MAR-ECO PRESS RELEASE/CONFERENCE, Bergen 5-6 August 2004

MARINE LIFE ON THE MID-ATLANTIC RIDGE

HIGHLIGHTS AND PRELIMINARY RESULTS FROM THE MAR-ECO EXPEDITION 2004

By

Odd Aksel Bergstad
Chair of the International Steering Group of MAR-ECO
Institute of Marine Research, Norway
E-MAIL: ODDAKSEL@IMR.NO

We inhabit the blue planet, but our knowledge of life underneath the blue surfaces of the ocean remains surprisingly limited. In reality, investigations of marine life have just begun, and it is only now, when we can utilize custom-built research ships and the finest modern technology, that we can learn how ecosystems in the oceans are structured and function.

The international research programme Census of Marine Life (CoML) addresses this situation and challenges marine biologists to utilize the most advanced technology to achieve true new information in areas of the ocean that were poorly studied previously. MAR-ECO, one of several elements of the CoML, is an international research project in which approx. 110 scientists and students from 16 nations take part. Norway, represented by the Institute of Marine Research (IMR) and the University of Bergen (UoB), co-ordinates the project that will ***enhance our understanding of occurrence, distribution and ecology of animals and animal communities along the mid-Atlantic Ridge (MAR) between Iceland and the Azores***. The primary groups of animals to be studied are fishes, crustaceans, cephalopods (squids and octopods) and a wide range of gelatinous animals (e.g. jellyfish) living either near the seabed or in midwater above the ridge. The depth range of the study extends from surface waters to the deep troughs associated with the MAR, at 4500 m. The project provides new data and material for basic science, and will enhance our knowledge of biodiversity of the poorly known mid-ocean habitats and ecosystems. This new insight will assist science-based management of oceanic living resources and habitats. MAR-ECO also provides good training and networking opportunities for a growing number of students and scientists from several disciplines.

In the 2003-2005 field phase a number of research cruises have been/will be carried out. A major effort has been this year's two-month international expedition on the Norwegian RV G.O. Sars, and the chartered longliner MS Loran.

Figure 1: RV G.O.Sars. Photo: David Shale
Figure 2: MS Loran. Photo: David Shale

FACTS ABOUT THE 2004 MAR-ECO EXPEDITION

Time period: 5 June-4 August. (Leg 1: 5 June-3 July, Leg 2: 4 July-4 August)
Study area: Section of the mid-Atlantic Ridge between Iceland and the Azores.
Depth range: 0-4000m
Vessels: RV *G.O.Sars* (entire period), MS *Loran* (5-20 July).
Scientific crew: 60 scientists, students, and technicians, from 13 countries (*Iceland, Portugal, Russia, USA, Germany, United Kingdom, Austria, Finland, Denmark, France, the Netherlands, Faroe Islands, Norway)*
Principal scientists: Leg 1: ***Olav Rune Godoe* (IMR, Norway),** Leg 2: ***Odd Aksel Bergstad,*** (IMR Norway), MS Loran: ***Jan Erik Dyb***, (Moere Research, Norway).

Port Calls: 3-5 July Horta, the Azores; 3 August Aberdeen, Scotland.
Approx. distance sailed, RV G.O. Sars: 6000 n.m. (11,112 km).

Funding:
RV G.O. Sars operation: IMR (75%), UoB (25%)
MS Loran operation and charter: Norwegian public and private fisheries agencies/interests, STATOIL, US National Marine Fisheries Service.
MAR-ECO: infrastructural grants from the A.P.Sloan Foundation, participant's institutional funds (mainly public), national research councils, Nordic Council of Ministers, corporate sponsorship agreements.

Figure 3a: Track and stations of Leg 1 of the RV G.O.Sars expedition, 5 June-3 July.
Figure 3b: Track and stations of Leg 2 of the RV G.O.Sars expedition, 4 July-4 August.

SELECTED HIGHLIGHTS

1) HYDROACOUSTIC RECORDING OF MARINE LIFE TO 2000-3000m DEPTH.

Scientists to be credited: Olav Rune Godoe, John Horne, Stein Kaartvedt, Caristiona Anderson, Ruben Patel

The use of acoustics (recording of sound reflected from organisms) to record and quantify marine life has traditionally been associated with studies in waters overlaying continental shelves. Recording conditions worsen with depth due to the limited range of scientific echosounders and by noise created by the research vessel (i.e. the signal to noise ratio prevents reliable recording to depths greater than 1000 m). The ability to census aquatic organisms are even more difficult in deep water as many fish species here lack a swimbladder – the major acoustic reflector in most shelf species.

