The Census of Marine Life Project

Census of the Diversity of Abyssal Marine Life

(CeDAMar)

Science Plan

Pedro Martínez Arbizu

German Centre for Marine Biodiversity Research

Senckenberg Research Institute

Südstrand 44

26382 Wilhelmshaven, Germany

Craig Smith

Department of Oceanography

University of Hawaii at Manoa

1000 Pope Road

Honolulu, HI 96822 USA

15 January 2004

Table of Contents

1 Executive Summary

The deep sea is the largest and least explored ecosystem on Earth. Up to the middle of the 19^{th} century, abyssal sediments (i.e., sediments at ocean depths > 4000 m) were believed to be azoic deserts due to a lack of sunlight and primary production. This picture changed dramatically with the first sampling of the sea floor. Today we know that deep-sea sediments are characterized by low biotic abundance and biomass, but potentially very high species richness. In addition, roughly 90% of the species collected in a typical abyssal sample are new to science. In practice, this means that relatively few, small animals will be found per sample in abyssal sediments, but nearly every animal in the sample will belong to a different, most likely unnamed, species. Abyssal habitats appear to be a major reservoir of biodiversity and evolutionary novelty despite extreme conditions of darkness, low temperatures (typically < 2 ^{o}C), enormous hydrostatic pressure, little habitat complexity, and extremely low food availability. The occurrence of potentially high biodiversity with extreme habitat conditions in the abyss remains one of the major biogeographic puzzles of our time; this puzzle can only be solved with far better understanding of biodiversity levels and faunal distributions in the abyss.

Studies of abyssal diversity and biogeography are complicated by the logistical challenges of deep-sea exploration. The total sampled area of deep-sea floor covers only a few football pitches. Unfortunately, our hypotheses concerning deep-sea diversity patterns are therefore the result of biased extrapolations based on few, spatially restricted observations. Only a concerted, international research program can help to overcome these difficulties and provide a broad foundation of knowledge on the biodiversity and distribution of abyssal species. With the proposed Census of the Diversity of Abyssal Marine Life “CeDAMar” as a field project of Census of Marine Life, we have worked out a series of cruises to help achieve this goal.

The limited number of taxonomists worldwide specializing on deep-sea groups, combined with the frequent collection of undescribed taxa, impede the characterization of biodiversity and ecosystem function in the abyss. To help to overcome this so-called “taxonomic impediment,” we have designed a “Deep-Sea Taxonomy Clearing House” consisting of a freely available database of taxonomists, a series of taxonomic workshops, and an exchange program for taxonomists within CeDAMar.

The results generated by the CeDAMar program will be made available through a series of open databases linked with the Ocean Biogeographic Information System (OBIS) and the Global Biodiversity Information Facility (GBIF).

2 Diversity of Abyssal Marine Life

The study of species diversity is a one of the focuses of modern ecological research. The term “diversity” is remarkable as it combines both the concept of species and the abundance of these species in a given sample. The terms “species” and “abundance” are basic for ecological theory. If one could understand which factors regulate the presence of species in a given area and which factors regulate the absolute and relative abundance of these species, then one would understand much of the functioning of the ecosystem as a whole. Today, the evaluation of biodiversity - defined as the variety and variability of genomes, populations, species, communities and ecosystems in space and time (Heywood, 1995) - is a central theme in biology and conservation.

When considering marine biodiversity we have to keep in mind that the deep sea underlies 90% of the ocean, which in turn constitutes three quarters of the Earth´s surface. About 50% of the earth is covered by oceans deeper than 3,000 m (Tyler, 2003). Despite the potential importance of this vast ecosystem as a reservoir for genetic diversity and evolutionary novelty, very little is known about how deep-sea species are distributed and what factors regulate deep-sea species richness (Gage & Tyler, 1990; Gray, 2002).

Modern marine diversity research began in the 1960´s when Sanders, Hessler, and co-workers were able to show that abundance of macrobenthic organisms decreases with depth while the number of species increases (Sanders et al., 1965; Hessler & Sanders, 1967; Sanders & Hessler, 1969). Pivotal in the development of the scientific interest in marine diversity patterns is a study by Grassle and Maciolek (1992) of a series of box corer samples collected along a 176-km transect on the NW Atlantic continental slope. Using species turnover rates along their transect, these authors estimated the global number of marine benthic macrofaunal species, suggesting that the number of species at the deep-ocean floor may rival that of tropical rainforests. This study lead to broad debate concerning the number of marine species and the distribution of diversity along bathymetric and latitudinal gradients. In particular, some authors postulated a decrease in species richness from the equator towards the poles, and from the slope to the abyss (Poore & Wilson, 1993; Rex et al., 1993; Thomas & Gooday, 1996; Rex, 1997; Culver & Buzas, 2000).

However, the actual factors that regulate species diversity in abyssal systems remain poorly understood (Snelgrove & Smith, 2002). Unfortunately, current hypotheses concerning global deep-sea diversity patterns are extrapolations derived from few, locally restricted observations (Culver & Buzas, 2000; Grassle & Maciolek, 1992; Gray, 1997, 2002; Rex et al., 1993, 1997, 2000, 2001; Lambshead et al., 2000, 2001, 2002).

With the exception of hydrothermal vents and some other chemosynthetic habitats, deep-sea communities depend on primary production in surface waters as the ultimate source of energy. While it seems evident that the biomass of deep-sea organisms should be positively correlated with food availability (Rowe, 1971; Smith et al., 1997; Brown et al, 2001), the relationship between food supply and the number of species present in a given deep-sea area is poorly understood. A study on the Pacific abyss demonstrated a link between surface productivity and the diversity of polychaetes (Glover et al., 2001) as well as nematodes (Lambshead et al., 2002). Results from the DIVA-1 expedition reveal a strong response in the abundance and diversity of deep-sea benthos to an increase in food availability. Stations studied on the southern (oligothrophic) side of the Benguela Frontal System (BFS) had fewer species than those at the eutrophic sites north of the BFS.

3 The CeDAMar Initiative

The Census of the Diversity of Abyssal Marine life aims to collect new reliable data on species assemblages of single ocean basins and on the large-scale distribution of species among these basins. The general objective of CeDAMar is to ***document actual species diversity of abyssal plains as a basis for global-change research and for a better understanding of historical causes and ecological factors regulating biodiversity*****.** We aim to provide a foundation of knowledge about the present state and health of the largest ecosystem on earth on which any future study of the effects of global warming and human interference can rely. We also plan to produce an abyssal database that will allow comparisons of deep-sea biogeographic patterns with those in other parts of oceans; in particular,it will be extremely interesting to compare the latitudinal gradients of biodiversity found by CeDAMar in the abyss with those established within CoML's plankton and nearshore (NaGISA) projects.

The CeDAMar program focuses on endobenthic (or infaunal), epibenthic and hyperbenthic organisms. Microorganisms, eukaryotic protists, and metazoans of all size classes will be considered. The simultaneous study of organisms of different size classes from the same area is an important novelty of the program because it is not expected that all kinds of organisms will respond similarly to environmental forcing. Morphological as well as molecular methods will be used to determine and describe the diversity of species assemblages.

In order to enhance the interpretability and comparability of results, we will focus on the relatively homogeneous, large-scale habitats of the abyssal plains. Small-scale areas with rough grounds, such as of seamounts, trenches, and continental slopes, as well as chemosynthetic environments, will not be addressed in CeDAMar (these habitats are recognized in the CoML Research Plan as separate Realms requiring more specialized sampling approaches.) Nonetheless, the task will require enormous scientific effort which can be successful only if all available specialists join forces in a single coordinated program. This will be composed of several units, each dedicated to a single ocean region. By ensuring the comparability of data from different expeditions with standardized methods, we will be able to combine results in the future to form a broad picture of the diversity of abyssal plains.

To begin this endeavour, we chose the South Atlantic Ocean from the tropics to the Antarctic Ocean. This decision was partly based on the availability of German research vessels in this area due to ongoing geological and oceanographic programs. U.S. A., Japanese and French expeditions to the manganese nodule areas of the central north Pacific Ocean will provide a second focal point. Additionally, the Mediterranean deep-sea basins will be the scope of a joint-venture between German and Greek institutes. The Mediterranean deep waters are anomalous by being warm (13° C), and extremely oligotrophic. Therefore it will be exciting to compare the response of benthic communities to these conditions with that in cold, oligotrophic deep-sea habitats. CeDAMar plans to extend the Atlantic transect to the North Atlantic and Arctic Oceans, and to conduct more comprehensive sampling campaigns in the Pacific and Indian Oceans, but this will probably only be possible beyond the main time frame of the Census of Marine Life.

