Cruise Report, BIOSYS 2007

Cruise 64PE263 on R/V Pelagia

Lysekill - Lysekill 7 - 13 March 2007

Sponge diversity in cold water coral bioherms and calcification rate and prokaryote-coral associations of *Lophelia pertusa (*Skagerrak, North Sea*)*

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Contents

1. Cold water coral bioherms and objectives of BIOSYS (NWO)

The distribution of cold water coral bioherms becomes more and more widespread with new discoveries of cold water coral habitats made throughout the world oceans which is facilitated by a fastly advancing deep-sea technology (Freiwald and Roberts, 2005; Rogers, 1999; Roberts et al, 2006). The mapping and recognition of these cold water coral bioherms and carbonate mounds is an important prerequisite in understanding patterns regulating the distribution of cold water corals Freiwald et al, 1997; Freiwald et al, 1999; Roberts et al, 2005; Hovland et al, 2002). Nevertheless, questions regarding coral biology and functioning need to be addressed in further detail since close-up studies on living coral specimen are scarce. This is to a great extent due to logistic constraints, where accessibility and restriction of ship time complicate representative sampling and investigation of live coral specimens and coral associated fauna. It has been shown that the deep water coral reefs support an increased biodiversity of benthos organisms. However, until recently the microbial abundance and diversity associated to the corals and deep water coral reefs has not been examined. There are also open questions with respect to energy demand and food supply to the deep water corals. It has been hypothesized, that deep water coral reefs are often restricted to the top of mounds where higher flow constraints allow for more particle encounter and prey capture at a given time (Genin et al, 1086, Mortensen, 2000). It has also been shown that potential food sources for deep water corals consist of zooplankton as a primary source, and also phytodetritus may contribute to coral nutrition. Previous indications of methanotrophic food supply could not be confirmed and the hypothesis of methanotrophy in deep water coral reefs seems no longer supported (Kiriakoulakis et al, 2004; Kiriakoulakis et al, 2005; Duineveld et al, 2004). We also know very little on growth rates of these deep reefs or calcification rates of single corals. Skeletal linear growth estimates are approximated with a range of 1-25 mm per year. These estimates are derived from indirect evidence of proxy evaluations and by studying coral growth on oil sea ridges – the latter allows estimating minimum skeletal growth of corals that have settled on this artificial substrate since deployment (Adkins et al, 2004; Bell and Smith, 1999; Gass and Roberts, 2006; Mortensen and Rapp, 1998). There are still a whole range of open questions regarding this fascinating ecosystem and yet it is already under great threat with deep bottom trawl and - on a more global scale - the anticipated impact of ocean acidification which may even affect the deeper cold water coral reefs more drastically than shallow water systems (Fosså et al, 2002; Guinotte et al, 2006; Orr et al, 2005).

A main goal within the BIOSYS project is to tackle some questions with respect to biology and ecosystem functioning of deep water corals and the ecosystem. Specifically, we aim at studying the main frame building deep water coral species *Lophelia pertusa, Madrepora oculata* and the solitary coral *Desmophyllum* spp. on the organismal level. A special emphasis is on coral growth, feeding and the role, abundance and diversity of microbial associations and the importance of associated prokaryotes in supporting coral functioning or providing additional food or energy to the deep water corals. In this frame, a central question is tackling the role of prokaryotes. Deep water corals and associated bacterial abundance and diversity are studied at different locations to decipher general

regimes related to deep water coral ecosystems and to distinguish them from site specific features (e.g. water depth, nutrients and temperature). Hetero- and autotroph production of coral-associated prokaryotes are determined and feeding experiments are conducted on board with freshly collected coral material to address the question if prokaryotes may sustain the nutritional requirements of the deep sea corals investigated. To decipher if regional settings may further influence coral-microbial associations and coral growth, cruises were already conducted to the Rockall and Porcupine area as well as to the Mingulay coral reefs during previous cruises (Van Duyl et al, 2005; Duineveld et al, 2006; Maier et al, 2006). The cruise to the Skagerrak constitutes an additional and final cruise within the NWO-funded project on biology and ecosystem functioning of cold water corals (BIOSYS) and as such geographically broadens our approach on coral-microbial interaction by adding a 3rd cold water coral site to our investigations.

2. Participants and Cruise Objectives

During this 1-week cruise, the scientific party consisted of participants of Royal NIOZ, University of Amsterdam, the Rotterdam Zoo, the Laboratoire d`Oceanographie de Villefranche (LOV, France) and scientists from Tjarnoe Marine Lab (TMBL, Sweden). During the cruise the most common stony coral, *Lophelia pertusa,* is studied and experiments with living corals directly on board the research vessel are carried out in temperature-controlled cool-containers at 10°C to study microbial abundance, and microbial community structure associated with the corals and within the gastral cavity of these corals. Further, radioisotope labeling experiments (^{3}H-Leucine, ^{14}C-sodium bicarbonate and $^{45}CaCl_2$) were used to study microbial protein-synthesis, microbial autotrophy and coral calcification. Further, research on sponge abundance is carried out to compare sponges of the Skagerrak cold water coral bioherms to the shallow-water (80-190m) near-shore *Lophelia* reefs at Mingulay and the deep-water (550-800m) reefs at the SE Rockall bank, visited during BIOSYS/HERMES 2005, MOUNDFORCE 2004 and HERMES 2006 (Van Duyl et al, 2005; Mienis et al, 2004; Duineveld et al, 2006). Main interest of the group of TMBL was to broaden the Multibeam coverage of potential cold water coral bioherm areas. They further provided guidelines for suitable sampling locations and assisted in identification of boxcore fauna. A participant of Rotterdam Zoo took care of maintaining animals not needed for experiments alive in our climate-controlled container for later transport to Rotterdam Zoo. The aim of this cooperation is to ultimately keep animals that would otherwise be discarded alive for educational purposes on cold water coral ecosystems through establishing a public aquarium exhibition on cold water coral ecosystems. A small ROV system was brought along by SEAfoundation for an initial testing in shipboard-related applications and for testing its suitability in retrieving benthos samples.

3. Study Area and Multibeam Survey

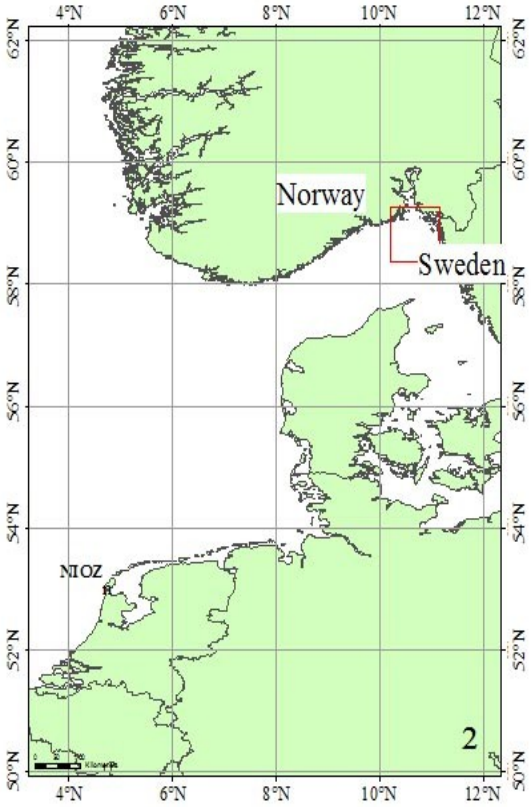

Fig. 1 Overview map showing cruise area at the Skagerrak, North Sea.

In 2006 Royal NIOZ acquired a new Kongsberg EM 300 multibeam echosounder for its research vessel Pelagia. The system is a 30 kHz echo sounder with a 1° opening angle for the transmitter and a 2° angle for the receiver. The transducers are mounted in a gondola attached along the port side of the hull. It uses 135 beams with a maximum coverage sector of 150°. The transmit fan is split into maximum 9 individual sectors that can be steered independently to compensate for ships roll, pitch and yaw. This is in order to get the best fit of the ensonified line perpendicular to the ships track and thus a uniform coverage of the sea bed. The ships motion is registered by a Kongsberg MRU-5 reference unit and its position and heading by two GPS antennas. Motion and position is combined in a Seapath 200 ships attitude processing unit and send to the transmitter and receiver unit (TRU). The system is synchronized by means of a 1 pulse per second signal produced by the Seapath 200 which is sent to the TRU. Data from the receiver transducer and the ships attitude are combined in an acquisition computer (Kongsberg HWS 10). For data acquisition Kongsbergs' SIS (Seafloor Information System) software is used. The sound velocity profile is calculated on basis of a CTD profile obtained with a Seabird CTD system. The sound velocity near the transducers in the gondola is measured by a Reson SVP 70 sound velocity probe.

Multibeam mapping in the Skagerrak area

Previously a few areas of the Skagerrak were multibeamed. During the BIOSYS cruise we used the EM300 multibeam to make more detailed maps covering some areas of particular interest to the Swedish researchers to cover prospective cold water coral areas (Fig. 2).

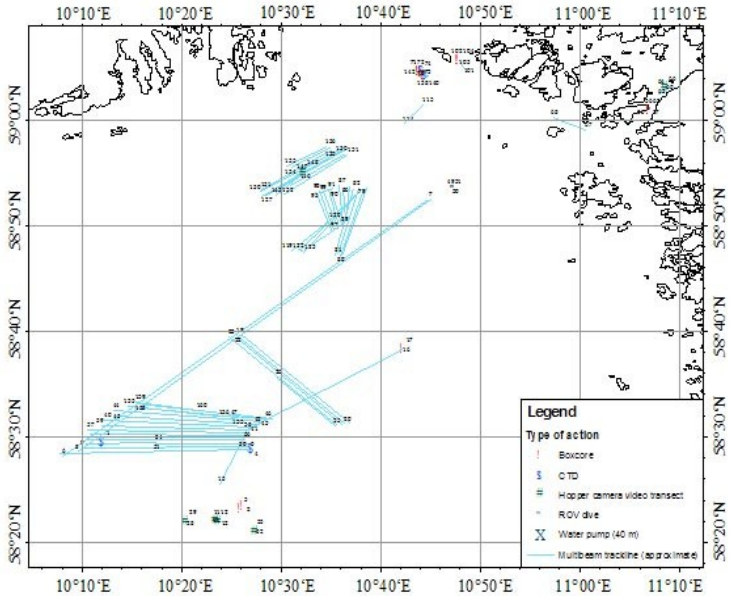

Fig. 2. Overview of Multibeam transects (blue lines) during cruise.

