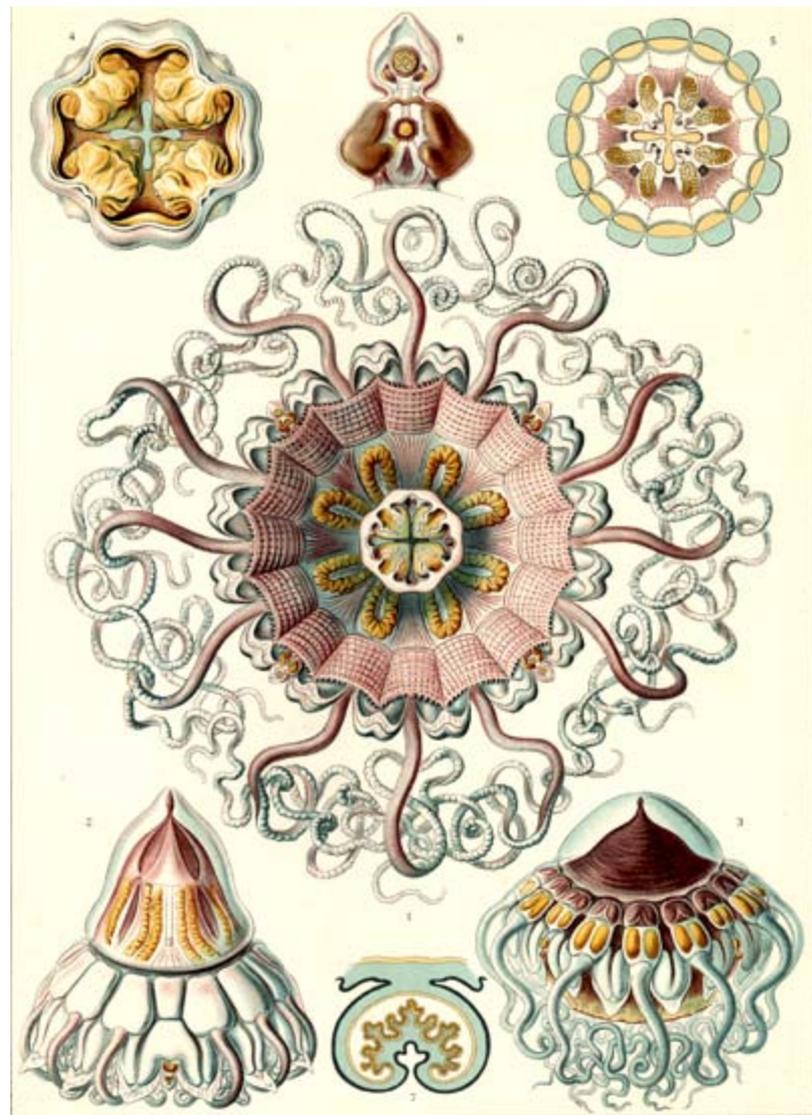
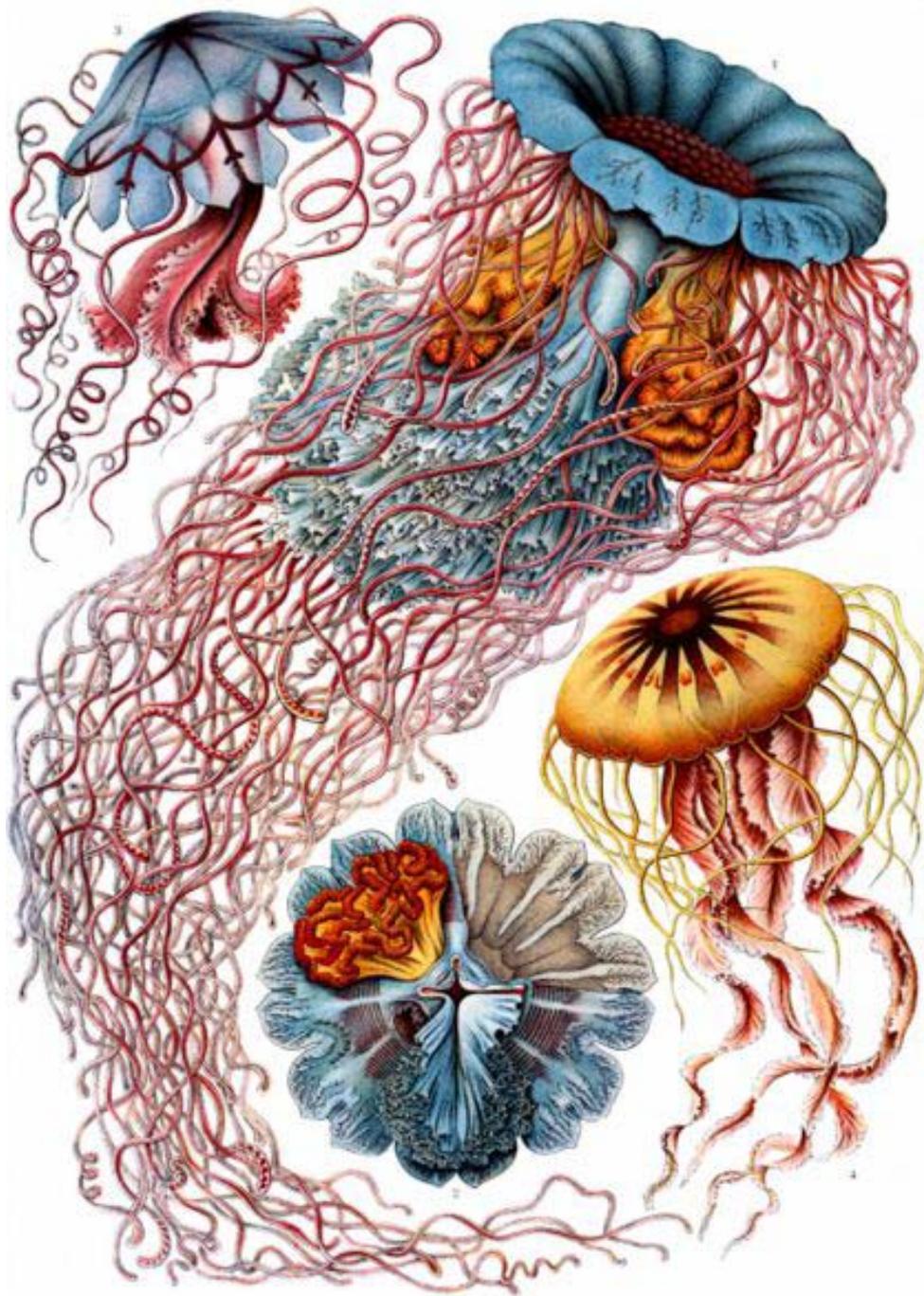


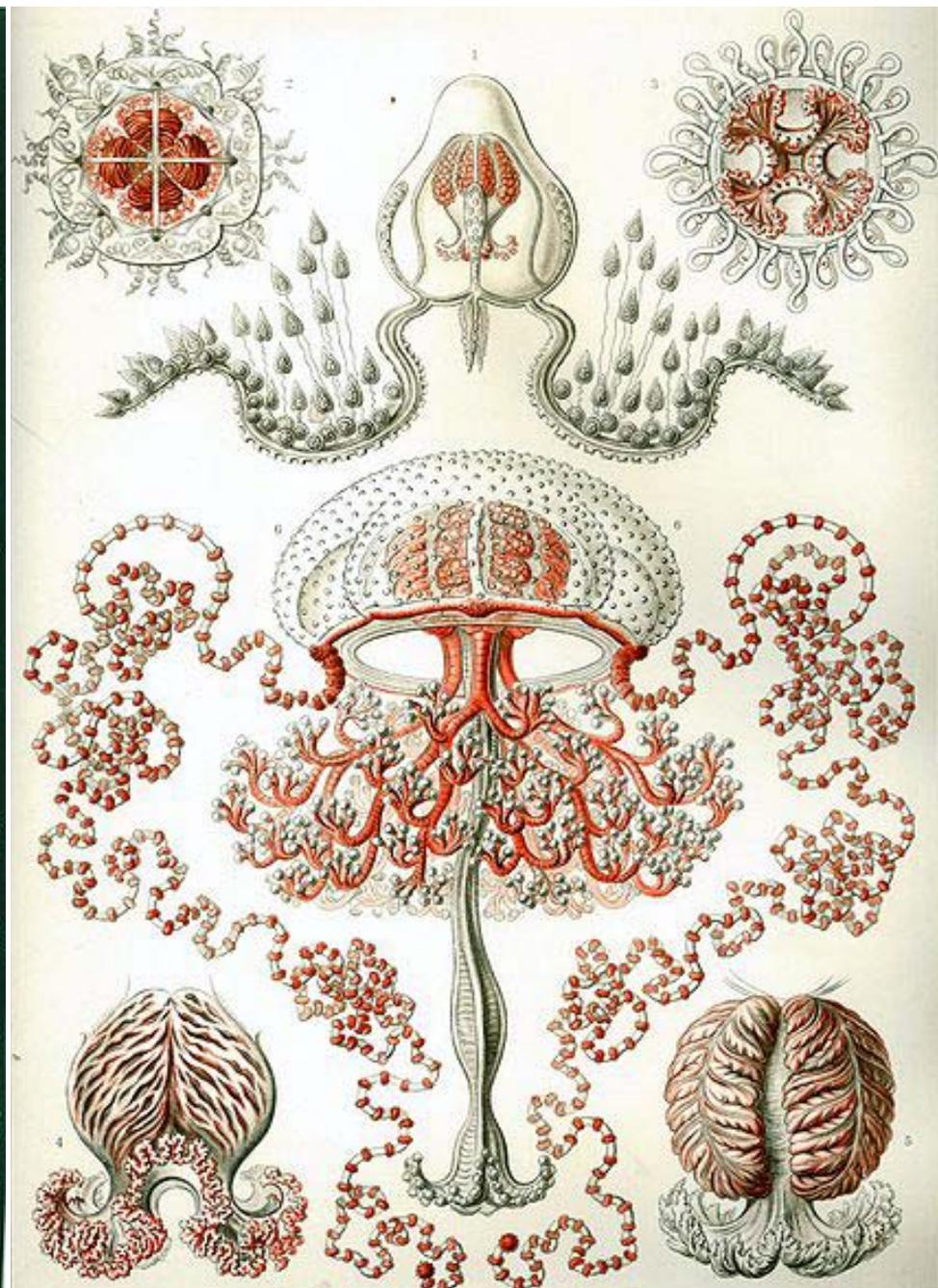
# Jellyfish: Swimming, Eating, Getting Eaten



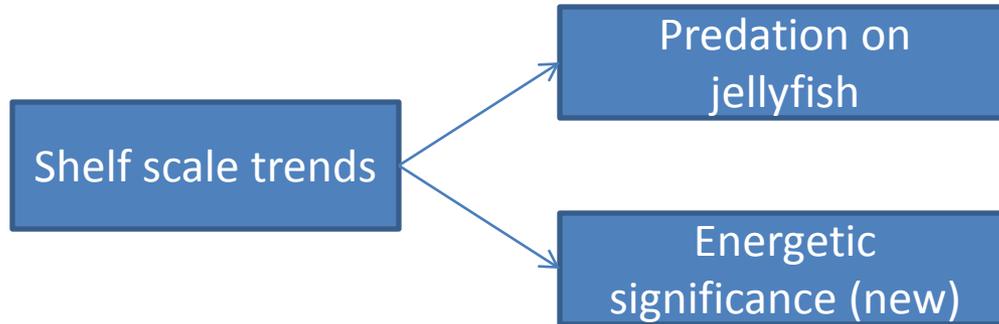
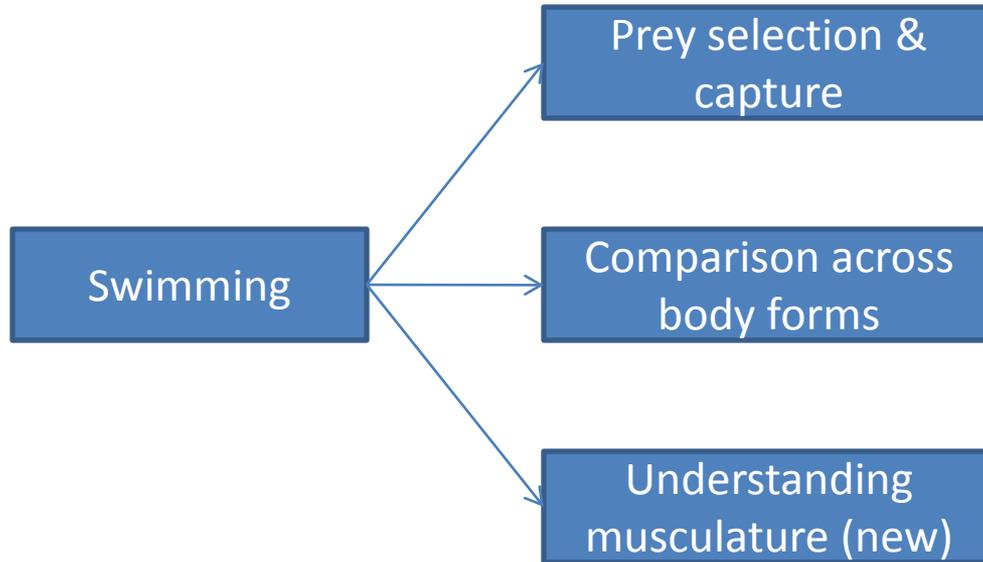
Michael Ford  
NOAA Fisheries