3.1 The Known, the Unknown and the Unknowable

While a substantial number of process studies have been conducted in the Atlantic, Pacific and Indian Ocean abyss (i.e., at depths greater than 4000 m) (see recent reviews in Tyler (2003)), there are very few abyssal data sets addressing species diversity in multiple size classes of organisms (e.g., microbes, meiofauna, macrofauna, megafauna). In addition, collection efforts by different research groups and nations have not been coordinated; most have used different taxonomists to enumerate (rather than describe scientifically) the species collected in different sampling programs. Thus, while we may have very rough estimates of the number of species in a particular taxon at a particular site (e.g., polychaetes in the some regions of the abyssal North Atlantic), we know very little about the ranges of species, or the number of species likely contained within a single abyssal basin. During the KUU workshop on biodiversity in deep-sea sediments (August 21-24, 2003), is was recognized that ist is essential to treat continental margins separately during scientific exploration of deep-sea biodiversity, especially considering what can be achieved in a reasonable time frame using the available resources and logistics constraints (see Appendix 4.8 for contents of the Workshop Report, and for a list of workshop participants).

It is clear that it will not be possible to sample the entire deep sea using available personnel and logistic resources. Even the exploration of every ocean basin seems unreachable within the 2010 time frame of the Census of Marine Life. Research vessels capable of sampling at abyssal sites belong to the large-scale facilities of participating nations, requiring highly competitive applications several years in advance of actual cruises.

In order to understand and predict patterns of deep-sea diversity, we need to use a theory- and hypothesis-driven approach. Data gathered in some selected ocean basins will be used to test hypotheses. By refining models derived from these results, we will be able to make predictions concerning the diversity of unsampled deep-sea basins, and to test these hypotheses in the future. Animals living on the abyssal plains of the world’s oceans depend on the rain of organic detritus from the euphotic zone as the main source of energy. Primary production changes with latitude and distance from the coast. Thus, a major project goal is determine whether deep-sea benthic diversity is correlated with the amount of primary production in the overlying water column.

CeDAMar expeditions are designed to sample abyssal plains at similar depths but at different productivity levels along latitudinal gradients. The comparison of alpha-diversity levels (sample diversity) at different stations will be the major source of information to elucidate the correlations described above. If we are able to show such a general correlation, we will be able to make predictions concerning, e.g., the effects of global warming (and consequent changes in primary production) on the diversity of one of the largest ecosystems on earth. Other factors, such as sediment characteristics, presence of stones and nodules, bottom currents, as well as the age of abyssal plains, will also be taken into consideration.

At the workshop, we recognized that the high species richness of deep-sea sediments will make it impossible to describe all the abyssal species of the world's oceans; At the same time we recognized the urgency of describing the most abundant species found in our samples, using both morphological and molecular methods. About 1.5 million terrestrial species have been described so far, but only some 266,000 marine species are known to science. These figures are could easily reflect the bias of our taxonomic efforts rather than the true distribution of diversity on Earth. In describing a species, scientist give it a unique and unequivocal name that is used to communicate with other scientists and compare biotas between samples. The absence of names and voucher specimens is a major handicap for biodiversity research in the deep sea. Modern methods of multivariate community analysis are based on the statistical similarity of samples, defined as the number of species shared between samples, and the similarity of their relative abundances. How can we use these methods if we are unable to assign specimens in our samples to identifiable species? The lack of species descriptions makes it impossible to compare the species-level similarity of ocean basins, nor can species turnover rates along major transects be calculated. The number of rare or endemic species in a given area cannot be evaluated. Species-level knowledge is essential to estimate how many species actually live in the abyss, and to evaluate the effects of human activities on deep-sea communities. We feel that the description of the 500 most common abyssal deep-sea species by CeDAMar researchers by 2010 is an achievable task that will help to overcome the taxonomic bottleneck. Taxomists will need assistance and external funds to achieve this endeavor. Within CeDAMar, we will support taxonomic work by organizing a ***series of workshops on taxonomy of deep-sea organisms***. Each workshop will be devoted to a common animal group and will serve as a tool to connect scientists working with abyssal organisms worldwide, and to help build capacities in this field. Standardized methods will ensure the comparability of taxonomic results from different expeditions and different ocean basins. In addition we will support ***short-term visits of taxonomists to institutes participating in CeDAMar*** in order to work with, and exchange knowledge concerning, abyssal material. This instrument will allow CeDAMar taxonomists to cross reference their samples with material from previous expeditions and natural-history collections. A database of taxonomists working on abyssal fauna will be made available through the CeDAMar homepage. Additional efforts will be made to ensure the participation of more young taxonomists in the CeDAMar program.

In addition to scientific description of 500 common abyssal species, CeDAMar will participate in CoML's DNA Barcoding initiative (see "DNA Barcoding" at website: http://www.coml.org/coml.htm). "DNA-friendly" samples will be collected using DNA Barcoding protocols, and barcodes (based on the sequence of the gene mitochondrial cytochrome c oxidase subunit I (COI)) determined for substantial numbers of individuals. Ultimately, the barcoding approach may allow relatively rapid enumeration of the number of species found in abyssal samples and sites.

Scientific results of CeDAMar expeditions will be published broadly in specialised journals; we also plan to produce a series of monographic volumes on deep-sea biodiversity. Two special volumes, each consisting o 25-30 peer-reviewed papers, are already at the editing stage. A special volume of the journal Organisms, Diversity and Evolution (Gustav Fisher Verlag), with planned publication in late 2004, will be devoted to the results of the DIVA-1 expedition. The second volume will be dedicated to Howard Sanders and will present the results of the ANDEEP 1-2 expeditions. It will be published in Deep-Sea Research II (Elsevier) in 2005.

Data mining is an additional important and achievable task for the CeDAMar program. Substantial collections of abyssal material, often with species “differentiated,” but not described, to the species level, have been archived by research efforts in many different countries (see reviews in Gage and Tyler (1991) and Tyler (2003) for descriptions of sampling efforts). We will build databases holding the information of previous deep-sea cruises and will offer this information through a web portal. Some data have already been catalogued at different institutes like IFREMER (France), the Senckenberg Institute (Germany), the Smithsonian Institution (USA), and the Natural History Museum (UK). A special effort will consist of linking these databases with mapping tools for interactive querying and map creation. The databases will be linked using standardized protocols to meta-portals like OBIS and GBIF.

3.2 Scientific Questions

The questions that will be addressed concerning abyssal communities by CeDAMar expeditions include:

- Based on statistically reasonable estimates, how many species are there in the abyssal deep sea?
- Are cosmopolitan species common in the deep sea?
- Are there endemic species in the abyss?
- Are there latitudinal gradients in species richness? Is the diversity of a given basin similar to the diversity of basins in other oceans at similar latitudes?
- Is there gene flow between distant abyssal communities of the same species?
- Are there centers of high diversity (hot spots of diversity) in the deep sea?
- How does sample diversity vary on different geographic scales?
- How does sample diversity vary between organisms of different size classes?
- What factors are correlated with high or low species richness?
- Is primary production in the water column coupled with benthic diversity?
- Are there biogeographic barriers for the distribution of abyssal fauna?
- What role does the geological history of basins play in determining diversity levels?
- Do organisms of different size classes respond similarly to environmental factors?
- How does the presence of manganese nodules or drop stones influence benthic diversity?

3.3 Main Goals and Implementation

3.3.1 Describing latitudinal gradients in the Atlantic Ocean

We aim to address the scientific questions listed above using the Atlantic Ocean as a model. The project *Latitudinal Gradients of Deep-Sea BioDIVersity in the Atlantic Ocean* (DIVA) is a 10-year initiative to achieve this goal (Prof. W. Wägele, University of Bochum and Dr. M.

