

Census of Marine Zooplankton (CMarZ)

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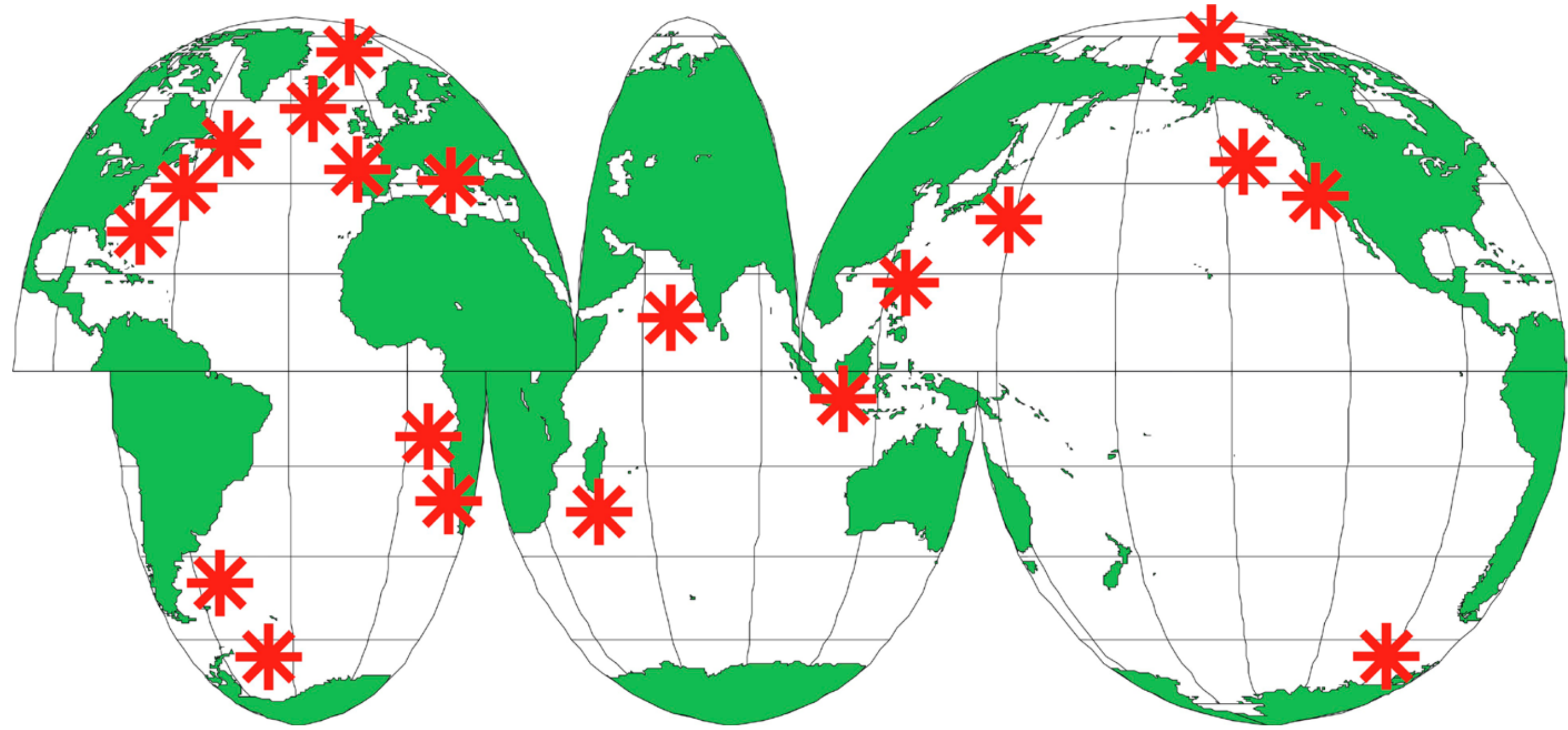
Abstract

Launched in 2004, the Census of Marine Zooplankton (CMarZ) is working toward a taxonomically comprehensive assessment of biodiversity of animal plankton throughout the world ocean. Zooplankton species diversity, biomass, and biogeographical distributions are being described with integrated morphological, ecological, and molecular genetic analysis by CMarZ Network members. The zooplankton assemblage currently includes ~6,800 described species in fifteen phyla; we expect discovery of many new species as a result of our efforts. CMarZ is analyzing biodiversity from diverse regions of the world oceans using existing samples and new collections from ships of opportunity and dedicated cruises for comprehensive coordinated analysis of the zooplankton assemblage. During 2005, three CMarZ Project Offices opened and 15 CMarZ cooperating projects were launched to sample throughout the oceans, with additional projects focused on database and website design. The CMarZ database—with Species Pages—was designed. The CMarZ Network is growing to include researchers (including taxonomic experts), technical staff, and students needed to analyze the many zooplankton samples.