Haeckel

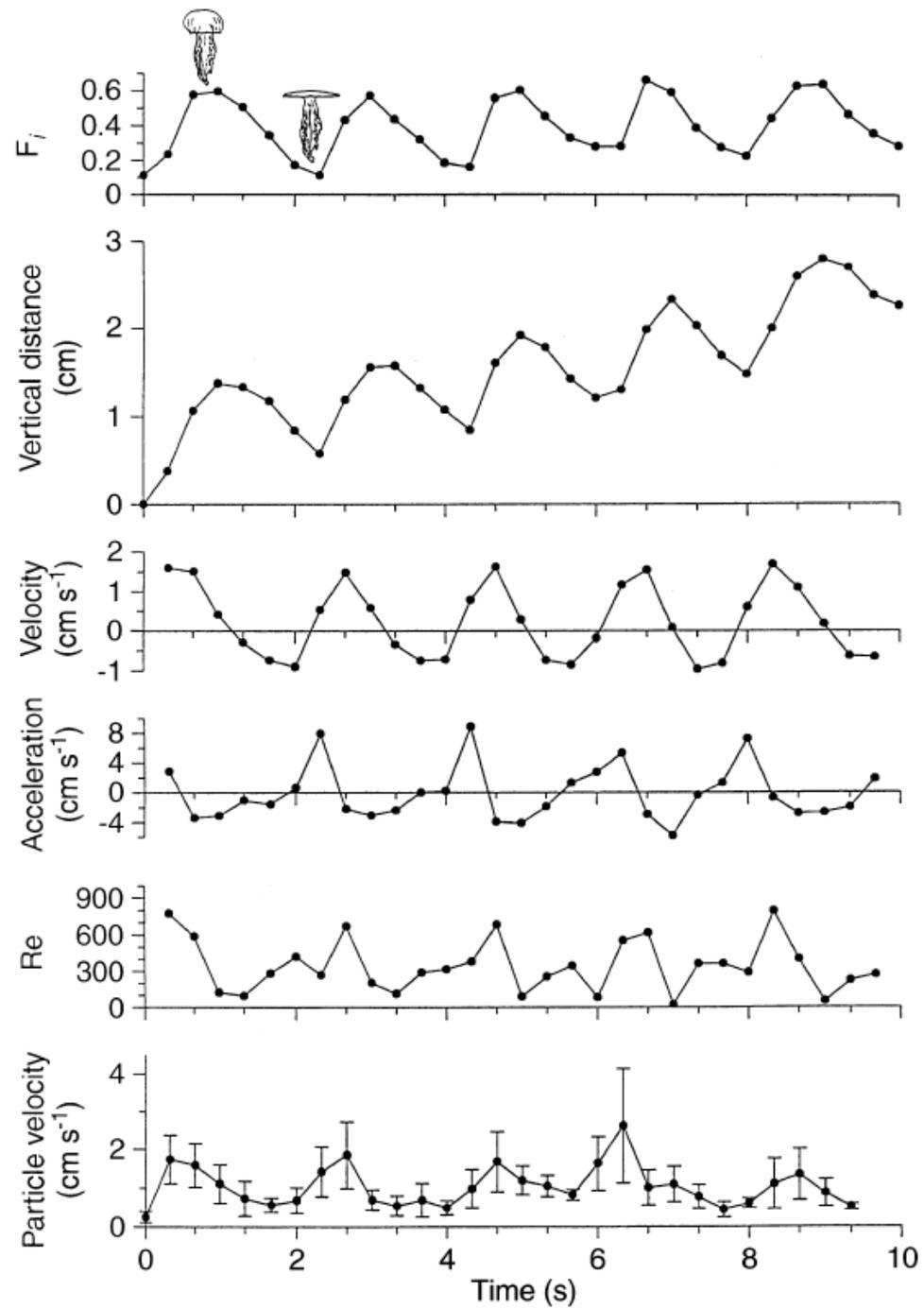


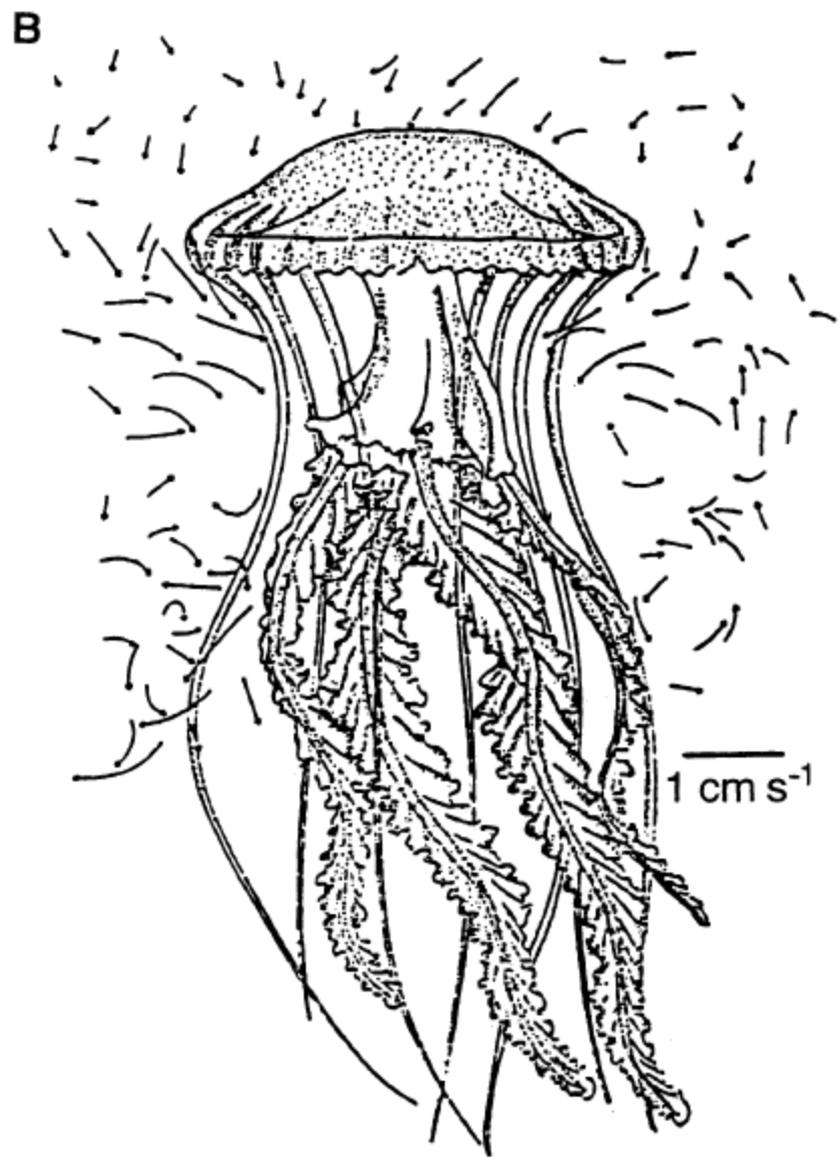
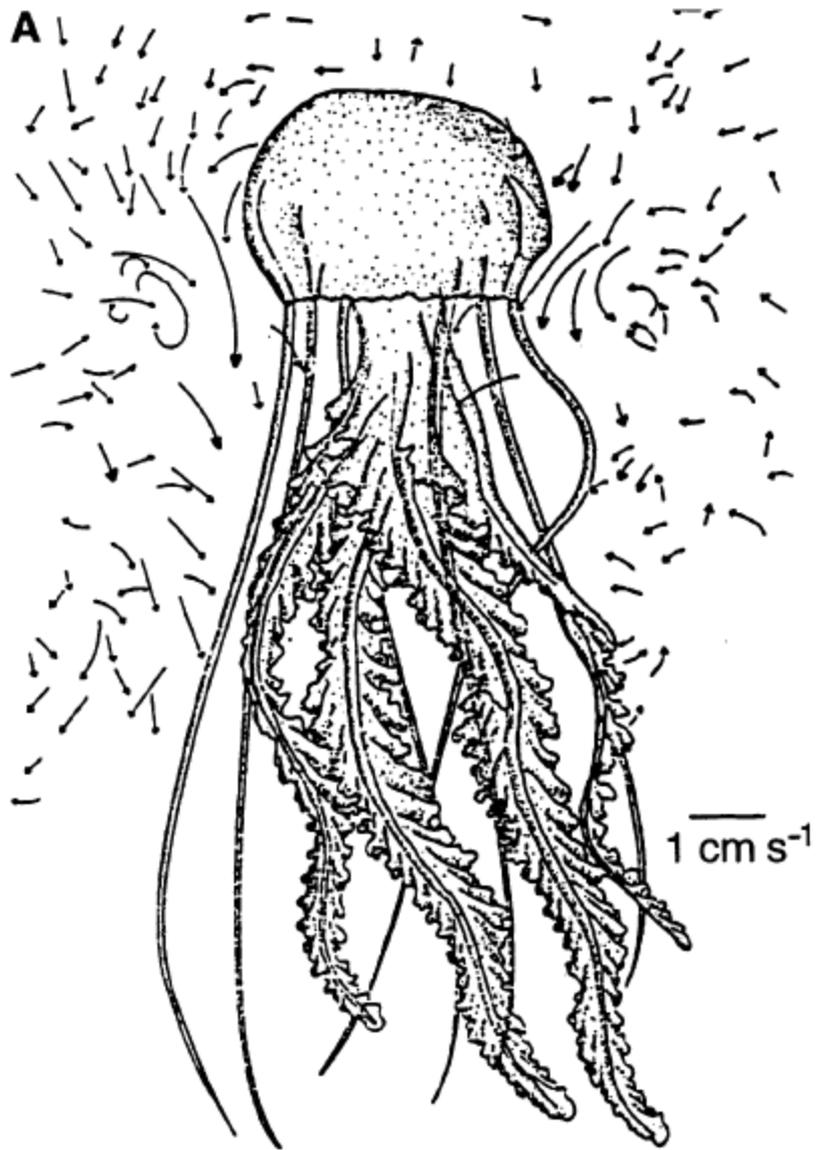
Haeckel

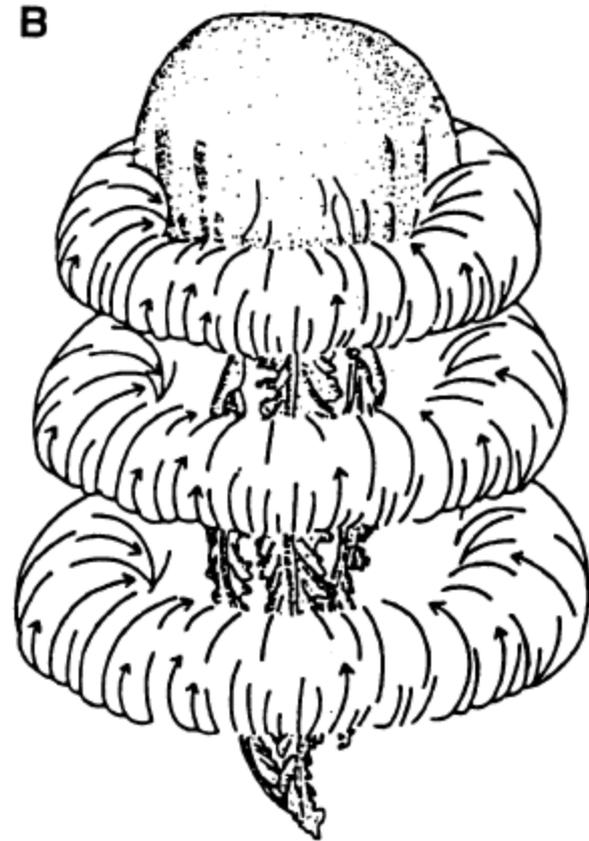
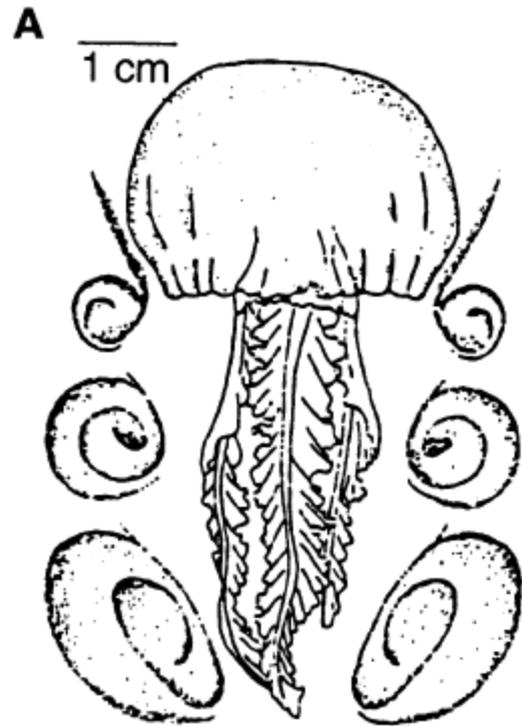


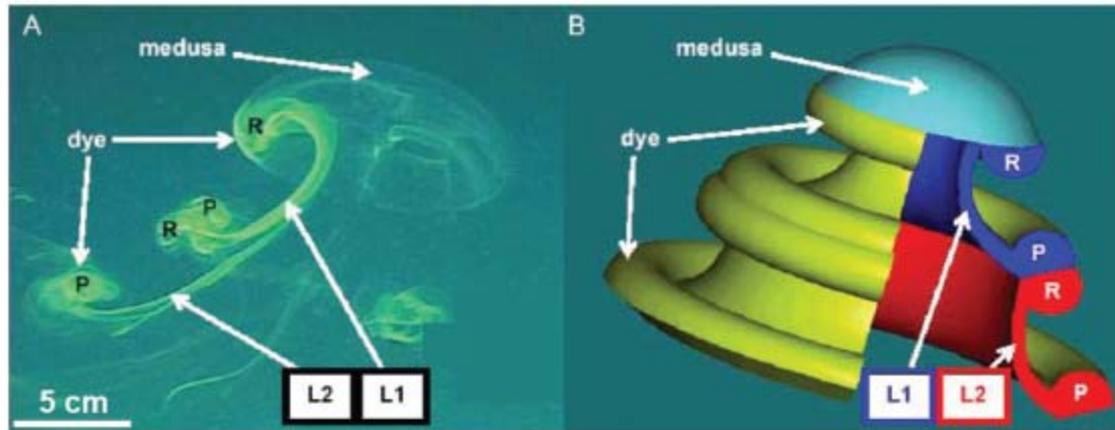
002062



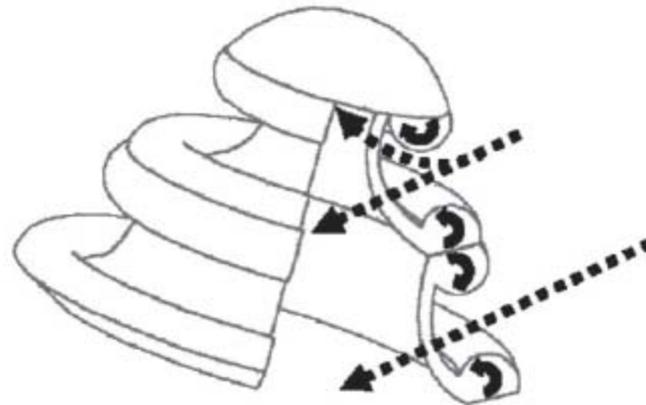




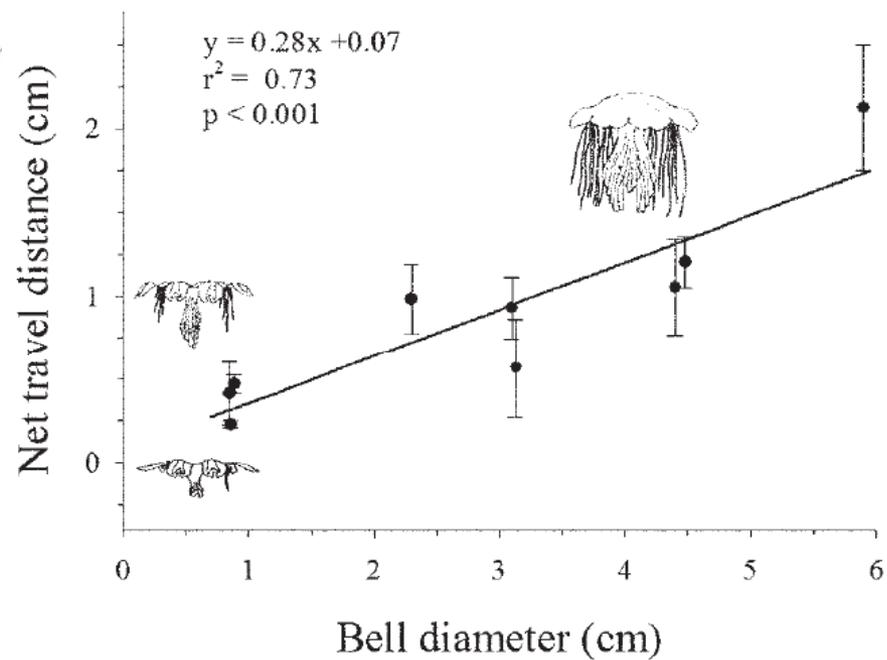
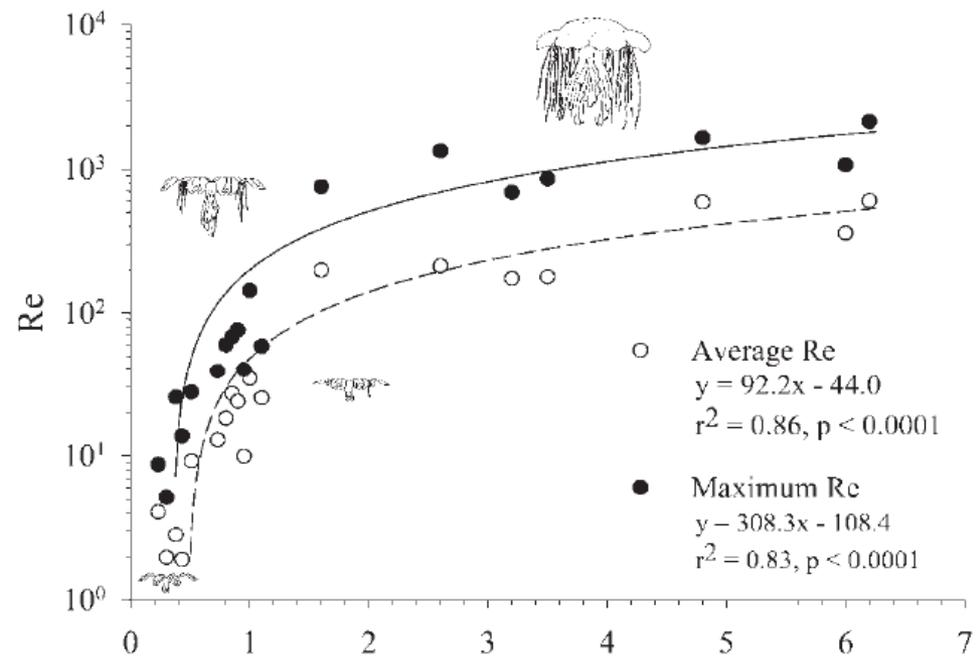
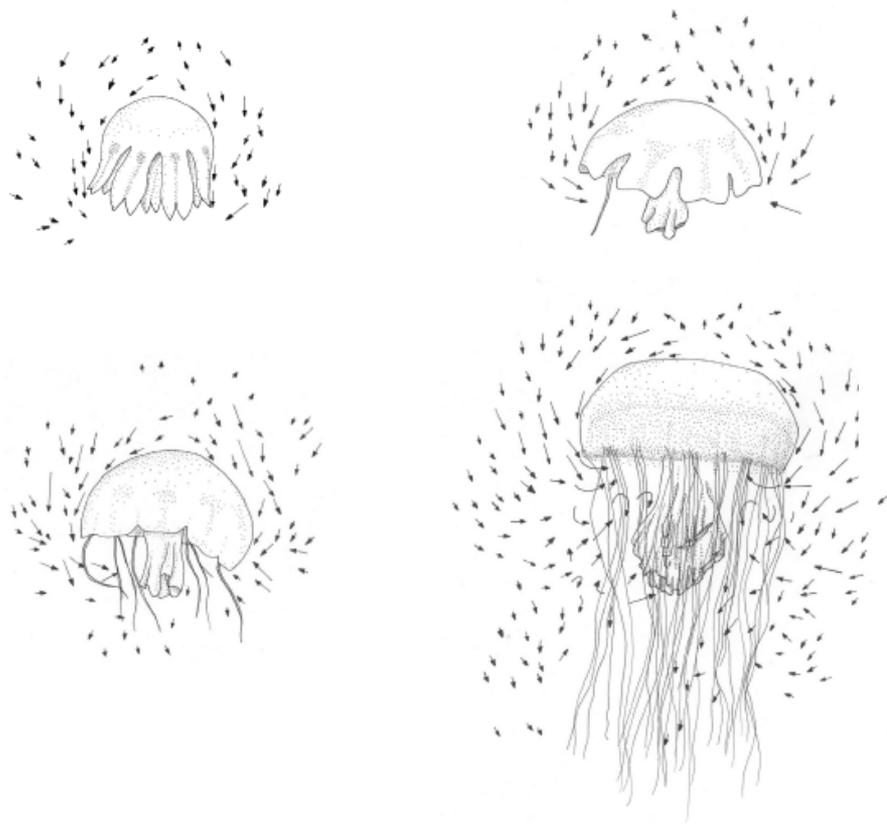


