CENSUS OF MARINE LIFE

CMarZ Ocean Exploration cruises

Zooplankton sampling of the deep Sea.

Peter H. Wiebe

This CMarZ project addresses the second grand challenge question of the Census of Marine Life (CoML):

"What lives in the ocean now?"

Funded by the NOAA Ocean Exploration Program and the Alfred P. Sloan Foundation

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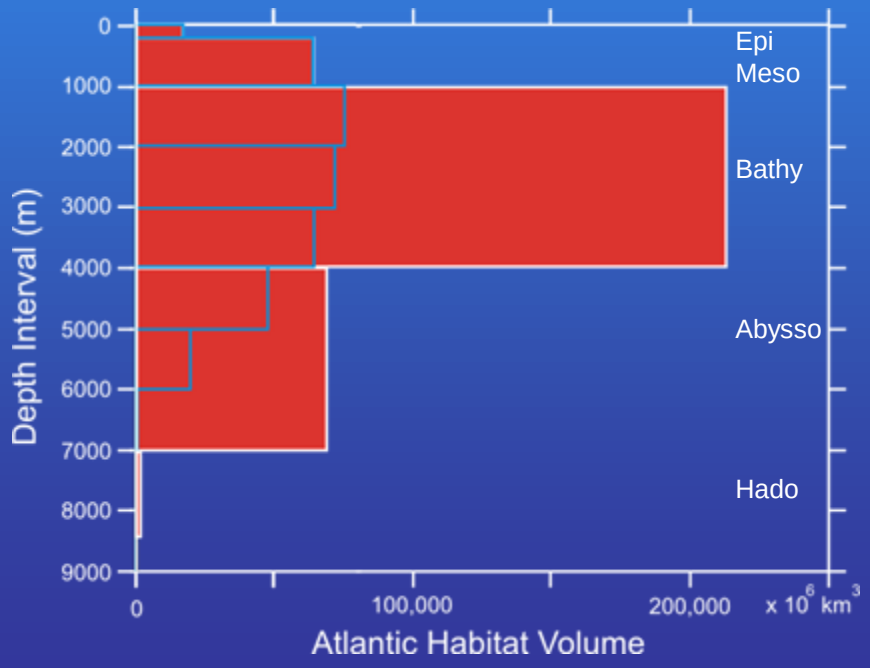
CMarZ

Atlantic Ocean pelagic habitat

Habitat Zone	*Volume 10^6 km^3*	*Percent volume in depth zones*
Epipelagic (0-200 m)	17,311.6	4.8
Mesopelagic (200-1000 m)	64,382.4	17.7
Bathypelagic (1000 - 4000 m)	213,140.0	58.6
Abyssopelagic (4000 - 7000 m)	68,859.0	18.9
Hadopelagic (>7000 m)	10.0	0.003

Volumes and percentages based on hypsometry from Menard and Smith (1966).
The ocean pelagic habitat has been divided vertically into five zones (Hedgepeth, 1957). The Hadopelagic occupies a small fraction of the ocean volume and is present in the Atlantic Ocean's Puerto Rico Trench (8400 m).



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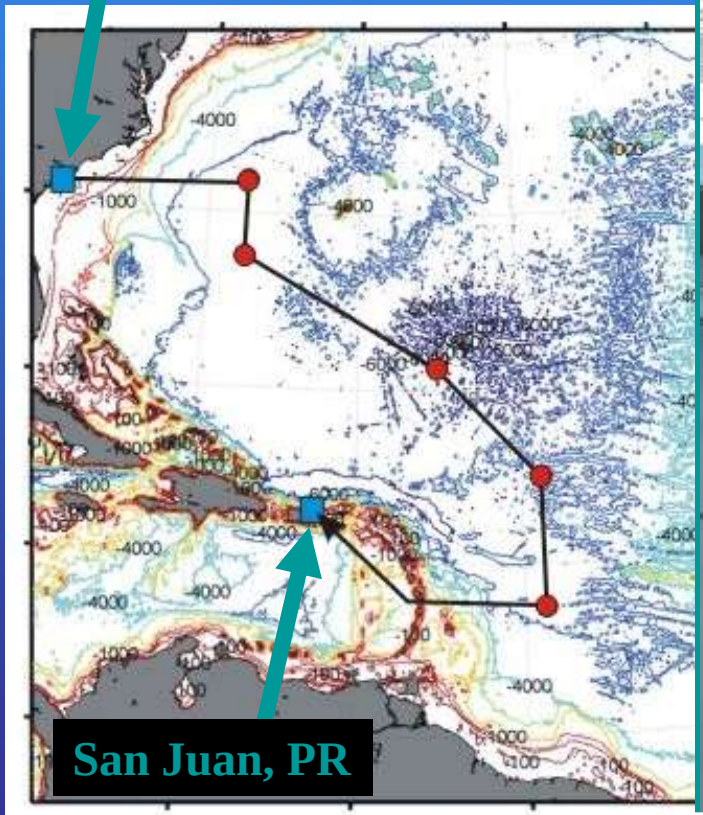
CMarZ Ocean Exploration cruises

A CMarZ cruise in April 2006 to collect zooplankton and fish from the deepest waters of the NW Atlantic. Participants included Steering Group members and students from 14 countries.

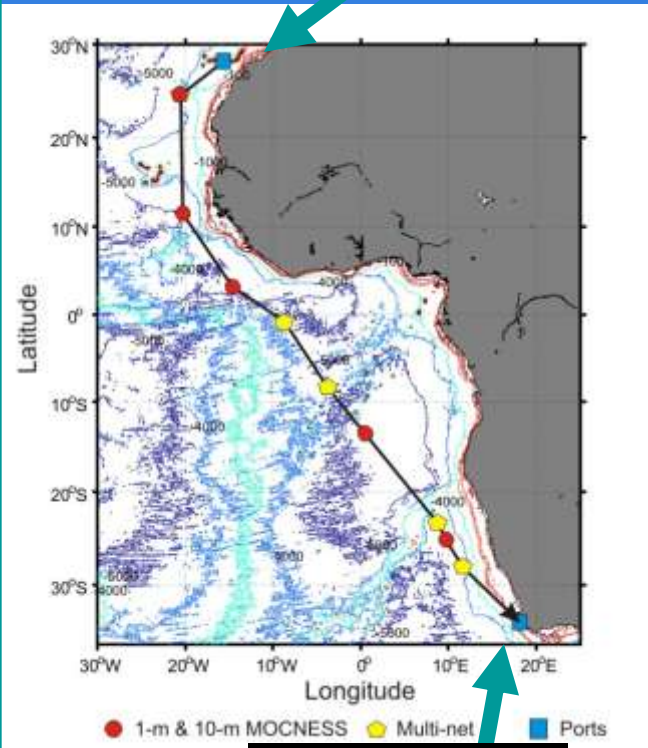
Charleston, SC



CMarZ Ocean Exploration cruises

A CMarZ cruise in November 2007 to collect zooplankton and fish from the deepest waters of the SE Atlantic. Participants included Steering Group members Associates, taxonomists, and students from 11 countries.