Species diversity—known and unknown—of holozooplankton

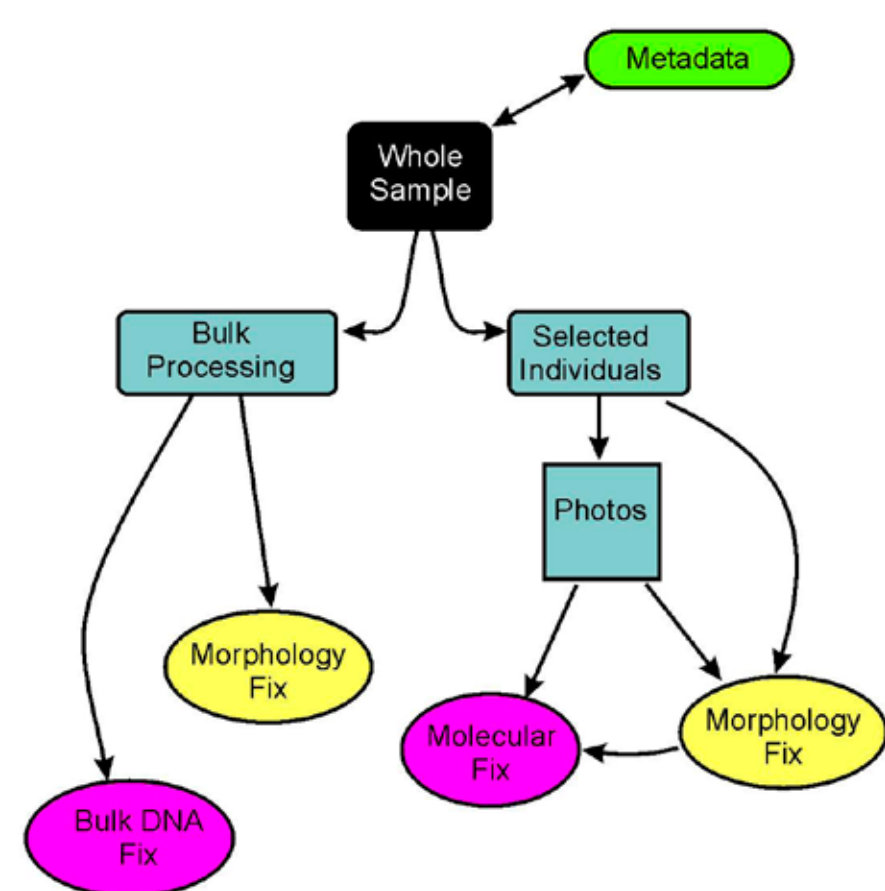
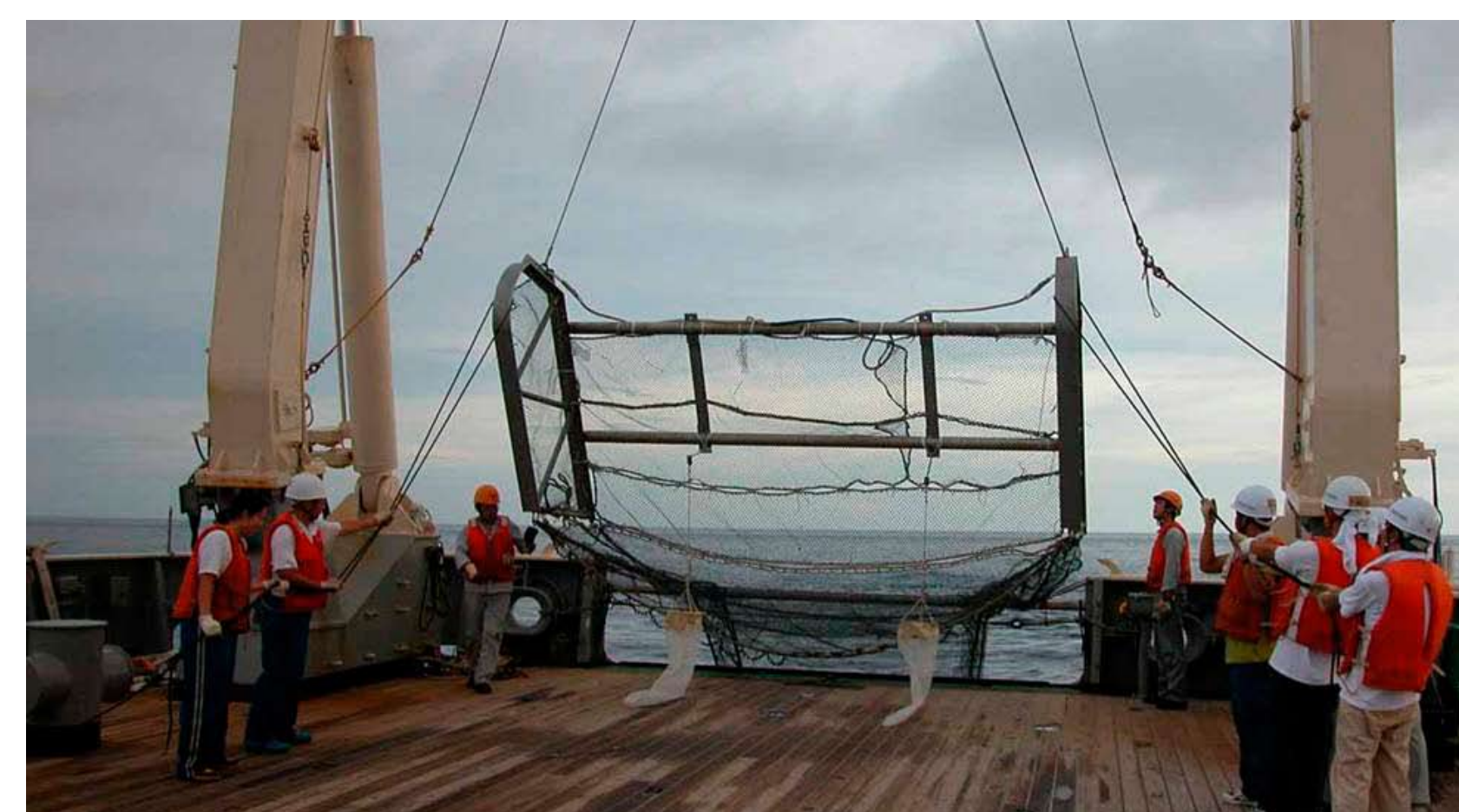
Phylum	Group	# described species	# new species
	Group	# sp known	# sp new
Foraminifera	Foraminifera	49	100-300
Actinoptera	Acantharea	150	
	Polycystina (rads)	350	
Cerczoa	Phaeodarea (rads)	350	
Ciliophora	Aloricate ciliata	150	Many
	Tintinnida	300	
Cnidaria	Hydromedusae	842	many
	Siphonophora	160	~100
	Cubomedusae	18	
	Scyphomedusae	161	
Ctenophora	Ctenophora	90	50-150
Rotifera	Rotifera	507	
Platyhelminthes	Platyhelminthes	37	
Nematomorpha	Nectonema	5	?
Nemertea	Nemertina	99	35+
Annelida	Polychaeta	110	25+
Mollusca	Heteropoda	29	
	Pteropoda	109	
	Nudibranchs	6	
	Cephalopoda	370	
Arthropoda	Cladocera	8	~5
	Ostracoda	169	200-400
	Isopoda	20	
	Copepoda	2000	1000-2000
	Mysidacea	700	
	Amphipoda	410	
	Euphausiacea	86	10-20
	Decapoda	50	
Chaetognatha	Chaetognatha	93	25-200
Chordata	Appendicularia	64	30+
	Pyrosoma	8	10
	Doliolida	17	10
	Saliidae	45	5-10
	TOTAL	7061	>1605

CmarZ Cooperating Projects 2004–2006



CmarZ began sampling from ships of opportunity and planned oceanographic research cruises. During 2004–2006, more than 20 field programs will sample for CMarZ.