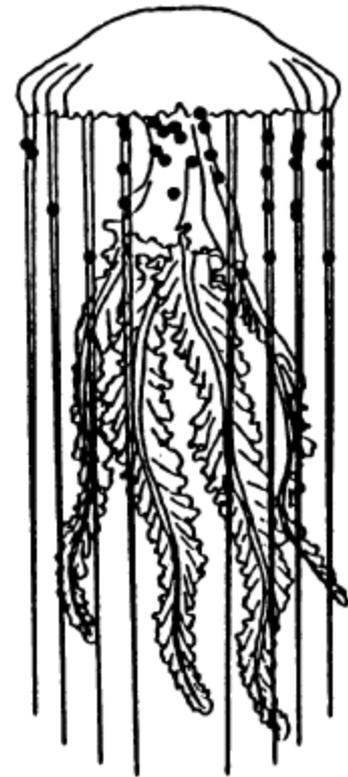
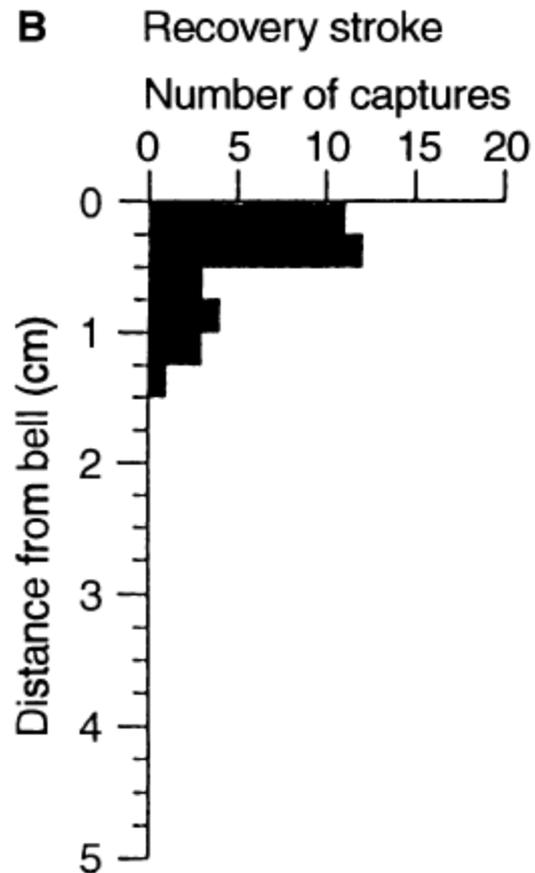
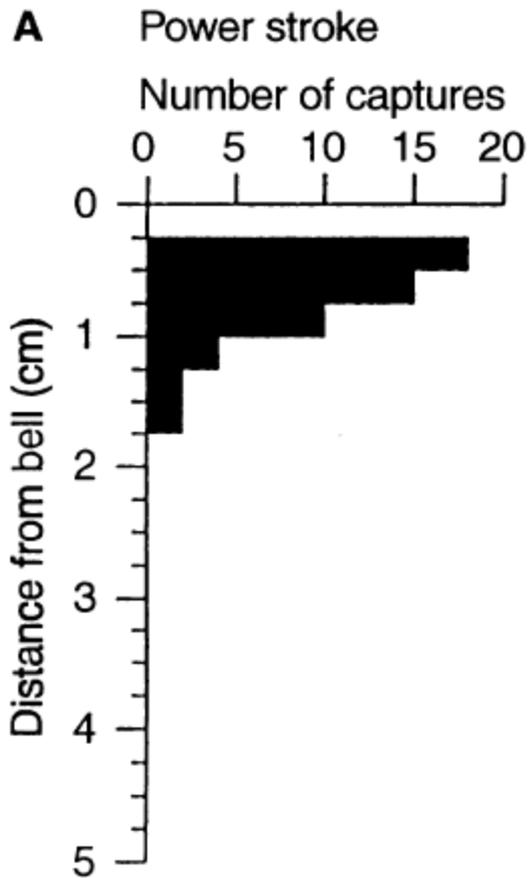


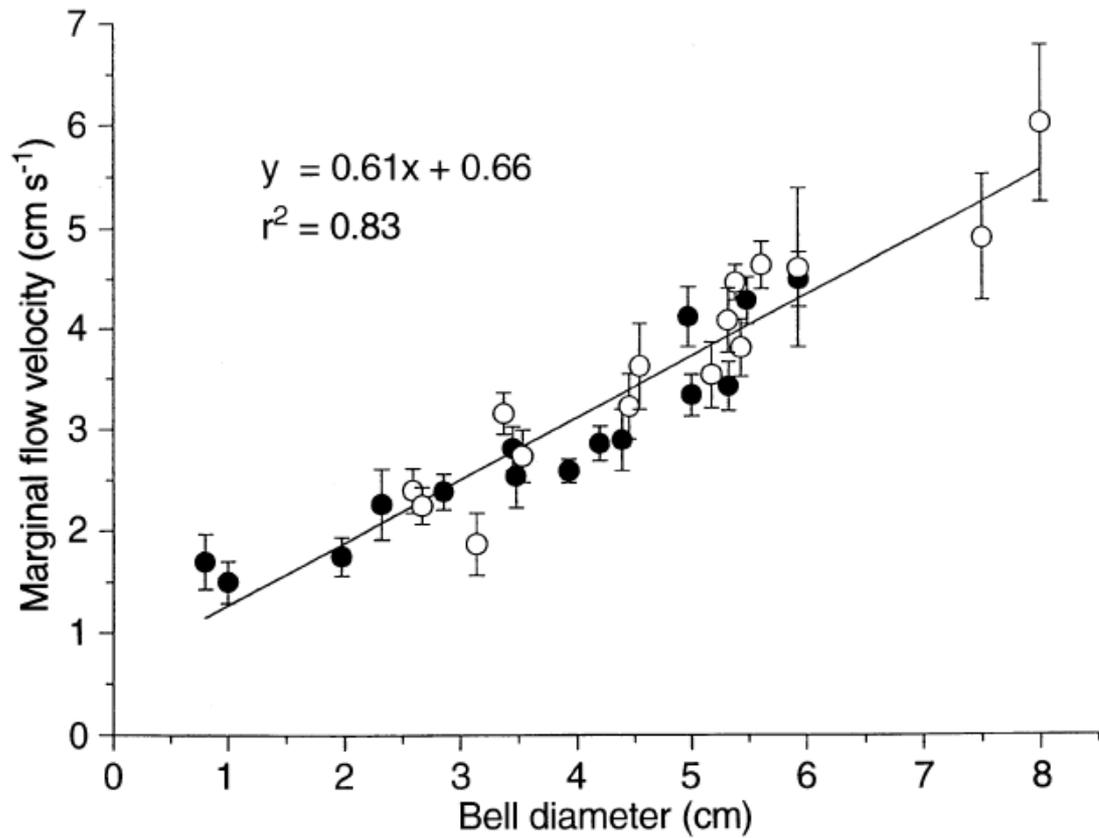
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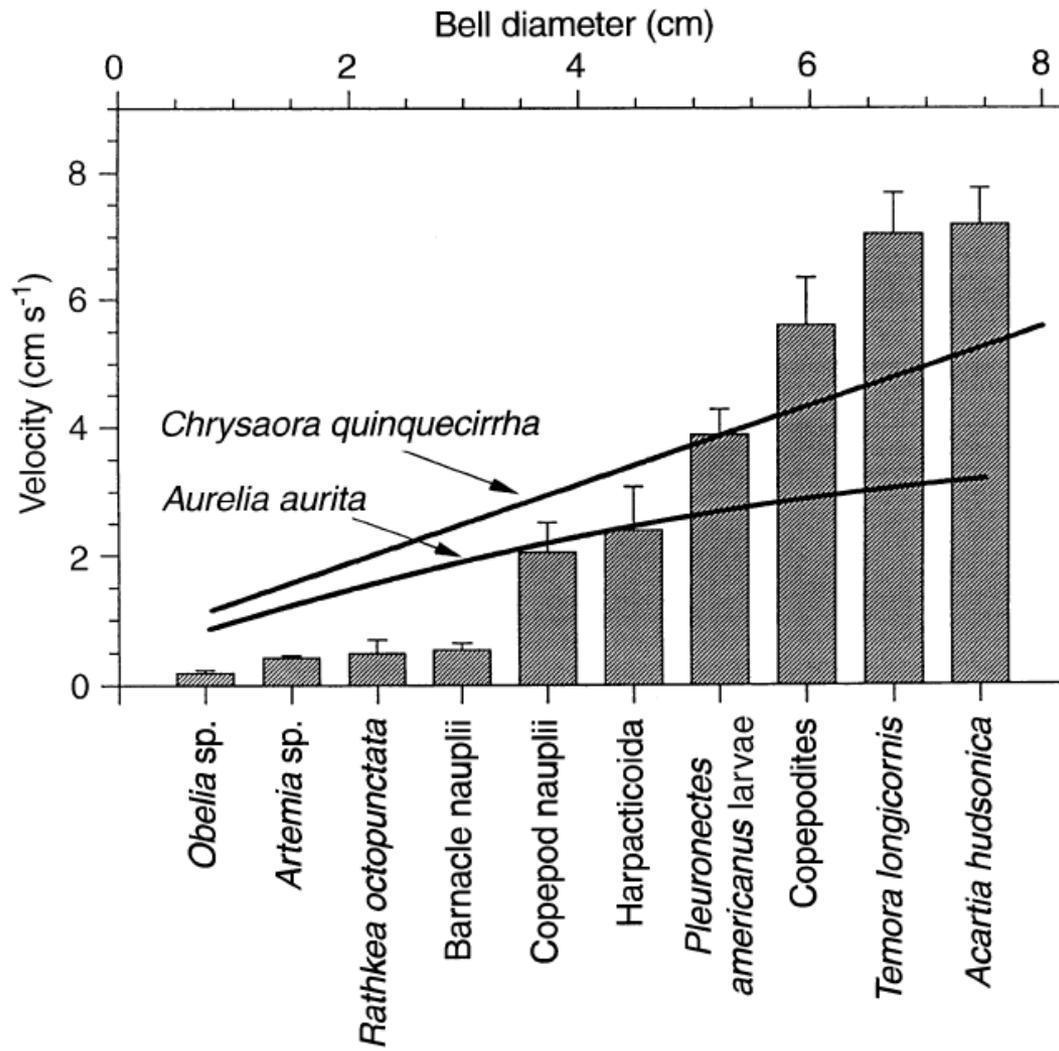


Aurelia [ephyra](#) swimming

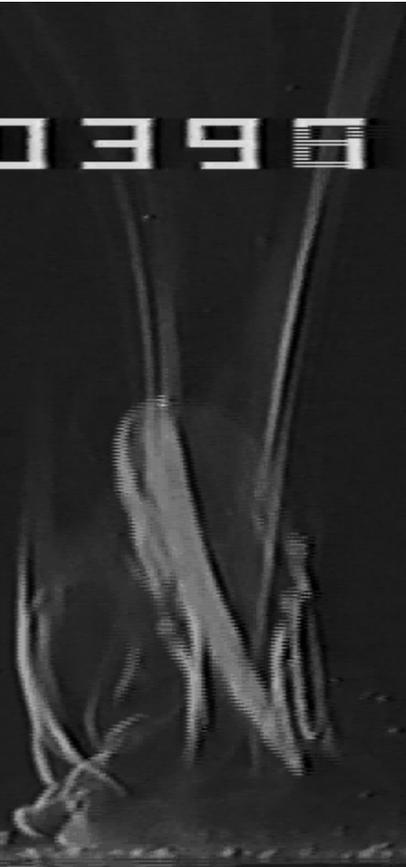




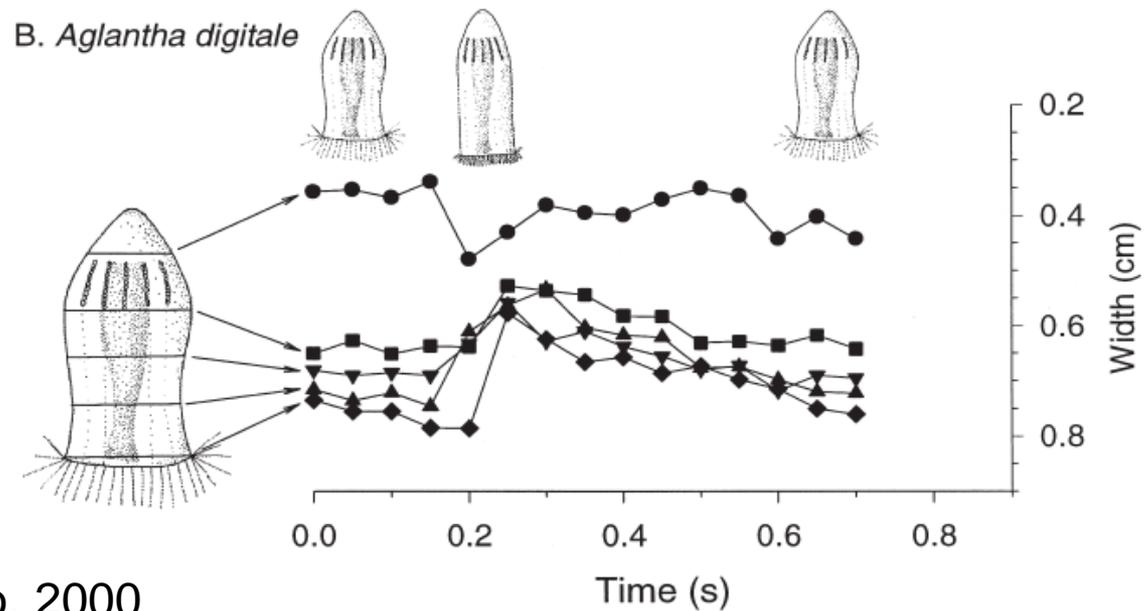
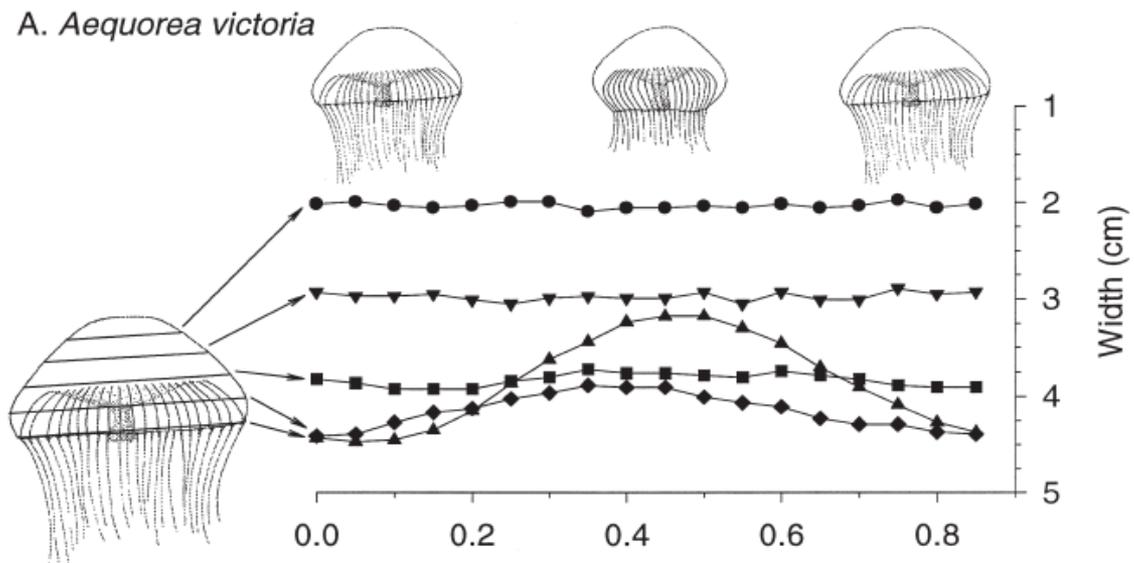