Las Palmas



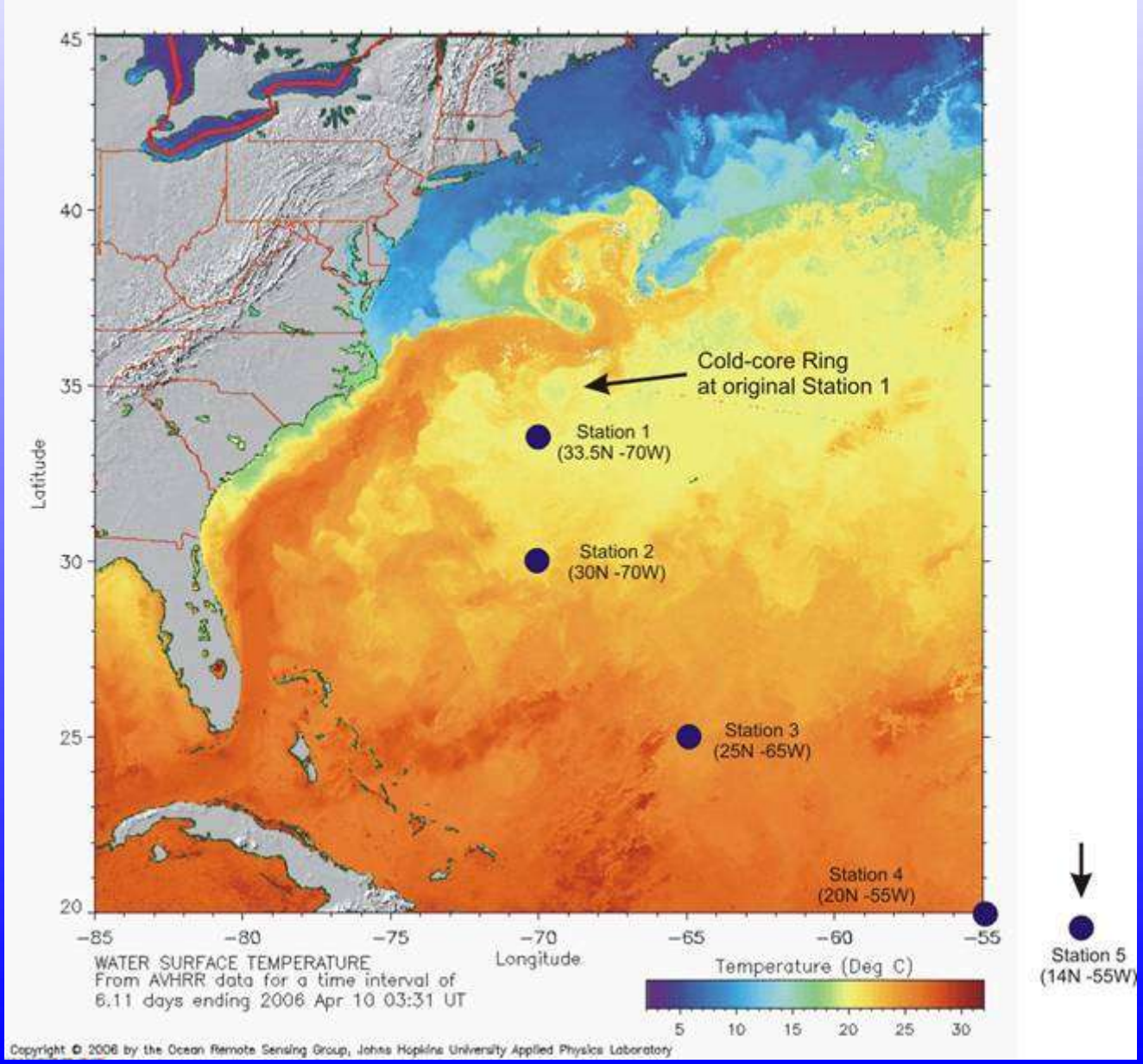
Cape Town

CMarZ Ocean Exploration cruises

Sea Surface Temperature Conditions in early April 2006

A transect extending from the Northern Sargasso Sea to 14 N east of the Windward Islands was sampled during a 21 day period.

Comprehensive surface-to-bottom sampling at five major stations extending from the northern Sargasso, to the Southern Sargasso and North equatorial current.