Sample splitting and preservation for CMarZ



Zooplankton are collected in many different types of nets and trawls. Samples must be handled carefully and rapidly to prevent damage to specimens and preserve tissues for molecular analysis. Samples are typically split to provide specimens for traditional taxonomic analysis and DNA barcoding.

Collection of zooplankton for CMarZ



CMarZ cooperating projects involve sampling from small boats (Manila Bay, left) and from large oceanographic research vessels (R/V Polarstern in Antarctic waters during a CMarZ Cooperating Project cruise).

The Known, The Unknown and The Unknowable

The Known: Humans have mapped the oceans, charted the currents and faunal boundaries, and defined biogeographical provinces (e.g., rich fishing grounds) since the earliest sea voyages. The voyage of the HMS Challenger (1873 – 1876) was one of the earliest attempts to record global patterns of biological, chemical, and physical properties in the oceans. Our current understanding of global patterns of pelagic biodiversity results from decades of work by oceanographers, ecologists, and taxonomists. Our knowledge is most complete for those species inhabiting the upper 100-200 m of the oceans and for coastal waters.

The Unknown: There has never been a taxonomically-comprehensive, global-scale assessment of biodiversity of marine zooplankton. Compared to the dimensions of the known—in terms of numbers of species and regions of the world oceans—the unknown is thought to be many times larger than the known.

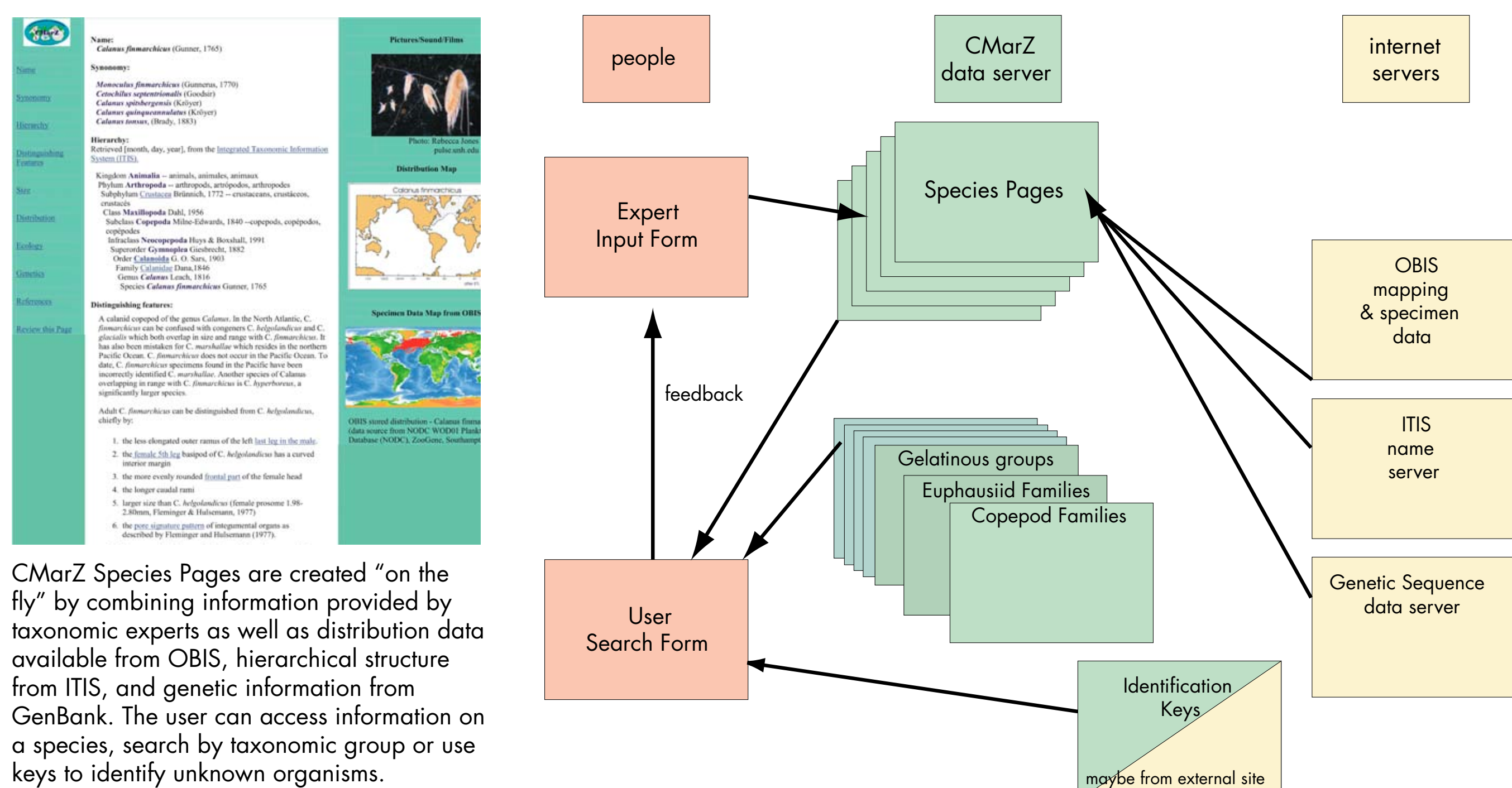
The Unknowable: The global ocean may remain unknowable because of its size and because of the interplay of time/space scales of variability in this complex environment. Even with anticipated technological advances, it may never be possible to obtain a synoptic top-to-bottom and pole-to-pole view of the world ocean.