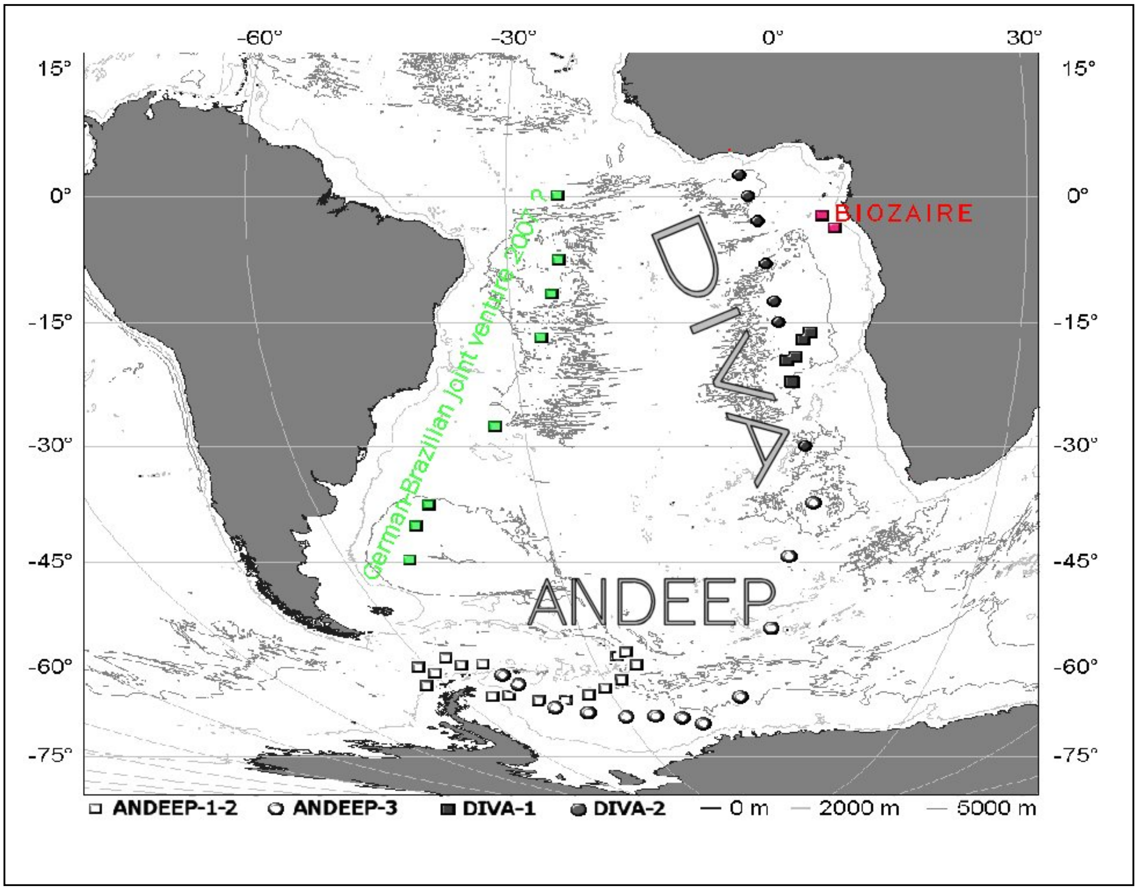

Fig.1: Location of the stations of the projects DIVA, ANDEEP, BIOZAIRE and the

Türkay, Senckenberg Institute). The pilot expedition DIVA-1 to the Angola Basin in the year 2000 was a contribution to the International Biological Observation Year (IBOY) of Diversitas. A second expedition, DIVA-2, will sample all basins from Cape Town to the Ivory Coast in March of 2005. With these expeditions, we will be able to sample abyssal plains exposed to a broad range of productivity regimes. The French project BIOZAIRE (Dr. M. Sibuet and J. Galleron, IFREMER) will contribute to this task by sampling abyssal sites in a high productivity area influenced advective inputs from the Zaire channel. In addition, there are ongoing plans to sample the basins on the western South Atlantic (~2007) within the scope of a German-Brazilian Cooperation in Science and Technology. The long-term prospective of DIVA includes a complete pole-to-pole transect in the Atlantic Ocean.

3.3.2 Diversity and Biogeography of Antarctic deep-sea fauna

The abyssal areas of the Atlantic side of the Antarctic Ocean are the focus of the project *ANtarctic benthic DEEP-sea biodiversity (ANDEEP): colonization history and recent community patterns* (Prof. A. Brandt and Dr. B. Hilbig, Universities of Hamburg and Bochum). The ANDEEP project conducts the first base-line survey of benthic deep-sea fauna of the Scotia and Weddell Seas. It will collect unique information on the biodiversity and biogeography of Antarctic fauna that will provide evidence concerning the isolation and origin of these communities. ANDEEP aims:

- to investigate the evolutionary processes and oceanographic changes which have resulted in the present biodiversity and distributional patterns in the Antarctic deep sea
- to investigate the influence of sea-floor habitat diversity on species and genetic diversity in the Antarctic deep sea
- to investigate the colonisation and exchange processes of the deep sea fauna in relation to changes in sea-bed geography over geological time
- to assess the importance of the Antarctic region as a possible source for deep-sea benthic taxa in other oceans.

The expeditions ANDEEP-1 and ANDEEP-2 took place in the year 2002 to collect samples in the Drake Passage, Scotia Arc, and Weddell Sea. The next expedition, ANDEEP-3, is intended to provide samples from a latitudinal gradient from the Cape Basin to Kapp Norvegia (eastern Weddell Sea) and a transect crossing the Weddell Sea to King George

Island in 2005. The expeditions ANDEEP-3, BIOZAIRE-3 and DIVA-1-2 will complete a transect spanning the eastern South Atlantic (Fig. 1).

3.3.3 Diversity and gene flow in nodule regions of the central North Pacific

The abyssal Pacific Ocean floor is thought to be a major reservoir of biodiversity, but the patterns and scales of this biodiversity are very poorly known. Nonetheless, a large area of the Pacific abyss is targeted by a number of nations for mining of manganese nodules (Fig. 2; Glover and Smith, 2003).

It is virtually impossible to evaluate the threat of nodule mining to deep-sea biodiversity (in particular, the likelihood of species extinctions) without knowledge of (1) the number of species residing within areas potentially perturbed by mining operations, and (2)

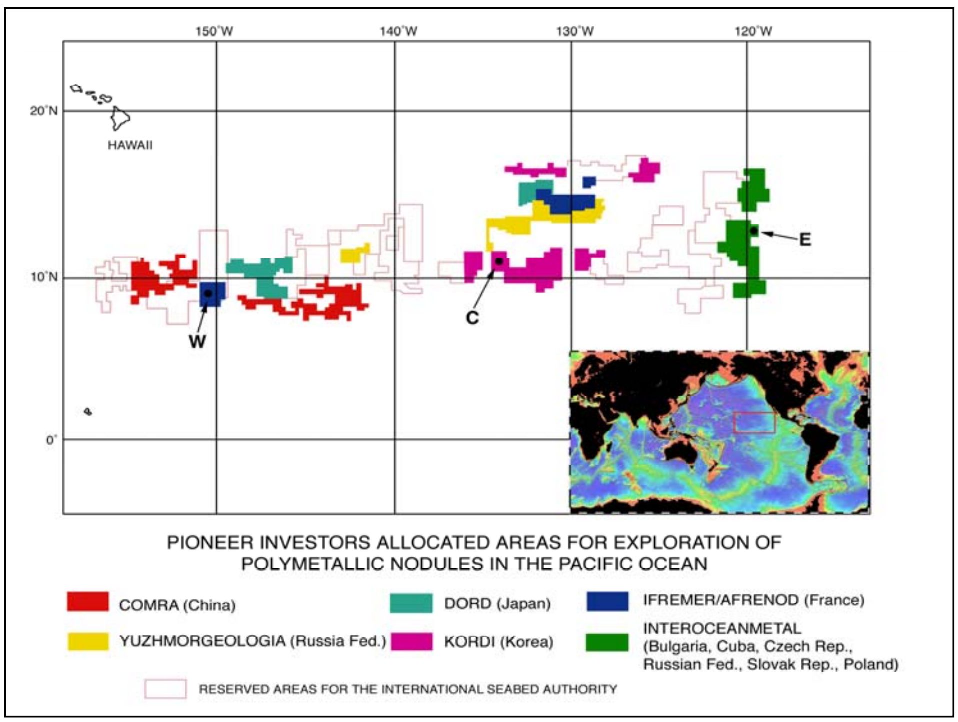

Fig. 2: Location of the sampling areas in the nodule province

the typical geographic ranges (and rates of gene flow) of species living within the targeted area. The project, *Biodiversity, species ranges, and gene flow in the abyssal Pacific nodule province: predicting and managing the impacts of deep seabed mining* (Prof. Dr. C. Smith, University of Hawaii), is designed to use recently developed molecular techniques to evaluate biodiversity levels, geographic ranges, and rates of gene flow for dominant animal groups living in the region targeted for mining (known as the “Pacific nodule province”). It will conduct a field program to quantitatively sample seafloor communities at three sites spanning the nodule province, and preserving these samples to allow DNA-based molecular-genetic analyses.