000395



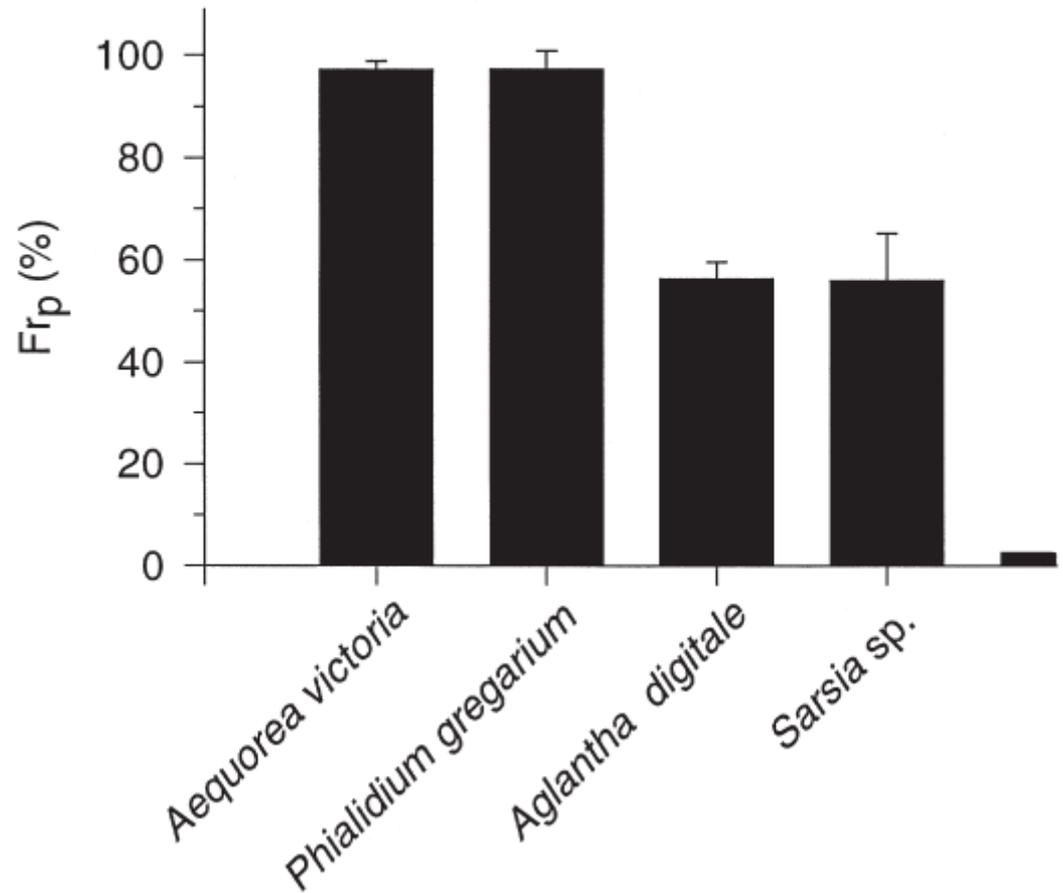




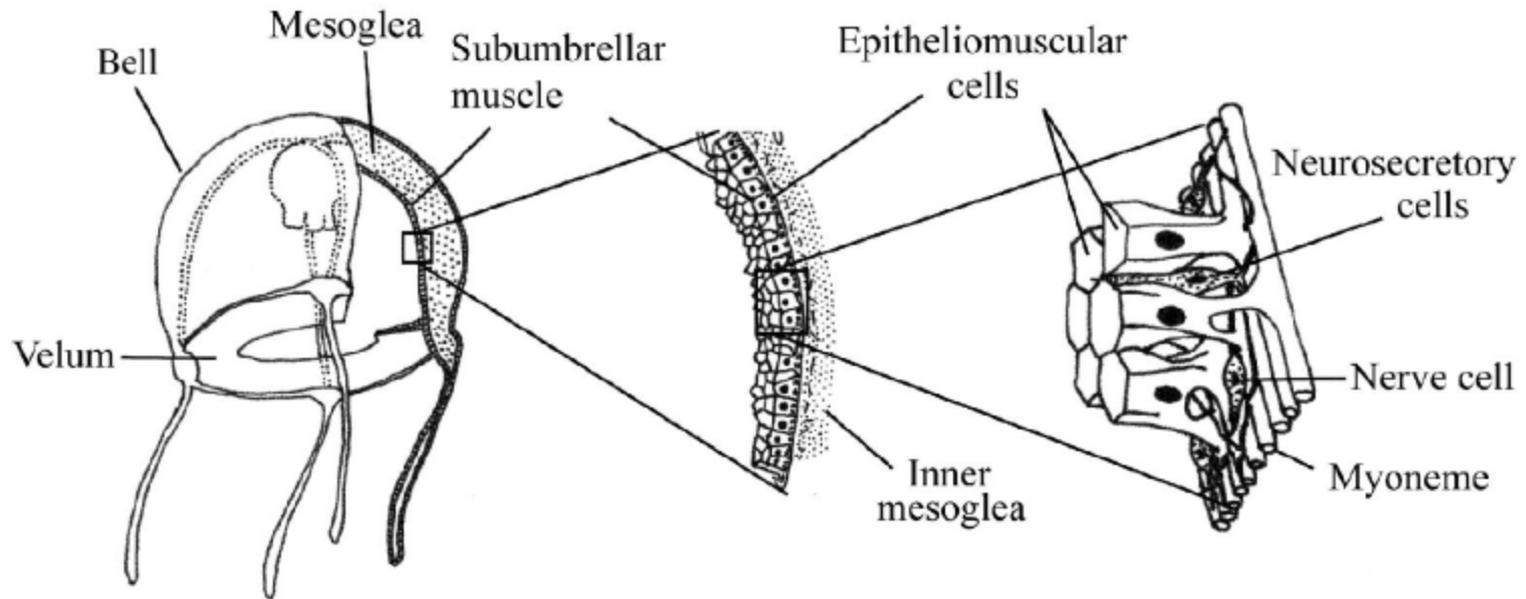
$$Fr_p = \frac{2V_m}{V_j + V_m} \cdot 100$$

energetic efficiency of  
thrust production

### Froude Propulsion Efficiencies

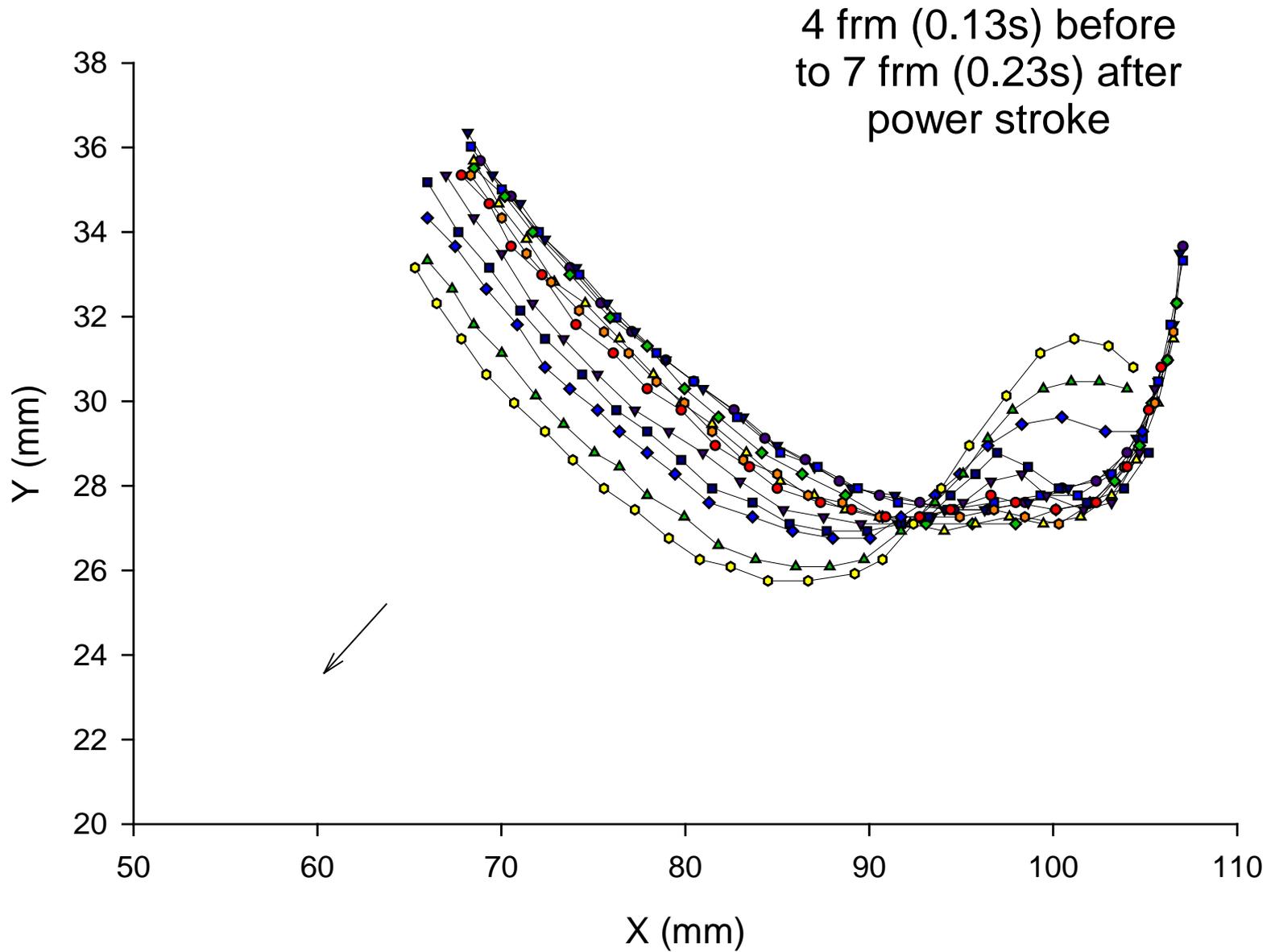


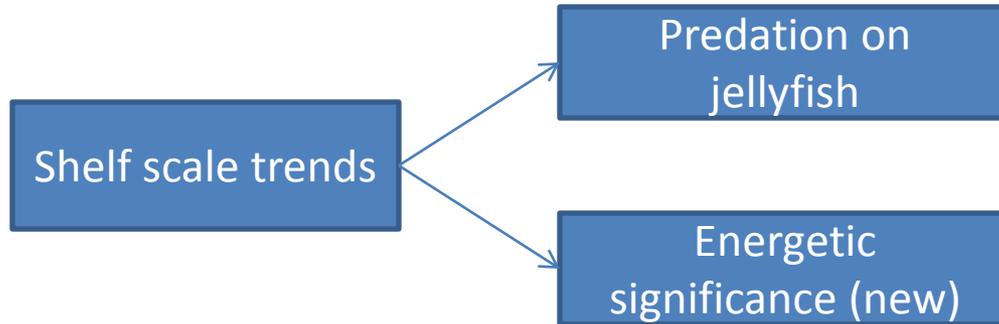
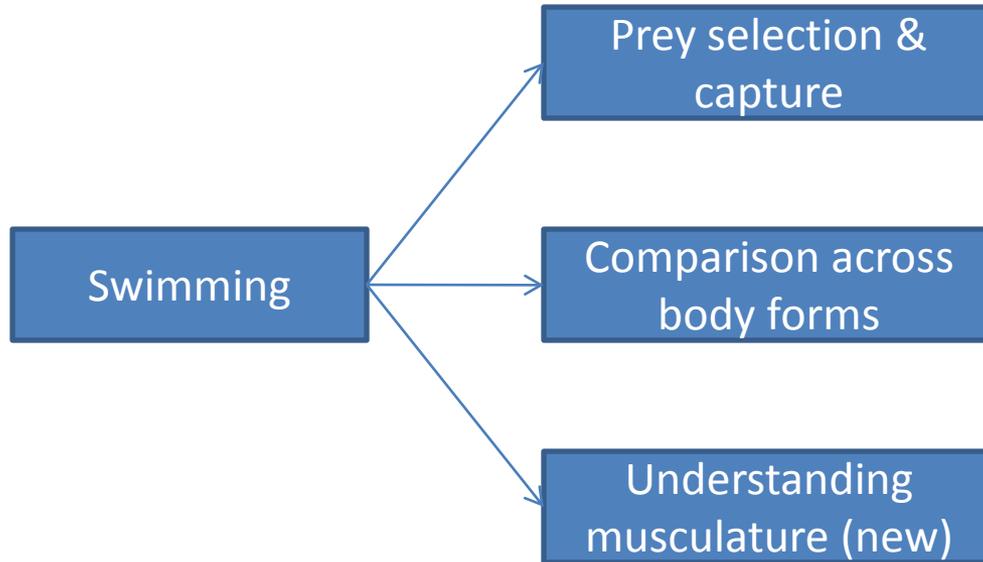


