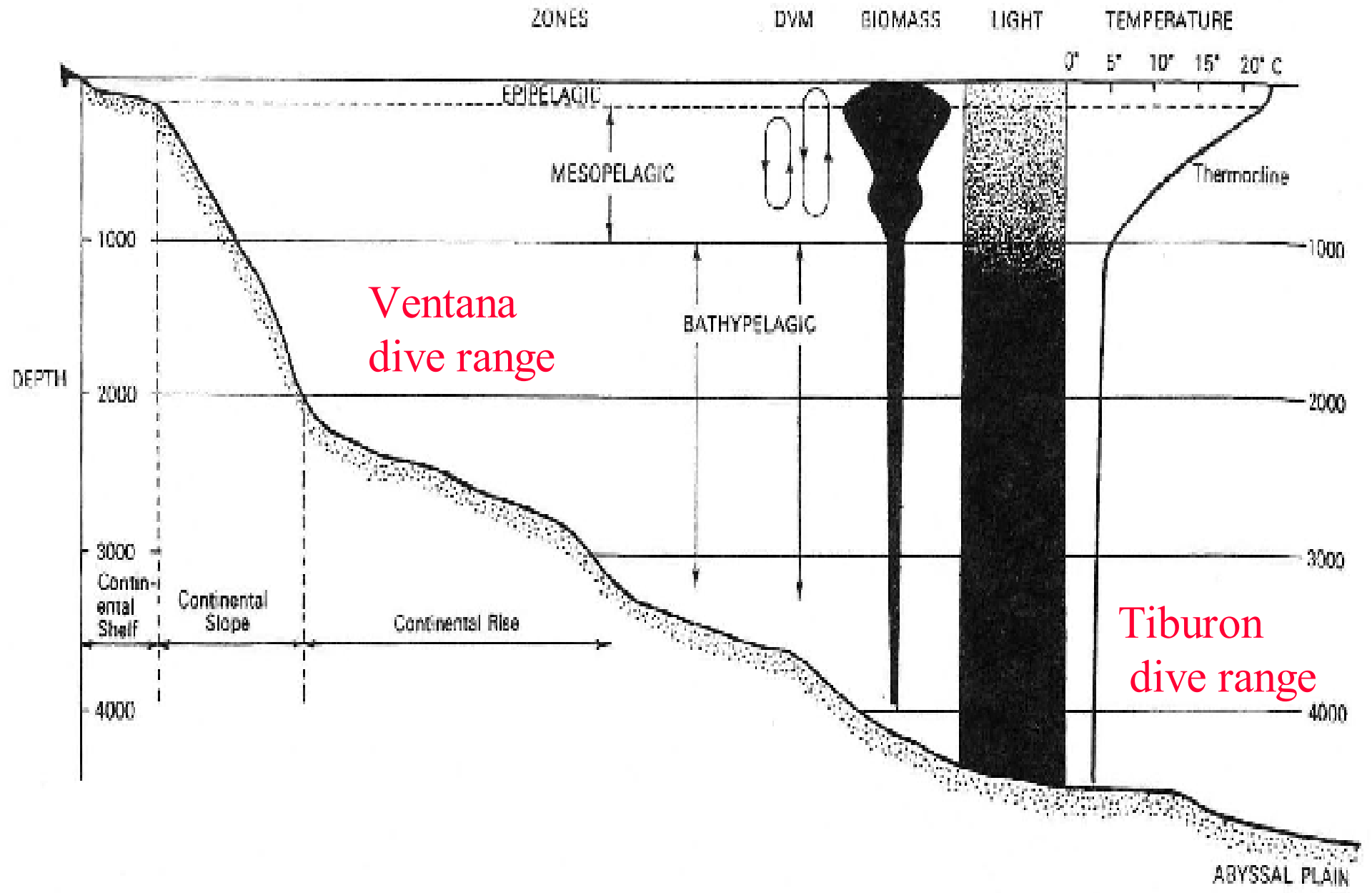
R/V Point Lobos
110’ x 26’
monohull,
support ship for:

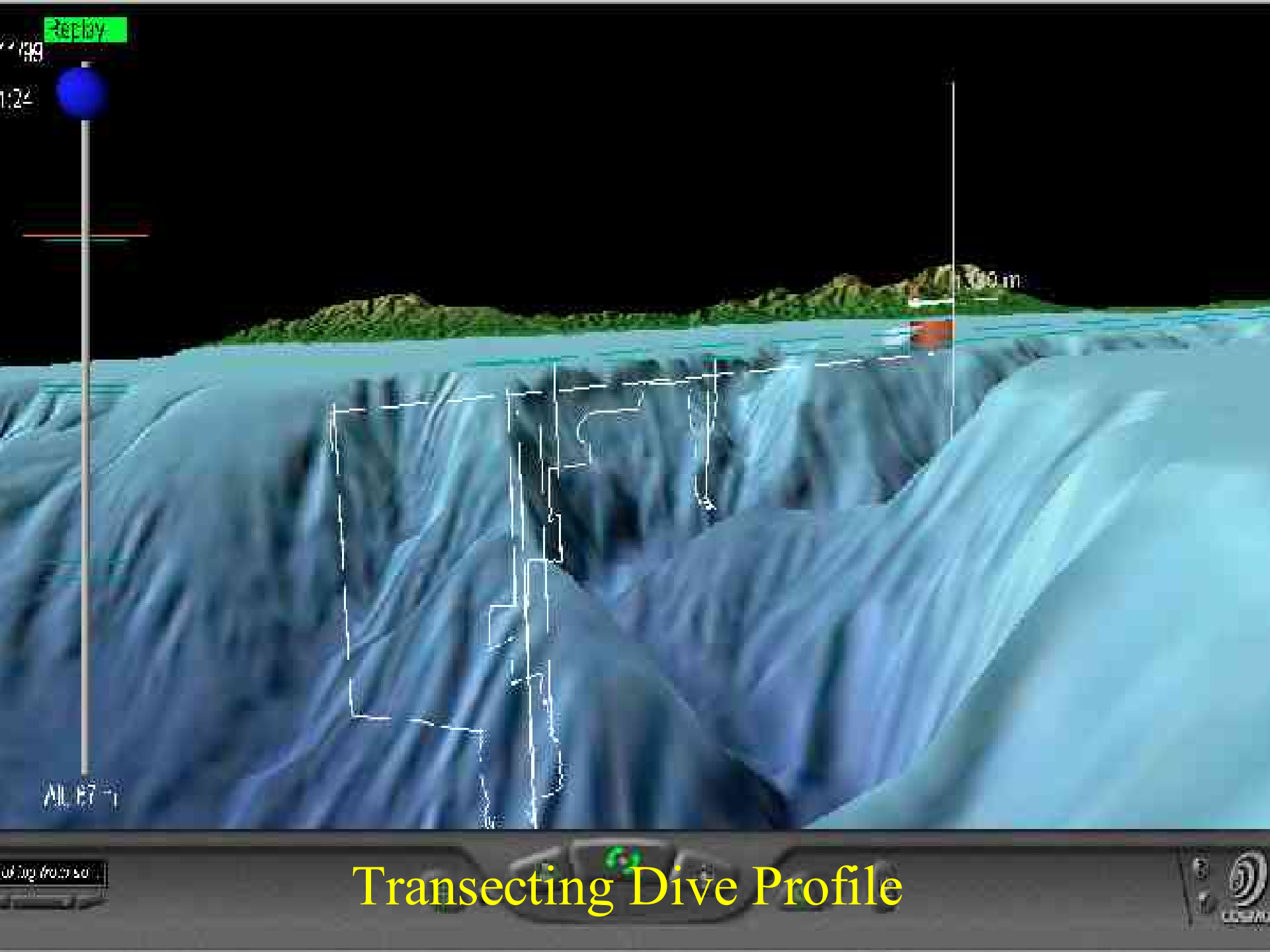
ROV Ventana:
1850 m depth
multiple tool sleds
hydraulic power
2500 dives

R/V Western Flyer
117’ x 54’
SWATH vessel,
support ship for:

ROV Tiburon:
- 4,000 m depth range
- multiple tool sleds
- variable ballast
- electric thrusters

750 dives


ZONES
DVM
BIOMASS
LIGHT
TEMPERATURE
0° 5° 10° 15° 20° C
EPIPELAGIC
MESOPELAGIC
BATHYPELAGIC
Thermocline
DEPTH
1000
2000
3000
4000
Ventana
dive range
Tiburon
dive range
Contin-
ental
Shelf
Continental
Slope
Continental Rise
ABYSSAL PLAIN



Transecting Dive Profile

Light and Vision:

Even down to 1000 m, ambient light is an important environmental factor.