The CMarZ Overarching Question

*What are the Patterns of Zooplankton Biodiversity throughout the world ocean, and how are they generated and maintained?**

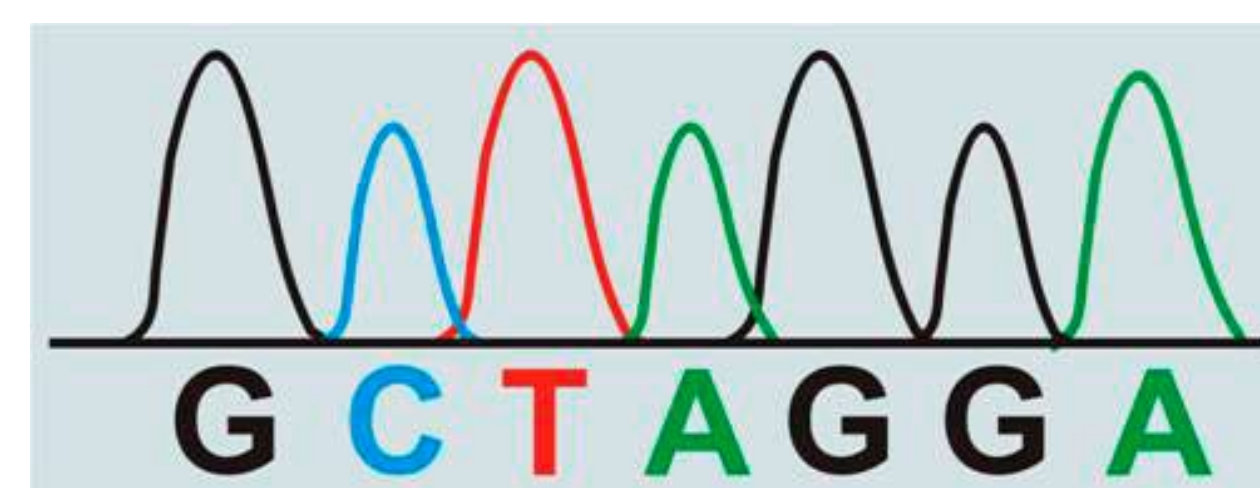
*CMarZ (2004) Science Plan for the Census of Marine Zooplankton. Unpublished report from a Census of Marine Life workshop held 17–22 March 2004 in Portsmouth NH, supported by the Alfred P. Sloan Foundation.