Also, the multibeam was used to get high-resolution maps for subsequent sampling with the boxcorer. These on-site multibeam coverage of sampling sites facilitated - together with the video-assisted box-corer - the successful sampling of live corals (Fig. 3).

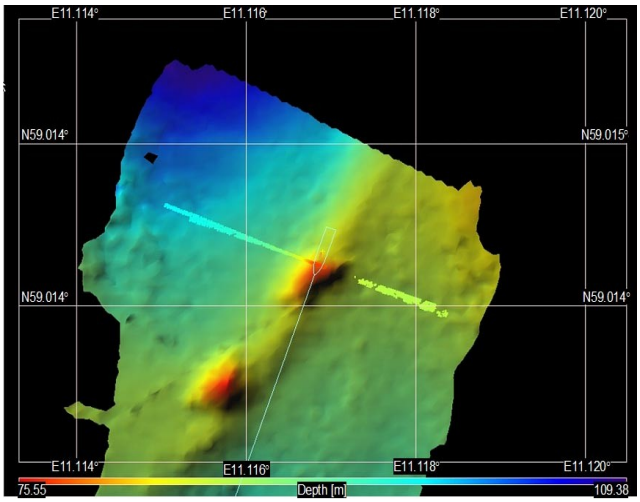

Fig. 3 Multibeam map made directly prior to sampling to facilitate exact sampling positions with respect to mound structures at the Sekken area. The mounds of Sekken area are extremely small with a diameter of less than 100 m. Note as reference the size of RV Pelagia on Multibeam screen.

4. Equipment

4.1 CTD

During the cruise the CTD-rosette sampler was equipped with 22 Noex bottles of 12 liter, a Seabird™ 911 CTD with auxiliary sensors for oxygen, turbidity (Seapoint) sensor and fluorescence (Chelsea Aqua 3). Data were acquired using the SeaBird SBEdata Processing –Win 32 software. The principal activities involving the CTD-rosette were sampling of bottom water and calibration of Multibeam.

4.2 Video-equipped box corer

Bottom samples were taken with a NIOZ boxcore (K18) equipped with a stainless steel cylindrical core of 50 cm in diameter and 55 cm height and a trip valve sealing the box. Boxcores (BX), which were taken during the cruise with date/time, coordinates and depth are listed in Appendix-II. The boxcore was equipped with an online-video system to facilitate successful sampling of living corals. When the boxcore came on deck, the valve was carefully opened and the overlying water was siphoned off. The seawater was used for experiments/measurements after it was decided that the boxcore was well taken (penetration of ca 10-50 cm in the bottom). Seawater samples were taken for microbe abundance and composition, heterotrophic bacterial production, inorganic nutrients, total and dissolved organic matter. The surface of the boxcore sample was photographed (Appendix-III) and described.

Fig. 4 Video-equipped boxcorer.

4.3. Video survey

Only few video surveys were carried out during this cruise to examine multibeam covered areas for coral abundance. Twice the NIOZ drop camera system was used. A couple of other attempts were carried out using the camera of the ROV system.

4.4. ROV testing

A small ROV has been brought on board by SeaFoundation (Ing. M. de Lange) for test deployment. A small garage system and additional equipment has been constructed by Leon Wuis (MTM; NIOZ) to better facilitate deployment of ROV system. The ROV test deployments were conducted as courtesy of BIOSYS but were not of any further relevance to project aims and the miniature ROV is not sturdy enough to easily facilitate benthos sampling.

Fig. 5 Deployment of small ROV with "garage" mounted on former boxcore frame

5. BIOSYS Methods and Some Results

5.1. Seawater Chemistry

We collected samples from the boxcore and waterbox for the measurement of dissolved inorganic nitrogen and phosphorous (NUTS, Appendix IV)), dissolved organic nitrogen and phosporous (DON/DOP), total organic carbon (TOC) and dissolved inorganic carbon (DIC). The NUTS, DON/DOP samples were filtered over a 0.2 µm Acrodisc and stored at –20°C, TOC was taken with a syringe and directly injected into a glass vial (15 ml), fixed with 8-10 drops concentrated phosphoric acid, sealed air-tight and stored at +4°C. For DIC a glass vial containing 20 µL saturated HgCl was carefully filled to the rim with seawater filtered over a 0.2 µm Acrodisc and stored at +4°C. All samples will be analysed at NIOZ later.

5.2 Microbial Abundance and Diversity

One of the main goals of BIOSYS is to study the microbial community structure and activity in deep coral reefs and the role of microbes in the functioning and nutrition of the corals. We aim at comparing several different deep water coral reef ecosystems to further elucidate the physiological and nutritional requirements of the deep water corals *Lophelia pertusa* and *Madrepora oculata* and the solitary corals *Desmophyllum* spp. We have already been studying the Rockall Trough/Rockall Bank and Mingulay area during cruises in 2005 and 2006 (cruise reports). We mainly investigate the microbial abundance, diversity and productivity in the ambient seawater, the deep water corals and some sponges. We carried out an experiment where seawater of the gastral cavity, mucus and ambient seawater (coelenteric fluid) are compare for prokaryote abundance (Bacteria, Archaea and Viruses) and diversity. This should shed light on the question if *Lophelia pertusa* is capable of "bacterial gardening". Other samples were collected to assess the role of allelochemicals from corals as defence system against bacteria. Radioisotope labelling of *L. pertusa* with ^{14}C-bicarbonate or ^{3}H-Leucine was carried out to estimate the contribution of auto- and or heterotrophic microorganisms to the coral metabolism.

We took seawater samples to determine microbial abundance and diversity from seawater of boxcore and CTD. Different sampling protocols were followed to determine bacteria, archaea and virus abundance. Seawater samples for analyses a) to e) from boxcores were prefiltered over a 0.8 µm polycarbonate membrane to remove suspended sediment. Some controls were taken without pre-filtration for comparison.

a) DAPI staining: For DAPI (4,6-diamidino-2-phenylindole) staining we used 5 ml of seawater. Seawater samples were fixed with glutaraldehyde and stained with DAPI, filtered onto a 0.2 µm pore size black polycarbonate membrane filter, embedded in immersion oil on a object slide and stored at –20°C. Counts will be done using an epifluorescence microscope.
b) Sample fixation for CARDFISH by adding formaldehyde to 20 ml seawater and fixation for 1 h at 4°C, the fixed sample was filtered on a µm pore size white polycarbonate membrane filter and stored at –20°C until further processing.
c) SYBRGreen I staining: 2 ml seawater sample were filtered over a 0.02 µm Anodisc filter (Whatman) to collect both bacteria and viruses, the filter was place on top of the stain SYBRGreen I and stained for 15 minutes. The filter was blotted dry and placed in a glycerol/PBS mix onto a glass slide and stored at –20°C. Counts will be done using an epifluorescence microscope.
d) Flow Cytometry (FCM): to determine bacteria and virus abundance by flow cytometry 1 ml seawater sample was fixed with glutaraldehyde for 10 minutes, flash frozen in liquid nitrogen and stored at –80°C. Also, to compare gastral cavity, mucus and ambient seawater samples, 5muL samples were taken and diluted to 250 muL and fixed for later analyses with the FCM.
e) DGGE/TRFLP for microbial diversity – Cells from 2 L of seawater were subsequently filtered onto a 0.8 µm and 0.2 µm polycarbonate filter and filters were frozen at –80°C for analyses of bacterial and archaeal diversity using denaturing

gradient gel electrophoresis (DGGE) (LOV) or Terminal restriction fragment length polymorphisms (TRFLP) (NIOZ). Bacteria on the tissue of corals and sponges were taken using cotton sticks and frozen at –80°C. Also, pieces of specimen were frozen.

5.3. Uptake Experiments Using Fluorescently Labelled Bacteria

During the cruise uptake experiments of fluorescently labelled bacteria (FLBs) were conducted over a 24 hour interval. During earlier experiments on bacteria feeding we found enhanced bacterial growth in seawater with cold water corals present which would mask any potential uptake of bacteria by the cold water corals. To overcome the problem of the stimulated bacterial growth with corals present, we used FLBs to determine the net uptake of bacteria by cold water corals. The FLBs were already prepared prior to the cruise by G. van Noort at NIOZ and stored at -20°C. For experiments 1 and 2, seawater from close to the sea bottom was taken by CTD and filtered over 0.8 µm to remove nanoflagellates. Fluorescently labeled bacteria were thawn and poured in a 2.5 L bottle which was carefully filled with the filtered seawater taking care that FLBs were thoroughly, but carefully mixed with seawater. For experiment 3 and 4, ultra-filtered seawater was used to also reduce natural bacteria and viruses. Twelve glasses of 200 ml (experiment 1 and 3) or 100 ml (experiment 2 and 4) for each time series in 8 replicate bottles coral branches were placed, while 4 glasses were used as blank (no coral added). Initial concentrations of bacteria and FLBs varied between experiments. From every glass subsamples of 10 and 2 ml were taken initially (T(0)) and after 12 (T(12)), 24 (T(24)) and 36 (T(36)) hours to determine abundance of FLBs and Bacteria, respectively. The 10 ml samples were filtered onto a black polycarbonate filter and mounted onto a microscope slide for later counts of FLBs. The 2ml samples for Bacteria counts were first stained using DAPI and then filtered and prepared similar like FLBs to later determine abundance of live bacteria during experiments.

