CMarZ cooperating projects

A. Funded cooperating projects

A1. Banda Sea (Indonesia) water column inventory (Larry Madin): Zooplankton samples will be collected during an expedition to the Banda Sea, Indonesia in the spring of 2005. Funded by NOAA Ocean Exploration and the National Geographic Society, this project, titled "A Vertical Inventory of Marine Life in the Banda Sea", will include sampling throughout the water column for zooplankton and nekton, using nets, trawls, ROV with suction sampler, baited cameras and SCUBA diving. The Indonesian archipelago is considered a center of marine biodiversity, but relatively little work has been done on the fauna of the water column. Support from CMarZ will be used for distribution of specimens to appropriate experts (sample containers, shipping, communications) and payment for their services (outside services). These are expenses not covered by existing expedition funding.

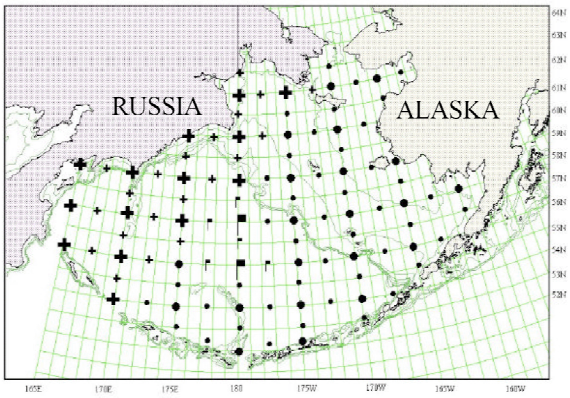

Figure 9. Station locations for BASIS surveys during 2002-2006.

A2. Coastal biodiversity in Southeast Asia - plankton (Shuhei Nishida): This international collaboration will include Japan, Thailand, Malaysia, Indonesia, Philippines, and Vietnam. The field studies will focus on zooplankton diversity, abundance, and community structure, as well as biodiversity and biogeochemical cycling in coastal waters of Southeast Asia, and marginal basins such as the Sulu Sea and Celebes Sea. Cruises will use the RV Hakuho-maru (requested for 2007) among others. The project will host a training course and workshop, and produce a practical manual, illustrated keys, and species lists.

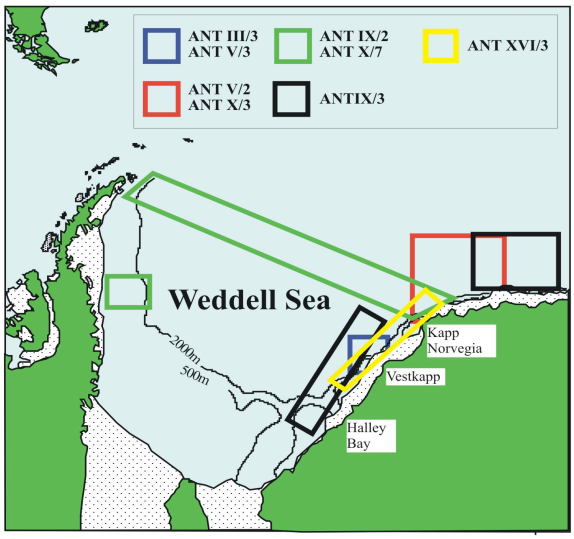

Figure 10. ISPOL Weddell Sea cruise areas.

A3. Science for the Protection of Indonesian Coastal marine Ecosystems (SPICE) (Sigrid Schiel): This cooperation project between Indonesia and Germany has support from the German Federal Ministry of Education and Research for 2004-2007. The study site is Spermonde Archipelago, Strait of Makassar, SW Sulawesi. In association with the Hasanuddin University (Makassar, Sulawesi), research topics include zooplankton diversity, distribution, abundance, community structure, and benthic-pelagic coupling. Sampling will be done with small plankton nets (Apstein, Nansen), with phytoplankton collection and hydrographic analysis.