Sample Species Page and Architecture

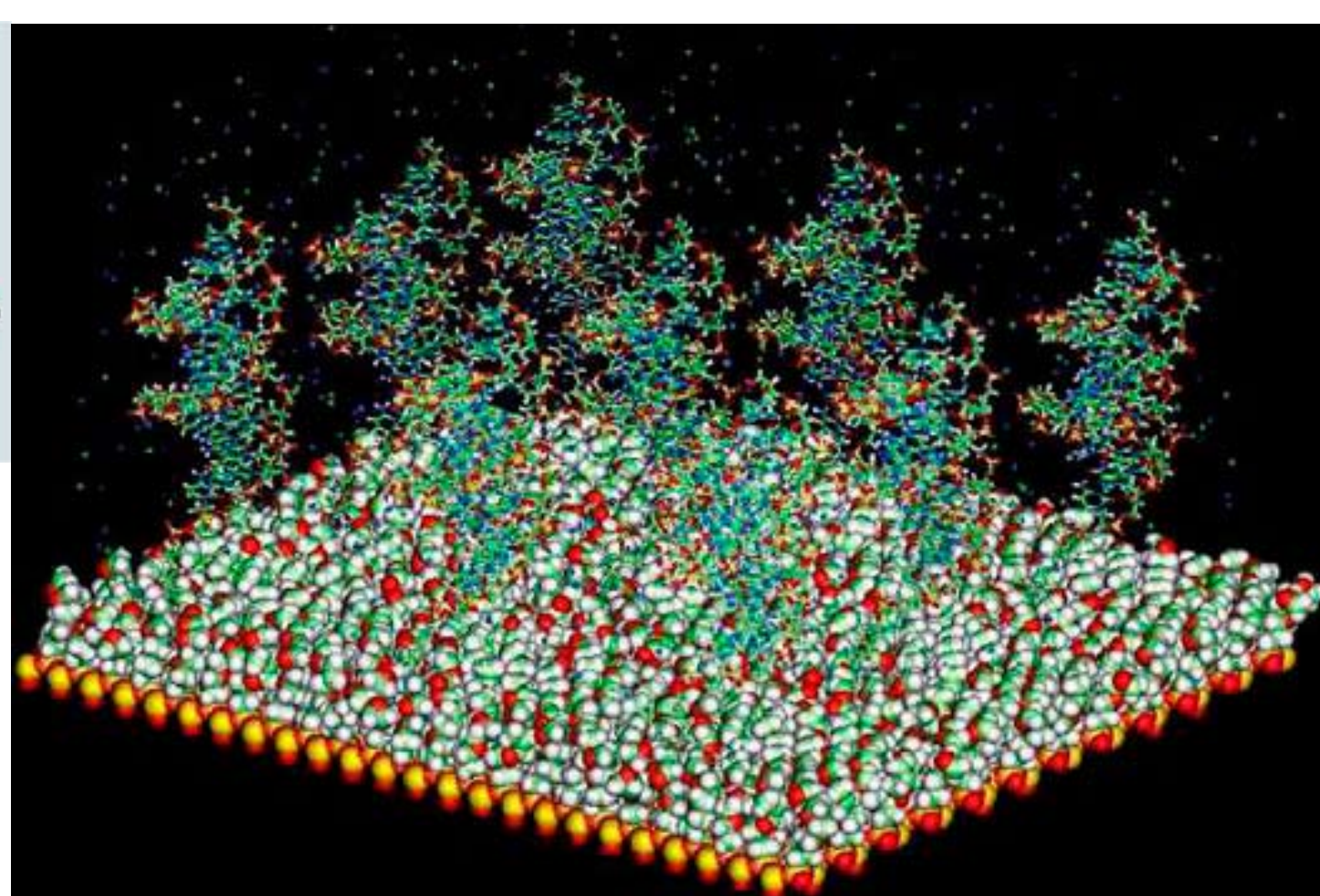


CMarZ Species Pages are created “on the fly” by combining information provided by taxonomic experts as well as distribution data available from OBIS, hierarchical structure from GenBank, and genetic information from GenBank. The user can access information on a species, search by taxonomic group or use keys to identify unknown organisms.

DNA Barcoding for CMarZ



DNA reference sequences—DNA barcodes—provide additional taxonomic characters for species identification, and may provide the basis of rapid, automatable protocols for species identification on DNA microarrays or “chips”. DNA barcodes can be used to identify unknown individuals for which a DNA sequence is already available in the database, but are not 100% reliable for classifying unknown species that are not in the database.