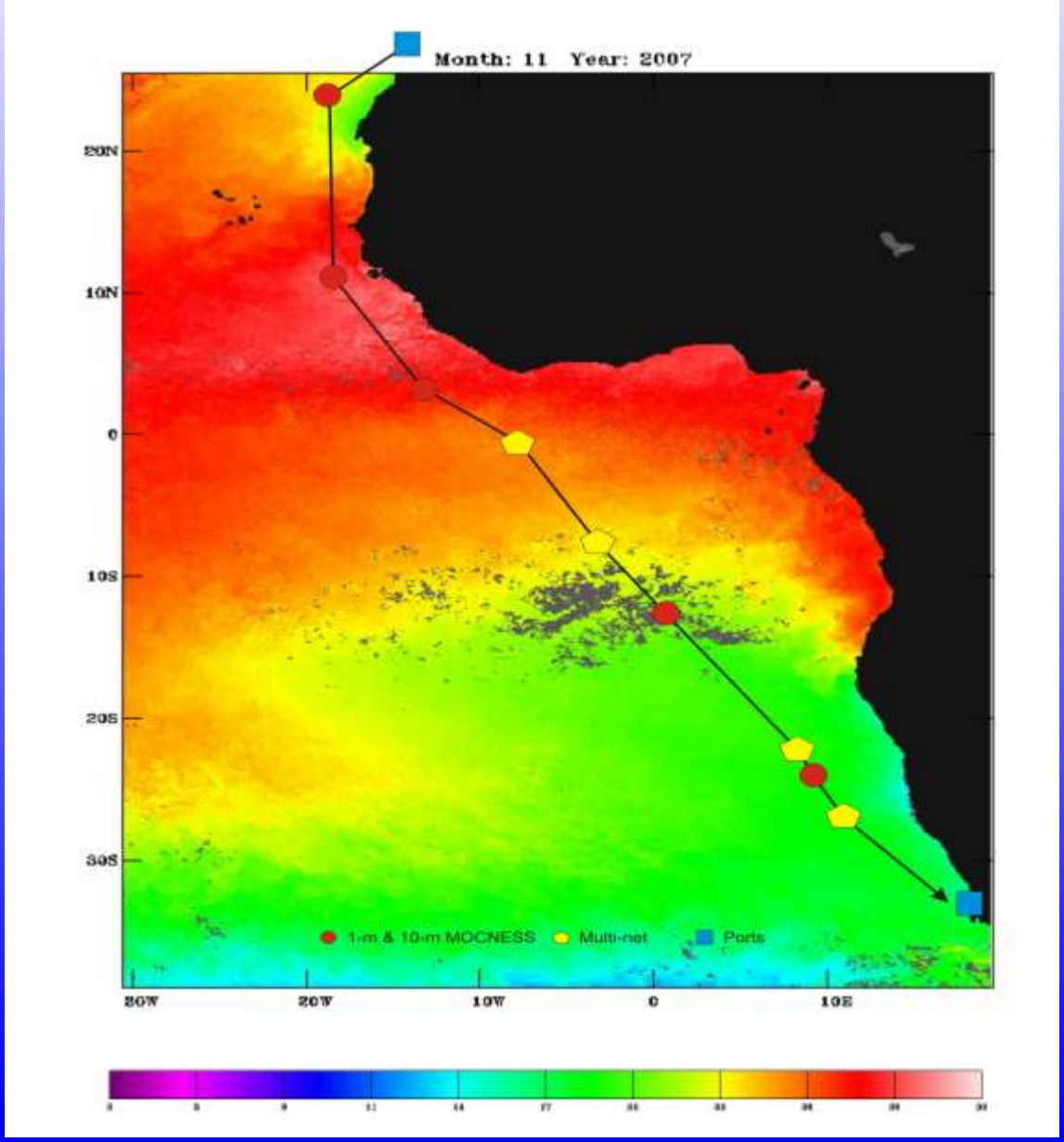


CMarZ Ocean Exploration cruises

Sea Surface Temperature Conditions in November 2007

A transect extending from the Northwest Africa to Cape Town, South Africa was sampled during a 21 day period.

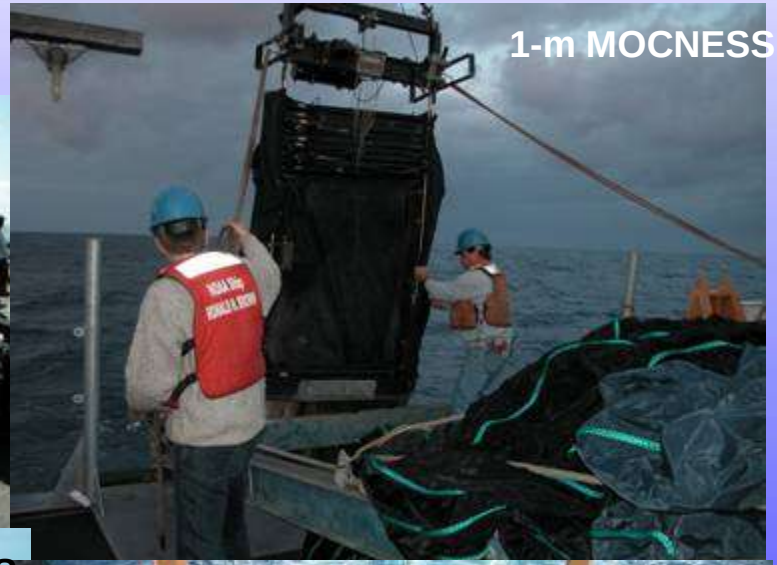
Comprehensive surface-to-bottom sampling at four major stations extending from the north of the equator to the South of of the Walvis Ridge.



