Expeditionsprogramm Nr. 62

FS POLARSTERN

ANT-XIX/3
ANT-XIX/4
ANT-XIX/5

2002

Koordinator:
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STIFTUNG ALFRED-WEGENER-INSTITUT
FÜR POLAR- UND MEERESFORSCHUNG

BREMERHAVEN, DEZEMBER 2001

Expeditionsprogramm Nr. 62

FS POLARSTERN

ANT-XIX/3
23.01.2002 - 26.02.2002
Punta Arenas - Punta Arenas

ANT-XIX/4
28.02.2002 - 01.04.2002
Punta Arenas - Punta Arenas

ANT-XIX/5
03.04.2002 - 05.05.2002
Punta Arenas - Ushuaia

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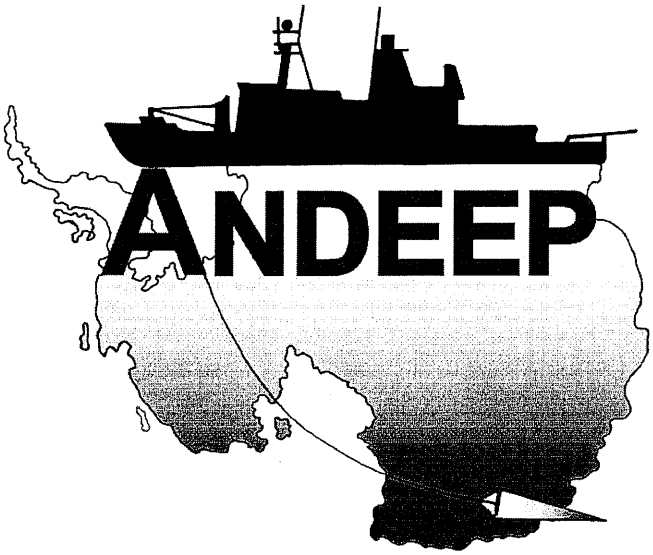
ANDEEP

EXPEDITION ANT-XIX
Legs ANT-XIX/3 and ANT-XIX/4

ZUSAMMENFASSUNG UND FAHRTVERLAUF

Die Fahrtabschnitte ANT-XIX/3 und /4 der *Polarstern*-Expedition ANT-XIX sind fast vollständig zwei größeren biologischen Forschungsprogrammen gewidmet, die im Seegebiet um die Antarktische Halbinsel, im Scotiameer und bei den Süd-Sandwich-Inseln im nördlichen Weddellmeer durchgeführt werden:
(1) Ein Projekt, ein Beitrag für CCAMLR (Kommission für die Erhaltung der antarktischen lebenden Rohstoffe) umfasst Untersuchungen zum Status der Fischvorkommen und entsprechende Begleitprojekte in den Gewässern um die Elephant-Insel und der Region der Süd-Shetland-Inseln.
(2) Das ANDEEP-Projekt (Biodiversität des antarktischen Tiefsee-Benthos) beschäftigt sich mit der Besiedlungsgeschichte und den heutigen Besiedlungsmustern in der Tiefsee; es ist ein internationales Projekt zur Erforschung der Tiefwasser-Biologie im Scotia- und Weddellmeer mit FS *Polarstern*.

Zusätzlich zu diesen großen Forschungsprogrammen werden einige ergänzende Forschungsprojekte durchgeführt: (a) Mikrobiologische Untersuchungen zur Häufigkeit und Lebensgemeinschaft oligotropher Bakterien, (b) Absorptions-spektroskopische Messungen atmosphärischer Spurengase zur Validierung des SCIAMACHY-Instruments auf dem Satellitien ENVISAT und nicht zuletzt (c) ein Projekt der AURICHER WISSENSCHAFTSTAGE, in dem eine Schülergruppe aus der Studienstufe des GYMNASIUM ULRICIANUM aus Aurich in praktischer Zusammenarbeit mit den Wissenschaftlern in Fragestellungen und Methoden moderner Meeres- und Polarforschung eingeführt wird.

Der Fahrtabschnitt ANT-XIX/3 beginnt für FS *Polarstern* am 23. Januar 2002 in Punta Arenas, Chile, und wird am 26. Februar 2002 in Punta Arenas enden. Die geplanten Beprobungen werden in der Drake-Straße beginnen, sich für die Fischerei-Untersuchungen auf den Schelf um die Elephant-Insel konzentrieren und für das ANDEEP-Projekts über die angrenzenden Kontinentränder bis in die Tiefsee von Scotia- und Weddellmeer erstrecken (Fig. 1).

Für den Fahrtabschnitt ANT-XIX/4 verlässt FS *Polarstern* Punta Arenas am 28. Februar 2002. Die Arbeitsgebiete dieses Abschnittes, der ausschließlich dem ANDEEP-Projekt gewidmet ist, liegen an der Spitze der Antarktischen Halbinsel, in der tektonisch unruhigen Region östlich der Süd-Sandwich-Inseln und auf Profilschnitten über die Tiefsee des östlichen Weddellmeeres und eventuell südlich Süd-Georgien (Fig. 1). Am 01. April 2002 wird FS *Polarstern* in Punta Arenas zurück erwartet.

Für die Fischerei-Untersuchungen wird als Standardgerät ein großes Grundschleppnetz auf etwa 40 geplanten Fangpositionen zum Einsatz kommen. Die Stationen für die ANDEEP-Untersuchungen werden in regelmäßigen Tiefenintervallen bei 750 m, 1000 m, 1500 m, 2500 m und 4000 m Wassertiefe durchgeführt werden. Jeweils mehrere Tiefenschnitte sind für die verschiedenen Zielgebiete

geplant (Fig. 1). Auf jeder Station sollen CTD+Rosette für Wasserproben, der Großkastengreifer, Vielkerngerät, Agassiz-Trawl und Epibenthos-Schlitten für die Gewinnung biologischer und geologischer Proben eingesetzt werden. Für eine genaue Auswahl und Festlegung der Probenstationen soll das Fächerecholotsystem HYDROSWEEP und das Sedimentecholot PARASOUND des FS *Polarstern* eingesetzt werden.

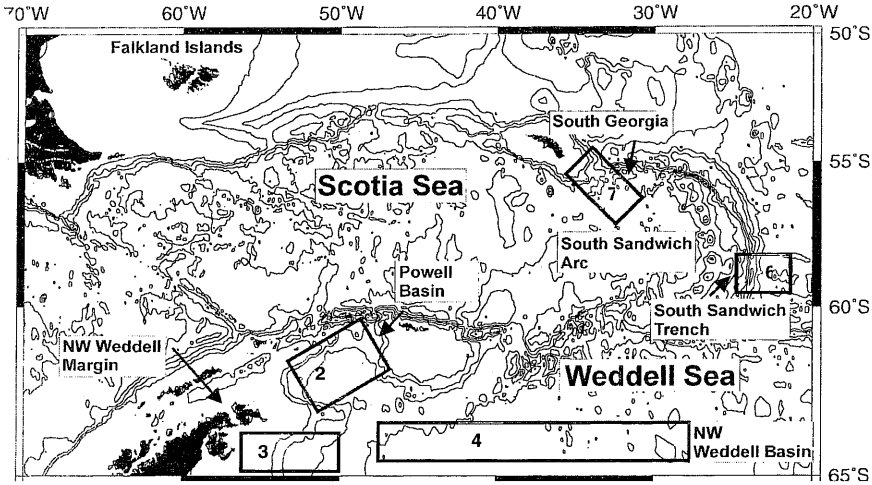

Fig. 1: Location of potential ANDEEP study areas. Drake Passage, shelf waters of Elephant Island, and areas (2) and (3) are planned to sample during Leg ANT-XIX/3 while Leg ANT-XIX/4 will focus on areas (6) and (7)

SUMMARY AND ITINERARY

In the framework of *Polarstern*-Expedition ANT-XIX, Leg 3 and Leg 4 will be devoted almost exclusively to two major biological programmes carried out in the waters at the tip of the Antarctic Peninsula, the Scotia Sea and the South Sandwich Islands:
(i) One project, as a contribution to CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) comprises the investigations on the state of fish stocks and associated projects in the waters around Elephant Island and of the South Shetland Islands region.
(ii) The ANDEEP project (Antarctic benthic deep-sea biodiversity) deals with the colonization history and recent community patterns of the deep sea and forms an international project to investigate the deep-water biology of the Scotia and Weddell seas from RV *Polarstern.*

Additionally to these main programmes some complementary research activities will be carried out such as: (i) microbiological research on the abundance and

community structure of oligotrophic, low-nutrient bacteria; (ii) Differential Optic Absorption Spectroscopy (DOAS) measurements to gain data of atmospheric trace gases for the validation of the SCIAMACHY instrument onboard the ENVISAT satellite, and (iii) an educational project of the AURICHER WISSENSCHAFTSTAGE comprising a practical project to introduce advanced students of the GYMNASIUM ULRICIANUM, Aurich, into modern topics and methods of marine and polar research.

Leg ANT-XIX/3 will start on 23 January, 2002 in Punta Arenas, Chile, and is planned to end in Punta Arenas on 26 February, 2002. Sampling will be carried out across the Drake Passage and in the shelf waters of Elephant Island for fisheries research and and along the continental slope and the deep sea for the various ANDEEP projects.

For Leg ANT-XIX/4 RV *Polarstern* will set sails on 28 February 2002 from Punta Arenas. Sampling for this ANDEEP leg will be carried out off the tip of the Antarctic Peninsula, in the tectonically active region to the east of the South Sandwich Islands and along one or more deep-water transects in the Eastern Weddell Sea or alternatively south of South Georgia (Fig. 1). This Leg is scheduled to end on 01 April 2002 in Punta Arenas, Chile.

A large bottom trawl will be used for sampling for the fisheries research study while sampling for ANDEEP studies will be carried out routinely on each station by a CTD + Rosette system for water samples, a large box corer (GKG), a multicorer (MUC), an Agassiz bottom trawl (AGT) and an epi-benthos sledge (EBS) for biological sampling. Stations are planned along regular depth intervalls at 750 m, 1000 m, 1500 m, 2500 m and 4000 water depth. Several depth transects are planned for the various target areas (Fig. 1). For precise selection of sample locations the use of the HYDROSWEEP swath-sounding system of RV *Polarstern* will be used.

ANDEEP - Antarctic benthic deep-sea biodiversity: colonization history and recent community patterns

The deeper waters of the Scotia and Weddell seas are some of the least explored parts of the world's oceans and we know almost nothing about the bottom dwelling animals that inhabit them. In contrast to the isolated shelf, waters deeper than 1000 m have broad connections with the Pacific, Atlantic and Indian oceans. Therefore, the faunas of the bathyal and abyssal areas around Antarctica may be similar to those of comparable depths elsewhere, and the degree of endemism may be much lower in the deep sea than on the shelf.

Periodic extensions of the ice sheet and deep-water production may have enhanced speciation processes from the continental shelf down into the deep sea of the world's oceans. It is possible that the deep bottom water production in the Weddell Sea acts as a distribution mechanism (e.g., via larvae), driving Antarctic deep-water faunas northwards into the Atlantic Ocean over evolutionary time-scales. Thus the Weddell Sea may be an important source for taxa presently living in the Atlantic and other neighbouring parts of the deep oceans.

Another scientific question is the faunistic link between South America and Antarctica

and whether an exchange of the respective faunas is still possible today (via island hopping or migration through the deep-sea basins). The formation of the Weddell Sea began during Jurassic time (165 million years ago), but a continental link between South America and Antarctica persisted until a little more than 20 million years ago. Geographical and climatic changes, including intermittent periods of global warming and global sea-level rise and fall, are likely to have influenced migration in and out of the Antarctic region.

Specific objectives during ANDEEP are:

- To conduct the first comprehensive survey of megafaunal, macrofaunal and meiofaunal deep-water communities in the Scotia and Weddell seas and to investigate their similarity at the taxonomic (morphological) and genetic (molecular) levels to the faunas of Atlantic basins and Antarctic shelf.
- To describe the variety of seafloor habitats in tectonically active and inactive regions and to determine the influence of habitat diversity on species and genetic diversity over a variety of spatial scales.
- To determine the importance of life history strategies and larval biology in determining species distributional patterns and geographical ranges.
- To investigate the evolutionary processes having resulted in the present biodiversity and distributional/zoogeographical patterns in the Antarctic deep sea.
- To investigate the colonisation and exchange processes of the deep-sea fauna, in particular the role of tectonic structures (for example ridges or seamounts).
- To assess the importance of the Antarctic as a region where shallow-water species may enter the deep sea by conducting experimental studies on the pressure and temperature tolerances of shallow and deep-water invertebrate larvae.

SCIENTIFIC PROJECTS during Leg ANT-XIX/3 and Leg ANT-XIX/4

Investigations on the state of fish stocks in the waters of Elephant Island and South Shetland Islands region (K.-H. Kock, BFA; ANT-XIX/3)

The Elephant Island - South Shetland Islands region has been exploited commercially by fishing fleets from 1977/78 through 1988/89. Most fishing occurred from 1977/78 and 1981/82 when concentrations of mackerel icefish, *Champsocephalus gunnari*, and marbled notothenia, *Notothenia rossii*, were fished. Since 1982/83 commercial fishing has only been conducted irregularly and with little success.

The "Commission for the Conservation of Antarctic Marine Living Resources" (CCAMLR) which was established in 1982, closed the region for finfishing after the 1989/90 season. Results from the first four surveys in the region after the closure of the fishery provided little prospect for re-opening the area for commercial fishing.

