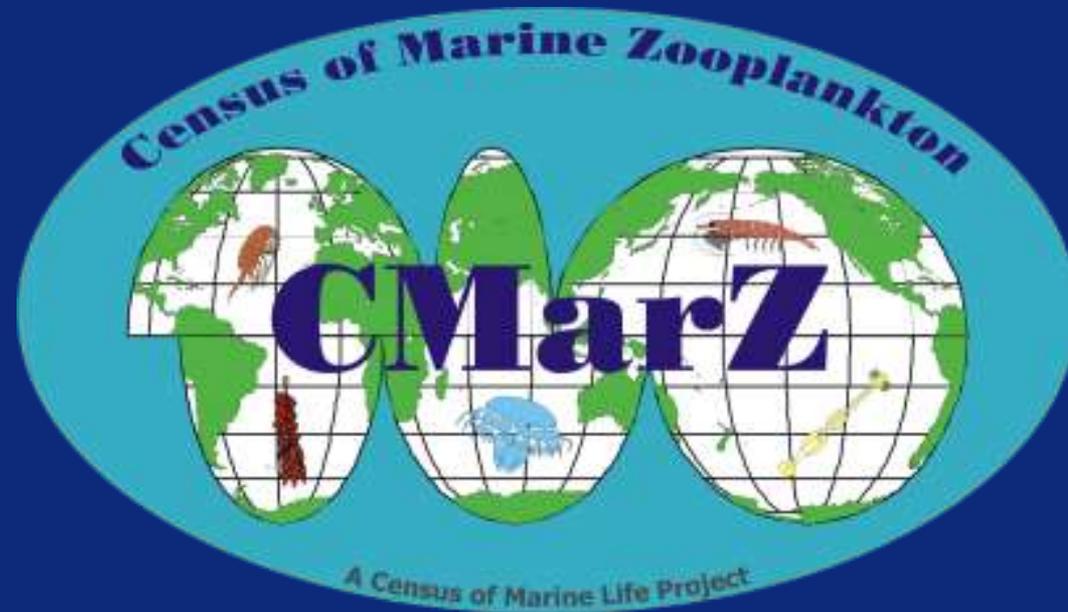
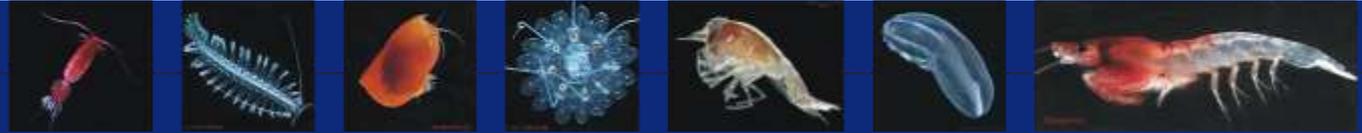


# Census of Marine Zooplankton



*Ann Bucklin*

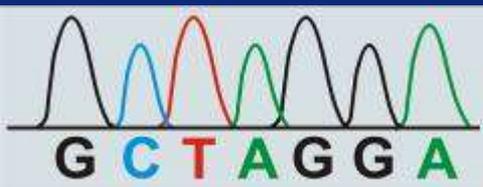
*University of Connecticut – Avery Point, USA*

*CMarZ Symposium and Steering Group meeting  
IOCAS, Qingdao CHINA – May 11-13, 2010*





***CMarZ Steering Group includes 23 people from 14 countries  
Shown here with Japanese colleagues at the University of Tokyo, Japan  
November, 2008***



- **Integrated morphological and molecular systematic analysis:** CMarZ cruises have included expert taxonomists and barcoders, who work together toward accurate descriptions of zooplankton species diversity, including discovery and description of new species.
- **Global surveys:** CMarZ Steering Group members have worked to achieve global sampling from ships of opportunity and dedicated cruises.
- **Biodiversity hotspots:** CMarZ has focused on biodiversity hotspots (areas of high probability for species discovery) in the deep sea, coastal regions of Southeast Asia, and other under-sampled ocean regions.