A first expedition, KAPLAN I, took place in February-March 2003 and successfully collected replicate samples with multicorer and box cores. This material was fixed for morphological as well as molecular studies.

A second expedition, aboard the Japanese vessel, RV *Umitaka-Maru*, is funded for February 2004 to sample Station W at the west end of the nodule province.

A third expedition, called NODINAUT, will use the French vessel RV *L’Atalante* and the submersible *Nautile* in July 2004, in a collaborative research effort funded by the IFREMER (France) and the ISA (postdoctoral support), and the Kaplan Fund, and is organized by IFREMER scientists Dr. Joelle Galeron and Dr. Myriam Sibuet. The goals are the collection of box-core and multiple-core samples, and the conduct of targeted sampling and process studies in different habitats with the manned submersible *Nautile*, at the central Station C (primarily) and near the western Station W (secondarily), which correspond to the French nodule claim areas (Fig. 2).

3.3.4 Mediterranean Sea: Diversity patterns in a warm deep sea

The Mediterranean abyssal plains are remarkable in several respects. Unlike other deep-sea areas, the Mediterranean abyss is warm (around 13 °C), extremely oligothrophic, and in some areas extremely saline. A joint venture between German and Greek scientist (Dr. M. Türkay, Senckenberg Institute and Dr. T. Tselepides, Institute of Marine Biology of Crete) will study diversity patterns in the Mediterranean deep sea in relation to distance from the coast and food availability. A proposal for the use of RV *Meteor* in 2006 (DIVMED) has been submitted and is currently in the process of evaluation.

3.3.5 Indian Ocean: Diversity versus food availability

Between 1 November 2004 and 28 February 2005 three cruises will be undertaken by RRS Discovery in the region of the Crozet Plateau, southern Indian Ocean, in a program called CROZEX (Dr. David Billett, SOC). Two cruises will characterize the production and export flux in two contrasting production regimes north and south of the Crozet Islands. A third multidisciplinary cruise will study the geochemistry and biology of abyssal sediments north and south of the islands in relation to both the quantity and quality of organic input. It is the program's intention to characterize the diversity and community structure of the benthos from protozoan meiofauna to large invertebrate megafauna in a permanently HNLC (High Nutrient Low Chlorophyll) region to the south of the Crozet Islands, and at a similar location to the northeast of the islands subject to seasonal pulses of OM.

3.3.6 Integration in the CoML Research Programme

CeDAMar expeditions will collect an unprecedented number of faunal samples from a variety of abyssal sediments in a range of ocean basins. There are great opportunities for collaborating and integrating with the activities of other CoML field projects. CeDAMar can provide expensive and rare abyssal samples for the Barcoding Initiative and for the emerging Census of Microbes. The insights gained by CeDAMar expeditions into the diversity and distribution of abyssal sediment fauna will provide an important deep-sea context for CoML studies of seamounts, canyons, chemosynthetic habitats, and the Arctic project, and will be essential to elucidation of the faunal relationships between continental slopes and abyssal plains. The information on the distribution of abyssal species will be made freely available through the metaportal of the Ocean Biogeographic Information System. Finally, the knowledge produced by CeDAMAr concerning the factors that regulate and promote abyssal biodiversity will help in understanding and predicting the effects of global climate change (e.g., latitudinal changes in production regimes), contributing to understanding the Future of Marine Animals Populations.

3.3.7 The international Scientific Steering Committee

A international steering group will guide the scientific objectives of CeDAMar, and will organize workshops and plan new cruises. The steering group will be defined at the first international meeting in 2004. It is planned to invite one scientist from Brazil and one scientist from Russia or Poland. CeDAMAr will welcome the participation of project leaders of other deep-sea related CoML projects as *ex officio* members in the steering group in order to strengthen the cooperation and sharing of resources between projects. The international steering group should meet at least once a year. Additional meetings should be organized coinciding with other CoML related meetings.

The following German scientists formed the initial steering group of CeDAMar:

Prof. Dr. Angelika Brandt, Universität Hamburg

Prof. Dr. J.W. Wägele, Ruhr-Universität Bochum

Prof. Dr. Klaus Hausmann, Freie Universität Berlin

Prof. Dr. H. K. Schminke, Universität Oldenburg

Dr. Michael Türkay, Forschungsinstitut Senckenberg

Prof. Dr. Pedro Martínez Arbizu, DZMB-Forschungsinstitut Senckenberg

The following scientists have agreed to serve on the international steering group:

Dr. Myriam Sibuet, IFREMER, France

Prof. Dr. Craig Smith, Hawaii University, USA

Dr. David Billett, Southampton Oceanographic Centre, UK

Dr. Tassos Tselepides, Institute of Marine Biology of Crete

4 Appendices

4.1 Budget

4.1.1 Proposed Sloan Contribution

The grant requested to establish a CeDAMar Secretariat responsible for the Project Management and Outreach Activities, and an International Steering Committee responsible for guidance and planning of research tasks is specified below.

The costs have been calculated in Euros and converted to U.S. Dollars (US$) at a rate of 1 Euro = 1.27 US$ (January 2004).

Scientific Project Manager (SPM)	48750	65000	16250	61913	82550	20638	165100
Running Costs SPM	3750	5000	1250	4763	6350	1588	12700
DNA-Extractions Kits	2000	2000		2540	2540		5080
Steering Group							
Steering Group Meeting ~June 04	11000			13970			13970
Steering Group Meeting ~Dez. 05		11000			13970		13970
Databases							
Database Server	5000			6350			6350
Programming, GIS, OBIS	20000	10000		25400	12700		38100
Workshops							
Polychaete Taxonomy	15000			19050			19050
Copepod Taxonomy	15000			19050			19050
Peracarid Taxonomy		15000			19050		19050
Molecular Methods/Protists		15000			19050		19050
Exchange of Taxonomists	20000	20000		25400	25400		50800
Outreach, flyers, homepage, etc	25000	10000		31750	12700		44450
UH Project Mgt. & Expedit. PI Kaplan	16402	16846		20830	21394		42225
Expedition PI Andeep	10000	10000		12700	12700		25400
Expedition PI DIVA	10000	10000		12700	12700		25400
Expedition PI Biozaire/Nodinaut	10000	10000		12700	12700		25400
Expedition PI CROZEX	10000	10000		12700	12700		25400
Overhead UH	5413	5480	2953	6875	6959	3750	17584
Overhead SNG	30825	28950	2625	39148	36767	3334	79248
Total	**258140**	**244276**	**23078**	**327838**	**310230**	**29309**	**667376**
(SNG Total)	252727	238796	20125	300133	281877	25559	607568

4.1.1.1 Budget justification

1. Salary of the Scientific Project Manager is based on the amount received by a scientist with Ph.D. degree determined by German law. The amount depends on the age and familiar status of the individual. For this position we want to nominate Dr. Brigitte Hilbig. Brigitte specializes on the taxonomy and systematics of polychaete worms, and has more than a decade of experience with deep-sea research at different U.S. American institutions. She has participated in 27 expeditions and published 33 papers in peer-reviewed journals. She fulfills all requirements needed to successfully oversee the management and outreach activities of CeDAMar. In addition, she is co-directing the ANDEEP program. The SPM will need a budget to cover running costs, including a laptop computer to use at meetings.
2. Costs for the University of Hawaii are distributed as follows. Two-weeks of salary are requested for Craig Smith in each of calendar years one and two for project management, participation in Steering Committee and CoML meetings, and to help run Kaplan Project field programs. Craig Smith expects to spend at least one month per year on the project, with the additional salary provided by UH. Iris Stowe will spend one month per year assisting in subcontract management, outreach, liaisons among the 5 CeDAMAR field programs, and in taxonomic intercalibration. Travel funds ($5000 in years one and two) will allow Craig Smith to attend one Steering Committee meeting in Europe per year, and participate in either one CeDAMAR field project, or attend one CoML meeting, in each of years one and two. Shipping and supplies funds will be used to buy and ship supplies, and to ship samples, to and from CeDAMAR field programs and workshops. Indirect costs are charged at 15% of UH direct costs, and at 15% on the first $25,000 of the subcontract to Senckenberg Research Institute in calendar years one and two.