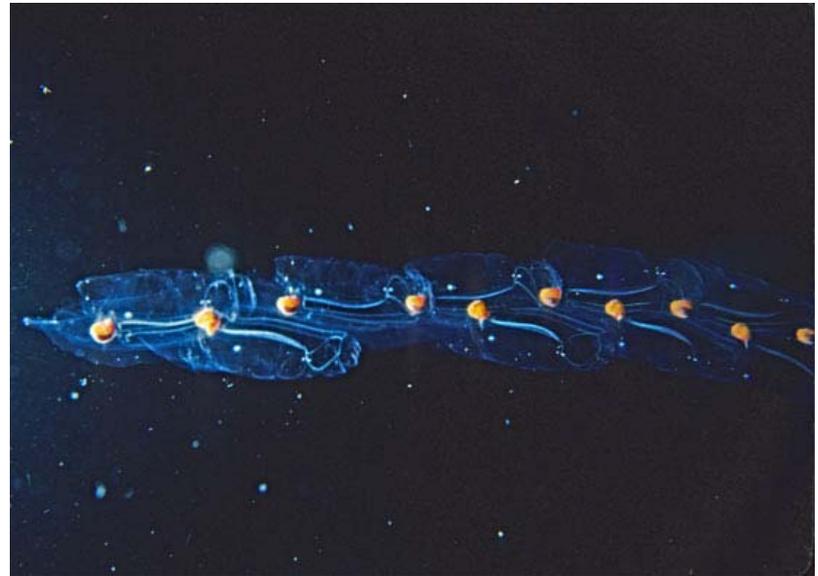
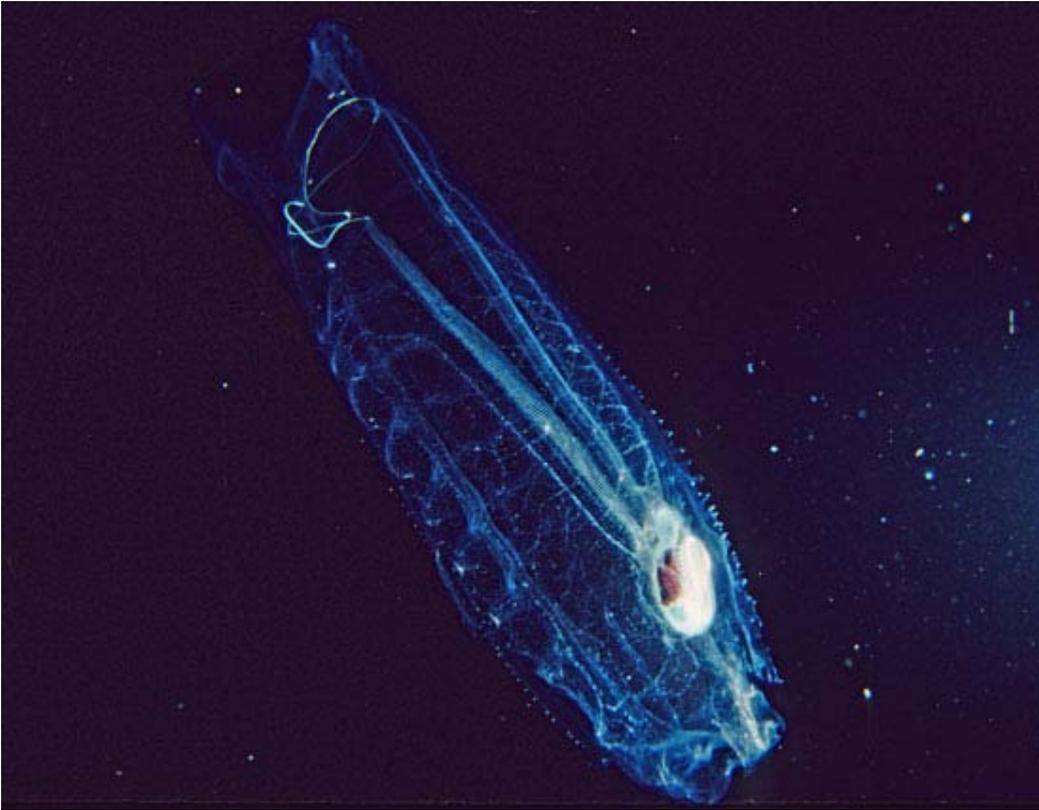


Specialized epidermis are made up of epithelialuscular cells (myoepithelial cells). In most cnidarians, these cells contain two or more Basal extensions running parallel of the body surface and containing contractile myofibrils or myonemes. These processes interconnect With neighboring epitheliomuscular cells to form a contractile sheet between the outer epidermis and the middle body layer. These Specialized cells appear to act as protective, supportive, and contractile layers.