--Prey silhouetting

--Visual trickery

--Many species have highly acute, binocular vision

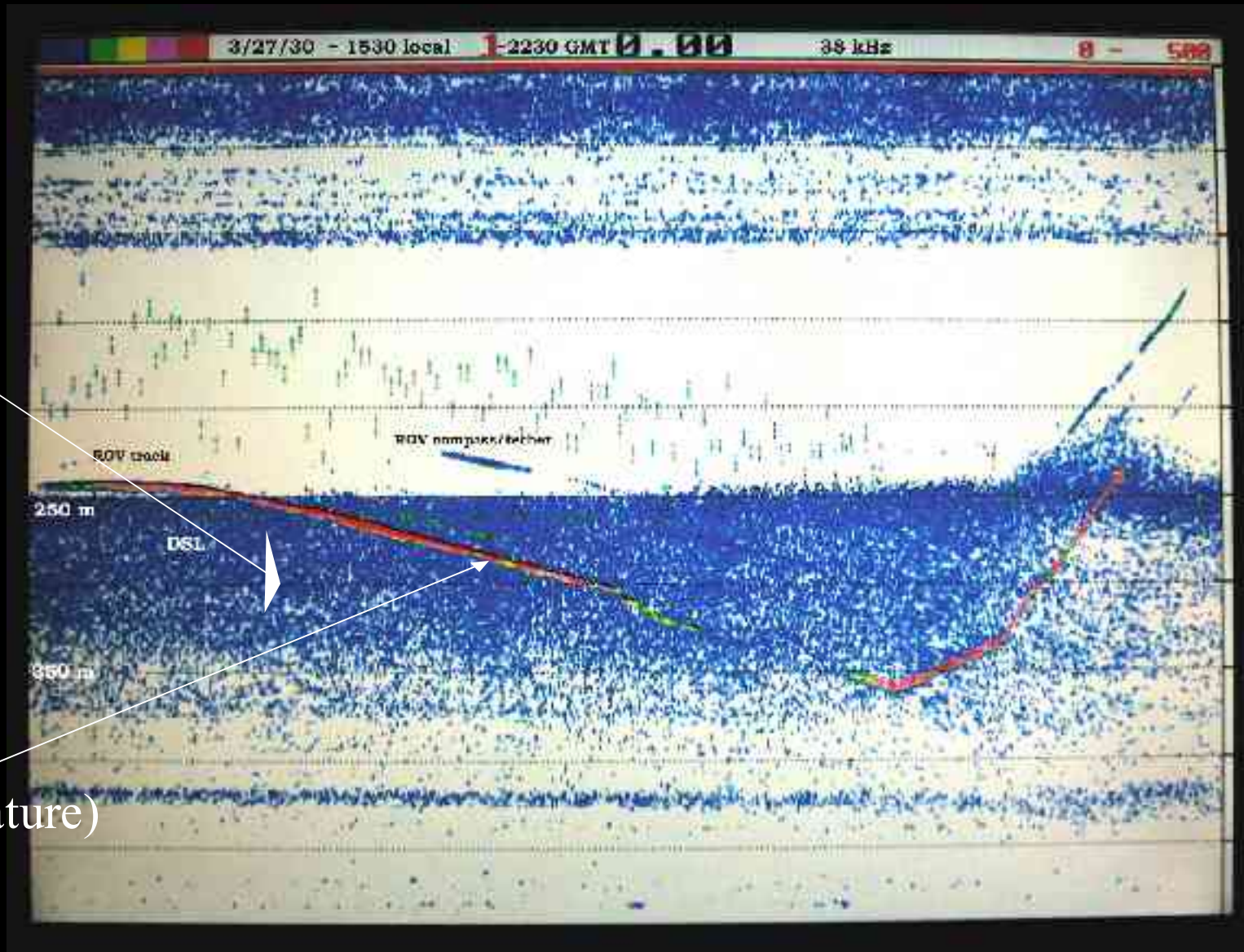
Bioluminescence continues to be a factor throughout the entire water column.


VERTICAL ALIGNMENT

Micronekton react to threat stimuli from below

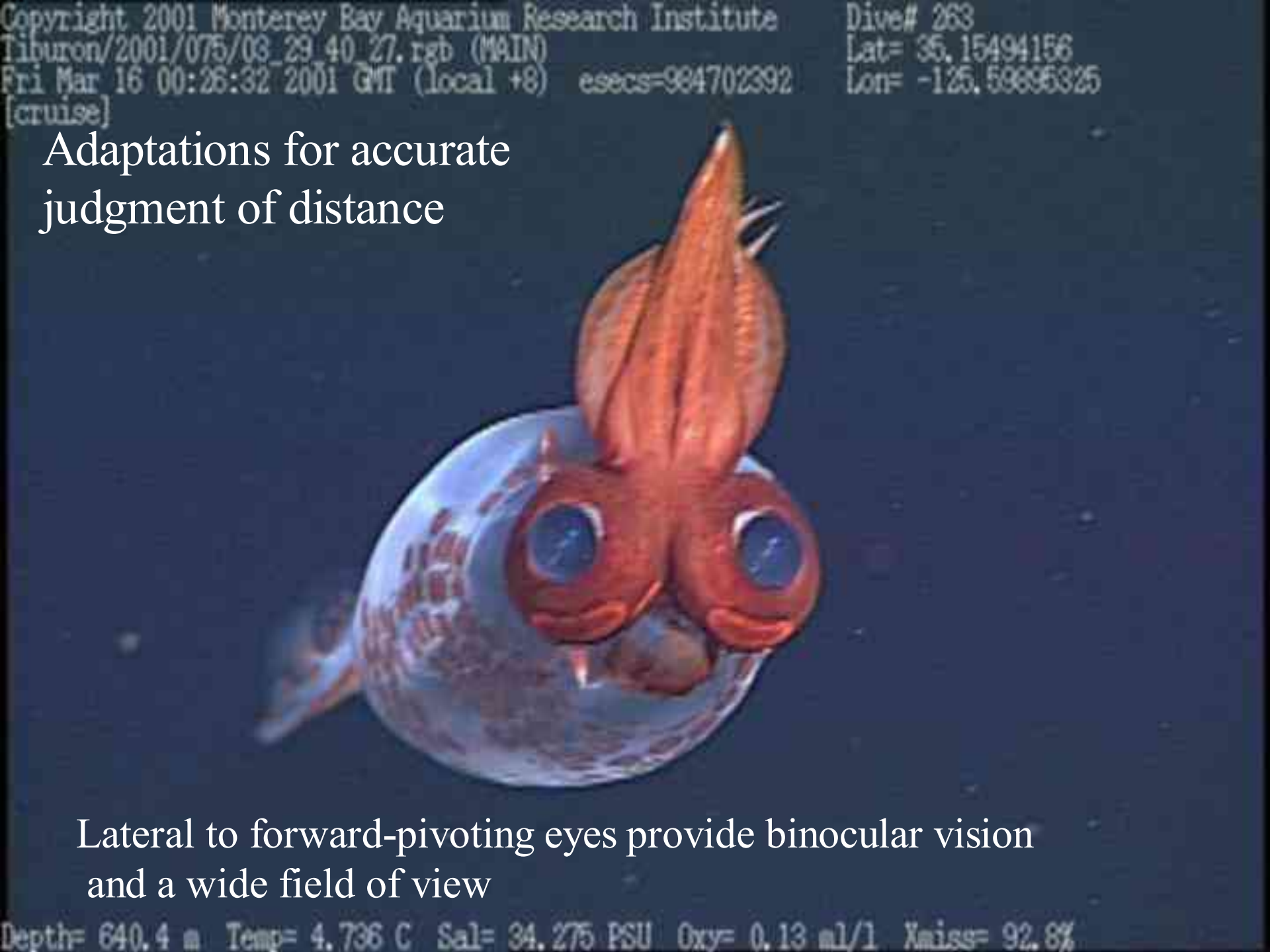
38 kHz signal

Tiburon
(acoustic signature)



Adaptations for vision in extremely low light

Upward to rostral-pivoting eyes allow prey silhouetting and forward binocular vision


Copyright 2001 Monterey Bay Aquarium Research Institute
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Fri Mar 16 00:26:32 2001 GMT (local +8) esecs=984702392
[cruise]
Dive# 263
Lat= 35.15494156
Lon= -125.59695325
Adaptations for accurate judgment of distance
Lateral to forward-pivoting eyes provide binocular vision and a wide field of view
Depth= 640.4 m Temp= 4.736 C Sal= 34.275 PSU Oxy= 0.13 ml/l Xmiss= 92.8%

Anti-predator
Visual Trickery

Mimicry:

-only in dim light

-only slow swimmers

-only non-luminous species

-fishes, worms, appendicularians, etc.