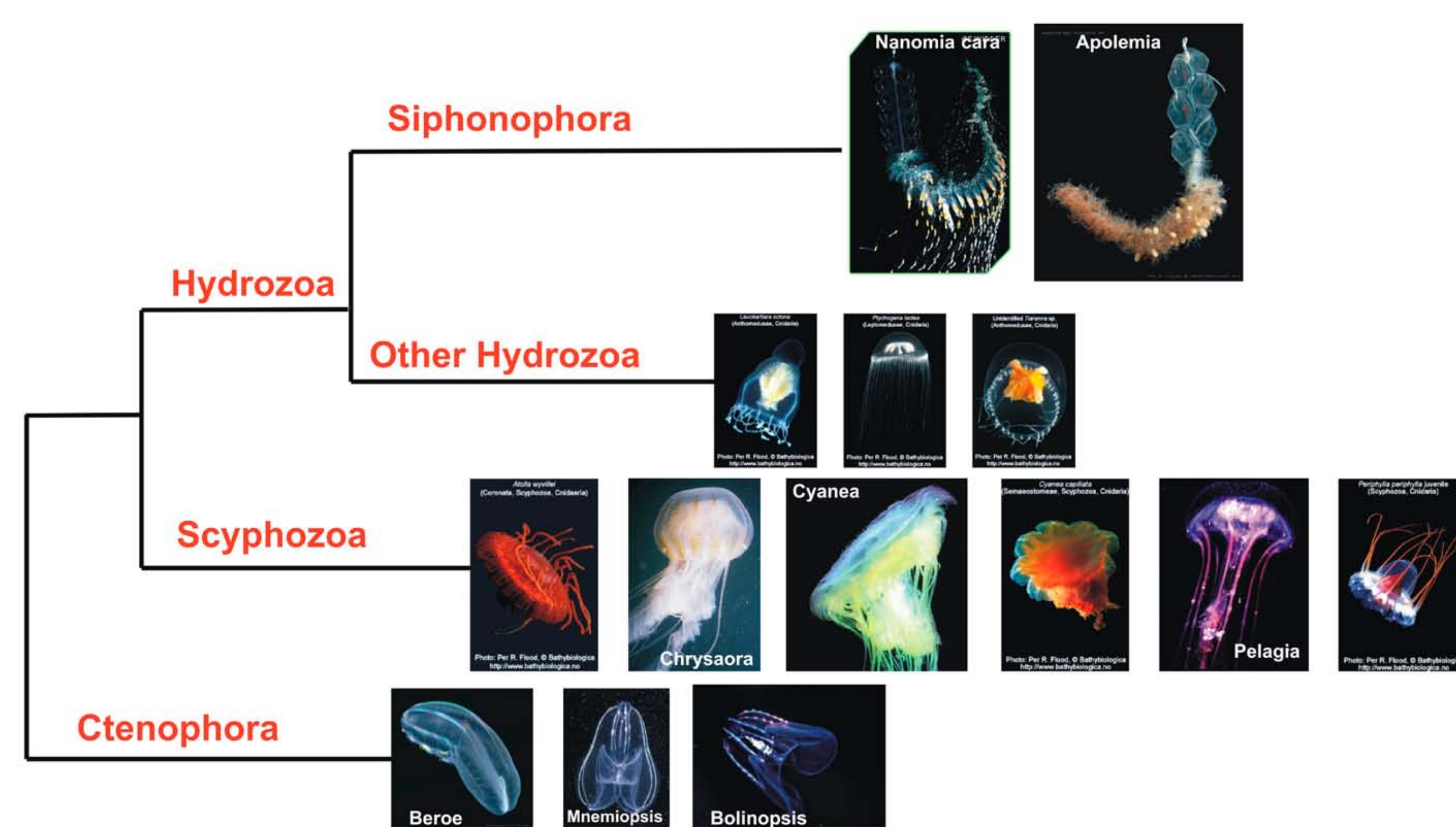


CMarZ Taxonomic Training Workshops



Undergraduate education and graduate training in zooplankton ecology and taxonomy are achieved through CMarZ workshops. Shown are workshops in the Philippines (left) and at sea in Monterey Bay, California USA (right)

DNA Barcoding Gelatinous Zooplankton



We are using a suite of genes for phylogeographic and phylogenetic analysis of gelatinous zooplankton. Our studies show that mtCOI can be used to barcode species of Cnidaria (excluding Anthozoa) and Ctenophora. Molecular systematic analysis of regional assemblages of gelatinous zooplankton serve as a baseline for recognizing species invasions, faunal shifts, and status of ecosystem health.

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