A4. BASIS zooplankton sample analysis (Russ Hopcroft): The Bering-Aleutian Salmon International Survey (BASIS) (http://www.afsc.noaa.gov/abl/occ/basis.htm) is an ongoing program developed by the North Pacific Anadromous Fish Commission (NPAFC), whereby Canada, Japan, Russia, and the US conduct long-term, large-scale ecosystem research on salmon in the Bering Sea. There are four cruises each year during 2002-2006 covering much of the Bering Sea region (Fig. 9). Samples could be collected for CMarZ, although funding is needed for more detailed taxonomic analysis. This project is expected to be followed by the Bering Sea Ecosystem Study (BEST) (http://www.arcus.org/bering/), which will also examine the ecology of the Bering Sea with zooplankton, including gelatinous forms.

A5. Ice Station Polarstern (ISPOL) (Sigrid Schiel): This international, multidisciplinary Antarctic expedition is taking place in the Weddell Sea from the *Polarstern* during November 2004 - January 2005 (Fig. 10). Zooplankton development in and under ice will be studied, with vertically-stratified sampling to 1000 m, and deeper where possible.

A6. Eastern Atlantic meso-zooplankton diversity in the euphotic zone (Steve Hay): This survey will cover the European continental shelf edge, from northern Bay of Biscay along the west coast of Ireland to northeast of Shetland. To be carried out during Scottish ICES mackerel egg surveys in 2004, these surveys will allow study of zooplankton biodiversity in the northeast Atlantic and European shelf seas. There will be opportunities for concurrent sampling for CMarZ.

A7. Long term investigations on zooplankton biomass and distribution in Icelandic waters in relation to marine climate (Astthor Gislason, with Olafur S Astthorsson and Hildur Petursdottir, Marine Research Institute, Reykjavik, Iceland): The geographical coverage of the Icelandic Marine Research Institute (MRI) zooplankton monitoring, including both Atlantic and Arctic water masses, provides important opportunities to examine species distributions and species composition in relation to the environment and biodiversity. Begun in 1960, the MRI spring survey samples 100-120 fixed stations along 10-12 transects each year. Samples are routinely preserved in formalin, but can be otherwise preserved by special arrangement.

A8. IMR (Norway) research cruises (Webjørn Melle): The Institute of Marine Research (Norway) conducts research and survey cruises throughout the Nordic and Barents Seas each year. Collection and preservation of zooplankton samples for CMarZ scientists will be possible, subject to restrictions on time required for any special protocols. Vertically-stratified sampling for major zooplankton groups is routinely carried out. Sample preservation in formaldehyde and alcohol, and possibly liquid nitrogen, is possible.

A9. Ecosystem monitoring by the US National Marine Fisheries Service (David Mountain, NOAA, NMFS, NEFSC): The US NMFS conducts environmental monitoring surveys on the northeast US continental shelf, in the Gulf of Mexico, on the California continental shelf, and off coastal Alaska. The surveys document the distribution, abundance and species composition of the zooplankton community in US coastal waters. The four regional programs have been conducted for a least a decade; two – on the northeast shelf and off California – for multiple decades. Subject to other constraints and by prior arrangement, NMFS will cooperate with CMarZ by providing access to existing databases, by collecting samples on surveys cruises

(preserved in formalin, alcohol or liquid nitrogen), and by providing bunk space for CMarZ participants on some cruises.

A10. Zooplankton sampling during SEA cruises (Peter Wiebe): Zooplankton samples will be collected in nets during teaching cruises of the Sea Education Association (SEA, Woods Hole, MA). SEA will arrange for collections during three or four cruises each year from NW Atlantic, Caribbean, and NE Pacific regions. Of particular interest are long transects crossing diverse ocean regions, e.g., between ports in Alaska, Baja California, Tahiti, and Hawaii.