Anti-predator Visual Trickery

Inking:

-trails

-clouds

-pseudomorphs

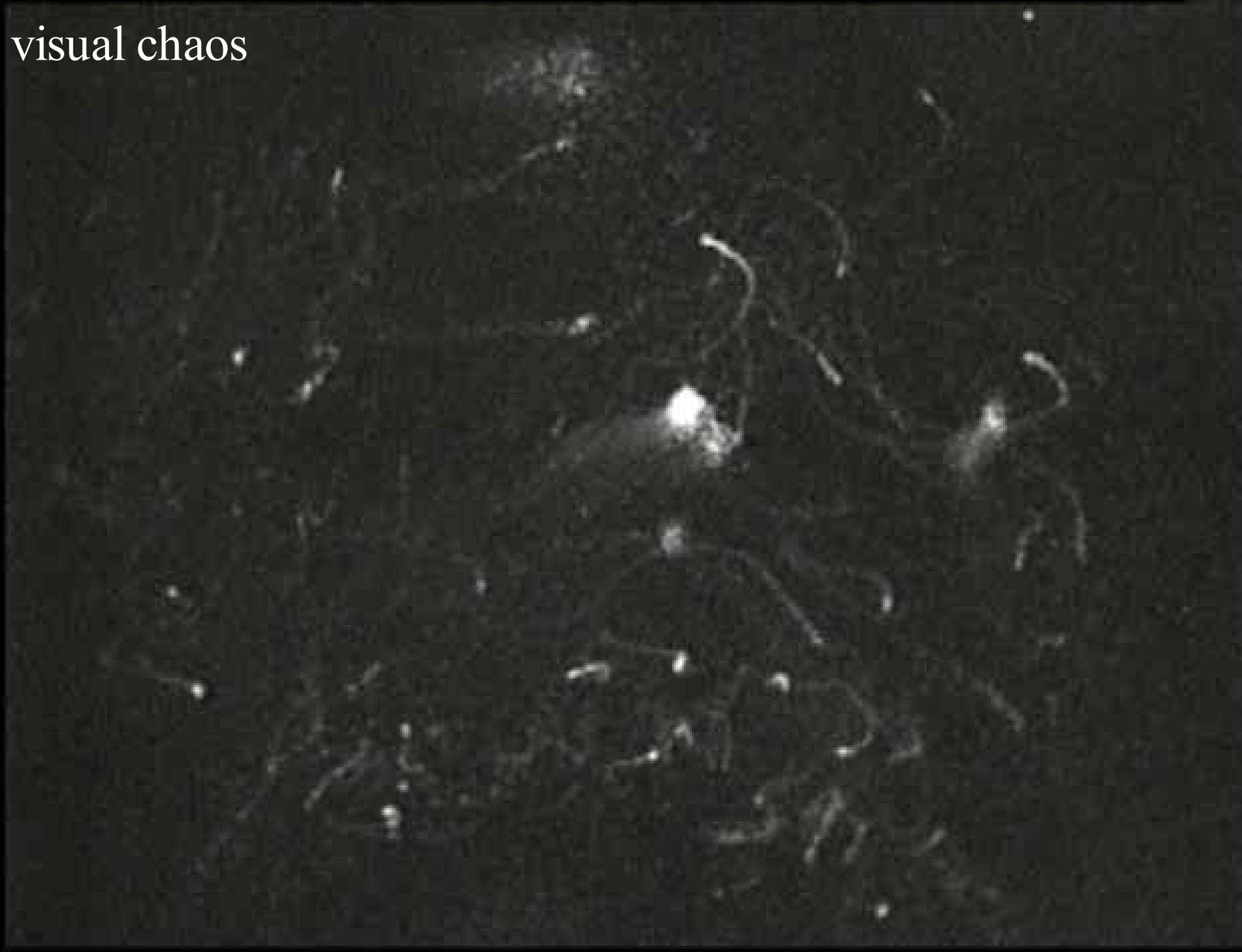
-and combinations

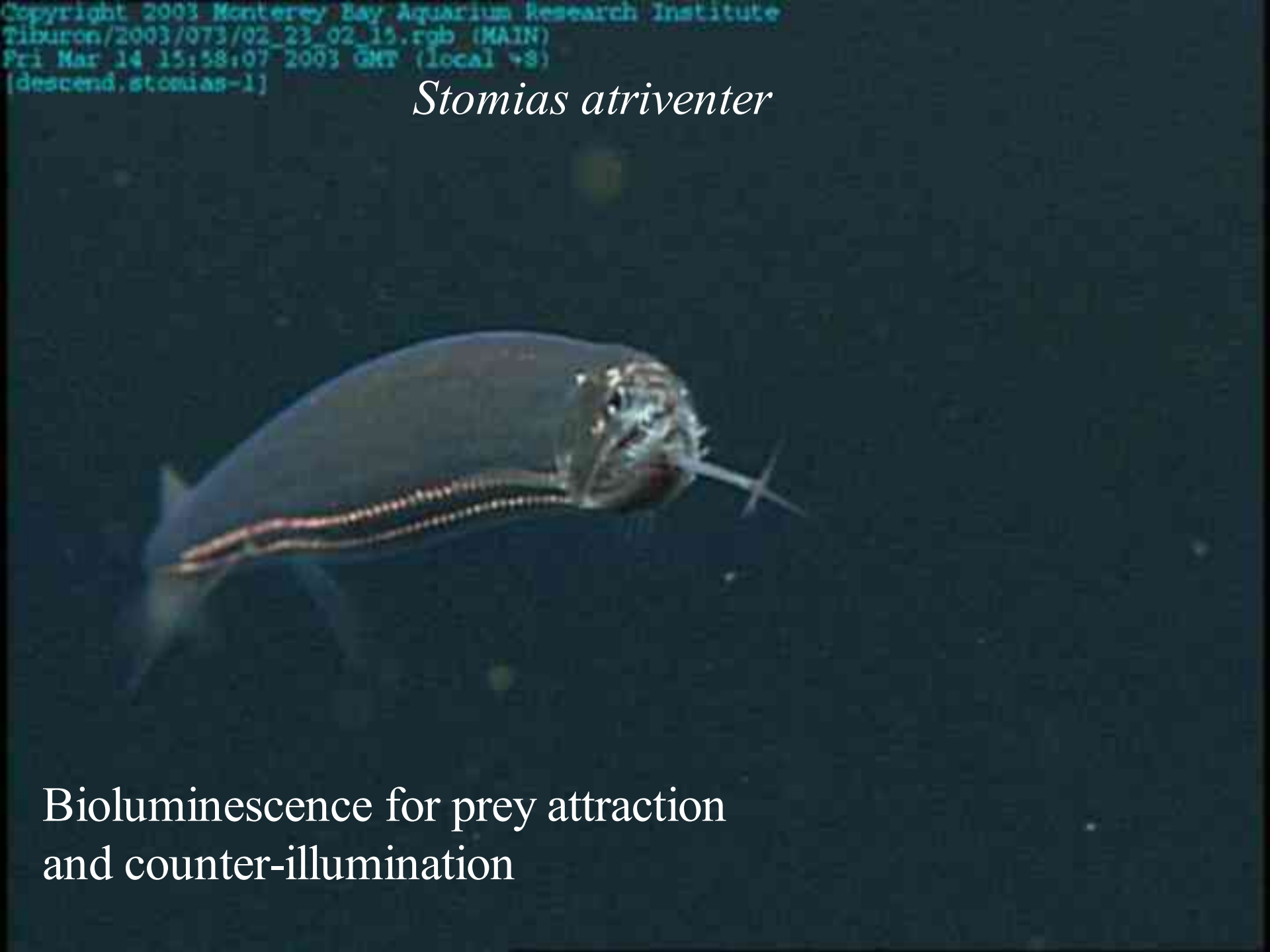
Bioluminescence for predator avoidance

Vampyroteuthis infernalis

Robison, et al. 2003 Biological Bulletin 205:102

visual chaos

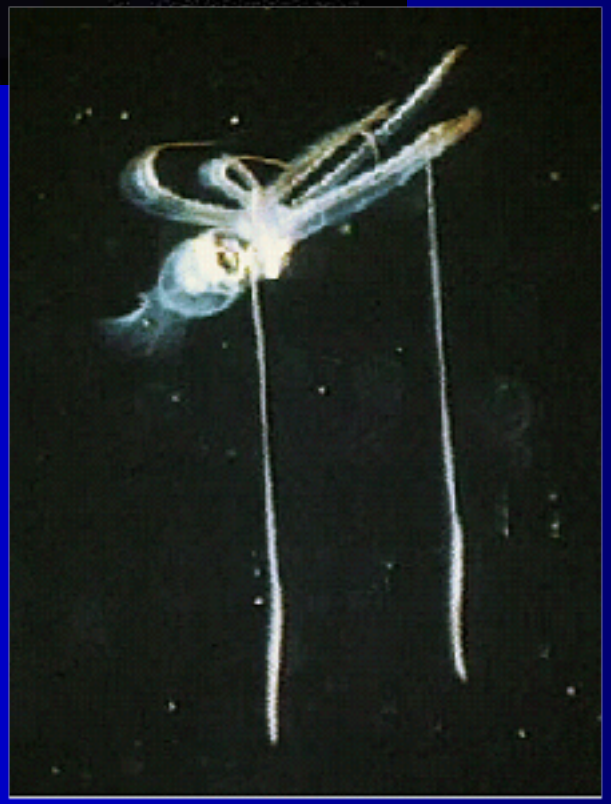




Stomias atriventer

Bioluminescence for prey attraction and counter-illumination

Chiroteuthis calyx



Bioluminescence for prey attraction

The Influence of Oxygen Minimum Layers:

Depth distribution

Vertical migration patterns

Activity levels

Predator selection

ROV DIVE SITES

in SEAFLOOR BASINS of the GULF OF CALIFORNIA

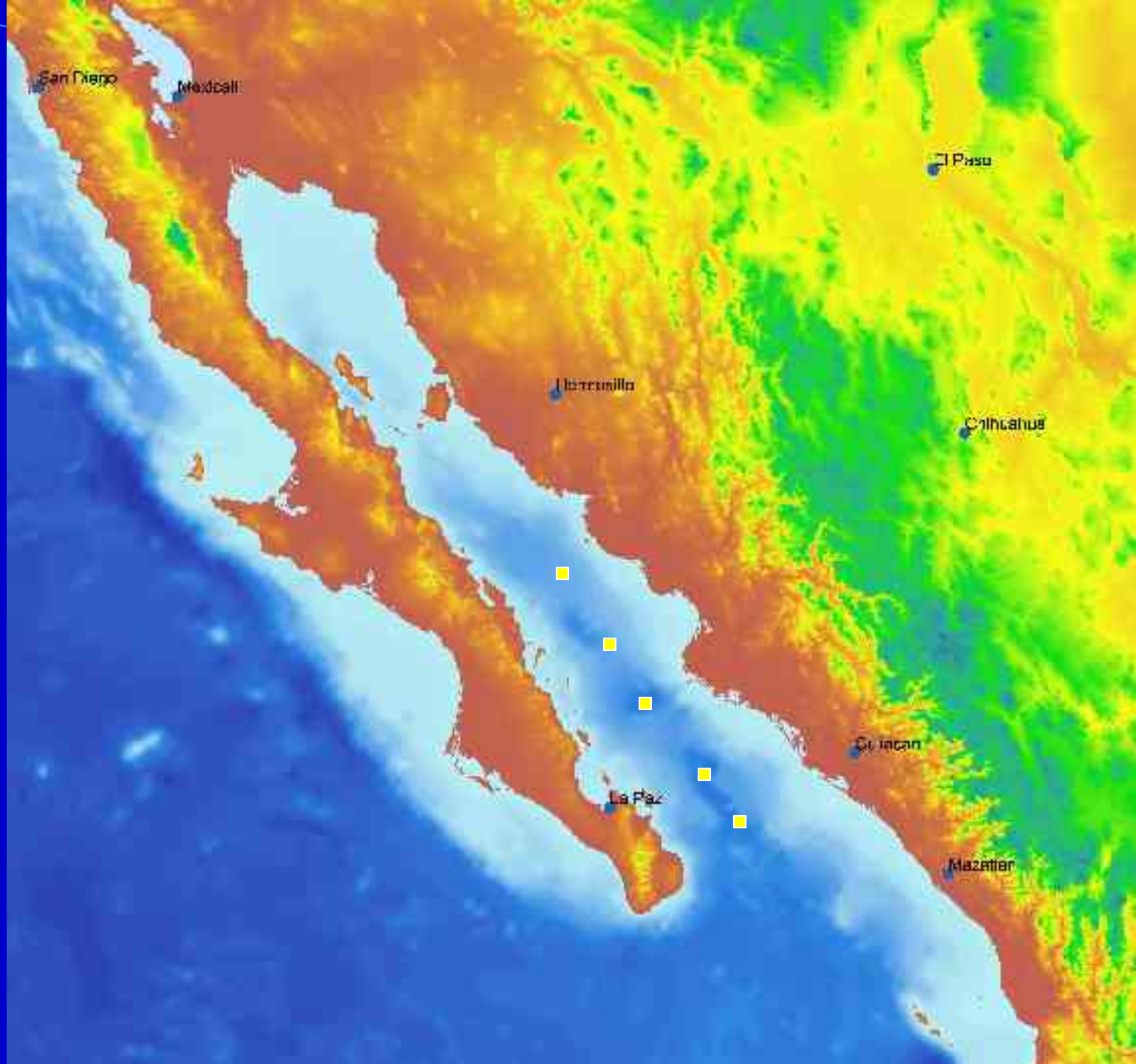
GUAYMAS

CARMEN

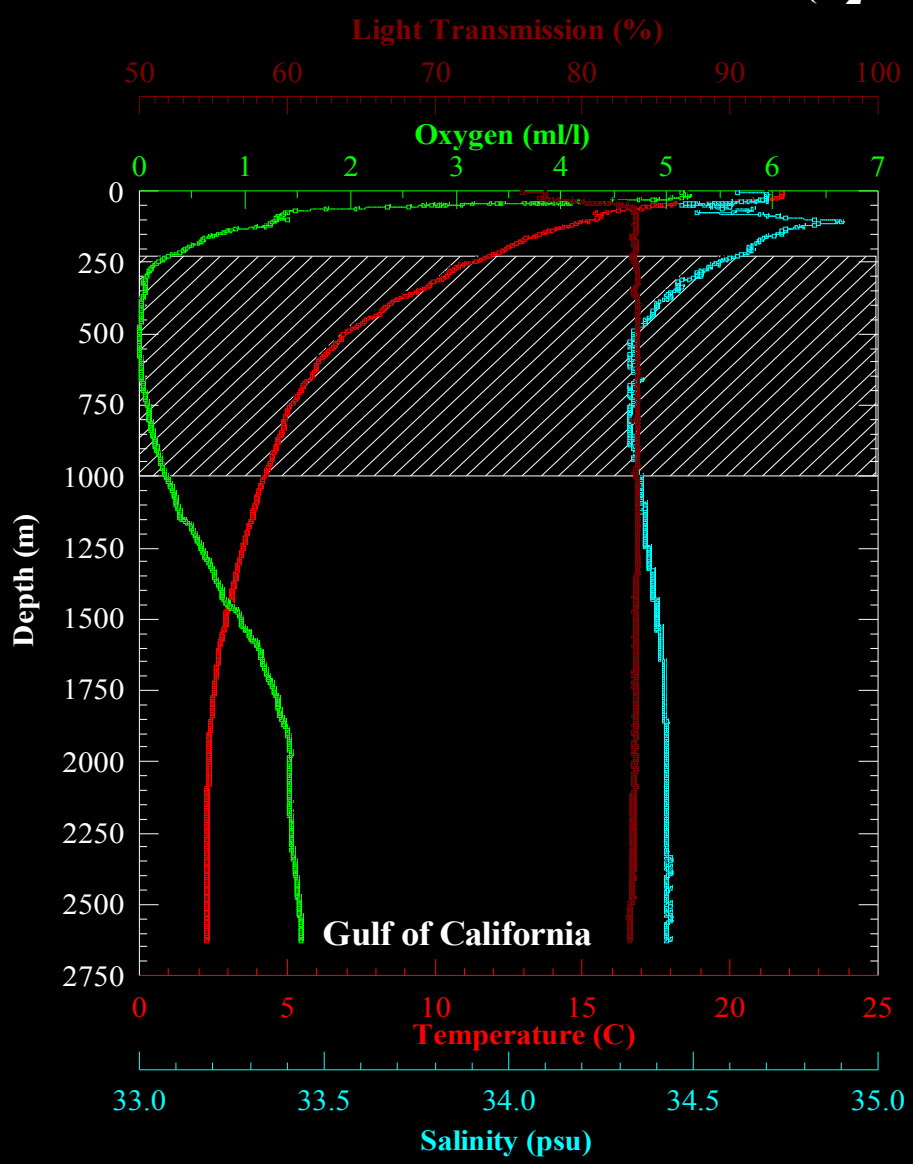
FARALLON

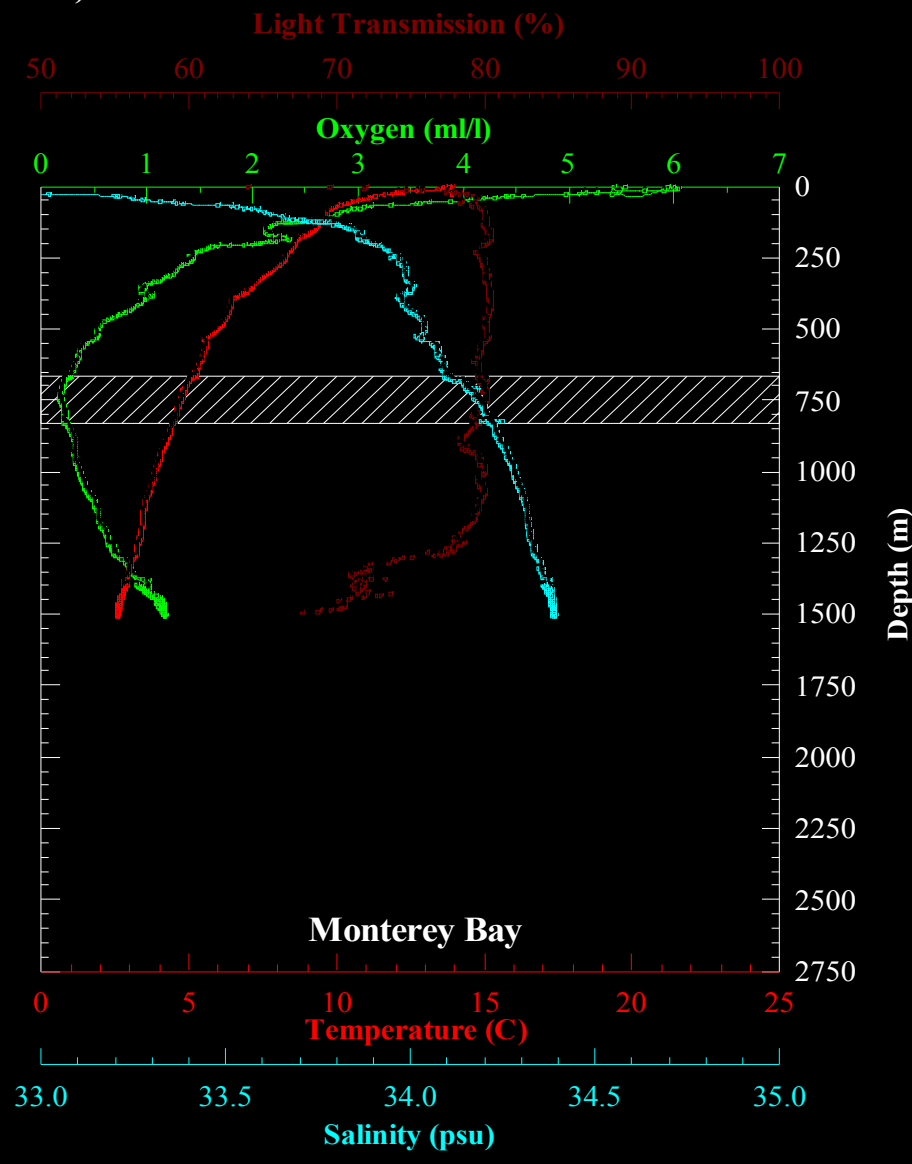