Since 1998, the USA and Germany have conducted a collaborative research programme in order to estimate stock sizes and to collect information on biological features of the abundant species. Thus far, three surveys have been conducted: 1998 and 2001 around Elephant Island and the lower South Shetland Islands, and in

1999 around the South Orkney Islands. They gave little indication that the two formerly most abundant species, *C. gunnari* and *N. rossii*, have recovered from over-exploitation. Other abundant fish species in the South Shetland Islands, such as *Gobionotothen gibberifrons*, were less abundant in 2001 than in 1998 while stock sizes in most of the icefish species were in the same order of magnitude as in 1998.

The fourth survey, carried out during January - February in austral summer2002 will be used to further clarify the state of fish stocks in the area and will collect additional material on the reproduction and food composition of the abundant fish species. The survey – comprising approximately 40 haules by a large bottom trawl - is a contribution of Germany to CCAMLR.

Electron microscopical and cytochemical studies on eggs and spermatozoa of Antarctic fishes (R. Riehl, IZUD; ANT-XIX/3)

Investigations of previously collected fishes of the Antarctic region have shown that the surface of eggs (ornamentation, distance and diameters of pores) and the morphology of the micropyles can be used to identify eggs of the various families, genera and even species of fish.

During Leg ANT-XIX/3 it is hoped to catch missing species and some specimens with more mature eggs of species which have been included in the existing lists. On board *Polarstern* the major aim will be to preserve or incubate ovarian or testicular tissues from the various fishes in Antartic waters which will be caught. This material will be collected and prepared particularly for histochemical, cytochemical and electron-microscopical investigations (TEM, SEM). To date only light-microscopical investigations of the development of sperms and eggs of Antarctic fishes exist. It is envisaged to add detailed electron-microscopical and cytochemical investigations of the oogenesis and sperm development with the collected materials. These will include the following investigations: (i) the complete description of oogenesis from the oogonia to the mature eggs with TEM in the representatives of the families Nototheniidae and Channichthydae; (ii) the development of the egg envelopes (zona radiata) to the stage when it is fully differentiated; (iii) the anatomy and dimensions of the egg envelope permits conclusions about the type of egg deposition; (iv) histo- and cytochemical investigations of the zona radiata, particularly the radiata externa, are to reveal whether sticky substances (mucopolysaccharides) are present. Their presence shows whether the eggs are deposited in benthic or pelagic regions. (v) the description of the complete spermogenesis and the morphology of mature sperms is to be investigated with the TEM in selected representatives of the families Artedidraconidae, Bathydraconidae, Channichthyidae and Nototheniidae.

Cephalopod diversity and ecology (U. Piatkowski, IFM; R.E. Young, NMS and M. Vecchione, NMNH; ANT-XIX/3)

Although cephalopods have been shown to be very important in the Antarctic food webs, the cephalopod fauna remains poorly known. For example, recent research on octopods nominally assigned to the genus *Pareledone* have revealed diversity much higher than previously expected. Based on results of a previous *Polarstern* cruise

(ANT-XIV/2), we have shown that cirrate octopods are much more abundant in the vicinity of the South Shetland Islands than was suspected. The other octopods and the squids of the Antarctic have not been investigated as thoroughly. Our previous studies have shown that (i) unknown octopod taxa (species, genera and perhaps families) remain to be described once adequate specimens have been collected, and (ii) squids, although usually rare in Antarctic trawls, occasionally are caught in comparatively large numbers, as would be expected by their common occurrence in predator stomachs.

During this cruise our research team will sample all cephalopods from all catches taken with the various sampling gears. Our overall goal is to expand our previous observations for improved understanding of the diversity, biology, life cycles, distribution and abundance of this important fauna. Examination of freshly caught material is particularly useful for documentation of subtle taxonomic characters such as colour patterns and skin texture, recording size and morphometric measurements prior to distorsion in preservatives, sampling and special fixation of tissues for studies of DNA, histology, etc., and removal of statoliths for age/growth analyses. A further aspect will be the on board investigation of stomach contents of sampled cephalopods to identify their prey and to relate this to the faunal groups caught with the various sampling gears.

Biology, taxonomy, diversity, and ecology of Antarctic cephalopods (L. Allcock, NMS; ANT-XIX/3 and /4)

We have already gathered some information about the octopuses of Antarctica from previous fishing cruises. The fauna has proved to be particularly interesting and is typified by the high levels of endemism and increased levels of species diversity often associated with Antarctica, but our data set is almost wholly limited to specimens from waters shallower than 600 m depth. The occasionally deeper trawls have revealed species hitherto unknown to science. Genetic and morphological studies focussing on Antarctica have shown that the subfamilial systematics of octopodids are severely flawed. Study of rare and poorly known deep sea fauna of Antarctica will almost certainly assist with the development of a more appropriate classification and lead to systematic progression in this group.

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Origin and evolution of the deep-sea and Antarctic anthozoan faunas: molecular, anatomical, and reproductive-pattern approaches (M. Conradi, UDS & C. Megina, CASEM; ANT-XIX/3)

Anthozoans are one of the major components in benthic communities in terms of both abundance and diversity. Moreover, many Antarctic species belonging to this group are yet unknown, present knowledge being estimated to encompass no more than 50 %.

The research of anthozoan material from the ANDEEP cruises compared with the recent EASIZ cruises and some Patagonian cruises will help to elucidate the importance of possible immigrant ways e,g, Drake Passage/Scotia Arc, and deep-sea areas, and the possible relict Cretaceous stock to conform the extant Antarctic fauna. In addition, a group extraordinarily diverse in Antarctica, the gorgonian family Primnoidae, seems to have exported some forms such as the northern deep-sea species of the genus *Convexella* living mainly deeper than 2000 m, usually between 4000-5000 m. Finally, among the anthozoans, other "bipolar" distribution such as those of the genera *Gersemia*, and *Paragorgia* are in need of additional data using other different tools than those of the traditional taxonomy.

The scientific objectives will be: (i) to detect the presence of latitudinal boundaries in the distribution of anthozoans at different taxa levels in the deep sea around the Scotia Arc. (ii) to evaluate the potential origin of the Antarctic anthozoan fauna according to the known distribution of genera/species in this and other biogeographical areas. (iii) to detect undescribed species that could help to understand the relationship between Antarctica and other deep-sea bottoms and the continental shelf in the past and present. (iv) to carry on with the bank of tissue usable for molecular studies (already initiated during EASIZ III). (v) to sustain the study of the reproductive patterns in Antarctic anthozoans and (vi) to continue the detection of secondary metabolites in anthozoans (in collaboration with Spanish/other chemical researcher teams) with a biological activity responsible for the evolutionary success of the group.

Contribution to the knowledge of life histories and reproductive biology of deep-sea hydrozoa and polychaeta (S. Piraino, UNILE; ANT-XIX/4)

Polar waters and deep-sea habitats share many common ecological features (e.g., low temperature, low food input, high biological interactions, relatively constant physical environment, relatively long geological history), in addition to the fact that both represent extreme environments. Therefore, ecological constraints in polar regions and in the deep sea are likely the same, and species are selected and/or can develop adaptations to such constraints in similar ways. To this respect, polar and deep-sea waters represent the most suitable environments to evaluate the relative contribution and interplay between phylogenetic and ecological factors in selecting life history traits.

Both Hydrozoa and Polychaeta represent important components of the Antarctic benthos, in terms of contribution to the overall biodiversity and their ecological relevance. Both these groups show also a large variety of life cycle traits and reproductive strategies. However, despite of their frequency, diversity and abundance, both hydroids and polychaetes are poorly known as regards to life history traits and their adaptive significance. The research project, proposed for ANDEEP, is in line with the above conceptual framework, and it is a continuation of previous studies carried out on board of RV *Polarstern* during the three EASIZ cruises. Three closely related sub-projects will be carried out.

(a) Biodiversity, life cycle, and reproductive biology of Hydrozoa
Participation in ANDEEP will allow to increase the knowledge on the diversity of the hydrozoan fauna, the biogeographical analysis and the description of the spatial and depth distribution in Antarctic and sub-Antarctic areas. Rearings on board will give the opportunity to gather new informations on developmental time and modes of deep-sea hydrozoans. The quantification of the invested reproductive effort will give a further contribution to the knowledge of pattern of hydrozoan population dynamics and to the understanding of seasonal changes in benthic community composition.

(b) Life cycle variability and reproductive biology of deep-sea Polychaeta, and comparisons with shelf species
The objective during this ANDEEP cruise is to increase the knowledge on reproductive biology of deep sea Antarctic polychaetes, with particular attention to those families and forms that can be found also in the shelf areas and that can be compared in their adaptation, in particular polynoids and sabellids. If such species are found, rearings on board will give the opportunity to gather new information on developmental time and modes of deep-sea polychaetes.

(c) Cyst diversity in deep-sea Antarctic sediments
The importance of cysts in deep waters is mostly neglected. In marine ecological systems, resting stages constitute a "potential biodiversity" allowing a structural continuity against the functional discontinuity represented by the presence of species in the water column. Resting stages may represent a fundamental biological link, via submarine canyons, in shelf-slope and shallow-deep sea coupling. In particular, upwelled waters might affect coastal planktic populations by not only supplying

dissolved nutrients, but also recruiting propagules (resting stages) for their life cycle dynamics. If so, the functioning of coastal Antarctic waters would be intimately linked with that of offshore ones, via canyon-driven circulation of propagules. The study of resting stage dynamics in Scotia Ridge deep-sea canyons will be a further step in this direction. Collection of deep-sea resting stages within the framework of ANDEEP will contribute to our knowledge on a cryptic, but ecologically important component of the Antarctic marine system.

Origin and Evolution of Antarctic and Deep-Sea Macroinfauna; Systematics and Reproductive Patterns of Polychaetes (J.A. Blake, ENSR; ANT-XIX/3 and /4)

There are very few data that address the origin of polychaetes in the Southern Ocean. The ANDEEP program will provide an opportunity to (i) address the origins of deep-sea benthic polychaetes in relation to the fauna of the Antarctic shelf, (ii) explore linkages of Antarctic deep-sea faunas with the Atlantic and Pacific Oceans, (iii) test hypotheses to explain high biodiversity in the deep sea, (iv) assess deep-sea benthic community structure in the Southern Ocean, and (v) develop data on the reproduction and larval development of benthic polychaetes.

From a systematic standpoint, the following seven polychaete families will be studied in detail: Orbiniidae*, Oweniidae, Paraonidae, Spionidae, Cirratulidae*, Scalibregmatidae, and Opheliidae*. Monographs on three of these families (*) have recently been completed; the new observations will allow testing of keys and species concepts.

The field work will focus on developing new data on transient larval and post-larval polychaetes from surficial sediments of undisturbed multicore and box core subsamples using meiofaunal extraction methods to carefully separate these organisms from the sediment. Field tests of these methods in the Weddell Sea in May 2000 proved that small polychaetes could be obtained from the mud, cultured in the laboratory, and observed. Results of May 2000 included observations on species of families, the juveniles of which had never previously been observed alive. These observations will be expanded; detailed photomicrographs will be taken and other specimens prepared for SEM. These data will be used to further understand developmental patterns in polychaetes and will contribute to an understanding of the phylogeny of polychaetes and interpreting broader patterns of reproduction and larval dispersal in the deep sea. It is likely that these studies will suggest mechanisms to explain the present distribution of polychaetes in the Southern Ocean.

Diversity of deep-sea benthic foraminifera - molecular versus morphological approaches (J. Pawlowski, UNIGE and A.J. Gooday, SOC; ANT-XIX/4)

Although benthic foraminifera are a dominant faunal element in deep-sea and high-latitude settings, they are often neglected by biologists. Most diversity data come from geological studies of fossilisable taxa, which ignore the frequently abundant soft-shelled species. The few studies that address "entire" (hard and soft-shelled), "live" (rose Bengal stained) faunas suggest that foraminifera make a major contribution to local deep-sea biodiversity. Recently, molecular systematics has

provided new insights into the diversity and evolutionary relationships of for a-minifera. These methods have established the phylogenetic position of foraminifera among protists and other eukaryotes) clarified their macroevolutionary relationships and revealed high genetic diversity, related to biogeography, in some species. However, molecular studies have not addressed deep-water foraminifera. To understand better the scale and pattern of deep-sea foraminiferal diversity, we must establish whether morphospecies are distinct entities at the molecular level and whether morphologically very similar cryptic species exist in the deep sea. A detailed molecular and morphological study of Antarctic deep-sea foraminifera will also help to establish evolutionary relationships with (i) bathyal and abyssal faunas in other regions and (ii) shallow-water faunas around the Antarctic continent. High genetic diversity exists among shallow-water Antarctic foraminifera in Explorers Cove (EC), an area resembling the deep sea in certain respects. This assemblage is strikingly similar to faunas from upper bathyal N. Hemisphere sites, suggesting that EC-type environments provide nurseries where foraminifera can evolve before invading the Antarctic deep sea and eventually other regions of the World Ocean.

Using material collected during R/V Polarstern Cruise ANT-XIX/4, we aim to: (i) evaluate and compare the diversity of Antarctic deep-sea foraminifera using molecular and morphological methods; (ii) establish phylogenetic relations between foraminiferal fauna living at different depths; (iii) examine polar endemism by molecular analysis of similar Arctic and Antarctic morphospecies; (iv) search for cryptic species in common deep-sea taxa; (v) compare foraminiferal morphospecies diversity in the Antarctic and in the temperate North Atlantic; (vi) use specific ribosomal DNA primers for the molecular identification of naked foraminifera in sediments.

