

Census of the Diversity of Abyssal Marine Life (CeDAMar)

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1. 2006 ACCOMPLISHMENTS & SCIENTIFIC HIGHLIGHTS

For CeDAMar, 2006 was a year of presentations of results to the scientific community. The International Deep-Sea Biology Symposium, held every three years, was hosted in July by the National Oceanography Centre, Southampton, UK. Thirty-six scientists involved in CeDAMar projects or otherwise associated with CeDAMar presented their work to their colleagues. Fourteen oral presentations and seventeen posters, many of them presented by several co-authors, gave an impressive insight into the scientific achievements of several CeDAMar projects.

The conference was extensively used for informal contacts between CeDAMar scientists and colleagues from other CoML projects, such as MAR-Eco, CoMarge, and CAML.

The advantage of having many participants of ANDEEP at the conference was used to stage a workshop over the following weekend at the Oceanography Centre. After four years, scientists went back to the initial questions of ANDEEP, evaluating which of these had been answered or partly answered, which methods had worked to address the questions and which had not. The inspiring days of the Symposium gave everybody an extra push which, at times, was needed after a rather exhausting week of listening to talks, looking at posters and establishing personal contacts.

There are two elements of NOCS work relevant to the CeDAMar project - the DEEPSETS Time Series work on the Porcupine Abyssal Plain and the Crozet abyssal project.

The National Oceanography Centre Southampton have maintained a long-term (17 years) time-series of seabed observations on the Porcupine Abyssal Plain (PAP) (4850m). This is one of only two such abyssal time-series world-wide. Biological studies are co-located with long-term sediment trap moorings. At PAP we have observed radical changes in the structure of the benthic community. We believe that these natural changes are driven by variability in organic matter supply to the seabed (Billett et al., 2001; Wigham et al., 2003), as seen in the sediment traps and seabed time-lapse photography. Samples for the PAP long-term time series were taken on RRS *Discovery* (cruise 296) in July 2005. In December 2005 to January 2006 we extended our research to contrast different, but closely situated, input regimes around the Crozet Plateau in the Southern Ocean (4300m deep) on RRS *Discovery* cruise 300.

Porcupine Abyssal Plain (4850m Northeast Atlantic)

Trawl samples taken in 2005 by NOCS showed that *Amperima rosea*, which has dominated the benthic community on the Porcupine Abyssal Plain since 1996, was not as abundant as in previous years. The catches were dominated by the holothurians *Psychropotes longicauda*, *Pseudostichopus villosus*,

Oneirophanta mutabilis. Selected holothurians were dissected to study the relationship between the chemical composition of the detritus in gut contents and the biochemistry of the gonad, gut wall and body wall. Particular attention was paid to carotenoid pigments that may play an important role in reproductive output and recruitment success. Core samples were sieved for macrofauna and sediment chemistry analyses (amino acids, pigments and lipids) and protozoan and metazoan meiofauna time series studies. One deployment of the SHRIMP camera/video system was made on top of an abyssal hill. Suspension feeders (sponges, cerianthid anemones, pennatulids (*Umbellula* sp.) and stalked crinoids) were particularly evident as well as large reticulated xenophyophores. A student has been appointed to study metazoan meiofauna in the time series through the European Network MarBEF (Marine Biodiversity and Ecosystem Functioning) and will be supervised jointly by the National Oceanography Centre, Southampton (NOCS), the German Centre for Marine Biodiversity (DZMB), the University of Ghent (UG) and the Hellenic Centre for Marine Research, Crete (HCMR). A PhD studentship jointly supervised by NOCS and the Natural History Museum, London (NHM) has shown that polychaete macrofauna showed a large increase in abundance at the time of the "Amperima Event" in 1996. In addition, the number of polychaete families increased from 15 families before 1994 to 36 at the time of the "Amperima Event" before declining slowly in subsequent years. The large increase in abundance therefore was not due to just one opportunistic species, but stimulated a significant increase in biodiversity. The PhD study is now examining changes at the species level. The "Amperima Event", therefore witnessed large scale regime shift in the whole benthic community (megafauna, macrofauna and protozoan and metazoan meiofauna) rather than just in any one size fraction. Climate change 3 miles deep affects all the benthic ecosystem. A series of papers detailing the changes in fauna, organic flux and seabed geochemistry are in preparation for submission to *Deep-Sea Research I* in early 2007.

Crozet Plateau (4300m Southern Ocean, Indian Ocean Sector)

Following on from RRS *Discovery* cruises 285 and 286 (November 2004 to January 2005) the NOCS revisited the Crozet region on RRS *Discovery* cruise 300 (December 2005 to January 2006) in collaboration with the Universities of Liverpool and Aberdeen, the British Antarctic Survey, the Natural History Museum, London and the National University of Ireland, Galway. Two sites selected during RRS *Discovery* cruises 285/286, one to the east of the Crozet Plateau under eutrophic surface waters, and the other, just 250 km away, to the south of the islands under HNLC oligotrophic waters, were studied intensively, including the recovery of sediment trap moorings (January 2005 to January 2006).

