

# CENSUS OF MARINE LIFE

## The Census of Marine Life in Europe



The Census of Marine Life (CoML) is a growing global network of researchers in more than 50 nations engaged in a ten-year initiative to assess and explain the diversity, distribution, and abundance of marine life in the oceans - past, present and future. Through 2010, scientists worldwide will work to quantify what is known, unknown and what may never be known about the world's oceans. Their answers will help identify threatened species and important breeding areas, providing scientific information to authorities who develop effective strategies for the sustainable management of marine resources. As the secrets of the planet's last unexplored frontier are revealed, they will contribute to our understanding of fundamental processes such as climate, evolution, extinction and migration.

The Census of Marine Life is committed to strengthening support for marine biodiversity research at the national and regional level that will continue after the CoML has concluded. Several nations and regional groups are now in the process of bringing together regional CoML stakeholders, such as researchers, government and non-government agencies, resource managers, and fishermen, to determine how best to organize national or regional implementation committees for the Program. These committees work under the umbrella of the CoML and the guidance of the international Scientific Steering Committee to identify regional research and data priorities, build partnerships, explore national sources of funding, and promote the CoML to local audiences. European scientists have been involved with CoML since its inception in 1999. The formal European committee (EuroCoML) was formed in 2003.

The Census program is structured into three components. History tells us what lived in the ocean. Exploration tells us what lives in the ocean now. By combining what we learn about historical trends with the knowledge of what lives there now, we can begin to formulate an answer to the core question of what will live in the ocean of tomorrow.

## The Scientific Program

### *What lived in the oceans?*

The CoML addresses this question through the [History of Marine Animal Populations \(HMAP\)](#) programme. A historical reference point of marine populations against which modern populations can be compared is necessary in order to determine how ocean ecosystems are changing with respect to human impact and even climate change. HMAP combines Marine Ecology, History and Palaeo-Ecology on a regional case study basis to piece together changes in specific populations over time. The result is a set of 500-2000 year time-series, which provides scientists with a baseline prior to the advent of modern technology or before significant human impact on the ecosystem.

The HMAP programme is co-ordinated by the University of Southern Denmark's Centre for Maritime and Regional Studies in Esbjerg. This Centre is responsible for communication between the project participants, including researchers and students from over 18 countries and a range of disciplines. This group also disseminates the HMAP vision and provides products to the scientific community and the wider world.

The Maritime Historical Studies Centre at the University of Hull (UK) serves as a second HMAP Centre. It is responsible for the data management strand of the HMAP programme, notably for integrating it with the Ocean Biogeographic Information System (OBIS). The data assembled by the case study research teams to date has been rendered accessible through the development of a common database format, which enables diverse datasets to be presented as a coherent whole.

Of the twelve HMAP case studies ongoing or in development, four are led by teams of European researchers focusing on European waters, including the North, Baltic, White, Barents, Mediterranean and Black Seas.

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### *What lives in the oceans?*

The main focus of the CoML program is on field projects in *ocean realms* to study the present diversity, distribution and abundance of life in the oceans. The realms are habitats defined by the methods and techniques that are required for biodiversity surveys and that depend on the specific environments in which they are used. In many cases, these realms are sub-divided into *zones*. The realms are designed to ensure shore-to-abyss coverage of research to provide information about life in the oceans, which is vital to science, management and policy.

Of the seven current [Ocean Realm Field Projects](#), three - CeDAMar, MAR-ECO and ChEss - are based in Europe. These projects focus on the deep-sea and are collaborating on synthesis of their exploration, identification and interpretation of the variation of biodiversity (pelagic and benthic) within and between deep-sea habitats to understand the interactions between the biota and the ecosystems in which they live.

### [Census of Diversity of Abyssal Marine Life \(CeDAMar\)](#)

*Realm: Hidden Boundaries; Zone: Abyssal plains*

CeDAMar collects data on the large-scale distribution of one of the largest and most inaccessible environments on our planet - the abyssal plains. CeDAMar examines the correlation between abyssal benthic diversity and the amount of primary production in the overlying water column.

The managerial base for CeDAMar is located at the Centre for Marine Biodiversity Research, Senckenberg University, Germany. CeDAMar is an umbrella program for a number of current and planned biological expeditions to abyssal plains around the world (Southern Atlantic, Antarctic, Pacific, Mediterranean and Indian Oceans). Many of these projects are under European leadership (Germany, France, Greece and the United Kingdom).

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[www.cedamar.org](http://www.cedamar.org)

### [Patterns and Processes of the Ecosystems of the Northern Mid-Atlantic \(MAR-ECO\)](#)

*Realm: Central Waters; Zone: Dark zone*

MAR-ECO is an exploratory study of the pelagic, benthopelagic and epibenthic fish, cephalopods, crustaceans, mammals, birds, and gelatinous zooplankton (jellyfish) of the northern mid-Atlantic Ocean and the processes that control distribution across a major geologic feature, the Mid-Atlantic Ridge. The research area includes waters over the Mid-Atlantic Ridge between Iceland and the Azores, a 1500 nautical mile stretch of ridge characterized by rough bottom topography. Ten sub-projects address the research foci.