During ANDEEP sediment samples will be collected from different water depths and seafloor habitats in the deep Scotia and Weddell Seas using a multi- or box-corer. Samples for molecular studies will be sieved immediately and living foraminifera picked under a binocular microscope. Some specimens will be photographed and their DNA extracted. Others will be deep-frozen for further DNA analysis. Sediment subsamples will be preserved in ethanol for molecular work. Ribosomal DNA sequences will be used for phylogenetic analyses. The rDNA fragments will be amplified by PCR using foraminifer-specific primers. Replicate multi-core samples for morpholospecies analyses will be cut into 1cm thick layers and each slice preserved in buffered 10 % formalin. In the laboratory, the core slices will be sieved on 150 and 125 µm screens, stained with rose Bengal and sorted under a binocular microscope for stained foraminifera. Soft-shelled species will be recognised on the basis of test morphology, aperture features and wall composition and structure.

Meiofauna of deep Antarctic waters with special emphasis on free-living nematodes: patterns of biogeography and biodiversity (S. Vanhove, UNIGE; ANT-XIX/4)

Nematodes are the most abundant metazoan group in bathyal sediments. In addition they are characterized by a high local biodiversity in the deep sea which can reach values up to three times higher compared to shallow water communities. Comparison of their communities from some geographically distinct and environmentally extreme sites in the deep sea has revealed some obvious trends. There is a

high similarity between communities from comparable depths in the Central Arctic Ocean, the W Indian Ocean, the SW Pacific and the Weddell Sea in terms of sizes, trophic and generic composition. This similarity is most obvious at bathyal depths, but reduces deeper down.

Thus far we can explain differences in the deep Southern Ocean (higher densities, higher average biomass, higher presence of epistratum feeders) by an increase of a few genera. Unfortunately, these observations are made at a single deep-sea depth (e.g., 2000 m). The general biogeographical pattern of meiofauna, at least in the marine field, seems still a "meiofauna paradox". What is the geographical range of the nematode communities at deeper localities? Do the biogeographical distribution patterns continue diverging from other deep-sea communities?

Our comparison thus far did not consider species level. How speciose are Antarctic nematodes? What is the rate of species endemism? Does it agree with the rate of endemism observed for meiobenthic copepods, halacarids and tanaidaids? Can we recognize depth and latitudinal clines in nematode species diversity?

The aims of the study in the Antarctic deep sea are plural: (i) to obtain an idea on local species richness (alpha biodiversity) at different depths in the Southern Ocean; (ii) to estimate the species turn-over (beta-diversity) on different spatial scales (from metres to thousand of kilometres); (iii) to recognize geographical patterns in community composition within the Antarctic deep sea; (iv) to compare Antarctic deep-sea meiofaunal diversity with other bathyal and abyssal areas .

Sediment samples will be collected by means of a multicorer at different depths from 500 to 5000 meters and at all geographical target areas during ANT-XIX/4. Each time several (2 to 4) replicate samples will be collected in order to estimate the local variation. Samples will be processed on board at *in situ* temperature and fixed for further analysis back on shore.The meiofaunal sized organisms will be extracted from the sediment, counted and prepared for microscopical analysis. Species identification will be facilitated by means of a digital database (NEMASLAN) on all known marine nematodes from Antarctica developed in a previous Antarctic research programme. New species will be added to the digital database which is suggested as the only realistic mean to obtain a better insight in the present species realm.

Species diversity of benthic copepods and loriciferans of the Southern Ocean
(P. Martínez Arbizu, DZMB; ANT-XIX/3)

After nematodes the Harpacticoida (Copepoda) and Loricifera are the most species rich metazoan groups in the deep sea. This will be the first study of the species diversity of these groups in the deep sea of the Southern Ocean.

For every corer the species composition and the abundance of the different species will be determined in order to reveal patterns of diversity. Harpacticoida, Loricifera and also Tantulocarida will be studied in this project. Other groups of the meiofauna will be studied by other scientists. The diversity of species of Harpacticoida is so great that it is impossible to determine them all. It is also to be expected that more than 90 % of the species found will be new to science.

Therefore it is necessary to concentrate on the study of a few families. Three families have been selected for this project: Argestidae, Pseudotachidiidae, and Huntemanniidae. All three are represented worldwide in the deep sea according to own investigations. Argestidae and Pseudotachidiidae are rich in species whereas Huntemanniidae are not so numerous. Huntemanniidae have the advantage that there is already a detailed study of deep-sea species from Antarctic waters.

All stations will be compared as to taxa composition and to differences in abundance, dominance and diversity. It is of interest to know the proportions of species with a wide distribution and species of only local occurrence. This proportion is important for all attempts to estimate the overall number of species of Harpacticoida in the world oceans. The results of this project will therefore also be compared with those of the DIVA project based on samples taken off the coast of Namibia.

It is also planned to compare the deep-sea harpacticoids with those of the Antarctic shelf in order to learn more about the zoogeographic processes at the root of recent distribution patterns. Species diversity cannot be studied unless the species are known. Therefore it is inevitable to also include species descriptions into the research programme.

Per leg samples are to be taken by multicorer at two widely distant stations. In order to obtain real replica at least five, preferably seven multicorers have to be deployed per station. For the sake of comparison with samples from other programmes (e.g. DIVA) it is important to take samples from 3000-5000 m depth.

Porifera of the deep Weddell and Scotia Sea: Taxonomy, biogeography and ecological aspects (D. Janussen, FIS; ANT-XIX/4)

Over the years, many genera and species of the Porifera have been described from the Antarctic seas, most of which were described from shelf areas well above 1000 m. Among those sponges, a high degree of endemism appears to be present, this is especially true for the Hexactinellida. However, since many species were found only once, it is possible that "endemism" is not always real. The abyssal and bathyal zones of the Weddell and Scotia seas are central connections between the deep sea areas of the world oceans, so endemism among sponges may be expected to be less pronounced in these areas.

So far the deep-sea sponges have not been documented by more recent investigation methods to study e.g. embryology and endosymbionts. According to the schedule the cruise will take place during the late Antarctic summer, and strong reproductive activity among the sponges can be expected. Because the Hexactinellida and most Demospongiae are viviparous, larval developmental stages can be studied within the well-fixed sponge tissues. Another main focus of research is the recording of the biogeographical assemblages and also the documentation of intraspecific variability in comparison with other deep sea occurrences.

The main scientific tasks are (I) to collect and document all representatives of the phylum Porifera from in samples of the ANDEEP II stations. (ii) the collection of small

samples for later ultrastructural and genetic studies. (iii) Description and photography of all species of the three Poriferan classes (Hexactinellida, Demospongiae, Calcarea) in fresh condition. Infauna is collected for later evaluation together with cooperation partners. (iv) further taxonomic studies by means of spicula preparations and histological sections. The latter is informative on skeletal architecture and tissue organization. (v) Reproductive stages within the sponges should be found and studied. (vi) Microscopic endosymbionts (bacteria) can be seen and documented with fluorescence light. (vii) diversity pattern and faunistic composition should be analysed and compared with the Poriferan faunas of other Antarctic regions and with abyssal, bathyal and deep-shelf areas of other oceans.

The polychaete communities of the Antarctic deep sea: the deep basins of the Weddell and Scotia Seas (B. Hilbig, ZIM; ANT-XIX/3 and /4)

The polychaete fauna of the deep Weddell and Scotia Seas will be investigated under several aspects: (i) characterization of a little known benthic community regarding the species composition and community structure, (ii) taxonomy, includeing traditional and interactive keys to species and species descriptions, (iii) assessment of the biodiversity, and (iv) comparison with previously sampled areas on the continental slope of the Weddell Sea on the one hand and other deep-sea basins of the world oceans, e.g., the recently sampled Angola Basin on the other.

As much of what is known today about the Antarctic benthos is derived from the shelf, the validity of phenomena such as eurybathy and a high degree of endemism, which have been found to be typical for the Antarctic shelf communities, is still questionable for the deep sea. The faunal comparisons with other deep-sea basins will help to elucidate the distributional patterns of deep-sea species and ultimately help to come to a better estimate of the still controversely discussed species richness of the deep sea.

Samples will be taken with a Sandia box corer (surface 50x50 cm, divided into 25 subcores), sieved through 0.3-mm screens, fixed in 4 % buffered formalin in seawater and preserved in 70 % ethanol. All polychaetes will be identified to species level (with preliminary species names such as sp. 1, sp. 2 etc. where necessary) and counted. Species that appear to be new will be described preliminarily on a standardized sheet to allow for efficient communication among coworkers.

Diversity and phylogenetic biogeography of Antarctic deep-sea Cumacea and Mysidacea (Crustacea, Malacostraca) (U. Mühlenhardt-Siegel, ZIM; ANT-XIX/4)

In some parts of the deep sea cumaceans are very abundant among the peracarids, while mysids are more rare; reported e.g., for the Angola Basin. This has to be verified or falsified for the neighbouring Antarctic deep-sea basin.

The most urgent questions are: (i) how many species of Cumacea and Mysidacea are in the Antarctic deep-sea (diversity)? (ii) from where did they get there (phylogenetic analysis): did they derive from shallow living species or from other deep-sea basins? Or (iii) are they endemic (biogeography)?

The most effective sample gear for catching cumaceans (and mysids) is the epibenthic sledge (EBS), which will be the primary gear used for these analyses, although box corer sometimes contains astonishing high numbers of specimens, at least of cumaceans, due to their patchy distribution. After short rinsing in freshwater the samples will be fixed and stored in 70 % ethanol to avoid decalcification.

Investigations on the systematics, zoogeography, and evolution of Antarctic deep-sea Isopoda (Crustacea, Malacostraca) (A. Brandt, W. Brökeland and G. Wegener, ZIM; ANT-XIX/3 and /4)

As supposed, in Pliocene and Pleistocene the Antarctic ice shelf never completely eradicated the Antarctic benthic shelf fauna. In the Meso-Cenozoic past Gondwana broke up and the subsequent isolation of Antarctica accompanied by climatic changes with intermittent periods of global warming and global sea-level changes might have determined faunal zoogeographic ranges, migration processes in and out of the Antarctic, and limits. Extensions of the ice sheet may have enhanced speciation processes (as demonstrated for the Serolidae and Arcturidae) on the Antarctic continental shelf, suitably named the Antarctic "diversity pump".

The Circumpolar Current isolates the Antarctic shelf, whose colonisation by the peracarid taxon Isopoda is relatively well documented. Isopoda occur with 88 % endemic species on the shelf. However, it is unclear, whether this high degree of endemicity also proves true for the Antarctic deep sea, and how this faunal component communicates with other deep-sea species of the world's oceans via the continental slope and Antarctic deep sea in space and time. Knowledge on the composition of Antarctic deep-sea isopods is generally scarce.

Already on the Antarctic shelf the isopod suborder Asellota dominates, which usually increases in species numbers with increasing depth. Therefore, we expect an increase of species numbers for Antarctic Isopoda with increasing sampling efforts in the deep sea of the Southern Ocean. Improved knowledge on Antarctic deep-sea Isopoda might facilitate and improve the investigation of the composition of the Southern Ocean isopod fauna and phylogenetic analyses of taxa will help to identify submergence or emergence phenomena of taxa.

Samples will primarily be taken with an epibenthic sledge, however, also isopods from box-corer and multiple-box-corer samples will be used. The samples will be immediately fixed in 80 % precooled ethanol in order to allow also future molecular studies. Large and well preserved animals will be photographed alive to document the colour patterns.

Comparative evolutionary histories of Antarcturidae and related families (Crustacea Isopoda) of southern continents (G.C.B. Poore, MOV; ANT-XIX/4)

During ANDEEP the origins and history of Antarctic benthic deepwater fauna will be investigated. Important questions for the Antarcturidae and related families are: (i) are any hypotheses generated for this sea generally applicable for other regions of

Antarctica? (ii) are the processes that might be elucidated to explain the relationships between shelf, slope and deep-sea faunas of Antarctica the same as those applicable in other continents, namely Australia?

The crustacean order Isopoda is one of the characteristic taxa of cold waters with greatest diversity in polar seas, the deep sea, and in much of the cool-temperate southern hemisphere. The isopod fauna of Antarctica has long received attention with 427 species described. The marine species of Australia number 786 described species, New Zealand 206 species, and South Africa 266 species. With one or two exceptions, no species are in common between Antarctica, Australia, New Zealand, South America and South Africa but common ancestors are suspected for many species.

Within the Isopoda some marine families are more cold-loving than others. Two groups are of special interest, the janiroidean Asellota and some families of Valvifera. It is thought that while some asellote families arose from deep sea ancestors, some valviferans and other flabelliferan groups probably arose from ancestors that inhabited cold-temperate Gondwana. It is probable that the Asellota, derived early in isopod evolution, colonised the deep sea early and are now widespread there with 11 endemic families. The Valvifera on the other hand are a highly and lately derived group of flabelliferans, the only one to effectively penetrate and diversify in deep waters during a period when the oceans may have been characterised by low oxygen barriers. The most important question remains: do the different faunas in Antarctica and southern Australia reflect ancient or recent (or both) periods of independent radiation?

New material of Antarcturidae and other Valvifera from ANDEEP samples in the Weddell Sea will become part of a rigorous phylogenetic analysis of genera. Only in this way will these specific questions be answered: Is the apparent emergence from the deep sea to the southeastern Australian slope, and radiation there, of these species groups paralleled in Antarctica? If not, does this suggest periods of extinction in Antarctica of a once more widespread cold-water fauna? Are common ancestors for Weddell Sea and Australian slope species groups to be found in the deep sea or elsewhere in Antarctica?

Samples taken with the epibenthic sledge (EBS) and other gear will be shared with the other isopod working groups.

Analysis of biogeography, speciation and biodiversity of Antarctic deep-sea-isopods using molecular marker (M. Raupach and G. Strieso, RUB; ANT-XIX/3 and /4)

It is intended to use sequence data from nuclear and mitochondrial genes to analyze the phylogeny and biogeography of deep-sea isopods from the Southern Ocean. In the lab of A. Brandt (Hamburg) the isopods will be described taxonomically using traditional methods and then analysed with the methods of molecular systematics in the DNA-lab of the Ruhr-University Bochum.