PESCADERO

MAZATLAN



Oxygen Minimum Layers
(O_2<0.25 ml/l)





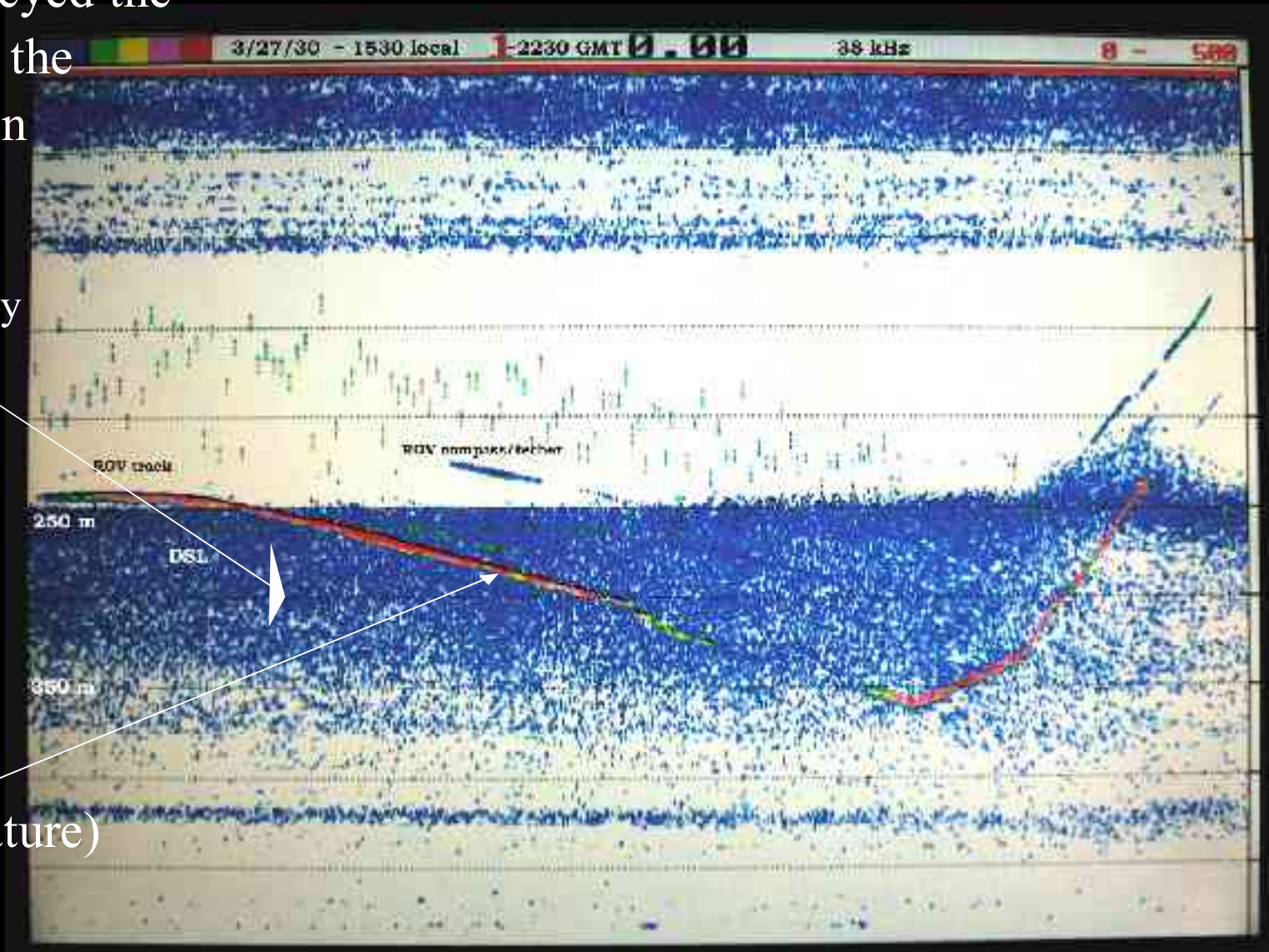
Sonic Scattering Layer: daytime profile

Tiburon surveyed the main layer in the Farallon Basin

38 kHz frequency

SSL
~ 250+m

Tiburon
(acoustic signature)