During the MAR-ECO cruise we used a SIMRAD EK-60 18 kHz scientific echosounder. When combined with the very low noise level of the RV ***G. O Sars***, we were able to detect and quantify acoustic layers to depths between 2000 and 3000 m. We were surprised by the geographical extent of layers recorded at about 1500 and 2300 m depth that were composed of fish without swimbladders (e.g. *Bathylagus* sp. and *Maulisia* sp.).

Figure 4: An echogram showing a deep scattering layer at more than 2000m, and the depth zones fished by the trawl.

2) MESOSCALE RING STRUCTURES REFLECTING PHYSICAL – BIOLOGICAL COUPLING
Scientists to be credited: Olav Rune Godoe, John Horne, Stein Kaartvedt, Caristiona Anderson, Ruben Patel

Physical - biological interactions are fundamental to the production and reproduction of marine life. These large-scale interactions can be observed through coincident distribution patterns of organisms and environmental variables (e.g. temperature). Direct physical-biological coupling is more difficult to observe, although internal waves are frequently mimicked in plankton distribution patterns as recorded by acoustic systems.

During the MAR-ECO cruise the scientific echosounders on the vessel recorded at least four clearly defined ring structures of planktonic organisms over horizontal scales ranging tens of kilometres. Due to the change in current flow at the centre of the structure, we assume these structures to be rings or eddies created either by topography, collision between water masses, or, most probably, an interaction between these factors. The structures were recorded east of the mid-Atlantic Ridge in the northern part of the study area and could potentially originate from water flow through the Charlie-Gibbs Fracture Zone. To our knowledge such large scale physical–biological coupling has not been previously observed.

Figure 5. Composite echogram showing ring structures.

3) NEW SQUID SPECIES
Scientists to be credited: Richard Young, Michael Vecchione, Uwe Piatkowski

All cephalopods captured on the MAR-ECO cruise will contribute to our understanding of their ecology, many will aid in clarifying the taxonomic status of their species, and some will provide new information on their life history and biology. Among the many specimens captured by the different trawls, we found at 45-50 different species. Two squid, however, stand out in their potential impact.

The first squid is a new and unusual species within the family Promachoteuthidae. The eleven previously known specimens in this family were taken from bathypelagic depths in the ocean and have small heads and small eyes covered with a semi-opaque "pseudocornea" of unknown function. Two of the eleven specimens belong to the only named species, *Promachoteuthis megaptera*, which was first taken during the RRS ***Challenger*** expedition over 100 years ago. The MAR-ECO specimen, which is in excellent condition, is similar to a specimen captured in the North Atlantic by the

R/V ***Walter Herwig*** during the early 1970s. If future study shows that the two latter specimens are indeed the same species, then they will provide sufficient material to describe and name the species.

The second squid belongs to *Planctoteuthis*, a genus of bathypelagic squid containing six species of which four are known only from paralarvae. The MAR-ECO specimen is a subadult, in excellent condition except for the loss of its tentacles during capture. Due to the squid's capture in the aquarium cod-end of the large Aakra trawl, the delicate and unique form of the head was preserved. The subsequent trawl captured another specimen of this genus that was entangled in the meshes of the net and badly damaged. The second specimen, however, has an intact tentacle-club and if further study proves that both specimens belong to the same species, we will have a composite of what now appears to be a seventh and new species in this poorly known family.

Figure 6: Composite showing several squids and octopods. Photo: Richard Young.
Figure 7: *Promachoteuthis megapter.* Photo: Richard Young.

4) FISH FAUNA, and NEW OR UNUSUAL FINDINGS
Scientists to be credited: Pelagic and demersal nekton teams, PIs: Tracey Sutton, Uwe Piatkowski, Franz Uiblein, Ingvar Huse.

In order to achieve a comprehensive understanding of the composition and distribution of MAR fishes, a range of methods and technologies for observation and sampling was applied. Leg 1 of the expedition focused on mid-water fishes and applied three trawls of different designs and sizes to obtain catches from different size ranges and depth strata. Hydroacoustic observations of sound-scattering layers were also central. Leg 2 fished on the bottom using trawl (RV G.O.Sars) and passive gears such as longlines, gillnets and traps (MS Loran). In addition, visual fish observations were made by remotely operated vehicles (ROVs) and baited video and still photo landers. Video clips show a varied fauna near the bottom, including also target species of fisheries, e.g. orange roughy (*Hoplostethus atlanticus*) and roundnose grenadier (*Coryphaenoides rupestris*). All size ranges of fish were observed and captured, from the tiniest larvae of a few mm total length, to a Greenland shark of 4,5 m caught on longline by MS Loran.