The Isopoda are one of the most important elements of the bathyal and abyssal

crustacean fauna, they occur in every hitherto studied region of the deep-sea. However, Antarctic deep-sea isopods are little known. This Antarctic fauna could have a higher proportion of species that evolved from shelf regions, since submergence has been observed for several taxa on the continental slope of Antarctica. It is therefore expected that some species belong to the more ancient deep-sea fauna, while other are derived from the more recently evolved polar shelf-fauna. It is not known if a local radiation occurred in the Antarctic deep-sea in parallel to the radiation observed on the Antarctic shelf. With the help of molecular-clock models we intend to date the divergence of deep-sea species in comparison with shelf species that had been collected during previous expeditions. We are also interested in the relationships of the more ancient faunal elements (mainly Asellota) with the deep-sea fauna of the more northern parts of the Atlantic (recently sampled during the expedition DIVA 1). Unpublished results imply that specialization of populations to certain depths leads to speciation in Antarctica. It is therefore important to compare at first sight similar specimens collected in different depths to study the degree of genetic divergence between populations.

Evidence for high biodiversity is not only the number of species, but also the degree to which species differ genetically. We want to use genetic distances as a proxy for biodiversity and develop a method to compare these data with species numbers identified by morphologists.

Samples will be collected with an epibenthic sledge (EBS)and are shared with all other biologists interested in benthic species. It is important that the specimens are fixed in cold alcohol as soon as possible to prevent the digestion of DNA, wherefore quick sorting is necessary. Specimens will be used for taxonomic as well as molecular analyses. Sorting and extraction of DNA will be done on board of RV *Polarstern*, the sequencing work and data analyses will follow ashore.

Biodiversity, molecular phylogeny and trophodynamics of amphipod crustaceans in the Antarctic deep sea (C. De Broyer, P. Dauby and P. Martin, SNB; ANT-XIX/3 and /4)

In the Antarctic coastal and shelf communities, the peracarid crustaceans, and in particular the Amphipoda with about 600 spp, are by far the most speciose animal group and one of the most diverse in terms of life styles, trophic types, habitats and size spectra.

The very rare deep-sea investigations in the Southern Ocean revealed so far the presence of 82 benthic amphipod species below 500m and only 20 benthic species below 2000 m, all belonging to relatively primitive families characterized by free-swimming males. These numbers are to compare with the 400 and 260 spp found respectively below 1000 m and 2000 m in the other oceans of the World.

The project will aim at discovering and characterizing the amphipod fauna of the Antarctic deep sea and comparing it to the Antarctic shelf fauna and to the deep sea fauna of the World. It will comprise several complementary approaches: (I) the taxonomic study will be integrated in the ongoing revision of the Antarctic fauna undertaken by the "Antarctic Amphipodologist Network" and data and material will

contribute to the ANT'PHIPODA reference centre developed at IRScNB, Brussels. (ii) Phylogeny and biogeography of selected amphipod taxa will be studied through parallel molecular and morphological study. (iii) The ecological and ecomorphological approach will focus on habitat diversity, mode of life, species and taxonomic diversity gradient along bathymetric transects, eurybathy, and a detailed study of trophic types and trophic roles. (iv) The processes of Antarctic deep sea colonisation and potential causes of deep sea amphipod diversity will be investigated.

Pioneer molecular studies (16s rRNA, 18s rRNA and CO1 data) on polar submergence in Antarctic serolid and arcturid isopods indicated several invasions into the deep sea from the Antarctic shelf, all of which occurred independently. Calibrating the local molecular clock by using the opening of the Drake Passage (23 MY) as a reference in time suggested that polar submergence within these isopod families may be closely related to the glaciation history in Antarctica.

Do the amphipod crustaceans exhibit similar trends? Can we establish phylogenetic links between shelf and deep sea fauna and trace the origin of some World deep-sea taxa in the Antarctic shelf or in the Weddell Sea deep sea ? Can we establish a gradient of apomorphy as distance (and elapsed time) from the Antarctic place of origin increases?

The deep sea colonisation and the polar submergence and "Antarctic biodiversity pump" hypotheses will be investigated within selected amphipod families by morphological and by molecular data, using the nuclear 18s rRNA and mitochondrial CO1 genes. A recent molecular study of amphipods from Lake Baikal was successfully carried out by IRScNB, hence offering the required expertise for the present project.

Among families widely distributed in both the Antarctic and the deep sea, lysianassoid amphipods probably constitute one of the most appropriate taxon for such kind of molecular and phylogeographic study: they are the most speciose amphipod group in the Antarctic sublittoral and are susceptible to represent the most abundant amphipod component in the Antarctic deep sea where they could be easily caught in significant numbers in baited traps.

Detailed stomach contents analysis and feeding behaviour observations of benthic amphipods of the Weddell Sea shelf communities have revealed a rather large diversity of trophic types. A preliminary stable isotopes approach confirmed this observation . and a fatty acid analysis further completed the study.

Relying on these results and applying in particular the stable isotope method completed by fatty acids analysis, comparative studies on the trophic structure of the deep sea benthic communities of the deep Weddell and Scotia seas will be conducted in co-operation with other benthologists. The role of the amphipod taxocoenosis in these communities will be investigated in more details.

Trawled samples will be shared with other scientists and processed as described by Brandt et al..

Amphipods living in association with other invertebrates and systematics of the amphipod family Stegocephalidae (W. Vader and J. Berge, ZUT; ANT-XIX/4)

Amphipod crustaceans are often the dominant macrofaunal element within marine benthic and epibenthic communities, e.g. in the Southern Ocean, and are widely used in environmental impact surveys and biodiversity assessments. They occupy the full range of both marine and freshwater habitats, from the depths of the deep-sea to interstitial and intertidal habitats, as well as subterranean and even semi-terrestrial habitats. Furthermore, amphipod lifestyles include the entire range from benthic to pelagic, as well as commensal and even parasitic associations. In 1993, there were about 6300 described species, placed in approximately 150 families and 4 suborders, but the figure at the species level has increased significantly since then.

Amphipod systematics has been dominated for the last three to four decades by two competing approaches: one approach was developed and promoted by Barnard, the other by Bousfield. The legacy of the methodological polarization of these two "schools" was the establishment of two parallel and independent, but different and incomplete, classifications of the Amphipoda.

The application of methods from the rapidly developing field of phylogenetic systematics provides a suite of powerful new tools for resolving the long-standing problems of Amphipod classification. A few previous studies have attempted to look at the phylogenetic relationships between families of amphipods using the methods of phylogenetic systematics, but all have suffered from limitations of small scale - they used too few taxa and too few characters.

A recently started research-project lead by J. Berge has as its main goal to provide new working hypotheses concerning the evolutionary history of the peracaridan order Amphipoda, by means of a comprehensive analysis using the methods of phylogenetic systematics on morphological data. Parallel to the phylogenetic analysis of the morphological data, molecular data will also be obtained for some of the included taxa. Examining the similarities between these taxa, based on molecular data, and comparing them with the morphologically based cladograms, will provide an independent test of the working hypotheses on the evolution of the Amphipoda. Additionally, as different methods for character coding and the choice of outgroup will be utilised, the molecular data will be invaluable for the evaluation of the different results.

Amphipods living in association with other invertebrates are proved to be much more common than previously envisaged, both in the pelagic and benthic realms, but we know as yet very little about the situation in the deep sea. Experience has taught that associations are very easily overlooked during general collecting and sorting; we therefore propose to look out especially for any symbiontic associations involving amphipods during the ANDEEP collecting programme.

The family Stegocephalidae was recently revised and especially the Southern Ocean proved to contain many previously undescribed taxa. In addition to the taxa that are known, several still undescribed taxa have been reported. Thus, in order to be able to provide a complete revision of the Stegocephalidae in the Antarctic, collection of supplementary material on the ANDEEP would be essential.

Thus, as part of our ongoing research project, we are hereby applying to collect amphipod material in the Southern Ocean during ANDEEP in such a manner that it is suitable for DNA-sequencing.

***Philobrya* - tracer for the possible Antarctic colonisation routes** (K. Linse, BAS; ANT-XIX/4)

The bivalve genus *Philobrya* (Fam. Phylobryidae: order Arcoidea) seems to be suited for studies on the potential origin of Antarctic marine taxa. The Philobryidae have a rich fossil history since the Eocene (*ca* 58-36 my) and *Philobrya* itself since the Miocene (22 my) from marine sediments in New Zealand. The recent distribution of the 45 described species of *Philobrya* is almost entirely restricted to the Southern Hemisphere, mostly to the southern tips of the America, Africa, Australia, and New Zealand and to Antarctica. The majority of species are recorded from Antarctic and sub-Antarctic waters (15 spp), New Zealand (7 spp), and from the Magellan region (6 spp).

Species of *Philobrya* occur from intertidal areas to depth of 1000 m, deeper records are unknown but during ANDEEP more deep-water material will be sampled. Their reproductive strategy (brooding) is important regarding their regional spread and migration. The released young shells have no pelagic stage during which they could drift long distances with water currents, but the energy-rich juveniles could be lecitotrophic for some time while using demersal drifts for migration. Another possible migration mechanism for *Philobrya* might be kelp-rafting, which could explain the distribution on the sub-Antarctic islands. But the origin of the genus and Antarctic species is still unknown.

The aim of this project is to analyse the phylogeny of *Philobrya* by using two different data sets: (i) morphology based on shell characters (e.g. prodissoconch, hinge, periostracum, etc.) - these data are available for all described and undescribed species, characters of the soft part anatomy for those species soft parts are available, and (ii) DNA sequences on species for which specimens fixed for molecular work are available.

We wish to examine all catches for relict faunal elements. Living material of brachiopods and molluscs (especially *Philobrya* and related genera) will be collected from all samples and prepared for further analysis (SEM, TEM, PCR). Prior to fixation, animals will be kept in aquaria on board to study and record their movements and ecology. Additionally the well-known shelf bivalve fauna will be compared with the deep-sea fauna.

Biodiversity of Antarctic Deep-Sea Molluscs (C. McClain, UMB; ANT-XIX/4)

Gastropod and bivalve molluscs constitute a major element of deep-sea benthic communities, both in terms of diversity and abundance. Their bathymetric and latitudinal patterns of diversity in the Atlantic are more well established than for any other taxonomic group. However, little is known of molluscan biodiversity at the

community or genetic levels south of 40 °S. The Southern Ocean is now recognized as a potential center of radiation for Atlantic taxa and possibly a continuing portal for colonization from the Indo-Pacific. Hence, the Antarctic deep-sea fauna may hold the key to explaining patterns and composition of Atlantic biodiversity. As part of ANDEEP, we plan to sample the molluscan fauna of the deep Scotia Sea to address two related aspects of Antarctic biodiversity.

Latitudinal species diversity gradients (LSDGs) in the N. Hemisphere are among the most well known biogeographic patterns on Earth, but their explanation remains uncertain. Large-scale patterns in the deep-sea benthos may help resolve the underlying causes of LSDGs because the deep sea is such an environmentally distinct environment. We have shown previously the bathyal molluscan fauna (gastropods and bivalves) shows latitudinal gradients of diversity in the North Atlantic. In the South Atlantic, deep-sea sampling has occurred over a much smaller latitudinal range, and far fewer samples are available. Measuring gastropod and bivalve diversity of samples collected in the ANDEEP Program will add more than 25° of latitude to the known range of benthic species diversity in the South Atlantic.

We are only now beginning to explore the evolutionary processes that generate this rich endemic deep-sea fauna. This research is revealing patterns of population differentiation and speciation on very large scales. We hope to develop a geographically referenced phylogeny of deep-sea molluscan taxa that will show the historical radiation and geographic spread of the deep-sea fauna in the Atlantic. Since Antarctic waters may play a determining role in invasion of the Atlantic and radiation of the deep fauna, it is crucial to include populations from this area to develop a comprehensive understanding of the origin of the Atlantic deep-sea fauna.

Trawled samples will be shared with other scientists and processed as described by Brandt et al..

Biodiversity, phylogeny, zoogeography and evolution of Antarctic molluscs, holothurians and crinoids (M. Schrödl, ZSM & J.M. Bohn, ZILMU; ANT-XIX/4)

ANDEEP will, for the first time, provide an ideal opportunity to study the up to now missing faunistic link between the temperate South American, the south Atlantic deep sea and the Antarctic shelf fauna. In all these areas, molluscs, holothurians and crinoids are among the most common and diverse benthic marine organisms, reaching from coastal waters to abyssal depths.

The material collected will be the basis for species descriptions, critical taxonomic revisions and zoogeographic analyses. The phylogeny of selected groups will be investigated using traditional and modern methods and cladistic analysis. Using historic distributional and evolutionary mechanisms evolutionary scenarios, explaining recent distributional patterns shall be developed. Thus the taxonomy, morphology, ultrastructure, and ontogeny of selected molluscs, holothurians and crinoids are a focus of our interest both per se and as essential parts of the phylogenetic mosaic towards a better understanding of Antarctic deep-sea diversity and evolution.

For a comprehensive bioinventory of this poorly known region, animals of these

groups (with special focus on micromolluscs, Monoplacophora, Lepetidae, Cocculiniformes, Ophistobranchia, Hyocrinida, Apodida, Elasipodida), shall be collected using different gear.