The sediment trap moorings confirmed that an extended period of organic matter deposition occurred at the eutrophic site extending from early January to mid May 2005. Photographic observations using WASP confirmed the presence of large patches of phytodetritus on the seabed at the eutrophic site in December 2006. Trawl samples (4) produced very large samples of megafauna dominated by deposit feeding holothurians (90% of wet weight biomass) with a wide variety of different forms. I (DSMB) have never seen such variety in all my deep-sea sampling life. Total wet weight biomass per unit area was 50% greater at the Crozet eutrophic site than found on the Porcupine Abyssal Plain. There was a remarkable similarity between the Crozet eutrophic samples and the PAP in terms of the overall proportions of the dominant holothurian families and genera. However, there were subtle differences in many of the species. Core samples were taken for analysis of sediment chemistry and meiofauna. Unfortunately, owing to the nature of the sediment and difficulties in sampling it, only a couple of samples were obtained for macrofauna. The sediment in all samples was a very soft mud, sometime containing small stones. Phytodetritus was not collected on any core indicating that the material was probably in suspension for most of the sampling period. This was supported by observations made by near-bed current meters and photographic observations made by the University of Aberdeen landers.

In contrast, the oligotrophic site had a much reduced megafaunal biomass (only about one third that at the eutrophic site). Holothurians accounted for only 70% of the megafaunal wet weight biomass and the dominant species differed from those at the eutrophic site. No evidence was seen of phytodetritus on the seabed in WASP photographs taken in January 2006. However, the sediment trap moorings recovered in the region indicated a large flux of organic matter over a very short period (minimum 2-weeks) in January 2005. While little primary production is evident in satellite images of ocean colour in the region in any year, some event had occurred that led to the deposition of a large amount of material in January 2005. It is not evident if this is an annual event or one that may occur only episodically. The megafaunal benthic community, however, showed several differences to the eutrophic site. Of the species present at the oligotrophic site the presence of the opportunistic holothurian *Kolga* indicate a response to the episodic flux recorded in January 2005. Coring operations at the oligotrophic site were very difficult. The top sediment was very soft mud. However, below 4cm the sediment was generally dry and uncohesive. Lack of coring success was attributed to the failure of the corer to penetrate a particularly hard layer of sediment and so cores dropped out the tubes on recovery. Quantitative samples for macrofauna were not taken at this site owing to the lack of coring success. Initial work on benthic foraminifera indicate that phytodetritus indicator species were much more common at the eutrophic site and analyses of pigments show much greater concentrations of chlorophyll *a* and other phytopigments at the eutrophic site. Qualitative polychaete macrofauna samples by the natural History Museum, London indicated that the polychaete community was abundant and diverse at both sites. Recent work on the porcellanasterid asteroids has identified a new genus at the oligotrophic site and extended species for a number of Southern Ocean forms, including *Damnaster tasmani*.

11th International Deep-Sea Biology Symposium, Southampton, 9-14 July 2006

More than 300 deep-sea scientists attended the 11th International Deep-Sea Biology Symposium in Southampton UK. Many of the early results from CeDAMar were presented as talks and as posters. A full programme of talks and social events was organised including coverage of recent deep-sea expeditions.

2. SOCIETAL BENEFITS, IMPACT & APPLICATIONS

As part of the 11th International Deep-sea Biology Symposium, Southampton, UK, 9-14 July 2006, a special session on Science and Ocean Management issues was held on Tuesday 11 July 2006. Professor Craig Smith led a discussion of current issues in ocean management. A summary of the main conclusions was produced by Dr Kerry Howell and Dr David Billett and is currently available for consultation by the deep-sea community before being published in a suitable journal and being sent to major policy making organisations and NGOs. The document will also be linked from the Census of Marine Life web pages.

The Symposium participants identified that it is almost impossible to advise on ocean management issues without detailed knowledge of the geographic and bathymetric distributions of key taxa, generally at the species level, and of their life history characteristics. The most immediate (direct) threat to deep-sea ecosystems was from commercial bottom trawling. The most important indirect threat was from long-term climate change. Time series projects were critical in addressing both these issues. For instance, human impacts are often measured against a baseline surveys, but what happens when the baseline moves naturally with time? CeDAMar projects are addressing issues relating to direct and indirect impacts.

In July 2006 Dr David Billett, National Oceanography Centre Southampton (NOCS) was elected for a 5-year term (January 2007 to December 2011) to the International Seabed Authority's (ISA) Legal and Technical Commission (LTC). Through this body the results from CeDAMar projects will be readily taken up into regulations for the controlled management of deep-sea mineral resources, such as polymetallic nodules, cobalt crusts and polymetallic sulphides.