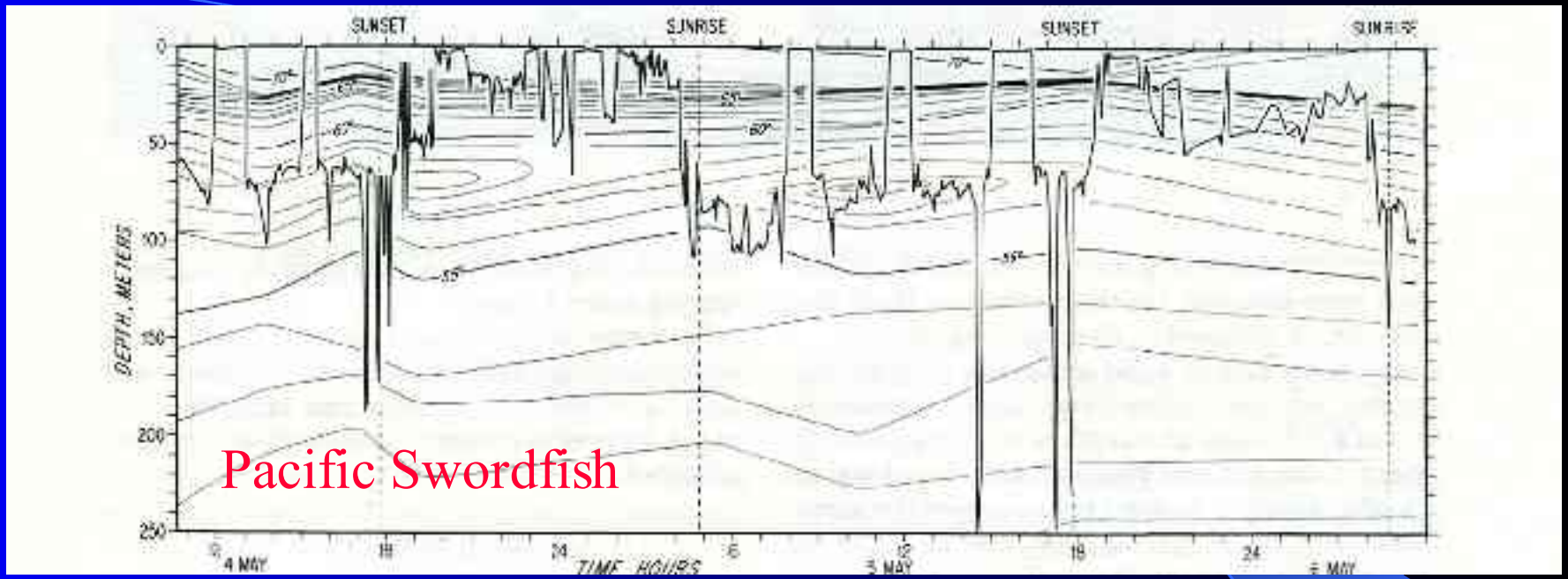


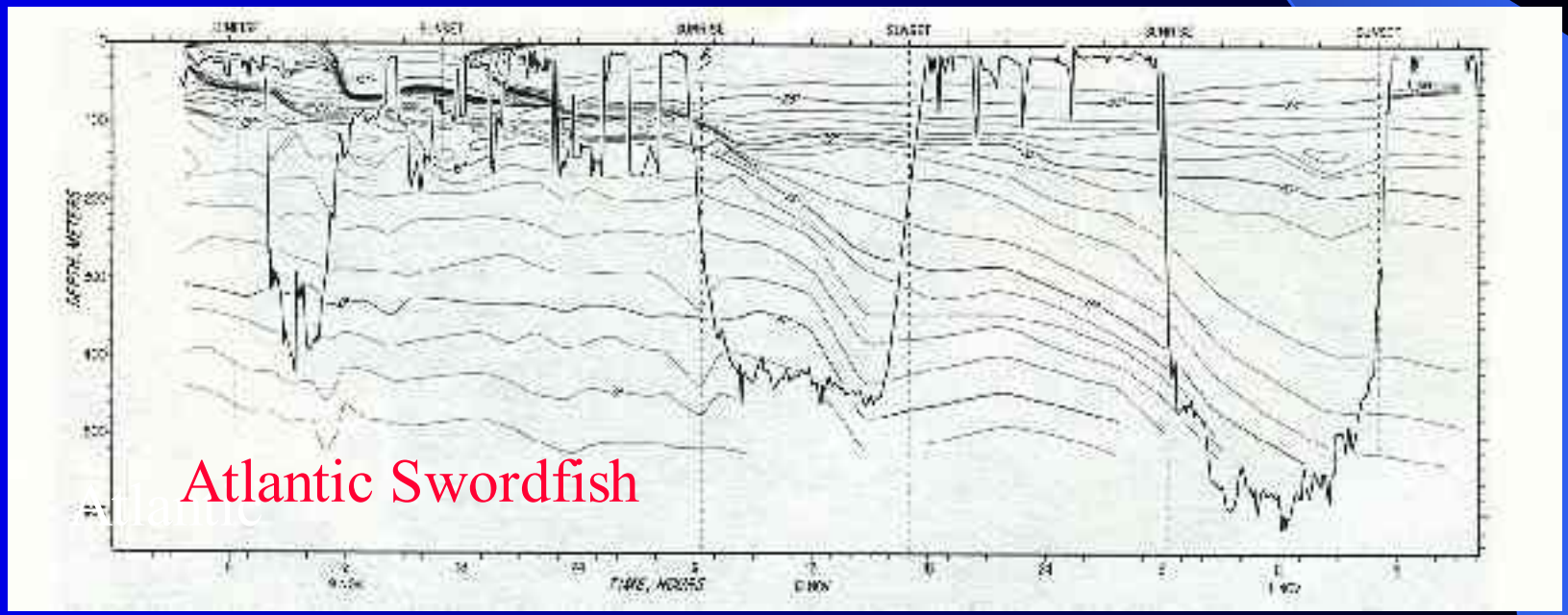
Gulf of California Myctophids

- *Triphoturus mexicanus*

Monterey Bay Myctophids

- *Tarletonbeania crenularis*





Carey & Robison 1981. Fishery Bulletin 79:277

The Replacement

Dosidicus gigas

Some Results from the Gulf:

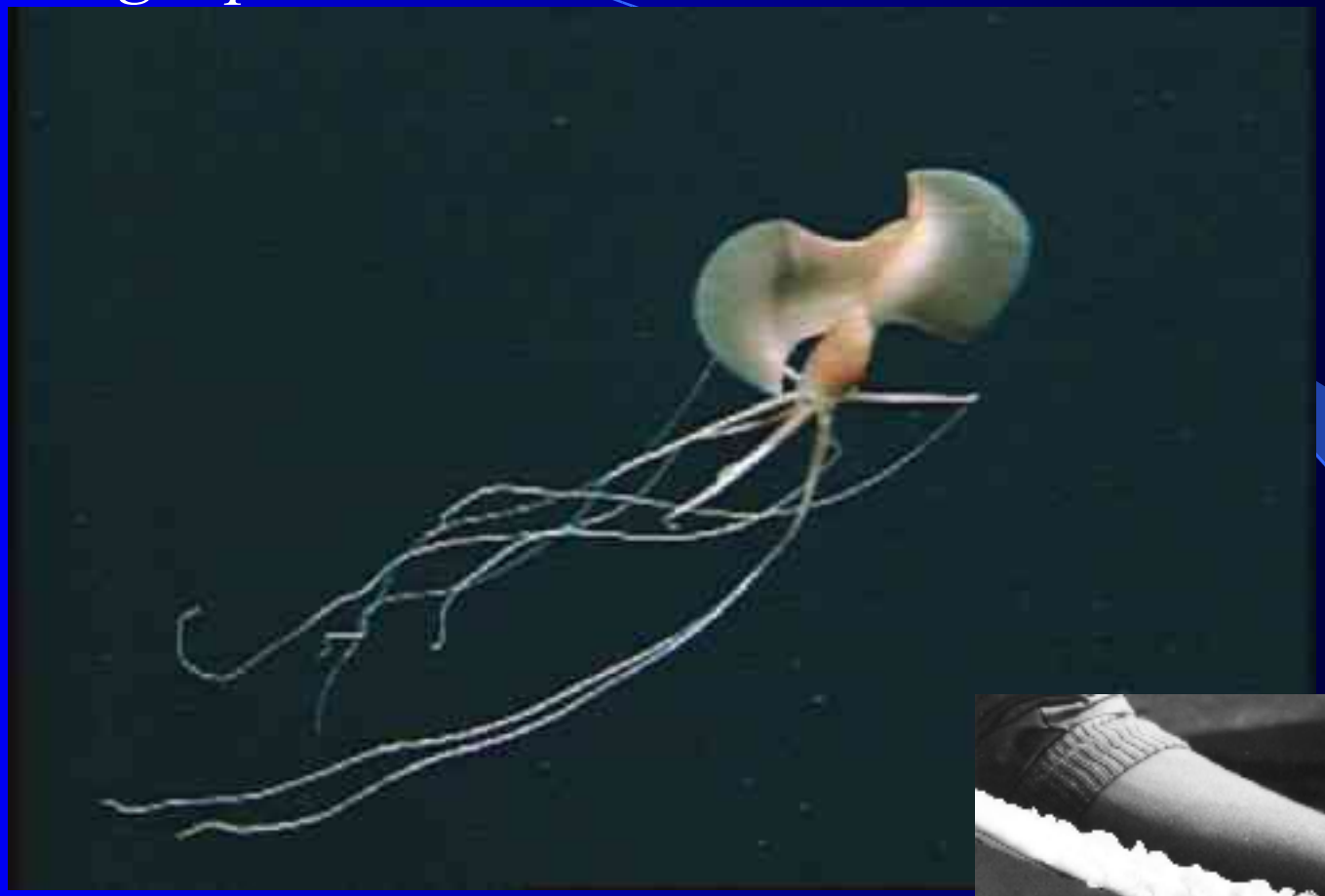
- Migratory midwater fish return to mesopelagic depths during the day, despite severely reduced oxygen levels
- At depth they are sparse, lethargic and tire easily
- Evidence suggests that they do not feed during the day
- This pattern reinforces the argument that the diel vertical migrations of midwater fishes are the result of predation pressure from visually-cued predators
- However, the reduced oxygen also influences their predators…