Phylogeny, reproductive mode, and parasitism in Antarctic cidaroid sea urchins (J. Pearse, R.J. Mooi, CAS and S.J. Lockhard, UCSC; ANT-XIX/3 and /4)

The origin of Antarctic biota remains uncertain. Shallow-water, circum-Antarctic habitats have been isolated from the rest of the world since Antarctica separated from Australia 40 mio years ago and the sustained cooling that followed. With the separation of Antarctica from South America 25 mio years ago, and the inception of the Antarctic Circumpolar Current and the Polar Frontal Zone, the isolation of the Antarctic biota from the rest of the world's oceans was complete, except for the deep sea, which is replenished by cold, sinking Antarctic bottom water. Many Antarctic species are endemic with apparent affinities to species in the deep sea. A major question about the Antarctic biota then is whether (i) deep-sea organisms invaded and radiated into the Antarctic benthos after it was isolated and cooled, or (ii) the Antarctic biota is some sort of refugium and/or source of deep-sea organisms and Antarctic species invaded the deep sea.

Cidaroid sea urchins are a wonderful group to explore these ideas. They are a large and diverse taxon found world-wide. There are at least 23 recognized nominal taxa within 7 genera in Antarctic waters, ranging from shallow to deep water at the base of the Antarctic continental shelf. It is not known how many clades are represented, or whether the stem groups are represented by shallow Antarctic species or those in the deep sea.

We propose to do a phylogenetic analysis of Antarctic and deep-sea cidaroids to determine the number of clades present and where diversification occurred. Such an analysis would involve both morphological and molecular characters that would be best resolved using properly fixed material collected from shallow depths to the deep sea around the Antarctic continent. The ANDEEP cruises in the Drake Passage and the vicinity of the Antarctic Peninsula, with a wide diversity of habitats, provide an excellent opportunity to collect many species of interest.

In addition to questions about the origins of Antarctic benthic biota, cidaroids are excellent for addressing lingering questions about "Thorson's rule", which posits that most polar (and deep sea) benthic animals develop without pelagic larvae in contrast to temperate and tropical species. While it is now known that this idea does not hold for most taxa, it has limited support with Antarctic (but not Arctic) echinoids. About half of the Antarctic echinoid species are known to brood their embryos and have no pelagic larvae. Most of the known brooders are spatangoids, which probably represent a single, speciose clade.

Brooding cidaroids do not have marsupia or other distinctive morphological characters. Brooding can only be detected when young are found nestled among the spines. Specimens of nine species have been collected brooding young among spines around the peristome and specimens of two other species had their young among spines on the apical system. Besides collecting specimens in the act of

brooding, determining whether eggs float or sink can indicate mode of development. Floating eggs will certainly have pelagic, larval development while sinking eggs will probably be retained among the spines of the parent where they can develop directly into juveniles. We propose spawning live animals soon after they are collected to see if the eggs float or sink to determine mode of development of as many species of cidaroids as possible. Coupled with our phylogenetic analysis, we can then determine whether brooding arose once or multiple times in the Antarctic. If the latter is indicated, that would add at least limited support to "Thorson's rule."

At least four species of Antarctic cidaroids are also of special interest because of a mysterious organism, *Echinophyces mirabilis*, that is known as mycelium-like filaments growing on and within the primary spines. Infection causes changes in external morphology, blurring generic characters, and internal morphology, redirecting gonoduct development so that the gonopores open orally rather than aborally. Although described in 1909, taxonomic affiliation of *E. mirabilis* remains unresolved. Moreover, the internal phase of the parasite has yet to be identified and described. We now have the molecular tools to determine the kind of organism *E. mirabilis* represents, and also to identify it within host tissues so that its mode of action can be followed. Living material needs to be collected and fixed properly for such analyses. We propose that all cidaroids collected should be carefully examined for the presence of *E. mirabilis*, and those infected preserved for appropriate molecular analyses.

We anticipate that a major activity of these cruises will be collecting benthic organisms with the Agassiz trawl and epibenthic sledge at a wide range of depths in the Drake Passage, near the northern portion of the Antarctic Peninsula, and in the area of the Scotia Arc.

Antarctic deep-sea holothurians (A.V. Gebruk, SIO; ANT-XIX/4)

Deep-sea holothurians, first of all belonging to the order Elasipodida, dominate the invertebrate megafauna in many areas of the deep sea and in modern oceanographic studies they are often used as "indicator species". As a group highly specialized to the deep-sea environment, holothurians deserve a special attention in the discussions about the history of the deep-sea fauna. The elasipodid holothurians are among classical deep-sea groups showing features of the Antarctic origin.

We have every reason to believe that the elasipodid fauna was widely distributed in the ancient Tethys Sea basin, and was split into at least three parts, following the break up of the Tethys Sea into the Indo-Malayan, the Mediterranean and the West Indian sections. The subsequent invasion of the Antarctic occurred most probably along the South American continental slope in the bathyal zone (by the Miocene), and a new stage in the history of deep-sea holothurians, the penetration of abyssal waters and their resultant world wide distribution, started in the Antarctic. Thus, the Antarctic can be considered as one of the centers of origin of modern deep-sea holothurian fauna.

The better knowledge of the Antarctic deep-sea holothurian fauna is especially crucial for understanding the history of this group, patterns of biodiversity, geographical

and vertical distribution. Based on a new material from the Antarctic, it would be especially interesting to address the following questions: (i) the composition of Antarctic deep-sea holothurian fauna (to clarify); (ii) links between Antarctic abyssal, bathyal and shelf fauna; (iii) links between the Antarctic and tropical deep-sea fauna; (iv) links between the Antarctic and high latitude fauna, and (v) the level of morphological specialization of the Antarctic deep-sea fauna

Holothurians from trawled samples will be shared with other scientists and processed as described above.

Large scale patterns in diversity and controls on regional macrobenthic community structure, particularly in Polychaeta (B.E. Narayanaswamy, DML; ANT-XIX/4)

The Southern Ocean is thought to have a high benthic diversity in comparison to the Arctic deep-sea basins where benthic biodiversity has been influenced by re-colonisation after Quaternary glaciation and by seabed topography separating the Antarctic basins from the Atlantic and Pacific Oceans. However, it is still not known to what extent deep-sea fauna in the Southern Ocean have evolved in place or is the result of migrations from the adjacent basins. Since the many larvae, and even adults, of benthic species are dispersed by water currents, the formation of the Antarctic Circumpolar Current (ACC) may have helped encourage a distinct Antarctic ecosystem to be developed.

In most other regions of the deep sea, surface productivity and water depth seem to be the primary control on the composition, abundance and diversity of the macrobenthic community. At smaller scales environmental factors such as hydrodynamics and down-slope processes and at even finer scales, biological interactions between species, may strongly influence local patterns. In the deep Southern Ocean some previous sampling has been undertaken in the SE Weddell Sea, but was confined to shelf and upper slope depths. Hence, overall very little is known of deep-sea macrofaunal communities in the Antarctic. Use of standardised deep-sea sampling techniques, including the box corer, will enable macrofaunal biodiversity (>250 µm) along a depth transect (1000-4000m) in the Powell Basin to be described. Taxonomic and functional-group analysis of the polychaetes will be undertaken in collaboration with other groups.

The planned area of study in the Powell Basin occurs within the maximum and minimum sea-ice limits and therefore experiences and increase in primary production as the ice retreats. Using determinations of sediment organic carbon to be undertaken by other groups it is hoped to help determine if and how polychaetes respond to variability in particle flux. An increase in particle flux may also result from strong currents, as revealed by scours, lineations and cloudy bottom water. The Powell Basin is known to provide a pathway of Antarctic Bottom Water (AABW) from the Weddell Sea to the Scotia Sea, and as well as bedforms, the occurrence of interface and suspension feeders in the community may also reflect strong currents. Results from Particle Size Analysis (PSA) will help to determine relationships of the macrobenthic polychaete community to bottom flow regime through pattern in sediment granulometry.

Spatial scales of Antarctic diversity (K.E. Ellingsen, UIO; ANT-XIX/3)

In terrestrial systems a marked decline in the species richness of many animals and plants from the tropics to the poles is the general rule. It has long been assumed that a decline in the species richness from the poles to the tropics is also found in the sea. More recently, similar latitudinal clines in species richness of shallow-water benthos have been reported for gastropods and bivalve molluscs, and in deep-sea benthos. Comparative studies are problematic due to use of different sampling gear, varied sampling effort, analyses at different spatial scales, use of different measures of biodiversity, application of varied statistical analyses, as well as varied patterns between taxonomic groups. There is no convincing evidence for a latitudinal cline across all taxa in the sea compared to that seen on land. Furthermore, the idea that coastal diversity is low compared with that of the deep sea has been firmly accepted. However, high species richness in soft sediments in coastal areas has been shown, questioning whether there is a decline of species diversity from shallow water to the deep sea.

There are a variety of indices and methods for the measurement of diversity. Whereas the latitudinal gradient in number of species most often is based on species lists, studies of gradients of diversity must involve quantitative sampling. This inevitably means that one has to take account of the spatial scale sampled. In relation to scale there is no single correct scale at which ecosystems should be described, but patterns and variability are likely to change with scale. Furthermore, it is likely that the community structure will vary greatly within any latitudinal area, and a comparison of only a few sites may be insufficient to detect latitudinal gradients in marine systems. It is by no means clear that diversity measured at a small scale is linearly related to diversity at a large scale. Few marine studies explicitly have taken scales into account when comparing diversity at different latitudes. It is therefore important to get good quantitative data from Antarctica and especially on spatial scales of diversity.

The ANDEEP cruises will provide important new data on species distributions and how they vary in a quantitative way with depth. However, in order to provide new insights into biodiversity issues, spatial scales need to be considered in more detail. There is a need to study spatial variability within depth ranges in order to obtain fundamentally new data on the scales of spatial variability. Without such data one can always argue that a depth gradient could simply be due to differences between two spatial distinct samples. Furthermore, sediment properties will be related to the faunal patterns.

Impact of the geological evolution on the Antarctic fauna (M.R.A. Thomson, BAS; ANT-XIX/4)

If we look at the marine fossil record of Antarctica and compare that with the composition of the benthic faunas of today, there are striking differences. The reptant decapods (crabs, lobsters), locally unusually abundant in late Cretaceous, Palaeocene and Miocene strata are nowhere to be seen around the coasts of Antarctica

today. Likewise the large chlamid scallops, present in strata only 4 mio years old or less, are absent from the present-day fauna. Both these are groups of active animals and should be able to migrate to avoid encroaching adverse conditions, and both should be able to tolerate cold water, so why have they disappeared? This question is all the more pertinent when we consider that some sessile animals, such as the scleractinian coral, *Flabellum,* present in Miocene strata on King George Island, and also the brachiopods, with a patchy but extended Tertiary fossil record, are still thriving on the sea floor just a few kilometres off the coast today. Crabs, lobsters and large scallops form an important part of the present-day marine benthos of Magellan Patagonia - they are not extinct, they have just apparently disappeared from Antarctica. Might therefore, some of these displaced animals also be living on deeply submerged continental fragments of the old link between South America and the Antarctic Peninsula, now dispersed within the Scotia arc, or even in the deep, virtually unexplored waters? And what is the evolutionary history of the groups that have stayed?

The object of this project is to examine the dredge hauls and sediment samples for evidence that some of the displaced taxa might still be present on isolated refuges within the Scotia Sea and to place these within the context of Scotia arc break-up. Because of their low dispersal potential, articulate brachiopods are often endemic at quite high taxonomic levels and hence are excellent markers for biogeographical processes extending over a long time-span. Brachiopods will be collected for comparison with the fossil record and for DNA studies of their molecular evolution. Any rock material found in the samples will be assessed for possible clues to the glacial history or the bed-rock geology of the region.

Characterization of physical and biological processes influencing surface sediment structure in the Southern Scotia and northern Weddell seas (R.J. Diaz, VIMS; ANT-XIX/3)

The factors structuring surface sediment, down to 20-30 cm from the sediment-water-interface (SWI), in the deep sea are a combination of physical and biological processes. The activities of benthic organisms (bioturbation) are responsible for destruction of primary physical sedimentary structures and production of secondary structure such as graded beds below the SWI and mounds or pits at the SWI. The surface and near-surface sedimentary structures are then a time-integrated record of recent biological and physical processes, which can be used to evaluate the importance of biology *versus* physics.

The primary objective of this project is to document and characterize sediment structure and fabric from the SWI to a depth of 20-30 cm using a combination of surface and sediment profile cameras. Information will be generated on the processes active at each of the stations in the Scotia and Weddell Seas that can be linked to biological fauna and geochemical data collected by multicorer and box-corer. Specific questions to be addressed are: (i) what is the relative importance of biological and physical processes in structuring bottom sediments? (ii) how far into the sediments does bioturbation extend and can mixed layer depth be estimated? (iii) what faunal components are responsible for major biogenic structures? (iv) is small scale (within a station) variation in sediments, from both biological and physical

factors, of the same magnitude as large scale variation?

In addition to the primary objective of characterizing recent sediment dynamics, images will be made available to other investigators to assist in interpreting patterns in biodiversity and geochemistry. A major problem with core samples is that during the processing of removing the organisms information on sediment fabric and biogenic structures is lost. The surface and profile images will provide data on *in situ* conditions.

Images of the sediment surface will be collected with a digital video camera system that has been developed at the Virginia Institute of Marine Science. It is a completely self-contained system with camera, recorder, and lighting. Sediment profile images will be collected with a Benthos Inc. deep-sea camera system. Data will be collected at each of the corer stations. On a single deployment 15 to 18 replicate samples will be collected. Digital video will be available for viewing immediately after deployment. The profile camera film may be developed on the vessel.

