MAR-ECO

CENSUS OF MARINE LIFE

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A two-months deep-sea exploration

What lives in the deep sea and how do topographical features and ocean current systems affect the distribution of these marine organisms? The two-month cruise during the summer of 2004 by MAR-ECO researchers aboard the new Norwegian research vessel, G.O. Sars, hopes to find some answers to these questions.

ELINOR BARTLE

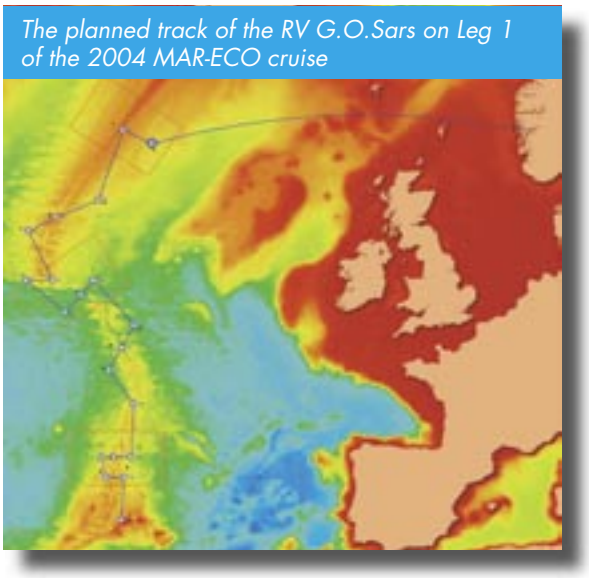
The G.O. Sars sets sail from Bergen, Norway, 5 June, 2004. July 3-4, the ship will dock in Horta in the Azores. While the crew changes, there will be an open ship opportunity for interested members of the public. The exciting two-months will end in Bergen, 4 August, 2004. Details of the cruise and day-to-day highlights will be available on MAR-ECO's ship-to-shore web site, *www.mar-eco.no/ship*.

The cruise is divided into two one-month "legs"; the first travelling south along the mid-Atlantic Ridge from south of Iceland to the Azores, the second travelling north along the same route. The second leg will particularly concentrate on two sub-areas, one just north of the Azores (approx 43°N), the second near the Charlie-Gibbs Fracture Zone (approx 52°N). The researchers will focus on the marine communities in the water column within the top 3000m.

South along the ridge to the Azores

Olav Rune Godø is the cruise leader for the first leg. Godø is the research leader in Observational Methods at the Norwegian Institute of Marine Research. The goal for this first leg is to obtain an overall quantitative assessment of the marine organisms present. This will enable researchers to generate an overview of this ecosystem, which then can be studied in greater detail in a few strategic locations during the second leg.

During the first leg the ship will conduct extensive acoustic survey activities. Acoustic information will be logged continuously from equipment mounted on the ship's hull or on the specially designed drop keel. Acoustic data will be collected at five different frequencies (18, 38, 120, 200, and 400 kHz). These acoustic data can be resolved to provide biomass information at a species or population level. The scientific crew, consisting of 30 technology and marine biology specialists, will collaborate to interpret the information.



The planned track of the RV G.O.Sars on Leg 1 of the 2004 MAR-ECO cruise

Currently eleven long (20 hour) stations and seven short (16 hour) stations are planned along the route. Activities will include vertical profiling of salinity, temperature, video images of plankton, bioluminescence, and depth-stratified plankton sampling (multinets and macrozooplankton trawls), as well as a fishing with mid-water fish trawls.

During the first leg, the ship will launch three independent, bottom-moored, monitoring instrument packages, including echosounders donated to MAR-ECO by the Norwegian marine technology company, KONGSBERG Simrad. A free-fall lander recording images of fish and other animals attracted to bait will also be deployed by the MAR-ECO partners from the University of Aberdeen (see feature article in this issue).

Another unique dimension to the first leg is the presence of a Norwegian Broadcasting Corporation (NRK) film-crew and an artist, Ørnulf Opdahl. Opdahl is a well-known Norwegian artist with a special love of marine themes.

Detailed investigations in strategic locations

Odd Aksel Bergstad, the MAR-ECO project leader, is the cruise leader for the second leg. This leg's goal is to undertake more in-depth studies of deep-water organisms in two particular areas. Eight days will be spent covering five stations in an area north of the Azores (approx 43°N). Here the work will focus on potential animal community differences, east and west of the mid-Atlantic Ridge. Stations will be positioned at approximately 2000 and 3000m on the east and west sides of the ridge, respectively, as well as one at 1000m at the top of the ridge.

The ship will then spend twelve days and cover 10-12 stations near the Charlie-Gibbs Fracture Zone, where the work will focus on potential differences north and south of the zone (five stations each). These stations will also hopefully be north and south of the sub-polar front, which is generally located near this fracture zone. The remaining two stations will be taken in the deep waters of the Fracture Zone.