Patterns of Vertical Structure
influenced by the oxygen minimum layer

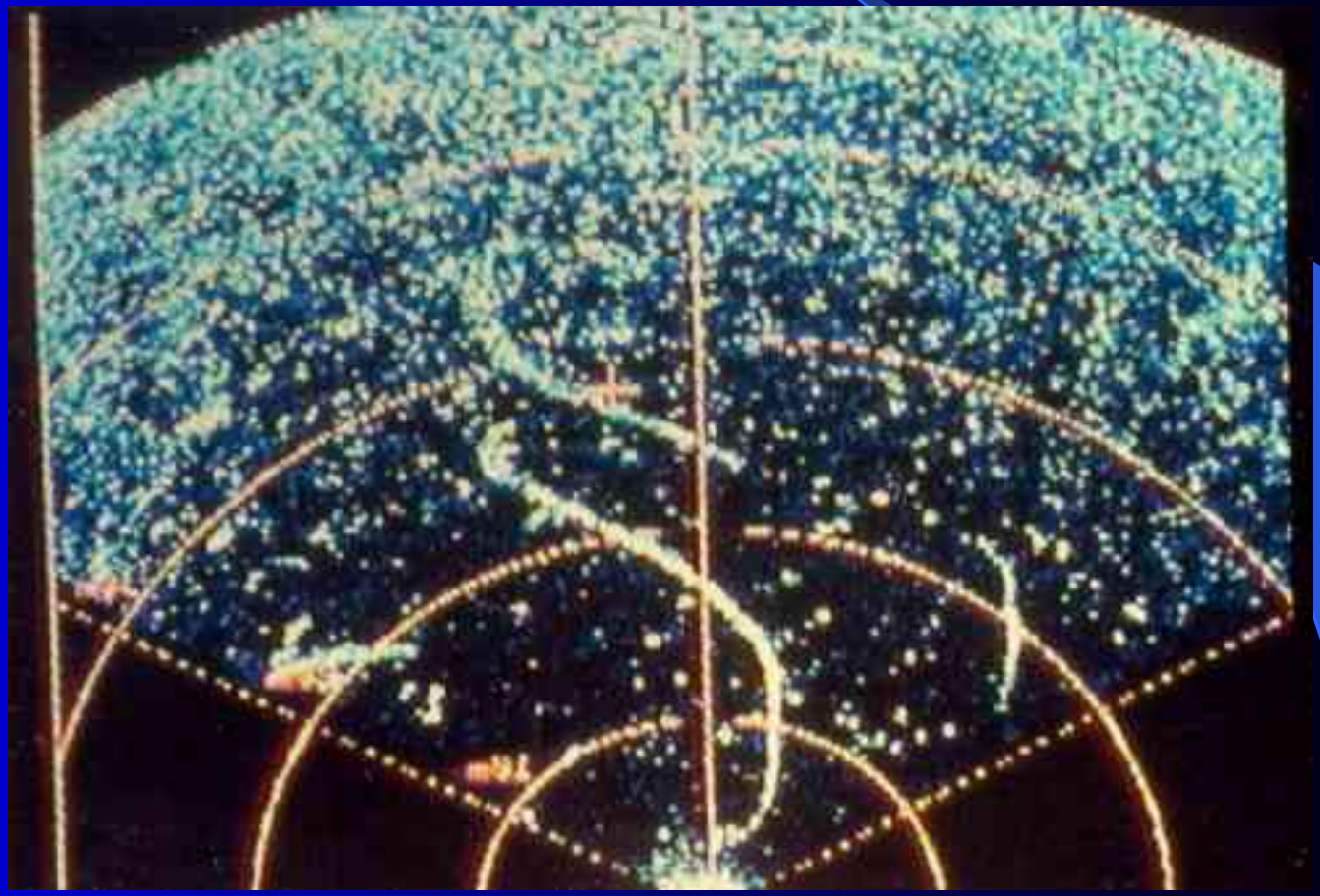
- Pronounced and often crowded stratification above the OML
- Split distributions above and below the OML (e.g. *Stomias*)
- Continuous distribution through the OML (e.g. *Dosidicus*)
- Some species found only within the OML (e.g. *Cyclothone acclinidens*)
- Some layering within the OML (myctophids, *Cyclothone*)
- Increased diversity and abundance just below the OML

MEGAFAUNA

Magnapinna at 3380 meters off Hawaii



Architeuthis

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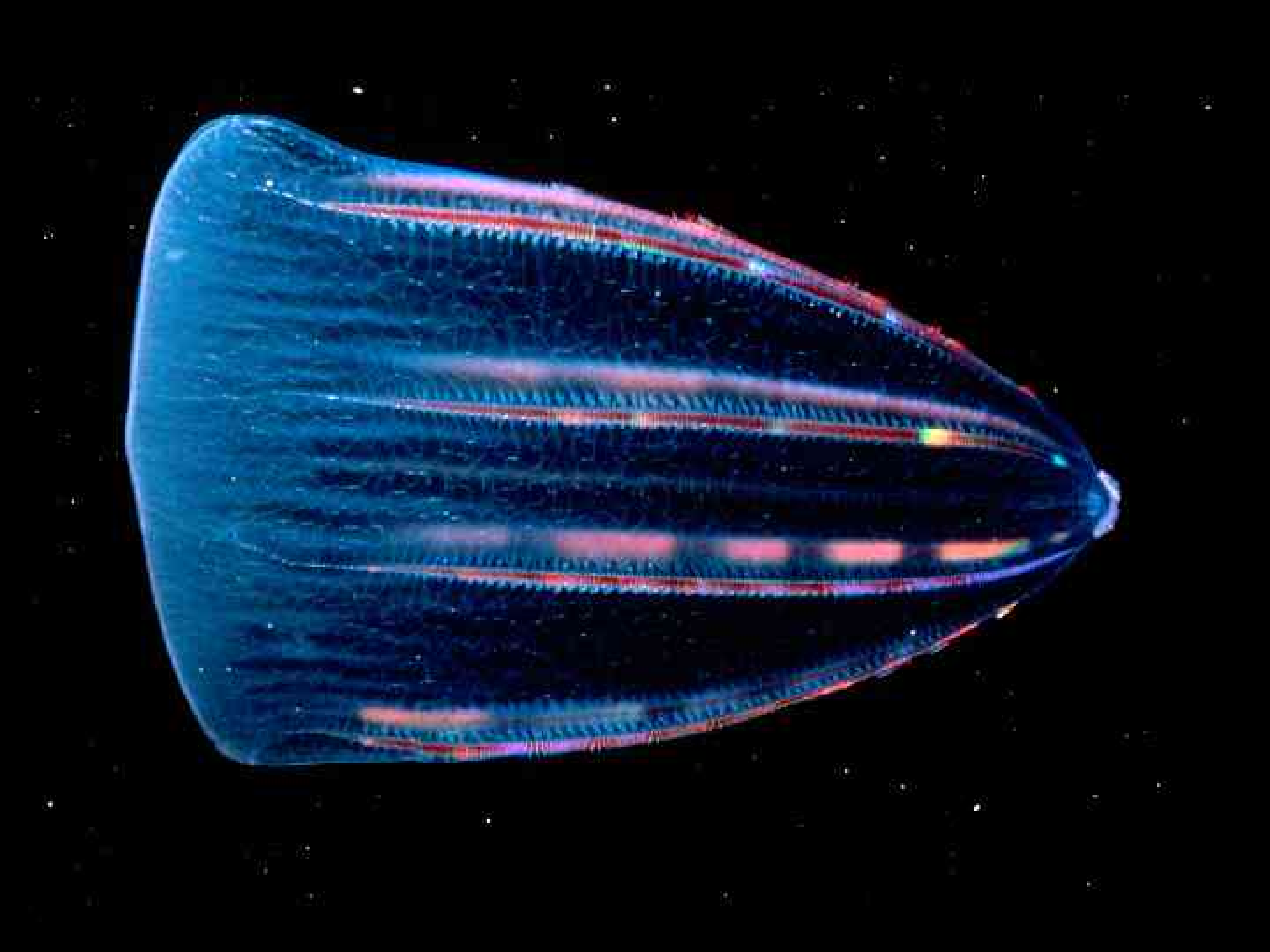
Praya dubia, up to 40 m long