Fig. 6 Govert van Noort and Markus Weinbauer taking seawater samples to determine bacteria growth and uptake of FLBs in a time series of 24 hours. Setup shows small glass bottles that contain branches with *L. pertusa* and FLBs and glass pots for subsampling seawater from glass pots through time.

Results uptake FLBs:

Back at the NIOZ, FLBs and bacteria were counted by G. van Noort by epifluorescence microscopy. Results showed that *L. pertusa* took up a significant amount of FLBs during experiments (Fig. 7) and that bacteria growth is generally enhanced by the presence of *L. pertusa.* Calculation of bacterial uptake rates revealed that a polyp of *L. pertusa* takes up more than10^6 bacteria per day.

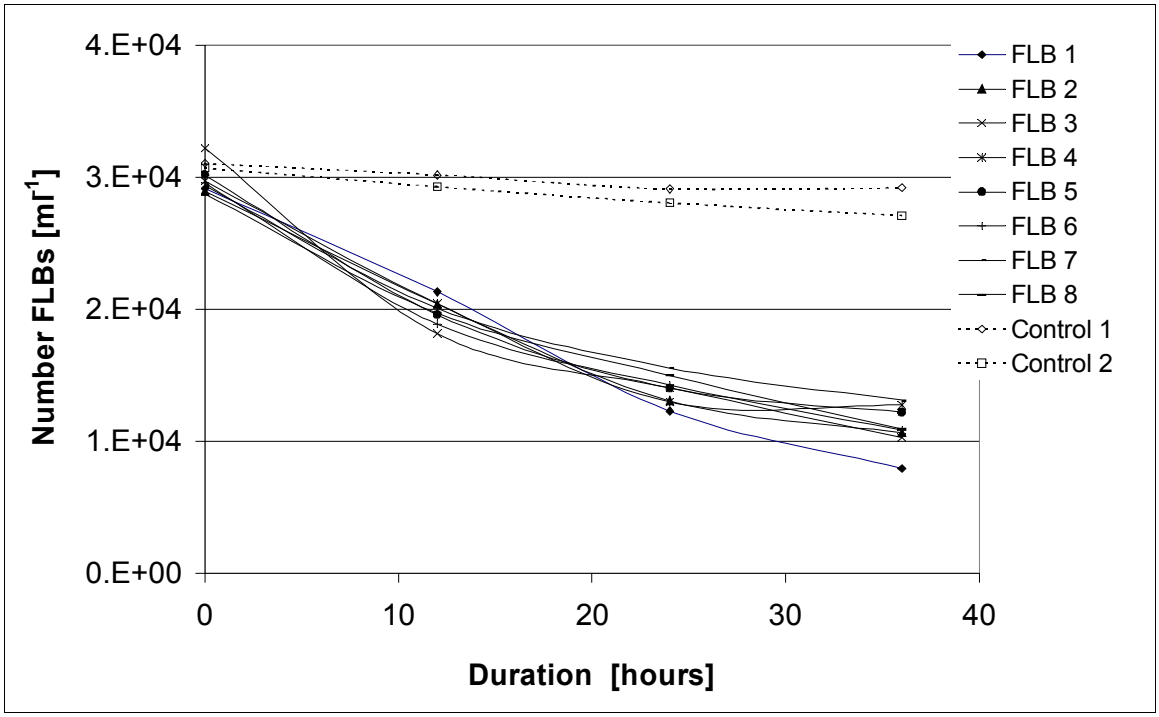

Fig. 7 Uptake of FLB by *L. pertusa.* Lines represent single replicates containing *L. pertusa* and FLBs (FLB 1-FLB 8) and controls without *L. pertusa.* All replicates show the same trend in uptake of FLBs by *L. pertusa* while controls remain almost constant.

5.4. Microbial auto- and heterotrophic production in ambient seawater and coral-associated prokaryotes

Similar to experiments carried out during the BIOSYS/HERMES cruise 2005 (Duyl et al, 2005) and the BIOSYS cruise 2006 (Maier et al, 2006), we conducted several radioisotope labeling experiments to determine seawater productivity and to investigate auto- and heterotrophic microbial activity in prokaryotes associated with the coral *Lophelia pertusa* from Skagerrak reefs.

Seawater collected from CTD, box corer or water box was incubated with either ^{3}H-Leucine (15nM hot and 15nM cold Leucine) or ^{14}C-sodium bicarbonate (50 µCi ml^{-1}) and incubated for 5 or 24 hours, respectively. Seawater was filtered over a 0.2 µm polycarbonate filter. For ^{3}H samples, filters were washed using ice-cold TCA to

precipitate proteins. Samples of ^{14}C incubations were fumed with concentrated HCl in an excicator to release CO_2. Samples were stored at -20°C until scintillation counting at the NIOZ.

Lophelia pertusa

To assess productivity of coral associated prokaryotes, small branches of *L. pertusa* collected at Mingulay were labeled with ^{14}C-sodiumbicarbonate or ^{3}H-Leucine. As a control, several samples were treated with 2.5 ml / 30 ml formaldehyde to kill coral and bacteria prior to experiment. To assess microbial activity in seawater used for radioisotope labeling a set of samples were labeled without *L. pertusa* and run in parallel.

Heterotrophic microbial productivity

Lophelia pertusa samples were incubated for 5 hours at 8-10°C with ^{3}H-Leucine (final concentration was 15 nM of hot and cold Leucine, each) and at the end the experiment was stopped by adding 2.5 ml formaldehyde. Seawater was filtered over a 0.2 µm polycarbonate filter. Coral tissue was dissolved by boiling the coral pieces in 10 ml of 2 N NaOH for at least 20 minutes. A subsample was neutralized with concentrated HCl and vacuum-filtered over a 0.2 µm polycarbonate filter. To precipitate proteins, the filter was rinsed twice with ice-cold TCA and finally rinsed with MilliQ water. The filters were frozen at -20°C and stored for later scintillation analyses in the radioisotope lab at NIOZ.

Autotrophic microbial productivity

The coral samples were incubated for 24 hours with ^{14}C-sodium bicarbonate (50 µCi ml^{-1}). After rinsing samples in filtered seawater the tissue was removed from the coral by heating samples for at least 20 minutes in 2 N NaOH. Skeletons were crunched beforehand to facilitate tissue removal. To release CO_2, filters were fumed for 20 minutes with concentrated HCl and stored at -20°C.

Scintillation counting

For measuring radioactivity in samples Ultima Gold XR scintillation liquid was added to samples and decay was counted in a Wallace 1211 Rack Beta scintillation counter using an external standard and corrected for quenching. For ^{3}H results from measurements of mean blanks (corals/prokaryotes killed prior to adding ^{3}H label) were subtracted from mean results. Blanks of ^{14}C labeling experiments were neglectable and not subtracted from results (Fig. 16).

5.5. Calcification rate of *Lophelia pertusa* under ambient seawater and reduced pH

During the BIOSYS 2006 cruise (Maier et al, 2006) calcification rate of *L. pertusa* from Mingulay reefs were determined at normal seawater pH (Maier et al, 2007). During the BIOSYS 2007 cruise, calcification rate of *L. pertusa* from Skagerrak was measured. In adjacent experiments, coral calcification at lower seawater pH (0.15 and 0.3 units below ambient pH) was tested. For experiments, small branches of *L. pertusa* were

labeled with $^{45}CaCl_2$ added to natural seawater and acidified seawater. Fifteen µL of ^{45}Ca label were added to 30 ml of sample. To controls, 2.5 ml formaldehyde was added prior to labeling experiments. Samples were incubated for 24 h at in situ temperature. After 24 hours, corals were rinsed twice in unlabeled filtered seawater for 1 hour. Whole colonies (containing tissue and skeleton) were immediately frozen at -20°C until further analyses.

5.6. Collection and Maintenance of *L. pertusa* and Other Live Animals

A cooperation between BIOSYS and Rotterdam Zoo has been initiated in begin of 2006. Cold water corals that were not suitable for experiments and other associated fauna were kept at adequate temperature on board R/V Pelagia and transported back to the NIOZ. *Lophelia pertusa* and other animals collected from box corer, that would otherwise have been discarded were thus kept alive. Directly after the cruise, the animals were transported from Texel to Rotterdam Zoo are kept under observation to see which of the animals are well suitable for maintaining in the aquarium and to establish a good environment for the different groups. For Rotterdam Zoo, the ultimate goal was to establish a cold water coral aquarium for public access at the Oceanium. This has been realized after gaining experience with the collections from BIOSYS 2006 and the public exhibition could be successfully established briefly after the BIOSYS 2007 cruise. This cooperation has been profitable to both parties with BIOSYS gaining from the aquarium expertise of Rotterdam Zoo, and Rotterdam Zoo getting access to the fauna of the deep coral reefs. A common ultimate goal herein is to broaden public awareness to the intriguing, but still obscure cold water coral ecosystems.

Part of the *L. pertusa* samples was transported back to the NIOZ climate chambers and will further be used to establish the abundance of potential microbial symbionts within this species. Changes in microbial diversity will be monitored while corals are kept under variable conditions at aquarium facilities of M. Weinbauer at LOV, France.

6. Report on the Porifera of *Lophelia* reefs in the Skagerrak (Rob van Soest)

Sponges are investigated within the BIOSYS project as a model taxon for tracing the connectivity of Eastern Atlantic Cold Water Coral Reefs. Sponges are a major part of the filter community and some species may interact with live corals. Species richness and composition of sponges are compared in reefs lying approximately in the same latitude but following a gradient from deep-oceanic to shallow near-shore. Numbers of shared vs. endemic species and relative degrees of richness and evenness are a proxy of larval exchange of these reefs.

Like in the previous BIOSYS cruises sponges were removed from the boxcore samples, identified on board, and preserved in alcohol 96% for further studies ashore. Large specimens were photographed prior to preservation. A large number of fragments of branches were preserved in toto for identification of the smaller sponge species in the laboratory in Amsterdam.