MAR-ECO is based at the Institute of Marine Research (IMR) in His, Norway. European scientists from Austria, Denmark, Germany, Iceland, Ireland, Norway, and the United Kingdom lead the ten sub-projects:

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### [Biogeography of Chemosynthetic Ecosystems \(ChEss\)](#)

*Realm: Active Geology*

ChEss is a global study of the distribution, diversity and abundance of species from deep-water chemosynthetic ecosystems including hydrothermal vents, seeps, whale falls, sunken wood debris, and oxygen minimum zones. It is an international collaboration between biologists, geologists, chemists, physiologists and ecologists to improve our knowledge of biogeography of chemosynthetic systems and the processes driving them. ChEss is developing three main field programmes at target areas where different chemosynthetic systems and a number of ecological, geological, evolutionary and topographic parameters are combined: Equatorial Atlantic Belt, Southeast Pacific, and New Zealand Region.

ChEss is headquartered at Southampton Oceanography Centre (SOC) in the United Kingdom and acts as an umbrella program to a number of component projects and expeditions. Southampton is coordinating a major international collaboration to collect and share data on global marine chemosynthetic ecosystems.

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Four additional Ocean Realm Field Projects involve European scientists or are seeking to globalize (e.g., replicate the research) into European waters.

### Natural Geography In Shore Areas (NaGISA)

[www.nagisa.coml.org](http://www.nagisa.coml.org)

*Realm: Human Edges; Zone: Nearshore*

Beginning in the Pacific, NaGISA is completing global latitudinal and longitudinal transects to assess and explain patterns of nearshore biodiversity. NaGISA employs a simple, cost-efficient and intentionally low-tech sampling protocol that can both be adopted by many research groups and countries and also promote local community involvement.

### Gulf of Maine Area Program (GoMA)

[www.usm.maine.edu/gulfofmaine-census/](http://www.usm.maine.edu/gulfofmaine-census/)

*Realm: Human Edges; Zone: Coastal*

Taking on the integration of physical, chemical and biological oceanographic information, GoMA was selected as the regional ecosystem study for CoML. It tests the feasibility and profit of assessing and explaining all diversity and processes from microbes to the top predators and even birds in the system. The project will advance knowledge of both biodiversity and ecological processes over a range of habitats and food-chain levels, and can be replicated at the regional level around the world.

### Pacific Ocean Shelf Tracking (POST)

[www.postcoml.org](http://www.postcoml.org)

*Realm: Human Edges; Zone: Coastal*

POST is a major project to develop and promote the application of new electronic tagging technology to study marine species along continental shelves. The focus of POST involves the development of a permanent continental-scale marine telemetry system. The POST tracking network will sit on the seabed of the continental shelf and slope, and will be used to monitor movements of organisms along the shelf or towards the open ocean. POST array data can then be applied toward the development of fishery management policies aimed at the sustainable harvest of marine resources. The POST arrays will be a coastal component of the Global Ocean Observing System (GOOS) and can host many other oceanographic sensors.

### Tagging of Pacific Pelagics (TOPP)

[www.toppcensus.org](http://www.toppcensus.org)

*Realm: Central Waters; Zone: Light zone*

TOPP is a collaboration among scientists from North America, Japan and Europe that aims to understand the migration patterns of large predators in the North Pacific basin and how these animals act and interact in their open ocean habitats. TOPP researchers use satellite tagging techniques to follow the movements of different species across multiple trophic levels (i.e. the food web) and in relation to physical oceanographic features. The tags allow scientists to track the movements of as many as 4,000 individual organisms at once. TOPP's automated technology will enable it to become an operational element of the Global Ocean Observing System (GOOS), supplementing data from fixed platforms and autonomous underwater vehicles with focused biological data.

Additional CoML projects are anticipated to begin by the end of 2005. These include the biodiversity of microbial life and zooplankton as well as habitats of the Arctic, Antarctic, continental margins, coral reefs and seamounts. Some of these (Margins, Arctic and

Antarctic) will have leadership based in Europe. In all cases, the participation of the European scientific community is strongly encouraged.

## What will live in the oceans?

The **Future of Marine Animal Populations (FMAP)** is the modeling component of the CoML. FMAP synthesizes the information generated by the CoML and made available through OBIS and use new and existing computer models to reveal patterns of biodiversity and to predict future changes in marine animal populations based on varied environmental and human-induced changes in the oceans. To that end, FMAP actually plays a significant role in answering all three questions of the CoML.

The components of FMAP include: (1) statistical design, (2) data exchange and model interface, (3) model development and sharing, (4) data synthesis, and (5) prediction. Working with a network of international fisheries biologists, FMAP will generate a community consensus on standardized formats for data compiled in OBIS and work to synthesize this information on world population dynamics. It will use observational data to test patterns of species richness and apply statistical methods to ensure a coherent sampling approach for CoML projects, which can then be adopted on a wide-scale by researchers around the globe.

There are three Centres responsible for FMAP research: Dalhousie University (Canada; coordinating centre), University of Tokyo (Japan), and the University of Iceland (Europe).