A11: Seasonal oceanography and fisheries in the Benguela Current region (Larry Hutchings and Hans Verheye): A BENEFIT-funded, dedicated environmental monitoring program for key areas along the Angolan, Namibian and South African west coasts. Five monitoring transects with comparable sampling and analysis methodologies are in place (Fig. 11).

A12. Environmental monitoring and pelagic fish stock assessment surveys in South Africa (Hans Verheye, with Jenny Huggett and Larry Hutchings): Annual zooplankton collections have been made along nearly the entire coast of South Africa since 1983, yielding information for management of marine ecosystems, indicators of ecosystem health, and baseline biodiversity assessment. Area of sampling is the continental shelf between ~29º S on the west coast and 28º E on the east coast of South Africa. Samples are routinely taxonomically analyzed, local taxonomic expertise needs to be uplifted.

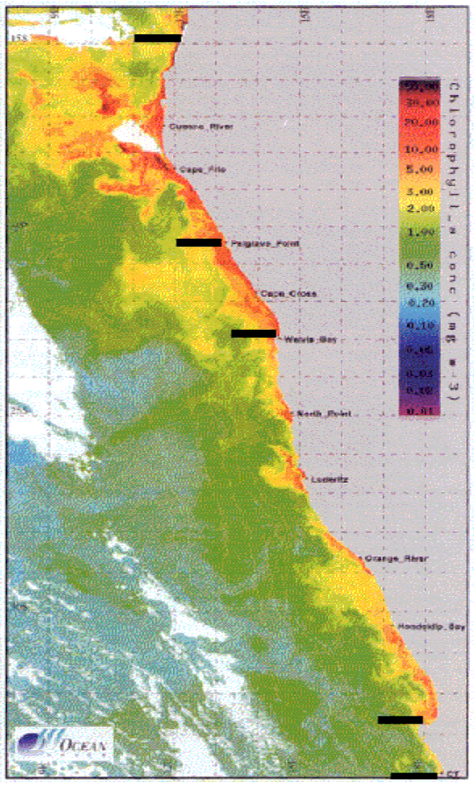

Figure 11. Ocean color satellite image of Benguela Current region (S. Atlantic Ocean), with monitoring lines off Angola, Namibia, and South Africa.

A13. African coelacanth ecosystem program (Hans Verheye). Coelacanths generally reside in caves (for predator avoidance and habitat preference). Zooplankton studies could help determine the food web associated with coelacanths and their unique environment, which in a CoML-CmarZ context is likely to be inhabited by endemic and hitherto undescribed zooplankton species. ACEP regions of study are Sodwana Bay, near the border between South Africa and Mozambique, and the Mozambique Channel. Zooplankton studies would be best added in Delagoa Bight, the Tanzanian coast, and Madagascar.

A14. US GLOBEC Gulf of Alaska field sampling (Russ Hopcroft). This project will contribute a more detailed taxonomic analysis of areas not extensively sampled during other field efforts associated with the LTOP surveys, including offshore sites and a site deep inside Prince William Sound fjord. Depth-stratified samples (to 600m) will be collected during seven cruises each year from 2004 – 2008. Samples will be preserved in ethanol for taxonomic analysis, and specimens of all species identified by taxonomic experts.

B. Proposed cooperating projects

B1. World Radiolarian Distributional Database (WoRaDD) (Demetrio Boltovskoy): The objective of this project is to generate a detailed database using all available published and unpublished data on the distribution of polycystine radiolarian species worldwide, from both planktonic and sedimentary (surface) materials. The information thus summarized will be analyzed with the aid of objective numerical and GIS techniques in order to derive global distributional patterns of both species and cell numbers. A proposal has been submitted to the Antorchas, a Latin American private funding agency. It will involve personnel from Argentina (D. Boltovskoy), Norway (K. Bjorklund), Japan (K. Takahashi), and the US (S. Kling).