SST from http://poet.jpl.nasa.gov/

CMarZ Ocean Exploration Cruise

Net Systems Used On Ron Brown to Collect Zooplankton


1-m MOCNESS


Ring Net

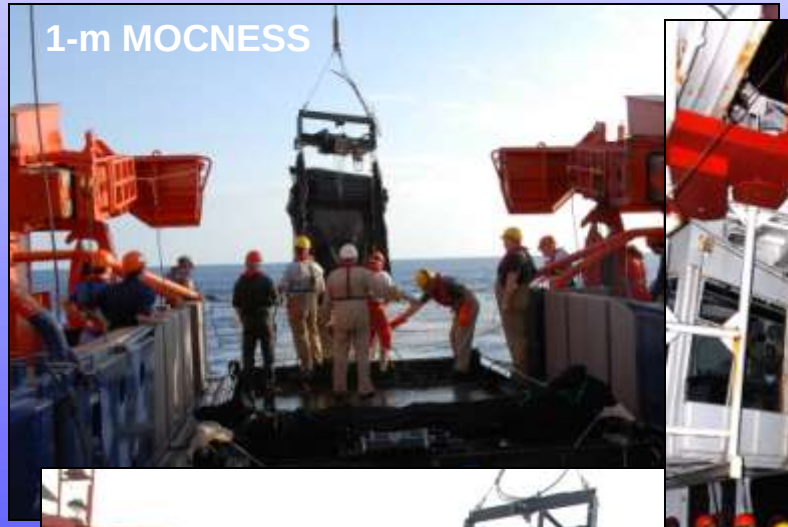

Apstein Net


¼-m MOCNESS


10-m and 1-m MOCNESS

CMarZ Ocean Exploration Cruise

Net Systems Used on Polarstern to Collect Zooplankton



CENSUS OF MARINE LIFE

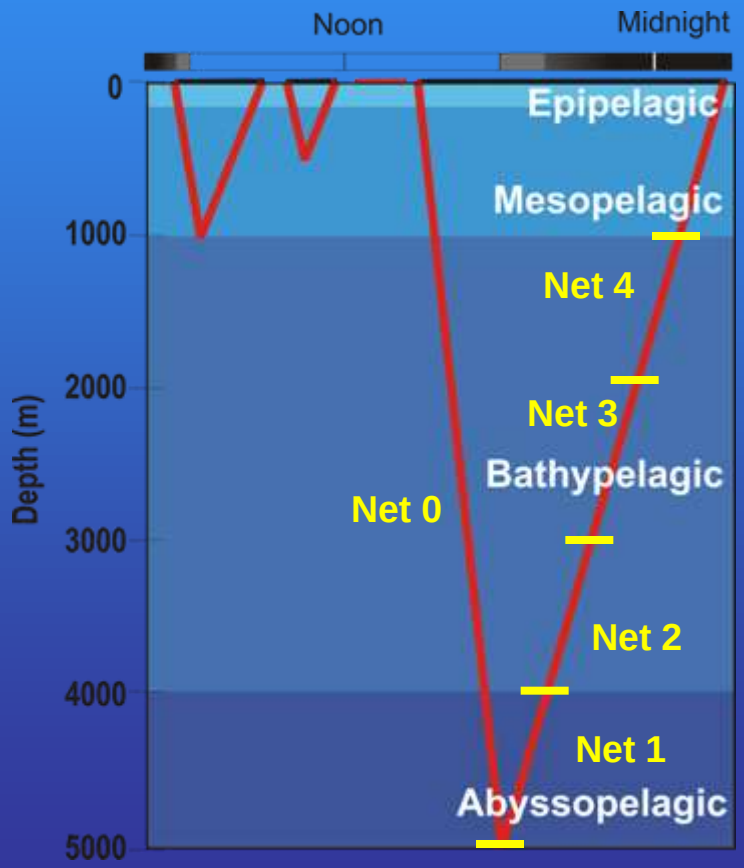
CMarZ Ocean Exploration Cruise

Net Systems Used on Polarstern to Collect Zooplankton

10-m
MOCNESS

CMarZ Ocean Exploration cruises

Deep-sea sampling to >5000m used a 10-m^2 trawl rigged with fine-mesh nets. Rare, small, deep-living zooplankton were captured and returned to the surface – in good shape for taxonomic analysis and DNA sequencing.



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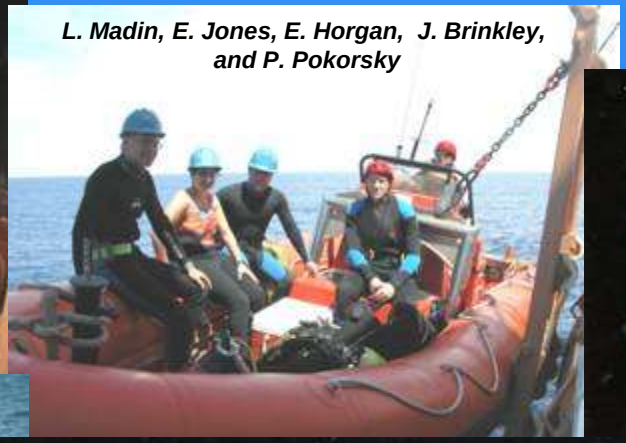
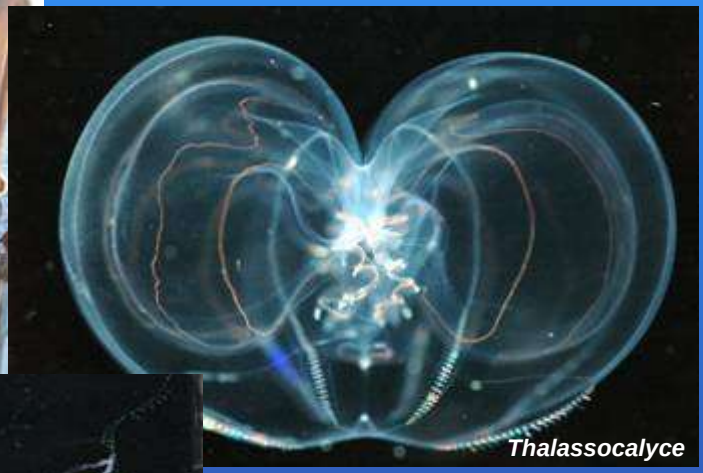
Day and Night Blue-Water Diving Done to Collect Zooplankton

L. Madin, E. Horgan, P. Pokorsky, and K. Plaskon

L. Madin, E. Jones, E. Horgan, J. Brinkley, and P. Pokorsky





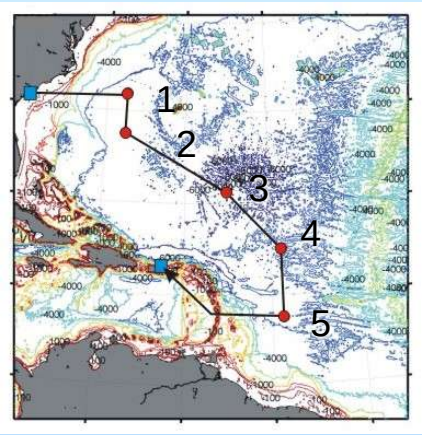
Thalassocalyce

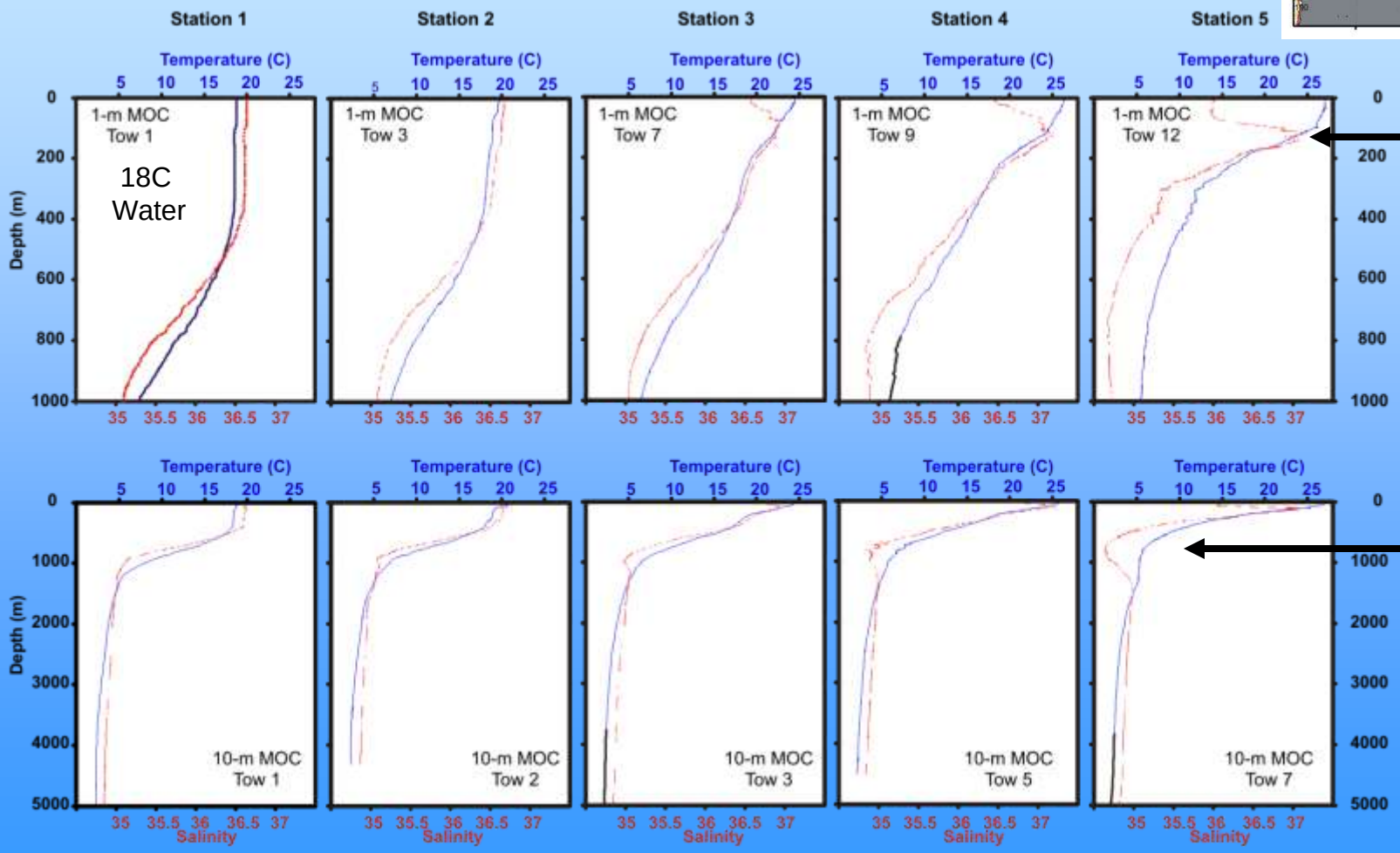
P. Pokorsky, E. Horgan, L. Madin, E. Jones, and J. Brinkleyand