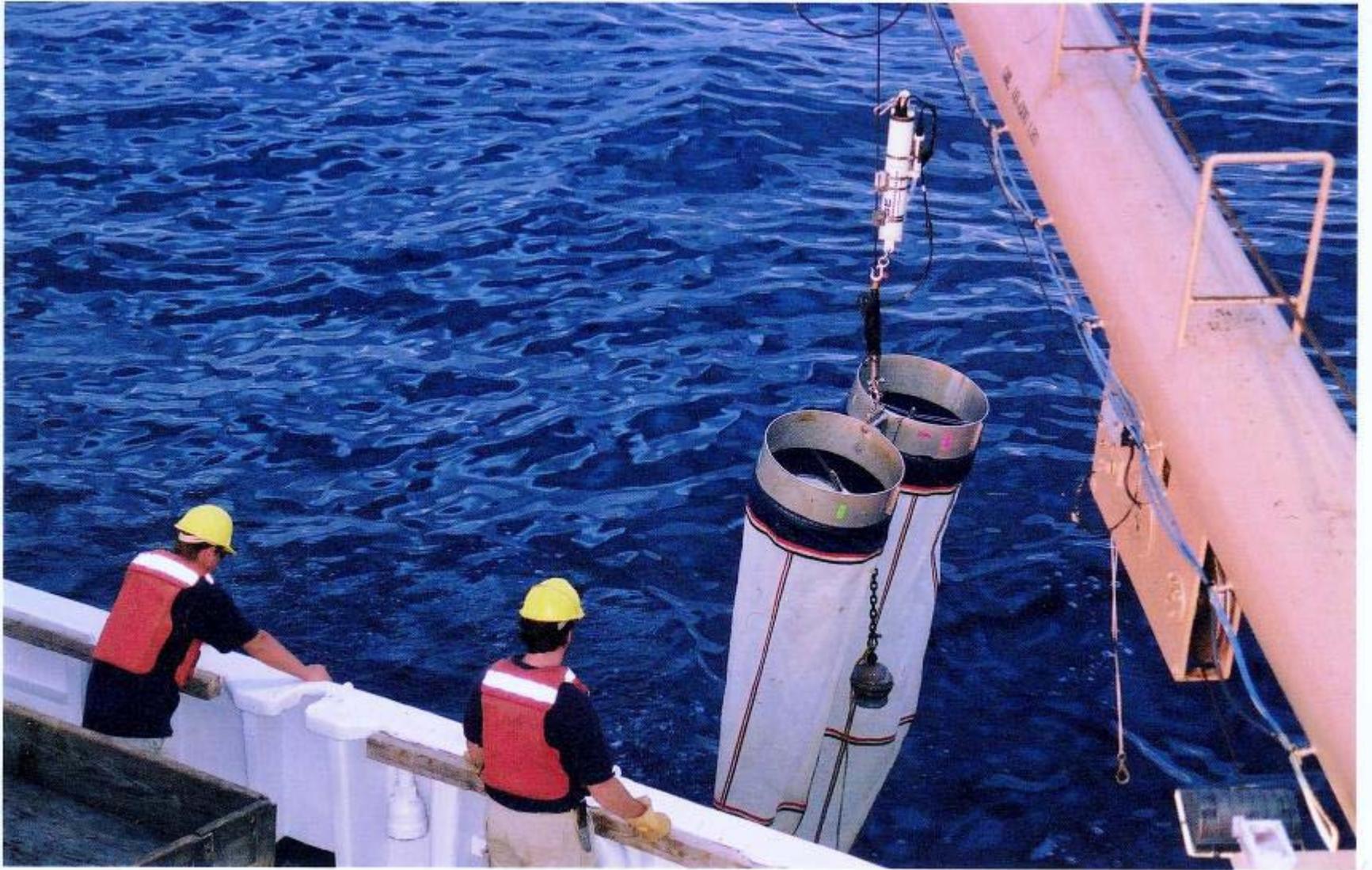
Laser sheet high-speed

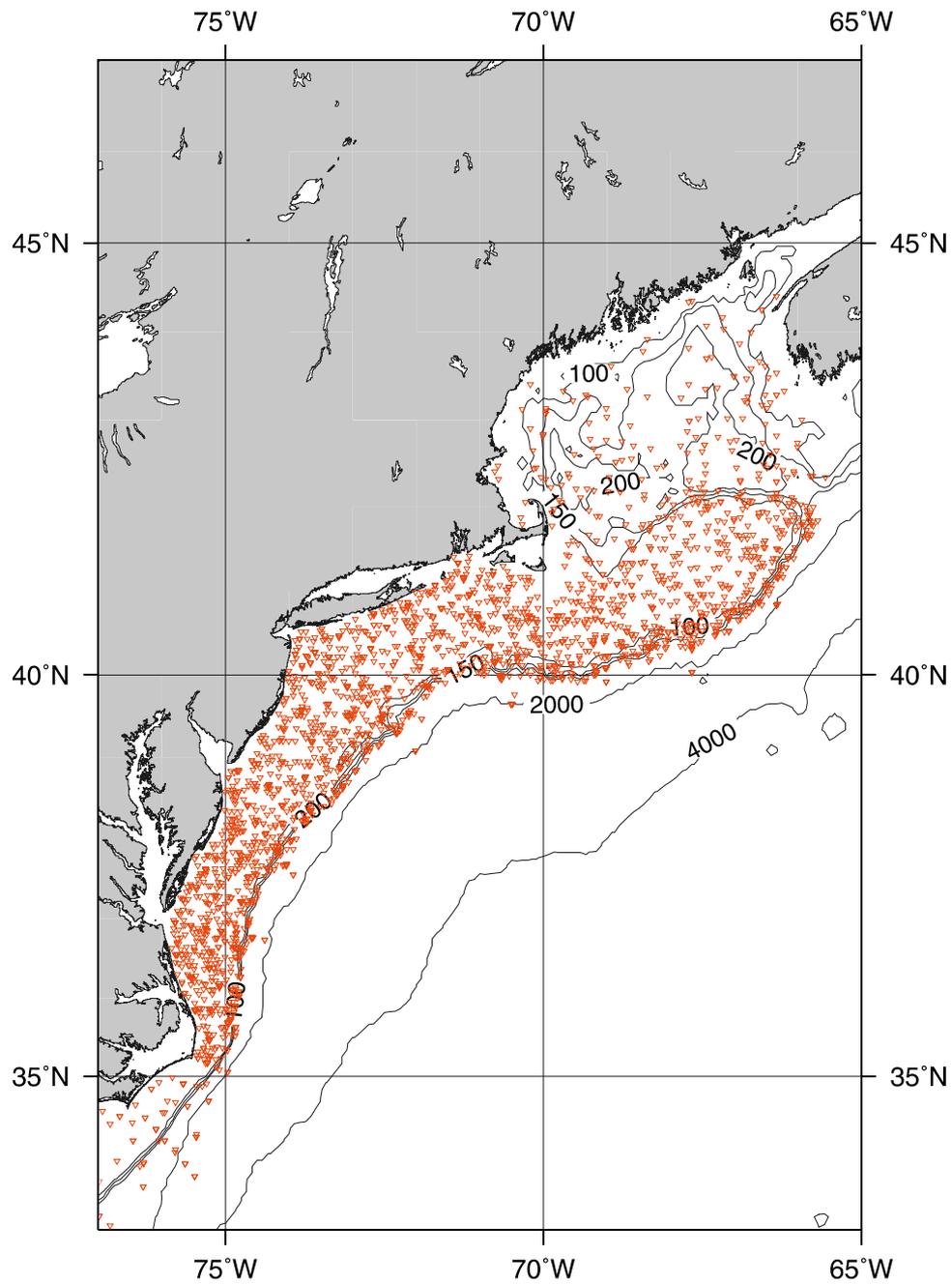


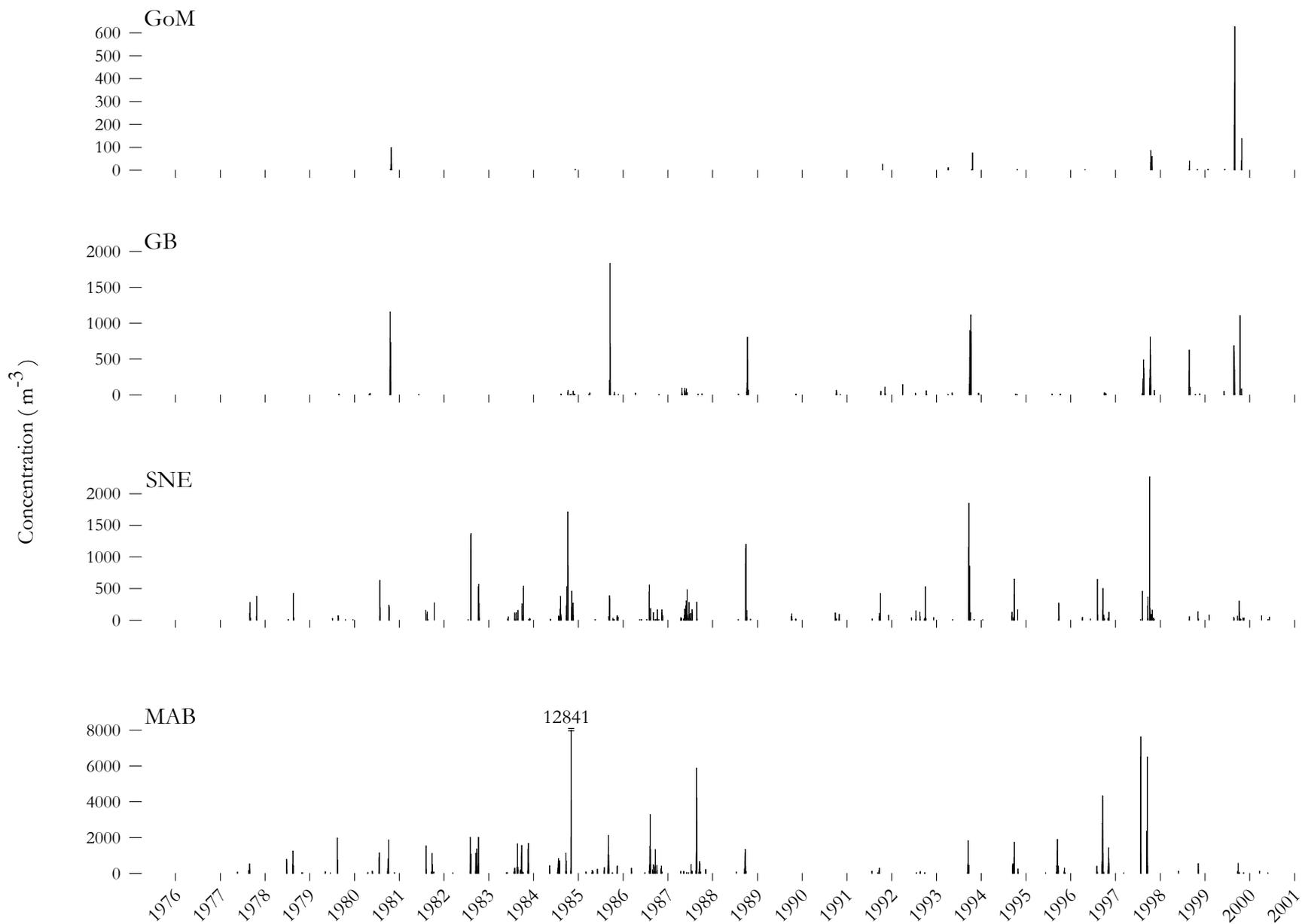


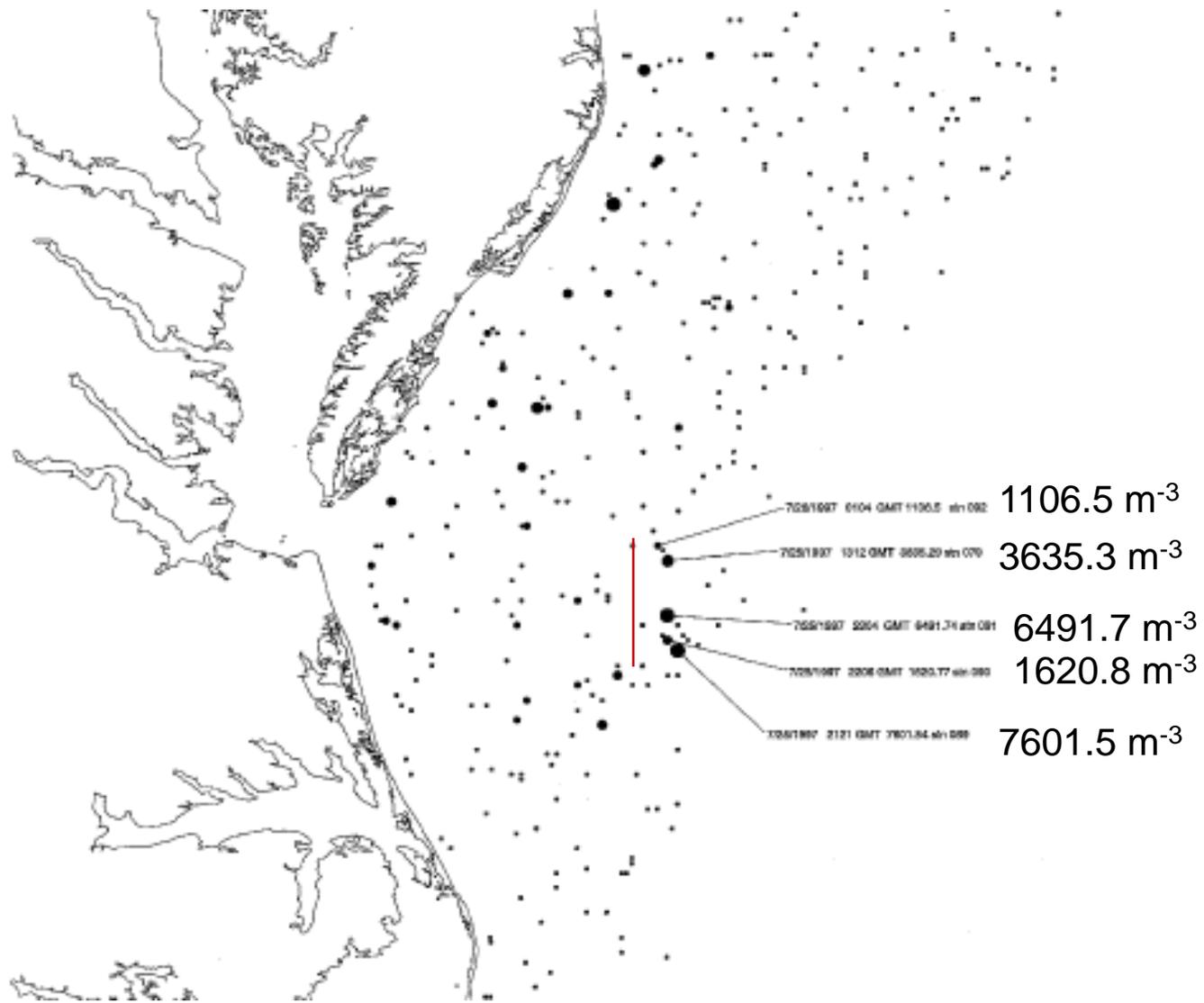


Larry Madin, WHOI



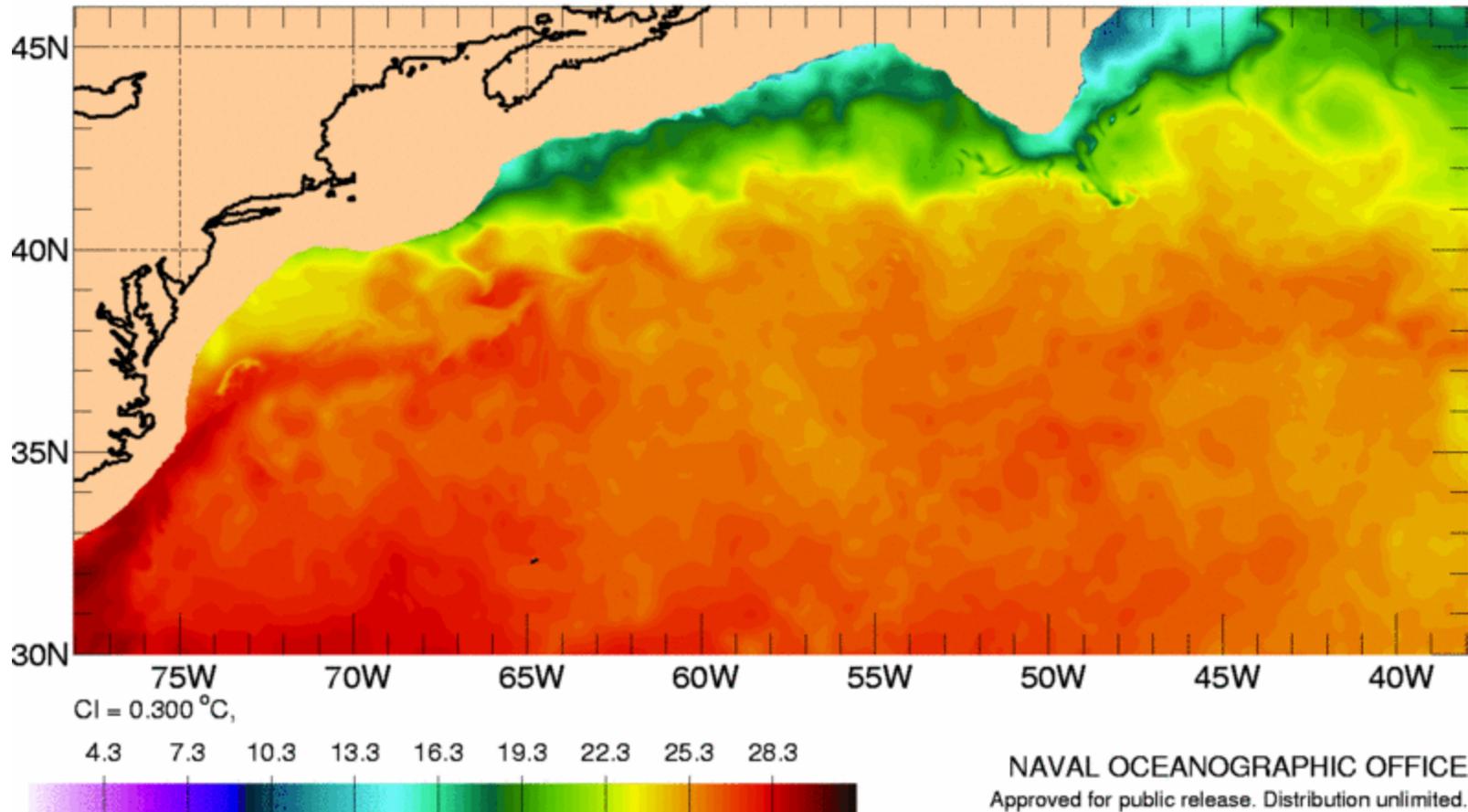






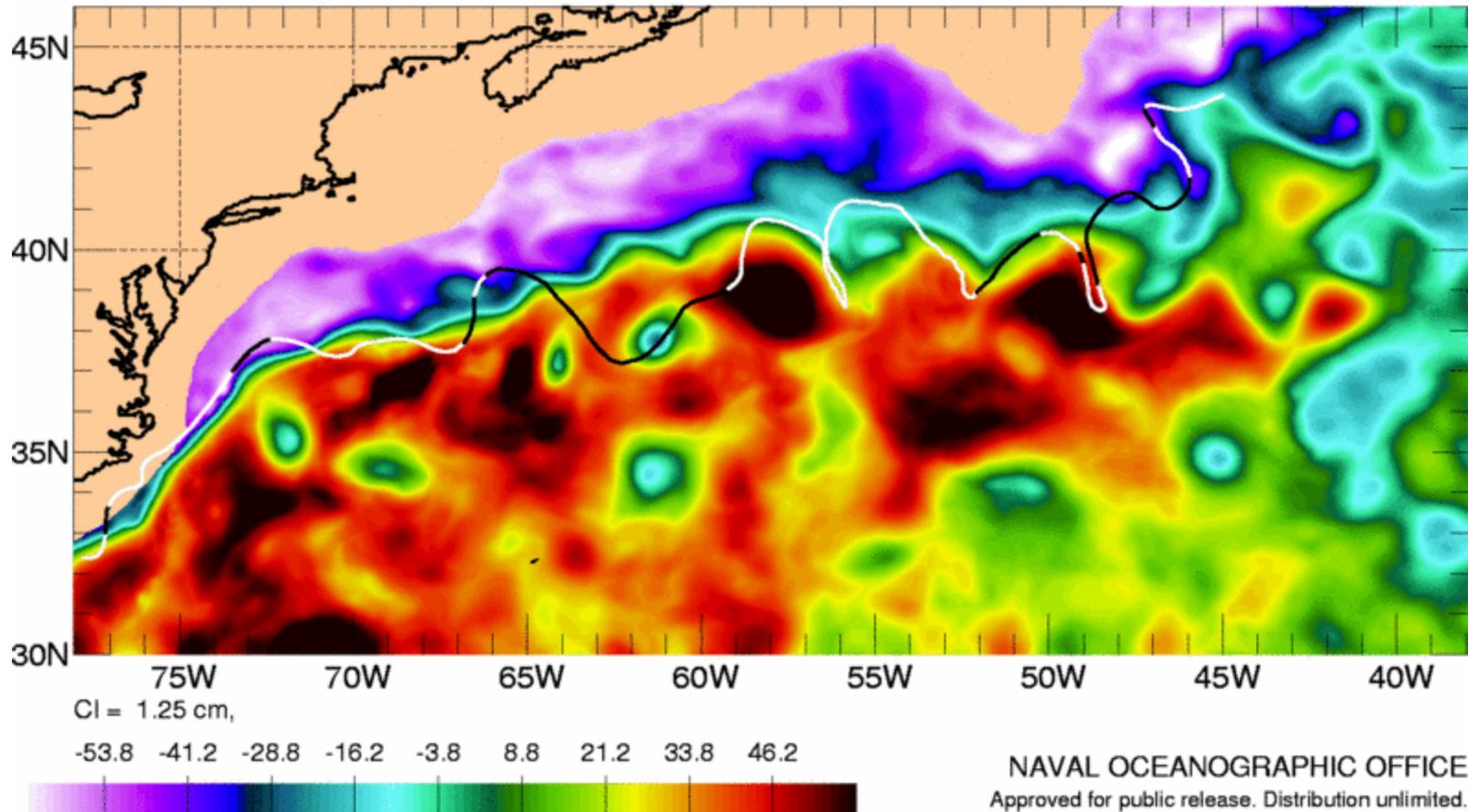
# UNCLASSIFIED: 1/32° Global NLOM

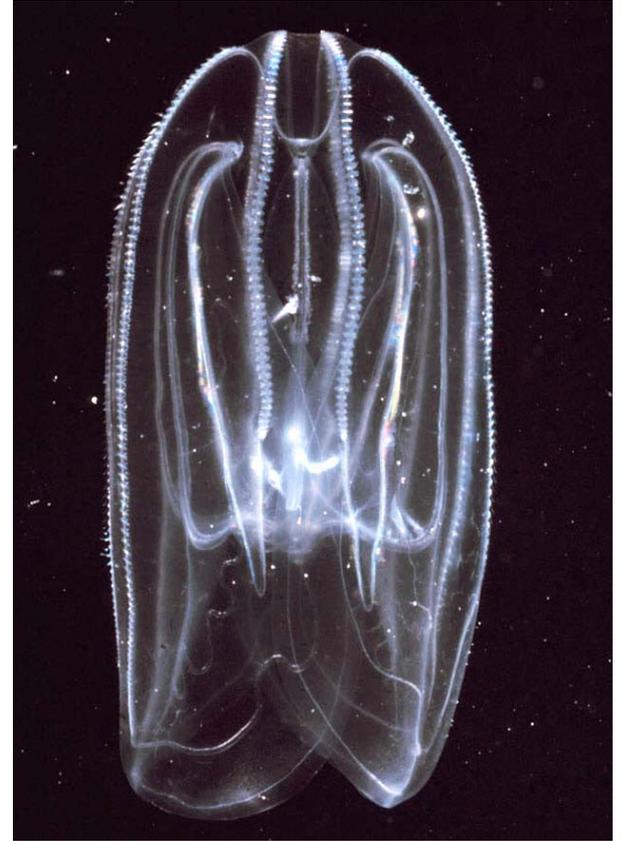
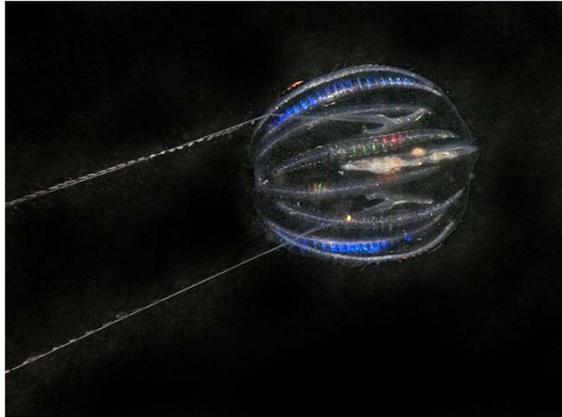
SST ANALYSIS: 20070725