B2. Digital expert system for pelagic copepods (Mark Ohman): This project will fill a critical need for modern, digital taxonomic tools to permit accurate species identifications of the most abundant and diverse multicellular plankton, the copepods. It will focus on the pelagic copepods in the upper 500 m of the Northeast Pacific, from the equator to the Bering Sea, and include pictorially-oriented keys and innovative pattern-matching algorithms for identifications, as well as complete morphological descriptions, depictions of known biogeographical distributions, digital video illustrating aspects of animal behavior, and hot-linked digital glossaries and bibliographies. It will build upon our successful *Euphausiids of the World Ocean* CD-ROM, in partnership with ETI at the University of Amsterdam.

B3. CalcOBIS (Colomban de Vargas): The aim of this project is to implement the Calcareous Plankton Ocean Biogeographical Information System, or *CalcOBIS* database. *CalcOBIS* is an interactive biogeographical system that will provide global taxonomic and phylogenetic information at the morphological and genetic species levels for all calcareous skeleton-bearing taxa in the marine zooplankton (foraminifers, tintinnids, pteropods, ostracods, heteropods). These groups have built a km-thick fossil archive at the ocean bottom that allows unique analyses of global distribution patterns of living plankton. Comprehensive gathering of fossil, plankton-tow, sediment trap, and genetic data from the target groups will establish global biogeographical maps for living organisms (Fig. 12); allow comparison of morphological and molecular biogeographies for each taxon; calibrate molecular clocks for diverse taxa; and provide valuable ecological and genetic data for accurate inferences about impacts of climatic variation.

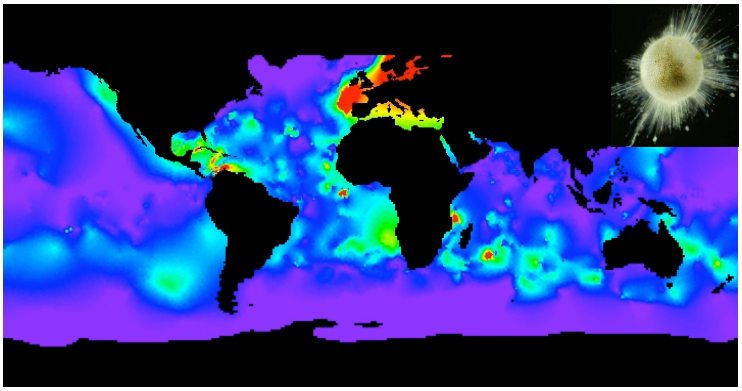

Figure 12. Map typical of CalcOBIS, this one for the planktonic foraminifer (*O. universa*) in modern deep-sea sediments of ocean basins.

B4. Potential plankton pilot project (Steve Haddock and Erik Thuessen): This project will implement a prototype sampling strategy in the Monterey Bay, NE Pacific coastal waters. The project will cross-calibrate collection methods, develop methods for sample processing and

species identification, and train plankton parataxonomists. The goal is to compare abundance, biomass, and diversity among zooplankton taxa based on the sampling gear used (nets, divers, ROV, submersibles). Preliminary data (Thuesen and Childress, in prep.) have shown that the taxonomic composition of samples varies widely with type of net or trawl. This effort will use simultaneous data collection from multiple sampling platforms, with near-immediate sample quantification. Funding is requested to add on to planned monthly cruises and/or to conduct a one-week midwater trawling cruise during December 2004.

B5. Biocontrol of an invasive species causing immense ecosystem damage and social problems in the Caspian Sea (Ahmet Kideys): A major objective of this project is a careful scientific study of the introduction of the invasive ctenophore, *Mnemiopsis leidyi,* to the Caspian Sea. Zooplankton monitoring and assessment will continue for 2004-2008 in different coastal regions of the Caspian, with participation by scientists from nine riparian and European countries. Zooplankton samples can be made available for other purposes, including molecular genetic analysis. The riparian countries propose to use a specific predator against *M. leidyi*. Proposed for EU funding.