A station during the second leg will involve about 25 hours of continuous activity. After some preliminary bathymetry work to determine optimal trawl locations, the activity will begin with the deployment of a lander. In addition to oceanographic and plankton vertical profiling activities, a major part of the station activity will involve ROV (Remotely Operated Vehicle) deployment. The G.O. Sars will carry two ROVs, the Aglantha, which can descend to 2000m and a new ROV that will be able to descend to 5000m. ROVs give researchers freedom of movement in deep, otherwise inaccessible locations using video and still cameras to record observations.

During leg 2, a Norwegian longliner will operate passive fishing gear (longline, traps) in areas nearby the G.O. Sars. This activity will supplement efforts to collect large, highly mobile organisms by bottom trawls operated by the research vessel.

Population substructuring in deep-sea fishes

A comparative molecular genetic study, based on hyper-variable, so-called microsatellite DNA, has been initiated. The intention is to quantify patterns and levels of population substructure in five key deep-sea fishes along the Mid-Atlantic Ridge and adjacent continental slope waters.

Roundnose grenadier, Orange roughy, Black scabbard fish, Greenland halibut and Alfonsino have been chosen for such analyses, and genetic variability patterns at 10 different microsatellites from each species will be characterised. These species differ in several key life-history characteristics, which will be utilized when evaluating the relative importance of various processes that are responsible for forming the genetic patterns within species.

The Norwegian Research Council has granted a three-year project starting September 2004. The project is international, with partners in the Azores and UK. It is led by Professor Nils Christian Stenseth (University of Oslo, CEES and Professor II at the Institute of Marine Research), and other partners are Rus Hoezel (Durham University, UK), Sergio Stefanni (University of Azores), Per Erik Jorde (IMR, Norway) and Halvor Knutsen (IMR, Norway). Colleagues at e.g. NMFS in the US, IFREMER in France, IPIMAR and DRP Madeira in Portugal provide reference material from many areas around the North Atlantic.

Landing on the ridge

The University of Aberdeen's Oceanlab has constructed a fleet of landers to investigate the deep-sea with the intention of expanding our understanding of its inhabitants and their role within our oceans.

Nicola King, Alan Jamieson, Kirsty Kemp, Phil Bagley and Monty Priede

The deep-sea represents the largest habitat on Earth with 79% of the volume occupied by life inhabiting depths exceeding 1000m. Animals that live in the deep-sea are adapted to extreme conditions, including high pressure, little or no light, low temperatures and reduced food supply. The deep-sea environment and the organisms therein are therefore extremely difficult for scientists to observe and study.

Robust Biodiversity lander (ROBIO)

The deep-sea community is supported by the import of particulate organic matter (POM) derived from surface primary production. A proportion of the surface primary production reaches the seafloor in the form of animal carcasses. Scavenging animals such as crustaceans and fish utilise such food-falls and are thought to be attracted to the carcasses by odour plumes spreading across the seafloor.

One of the present challenges in deep-sea research is to understand how agents, such as fish, transport this organic matter across the sea floor. In this respect the study of deep-sea animals is essential to the understanding of carbon cycling and dispersal in the world's oceans. Another future area of research will be to determine the affects of current regime and complex topography on odour plumes using computer-modelling techniques. Advanced odour plume models will enable accurate species abundance estimates to be made.

One of the most successful and widely applicable methods for studying deep-sea fauna in situ is the autonomous lander vehicle. Autonomous landers have gained widespread acceptance as a tool for deep-sea research through the optimisation of ship-time and the ability to carry out studies without removing animals from their natural environment. Landers are also completely independent of the ship, unlike manned submersibles and remotely operated vehicles (ROVs), and can be left to work autonomously while the ship continues with other tasks.

Deep Ocean Benthic Observer (DOBO)

A typical lander is comprised of a short positively buoyant mooring line, a metal frame on which to mount scientific instruments and releasable ballast weights. Landers are deployed from a ship whereupon they free-fall to the seabed. On touchdown, pre-programmed observation or monitoring tasks can operate for periods of hours to months. At the end of the experiment an acoustic command from the ship releases ballast weights and the vehicle ascends to the surface by virtue of positive buoyancy.

Since the 1980's, the Aberdeen University Deep Ocean Submersible (AUDOS) lander has provided time-lapse photographic biodiversity surveys in a variety of applications around the world. Following the success of AUDOS, the Robust Biodiversity lander (ROBIO) has been constructed to provide rapid biodiversity surveys down to 6000m. The ROBIO is a deep-sea photographic lander, with instrumentation allowing salinity, temperature and depth profiling, current measurement, and animal community observation. Amalgamation of this biological and physical data allows distribution maps of deep-sea habitats and species to be constructed. ROBIO is due to be deployed on the second leg of the MAR-ECO cruise on the Mid-Atlantic Ridge. The mission objective is to identify potential variations in the types of animals present at different locations on the ridge.