The depositional history of recent deep-water sediments in the Southern Scotia and northern Weddell Seas (J.A. Howe, DMI; ANT-XIX/3)

Sediment deposition within the Scotia and northern Weddell Sea is controlled by Neogene basement topography producing regions of erosion and deposition in response to bottom-current, hemipelagic and downslope activity. Extensive studies in the Scotia Sea have revealed the influence of the geographically constrained Antarctic Circumpolar Current (ACC) dominating sediment deposition and redistribution with both contourite drifts and regions of erosion common. Deposition occurs as mounded drifts and moats or as zones of flatter more hemipelagic drape, locally occurring in the lees of the rough basement topography. Downslope debris flows and turbidites are most dominant in the deep-water areas adjacent to continental blocks (e.g. South Georgia). A core transect across the Scotia Sea indicates decreasing bottom-current influence towards the south away from the main axis of the ACC with a corresponding decrease in biogenic content towards the influence of the Weddell Gyre. The main zone of productivity is controlled by the position of the Polar Front and spring sea-ice edges. Sedimentation rates vary across this region from 17-3 cm per 1000 years and current speeds increase from 7cm/s in the south to 17 cm/s in the north with an associated increase in benthic storm frequency towards to the axis of ACC flow. Towards the south in the northwestern Powell Basin, northern Weddell Sea, an area of mudwave development has been identified. The active wave-field is located near the base of the continental slope in water depths of 2800-3100 m, and may reveal a pathway of Antarctic Bottom Water (AABW) flow from the Weddell Sea to the Scotia Sea. The original construction of the waves may have been via downslope turbidity currents predominantly supplied from the basin floor channels. Present day deposition appears to be maintained by fine-grained sediment supply as a result of the lateral transfer of distal turbidites from the basin floor channels by bottom currents. The initiation of current-influenced sedimentation appears closely linked to the onset of AABW flow during the Early Miocene, following the separation of the South Orkney Microcontinent and the opening of Powell Basin during the Late Oligocene, 20-25 million years ago.

Building upon these previous studies, it is proposed to examine the recent sediment history of the deepwater areas of the South Sandwich Trench, Scotia and Weddell Seas. Valuable information can be gathered on the processes active across the sites where biological fauna is collected as part of the ANDEEP aims. Little is known of the sedimentary processes active in these regions, most importantly, specific questions: (i) what are the gross depositional regimes operating in the extreme deep-water areas? (ii) are bottom-currents (either ACC or Southern Origin Bottom Water) influencing sedimentation, downslope turbidity currents or low energy pelagic/hemipelagic settling? This work aims to support the main faunal studies of ANDEEP by providing general information on sea-floor environment therefore assisting in ecological studies.

Utilising collected short-cores (either from the multicorer or by sub-coring a box-core) to examine any sedimentary and bioturbation structures (X-radiographs), microfaunal composition providing information on productivity and hence sea surface conditions and sea-ice distribution.

As a post-cruise study submit samples for particle size analysis (PSA for bottom-current influences). Radiocarbon (C^{14} AMS of surface sediments for carbon reservoir effect. Geochemistry using ICPMS for Ba palaeoproductivity, dating to reveal sediment ages, accumulation rates and any recent (latest Holocene) palaeoclimate record.

This general programme of work aims to use cores already collected for the projected faunal work of ANDEEP and is in collaboration with B. Diaz (VIMS). Follow-up work will be conducted at the University of the Highlands Islands project, Dunstaffnage Marine Laboratory as part of Core Research programmes on Polar Seas and the British Antarctic Survey.

Community structure and abundance of oligotrophic bacteria (T.-L. Tan, AWI; ANT-XIX/4)

Oligotrophic, low-nutrient bacteria will be investigated at 10 stations at 25, 50, 100 and 200 m water depths. The bacteria from seawater samples have to be separated from ciliates and flagellates by filtration with a 10 µm pore-size nylon filter. Subsequently, the bacterial cells will be collected on a 0.2 µm polycarbonate filter. After resuspending the bacteria in sterile seawater, the cells are transferred into a dialysis chamber of about 32 ml volume. The dialysis culture is then incubated in a sewater bath at 2 °C in a cold room. In the home lab these dialysis cultures are further used to get isolates of oligotrophic bacteria by means of single cell separation techniques, e.g., using a laser micro-pincette.

Besides these enrichment cultures in dialysis chambers, another dilution culture method for growing oligotrophic bacteria in low-nutrient media containing 0.5 mg peptone plus trace amounts (20 nCi) of ^{14}C labelled proteinhydrolysate per liter of seawater will be used on board. This method, based on uptake of ^{14}C labelled substrate by bacteria cells (autoradiography) and recognizing the different phylogenetic groups of bacteria by fluorescent staining with specific oligonucleotide probes (Fluorescence In Situ Hybridization, FISH) will give us more information about the

structure and abundance of the natural oligotrophic bacterial community.

From the bacterial community in 25 m water depth, enough biomass has to be collected from 100 liter seawater, in oder to make a 168 rDNA clone library later on. After separating ciliates and flagellates by pressure filtration, the bacteria cells will be collected on Millipak-200 filter units and the filters stored at minus 80 °C.

Multi-Axis-DOAS measurements of atmospheric trace gases for SCIAMACHY / ENVISAT validation purposes (U. Platt et al. IUP; ANT-XIX/3 and /4)

An important aspect of environmental sciences is the knowledge on the kinds and quantities of atmospheric trace gases. A now approved detection method for trace gases such as O_3, SO_2, NO_2, H_2O, BrO is the so-called Differential Optic Absorption Spectroscopy DOAS.

Two different spectrographs observing scattered ultraviolet and visible sunlight with several small telescopes will be used for the ANT-XIX-measurements. To record the observations in the different wavelengths, a CCD camera and a photodiode-line will be used. Due to their absorption at different wavelengths it is possible to identify the detected atmospheric trace cases. With further work on measurement data, it is possible to make statements on quantities of the observed gases.

The main purpose of these measurements is to gain data for the validation of the SCIAMACHY instrument onboard the ENVISAT satellite. ENVISAT will be on a polar orbit. Due to it's orbital position, geometric observation conditions for SCIAMACHY will change. For validation, measurements under comparable circumstances are necessary. On a ship voyage from northern to southern latitudes this will be possible.

Another purpose of the DOAS experiment taking part in ANT XIX is that this offers the opportunity of measurements in areas where only few ground-based experiments exist.

Furthermore, the gathering of such an amount of data is important for environmental science. DOAS-measurements onboard the RV *Polarstern* were performed with good success earlier in 1990, 1993 and 2000 by the Heidelberg Institute for environmental physics.

Who the hell are THEY ??????

When stumbling across a handful of people who just seem too young to be successful scientists yet, you might start wondering who the hell these people are and where they come from. "Shouldn't they be at school at this age?" might be another question racing through your mind.

Well, we would be too, probably despairing over Maths exams if it weren't for the Alfred Wegener Institute Bremerhaven, to which we are very grateful.

And this is the story how we came on board *Polarstem:* For many years our schools, the Gymnasium Ulricianum and the BBS II Aurich {East Frisia), have organized the

Wissenschaftstage (Science Days), in the course of which famous scientists from all over Germany make their way to Aurich to give a speech about a topical scientific project or their work as a scientist in general. The aim of the *Wissenschaftstage* is to create a forum of a third culture where science and humanities can meet and misunderstandings be dispelled. Recently polar research has been a topic of several speeches, given by various scientists of the AWI. A very special event for our school was last year's opening speech by Professor Thiede, at the end of which there was a life link-up to the Neumayer-Station.

Another aspect of the *Wissenschaftstage* is the scholarship programme, in which participating students get the opportunity to experience science not only in dusty classrooms with teachers standing behind them with a red marker, but live and unplugged. One of the institutes which has provided shelter for many students during the past years was the AWI.

This time, however, the AWI not only offered places in their ice cellars, but even four places on the *Polarstem.* The four of us, Katharina Voigt (17), Mareike Aden {18), Markus Seemann (18) and Fadi Ramadan (18), were the lucky ones who were selected to go on this fantastic expedition, which will certainly be an experience of a life-time for all of us.

During the trip from Punta Arenas to the Antarctic each of us will participate in one of the projects going on on board. Accordingly, Marcus will work with Dr. Uwe Piatkowski, who examines cephalopods. Katharina chose to participate in the project of Dr. Karl-Hermann Kock, who will investigate the density of fish in the surroundings of Elephant Island and the South Shetland Islands. Fadi will work together with Dr. Rüdiger Riehl and examine the eggs and sperms of Antarctic fish. More specifically, Fadi will focus on the methods used during this project. Mareike selected the project of Professor Joseph Eastman, whose research project will concentrate on buoyancy and morphological studies of notothenoid fishes.

Aboard we will write an assessment of the scientific insights we have gained. Mareike win apart from that investigate the topic of scientific journalism and the new possibilities that are offered to scientists to publish their work.

Although our school is far away from the Antarctic we didn t manage to completely leave school and the previously mentioned Maths exams behind: Mrs. Scherf and Mr. Stracke (two Maths teachers by the way) will be a constant reminder of school life. Coaching, teaching and keeping contact with the school are their declared ambitions. However, they couldn't totally convince us that taking care that we behave properly wasn't another reason for their presence on board. Honestly though, we very much appreciate the fact that they are prepared to do so. Furthermore, they will assist us in organizing an exhibition for the general public about this trip and the experiences made. We hope it will be a safe one, anyway and so does the German Minister of Science and Education, Mrs. Bulmahn, who sent her best whishes for the *Po/arstem Expedition.*

Students: Mareike Aden, Fadi Ramadan, Markus Seemann, Katharina Voigt
Teachers: Regina Scherf, Alexander Stracke

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Wissenschaftliches Personal / Scientific Crew

Name	Vorname	Institut	ANT-XIX/3	ANT-XIX/4
Aden	Mareike	GY Aurich	x	
Allcock	Louise	NMS Edinburgh	x	x
Bertouch, von	Gillian	CCAMLR Hobart	x	
Blake	James A.	ENSR Woods Hole	x	x
Bohn	Jens Michael	ZILMU München		x
Brandt	Angelika	ZIM Hamburg	x	x
Broekeland	Wiebke	RUB Bochum	x	x
Broyer, de	Claude	SNB Brüssel	x	
Buldt	Klaus	DWD Hamburg	x	x
Carpenter	Lawrence	VIMS Gloucester Pt.		x
Conradi	Mercedes	UDS Sevilla	x	
Cornelius	Nils	SOC Southampton		x
Danulat	EVA	Journalist		x
Dauby	Patrick	SNB Brüssel	x	x
Diaz	Robert	VIMS Gloucester Pt.	x	
Doolittle	Daniel	VIMS Gloucester Pt.	x	
Eastman	Joseph	OHIOU Athens	x	
Ellingsen	Kari Elsa	UIO Oslo	x	
Evans	Marie	ENSR Woods Hole	x	x
Fanta	Edith	UFPR Curitiba	x	
Friedeburg, von	Christoph	IUP Heidelberg	x	
Fütterer	Dieter, K.	AWI Bremerhaven	x	x
Gebruk	Andrey	SIO Moskau		x
Germer	Christian	AWI Bremerhaven		x
Gooday	Andrew J.	SOC Southampton		x
Heumann	Holger	IUP Heidelberg		x
Hilbig	Brigitte	ZIM Hamburg	x	x
Howe	John A.	DML Argyll		x
Janussen	Dorte	FIS Frankfurt		x
Jones	Christopher	UCSD La Jolla	x	
Kock	Karl-Hermann	BFA Hamburg	x	
La Mesa	Mario	IRPEM Ancona	x	
Linse	Katrin	BAS Cambridge		x
Lockhart	Susanne	UCSC Santa Cruz	x	x
Martin	Patrick	SNB Brüssel		x
Martinez Arbizu	Pedro	DZMB Oldenburg	x	
McClain	Craig R.	UMB Boston		x
Megina	Cesar	CASEM Cadiz		x
Mesel, de	Ilse	RUG Gent		x
Möller	Hans-Joachim	DWD Hamburg		x
Mooi	Richard	CAS San Francisco	x	
Mühlenhardt-Siegel	Ute	ZIM Hamburg		x
Narayanaswamy	Bhavani Emma	DML Argyll		x
Nyssen	Fabienne	SNB Brüssel	x	x
Pawlowski	Jan	UNIGE Genf		x
Piatkowski	Uwe	IFM Kiel	x	

Name	Vorname	Institut	ANT-XIX/3	ANT-XIX/4
Piraino	Stefano	UNILE Lecce		x
Poore	Gary C.B.	MOV Melbourne		x
Pshenichnov	Leonid	YugNIRO Kerch	x	
Ramadan	Fadi	GY Aurich	x	
Raupach	Michael	RUB Bochum	x	x
Riehl	Rüdiger	IZUD Düsseldorf	x	
Scherf	Regina	GY Aurich	x	
Schöling	Susanne	BFA Hamburg	x	
Schrödl	Michael	ZSM München		x
Seemann	Markus	GY Aurich	x	
Siegert	Christine	AWI Potsdam	x	
Spahic	Susanne	AWI Bremerhaven		x
Stracke	Alexander	GY Aurich	x	
Strieso	Gabriela	RUB Bochum	x	x
Strüfing	Reinhard	DWD Hamburg	x	
Tan	Tjhing Lok	AWI Bremerhaven		x
Thomson	Michael	BAS Cambridge		x
Vanreusel	Ann	UNIGE Gent		x
Vecchione	Michael	NMNH Washington	x	
Voigt	Katharina	GY Aurich	x	
Wegener	Gisela	ZIM Hamburg	x	x
Zane	Lorenzo	UNIPD Padua	x	
Zittlosen	Gert Johann	AWI Bremerhaven	x	