3. A series of DNA-Extractions Kits will be necessary for molecular work on board research vessels during CeDAMAR field programs. Previous experience has shown that this step on board is crucial for the successful extraction of deep-sea DNA material. Costs for sequencing and subsequent molecular analysis will be covered by the University of Bochum and the British Antarctic Survey (see matching funds).
4. The program will need a dedicated database server in order to store all data produced by CeDAMar and guarantee its safety with regular backups. In addition, the need of programming aid for web and mapping tools programming and integration with OBIS and GBIF is presented above. The Senckenberg Institute will match this amount by the dedication of a computer scientist during 3 months per year.
5. The costs of the workshops are calculated for a number of 15 participants needing on average 1,000 Euro per workshop for travel and daily allowance.
6. The amount dedicated to exchange of taxonomists is calculated on the base of 10 grants per year at an average allowance of 2,000 Euro per grant.
7. The amount proposed for the Principal Investigators (PI´s) of the 5 most important running cruises is needed to cover the travel costs to CoML related meetings, or representing CeDAMar at international meetings, management of the cruises, etc.
8. The overhead of the Hawaii University (UH) is needed for management of the grant and bank taxes. The overhead of the Senckenberg Institute (SNG), calculated at 15% of the managed grant, is needed to cover the costs originated by coordinating the CeDAMar program (it includes the travel costs of Senckenberg employees (Martínez, George, Rose, Hilbig) to CoML related meetings).

4.2 Matching Funds and Facilities Available

Here we list the cost covered by different institutes and organizations supporting CeDAMar. We are including the costs matched from the beginning of our activities in the year 2000 to the end of the period applied here (2 years from now). Substantial additional funding will be made available for the future expeditions DIVMED and DIVA-3 by national funding agencies.

4.2.1 Expeditions

4.2.1.1 Ship time

Ship time for large research vessels is very expensive. The use of the German research vessels *Polarstern* and *Meteor* is covered by the German Ministery of Sience and Education (BMBF), the use of the French research vessel *L`Atalante* by IFREMER and partially by the oil company TOTAL, the use of the U.S. research vessel *New Horizon* by the Kaplan Fund, the US National Science Foundation, and the International Seabed Authority, the use of the *Umitaka-Maru* by the Japanese government, and the use of British RSS *Discovery* by the government of the United Kingdom. The following calculation of the costs of using research vessels for the Census of Marine Life program takes into consideration expeditions that took place from the year 1/1/00 and 12/31/04, as well as those that have already been approved and scheduled. We have already applied for additional ship time for expeditions that will take place in 2006 and beyond. These costs are not presented here.

The costs of CeDAMar expeditions, including ship time and travel expenses of scientists to and from port, are roughly estimated as follows:

DIVA-1: Angola Basin (2000), RV *Meteor,* 30 days.	1,400,000 US$
DIVA-2: Cape Basin- Guinea Basin (2005), RV *Meteor*, 35 days.	1,600,000 US$
ANDEEP-1 & -2: Drake Passage, Scotia Arc, Weddel Sea (2002), RV *Polarstern*, 60 days.	3,800,000 US$
ANDEEP-3: Cape Basin, Weddell Sea (2005), RV *Polarstern,* 72 days.	4,525,000 US$
BIOZAIRE: off Zaire (2003-2004), RV *L´Atalante*, 30 days.	800,000 US$

KAPLAN: Manganese Nodule Area, central north Pacific (2003),	
RV *New Horizon*, 26 days and RV *Umitaka-Maru* 6 d.	645,000 US$
NODINAUT: Manganese Nodule Area, central north Pacific (2004),	
RV *L´Atalante* with *Nautile*, 42 days.	1,800,000 US$
CROZEX: Crozet Plateau (204-2005),	
southern Indian Ocean, (RRS Discovery) 40 days.	1.8000,000 US$
Subtotal Expedition costs:	**16,370,000 US$**

4.2.1.2 Sampling gear available

The sampling gears needed to collect the abyssal samples are being made available by the different institutions. In addition, the French NODINAUT expedition will make use of the submersible NAUTILE and will produce photographic and video documentation of the abyssal fauna of the manganese nodule area in the Pacific. The costs of NAUTILE dives are not reported here as they are included in the expedition costs above.

	Approx. value
Box Corer, Senckenberg Institute	25,000 US$
Box Corer, University of Hawaii	25,000 US$
Box Corer, IFREMER	25,000 US$
Box Corers (2), Alfred-Wegener-Institute	50,000 US$
Box Corer, SOC	25,000 US$
Megacorer, Senckenberg Institute	40,000 US$
Multicorer, University of Hawaii	40,000 US$
Megacorer, IFREMER	40,000 US$
Megacorer, SOC	40,000 US$

Epibenthic Sledge1 & 2, Bochum University	40,000 US$
Epibenthic Sledge1, IFREMER	20,000 US$
Epibenthic Sledges 3 & 4, Univ. Bochum & Senckenberg Institute	40,000US$
Epibenthic Sledge, SOC	20,000 US$
Agassiz Trawl, Senckenberg Institute	10,000 US$
Otter Trawl, SOC	10,000 US$
Subtotal	**450,000 US$**

4.2.1.3 DNA extraction

The costs originated by the DNA-extractions and molecular work are estimated as follows:

Molecular laboratory at University Bochum (DIVA, ANDEEP)

9,000 U$ for Consumables and running costs per year

2001 –2005:	45,000 US$
Molecular Laboratory at British Antarctic Survey (KAPLAN)	
Consumables and running costs for KAPLAN:	20,000 US$
Subtotal DNA	**65,000 US$**

4.2.2 Personnel

There will probably be over 100 scientists and technicians devoting some of their time to the study of material collected during CeDAMar expeditions. The following list considers only those scientists that dedicate over 90 % of their time to the study of CeDAMar material.

4.2.2.1 Postdoctoral students

Dr. Kai George, Senckenberg Institute, CeDAMar secretary and study of Deep-Sea harpacticoid copepods.

contract 2002-2005, 74,000 US$ per year:	296,000 US$

Dr. Armin Rose, Senckenberg Institute, alpha-diversity studies on abyssal communities.

contract 2002-2005, 74,000 US$ per year:	296,000 US$

Dr. Brigitte Hilbig, DFG (German Science Foundation) Polychaetes from DIVA and ANDEEP.

contract 2001-2002 (DIVA), 80,000 US$ per year

Grant 2002-2004 (ANDEEP), 25,000 US$ per year	210,000 US$

Dr. Ute Mühlenhardt-Siegel, DFG (German Science Foundation) Cumaceans from DIVA expedition

contract 2001-2003, 74,000 US$ per year (3 yrs):	222,000 US$

Dr. Sybille Seifried, DFG (German Science Foundation) Meiofauna from DIVA expedition

contract 2001-2004, 74,000 US$ per year (3 yrs):	222,000 US$

Dr. Elke Willen, DFG (German Science Foundation) Meiofauna from ANDEEP expedition

contract 2003-2005, 74,000 US$ per year (2 yrs):	148,000 US$

Dr. Lenaïck Menot (Ifremer-ISA), Ecology of macrofauna,

contract 2004-2005, 45,000 US$ per year (1.5 year)	67,500 US$

Dr. Alan Hughes, SOC (Natural Environment Research Council)

(submitting thesis 2004):	150,000 US$

4.2.2.2 PhD Students

Gunnar Gad, (University of Oldenburg)

Revision of Loricifera

contract, 2001-2004, 43,000 US$ per year (3 yrs): 129,000 US$

Jürgen Guerrero-Kommritz, DFG (German Science Foundation)

Tanaidacea from DIVA expedition

contract, 2000-2003, 43,000 US$ per year (3 yrs): 129,000 US$

Saskia Brix, DFG (German Science Foundation)

Isopoda from DIVA expedition

contract July 2002 –July 2005, 43,000 US$ per year (3 yrs): 129,000 US$

Wiebke Brökeland, DFG (German Science Foundation)

Molecular phylogeny of Isopoda from ANDEEP expedition

contract 2002 –2004, 43,000 US$ per year (3 yrs): 129,000 US$

Nils Brenke, DFG (German Science Foundation)

Isopods from DIVA expedition

contract 2002 –2004, 43,000 US$ per year (3 yrs): 129,000 US$

4.2.2.3 Computer scientist

Burkhart Köster, Senckenberg Institute

Database Design and Administration, Data safety and Maintenance

Permanent position, 74,000 US$ per year, 3 months x 2 years: 18,000 US$

4.2.2.4 Technicians

Marco Bruhns, Senckenberg Institute, sorting of ANDEEP and DIVA samples

Permanent position, 48,000 US$ per year, 2002-2005: 192,000 US$

Jutta Heitfeld, Senckenberg Institute, sorting of ANDEEP and DIVA samples

Permanent position, 48,000 US$ per year, 2002-2005: 192,000 US$

Annika Henche, Senckenberg Institute, sorting of ANDEEP and DIVA samples

Permanent position, 45,000 US$ per year, 2002-2005: 180,000 US$

Subtotal personnel costs: 2.850,500 US$

4.2.3 Total of matching funds and value of facilities available

Expedition Costs		16,360,000 US$
Equipment		450,000 US$
DNA		65,000 US$
Personnel		2.850,500 US$
Total		**19.725,500 US$**