The Deep Ocean Benthic Observer (DOBO) lander is designed to investigate fish distribution and migration patterns in response to physical oceanographic conditions for up to 9-months at a time. It aims to identify and understand the significance of environmental time signals available to deep-sea organisms. The fish are photographed using a time-lapsed stills camera and physical data is obtained using a current profiler. he DOBO lander will use the novel long-term periodic bait release mechanism for the first time on the forthcoming MAR-ECO cruise. The experiment is designed to introduce bait into view of the camera every 5 days over a period of one month. This technique is the equivalent of regular baited camera experiments over extended periods, but with a greatly reduced need for ship time.

For further information about the University of Aberdeen's Oceanlab and deep-ocean landers please visit our website at: *www.abdn.ac.uk/oceanlab*

NEWS

Proposal submitted
In early January the US MAR-ECO consortium submitted a collaborative research proposal to the National Science Foundation. The proposal "Biodiversity of the Bathypelagic Fauna of the Mid-Atlantic Ridge – a MAR-ECO project" and the principal investigator is Dr. Tracey Sutton of the Harbor Branch Oceanographic Institution in Florida.

Study on Sub-polar front
On 5–6 February the United Kingdom group led by Prof. I.G. Priede at Aberdeen University met to draft a multi-institutional consortium proposal to the National Environment Research Council including several cruises on UK vessels, and the use of the ROV Isis. The study will focus on ecosystems associated with the Sub-polar front near the Charlie-Gibbs Fracture Zone.

Funding for MAR-ECO students
The Marine Research Institute of Iceland funds two MAR-ECO students to work with Drs Olafur S. Astthorsson and Astthor Gislason on zooplankton data from the RV Arni Fridriksson cruise in 2003 and other MAR-ECO cruises.

Grants for curation and exhibition
The Bergen Museum has won two internal grants to support curation of MAR-ECO material and the deep-sea biology exhibition to open in June 2004.

Commercial longliner chartered
MAR-ECO is chartering the Norwegian commercial longliner MS Loran to work alongside RV G.O.Sars in July 2004 and operate longlines, traps and nets. Substantial support from Norwegian and US fishing industry partners and public agencies/ authorities facilitated this operation. Sponsors: Norwegian Fishing Vessel Owner's Association; STATOIL; the Norwegian Directorate of Fisheries; the counties Møre & Romsdal, Sogn & Fjordane; Normarine ASA; Sunnmøre & Romsdal Fiskesalslag; The Norwegian Fisheries and Aquaculture Science Foundation (FHF); the US National Marine Fisheries Service.

MAR-ECO sponsors / commercial associates

Sealink

TELENOR ASA *provides communication solutions for the RV G.O.Sars cruise 2004.*

KONGSBERG

Kongsberg SIMRAD *provides in-kind support for hydroacoustics.*

Arcus

ARCUS ASA *provides in-kind support to Bergen Museum (ethanol for conserving MAR-ECO collections).*

BRAATHENS
Member of the SAS Group

Airliner BRAATHENS *transports personnel Bergen-Azores-Bergen.*

SCANMAR

SCANMAR ASA *supports fishing gear monitoring technology solutions.*

INSTITUTE OF MARINE RESEARCH

UNIVERSITAS BERGENSIS

The Norwegian Institute of Marine Research *and the* ***University of Bergen*** *provides substantial infrastructural support to secretariat and management.*

MAR-ECO, a field project of the Census of Marine Life
The Census of Marine Life (CoML) initiative, formalised in 1997, is an international research programme aiming at assessing and explaining the diversity, distribution and abundance of marine organisms throughout the world's oceans.
It is a central objective of CoML that innovative research effort be focused on poorly known ecosystems and/or communities for which new information would be particularly important to enhance understanding. The vast oceanic areas off the continental shelves represent such poorly known areas, and the ecosystems of the mid-oceanic ridges and the mesopelagic zone are of particular interest.

Recognising this continued need for exploratory research in oceanic waters, Norway represented by the Institute of Marine Research and the University of Bergen offered to take the lead in developing a regional collaborative CoML pilot project focusing on macrofauna of the northern mid-Atlantic Ridge (MAR) from Iceland to the Azores.

The project was given the acronym **MAR-ECO**, and has the following overriding aims:

"To describe and understand the patterns of distribution, abundance and trophic relationships of the organisms inhabiting the mid-oceanic North Atlantic, and identify and model the ecological processes that cause variability in these patterns."

CONTACT:
Dr. Odd Aksel Bergstad
(PI MAR-ECO) Tel: +47-37059019
oddaksel@imr.no

Dr. Tone Falkenhaug (MAR-ECO Secretary), Tel: +47-37059020,
tonef@imr.no

PUBLIC OUTREACH CONTACT:
MarEco.PO@imr.no

Ms. Anette W. Petersen
Institute of Marine Research,
Tel: +47-55238443
Anette.Petersen@imr.no

Ms. Elinor Bartle
University of Bergen,
Tel: +47-55583180,
Elinor.Bartle@form.uib.no

www.mar-eco.no