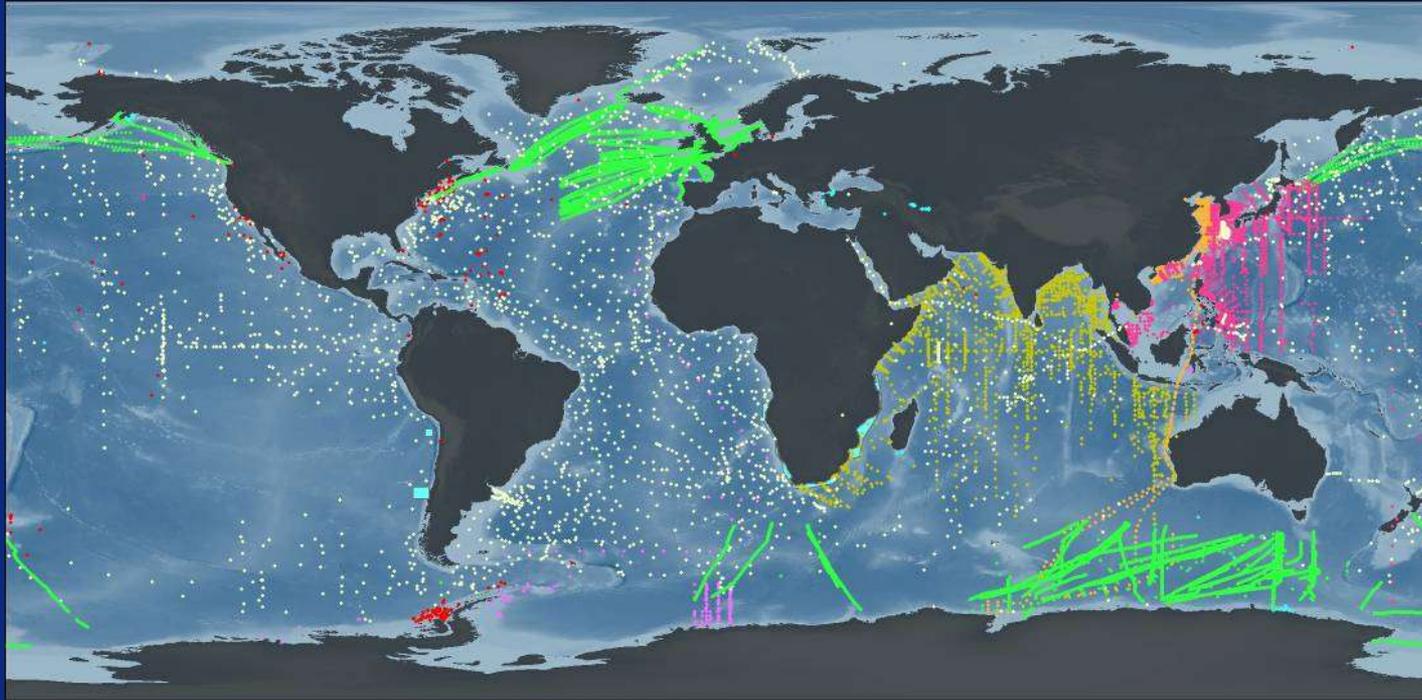


# Zooplankton Diversity

Phylum		Taxon		Species
1	Foraminifera	1	Foraminifera	49
2	Actinopoda	2	Acantharea	150
		3	Polycystinea (Radiolaria)	350
3	Cercozoa	4	Phaeodarea (Radiolaria)	350
4	Ciliophora	5	Aloricate Ciliata	150
		6	Tintinnida	300
5	Cnidaria	7	Hydromedusae	842
		8	Siphonophora	160
		9	Cubomedusae	18
		10	Scyphomedusae	161
6	Ctenophora	11	Ctenophora	90
7	Rotifera	12	Rotifera	50
8	Platyhelminthes	13	Platyhelminthes	3
9	Nematomorpha	14	Nectonema	5
10	Nemertea	15	Nemertinea	99
		16	Polychaeta	110
12	Mollusca	17	Gastropoda	144
		18	Cephalopoda	370
		19	Cladocera	8
13	Arthropoda	20	Ostracoda	169
		21	Isopoda	20
		22	Copepoda	2000
		23	Mysidacea	700
		24	Amphipoda	400
		25	Euphausiacea	86
		26	Decapoda	50
		27	Insecta	5
		28	Chaetognatha	93
		15	Chordata	29
30	Pyrosoma			8
31	Doliolida			17
32	Salpidae			45
	<b>TOTALS</b>			