Sponge samples obtained

A total of 102 samples consisting of one or more individuals of a given species were obtained from 15 boxcores. Two of these boxcores did not contain any sponges. A total of 47 species were found (see list of species below). The richest boxcore was BX72 which yielded 15 species. However, since considerable numbers of branch fragments from several boxcores are not yet analyzed, all these results remain tentative and preliminary.

The Swedish colleagues Tomas Lundalv and Lisbeth Jonsson have made many ROV video recordings in the recent past and in these several species could be recognized, which have not been obtained in the boxcores. Notably among these are *Antho (Antho) dichotoma*, *Axinella rugosa*, and *Stryphnus ponderosus*, while of the apparently very common *Phakellia ventilabrum* only one very small specimen was obtained. This leads to the conclusion that our survey cannot be considered comprehensive as the number of boxcore samples is clearly too low and they were partially also taken in unsuitable areas.

At the request of Fleur van Duyl, four fragments of sponges were frozen in liquid nitrogen immediately after collection. These will be used for measuring ATP activity. The four fragments are numbered as follows:

1. *Mycale (Mycale) lingua* from BX 72
2. *Geodia barretti* from BX 141
3. *Stelletta normani* from BX 141
4. *Iophon piceus* from BX 104

Interesting records

Our results may be compared with a regional monograph on the sponges of the Swedish west coast (Alander, 1942), obtained by many dredgings, which discusses many records from *Lophelia* reefs. Most of the sponges we obtained were also previously recorded by Alander (and before him by Fristedt, 1885), but we collected several species not described in these local monographs: *Pachastrella monilifera, Alectona millari, Iophon dubius, Desmacella annexa, Bubaris vermiculata, Acanthella erecta,* and several *Hymedesmia* species. A further remarkable observation is the richness and high abundance of *Iophon* species in the Skagerrak reefs. Especially, *Iophon piceus* appears to be one of the most abundant species, along with *Geodia barretti* and *Mycale (Mycale) lingua*.

An important observation is also the extent to which sponges appear to compete with live *Lophelia* colonies, which has not been noted in our previous BIOSYS cruises. *Hymedesmia (Stylopus) coriacea* manifests itself in many living reefs as a pale orange thin encrustation, completely covering the polyps, and itself covered in mucous (which presumably is exuded by the coral as a defensive reaction). Additionally, *Mycale (Mycale) lingua* frequently grows on live branches of *Lophelia*, smothering it by its sheer size.

Fig. 8 Live coral branch overgrown by *Hymedesmia coriacea* (Foto: M. Weinbauer)

Comparison of Skagerrak reefs with Mingulay and Rockall reefs

This comparison is difficult because there is a large discrepancy between the numbers of samples taken during the various cruises, with Rockall Bank boxcores (104) sevenfold that of the Skagerak (15). The present number of boxcores lies well below the threshold of 20-25 boxcore samples needed for a representative coverage of the sponge diversity (see results of Van Soest & Lavaleye, 2005; Van Soest et al. submitted). In addition, the branches left for study in Amsterdam may be expected to yield 10 – 20 additional species, so a comparison can only give a first indication.

Area	N shared	N different
Mingulay	22	25
Rockall (incl. Porcupine)	20	27
Combined Mingulay+ Rockall	29 (61%)	18 (39%)

The number of species shared with both Rockall and Mingulay is 13 (28%), among which are species that appear equally common in all three reef locations like *Plocamionida ambigua* and *Hymedesmia (Stylopus) coriacea*. Others differ strongly in abundance, such as *Mycale (Mycale) lingua*, which is rare in Rockall, but dominant in Skagerak reefs.

Porifera Species List BIOSYS 2007: Skagerak CWReefs

Demospongiae: **Astrophorida**
Stelletta normani Sollas, 1880
Stelletta spec. yellow balls
Geodia barretti Bowerbank, 1858
Pachastrella monilifera Schmidt, 1870

Hadromerida
Sphaerotylus capitatus (Vosmaer, 1882)
Tentorium semisuberites (Schmidt, 1870)
Protosuberites incrustans (Hansen, 1885)
Alectona millari Carter, 1879

Poecilosclerida: **Microcionina**
Iophon piceus (Vosmaer, 1882)
Iophon dubius Lundbeck, 1905
Iophon variopocillatum Alander, 1942
Clathria (Microciona) bitoxa (Burton, 1930)
Clathria (Microciona) ctenichela (Alander, 1942)
Clathria (Microciona) aff. *anchorata* (Carter, 1874)
Eurypon radiatum (Bowerbank, 1866)
Eurypon aff. *scabiosum* (Topsent, 1927)
Eurypon viride (Topsent, 1889)

Myxillina
Forcepia forcipis (Bowerbank, 1866)
Lissodendoryx (Lissodendoryx) fragilis (Fristedt, 1885)
Hymedesmia (Hymedesmia) bocki Alander, 1942
Hymedesmia (Hymedesmia) bractea Lundbeck, 1910
Hymedesmia (Hymedesmia) clavigera (Levinsen, 1887)
Hymedesmia (Hymedesmia) peachi(Bowerbank, 1882)
Hymedesmia (Hymedesmia) paupertas (Bowerbank, 1866)
Hymedesmia (Hymedesmia) rugosa
Hymedesmia (Stylopus) coriacea (Fristedt, 1885)
Plocamionida ambigua (Bowerbank, 1866)
Crella (Grayella) schottlaenderi Arndt, 1913
Myxilla (Myxilla) fimbriata (Bowerbank, 1866)

Mycalina
Biemna variantia (Bowerbank, 1866)
Desmacella annexa Schmidt, 1870
Hamacantha (Vomerula) falcula (Bowerbank, 1874)
Mycale (Mycale) lingua (Bowerbank, 1866)
Mycale (Rhaphidotheca) marshallhalli (Kent, 1870)

Halichondrida
Phakellia ventilabrum Bowerbank, 1862
Bubaris vermiculata (Bowerbank, 1866)
Acanthella erecta (Carter, 1876)
Hymeniacidon fallax (Bowerbank, 1861)

Haplosclerida
Haliclona (Haliclona) urceolus (Rathke & Vahl, 1806)
Haliclona (Gellius) arnesenae (Lundbeck, 1902)

Dictyoceratida
Dysidea aff. *fragilis* (Montagu, 1818)
Pleraplysilla spinifera Schulze, 1879

Dendroceratida
Aplysilla sulfurea Schulze, 1878

Halisarcida
Halisarca dujardini Johnston, 1842

Calcarea: **Calcaronea**: **Leucosolenida**
Sycon ciliatum Fabricius, 1870
Aphroceras ensata Gray, 1867
Ute gladiata Borojevic, 1967

7. Rationale for participation of Swedish scientists in the BIOSYS cruise with R/V Pelagia in the Skagerrak, March 8 – 16, 2007 (by Tomas Lundalv)

0 An important objective for the Swedish participation was utilisation of the capabilities of R/V Pelagia for multibeam bathymetry mapping of hitherto unmapped parts of NE Skagerrak. It is anticipated that the data obtained will be of great value in future attempts to localise biological hot-spots, such as cold-water coral assemblages, in on-going ground-truthing operations utilising ROV- and drop-camera techniques. The data will also be of great value in on-going projects centered on development of techniques for predictive habitat mapping.

1 A second objective was to utilise available equipment on board Pelagia for ground-truthing of certain observed benthic structures. This proved to be a difficult task on the present cruise, both due to unfavourable weather conditions (high swell) and lack of precise underwater positioning techniques. However, valuable data that can be used to quantify occurrence of sediment epifauna (such as pennatulaceans) in relation to trawl fishery intensity were obtained. A new locality with occurrence of dense gorgonian coral stands was also identified.

2 A third objective was to obtain additional samples for an on-going study aimed at fine-scaled genetic characterisation of populations of *Lophelia pertusa* in the NE Skagerrak. A substantial addition of samples were obtained.

3 A fourth objective was to obtain additional information on fauna occurring in association with cold-water coral habitats. A substantial amount of information and samples were obtained, and of particular value was the presence of a specialist in Poriferan taxonomy (Dr. Rob van Soest).

4 A fifth objective was to obtain additional information on the occurrence of a lethal pandemic in the poriferan species *Geodia baretti*, that had been observed in a few localities in previous cruises. The Pelagia cruise yielded a large number of new observations on the geographical and quantitative extent of this pandemic, as well as samples of *Geodia* specimens in various stages of influence from the disease, that may possibly lead to clues with respect to the origin of the pandemic.

5 A final objective of the Swedish participation was to share existing know-how with respect to coral distribution and condition in the investigated area, in order to assist the objectives of other participating scientists.