Schiffspersonal / Ship's Crew

Position	Name	ANT-XIX/3	ANT-XIX/4
Master	Keil, Jürgen	x	x
1. Offc.	Grundmann, Uwe	x	x
Ch. Eng.	Pluder, Andreas	x	x
2. Offc.	Spielke, Steffen	x	x
2. Offc.	Peine, Lutz	x	x
2. Offc.	Domke, Uwe	x	
2. Offc.	Hartung, René		x
Doctor	Kohlberg, Dr., Eberhard	x	x
R. Offc.	Koch, Georg	x	x
1. Eng.	Delff, Wolfgang	x	x
2. Eng.	Ziemann, Olaf	x	x
2. Eng.	NN	x	x
Electron.	Bretfeld Holger	x	x
Electron.	Greitemann-Hackl, A.	x	x
Electron.	Muhle, Helmut	x	x
Electron.	Roschinsky, Jörg	x	x
Electr.	Muhle, Heiko	x	x

Position	Name	ANT-XIX/3	ANT-XIX/4
Boatsw.	Clasen, Burkhard	x	x
Carpenter	Reise, Lutz	x	x
A. B.	Schmidt, Uwe	x	
A. B.	NN		x
A. B.	Moser, Siegfried	x	x
A. B.	Gil Iglesias, Luis	x	x
A. B.	Pousada Martinez, S.	x	x
A. B.	Burzan, G.-Ekkehard	x	x
A. B.	Guse, Hartmut	x	
A. B.	Hartwig, Andreas	x	x
A. B.	Winkler, Michael	x	
A. B.	Schultz, Ottomar		x
A. B.	Kreis, Reinhard		x
Apprentice	Kruse, Lars	x	
Apprentice	Wanke, Steffen	x	
Storek.	Preußner, Jörg	x	x
Mot-man	Voy, Bernd	x	x
Mot-man	Elsner, Klaus	x	x
Mot-man	Hartmann, Ernst-Uwe	x	x
Mot-man	Grafe, Jens	x	x
Mot-man	Ipsen, Michael	x	x
Cook	Haubold, Wolfgang	x	x
Cooksmate	Silinski, Frank	x	x
Cooksmate	Völske, Thomas	x	x
1. Stwdess	Jürgens, Monika	x	x
Stwdess/KS	Wöckener, Martina	x	x
2. Stwdess	Czyborra, Bärbel	x	x
2. Stwdess	Silinski, Carmen	x	x
2. Stwd.	Gaude, Hans-Jürgen	x	x
2. Stwd.	Huang, Wu-Mei	x	x
2. Stwd.	Möller, Wolfang	x	x
Laundrym.	Yu, Chung, Leung	x	x
Trainee	Morley, Kieran	x	x
Trainee	Rumler, Etienne		x


LATIN AMERICAN
PUNTA ARENAS 03 APRIL 2002
USHUAIA 05 MAY 2002
"POLARSTERN" STUDY
South Georgia
SCOTIA ARC
South Sandwich Islands
South Orkney Islands

LAMPOS

EXPEDITION ANT-XIX
Leg ANT-XIX/5

ZUSAMMENFASSUNG UND FAHRTVERLAUF

Zwischen den Gewässern um den südlichen Teil Südamerikas, die Magellanprovinz, und den Gewässern um die subantarktischen Inseln und den antarktischen Kontinent bestehen spezielle Beziehungen. Sie gehen zurück auf die gemeinsame Vergangenheit dieser Regionen als Teile des Gondwana-Kontinents und auf die enge Nachbarschaft der beiden Kontinente bis zum heutigen Tag im Vergleich zu den Entfernungen zwischen der Antarktis und den anderen Nachbarkontinenten. Diese beiden Faktoren, wie auch die gegenwärtige Isolation der Antarktis durch die Tiefsee und das Strömungssystem und vergangene Perioden des Austauschs, der Radiation und der Extinktion von Organismen spiegeln sich in den heutigen Biota auf beiden Seiten der Drake-Passage. Diese Zusammenhänge sind ein einzigartiger Fall von Wechsel und Evolution eines Ökosystems auf unserem Planeten und eine große Herausforderung für die Forschung.

LAMPOS - die Latin American „Polarstern" Study - wurde in gewisser Weise als Nachfolgeprogramm von EPOS geplant, der European „Polarstern" Study, die 1988/89 viele europäische Polarwissenschaftler in der Untersuchung antarktischer Ökosysteme vereinte. Im gegenwärtigen Fall geht die Herausforderung in erster Linie an lateinamerikanische Wissenschaftler und an Europäer, die ein spezielles Interesse an der Kooperation mit Lateinamerika bewiesen haben. Allerdings ist LAMPOS ein bescheidenerer Ansatz als EPOS, weil nur ein Monat Schiffszeit zur Verfügung steht. LAMPOS wird auch den wissenschaftlichen Ansätzen folgen, die (in viel weiterem latitudinalem Rahmen) während der EASIZ-Expeditionen der „Polarstern", der „Victor Hensen"-Kampagne 1994 und verschiedenen Reisen des spanischen Forschungsschiffs „Hespérides", der italienischen „Italica" und der chilenischen „Vidal Gormaz" gemacht wurden.

Auf der LAMPOS-Reise sollen biogeographische und evolutionäre Verknüpfungen zwischen der Magellanregion (Südamerika) und dem antarktischen Kontinent untersucht werden. Zu diesem Zweck wird sich die Arbeit auf die benthische Fauna konzentrieren, und „Polarstern" wird dem Scotia-Bogen folgen und dabei die biologischen Aufsammlungen auf Tiefen zwischen 200 und 600 m beschränken. Der magellanische und antarktische Einfluß auf die Dispersion der Fauna soll entlang der nördlichen und südlichen Kette von Inseln und Flachs im Scotia-Bogen untersucht werden, um auf diese Weise mögliche Wege der Wiederbesiedlung des antarktischen Schelfs nach klimabedingten Auslöschungen aufzudecken. LAMPOS ist daher komplementär zu den ANDEEP-Expeditionen, auf denen die Wiederbesiedlung über die Tiefsee verfolgt werden soll.

Die Hauptthemen der Forschung während der LAMPOS-Expedition sind

- biogeographische und evolutionäre Verknüpfungen
- Biodiversität
- strukturelle Eigenschaften von Benthos- und Fischgemeinschaften

- pelago-benthische Kopplung
- ökologische und physiologische Anpassungen benthischer Wirbelloser und Fische.

Daraus ergeben sich u. a. die folgenden Fragen:

- Ist der Scotia-Bogen ein Übergangsgebiet zwischen der Magellan- und der antarktischen Region?
- Verlaufen Veränderungen – z. B. Diversitätsgradienten – allmählich, oder weisen sie Brüche auf? Setzen sich Muster entlang beider Küsten von Südamerika in die Antarktis fort oder umgekehrt?
- Dienen die verschiedenen Inseln und Flachs als Trittsteine zur Unterstützung der Faunenverbreitung? Falls ja, geschieht dies nur in West-Ost-Richtung, d. h. mit dem Zirkumpolarstrom?
- Ähneln Artenzusammensetzung und Larvenvorkommen auf dem nördlichen Zweig des Scotiabogens eher den Bedingungen in der Magellanregion, und sind diese Muster auf dem südlichen Zweig antarktischen Bedingungen ähnlicher? Dienen die South Sandwich Islands als Nord-Süd-Verbindung?
- Erweisen sich Muster der Artenverbreitung als hilfreich für die Erklärung der (Nicht-) Existenz bestimmter Taxa auf der Antarktisseite? Was bedeutet das für die Evolution?
- Inwieweit sind (mega, macro, meio) benthische und Fischgemeinschaften entlang dem Scotia-Arc vergleichbar mit ihren Gegenstücken im hochantarktischen Weddellmeer, um die Antarktische Halbinsel und in der Magellanregion?
- Inwieweit beeinflussen topographische Muster am Meeresboden die Struktur und Diversität der Gemeinschaften?
- Was ist die Rolle der Polarfront für die Benthosverbreitung, -struktur, -diversität und für die pelago-benthische Kopplung?
- Welche Eigenschaften in bezug auf Reproduktion, Populationsdynamik oder Physiologie weist die Fauna im Scotia-Bogen im Herbst auf? Inwieweit spiegeln diese Charakeristika Breitengradienten?

Die biologischen Arbeiten werden sich auf wenige Stationen entlang des Scotia-Bogens konzentrieren. Dort sollen sämtliche stechenden, geschleppten und visuellen Geräte eingesetzt und durch CTD, Planktonnetze und beköderte Fallen unterstützt werden. An einigen zusätzlichen Stationen soll lediglich der Agassiztrawl eingesetzt werden, um mehr Material zur Beantwortung der Fragen zu Biogeographie und Biodiversität zu gewinnen. Hydrosweep wird zur besseren Identifizierung topographischer Muster am Meeresboden benutzt. An logistischen Aktivitäten fallen die Aufnahme von Verankerungen in der Drake-Passage und von Proben und Geräten aus dem Dallmann-Labor (Station Jubany, King-George-Insel) an.

Die „Polarstern" wird Punta Arenas (Chile), wo die lateinamerikanischen Teilnehmer mit ihrer Ausrüstung an Bord gehen, am 03. April 2002 verlassen. Das Schiff wird durch den Ostausgang der Magellanstraße und dann südlich zur Burdword Bank fahren, wo die erste Probennahme geplant ist. Die „Polarstern" wird dann der nördlichen Kette des Scotia-Bogens über Südgeorgien bis zu den Süd-Sandwich-Inseln folgen (Abb. 1) und dabei die Flachs zwischen den Inseln bearbeiten. Nach Passage der Süd-Sandwich-Inseln in N-S-Richtung wird in der selben Weise die Südkette auf dem Weg zurück an die Antarktische Halbinsel bearbeitet. Ein

zusätzlicher Hydrosweep-Survey soll NW von Elephant Island durchgeführt werden, bevor das Schiff Kurs auf das Dallmann-Labor auf der King-George-Insel nimmt, wo Gerätschaften und Materialien aus dem Sommereinsatz aufgenommen werden. Auf dem Weg zum Beagle-Kanal sollen mehrere Verankerungen in der Drake-Passage aufgenommen werden. „Polarstern" wird am 05. Mai 2002 in Ushuaia (Argentinien) einlaufen.

SUMMARY AND ITINERARY

Special relationships exist between the waters around the southern part of South America, the Magellan Province, and the waters around the Subantarctic islands and the Antarctic continent. They have their origin in the common past of these regions as part of the Gondwana continent and in their close vicinity up to the present day as compared to the distances between Antarctica and the other surrounding continents. Both factors, as well as the actual isolation of Antarctica by deep water and the current system, and periods of interchange, radiation and extinction in the past, are reflected in the present-day marine biota on either side of the Drake Passage. This context represents a singular case of ecosystem change and evolution on our planet, and a great challenge to research.

LAMPOS – Latin American „Polarstern" Study – is planned, in a way, as a successor of EPOS, the European „Polarstern" Study which in 1988/89 assembled many European polar scientists in an effort to study Antarctic ecosystems. This time the challenge is principally addressed to Latin scientists and to Europeans who have demonstrated a particular interest in Latin American cooperation. Obviously LAMPOS will be a more modest approach as compared to EPOS due to only one month of available ship time. LAMPOS will also continue the scientific line followed, in a much wider latitudinal frame, during the EASIZ cruises of „Polarstern", the „Victor Hensen" Campaign in 1994 and various expeditions of the Spanish RV „Hespérides", the Italian RV „Italica", and the Chilean vessel „Vidal Gormaz".

The LAMPOS cruise is planned to study biogeographical and evolutionary links between the Magellan region (South America) and the Antarctic continent. For this purpose, work will be focussed on the benthic fauna, and „Polarstern" will follow the Scotia Arc, concentrating biological sampling on depths between 200 and 600 m. The idea is to study the Magellan and Antarctic influence on faunal dispersal in the northern and southern chain of islands and shallows within the Arc, and thus identify potential pathways of recolonisation of the Antarctic shelf after climate-induced extinctions. LAMPOS is therefore complementary to the ANDEEP cruises, which are intended to investigate recolonisation via the deep sea.

The principal subjects of research during this expedition will include the study of

- biogeographic and evolutionary links
- biodiversity
- structural properties of benthic and fish communities
- pelago-benthic coupling
- ecological and physiological adaptations of benthic invertebrates and fish.

Research to be addressed will include, e.g., the following questions:

- Is the Scotia Arc a transitory area between the Magellan and the Antarctic regions?
- Are changes – e.g., diversity clines - gradual, or are there breaks? Do patterns found along either side of South America continue into the Antarctic, or vice versa?
- Do the various islands and shallows serve as footsteps supporting faunal distribution? If so, does this work only in a W-E direction, i.e. following the Circumpolar Current?
- Do species composition and larval occurrence on the northern branch of the Scotia Arc rather resemble conditions in the Magellan region, and are these patterns more similar to Antarctic conditions on the southern branch? Do the South Sandwich Islands present a N-S connection?
- Are species distribution patterns found helpful in explaining the (non)existence of certain taxa on the Antarctic side? What does this mean for evolution?
- How do (mega-, macro-, meio-) benthic and fish communities along the Scotia Arc compare with those in the high Antarctic Weddell Sea, around the Antarctic Peninsula, and in the Magellan region?
- To what extent do topographic patterns at the seafloor influence community structure and diversity?
- What is the role of the Polar Front for benthic distribution, structure, diversity, and for pelago-benthic coupling?
- What are the reproductive, population dynamic, or physiological properties of the fauna in the Scotia Arc in autumn? In which way do these characteristics reflect latitudinal gradients?