3. WORK PLANNED FOR 2007

DIVA

The cruise DIVA 3 to the basins off Brazil and Argentina is now scheduled firmly for 30 days in December 2008/January 2009. The planning of the cruise will start in 2007.

We plan a DIVA workshop in Fall 2007.

ANDEEP

A final workshop will take place in Southampton directly after the Deep-Sea Biology Symposium. We will discuss scientific results focusing on ecosystem structures rather than pure taxonomy and prepare publications for a second Special Volume of Deep-Sea Research in 2007.

SYSTCO and IPY

The follow-up project of ANDEEP for the International Polar Year, SYSTCO, is entering a final planning phase of the expedition which is to take place from November 2007 to February 2008. Flyers and Science Plans are being produced and will be ready for distribution next week. A meeting of the participants of the expedition is planned for the beginning of September in Bremerhaven, Germany to tighten up the scientific program and to allocate berths to SYSTCO and its partner project SCACE.

In 2007 the Porcupine Abyssal Plain time series will be worked up in more detail increasing the number of years analysed for megafauna, macrofauna and metazoan meiofauna. The joint publication of a number of papers covering organic matter deposition, sediment geochemistry and faunal changes are planned for submission to *Deep-Sea Research I* in January 2007. Opportunities for sampling on the Porcupine Abyssal Plain will be continued on an ad hoc basis. There are serious concerns on the ability of continuing the time series sampling at the level of sampling intensity that is obviously required and funding under the new EU Framework VII Programme will be sought to continue the work. Samples will be sorted and identified wherever possible to the species level. Work will continue on the Crozet Plateau samples creating a large database of the species and their abundances at the eutrophic and oligotrophic sites.

4. EDUCATION & OUTREACH

Education and Outreach activities were characterized by the formation of the DESEO group in January. DESEO currently includes E&O managers from MAR-Eco, ChESS, CoMargE, and CeDAMar, with EuroCoML facilitating communication and interactions. The first joint project is the travelling exhibit "Deeper than Light", scheduled to start in Norway early in 2007, and an accompanying multilingual booklet. The exhibit was conceptualized by MAR-Eco, and each of the other projects is going to add its own module to the exhibition. It will also be possible to add special regional aspects to the exhibition as it travels through European museums. Its path is still being set up.

As part of the 11th Deep-Sea Biology Symposium, Southampton, 9-14 July 2006, an Underwater Image Competition was sponsored by BP and Kongsberg Maritime. A wide variety of high class images were

submitted in 5 categories. The categories included 1) best photographic image of a deep-sea animal taken deeper than 200m, 2) best image of an animal collected deeper than 200m (but which might then have been photographed in the laboratory), 3) best short video clip (1 minute), 4) best non-photographic image of the seafloor and 5) best operational photograph of deep-sea sampling activities. The winning images were featured in double page spreads in both *Nature* and *New Scientist*, and featured in several newspaper articles.

5. GEOGRAPHIC EXPANSION

In 2006-2007 we extend to the Mediterranean with the cruise Levar.

6. PARTNERSHIPS & COLLABORATION

a. Partnerships

Organization Name	Point-of-Contact (Name)	Nature of Relationship
Natural Environment Research Council, UK	David Billett	Funding of Core Strategic Project on Biogeochemical Interactions and Controls on Export Flux (BICEP) (to 2007)
Natural Environment Research Council, UK	David Billett	Strategic Research Project on open ocean ecosystems (Oceans 2025) (from 2007)
MarBEF	Pedro Martinez, David Billett	Partner, Steering Group Member EU Network on Marine Biodiversity and Ecosystem Functioning (MarBEF)
International Seabed Authority (ISA) Legal and Technical Commission (LTC)	Craig Smith, Pedro Martinez, David Billett	LTC member 2007 to 2011.

b. Links to Other CoML Ocean Realm Projects

Project Name	Cross-Over Person(s)	Nature of Relationship
COMARGE – Continental Margin Ecosystems on a Worldwide Scale	Dr David Billett Dr Myriam Sibuet	Steering Group Member Steering Group Member
ChESs	Craig Smith	Steering Group Member
ArCod	Pedro Martinez	Steering Group Member

c. Links to CoML National and Regional Implementation Committees (NRICs)

NRIC	Liaison or Cross-over personnel	Nature of Relationship
Australia		
Canada		

Caribbean		
China		
Europe	Pedro Martinez	Steering Group Member
Indian Ocean		
Japan		
South America		
Sub-Saharan Africa		
USA		

d. Liaisons to CoML Cross-Cutting Groups

Project Name	Liaison Name & Institution	Nature of the Relationship
OBIS		
HMAP		
FMAP		
SCOR Tech Panel		
E&O		
Barcoding		