During Leg 1, 179 mid-water fish species were identified, but several specimens could not readily be identified to more than family or genus level. The number of species will increase, probably well beyond 200. On Leg 2, there is more uncertainty, but (as of 22 July) at least 87 different near-bottom fish had been identified to species, and again the number is certain to increase when the samples are analysed further. The remarkable news is that 13 of the species are new to the North Atlantic, and another 44 have only been recorded 5 or less times previously.

The material collected (at least 80,000 specimens), includes specimens of uncertain identity, but further analyses are required to determine if any of these represent new species to science. Some candidate new species are:

New ceratioid anglerfish?

Scientists to be credited: Tracey Sutton

The deep-sea anglerfishes (suborder Ceratioidei) are the most diverse group of bathypelagic (1000 m and below) fishes, with 157 currently recognized species. During the MAR-ECO cruise, an anglerfish was captured which could not be assigned to species. The specimen could easily be assigned to the family Oneirodidae, genus *Lophodolos,* by the form of its head spines and the placement of the luring apparatus. The specimen differed from the two known species in the genus by the structure of the head and the form of the 'lure' at the tip of the luring apparatus. The 'lure' structure, known as the 'esca,' is a primary character used to differentiate species. Further detailed analysis of this specimen and comparisons with museum specimens will be required for verification. Several specimens of other anglerfish species were diagnosed only to genus during the cruise, but given the lack of sampling in this specific location, and the lack of sampling in the bathypelagic zone in general, it would not be surprising if some of these forms proved to be new to science as well after detailed examination.

Figure 8: The ceratioid anglerfish of the genus *Lophodolus* that may be a new species. Photo: Tracey Sutton.

New Ophidiform fish?

Scientist to be credited: Franz Uiblein

One of the most common fish orders in the deep sea is the Ophidiformes, and from this group new records or species may still be expected. Two specimens collected in the central rift valley in the southern MAR-ECO box could only be identified to the genus *Porogadus*, but they turned out to be different from the three *Porogadus* species known from the western Atlantic and other candidate species from the eastern Atlantic. These two specimens may represent a new species, but further comparisons and detailed taxonomic investigations need to be carried out to provide the necessary clarification.

Figure 9: The ophidiform fish of the genus *Porogadus* that may be a new species. Photo: Franz Uiblein.

Rare occurrence of the *Aphyonus gelatinosus*

Scientist to be credited: Ingvar Byrkjedal.

This peculiar fish was captured twice in the bottom trawl. Previously it has only been recorded once in the North Atlantic, near the Azores. It appears to occur in several of the world's oceans, yet, in total only a few specimens are known. The species belongs to the family Aphyonidae which contains 20 species, all of which have been found on or near the bottom at great depths. All of them are semitransparent, covered in a gelatinous layer, and they have very poorly developed eyes.

The species captured on the MAR-ECO cruise is pinkish and has a blue-coloured stomach. The previous North Atlantic record was from 1100-1200m depth. The present specimens were taken from even greater depths, about 1750 and 3000m.

The members of this fish family are viviparous, which means that instead of spawning eggs, they give birth to young. Practically nothing else is known about their biology.

This peculiar fish was captured twice in the bottom trawl. It has only been recorded very few times in the Atlantic Ocean.

Figure 10: *Aphyonus gelatinosus,* a peculiar fish caught only rarely in the North Atlantic. Photo: David Shale.

Evidence of past fisheries
Scientists to be credited: Ricardo Serrao Santos, Gui Menezes, Odd Aksel Bergstad

While it is not a specific aim of MAR-ECO to assess the impact of anthropogenic activities such as fishing on the MAR ecosystems and fauna, evidence of past activities were observed during the expedition. There has been commercial fishing along the MAR since the early 1970s, so these are not to be regarded as pristine fishing ground. Trawling and longline fisheries have been conducted on many hills, mainly targeting near-bottom fishes such as roundnose grenadier, alfonsino, orange roughy, and redfish. Assessment of the impact of these fisheries on abundance of target species, communities, and habitats is beyond the remit of the project, but a few observations of human influence were made:

During ROV dives we observed occasionally lost fishing gear, primarily in rugged terrain on top of mounds. On one occasion a trawl net was found. MS Loran also recorded lost longlines, that appeared to have been lost recently.