4.3 Literature cited

Brown, C.J., Lambshead, P.J.D., Smith, C.R., Hawkins, L.E. & Farley, R. 2001. Phytodetritus and the abundance and biomass of abyssal nematodes in the central, equatorial Pacific. - Deep-Sea Research I, 48:555-565

Culver & Buzas (2000). Global latitudinal species diversity gradient in deep-sea benthic foraminifera. - Deep-Sea Research I 47:259-275

Gage, J.D. & Tyler, P.A. (1990). *Deep-Sea Biology. A Natural History of Organisms at the Deep-Sea* Floor. Cambridge University Press. 504pp

Glover, A.G., Paterson, G.L.J., Bett, B.J., Gage, J.D., Sibuet, M., Sheader, M., Hawkins, L. (2001). Patterns in polychaete abundance and diversity from the Madeira Abyssal plain, northeast Atlantic. -Deep-Sea Research I, 48:217-238

Grassle, J.F. & Maciolek, N.J. (1992). Deep-sea species richness: regional and local diversity estimates from quantitative bottom samples. -American Naturalist, 139(2):313-341

Gray, J.S. (1997). Gradients in marine biodiversity. In "*Marine Biodiversity: Patterns and Processes*" (Ormond, R.F.G., Gage, J.D. & Angel, M.V. Eds), pp 19-34

Gray, J.S. (2002). Species richness of marine soft sediments. -Marine Ecology Progress Series, 244:285-297

Heywood, V. H. (1995). Global Biodiversity assessment. UNEP, Cambridge University Press, 1-1140

Lambshead, P.J.D., Tietjen, J., Ferrero, T., & Jensen, P. (2000). Latitudinal diversity gradients in the deep sea with special reference to North Atlantic nematodes. -Marine Ecology Progress Series, 194:159-167

Lambshead, P.J.D., Tietjen, J., Moncrieff, C.B. & Ferrero, T (2001). North Atlantic latitudinal diversity patterns in deep-sea marine nematode data: a reply to Rex et al. -Marine Ecology Progress Series, 210:200-301

Lambshead, P.J.D., Brown, C.J., Ferrero, T.J., Mitchell, N.J., Smith, C.R., Hawkins, L.E. & Tietjen, J. (2002). Latitudinal diversity patterns of deep-sea marine nematodes and organic fluxes: a test from the central equatorial Pacific. -Marine Ecology Progress Series, 236:129-135

Poore, G.C.B. and Wilson, G.D.F., 1993. Marine species richness (with reply from R.M. May). –Nature, 361: 597–598.

Rex, M.A., 1997. An oblique slant on deep-sea biodiversity. –Nature, 385: 577–578.

Rex, M.A., Stuart, C.T., Hessler, R.R., Allen, J.A., Sanders, H.L. & Wilson, G.D.F. (1993). Global scale latitudinal patterns of species diversity in the deep-sea benthos. –Nature, 365:636-639

Rex, M.A., Etter, R.J. & Stuart, C.T. (1997). Large-scale patterns of species diversity in the deep-sea benthos. In "*Marine Biodiversity: Patterns and Processes*" (Ormond, R.F.G., Gage, J.D. & Angel, M.V. Eds), pp 94-121

Rex, M.A., Stuart, C.T. & Coyne, G. (2000). Latitudinal gradients of species richness in the deep-sea benthos of the North Atlantic. -Proceedings of the National Academy of Sciences USA, 97:4082-4085

Rex, M.A., Stuart, C.T. & Etter, R.J. (2001). Do deep-sea nematodes show a positive latitudinal gradient of species diversity? The potential role of depth. -Marine Ecology Progress Series, 210: 297-298

Rowe, G. T. (1971). Benthic biomass and surface productivity. In: J. D. Costlow (Ed.), *Fertility of the Sea*, Vol. 2. Gordon and Breach Science Publications, New York, pp. 441-454.

Sanders, H.L. and Hessler, R.R., 1969. Diversity and composition of abyssal benthos. –Science, 166: 1033–1034.

Sanders, H.L., Hessler, R.R. and Hampson, G.R., 1965. An introduction to the study of deep-sea benthic faunal assemblages along the Gay Head-Bermuda transect. -Deep-Sea Research, 12: 845–867.

Snelgrove, P.V.R. & Smith, C.R. (2002). A riot of species in an environmental calm: the paradox of the species-rich deep-sea floor. -Oceanography and Marine Biology, 40:311-342

Thomas, E., and Gooday, A.J., 1996. Cenozoic deep-sea benthic foraminifers: Tracers for changes in oceanic productivity? –Geology, 24: 355-358.

Tyler, P. A. (2003). Ecosystems of the deep Ocean, Introduction. In: Goodall D. W. *Ecosystems of the World*. Elsevier, pp. 1-3.

4.4 Curriculum Vitae Prof. Dr. Pedro Martínez Arbizu

Name: Pedro M. Martínez Arbizu

Title: Professor of Marine Biodiversity at University of Oldenburg

Address:DZMB- Forschungsinstitut Senckenberg, Südstrand 44

City, State, Zip: 26382 Wilhelsmhaven, Germany

Telephone Number: +49 4421 9475 101

Fax Number: +49 4421 9475 111

E-Mail Address: pmartinez@senckenberg.de

Birthday and location:20/05/1969 at Valencia Spain

Education and professional carrer:

Studied Biology (Diplom) at the Carl von Ossietzky Universität Oldenburg, Germany. Ph. D. degree at the Carl von Ossietzky Universität Oldenburg (2000). Project: "The paraphyly of Cyclopinidae Sars, 1913 and the phylogenetic position of poecilostome families within Cyclopoida Burmeister, 1835 (Copepoda: Crustacea)" (*Summa cum laude*).

1994-1998: Research assistant (Universität Oldenburg): Quantitative and systematic composition of Arctic meiofauna, specially harpacticoid copepods, and Latitudinal species diversity gradients of deep-sea meiofauna in the Southern Atlantic.

1999- 2001: Professor at Universidade Federal do Paraná in Curitiba, Brazil.

Since 12. 2001: Professor at the University of Oldenburg and Director of the German Center for Marine Biodiversity Research, at Senckenberg Research Institute

Since 03.2003: Member of the Steering Group of DIVERSITAS-Germany.

Expeditions

Three expeditions with RV *Polarstern* (1993, ARK-IX/4 to the Arctic Barents-, Kara- und Laptev-Seas; 1996, ANT XIII/5 (Punta Arenas- Bremerhaven); 2002, ANT XIX/3 (Punta

Arenas- Punta Arenas), ANDEEP I). One expedition with RV Meteor (1998, M42-5 (Lisboa - Las Palmas) to the Seamount called Great Meteor Seamount)

Five selected references out of 27 peer-reviewed publications

Martínez Arbizu, P. & S. Seifried (1996): The phylogenetic position of *Arcticomisophria bathylaptevensis* gen. et sp. n. (Crustacea: Copepoda) a new misophrioid from hyperbenthic deep-sea waters in the Laptev Sea (Arctic Ocean). SARSIA 81: 285-295

Martínez Arbizu, P. (1997): *Cyclopicina sirenkoi* sp. n. (Copepoda: Cyclopinidae) from deep waters in the Laptev Sea (Arctic Ocean), with comments on the phylogenetic relationships of copepod orders. SENCKENBERGIANA BIOLOGICA 77: 89-99.

Vanaverbeke, J., Martínez Arbizu, P., Dahms, H.-U. & H. K. Schminke (1997): The metazoan meiobenthos along a depth gradient in the Arctic Laptev Sea, with special attention to nematode communities. POLAR BIOLOGY 18: 391-401.

Martínez Arbizu, P. (2000a) A new species of *Cyclopetta* from the Laptev Sea (Arctic Ocean), with the recognition of Cyclopettidae fam. nov. a new monophylum of free-living Cyclopoida (Copepoda). BULLETIN DE L´INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE, 70 : 91-101

Martínez Arbizu, P. (2000b) Giselinidae fam. nov., a new monophyletic group of cyclopoid copepods (Copepoda: Crustacea) from the Atlantic deep sea. HELGOLAND MARINE RESEARCH, 54: 190-212.