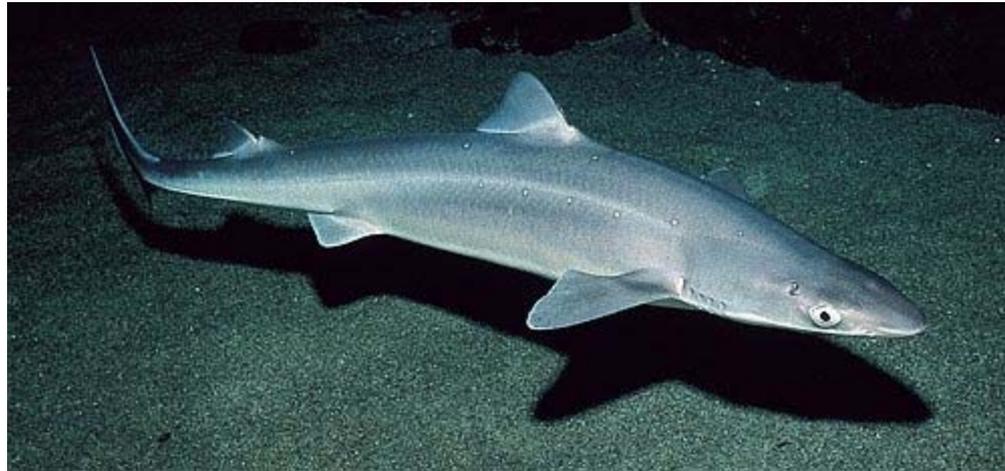


# UNCLASSIFIED: 1/32° Global NLOM

SSH ANALYSIS: 20070725

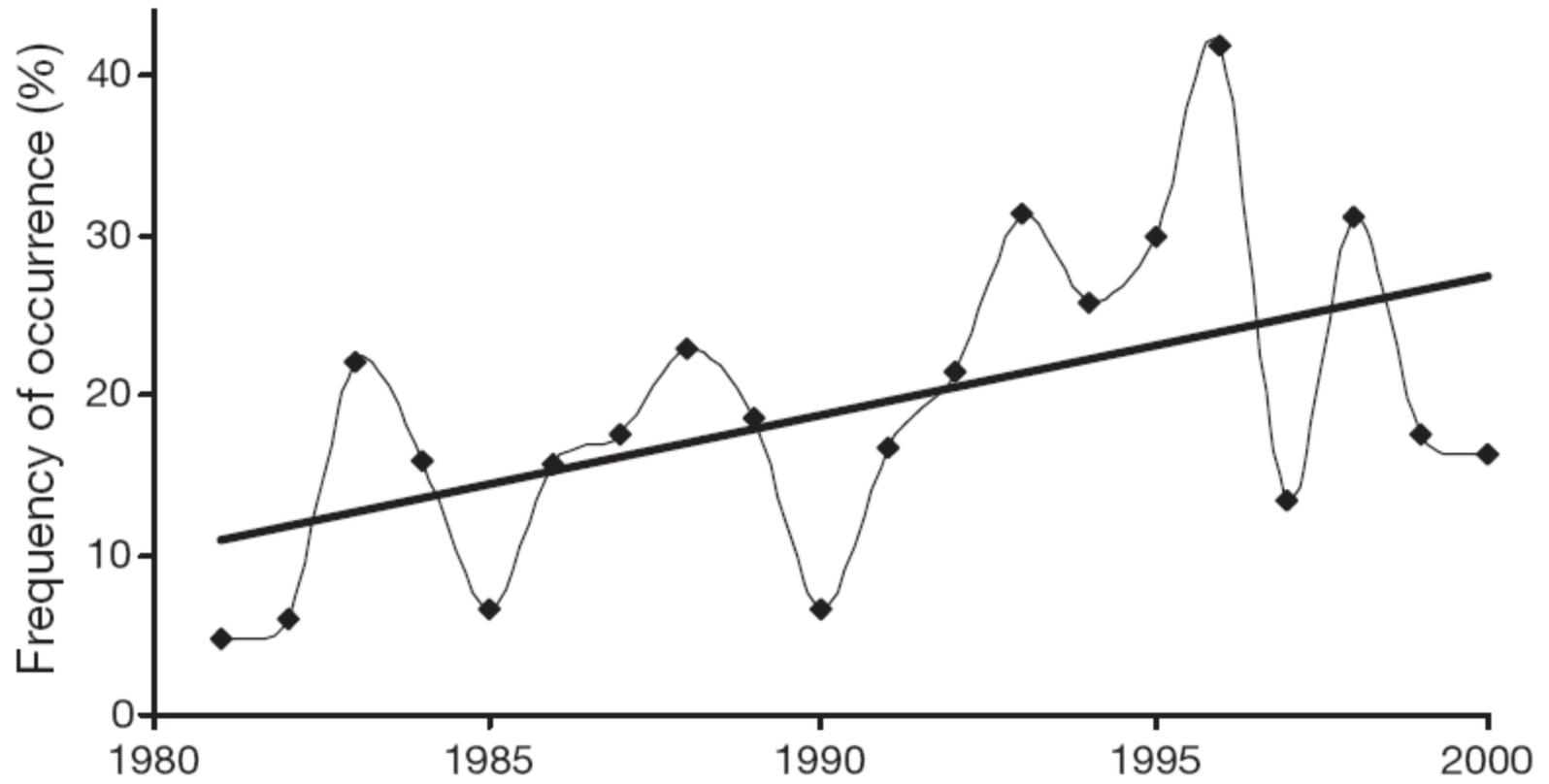


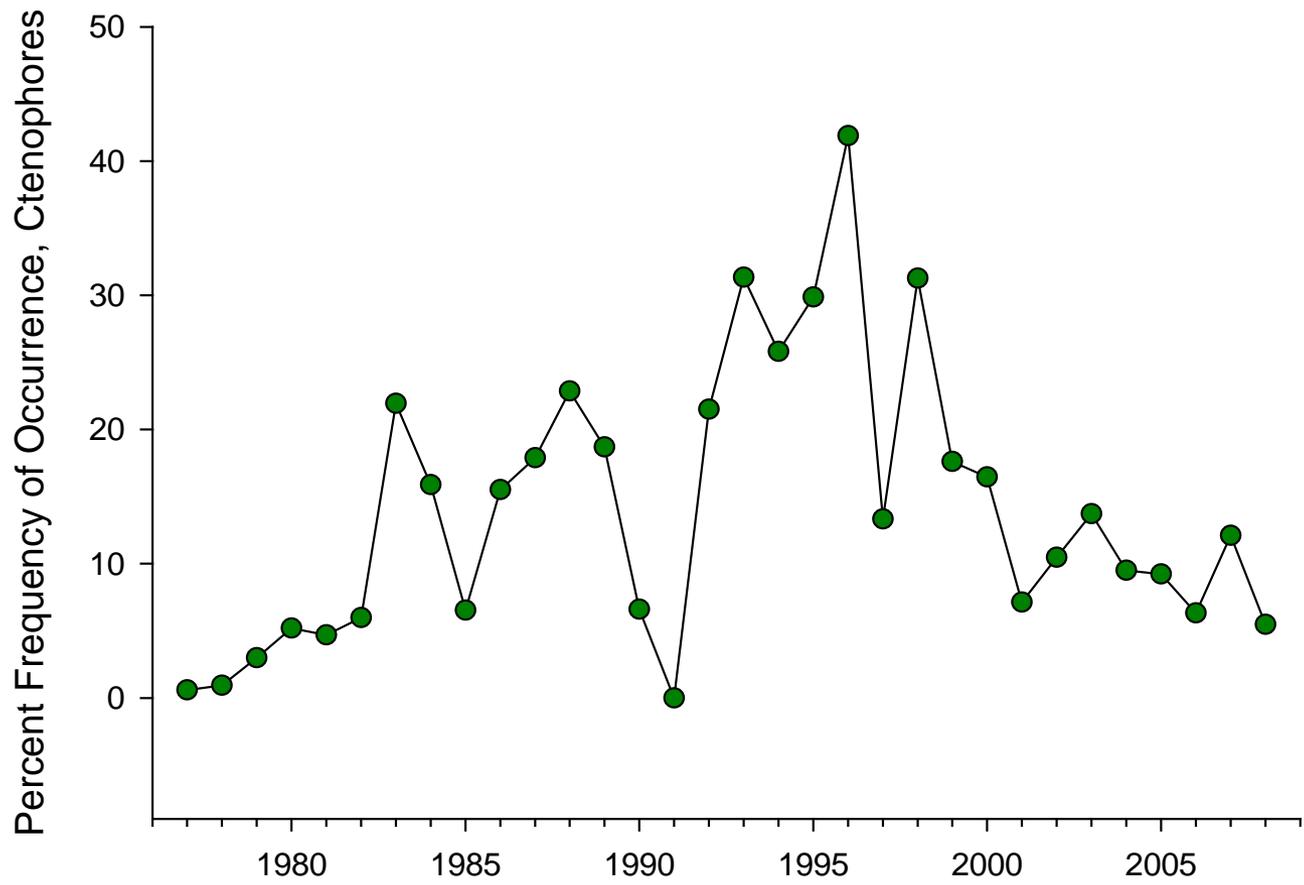


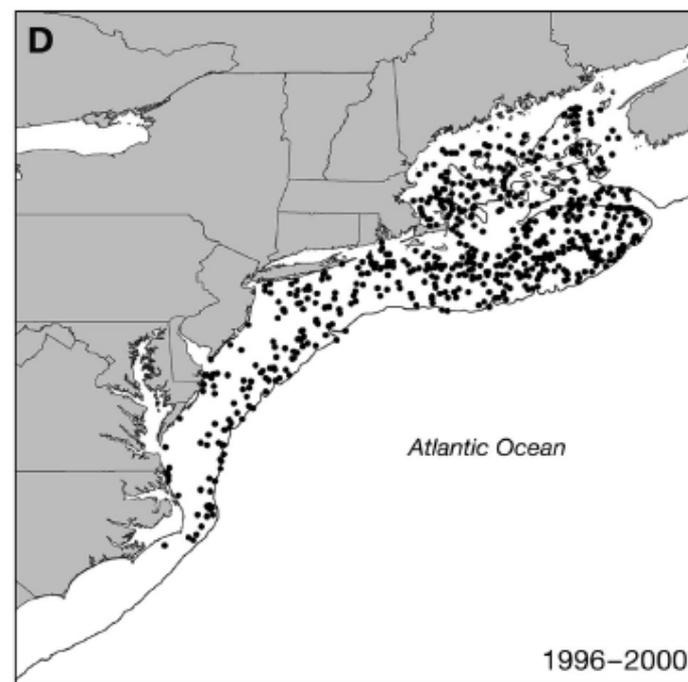
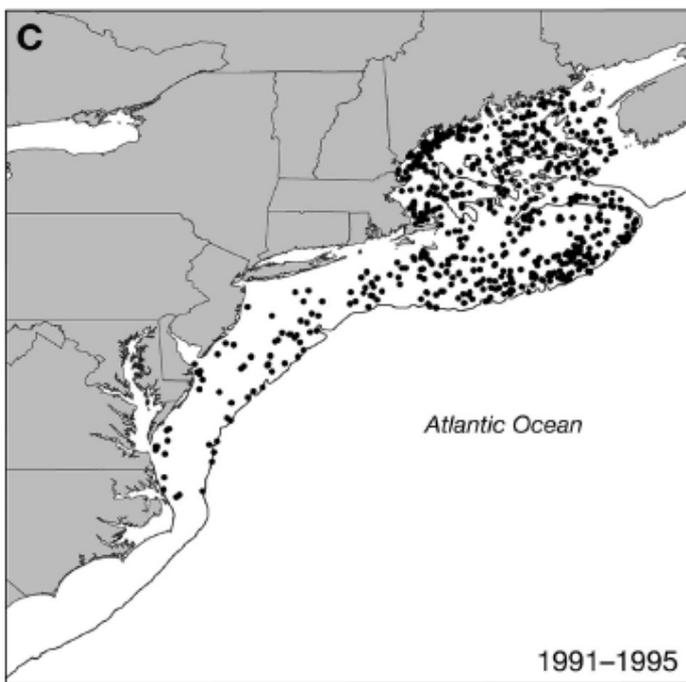
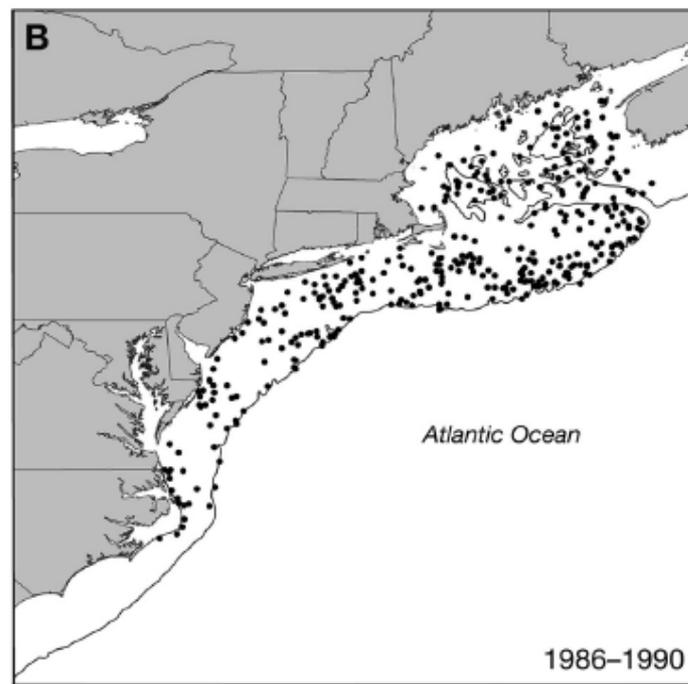
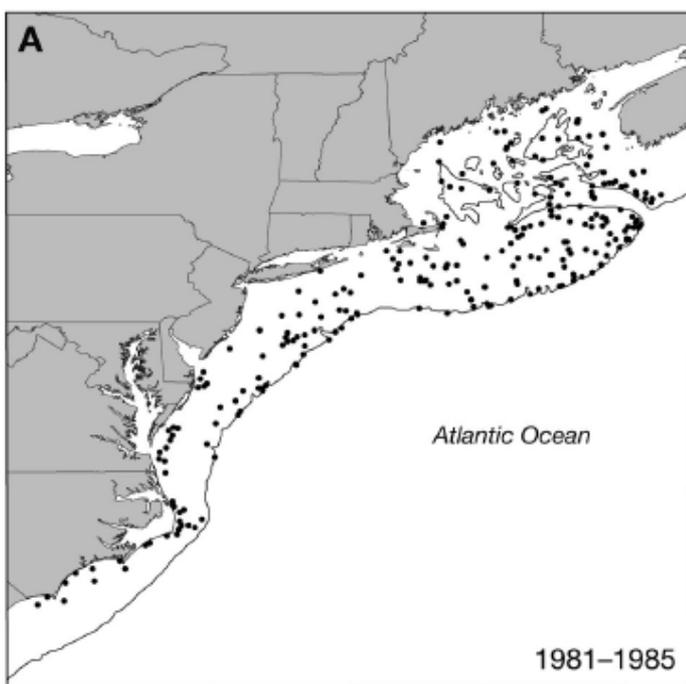


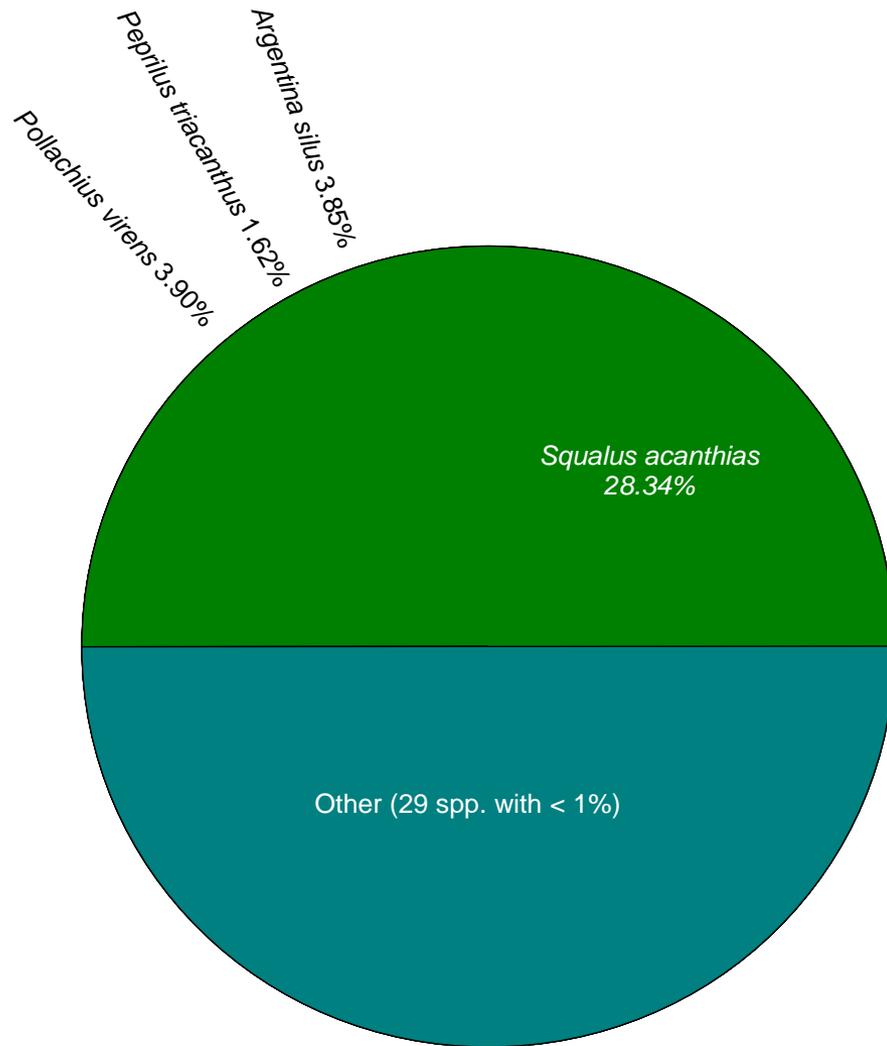


- most (70%) stomachs contained 5-10g ctenophores
- calorimetric values for hydromedusae, ctenophores range from 90 to 200 cal g<sup>-1</sup>\*
- calorimetric estimate from observed stomachs is 450 to 2000 cal

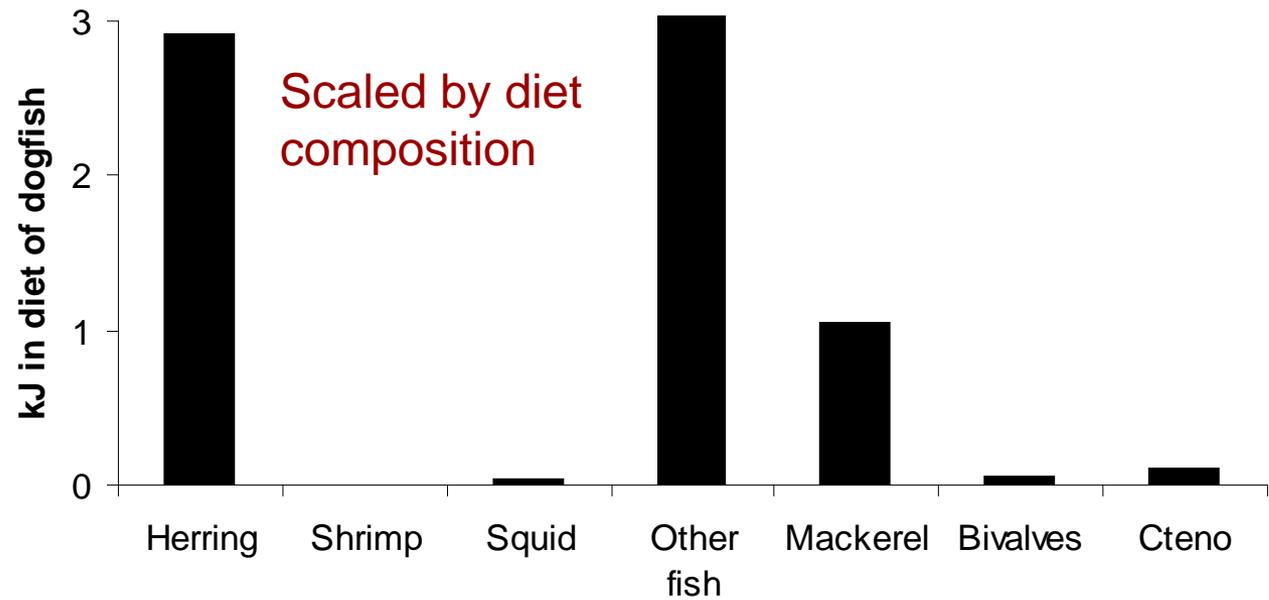
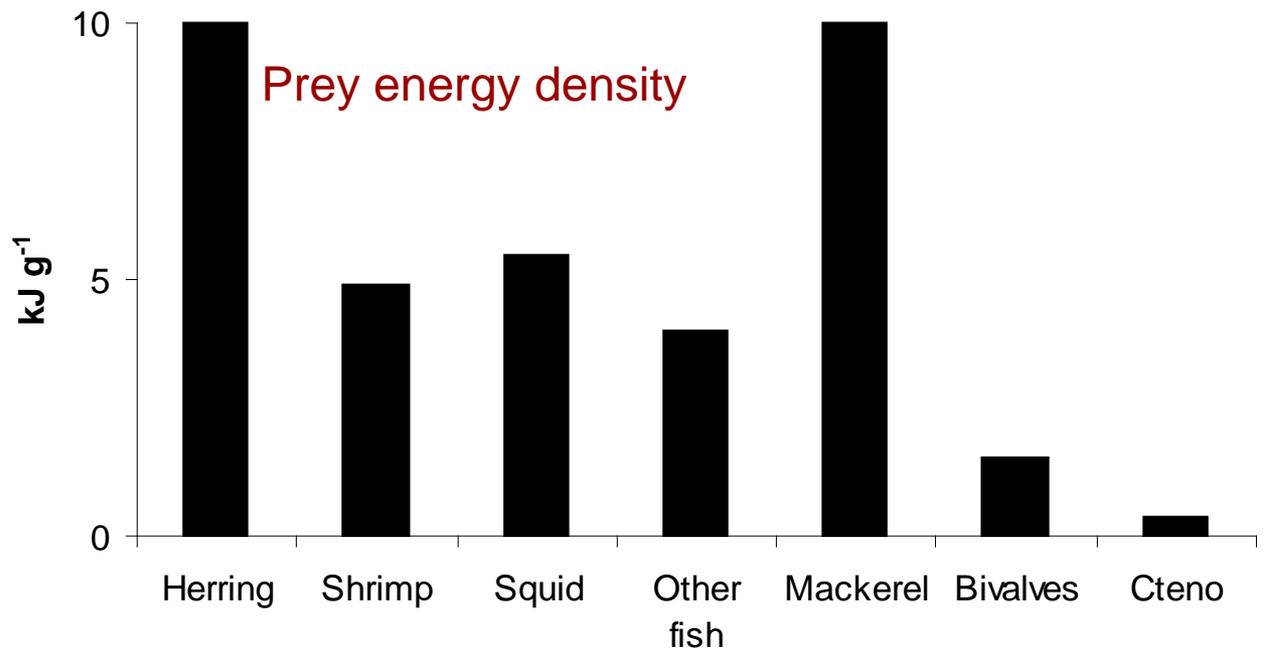