Another sign of anthropogenic influence is the frequent occurrence of garbage, e.g. plastic bags and other objects, in the bottom trawl catches at all depths over very wide areas.

5) THE SIGNIFICANCE OF THE CHARLIE-GIBBS FRACTURE ZONE and the SUB-POLAR FRONT.

Scientists to be credited: MAR-ECO zooplankton and pelagic nekton teams. PIs: Tone Falkenhaug, Astthor Gislason, Uwe Piatkowski, Leif Noettestad, Henrik Skov.

At around 52^{o}N, a major topographical feature known as the Charlie-Gibbs Fracture zone divides the MAR into a northern and southern section. The CGFZ is a system of two main parallel deep rift valleys running perpendicular to the main Ridge axis. Previous studies by current meter moorings and deep drifters have shown major flow of deep-water between the western and eastern deep-sea basins of the North Atlantic through these deep channels. The topography is truly spectacular with depths ranging from 4500 m in the deepest channel to only 700-800m on top of adjacent seamounts. Near the CGFZ is also the near-surface frontal zone between cold water to the north and warm saline water to the south, known as the Sub-polar Front.

The ecological processes in this topographically and hydrographically interesting area are not well understood, but observations made during the MAR-ECO cruises in 2003 and 2004 should stimulate further studies in future years.

Figure 11. Map showing the topography of the Charlie-Gibbs Fracture Zone.

Some highlights:

The abundance of large mid-water crustaceans; mainly decapods (shrimps) and amphipods, increased from the north towards CGFZ where there was a maximum. Further south, the abundance declined significantly. This indicates that the standing stocks of crustaceans are particularly high in the frontal zone near CGFZ. This was not only seen in catches, but also from optical recording of zooplankton by the Underwater Video Profiler (UVP) operated in the upper 1000m. The crustacean fauna is characterised by large beautiful red shrimps and krill. Further analyses are needed to clarify species compositions and biogeographical patterns.

Another indication of the significance of this area came from near-surface copepod egg production studies. Nowhere along the MAR were the egg production rate higher than in the CGFZ and Sub-polar front. Copepods are important grazers of phytoplankton at the surface, and themselves major prey of vertically migrating mid-water predators such as small fish, large crustaceans and gelatinous zooplankton.

An example of biogeographical pattern was offered by the occurrence of two different squid species, *Gonatus* sp. and *Heteroteuthis dispar* north and south of the frontal zone, respectively. It is anticipated that many similar patterns will be revealed by future detailed analyses of the data obtained on both Leg 1 and 2.

Mammals occurred along the entire section of the MAR studied. On Leg 1, the mammal team observed more than 1400 whales and dolphins, and baleen whales (particularly sei whale, and fin whale) where especially abundant near the CGFZ in association with steep topography. Seabirds were observed systematically on Leg 1, and more than 1900 birds were counted and identified along the survey tracks.

Figure 12. Geographical distribution of crustacean plankton catches. Photo: David Shale.
Figure 13. Geographical distribution of copepod egg production. Photo: Astthor Gislason.
Figure 14. Occurrence of two different squid species, a) *Gonatus* sp. and b) *Heteroteuthis dispar*. Photo: Uwe Piatkowski.

6) SPECTACULAR BOTTOM FAUNA

Scientists to be credited: Andrey Gebruk, Ricardo Serrao Santos

Deep-sea corals *Lophelia pertusa*, live and dead.

Tops of seamounts, submerged from several hundreds to one thousand meter depth, are very often densely inhabited by a variety of organisms that feed from the water column, either filtering particles or suspending them. This type of environment is commonly characterized by strong currents and water circulation. Water moves and carries food particles used by epifauna attached to the rocks. Filter-feeding is common for example for sponges and bivalves. Suspension-feeding is used by some brittle stars, sea lilies, sea stars, sea pens, anemones and a variety of corals. Most abundant among corals on seamounts are gorgonian and soft corals, and also solitary madreporarian corals that have a hard calcium carbonate skeleton like their shallow-water relatives. The only reef building coral that lives at these depths is a deep-water coral *Lophelia pertusa*. *Lophelia* lives mainly along the continental shelf, at depths from 200 to almost 2000 m. Most records of this coral come from the north-east Atlantic but it has also been recorded in the Mediterranean Sea, along the coasts of eastern north America, Brazil, west Africa and on the Mid-Atlantic Ridge. Biology of this coral is known very poorly and there are only a handful of observations on live *Lophelia* in its natural habitat.