The Jelly Web

An unexpected and enormous component of the pelagic food web

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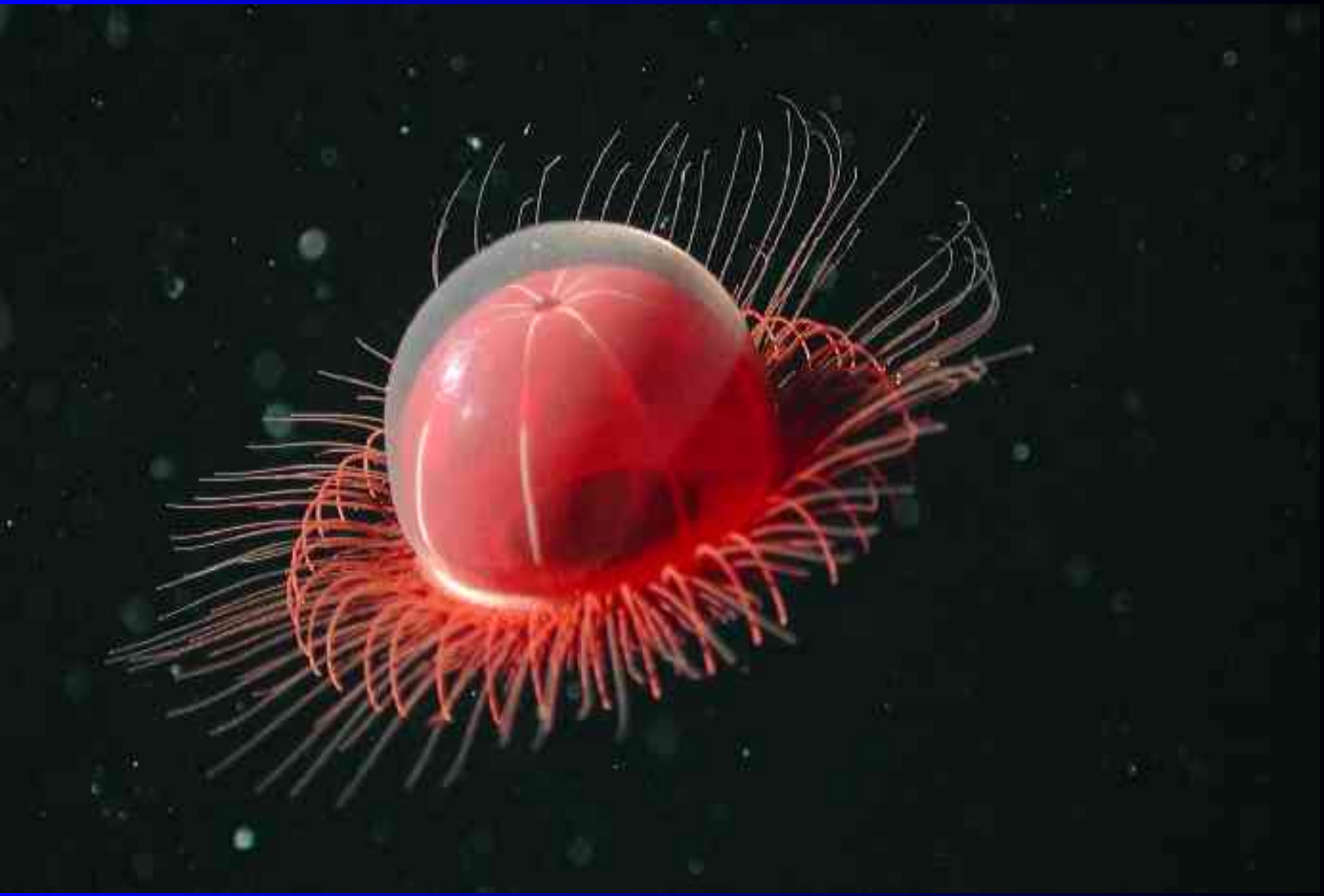

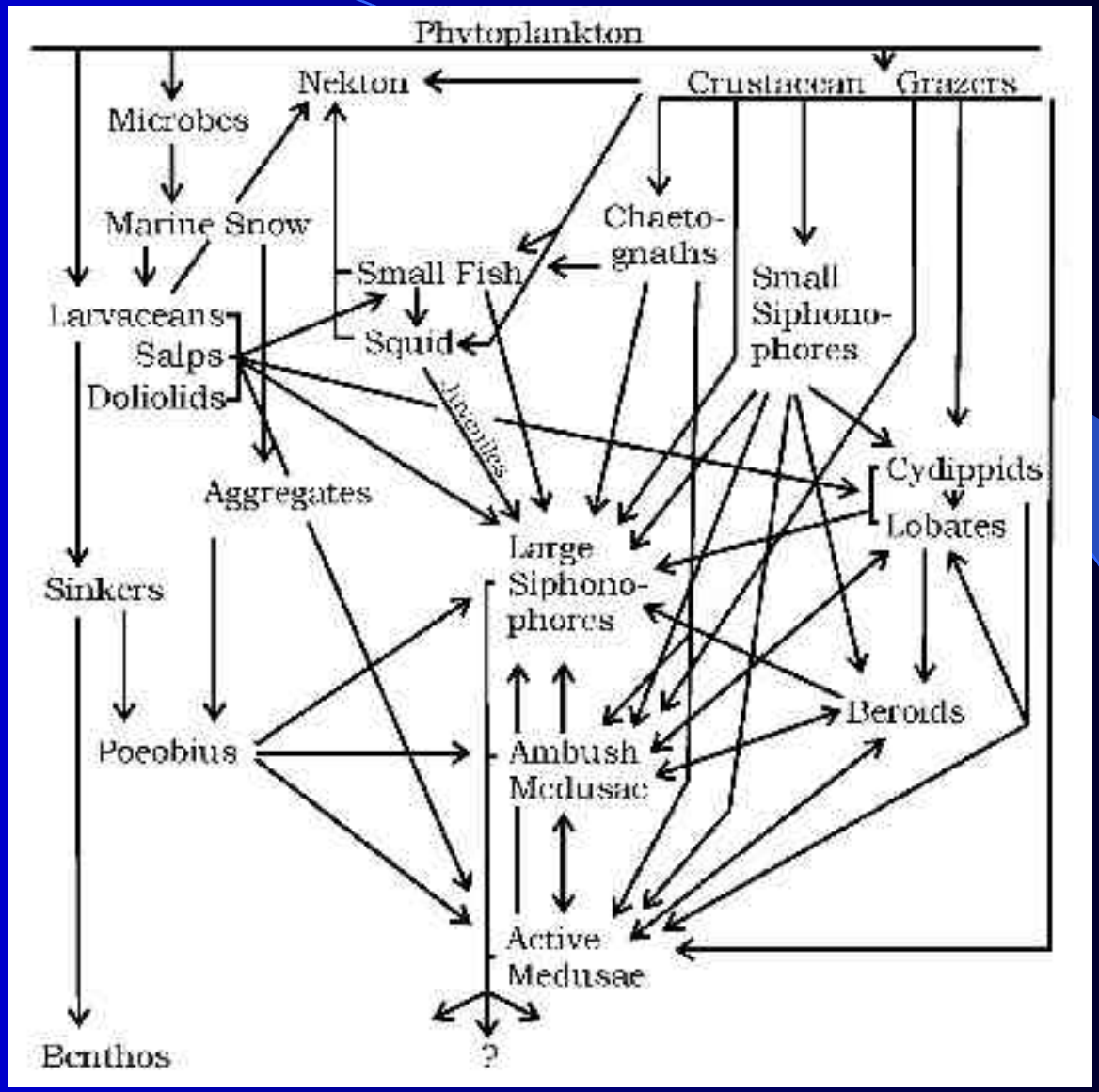

Robison (2004) JEMBE, 300(1-2):245-264.

SUMMARY

Direct access with ROVs allows us to investigate behavior, physiology, and activity levels, to collect live specimens and to make high resolution measurements of abundance and distribution.

Light has a profound effect on predator/prey interactions throughout the upper kilometer of the water column.

Variations in oxygen concentration can affect vertical distribution, activity levels, and the presence of both predators and prey.

The midwater fauna is vastly more complex and interesting than we ever imagined.