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## Access to information

The Field Projects and HMAP deposit their data into the **Ocean Biogeographic Information System (OBIS)**, a web-based catalog of global geo-referenced information on marine species, with on-line tools for visualizing relationships among species and their environment. It currently contains over 2.8 million geo-referenced species records. In addition, OBIS continually seeks cooperation from worldwide researchers, organizations, industry and government agencies with databases that can be effectively incorporated into OBIS. OBIS is governed by an International Committee.

The European Nature Information System is a contributor to OBIS, and OBIS is the principal marine associate for the Global Biodiversity Information Facility. Currently a project is under way to collect computerized Marine Biodiversity data from the Eastern Mediterranean and Black Sea waters by the Institute of Marine Biology of Crete (IMBC).

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## European Scientific Steering Committee Members of the Census of Marine Life

**Ulf Lie (Norway), Chair:** Professor Emeritus at the Centre for Studies of Environment and Resources, University of Bergen, Norway. Dr Lie served for several years as the Chairman for UNESCO's Intergovernmental Oceanographic Commission.

**Ahmet Kideys (Turkey):** Associate professor at the Institute of Marine Sciences of the Middle East Technical University in Erdemli, Turkey.

**Alasdair D. McIntyre (UK):** Emeritus Professor of Fisheries and Oceanography at the University of Aberdeen in Scotland and former Director of Fisheries Research for Scotland. Dr McIntyre served as Chairman of GESAMP (The UN Group of Experts on the Scientific Aspects of Marine Pollution) and has been associated with the International Council for the Exploration of the Sea.

**Anastasios Eleftheriou (Greece):** Emeritus Professor of Marine Biology at the University of Crete and former Founder Director of the Institute of Marine Biology of Crete. Professor Eleftheriou has been the Greek National Delegate for CIESM, IOC, UNEP, MAST-COM and ICES.

**Andrey Gebruk (Russia):** Director of the Laboratory of Oceanic Benthic Fauna at the P.P. Shirshov Institute of Oceanology, Russia.

**Carlo Heip (The Netherlands):** Director of the Centre for Estuarine and Marine Ecology of the Netherlands Institute of Ecology and professor at the Universities of Gent (Belgium) and Groningen (The Netherlands). Dr Heip is co-ordinator of the Network of Excellence MARBEF (Marine Biodiversity and Ecosystem Functioning) and member of the steering committee of the DIVERSITAS programme.

**David J. Starkey (UK):** Director of the Maritime Historical Studies Centre, University of Hull, and member of the International Steering Group of the HMAP programme.

**Graham Shimield (UK):** Director of the Scottish Association for Marine Science based at the Dunstaffnage Marine Laboratory, Vice President of the European Federation of Marine Science and Technology Societies (EFMS), and Chair of Research of the UHI Millenium Institute in Scotland.

**Henn Ojaveer (Estonia):** Senior research scientist at the Estonian Marine Institute, University of Tartu in Estonia and works for the Helsinki Commission (HELCOM) as the Head of the Lead Laboratory on Coastal Activities of the GEF-funded Baltic Sea Regional Project.

**Isabel Sousa-Pinto (Portugal):** Head of the Coastal Biodiversity Laboratory at the Centre of Marine and Environmental Research and Professor at the Botany Department, Faculty of Sciences, University of Porto, Portugal.

**Jean-Pierre Féral (France):** Director of the Diversity, Evolution and Marine Functional Ecology Laboratory at the Centre of Oceanology of Marseilles, France. Dr Feral contributed to the Mediterranean Action Plan of the United Nations Environment Programme.

**Pedro Martinez Arbizu (Germany):** Professor of marine biodiversity at University of Oldenburg, Germany, and leader of the German Center for Marine Biodiversity Research. He is the coordinator of the CEDAMAR project of CoML. Dr Martinez Arbizu is a member of the Steering Group of DIVERSITAS-Germany since 2003.

**Per Nilsson (Sweden):** Professor at the Tjärnö Marine Biological Laboratory of the Göteborg University, Sweden and member of the Swedish Scientific Council on Biodiversity.

**Roberto Danovaro (Italy):** Professor at the Polytechnic University of Marche in Ancona and Chair of the Italian Chapter of the Eco-Ethics International Union.

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### Front photo credits (clockwise from top):

(1) Squid, *Illex illecebrosus*. Courtesy of National Oceanic and Atmospheric Administration/Department of Commerce (Photographer: William Millhouser, NOS)

(2) Large decapod crustaceans, *Plesiopenaeus armatus*, at about 5400m on the Madeira Abyssal Plain. Copyright Southampton Oceanography Centre, UK

(3) A pelagic pteropod from the Arctic. Courtesy of NOAA Ocean Explorer (Photographer: Russ Hopcroft, University of Alaska, Fairbanks)

(4) Blackbar soldierfish. Courtesy of NOAA OAR/National Undersea Research Program (NURP), Caribbean Marine Research Center

(5) Sunflower sea star, *Pycnopodia helianthoides*. Courtesy of National Oceanic and Atmospheric Administration/Department of Commerce