4.5 Curriculum Vitae Prof. Dr. Craig Smith

Name: Craig R. Smith

Title: Professor of Oceanography

Campus Address: Department of Oceanography, 1000 Pope Road

City, State, Zip: Honolulu, HI 96822

Telephone Number: 808-956-8623

Fax Number: 808-956-9516

E-Mail Address: csmith@soest.hawaii.edu

Social Security Number: 385-60-2563

Education

B.S., 1977, with high honors, Biological Science, Michigan State University

Ph.D., Dec 1983, Biological Oceanography, Scripps Institution of Oceanography, UCSD

Professional Experience

1995-present: Professor, Department of Oceanography, University of Hawaii at Manoa

1988-1995: Associate Professor, Department of Oceanography, University of Hawaii

1986-1988: Research Assistant Professor, School of Oceanography, University of Washington

1985-1986: Postdoctoral Research Associate, School of Oceanography, University of WA

1983-1984: Postdoctoral Scholar, Woods Hole Oceanographic Institution

1979-present: Chief scientist on 45 oceanographic expeditions in the Pacific and Southern Oceans; >100 dives with manned submersibles and ROVs

Major Research Interests:

Seafloor ecology including processes of disturbance and succession, bioturbation, carbon flux, deposit feeding, reducing habitats, biodiversity, bentho-pelagic coupling, and anthropogenic impacts on the ocean

Peer-reviewed Publications Since 2002 (out of a total of 75)

Snelgrove, P.V.R. and C. R. Smith. 2002. A riot of species in an environmental calm: the paradox of the species-rich deep-sea floor. *Oceanography and Marine Biology Annual Review*, 40, 311-342.

Smith, C.R. and C. Rabouille. 2002. What controls the mixed-layer depth in deep-sea sediments? The importance of POC flux. *Limnology and Oceanography* 47:418-426.

Austen, M.C., P. J. D. Lambshead, P.A. Hutchings, G. Boucher, P.V.R. Snelgrove, C. Heip, G. King, I. Koike, and C. R. Smith. 2002. Do biodiversity links above and below the marine sediment-water interface affect stability of benthic and pelagic communities? *Biodiversity and Conservation* 11, 113-136.

Lambshead, P.J.D., C.J. Brown, T. J. Ferrero, C.R. Smith, L.E. Hawkins and J. Tietjen. 2002. Latitudinal diversity patterns for deep-sea nematodes and organic fluxes – a test from the central equatorial Pacific. *Marine Ecology Progress Series*. 236: 129-13

Smith, C. R., A. Baco and A. Glover. 2002. Faunal Succession on Replicate Deep-Sea Whale Falls: time scales and vent-seep affinities. *Cahiers de Biologie Marine*, 39:293-297.

Smith, C. R. and A.W.J. Demopoulos. 2003. Ecology of the deep Pacific Ocean floor. 2002. In: *Ecosystems of the World Volume 28: Ecosystems of the Deep Ocean*, P. A. Tyler, ed., Elsevier, Amsterdam. pp. 179 – 218.

Demopoulos, A.W.J., C. R. Smith and P. A. Tyler. 2003. Ecology of the deep Indian Ocean floor. In: *Ecosystems of the World Volume 28: Ecosystems of the Deep Ocean*, P. A. Tyler, ed., Elsevier, Amsterdam. Pp 219-237.

Glover, A.G., C. R. Smith, G.L.J. Paterson, G. D. F. Wilson, L. Hawkins and M. Sheader. Polychaete species diversity in the central Pacific abyss: local and regional patterns, and relationships with productivity. *Marine Ecology Progress Series*, 240:157-170.

Smith, C.R. and A. R. Baco. 2003. The ecology of whale falls at the deep-sea floor. *Oceanography and Marine Biology Annual Review*, 41: 311-354.

Demopoulos, A.W.J., C.R. Smith, D.J. DeMaster, W. L. Fornes. 2003. Evaluation of excess ^{234}Th activity in sediments as an indicator of food quality for deep-sea deposit feeders. *Journal of Marine Research*, 61: 267-284.

Glover, A. G. and C. R. Smith. 2003. The deep seafloor ecosystem: current status and prospects for change by 2025. *Environmental Conservation*, 30: 219-241.

Suhr, S.B., D.W. Pond, A. J. Gooday and C.R. Smith. 2003. Selective feeding by benthic foraminifera on phytodetritus on the western Antarctic Peninsula shelf: Evidence from fatty acid biomarker analyses. *Marine Ecology Progress Series*, in press.

Baco, A.R. and C. R. Smith. 2003. High species richness in deep-sea chemoautotrophic whale skeleton communities. *Marine Ecology Progress Series* 260: 109-114.

Schuller, D., D. Kadko and C. R. Smith. 2004. Use of ^{210}Pb/^{226}Ra disequilibrium in the dating of deep-sea whale falls. *Earth and Planetary Science Letters*, in press.

4.6 *Curriculum Vitae Dr. Brigitte Hilbig*

Name: Brigitte Hilbig

Title: Guest Investigator

Address: Lehrstuhl für Spezielle Zoologie, Geb. ND 05/780, Ruhr-Universität Bochum, Universitätsstr. 150

City, State, Zip: D-44780 Bochum, Germany

Telephone Number: +49 234 32-24997

Fax Number: +49 234 32-14114

E-Mail Address: Brigitte.Hilbig@rub.de

Birthday and location:02/09/1953 at Zweibrücken, Germany

Education and professional carrer:

Studied Biology (Diplom) at the University of Hamburg, Germany. Ph. D. degree at the University of Hamburg (1983). Dissertation on ultrastructures of the integument of selected polychaetes.

1983-1985: Researcher, University of Münster, Germany, Experimental Department of the Dermal Clinic. Production of monoclonal antibodies against tissue factors of tumors.

1985-1997 Scientist and Senior Scientist at 3 consulting firms in Massachusetts, U.S.A. (Battelle New England, Science Applications Internmational Corporation, ENSR) Environmental monitoring projects and impact statements in the deep sea off the U.S. west and east coasts and coastal waters.

1997-2003 Researcher, University of Hamburg. Projects: biodiversity of deep-sea polychaetes in the Antarctic (including ANDEEP) and the south Atlantic (DIVA).

Since 2003 Researcher, university of Bochum. Biodiversity of deep-sea polychaetes, continuation of above projects.

Expeditions

More than 20 cruises on U.S. American ships to coastal and deep waters, about 10 as Chief Scientist; two expeditions with RV *Polarstern* (1998, ANT XV/3 to the Weddell Sea; 2002, ANDEEPI/II to the Weddell and Scotia Seas). One expedition with RV *Meteor* (2000, DIVA-1 to the Angola Basin)

Five selected references out of 33 peer-reviewed publications

Hilbig, B. 1994. Faunistic and zoogeographical characterization of the benthic fauna on the Carolina continental slope. Deep-Sea Res. (II) 41:929-950.

Hilbig, B. 2000. Family Terebellidae Malmgren, 1867. Chapter 9 in: J.A. Blake und B. Hilbig (eds), Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. Vol. 7. The Annelida Part 4. Santa Barbara Museum of Natural History.

Hilbig, B. 2001. Deep-sea polychaetes in the Weddell Sea and Drake Passage: first quantitative results. Polar Biol. 24:538-544.

Hilbig, B. & J.A. Blake. 2000. Long-term analysis of polychaete-dominated benthic infaunal communities in Massachusetts Bay, U.S.A. Bull. mar. Sci. 67 (1):147-164.

Hilbig, B. & D. Fiege. 2001. A new species of Dorvilleidae (Annelida:Polychaeta) from a hydrothermal vent in the northeast Pacific. Proc.biol.Soc.Wash. 114(2):396-402.

Hilbig, B. & A. Montiel. 2000. Harmothoe campoglacialis spec. nov. (Polychaeta: Polynnoidae), a new scaleworm from the Magellan Region, Chile. Mitt.hamb.zool..Mus.Inst. 97:5-12.