Rhizophysa

CMarZ Ocean Exploration cruises

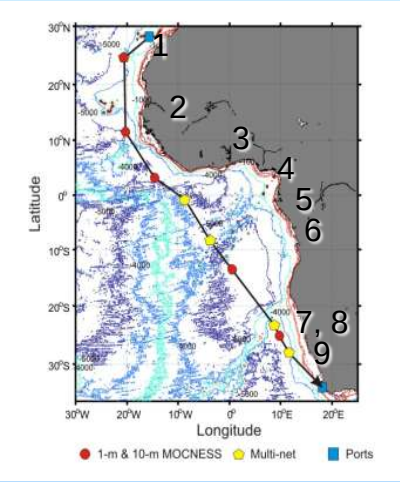
MOCNESS Environmental Data
R/V Ron Brown



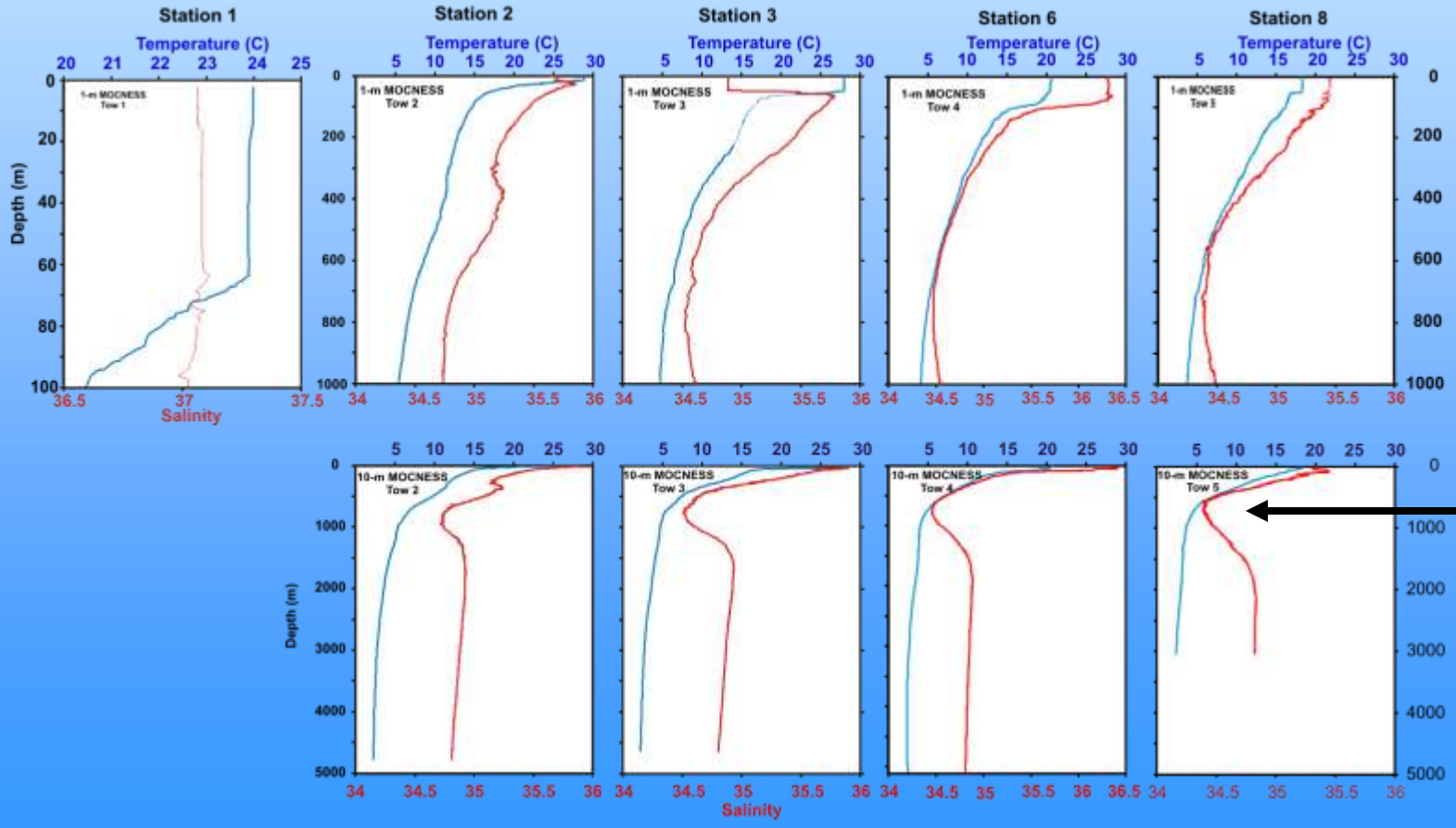


CMarZ Ocean Exploration cruises

MOCNESS Environmental Data



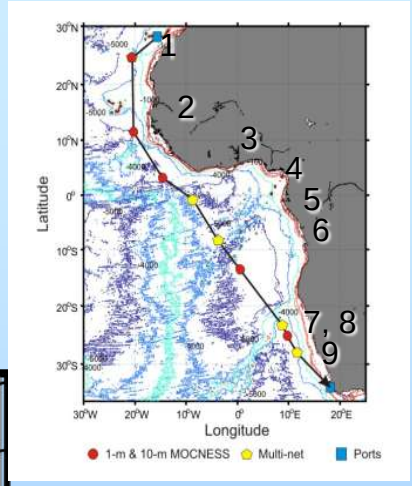
FS Polarstern ANT-XXIV/1



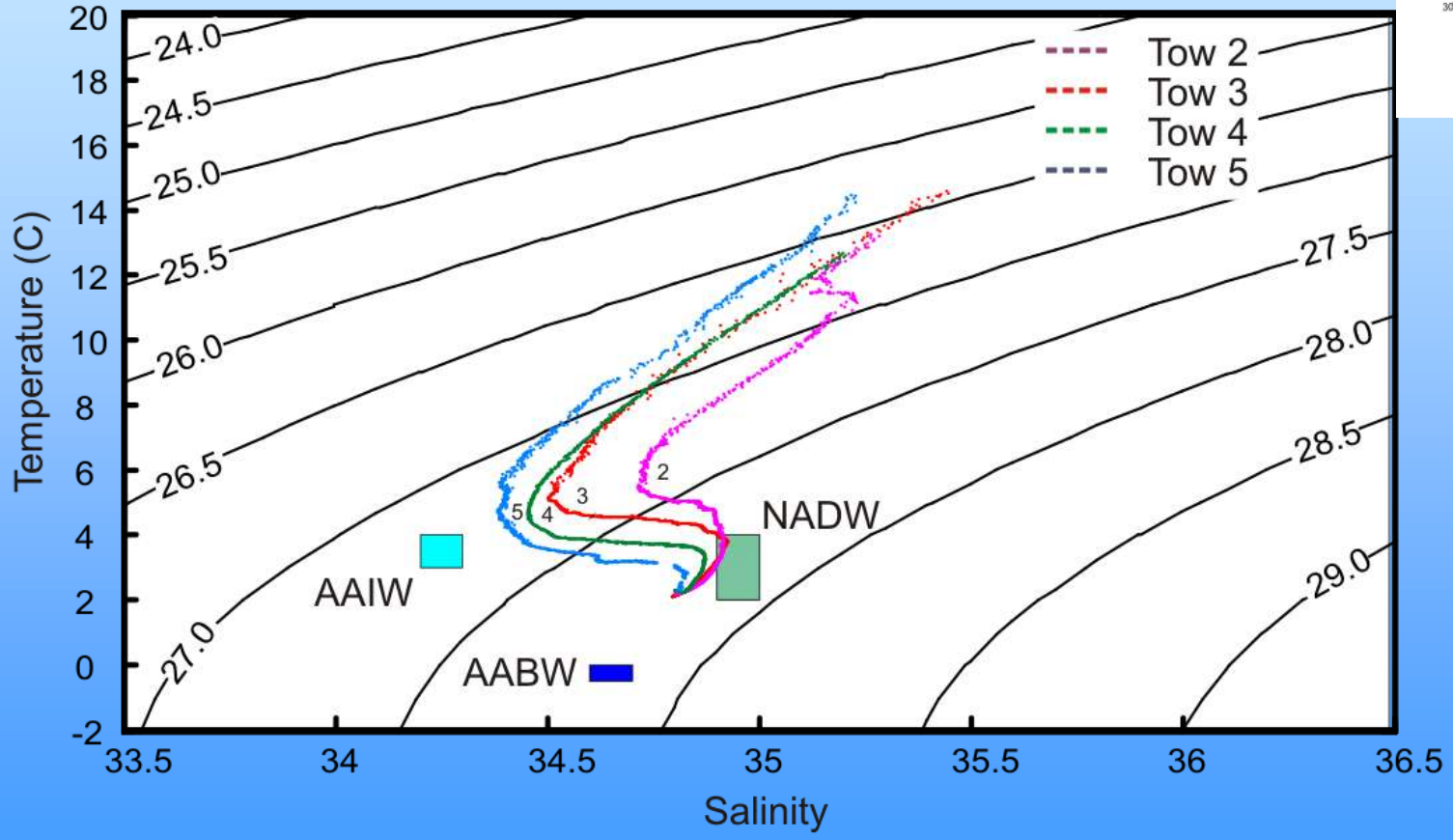
Antarctic Intermediate Water

CMarZ Ocean Exploration cruises

MOCNESS Environmental Data



FS Polarstern ANT-XXIV/1



AAIW =Antarctic Intermediate Water
AABW= Antarctic Bottom Water
NADW = North Atlantic Deep Water

CMarZ Ocean Exploration cruises

Draft Sample Handling Protocol

On Deck

1) Wash nets carefully.
2) Put cod-ends into numbered buckets with ice to keep samples cool.
3) Move buckets expeditiously into the walk-in cold room.
4) Samples logged in.

Stratified and Integrated Samples

In Wet Lab (1)

Three teams (Picker/Recorder)
Remove/Record large specimens of:

1) Gelatinous forms,
2) Fish
3) Macrozooplankton/nekton.

All specimens removed recorded in CMarZ Specimen Log

In Lab

Photo Imaging
Species Identification
Dissection/Preservation

Stratified Samples

In Wet Lab (2)

Splitter Team splits and preserves samples

½ split: (A) removed, sieved, preserved in formalin
½ split again to:
¼ split: (B) for live picking in main lab and then alcohol preserved for later taxonomic analysis.
¼ split: (C) preserved in alcohol.

Integrated Samples

In Wet Lab (2)

Splitter Team splits and preserves samples

½ split: (A) used for live picking, then preserved in alcohol.

½ split: (B) to formalin for later taxonomic analysis (preservation under hood)

Ship Laboratory Sample Analysis

Split (A) Archived after used for silhouette analysis.

Split (B) used for taxonomic analysis on board.

Split (C) used for archive.

In Lab

BARCODE vial with specimens
Extraction,
PCR,
Sequencing


Return to Surface


Hauling Net In


Removing Bucket


Admiring Catch


Cold-room Storage


Splitting Samples


Sorting Samples


Preserving Samples

CENSUS OF MARINE LIFE

CMarZ Ocean Exploration cruises

CMarZ

Investigators at Work on the Collections.