*Since 2004, CMarZ has completed more than 90 cruises and collected samples from > 12,000 stations; 6,500 archived samples have been available for analysis.*



- |                                    |                                    |
|------------------------------------|------------------------------------|
| ● V. Nair (NIO, India) *           | ● S. Schnack-Schiel (AWI, Germany) |
| ● D. Boltovskoy (UBA, Argentina) * | ● P. Wiebe/L. Madin (WHOI, USA)    |
| ● P.C. Reid (SAHFOS, UK)           | ● S. Nishida (ORI, Japan)          |
| ● S. Sun (IOCAS, China)            | ● Others                           |

\* Historical collections

*CMarZ has carried out comprehensive biodiversity surveys, with at-sea taxonomic analysis of samples, photography of living specimens, and DNA barcoding.*

Taxonomic Analysis

R. Hopcroft



M. Kuriyama & H. Matsuura



U. Piatkowski & H. Ossenbrügge  
(left); P. Batta Lona (below)



DNA Barcoding at Sea

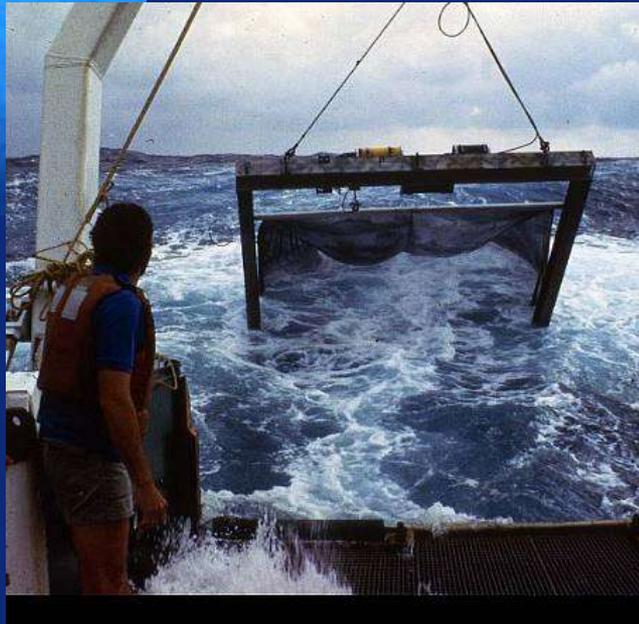


PCR machines

ABI 3130 Capillary Sequencer

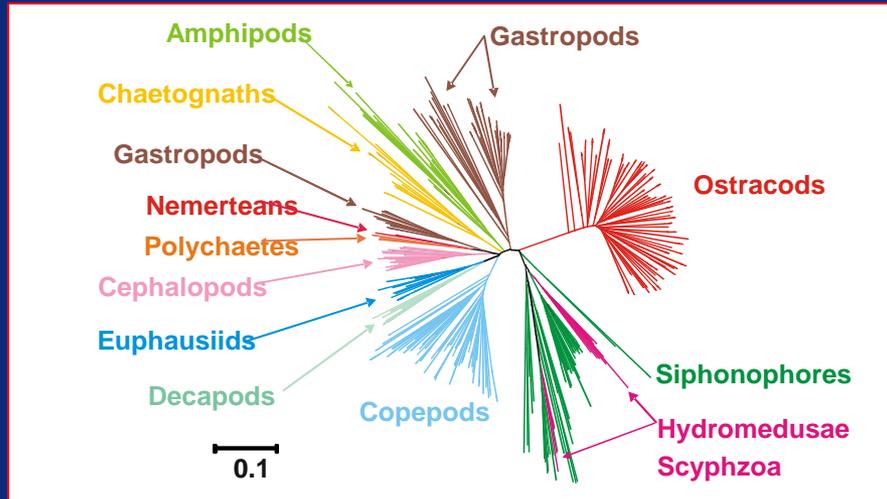


B. Ortman & P. Batta Lona