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Appendix I. Scientific party and crew of RV Pelagia during BIOSYS cruise 2006

R/V Pelagia:
John Betsema (crew)
Cees G. de Graaff (Captain)
Mark de Vries (2nd officer)
Klaas Kikkert (1st engineer)
Jan Korver (cook)
Hans List (2nd engineer)
Bert Puyman (1st officer)
Cor T. Stevens (crew)
Ron van der Slikke (crew)
Jose Vittoria (crew)

BIOSYS:
Royal Netherlands Institute for Sea Research (NIOZ), NL:
Sander Asjes (electronics engineer)
Jan Hegeman (radioisotope technician)
Conny Maier (chief scientist)
Govert van Noort (lab technician, microbiology)
Jan-Willem Schmelling (electronics engineer)
Leon Wuis (mechanical engineer)
Laboratoire Océanographie de Villefranche (LOV), France:
Markus G. Weinbauer (scientist)
University of Amsterdam, NL:
Rob van Soest (scientist)
Ozeanium, Rotterdam Zoo, NL:
Michaël Laterveer (scientist)
Rijksuniversiteit van Groningen (RUG), NL:
Julie Ogier (stagiaire)
University of Cadiz, Spain:
Beatriz Gómez-Carreño Sánchez (stagiaire)

NON-BIOSYS:
Tjärnö Marine Biological Laboratory (TMBL), Sweden:
Genoveva Gonzalez-Mirelis (scientist)
Lisbeth Jonson (scientist)
Tomas Lundalv (scientist)

The SEAfoundation, NL:
Mattijs de Lange (hydrographer)

Appendix II - Logbook

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
1	1	CTD	Begin	Mar 08 2007 18:05:21	58.492	10.201	438	
1	1	CTD	Bottom	Mar 08 2007 18:12:59	58.492	10.201	439	
1	1	CTD	End	Mar 08 2007 18:31:14	58.492	10.201	437	
2	1	Boxcore	Bottom	Mar 09 2007 11:21:29	58.390	10.437	321	Failed
3	1	Boxcore	Bottom	Mar 09 2007 13:35:17	58.386	10.433	321	
4	1	CTD	Begin	Mar 09 2007 14:42:20	58.480	10.449	321	
4	1	CTD	Bottom	Mar 09 2007 14:47:38	58.479	10.448	321	
4	1	CTD	End	Mar 09 2007 15:04:38	58.479	10.449	321	
5	1	MULTIBEAM	Bottom	Mar 09 2007 15:13:10	58.480	10.449	321	start multibeam track 1
5	2	MULTIBEAM	Bottom	Mar 09 2007 17:16:12	58.474	10.129	507	end multibeam track 1
6	1	MULTIBEAM	Bottom	Mar 09 2007 17:47:37	58.469	10.135	514	start multibeam track 2
6	2	MULTIBEAM	Bottom	Mar 09 2007 22:45:16	58.876	10.746	95	end multibeam track 2
7	1	MULTIBEAM	Bottom	Mar 09 2007 22:55:09	58.876	10.750	95	start multibeam track 3
8	1	MULTIBEAM	Bottom	Mar 10 2007 04:39:53	58.476	10.157	474	end multibeam track 3
9	1	MULTIBEAM	Bottom	Mar 10 2007 04:48:05	58.482	10.167	471	start multibeam track 4
10	1	MULTIBEAM	Bottom	Mar 10 2007 06:14:21	58.484	10.450	277	end multibeam track 4
11	1	Hopper camera start	In water	Mar 10 2007 07:38:04	58.371	10.400	360	
11	3	Hopper camera end	Out water	Mar 10 2007 08:22:19	58.367	10.394	372	
12	1	Hopper camera start	In water	Mar 10 2007 08:35:08	58.372	10.401	357	
12	2	Hopper camera end	Out water	Mar 10 2007 09:11:58	58.366	10.395	370	
13	1	MULTIBEAM	Bottom	Mar 10 2007 09:50:46	58.426	10.397	342	start multibeam track 5
14	1	MULTIBEAM	Bottom	Mar 10 2007 10:45:44	58.513	10.444	254	end multibeam track 5
15	1	MULTIBEAM	Bottom	Mar 10 2007 10:57:47	58.512	10.443	261	start multibeam tack 6
16	1	MULTIBEAM	Bottom	Mar 10 2007 12:40:55	58.639	10.704	101	end multibeam track 6
17	1	Boxcore	Bottom	Mar 10 2007 14:45:24	58.638	10.703	82	failed
17	2	Boxcore	Bottom	Mar 10 2007 15:07:45	58.639	10.704	90	
17	3	Boxcore	Bottom	Mar 10 2007 15:47:30	58.639	10.704	87	
17	4	50 m pump	Bottom	Mar 10 2007 16:50:17	58.638	10.703	85	start pumping
17	5	50 m pump	Bottom	Mar 10 2007 17:52:14	58.639	10.704	82	stop pumping
18	1	MULTIBEAM	Bottom	Mar 10 2007 19:29:08	58.521	10.614	161	start multibeam track 7
18	2	MULTIBEAM	Bottom	Mar 10 2007 21:05:00	58.662	10.432	168	end multibeam track 7
19	1	MULTIBEAM	Bottom	Mar 10 2007 21:14:39	58.659	10.426	177	start multibeam track 8
20	1	MULTIBEAM	Bottom	Mar 10 2007 22:53:31	58.520	10.607	165	end multibeam track 8
21	1	MULTIBEAM	Bottom	Mar 10 2007 23:01:17	58.519	10.602	167	start multibeam track 9
22	1	MULTIBEAM	Bottom	Mar 11 2007 00:32:05	58.657	10.424	174	end multibeam track 9
23	1	MULTIBEAM	Bottom	Mar 11 2007 00:46:21	58.659	10.412	191	start multibeam track 10
24	1	MULTIBEAM	Bottom	Mar 11 2007 02:25:30	58.519	10.594	164	end multibeam track 10
25	1	MULTIBEAM	Bottom	Mar 11 2007 02:34:38	58.519	10.590	168	start multibeam track 11
26	1	MULTIBEAM	Bottom	Mar 11 2007 03:29:13	58.595	10.491	185	end multibeam track 11
27	1	Hopper camera start	In water	Mar 11 2007 08:13:48	58.370	10.351	407	
28	1	Hopper camera mid	Transect point	Mar 11 2007 08:55:57	58.367	10.343	398	
29	1	Hopper camera end	Out water	Mar 11 2007 09:18:01	58.366	10.341	400	
30	1	MULTIBEAM	Bottom	Mar 11 2007 10:40:39	58.488	10.444	280	start multibeam track 12
31	1	MULTIBEAM	Bottom	Mar 11 2007 11:30:09	58.490	10.287	372	end multibeam track 12 (interrupted)
32	1	Hopper camera start	In water	Mar 11 2007 13:39:57	58.349	10.459	371	
33	1	Hopper camera end	Out water	Mar 11 2007 14:04:07	58.351	10.455	310	
34	1	MULTIBEAM	Bottom	Mar 11 2007 15:21:06	58.490	10.290	380	start multibeam track 12 (continued)
34	2	MULTIBEAM	Bottom	Mar 11 2007 15:58:56	58.490	10.171	458	end multibeam track 12
35	1	MULTIBEAM	Bottom	Mar 11 2007 16:04:36	58.496	10.173	452	start multibeam track 13
35	2	MULTIBEAM	Bottom	Mar 11 2007 17:23:53	58.495	10.441	285	end multibeam track 13
36	1	MULTIBEAM	Bottom	Mar 11 2007 17:32:19	58.501	10.439	284	start multibeam track 14
36	2	MULTIBEAM	Bottom	Mar 11 2007 18:58:14	58.505	10.177	441	end multibeam track 14
37	1	MULTIBEAM	Bottom	Mar 11 2007 19:03:32	58.511	10.176	437	start multibeam track 15
37	2	MULTIBEAM	Bottom	Mar 11 2007 20:17:43	58.507	10.439	267	end multibeam track 15
38	1	MULTIBEAM	Bottom	Mar 11 2007 20:25:26	58.511	10.445	257	start multibeam track 16
39	1	MULTIBEAM	Bottom	Mar 11 2007 21:43:47	58.518	10.198	411	end multibeam track 16
40	1	MULTIBEAM	Bottom	Mar 11 2007 21:53:42	58.526	10.205	400	start multibeam track 17
41	1	MULTIBEAM	Bottom	Mar 11 2007 23:05:57	58.516	10.451	245	end of multibeam track 17
42	1	MULTIBEAM	Bottom	Mar 11 2007 23:18:19	58.520	10.462	230	start of multibeam track 18
43	1	MULTIBEAM	Bottom	Mar 12 2007 00:44:29	58.533	10.220	391	end multibeam track 18
44	1	MULTIBEAM	Bottom	Mar 12 2007 00:51:14	58.541	10.220	372	start multibeam track 19
45	1	MULTIBEAM	Bottom	Mar 12 2007 02:16:40	58.524	10.468	225	end multibeam track 19
46	1	MULTIBEAM	Bottom	Mar 12 2007 02:22:37	58.528	10.474	220	start multibeam track 20
47	1	MULTIBEAM	Bottom	Mar 12 2007 02:44:19	58.531	10.418	281	end multibeam track 20
48	1	ROV start	In water	Mar 12 2007 08:09:30	58.890	10.787	75	Test with Frame only
49	1	ROV end	Out water	Mar 12 2007 08:19:55	58.891	10.787	77	
50	1	ROV start	In water	Mar 12 2007 09:04:44	58.890	10.787	74	
51	1	ROV end	Out water	Mar 12 2007 10:08:25	58.890	10.787	75	
52	1	ROV start	In water	Mar 12 2007 12:36:44	59.014	11.117	82	
53	1	ROV end	Out water	Mar 12 2007 13:49:38	59.014	11.116	91	
54	1	ROV start	In water	Mar 12 2007 14:04:42	59.014	11.117	79	
55	1	ROV end	Out water	Mar 12 2007 15:03:28	59.014	11.117	80	