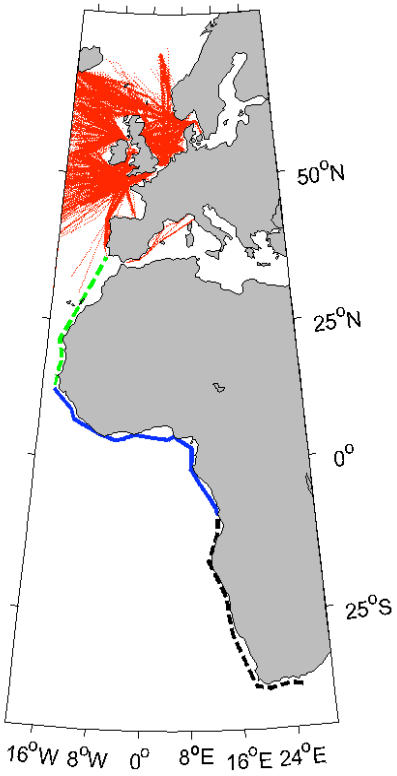

Figure 13. Routes of the Atlantic Eastern Margin Transect (AEMT), with proposed section from Portugal to Guinea Bisseau (in green).

B6. Plankton diversity of Andaman Sea (Russell Hopcroft): This proposed international collaboration (Denmark, Thailand, and US) will begin a sampling program in conjunction with Phuket Marine Biology Center (PMBC), where CoML NaGISA is already involved, using the PMBC research vessel, Chakratong Tongyai. The Andaman Sea is a deep-water basin separated from the remainder of the Indian Ocean by an archipelago along its western border. Plankton diversity is high, onshore-offshore gradients can be strong, and gelatinous zooplankton form a significant proportion of the zooplankton community. Funding has been requested from the NSF (US) and the Carlsberg Foundation (Denmark).

B7. Pelagic Ecophysiology and Lifecycles: African German Oxygen Studies (PELAGOS) (Hans Verheye): An integrated multilateral collaborative program to examine the effects of low oxygen levels on the physiology of zooplankton and other taxa. This multi-year program, now in final planning stages, will offer good opportunities to make collections of species specially adapted to hypoxic/anoxic conditions. PELAGOS will continue an ongoing focus on the ecology of zooplankton in the region of the Angola-Benguela Front (ABF) and the northern Namibian shelf, which is characterized by extensive and persistent epipelagic oxygen minimum layers in the vicinity of the ABF and hypoxic conditions with hydrogen sulphide further south.

B8A. The Atlantic Eastern Margin Transect (AEMT) (Anthony Richardson): This pilot project by SAHFOS will provide a synoptic, frequent (six-weekly) view of plankton biodiversity along

the eastern continental margin of the Atlantic Ocean, in order to resolve seasonal variability at large spatial scales. The transect will be sampled by towing the Continuous Plankton Recorder (CPR) behind Ships of Opportunity. Many of the CPR routes required for AEMT already exist or are likely to be funded. Funding from CMarZ will be used for proof-of-concept tows from southern Portugal to Guinea Bisseau (Fig. 13, shown in green) in order to complete the AEMT. A regional center for each section of the AEMT will be set up to ensure training of local parataxonomists.

B8B. Plankton biodiversity in the Guinea Current (Anthony Richardson): As part of the Guinea Current Large Marine Ecosystem program, six-weekly CPR tows are planned over five years, beginning in 2005 (Fig. 13, see blue line). Samples will be counted for phyto- and zooplankton. Topics for research include zooplankton biodiversity, distribution and relative abundance.

B8C. Southern African CPR route (Hans Verheye): This effort will add another new CPR route between Port Elizabeth, South Africa and Luanda, Angola (Fig. 13, see dotted black line). This route will extend the proposed AEMT and link up five monitoring transects of the BENEFIT program.