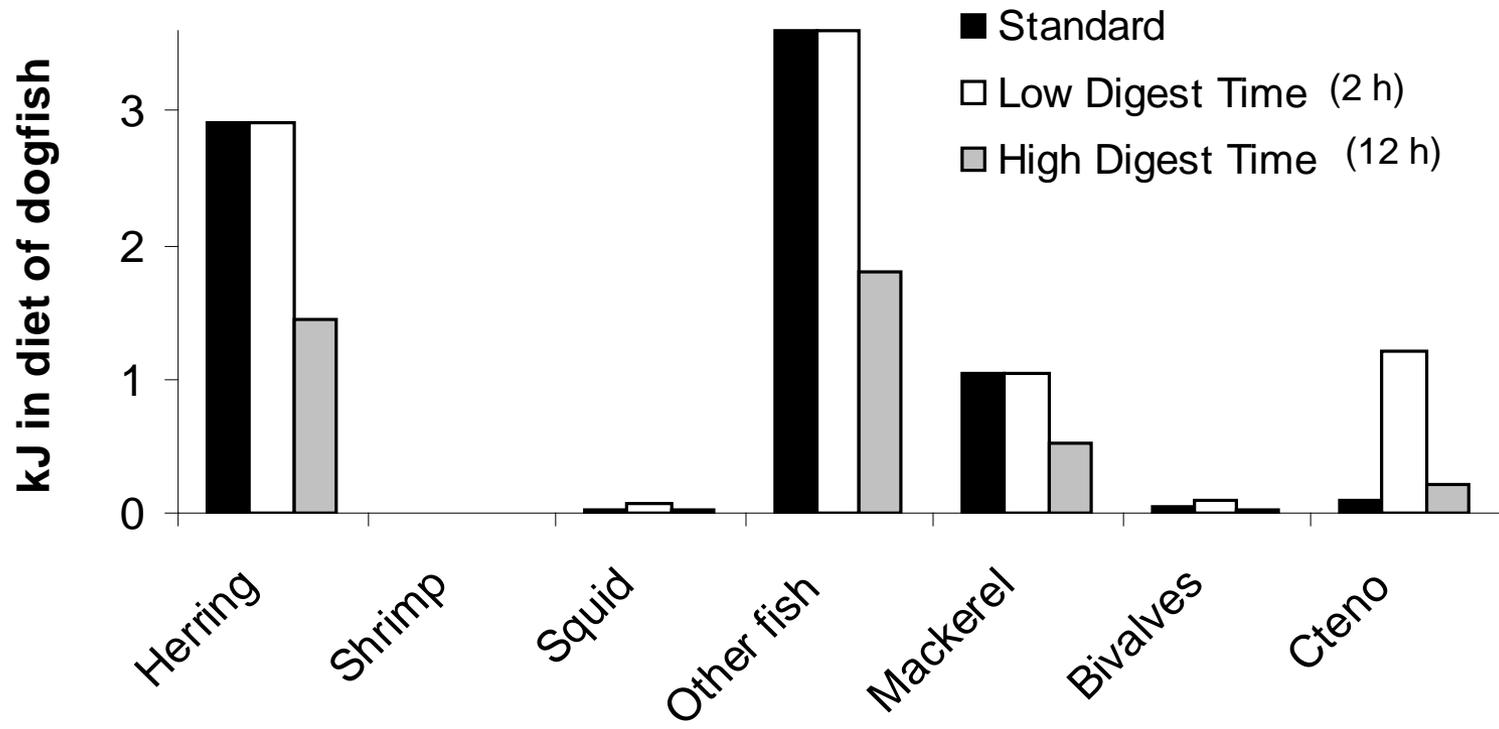
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CHUM SALMON

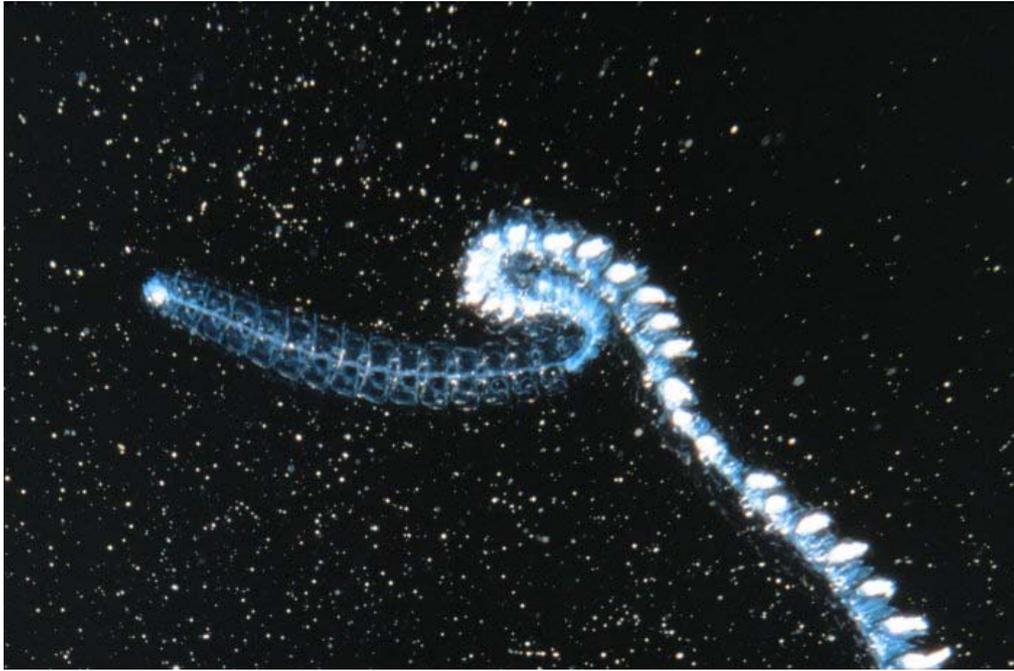


1 h



As a function of digestion time





*Nanomomia cara*

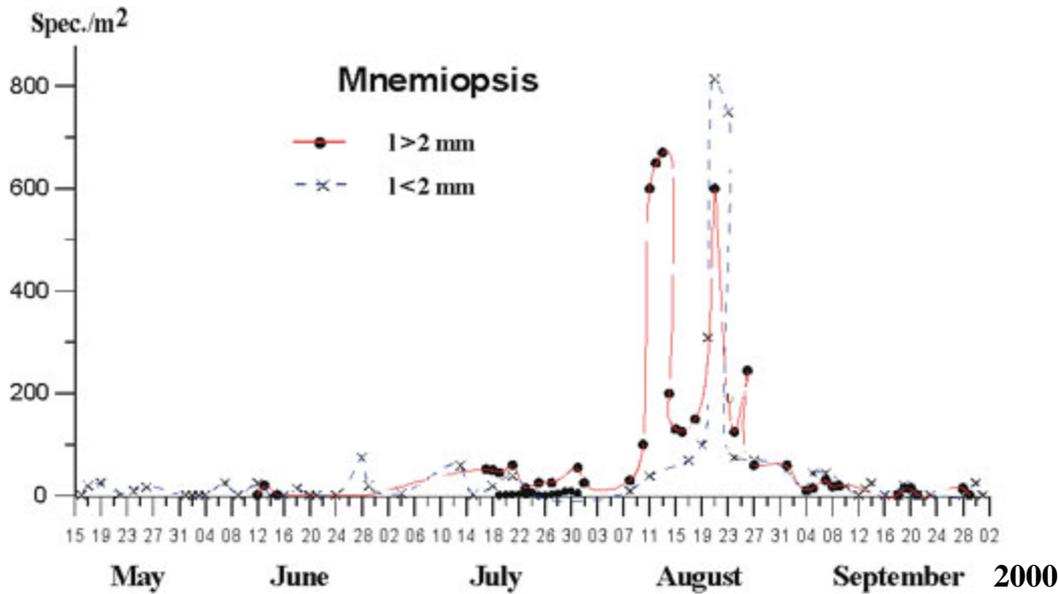
August 1975

Fishermen from Gloucester, MA to Portland, ME lost \$100,000  
-\$300,000 in 1975 from *N. cara* with comparable losses to Maine  
shrimp industry

Rogers, 1976

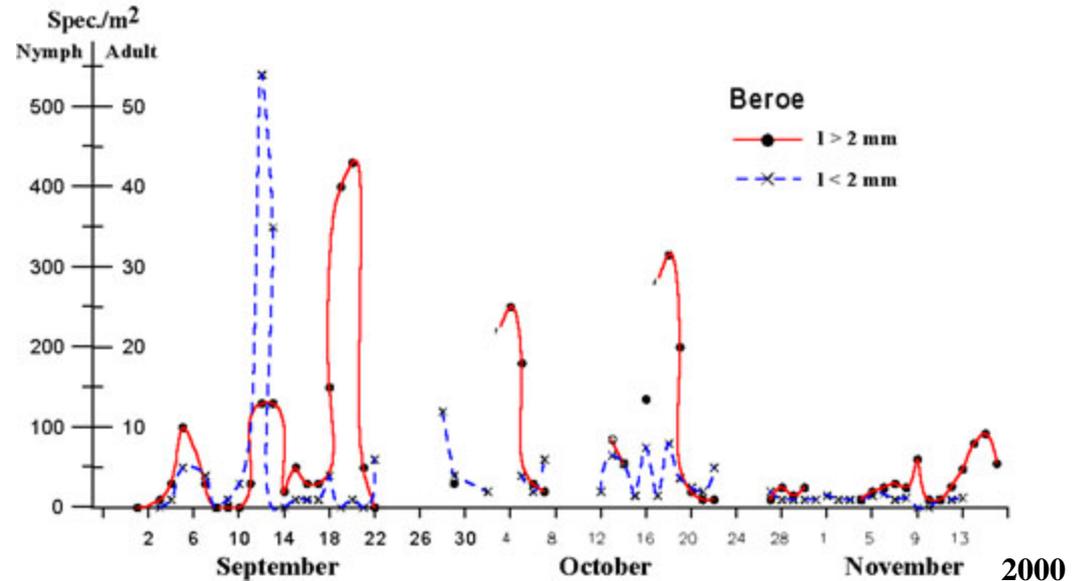






Explosion of *Mnemiopsis leidyi*  
In the Black Sea, 2000  
Ctenophore biomass exceeds  
commercial fish harvest

Regular *Boreo ovata*  
explosion  
exerts pressure on *M.*  
*leidyi* &  
restores forage  
zooplankton  
and bivalves.





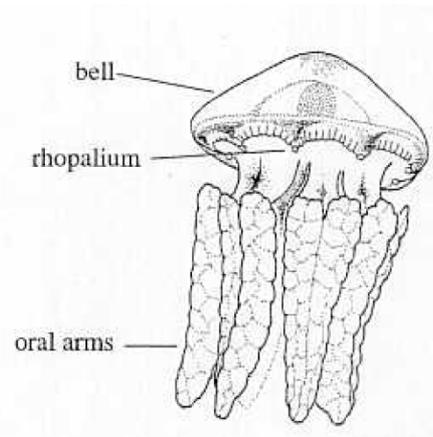
## Jellyfishery

200,000 - 500,000 Mt y<sup>-1</sup>  
since 1992

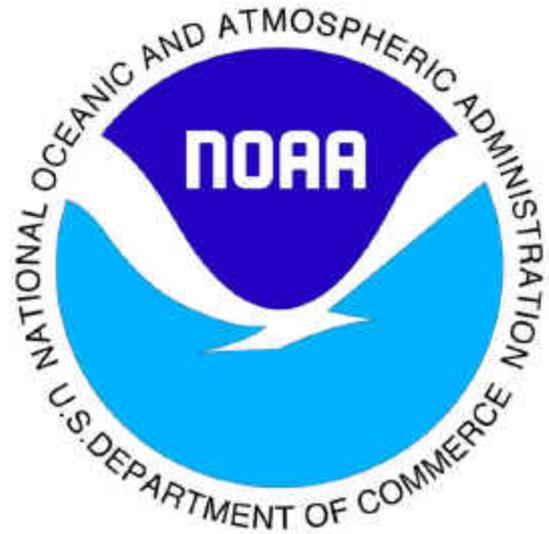
\$43.6M imported to Japan  
\$13M to Korea  
(FAO, 1997)

Order Rhizostomeae  
(dense mesoglea)

China  
Indonesia  
Malaysia  
Philippines  
Thailand  
Turkey



*Catostylus mosaicus*



National Marine *Jelly* Fisheries Service

Extras...

Phylum Cnidaria

Class Cubozoa

Class Scyphozoa

Order Semeostomeae

Family Pelgaidae

*Clrysaora quinquecirrha*

Family Cyaneidae

*Cyanea capillata*

Family Ulmaridae

*Aurelia aurita*

Class Hydrozoa

Order Leptothecatae

Phylum Aequoreidae

*Aequorea victoria*

Phylum Corynidae

*Sarsia tubulosa*

Order Tracymedusae

*Aglantha digitale*

Subclass Siphonophorae

Class Anthozoa

Phylum Ctenophora

Class Tentaculata

Class Nuda

Phylum Chordata

Subphylum Urochordata (Tunicata)

Class Ascidiacea

Class Larvacea (Appendicularia)

Class Thaliacea

Order Pyrosomatida

Order Doliolida

Order Salpida

Subfamily Cyclosalpinae

Genus Cyclosalpa

Genus Helicosalpa

Subfamily Salpinae

Genus Brooksia

Genus Iasis

Genus Ihlea

Genus Metcalfina

Genus Pegea

Genus Ritteriella

Genus Salpa

Genus Thalia

Genus Traustedtia

Genus Thetys

# Outline

- Kinematics
  - Swimming is feeding
    - First paper on capture sites
  - Not all jellyfish swim the same way
    - Jets paper
    - Subsequent developments
  - How can jellyfish do all this with their construction
    - Muscle tissue configuration
    - High-resolution kinematics leading to histology studies
- Shelf scale trends
  - Looking at jellies over the entire shelf
  - Looking through the guts of dogfish
- Caloric significance
  - Why even eat a jellyfish?
- Significant events
  - Rhacastoma
  - Salps on NEUS shelf