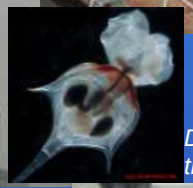

D. Lindsay


Streetsia challenger


M. Kuriyama, and H. Matsuura


R. Hopcroft


Histioteuthis


Diacria trispinosa


Lucicutia aurita

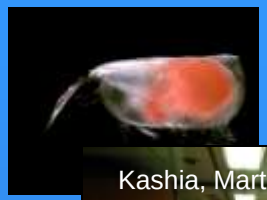

L. Devi and S. Panampunnayil

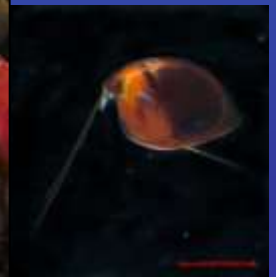

Valdiviella insignis


T. Sutton, H. Matsuura, F. Pages, Y. Ujiie, and P. Batta Lona

CMarZ Ocean Exploration cruises

Investigators at Work on the Collections.





CMarZ Ocean Exploration cruises

UConn "Team DNA" set up a DNA sequencing laboratory on board the *RV Ron Brown*.

Brian Ortman, Rob Jennings, Paola Batta Lona, Ebru Unal, Leo Blanco Bercial, Jason Beaudet

ABI 3130
4 capillary DNA sequencer

CMarZ Ocean Exploration cruises

"Team DNA" set up a DNA sequencing laboratory on board the *RVIB Polarstern*.

Christina Folkers, Paola Batta Lona, Leo Blanco Bercial, Lisa Nigro, Rob Jennings, Ann Bucklin, Chris Sweetman

ABI 3130
4 capillary DNA sequencer

Deep-Sea Fish Collected Too

***Stylephorus chordatus* juvenile (25 mm SL), composite photo. T. Sutton April 2006.**

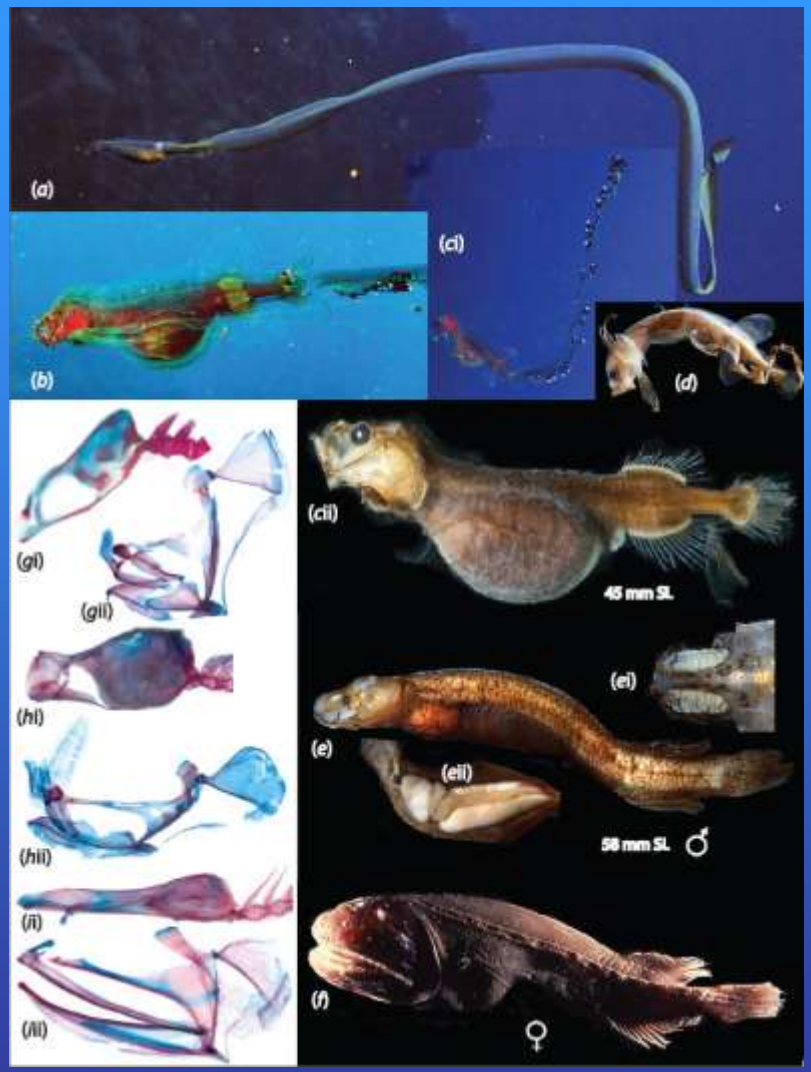
RHB - 3,965 fish specimens collected with at least 127 species (84 genera in 42 families) identified.

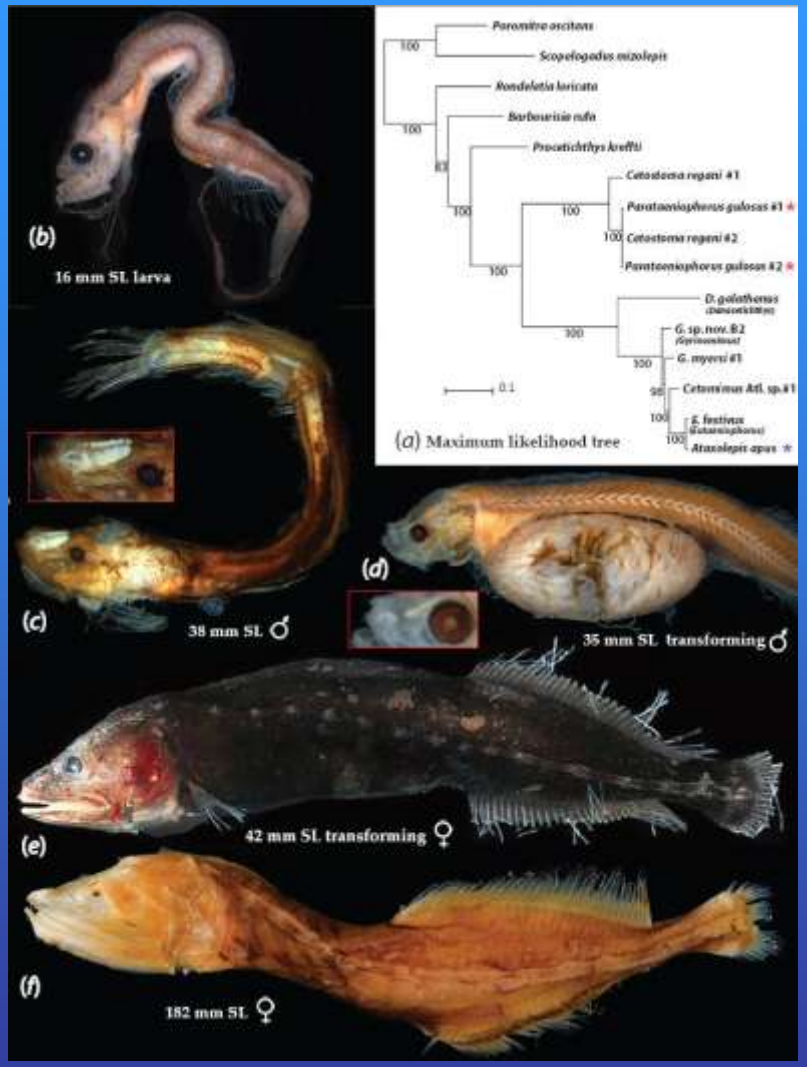
PS - 1,778 fish specimens collected with At least 118 species (78 genera in 36 families) Identified.