4.7 Participating institutions by country and expedition

		DIVA	ANDEEP	KAPLAN	BIOZAIRE	NODINAUT	CROZEX
Australia:	Museum Victoria Melbourne		X				
Belgium:	Marine Biology Section, Zoological Institute, University of Gent		X		X	X	
	Institut Royal des Sciences naturelles de Belgique	X	X				
	Laboratoire de Biologie marine, Université Libre de Bruxelles		X				
Canada:	Canadian Museum of Nature	X					
Denmark:	Zoological Museum, University of Copenhagen	X					
France:	Centre des Sciences de la Terre, DIJON		X				
	IFREMER			X	X	X	
	Museum national d´Histoire Naturelle, Paris.				X	X	
Germany:	Zoologisches Institut und Museum der Universität Hamburg (ZIM)	X	X				
	Spezielle Zoologie, Ruhr-Universität Bochum	X	X				
	Zoologisches Institut der LMU München		X				
	Alfred-Wegener-Institut für Polar und Meeresforschung, Bremerhaven		X				
	Forschungsinstitut Senckenberg	X	X			X	
	Zoologische Staatssammlung München	X	X				
	Institute for Polar Ecology, University of Kiel		X				
	Ag. Zoosystematik und Morphologie, Universität Oldenburg	X	X				
	Museum für Naturkunde, Berlin	X					
	Universität Osnabrück	X					
	Zoologisches Institut der Freien Universität Berlin	X					
	Zoologisches Institut, Universität Köln	X					
	Institut für Meereskunde, Kiel	X					
Italy:	Dipartimento di Scienze e Technologie Biologiche ed Ambientali, Università di Lecce		X				
Japan:	Shizuoka University			X			
	JAMSTEC			X			
Norway:	Department of Zoology, University of Tromsø,		X				
	Department of Marine Zoology and Marine Chemistry, University of Oslo		X				
Russia :	P. P. Shirshov Institute of Oceanography, Russian Academy of Science, Moscow		X				
Spaim:	Departamento Fisiología Animal y Zoología, Facultad de Biología, Universidad de Sevilla		X				
	Facultad de Ciencias del Mar, Universidad de Cádiz		X				
	Dept. Zoología, Universidad del Pais Vasco, Bilbao	X					
	Laboratorio de Zooloxia Marina, Universidad de Santiago de Compostela	X					
	Dept. Zoología, Universidad da Coruña	X					
	Dept. Zoología, Universidad de Vigo	X					
Switzerland:	Station de Zoologie, Universite de Geneve		X				
UK:	National Museum of Scotland		X				
	Southampton Oceanography Centre, Southampton		X	X			X
	British Antarctic Survey, Cambridge		X	X		X	X
	Scottish Association for Marine Science, Oban, Argyll		X				
	Natural History Museum of London			X		X	
	University of Liverpool						X
	University of Aberdeen						X
USA:	University of Hawaii at Manoa			X		X	
	Diversa Corporation, San Diego			X		X	
	ENSR, Woods Hole		X				
	Virginia Institute of Marine Science, Virginia		X				
	Scripps Institution of Oceanography, La Jolla, California		X				
	University of California Santa Cruz, Santa Cruz		X				
	Dept. of Invertebrate Zoology & Geology, California Academy of Sciences, San Francisco		X				
	Department of Biology, University of Massachusetts, Boston		X				
	Natural History Museum, Smithsonian Institution, Washington	X					

4.8 Table of Contents for Report and List of Participants from the CoML workshop:

Deep-Sea Sediments: The Known, the Unknown and the Unknowable

Hatfield Marine Science Center, Newport, Oregon, USA
21 to 24 August 2003

Reported by:

Dr. Tammy Horton, Dr. Ben Wigham and Dr. David Billett
Southampton Oceanography Centre, DEEPSEAS Group, Empress Dock, European Way, Southampton SO14 3ZH, UK

***Table of Contents* (illustrating the scope of discussions)**

Participants in the Hatfield <u>Deep-Sea Sediments</u> CoML Workshop

Dr David Billett, Southampton Oceanography Centre, DEEPSEAS Group, Empress Dock, Southampton, SO14 3ZH, UK. dsmb@soc.soton.ac.uk

Prof Angelika Brandt, Universitat Hamburg, Zoologische Institut und Museum, Martin Luther King Pl. 3, D-20146, Hamburg, Germany. ABrandt@zoologie.uni-hamburg.de

Dr Lucia Campos-Creasey, Departamento de Zoologia, IB/CCS, Universidade Federal do Rio de Janeiro, Prédio do Centro de Ciências da Saúde, BL "A", sub-solo Av. Pau Brasil, 211, Ilha do Fundão, CEP 21941-590, Rio de Janeiro-RJ, Brazil. lsc_creasey@biologia.ufrj.br

Prof Robert Carney, Coastal Ecology Institute, Louisiana State University, Baton Rouge, La 70803, USA. rcarne1@lsu.edu

Dr Thomas Cronin, Climate History Team, US Geological Survey, Reston, Virginia 20192, USA. tcronin@usgs.gov

Dr Kari Ellingsen, Avdeling for Marinbiologi og Limnologi, Biologisk Institutt, Universitetet i Oslo, Pb 1064 Blindern, 0316 Oslo, Norge. k.e.ellingsen@bio.uio.no

Dr Ana Falcão, Gerência de Avaliação e Monitoramento Ambiental, Centro de Pesquisas Desenvolvimento Leopoldo A. Miguez de Mello, (CENPES) – PETROBRAS, Av. Hum - Quadra 07, Cidade Universitária - Ilha do Fundão, Rio de Janeiro, Brazil.apfalcao@cenpes.petrobras.com.br

Prof. John Gage, Scottish Association for Marine Science, Dunstaffnage Marine Laboratory, Oban, Argyll, Scotland, UK. jdg@sams.ac.uk

Dr Adrian Glover, Natural History Museum, Zoology Department, The Natural History Museum, Cromwell Rd, London SW7 5BD, UK.a.glover@nhm.ac.uk

Dr Andrew Gooday, Southampton Oceanography Centre, DEEPSEAS Group, Empress Dock, Southampton, SO14 3ZH, UK. ang@soc.soton.ac.uk

Dr Tammy Horton (Rapporteur 1), Southampton Oceanography Centre, DEEPSEAS Group, Southampton, SO14 3ZH, UK. txh@soc.soton.ac.uk

Prof. Lisa Levin, Integrative Oceanography Division, Scripps Institution of Oceanography, La Jolla, CA 92093-0218, USA. llevin@ucsd.edu

Prof. P. Martinez Arbizu, DZMB - Forschungsintitut Senckenberg, Schleusenstr. 1, 26382, Wilhelmshaven, Germany. pmartinez@senckenberg.de

Dr Nagender Nath, National Institute of Oceanography, Dona Paula, Goa 403004, India. nagender@csnio.ren.nic.in

Dr Gary Poore, Museum Victoria, GPO Box 666E, Melbourne, VIC 3001, Australia. gpoore@mov.vic.gov.au

Prof. Mike Rex, Department of Biology, University of Massachussetts, Boston, MA 02125, USA. michael.rex@umb.edu

Prof. Gil Rowe, Department of Marine Biology, Texas A&M University at Galveston, Galveston, Texas 77551-5923, USA. roweg@tamug.edu

Prof. Yoshihisa Shirayama, Seto Marine Biological Laboratory, Kyoto University, 459 Shirahama-Cho, Wakayama Pref. 649-2211, Japan. yshira@seto.kyoto-u.ac.jp

Dr. Myriam Sibuet, Direction des Recherches Océaniques, IFREMER, Brest, France. Myriam.Sibuet@ifremer.fr

Prof. Craig Smith, Department of Oceanography, University of Hawaii, 1000 Pope Rd, Honolulu, HI 96822, USA. csmith@soest.hawaii.edu

Prof. Ken Smith, Marine Biology Research Division, Scripps Institute of Oceanography, University of California San Diego, La Jolla, CA 92093-0202, USA. ksmith@ucsd.edu

Dr. Paul Snelgrove, Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, Newfoundland, Canada A1C 5S7. psnelgro@mun.ca

Dr Stefan Sommer, GEOMAR Forschungszentrum für marine Geowissenschaften, Wischhofstr. 1-3, 24148 Kiel, Germany. ssommer@geomar.de

Dr. Anastasios (Tassos) Tselepides, Institute of Marine Biology, Crete, PO Box 2214, 710 03 Heraklion, Crete, Greece. ttse@imbc.gr

Prof. Ann Vanreusel, Marine Biology Section, University of Ghent, Krijgslaan 281, S8 - Sterre Campus, B-9000 Ghent, Belgium. ann.vanreusel@rug.ac.be

Dr Ben Wigham, (Rapporteur 2), Southampton Oceanography Centre, DEEPSEAS Group, Southampton, SO14 3ZH, UK. bdw@soc.soton.ac.uk