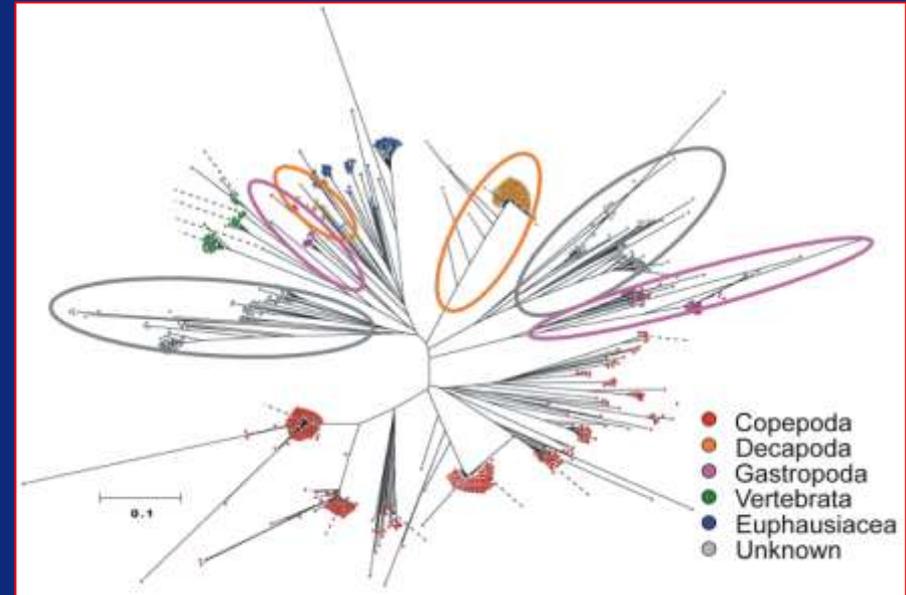


**Gold standard barcoding (determination of ~548 base-pair sequence of mtCOI from identified specimens) will yield a ROSETTA STONE for identification of zooplankton species.**

**Environmental barcoding of zooplankton (sequencing of COI from bulk environmental samples) allows rapid biodiversity assessment; species are identified using barcode library.**



**Sargasso Sea barcodes: Bucklin, Ortman, et al. Rosetta Stone for zooplankton (2010) Deep-Sea Research II**



**Barcodes for sample from Pohnpei Island, Micronesia, Equatorial Pacific Ocean: Machida Hashiguchi, et al. (2009) BMC Genomics**



*Hippopodius hippopus*



*Limacina helicina*



*Salpa cylindrica*



➤ *CMarZ new species descriptions (published):*

Phylum	Group	New Species	New Genus	New Family
<i>Cnidaria</i>	<i>Hydromedusae</i>	2	1	1
	<i>Narcomedusae</i>	1	1	
	<i>Siphonophores</i>	1		
	<i>Scyphomedusae</i>	2		
<i>Arthropods</i>	<i>Amphipods</i>	1		
	<i>Copepods</i>	19	1	
	<i>Ostracods</i>	3		
	<i>Mysids</i>	49	1	
<i>Annelids</i>	<i>Polychaetes</i>	1		
<i>Chaetognaths</i>		2		
<b>TOTALS</b>		<b>81</b>	<b>4</b>	<b>1</b>