On our cruise, using the Remote Operated Vehicles (ROV), we repeatedly observed live *Lophelia* colonies on the seamounts that form a chain of the Mid-Atlantic Ridge. The deepest record was at 1340 m, south of the Charlie Gibbs Fracture Zone. We did not see very massive structures, the largest colony was probably 1 m across.

Lophelia reefs provide a habitat for many other species, such as sea lilies, sea stars, sea urchins, brittle stars, polychaete worms, sponges, bivalves and many others. Observed diversity and density of fauna associated with deep coral banks was remarkable!

After *Lophelia* corals die the structures they built still provide a home for many groups of animals. Even after the colonies destroy they form a layer of pebble that accumulates over hundreds and thousands of years and can be a pronounced feature of the habitat on tops of seamounts. This pebble is a substrate for various attached groups of animals. North of the Azores we saw a seamount covered with a thick layer of a coral pebble on the top and slopes with very few live bushes. Even long after their death *Lophelia* corals form a landscape on the seamounts in the North Atlantic.

Mysterious burrow-makers.

Tracks on the sediment left by animals living on or inside it, mirror the activity of life in the habitat. Scientists use the term 'bioturbation' when they speak of the impact of organisms on the sediment. Different animals leave different tracks on the sediment. There is a whole classification of these tracks known as 'lebenspuren'. For many kinds of the tracks, the animals producing them are known, but for a great variety they are not known.

On one of the ROV dives on the seamount north of the Azores at the depth around 2000 m we observed a great number of traces left by an unknown animal. The traces were almost straight or curved lines of regularly placed perforations, as if somebody used a sewing machine to create this landscape. The lines, some of them several meters long, were going in different directions. Diameter of holes varied but often was around 5 cm. Some of the holes were not circular, they rather had a dash-line pattern.

Naively we were sitting for a long time looking inside the holes hoping to see who makes them. With no success! The only idea that came to our minds was that these rows of burrows are made by some big crustacean, maybe a deep-sea blind lobster that we caught in trawl on this seamount? Perhaps each line is a burrow with multiple entries, or is it a succession of burrows with just a single opening, but then how and why can these lines be that straight? We were so confused after this dive…and still are.

Figure 15. Photo from ROV showing live *Lophelia* corals. Photo: MAR-ECO.
Figure 16. Photo from ROV showing mysterious burrows. Photo: MAR-ECO.

7) BEAUTIFUL GELATINOUS ZOOPLANKTON
Scientists to be credited: Marsh Youngbluth, Aino Hosia, Tom Soernes.

Jellyfish, members of a group also known as gelatinous zooplankton, are amazing creatures. They occur in all the oceans from the surface to the seafloor. In addition to being beautiful, these drifters are capable of eating enormous amounts of prey and may compete with fishes for these natural resources. Many species grow quickly and produce large populations. When numerous, jellyfish are hostile toward humans or any other animals that swim into their stinging tentacles. But what happens in the deep sea, a place where people rarely visit? We don't know the answer yet. This environment is the largest and darkest habitat on our planet. How many gelatinous forms live there? The MAR-ECO project has provided opportunities to explore with a suite of modern technologies that enable us to enter, watch, photograph, record, capture and respire a variety of jellyfish. In the span of two weeks we have descended more than 2000 m to the seafloor around the mid-Atlantic ridge. We've learned that jellyfish segregate in layers with regard to depth. Animals like comb jellies and medusae are often numerous in a zone 300 to 600 m below the surface and were most diverse just north of the Azores. Each time we splashed into the sea with an ROV we encountered wondrous and apparently undescribed animals that behave in unexpected ways.

Figure 17. *Aulococtena acuminata*. A cydippid ctenophore from the deep-sea which uses two tentacles to snare its prey. (15 cm long). Photo: Marsh Youngbluth.

Figure 18. *Bathycyroe fosteri*. A lobate ctenophore found at intermediate depths in all the oceans. This species is very common and abundant near the mid-Atlantic ridge. (5 cm tall). Photo: Marsh Youngbluth.