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
56	1	Boxcore	Bottom	Mar 12 2007 15:35:24	59.014	11.117	78	
57	1	Boxcore	Bottom	Mar 12 2007 16:00:58	59.014	11.117	79	
58	1	MULTIBEAM	Bottom	Mar 12 2007 16:27:16	59.043	11.134	136	start multibeam track 21
59	1	MULTIBEAM	Bottom	Mar 12 2007 16:35:07	59.056	11.155	108	end multibeam track 21
60	1	MULTIBEAM	Bottom	Mar 13 2007 06:37:20	59.056	11.156	132	start multibeam track 22
61	1	MULTIBEAM	Bottom	Mar 13 2007 06:43:20	59.048	11.144	150	end multibeam track 22
62	1	Boxcore	Bottom	Mar 13 2007 07:10:00	59.014	11.118	88	
63	1	MULTIBEAM	Bottom	Mar 13 2007 07:44:25	59.043	11.132	135	start multibeam track 23
64	1	MULTIBEAM	Bottom	Mar 13 2007 08:15:56	59.052	11.145	43	end multibeam track 23
65	1	ROV start	In water	Mar 13 2007 08:27:15	59.053	11.145	42	
66	1	Hopper camera end	Out water	Mar 13 2007 10:49:38	59.053	11.145	114	
67	1	MULTIBEAM	Bottom	Mar 13 2007 11:39:02	58.984	11.011	102	start multibeam track 24
68	1	MULTIBEAM	Bottom	Mar 13 2007 11:59:45	59.005	10.954	73	end multibeam track 24
69	1	MULTIBEAM	Bottom	Mar 13 2007 12:49:35	59.068	10.745	86	start multibeam track 25
70	1	MULTIBEAM	Bottom	Mar 13 2007 14:02:56	59.082	10.732	67	end multibeam track 25
71	1	Boxcore	Bottom	Mar 13 2007 14:32:59	59.076	10.736	112	failed
72	1	Boxcore	Bottom	Mar 13 2007 14:40:20	59.076	10.736	109	
73	1	Boxcore	Bottom	Mar 13 2007 15:31:33	59.076	10.736	107	
74	1	CTD	Begin	Mar 13 2007 16:17:30	59.076	10.736	107	
74	1	CTD	Bottom	Mar 13 2007 16:20:12	59.076	10.736	106	
74	1	CTD	End	Mar 13 2007 16:31:03	59.076	10.736	106	
75	1	MULTIBEAM	Bottom	Mar 13 2007 18:07:18	58.893	10.643	154	start multibeam track 26
76	1	MULTIBEAM	Bottom	Mar 13 2007 19:22:47	58.785	10.602	112	end multibeam track 26
77	1	MULTIBEAM	Bottom	Mar 13 2007 19:26:27	58.785	10.600	112	start multibeam track 27
78	1	MULTIBEAM	Bottom	Mar 13 2007 20:28:20	58.893	10.637	150	end multibeam track 27
79	1	MULTIBEAM	Bottom	Mar 13 2007 20:37:32	58.894	10.630	236	start multibeam track 28
80	1	MULTIBEAM	Bottom	Mar 13 2007 21:45:06	58.786	10.596	115	end multibeam track 28
81	1	MULTIBEAM	Bottom	Mar 13 2007 21:52:16	58.787	10.592	114	start multibeam track 29
82	1	MULTIBEAM	Bottom	Mar 13 2007 22:52:24	58.894	10.621	236	end of multibeam track 29
83	1	MULTIBEAM	Bottom	Mar 13 2007 23:01:02	58.895	10.614	236	start of multibeam track 30
84	1	MULTIBEAM	Bottom	Mar 13 2007 23:41:24	58.842	10.608	126	end of multibeam track 30
85	1	MULTIBEAM	Bottom	Mar 13 2007 23:43:27	58.842	10.607	127	start multibeam track 31
86	1	MULTIBEAM	Bottom	Mar 14 2007 00:13:02	58.893	10.603	233	end multibeam track 31
87	1	MULTIBEAM	Bottom	Mar 14 2007 00:17:09	58.897	10.598	188	start multibeam track 32
88	1	MULTIBEAM	Bottom	Mar 14 2007 01:13:32	58.836	10.604	129	end multibeam track 32
89	1	MULTIBEAM	Bottom	Mar 14 2007 01:16:21	58.835	10.602	132	start multibeam track33
90	1	MULTIBEAM	Bottom	Mar 14 2007 01:43:57	58.887	10.585	214	end multibeam track 33
91	1	MULTIBEAM	Bottom	Mar 14 2007 01:48:05	58.891	10.580	198	start multibeam track 34
92	1	MULTIBEAM	Bottom	Mar 14 2007 02:33:06	58.831	10.597	125	end multibeam track 34
93	1	MULTIBEAM	Bottom	Mar 14 2007 02:36:14	58.830	10.594	126	start multibeam track 35
94	1	MULTIBEAM	Bottom	Mar 14 2007 03:13:18	58.888	10.571	186	end multibeam track 35
95	1	MULTIBEAM	Bottom	Mar 14 2007 03:20:21	58.889	10.564	161	start multibeam track 36
96	1	MULTIBEAM	Bottom	Mar 14 2007 04:09:10	58.827	10.589	130	end multibeam track 36
97	1	MULTIBEAM	Bottom	Mar 14 2007 04:14:43	58.826	10.585	136	start multibeam track 37
98	1	MULTIBEAM	Bottom	Mar 14 2007 04:56:00	58.889	10.557	152	end multibeam track 37
99	1	MULTIBEAM	Bottom	Mar 14 2007 05:02:50	58.885	10.567	227	start multibeam track 38
100	1	MULTIBEAM	Bottom	Mar 14 2007 05:20:12	58.893	10.588	171	end multibeam track 38
101	1	MULTIBEAM	Bottom	Mar 14 2007 06:49:14	59.085	10.806	140	start multibeam track 39
103	1	MULTIBEAM	Bottom	Mar 14 2007 08:17:14	59.094	10.798	95	end multibeam track 39
102	1	Boxcore	Bottom	Mar 14 2007 08:30:38	59.094	10.798	97	
104	1	Boxcore	Bottom	Mar 14 2007 08:59:25	59.094	10.798	99	
105	1	MULTIBEAM	Bottom	Mar 14 2007 09:57:15	59.072	10.747	123	start multibeam track 40
106	1	MULTIBEAM	Bottom	Mar 14 2007 10:04:31	59.073	10.737	126	end multibeam track 40
107	1	Boxcore	Bottom	Mar 14 2007 10:25:17	59.072	10.741	117	
108	1	ROV start	In water	Mar 14 2007 12:31:04	59.074	10.738	87	
109	1	ROV end	Out water	Mar 14 2007 14:23:03	59.074	10.738	85	
110	1	ROV start	In water	Mar 14 2007 14:45:29	59.072	10.741	101	
111	1	ROV end	Out water	Mar 14 2007 15:18:29	59.072	10.741	100	
112	1	CTD	Begin	Mar 14 2007 15:48:27	59.071	10.740	127	
112	1	CTD	Bottom	Mar 14 2007 15:50:41	59.071	10.740	128	
112	1	CTD	End	Mar 14 2007 16:01:06	59.071	10.740	129	
113	1	MULTIBEAM	Bottom	Mar 14 2007 16:51:36	59.025	10.738	412	start multibeam track 41
114	1	MULTIBEAM	Bottom	Mar 14 2007 17:12:15	58.993	10.705	198	end multibeam track 41
115	1	MULTIBEAM	Bottom	Mar 14 2007 18:00:07	58.881	10.624	296	start multibeam track 42
116	1	MULTIBEAM	Bottom	Mar 14 2007 19:04:34	58.794	10.531	140	end multibeam track 42
117	1	MULTIBEAM	Bottom	Mar 14 2007 19:11:45	58.794	10.535	135	start multibeam track 43
118	1	MULTIBEAM	Bottom	Mar 14 2007 20:30:14	58.796	10.527	146	end multibeam track 43
119	1	MULTIBEAM	Bottom	Mar 14 2007 20:36:19	58.794	10.519	124	start multibeam track 44
120	1	MULTIBEAM	Bottom	Mar 14 2007 21:06:46	58.842	10.582	121	end multibeam track 44
121	1	MULTIBEAM	Bottom	Mar 14 2007 21:15:58	58.836	10.602	134	start multibeam track 45
122	1	MULTIBEAM	Bottom	Mar 14 2007 21:46:59	58.794	10.538	133	end multibeam track 45
123	1	MULTIBEAM	Bottom	Mar 14 2007 21:54:18	58.792	10.539	126	start multibeam track 46

Station/ Track	Cast/ Action	Type	Event	Datum/ Tijd	Lat	Lon	Diepte	Opmerking
124	1	MULTIBEAM	Bottom	Mar 14 2007 23:15:53	58.890	10.633	147	end multibeam track 46
125	1	MULTIBEAM	Bottom	Mar 14 2007 23:51:59	58.955	10.612	150	start multibeam track 47
126	1	MULTIBEAM	Bottom	Mar 15 2007 00:59:47	58.879	10.472	154	end multibeam track 47
127	1	MULTIBEAM	Bottom	Mar 15 2007 01:04:53	58.880	10.467	158	start multibeam track 48
128	1	MULTIBEAM	Bottom	Mar 15 2007 02:14:55	58.954	10.604	174	end multibeam track 48
129	1	MULTIBEAM	Bottom	Mar 15 2007 02:19:44	58.956	10.603	174	start multibeam track 49
130	1	MULTIBEAM	Bottom	Mar 15 2007 03:27:50	58.885	10.462	166	end multibeam track 49
131	1	MULTIBEAM	Bottom	Mar 15 2007 03:33:32	58.891	10.468	167	start multibeam track 50
132	1	MULTIBEAM	Bottom	Mar 15 2007 04:19:06	58.953	10.586	129	end multibeam track 50
133	1	MULTIBEAM	Bottom	Mar 15 2007 04:23:47	58.955	10.581	122	start multibeam track 51
134	1	MULTIBEAM	Bottom	Mar 15 2007 04:51:38	58.925	10.514	155	end multibeam track 51
135	1	MULTIBEAM	Bottom	Mar 15 2007 04:55:59	58.928	10.510	161	start multibeam track 52
136	1	MULTIBEAM	Bottom	Mar 15 2007 05:24:05	58.958	10.577	185	end multibeam track 52
137	1	Boxcore	Bottom	Mar 15 2007 07:10:57	59.072	10.741	115	
138	1	Boxcore	Bottom	Mar 15 2007 07:40:29	59.072	10.741	116	
139	1	ROV start	In water	Mar 15 2007 08:28:18	59.072	10.741	117	
140	1	ROV end	Out water	Mar 15 2007 09:34:40	59.072	10.742	76	
141	1	Boxcore	Bottom	Mar 15 2007 10:14:10	59.078	10.732	112	
142	1	Boxcore	Bottom	Mar 15 2007 10:47:26	59.078	10.732	114	
143	1	MULTIBEAM	Bottom	Mar 15 2007 12:20:15	58.936	10.555	155	start multibeam track 53
144	1	MULTIBEAM	Bottom	Mar 15 2007 12:59:34	58.884	10.490	172	end of multibeam track 53
145	1	MULTIBEAM	Bottom	Mar 15 2007 13:03:07	58.882	10.493	162	start multibeam track 54
146	1	MULTIBEAM	Bottom	Mar 15 2007 13:24:36	58.913	10.532	171	end multibeam track 54
147	1	Hopper camera start	In water	Mar 15 2007 13:55:50	58.919	10.534	215	Drop camera (Tomas)
148	1	Hopper camera end	Out water	Mar 15 2007 15:07:38	58.918	10.539	221	
149	1	MULTIBEAM	Bottom	Mar 15 2007 15:45:48	58.897	10.516	168	start multibeam track 55
150	1	MULTIBEAM	Bottom	Mar 15 2007 16:25:50	58.947	10.607	151	end multibeam track 55
151	1	MULTIBEAM	Bottom	Mar 15 2007 16:31:23	58.945	10.612	151	start multibeam track 56
152	1	MULTIBEAM	Bottom	Mar 15 2007 17:25:22	58.882	10.503	159	end multibeam track 56
153	1	MULTIBEAM	Bottom	Mar 15 2007 20:31:03	58.531	10.428	251	start multibeam track 57
154	1	MULTIBEAM	Bottom	Mar 15 2007 22:07:37	58.548	10.242	329	end multibeam track 57
155	1	MULTIBEAM	Bottom	Mar 15 2007 22:16:40	58.548	10.247	21	start multibeam track 58
156	1	MULTIBEAM	Bottom	Mar 15 2007 23:21:58	58.532	10.396	277	end multibeam track 58
157	1	MULTIBEAM	Bottom	Mar 15 2007 23:51:58	58.529	10.485	214	start multibeam track 59
158	1	MULTIBEAM	Bottom	Mar 16 2007 02:13:13	58.552	10.256	331	end multibeam track 59
159	1	MULTIBEAM	Bottom	Mar 16 2007 02:18:00	58.554	10.256	331	start multibeam track 60
160	1	MULTIBEAM	Bottom	Mar 16 2007 02:51:55	58.540	10.359	329	end multibeam track 60