Russ Hopcroft & Dhugal Lyndsay



Janet Bradford Grieve



Martin Angel



D. Boltovskoy

➤ *Estimated new species 'discovered' = over 100.*

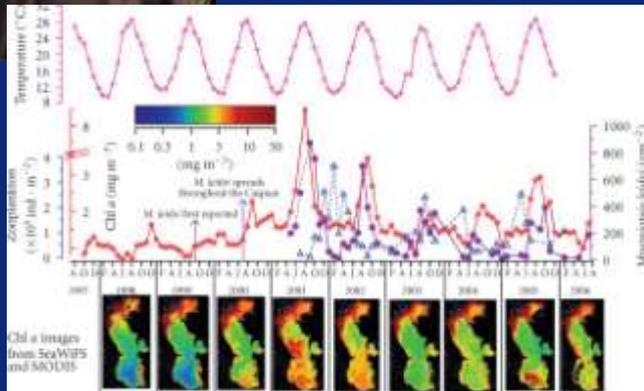
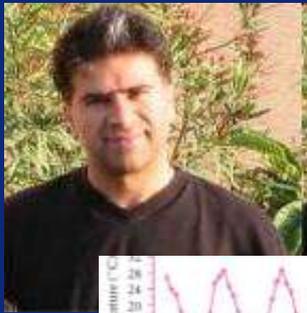
➤ *Group-by-group analyses include:*

- *Handbook of the Radiolaria*. Monographic publication now in press. [Demetrio Boltovskoy]
- *Taxonomy, phylogeography, and phylogeny of chaetognaths*. [Annelies Pierrot-Bults]
- *Atlantic atlas for the planktonic ostracods*: Publ. on NHM (London, UK) website. [Martin Angel]



## Ballast Water in Argentine Ports:

Transoceanic ships' ballast water was monitored; salinity is measured; plankton samples are collected and distributed among 10 specialists in various taxonomic groups for identification of freshwater and marine zooplankton. [Demetrio Boltovskoy - Argentina]



## Impacts of a Marine Bioinvasion:

Sampling from the Caspian Sea showed striking impacts of the invasive predatory ctenophore *Mnemiopsis leidyi*. Satellite-derived chlorophyll-a concentration was significantly correlated with ctenophore biomass. By consuming grazing zooplankton, *M. leidyi* may have caused levels of Chl a to rise to record high values (9mg /m<sup>3</sup>). [Ahmet Kideys - Turkey]



*JSPS-CMarZ Training Course, Univ. Philippines, Los Baños, Dec. 2004*



*Asahi Press, Jan. 2010*



*Rosamma Stephen at AWI, July 2006*

CMarZ has organized >358 E&O events attended by >1,400 people, excluding television audiences. Activities have included:

- Advanced training in taxonomy and DNA barcoding for researchers,
- Field trips for elementary school students,
- Newspaper and magazine articles for the general reader.

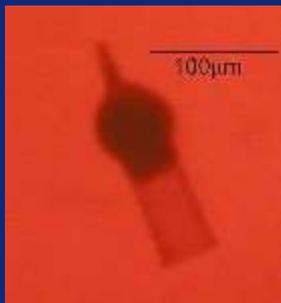
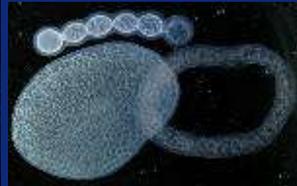
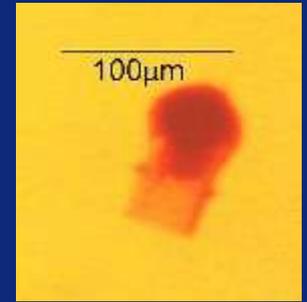




Image credit: NOAA/CI



Image credit: NOAA/CI

- 1. CMarZ Symposium**
  - New results and findings
  - New perspectives and analysis
- 2. CMarZ Synthesis**
  - Sample collection and analysis
  - Data collection and analysis
  - Reports and publications
  - Education and outreach
  - Communications
- 3. CMarZ Synthesis Products and Plans**
- 4. Planning for CoML finale and CMarZ wrap-up**
  - Posters and presentations
  - Proposals for new funding and next steps

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