Tracey Sutton (HBOI).

Note: bioluminescence isn't know for this fish species/family. So what is the structure at the end of the elongated caudal ray?

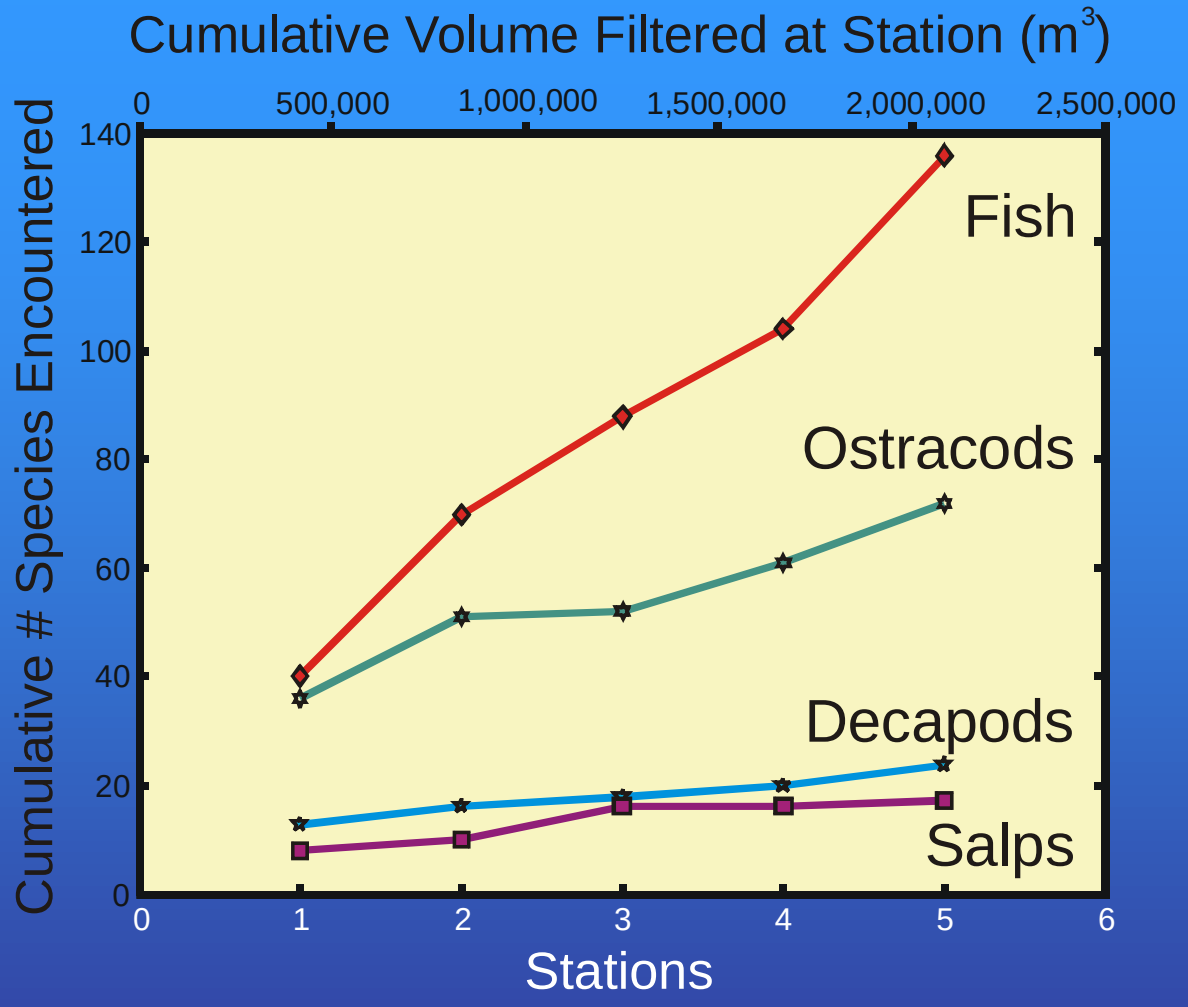
Deep-Sea Fish Collected Too





Fishes currently assigned to three families with greatly differing morphologies, Mirapinnidae (tapetails), Megalomycteridae (bignose fishes) and Cetomimidae (whalefishes), are larvae, males and females, respectively, of a single family Cetomimidae.

Johnson, G.D., J.R. Paxton, T.T. Sutton, T.P. Satoh, T. Sado, M. Nishida, and M. Miya. 2009. Deep-sea mystery solved: astonishing larval transformations and extreme sexual dimorphism unite three fish families. RSBL. 5: 235-239.



For Groups where all species were sorted and identified in the samples, new species were still being added to the species list in spite of sampling very large volumes of water.

Summary

1) Sampling was successfully completed from 5000 m to the surface at 5 stations in the Western North Atlantic Ocean and 4 stations in the Eastern South Atlantic.

2) For several taxonomic groups, a significant fraction of the known species were collected and identified (e.g., Ostracods, Shelled Pteropods).

3) A number of species were not yet described in the scientific literature and are likely new species.

4) The teams of expert taxonomists identified more than 500 species and provided more than 1000 individuals to the DNA lab on the RB cruise, and 2,043 individual specimens were submitted for barcoding during the cruise with 338 definitively-identified species of zooplankton another 51 tentative species.

Summary

5) DNA sequencing was successfully carried out at sea by modifying standard protocols on both cruises.

6) The special deployment of trawls to sample large volumes at great depths for small zooplankton yielded preliminary confirmation that there is considerable species diversity at depth (with many more species yet to be captured and studied), but abundance/biomass is low.

www.cmarz.org

END

Solvin Photo