Appendix III - Boxcore Description and Photos

PHYLUM			GENUS+SP	BX 16	BX 17	BX 56	BX 57	BX 62	BX 72	BX 73	BX 102	BX 103	BX 107	BX 137	BX 138	BX 141	BX 142
PORIFERA			*Hymedesmia coriacea*	X										X	X		
PORIFERA			*Iophone sp*	X													
PORIFERA			*Hymeniacidon fallax*			X											
PORIFERA			*Ute gladiata*			X											
PORIFERA			*Sycon ciliatum*					X									
PORIFERA			*Iophon piceus*					X									
PORIFERA			*Mycale lingua*						X			X		X	X		
PORIFERA			*Geodia barreti*						X		X				X	X	
PORIFERA			*Halisarca dujardini*						X			X					
PORIFERA			*Hymedesmia paupertas*								X	X					
PORIFERA			*Steletta normani?*									X				X	
PORIFERA			*Tentorium semisuberites*											X		X	
PORIFERA			*Crella schottlaenderi*											X			
PORIFERA			*Haliclona urceolus*												X		
PORIFERA			*Halicloona arnesenae*												X		
PORIFERA			*Alochtona milleri*												X		
PORIFERA			*Haliclona urceolus*													X	
PORIFERA			*Phakellia ventilabrum*													X	
CNIDARIA			*Athecabe hydroid*	X													
CNIDARIA			*Lophelia pertusa*			X (death)			X	X	X	X	X	X	X		
CNIDARIA		Hydroida						X	X								
CNIDARIA			*Sarcodictyon roseum ?*					X		X							
CNIDARIA			*Protanthea simplex*												X		
ANNELIDA			*Glycera sp*	X													
ANNELIDA	Polychaeta			X		X	X	XXX			XX	XX		X			
ANNELIDA			*Sabella pavonina*			X	X		X			X				X	
ANNELIDA			*Placostegus tridentatus*					X				X	X		X		X
ANNELIDA			*Filograna implexa*					X				X	X	X	X	X	X
ANNELIDA			*Polyphysia crassa*					X	X		X						
ANNELIDA			*Eunice norvegica*					X				X	X				
ANNELIDA			*Chaetopterus sp*								X		X				
ANNELIDA			*Protula sp*								X	X	X	X	X		X
ANNELIDA			*Chaetopterus sp*									X					
ANNELIDA			*Serpula vermicularis*									X					
MOLLUSCA			*Astarte sp*	X	X	X		X									
MOLLUSCA	Gastropoda			X													
MOLLUSCA			*Antalis entalis*		X												
MOLLUSCA			*Emarginula fissura*		X												
MOLLUSCA	Polyplacophora					X			X								
MOLLUSCA			*Modiolula phaseolina*					X	X	X	XX	X	X	X	X	X	
MOLLUSCA			*Leptochiton alueolus?*					X									
MOLLUSCA			*Bucchinum undatum*						X								
MOLLUSCA			*Chlamis varia*									X			X		
MOLLUSCA			*Protanthea simplex*									X					
MOLLUSCA			*Acesta excavata*									X	X				
MOLLUSCA			*Anomia sp*												X		
MOLLUSCA			*Hiatella sp*												X	X	
ECHINODERMATA			*Amphiura chiajei*	X													
ECHINODERMATA			*Hathrometra sarsi*			X	X										
ECHINODERMATA			*Ophiopholis aculeata*				X						X	X	X	X	X
ECHINODERMATA			*Ophiocomina nigra*					X									
ECHINODERMATA	Ophiuroidea								X		X	X	X	X			
ECHINODERMATA			*Ophiotrix fragilis*						X				X				
ECHINODERMATA			*Psammechiuus militaris*						X			X					
ECHINODERMATA			*Porania pulvillus*							X							
ECHINODERMATA			*Hernicia sp*											X			X
ARTHROPODA			*Chirona hammeri (bolonus)*	X													
ARTHROPODA			*Pandalus borealis*					X									
ARTHROPODA			*Nymphon sp*					X									
ARTHROPODA		Amphipoda						X	X						X	X	X
ARTHROPODA			*Manidopsis serricornis*						X			X	X	X	X		X
ARTHROPODA			*Pagurus sp*						X								
ARTHROPODA			*Lebbeus polaris*									X					
ARTHROPODA			*Pandalus borealis*									X	X	X	X		
ARTHROPODA			*Munida rugosa*													X	
ARTHROPODA		Cumacea														X	
CHORDATA			*Ascidia callosa*				X	X	X	X	X	X	X		X	X	X
CHORDATA			*Ascidia mentula*			X	X	X	X			X					X
CHORDATA			*Ciona intestinalis*				X										
CHORDATA			*Polycarpa pomaria*				X	X	X		X					X	
CHORDATA			*Ascidia prunum*					X				X					
CHORDATA		Ascidiacea								X							
CHORDATA			*Icelus bicornis*							X							
CHORDATA			*Ascidia adspersa*														X
BRACHIOPODA			*Macandreria cranium*			X	X	X		X	X	X		X			
BRACHIOPODA			*Terebratulina retusa*								X	X		X	X	X	
PRIAPULIDA			*Priapulus candatus*					X									
ECHIURA			*Bonellia viridis*					X	X	X	X	X	X		X	X	
BRYOZOA			*Crisia eburnea*						X								
BRYOZOA			*Reteporella beaniana*										X		X		

Boxcore Photos


BX 16


BX 56


BX 57


BX 62


BX 72


BX 73


BX 102


BX 103


BX 107


BX 137


BX 138


BX 141


BX 142

Appendix IV - Cruise Diary

R/V Pelagia Cruise BIOSYS 2007

Friday, 9 March 2006

Leaving the harbor of Texel late evening on Monday, we steamed with a strong rear wind towards the Skagerrak to investigate deep water coral reefs within the frame of the BIOSYS project. After almost two days, which were filled with preparatory work to set up the sampling equipment and enlightened by the good work of Jan the cook, we arrived on Wednesday in the Swedish town Lysekil. The weather was so rainy and foggy that only few used the opportunity to visit the town.
The next morning, the Swedish team arrived and after lunch, we steamed towards our first sampling area to map the sea floor and find new deep water coral reefs. The weather had cleared and the sun came out. Steaming out of Lysekil was quite spectacular with water and sky blue and the coastline and the many islands red from the iron rich granite. Govert van Noort was fascinated by the round granite blocks formed by the glaciers that also "pushed" Texel into existence.

View of Lysekil in the sun…

…and in the mist

For the BIOSYS cruise, I am investigating the diversity of bacteria associated to deep water corals and sponges. Also, I am interested in the question whether the corals take up bacteria and use them as food source. This is my cruise no 6 on the Pelagia and I enjoy the performance of ship, captain and crew and the luxury of having a cabin by my own. One of my favorites is to sit in a chair in the rear of the bridge and watch out along the 360° panorama for whales, ships, the green flash and whatsoever.
The bad news from yesterday was that in the evening Tomas Lundalv squeezed his finger badly in a door. That really hurts, it happened to me as well a couple of years ago on a ship. We had to go back to Lysekil to bring him to the hospital to get the thumb fixed. Tough Viking that he is, he came back to the ship to resume his research and give advise on the areas to be scrutinized to find deep water corals.

Markus Weinbauer
Laboratoire d'Océanographie de Villefranche, France

R/V Pelagia Cruise BIOSYS 2007

Saturday, 10 March 2006

During the night we had continued to do multibeam transects in the Bratten area.

After breakfast we started directly with two video transects parallel to each other in a deep site in the Bratten area. Tomas Lundalv and I had picked this site as it showed some interesting looking features on the bathymetric map such as small pockmarks and steep slopes with hard bottoms. The bathymetric map shows the depth contours of the sea bottom. The data for the map we get from the multibeam echo sounding. Pockmarks are small round craters in the sea bottom created through gas leaking up. In the Bratten area we have seen several such pockmarks on the bathymetric maps, some of them as big as 100 m in diameter. The structures at this site were quite small however, and probably we missed them with the drop camera as the video only showed soft sediment bottom.

We tried the box core anyway. The first box core was empty, the next was filled with mud but the third one was ok though still with mud in it.

Swedish guest scientists with Geno Gonzalez-Martinez and Tomas Lundalv

Lisbet Jonsson

We found only a few species in the mud, but succeeded to get quite muddy ourselves. Nothing of interest for me really in the box core as I am mostly interested in species associated with the tusk coral found in deep waters. Back home at my laboratory I and Tomas work with a ROV (Remotely Operated Vehicle). We use it for video recording and taking still photos of species and biotopes in deep waters, and especially of the tusk coral. Many species are difficult to identify properly on video or still photos so on this cruise I hope to be able to sample and identify some of the species I have seen on the videos but not been able to identify.

The plans were to continue with a test of the small ROV Mattijs de Lange had brought with him but the weather made it impossible. During the whole morning the wind had increased in speed and had by now reached 7 on the Beaufort scale. The waves seemed to grow bigger by the minute and Pelagia had started to roll rather uncomfortable in the big waves. The intention was to use the drop camera frame also as a frame for the garage for the ROV and for boxes for samples, but the rolling would make the drop camera frame bounce too much above the bottom. So instead we continued with multibeam transects as it was the only thing we could do in this kind of weather.

The usual evening meeting at 7 o'clock took place as usual in the conference room in the front of the ship - not a very suitable place this evening: The ship was rolling badly in the rough sea and right away several of us started to turn very white in the faces. So after only five minutes Conny, our expedition leader, quickly decided to finish the meeting, it was probably be the shortest evening meeting of the whole cruise.

Lisbeth Jonsson, Tjarnoe Marine Biological Laboratory, Sweden

R/V Pelagia Cruise BIOSYS 2007

Sunday, 11 March 2006

The first Sunday on R/V Pelagia started with a nice breakfast full of conversations about the hectic night. Everybody was happy that the night was over, the swell was high and it was hard to sleep. In the middle of the night, there was also a fire-alarm in the engine room. Most of the people heard about this in the morning, because it was very quick under control. After breakfast the preparation of the video transect started. The video transect covered two areas that were supposed to be interesting.

Julie and Beatriz in the wetlab of Pelagia

Unfortunately we didn't find good places to do box-coring. In the meantime something was happening in the mess room. During the coffee break the cook Jan served really delicious chocolate cake, because of his birthday.
While the second video transect still running, we were helping Jan in the kitchen preparing the brunch, that we had when the Multibeaming started. We had nice snacks and drinks and we saw some ROV-images by Tomas Lundalv of the areas that we are going to enter the next week. We, Beatriz and Julie, are interns at the NIOZ supervised by Conny Maier. This is our first cruise, so everything is new for us. I, Julie, am a master student at the University of Groningen. For my master I have to do several research projects. For my first one I chose a project about the abundance of prokaryotes in the different compartments of cold water corals at the NIOZ. On this cruise I hope to find living corals, so I can collect the mucus, the tissue and the coelenteric fluid. Back at the NIOZ I will process the samples taken aboard and determine the abundances. I, Beatriz, am a last year student at the University of Cadiz (Spain), where I study Marine Sciences. I decided to make this internship before finishing my studies to learn how Marine Science is in practice. I think that it is a better way of learning, so during this cruise I have the opportunity of seeing in real the sampling devices deployed that I only had seen in books so far. We only have one week left now, and we hope that we will find more interesting areas to sample so we can take a lot of work back to the NIOZ.

Julie Ogier and **Beatriz Gomez-Carreno Sanchez**
University of Groningen, The Netherlands and University of Cadiz, Spain

R/V Pelagia Cruise BIOSYS 2007

Monday, 12 March 2006

The ship was sat in the middle of very thick fog when we got up this morning. We had to change our plans slightly, as doing the ROV dive at the Sakken area was not practicable. We sailed west, still in the Sakken area, where we found a suitable site to launch the ROV. Mattijs was very satisfied with the dive. We decided to stick near the boundary to Norway, and await (eagerly) the permit from norwegian authorities to cross over to continue our planned research at Norwegian cold water coral reefs. But since it did not come in today we launched launched the ROV again, and though we didn't see any live coral we did manage to grab a small piece of dead coral, which was officially our first sample for this cruise. At some point today the ROV became known

Sander holding up the "ROT"

Everyone waiting in the wetlab for the Boxcore to come up

Later in the afternoon we put down the box core twice and brought up some coral rubble and mud. In it, there was a few interesting specimens to keep the taxonomists Rob "Spongebob" and Lisbeth busy for a few hours. This is my first long oceanographic cruise and it's turning into a quite intensive learning experience. It is easy to underestimate the difficulty of operating machines and getting the data that you are after at sea; but one must not forget that team work is just as important as luck.

Geno Gonzalez Mirelis
TMBL, Sweden

R/V Pelagia Cruise BIOSYS 2007

Tuesday, 13 March 2006

Today marks the end of a long wait for permission to sample the Norwegian Cold Water Reefs. Conny finally coaxed the Norwegian officials into giving us the green light, and this yielded applause and cheers when she came to tell us. We were looking forward to see live corals and healthy associated fauna on deck after an admittedly anxious four to five days of sampling muddy dead reefs along the west coast of Sweden, looking at tempting underwater scenes from the Hopper Camera and the ROV, and some of us becoming frustrated by the reality that we were not allowed to execute our skills.

As if to mark the occasion, the weather today turned out to be great, with sunny spells and little wind. This means that everybody was in an excellent mood, strengthened not in the least by the great food served daily by Jan the cook.

Rob and Lisbet examining a boxcore

A "one-eye sponge" found all over at the research area

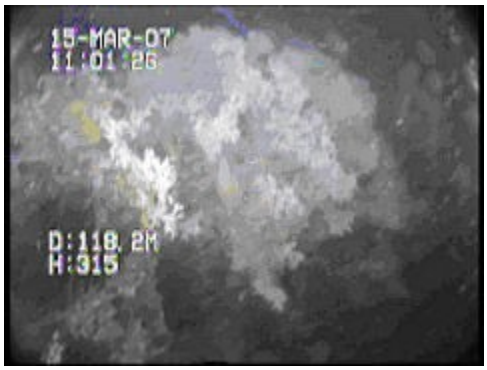
Today's report is by Rob van Soest, Zoological Museum of the University of Amsterdam, participant of the BIOSYS program for the biodiversity of sponges in Cold Water Reefs (CWRs). Sponges were important associates in the CWRs we sampled so far in previous years (Rockall Bank reefs off the west coast of Ireland yielded more than 135 species and Mingulay reef in Scottish waters almost 100), but they seemed to be only rarely present if the results until this morning would have been representative.. We see a lot of large sponges in the various videos, so I was not surprised that they were well-represented in the living reefs we saw today and hopefully tomorrow. My interest is to investigate whether the sponge fauna of CWRs positioned in approximately the same latitude (55-59 N) but in different depths and distance to the mainland, shows differences attributable to the offshore and inshore conditions.With today and an expected good day tomorrow I should be able to make some conclusions. I include a one-eyed sponge that is found all over the reefs of this area. Handling the contents of the boxcores during our present cruise is performed rather differently from previous BIOSYS cruises because of the absence of Marc Lavaleye and his set of sieves. Marc is a walking encyclopedia of biodiversity knowledge (and thus is sorely missed), also because of his skill in sieving the largest quantities of sand and mud in no time to clean batches of corals and associate animals. Of course, we have Lisbeth Jonsson and Tomas Lundalv as Swedish experts to make sure we get to name all the invertebrates in the boxcores, duly recorded by the Spanish students Bea and Geno. And not to forget: Conny, to finish it all off afterwards with the hose at maximum water pressure. This is all from Pelagia for today. I am off to the bar!

Rob van Soest, Zoological Museum, UvA, The Netherlands

R/V Pelagia Cruise BIOSYS 2007

Thursday, 15 March 2006

A new day with new chances for living coral. Actually the day started at 00.00 hours with a discussion about a big hole in the seafloor spotted during the multibeam survey on our transit to Soester Fjord. Tomas Lundalv came up and informed that he spotted a hole of an relative depth of 120 meters completed circle with a diameter of approx 1/3 nautical mile. Suggestion came that it could be a meteor hole or hiding place for submarines of the cold war period. Other suggestions were that it might be a black hole and if investigated the RV PELAGIA would be sucked in. More wiser suggestions were there is something wrong with the multibeam. But Govert van Noort of the NIOZ with knowledge on the geology of the ice ages, said very firmly "it is impissible" (as trying to say impossible). A good laughter, a new round at the bar and the hole was named from that moment on "The impissible hole". To cut the story short: The captain informed that with a new survey line the hole was nicely covered with soundings and thus disappeared.



ROV video footage at Fjellknausene deep water coral reefs (Norway)


Mattijs preparing ROV launch

Anyway this gives an idea on the good mood we were now the permit was there and sampling with boxcore could go on its way. We went further out to the spots of interest for video footage. The SEAfoundation was invited to give assistance on close-up ROV video footage for education and outreach on cold water corals together with another cruise participant, Michael Laterveer, who collects some material for the Oceanium at Rotterdam Zoo. For SEAfoundation it was a last minute call since when it became apparent, that the ROV from TMBL was not brought onboard and the SEAfoundation was willing to step in with her ROV system Zeelandis. To gain technical and operational experience with this low cost type of ROV in combination with a ship like R/V Pelagia and her hoisting system. On very short notice a "ROV garage" was made by the NIOZ technician Leon Wuis, on an old box core frame used for video transects. And after a couple of trials an operationally and technically workable set-up was established. Due to the nature of the deep water corals further experience was gained in using the ROV's options to move in a "hovering" way instead of "hopping" over the sea bottom. We first went down to a spot of roughly 100 m but it showed no live coral. We went thus back to a different spot known to have live corals. A perfect trip with the ROV was made to a new record depth of 120 m with great footage of living deep water coral reefs at the Fjellknausene area in Norwegian waters.

Ing. Mattijs de Lange Bsc., Seafoundation, the Netherlands