Biological work will concentrate on few stations along the Scotia Arc where the whole range of coring, trawling and visual equipment will be employed, supported by CTD, plankton nets and baited traps. At a number of additional stations, only Agassiz trawls will be taken to provide more material for answering biogeographic and biodiversity issues. Hydrosweep will be used to better recognize topographic patterns at the seafloor. Logistic activities include retrieval of moorings in the Drake Passage and removal of samples and gear from the Dallmann laboratory (Jubany station, King George Island).

RV „Polarstern" will leave Punta Arenas (Chile), where also the Latin American participants will board the vessel with their equipment, on April 03, 2002. The vessel will leave the Straits of Magellan via the eastern entrance and head south towards Burdwood Bank where the first sampling is planned. „Polarstern" will then follow the Scotia Arc on its northern branch via South Georgia to the South Sandwich Islands (Fig. 1), working her way along the shallows around and between the islands. Passing the Sandwich Islands in N-S direction, the same procedure is planned for the southern branch of the Scotia Arc on the way back towards the Antarctic Peninsula. An additional hydrosweep survey is to be carried out NW of Elephant Island, before the vessel will approach the Dallmann laboratory on King George Island to collect materials left by the summer campaign. On the way back to the Beagle Channel, a series of moorings will be retrieved in the Drake Passage. „Polarstern" is scheduled for arrival at Ushuaia (Argentina) on May 05, 2002.

Scientific Projects

The idea is that during the LAMPOS cruise all participants including the Latin Americans cooperate in a few core programmes and answer jointly the questions put forward above, rather than accumulating large individual samples which lateron are difficult to analyze on a joint basis. For this reason, only few programmes are listed here which always comprise various institutions. Repartition of work at sea and data analysis will be organized aboard the vessel at the beginning of the cruise.

Biodiversity, biogeography and evolution of Antarctic fauna

Biodiversity and evolution of Antarctic molluscs, holothurians and crinoids (MACN, UNP, ZSM)

Rationale
Considerable information exists on the Magellan and Antarctic molluscan and echinoderm fauna gained from previous expeditions. Bioinventory during the LAMPOS expedition to the Scotia Arc will add faunistic and zoogeographic information for this rather poorly known region. The role of this area in the historical distribution and evolution of different taxa will be investigated.

Work at sea
Mollusca and Echinodermata will be collected using different gear (AGT, bottom trawl, multi grab, box corer). Special focus will be given to monoplacophorans, patello- and cocculiniform gastropods, opisthobranchs, hyocrinids, apodous holothurians and, in general, to all microscopic and thus often neglected molluscan and echinoderm taxa. The living material will be photographed before being preserved for different purposes (alimentation, morphology, histology, ultrastructural, biochemical and molecular studies). Species lists of the investigated area are to be developed, compared with those of adjacent regions and conclusions concerning recent zoogeographic relationships as well as evolutionary processes will be drawn.

Micromollusc assemblages from the Scotia Sea, their links with Magellanic and Antarctic faunas (FCNYM)

Objectives
The general objective of the project is to analyse the biogeographic relationships between the Magellanic and Antarctic molluscan assemblages, and in particular, to clarify the affinity of the faunas from the Scotia Arc Islands. LAMPOS will allow us to examine the similarities or discordances between faunistic assemblages from both regions. New information on molluscan diversity along the Scotia Arc will allow characterising their ecological patterns of diversity, levels of endemism, and species richness. Taking into account the geographic position of the Scotia Arc Islands, the information to be obtained will be extremely useful to establish the existence of diversity clines or breaks between Magellanic and Antarctic faunas of micromolluscs. The significance of environmental parameters as determining factors for species distribution in the area covered by the LAMPOS cruise track will also be studied. Finally, the idea is to obtain information on the reproductive condition and

reproductive patterns of selected taxa, as well as to obtain general information on population dynamics of micromollusc faunas during the Antarctic autumn.

Work at sea
Participation in general tasks related to sorting of molluscs from dredge and dragnet samples; to undertake anatomical observations on living specimens obtaining an adequate photographic register of them; to prepare samples of selected taxa for microanatomical studies (fixation, partial dissections, etc.)

Evolution of the Antarctic benthic fauna and molluscan diversity patterns along the Scotia Arc (BAS)

The break-up of the continental bridge between South America and the Antarctic Peninsula was one main event to influcence the evolution of the Antarctic marine benthic fauna. A better understanding of the animal distributions and of plate tectonics within the Scotia Sea – from deep-sea (ANDEEP) to shallow waters (LAMPOS) - will throw further light on the evolution of the present fauna.
The objectives of our working group are to study the causes and consequences of recent Antarctic marine biodiversity. We are constructing comprehensive databases of living Antartic marine faunas to allow detailed comparisons of selected taxonomic groups with various lower latitudes. Evolutionary hypotheses for polar marine molluscs (e.g. pteriomorph bivalves) and for brachiopods, pygnogonids and echinoderms will be tested using phylogenetic and palaeontological techniques.

Key taxa for our studies are the bivalve families Philobryidae and Limidae and their relatives. Species of *Philobrya* and *Limatula* occur from intertidal areas to a depth of 1000 m, deeper records are unknown but during ANDEEP more deep-water material will be sampled. Their reproductive strategy (brooding in *Philobrya*, brooding and planktotrophic development in *Limatula*) is important regarding their regional spread and migration. In the brooding taxa, the released young shells have no pelagic stage during which they could drift long distances with water currents, but the energy-rich juveniles could be lecithotrophic for some time while using demersal drift for migration. Another possible migration mechanism might be kelp-rafting, which could explain the distribution on the sub-Antarctic islands. The origin of the genera and their various Antarctic species is, however, still unknown.

Work at sea
Living material of brachiopods, molluscs, pygnogonids and cidarid urchins will be collected from all samples and prepared for further analysis (SEM, TEM, PCR). Prior to fixation, animals will be kept in aquaria on board to study and record their movements and ecology. Additionally the well-known Weddell Sea and Magellanic mollusc faunas will be compared with those of the Scotia Arc regions.

Any rock material found in the samples will be assessed for possible clues to the glacial history or the bed-rock geology of the region.

Biodiversity, biogeography, phylogeny and tropho-dynamics of the Scotia Arc Amphipoda (IRNSB, AWI)

Background and rationale
The diversity, abundance, ubiquity and low dispersal capabilities of the amphipod crustaceans make them a good model group for studying the patterns and processes of biodiversity and biogeography.

A large dataset on amphipod diversity, distribution and ecology has been produced by previous *Polarstern* and *Victor Hensen* campaigns in the eastern Weddell Sea, the Antarctic Peninsula and the Magellan region. These data and reference collections have been mostly concentrated in the Biodiversity Reference Centre for Antarctic Amphipods ("Ant'Phipoda") supported by the "Antarctic Amphipodologist Network (AAN)", an international network of specialists engaged in the revision of the Antarctic amphipod fauna, the synthesis of their distributional and ecological traits and the preparation of new identification tools.

Relying on previous experiences, on the Ant'Phipoda database and the expertise of the network, the present proposal will aim at characterising the biodiversity and biogeography of the amphipods of the Scotia Arc and will contribute to the study of phylogeny and phylogeography of selected amphipod taxa also conducted under the ANDEEP programme.

Detailed stomach contents analyses and feeding behaviour observations of benthic amphipods of the Weddell Sea shelf communities have revealed a rather high diversity of trophic types (Dauby et al. 2001a,b). A preliminary stable isotope approach confirmed this observation and a fatty acid analysis further completed the study. The LAMPOS campaign offers a new opportunity to pursue, by a multiple approach, the investigation of the ecological roles, in particular the trophic role, of the amphipod taxocoenosis in the shelf benthic communities of the Scotia Arc. The project will be a part of the Belgian Antarctic Research Programme and will contribute to the following programmes: SCAR EASIZ, SCAR EVOLANTA, DIVERSITAS, Systematics Agenda 2000, Census of Marine Life.

Objectives
The project will focus on several complementary objectives detailed hereafter:

Biodiversity
- To document the composition and characteristics of the Scotia Arc amphipod fauna in comparison with other Antarctic, Magellan and Subantarctic zoogeographical subregions, and with the deep slope and abyssal zones investigated by ANDEEP.
- To complete the comprehensive photographic documentation of amphipods and other benthic animals undertaken in previous cruises (M. Rauschert).
- To contribute by taxonomical material, photographic records, distribution and ecological data to the ongoing revision of the whole Antarctic fauna and the preparation of new identification tools undertaken by the AAN.

Phylogeny and biogeography
- To investigate the phylogeny of selected amphipod taxa (in particular Lysianassoidea) and their biogeographical history by a parallel molecular and

ecomorphological study relying on both shelf (LAMPOS) and deep sea (ANDEEP) material. In particular, to investigate the Scotia Arc colonisation and the polar submergence hypotheses within selected taxa by molecular data, using the nuclear 18s rRNA and mitochondrial CO1 genes.

Ecology
- To characterize the ecological traits of the amphipod taxocoenosis; in particular habitat diversity, ecomorphological types and life styles.
- To investigate in detail the trophodiversity and the trophodynamics of the amphipod taxocoenosis in the Scotia Arc benthic communities. The approach will be multiple involving digestive tract analyses and feeding behaviour observations in aquaria, as well as the use of stable isotope (carbon and nitrogen) ratio and fatty acids as amphipod diet tracers to delineate the trophic relationships.
- To investigate the trophic adaptive radiation in selected taxa by a morphofunctional approach coupled with a molecular identification of trophic homologies and analogies and molecular polarization of the ecomorphological adaptations.
- To evaluate the significance of the amphipods as prey for other macrobenthos and demersal fish.

Phylogeny of the amphipod families Epimeriidae and Iphimediidae (ZIM)

Rationale
The phylogeny of Epimeriidae and Iphimediidae is studied on morphological and molecular level. The molecular distance of certain genera (e.g. *Epimeria*, *Epimeriella*, *Iphimediella, Gnathiphimedia*....) from different sampling localities along the Scotia Arc will be analysed. Gene sequence comparison of the newly collected specimens with those specimens collected during ANT XVII-3 (Weddell, Antarctic Peninsula) and ANDEEP (Scotia Arc, Drake Passage) will help to understand how the epimeriid and iphimediid evolution took place, e.g. by submergence or emergence. Sequence data from the ANT XVII-3 specimens indicate an interesting story to tell.

Work at Sea
- Pictures of living Epimeriidae and Iphimediidae will be taken on board. Several species are known to have various colour varieties, which fade after fixation.
- Epimeriidae and Iphimediidae will be fixed in pre-chilled ethanol for molecular and morphological studies.
DNA extraction will take place on board.
- Additionally spongicolous amphipods will be collected for ongoing studies.

Molecular systematics of copepods in the Southern Ocean (AWI)

Copepods are one of the most abundant taxa of marine zooplankton and very important within pelagic food webs. Although copepods are distributed through the entire water column they tend to accumulate in patches near the surface layer or the bottom. In 1998 Linse et al. collected a large number of copepods, including several new species, with an epibenthic sledge near the Antarctic Peninsula. Another phenomenon was that Antarctic ascidians sampled in 2000 by Arntz & Gili had ingested many copepods, which indicates bentho-pelagic coupling.

This project on molecular systematics combines traditional planktonic taxonomy and new molecular methods. A molecular phylogenetic tree for copepods will be developed using the slow-evolving nuclear ribosomal 18s gene and the fast-evolving mitochondrial gene COI (cytochrom oxidase I). All sequences used to construct this tree are the basis to develop general molecular identification protocols for different species at every developmental stage. In addition to the molecular tree population genetics examinations the main processes of spaciation will be studied.

Work at sea
Metridia gerlachei, one of the dominant and endemic copepod species in the Southern Ocean, will be sampled with a multi opening and closing net, which provides the possibility to compare populations of different depth strata. Bongo and CalCofi net will collect many different copepod species to complete the molecular tree. At each station a hydrographic profile will be taken by CTD sonde.
After retrieval of the gear, copepods will immediately be sorted, identified and preserved in -80 °C or ethanol for molecular-genetic analysis. Some live female copepods will be transported back to the laboratory at the AWI-Bremerhaven.

Biogeographic research on Asteroidea (UMAG, AWI)

The Scotia Arc is zoogeographically of outstanding importance as a natural bridge for faunal exchange between South America and the Antarctic continent. The seastars (Asteroidea) represent a group which is quite diverse both around the South American continent and in Antarctic waters.

Both regions reveal an interesting species richness and high endemism, while at the same time, mostly on higher taxonomic levels such as family and genus, there has remained a considerable faunal overlap between the two regions. The asteroid fauna of the Scotian Arc is less well-known than that of other Antarctic and also South American regions. The study planned during ANT XIX/5 will investigate the zoogeography of seastars in the Scotian Arc, principally in the light of the exchange between the Antarctic and South American continents and in terms of endemic species.

For this reason, quantitative samples will be taken from all available gear. The asteroid fauna will be preserved in formalin and studied later at the
UMAG and AWI laboratories.

Macrozoobenthic structure in an area of the Antarctic platform (IMARPE, UNMSM, AWI)

Scientific background
A quantitative and qualitative study of benthic organisms and their relation to sedimentology and geochemistry is being considered, taking samples based on the work undertaken during three Peruvian expeditions to the Antarctic Region (ANTAR III, ANTAR X and ANTAR XI).

During ANTAR III, two samples collected (30 m) at a station located within Mackellar Bay reported abundance of soft-bottom benthic molluscs with high diversity and biomass levels and low diversity level. The most important groups were: Urochordata (Ascidiacia), Echinodermata (Holothuroidea) and Polychaeta (*Thelepus sp., Aglaophamus sp.*). During ANTAR X, two shallow stations (20 m) facing Crepin Point were studied, reporting high diversity and abundance values and polychaete dominance, followed by crustaceans and molluscs. During ANTAR XI, samples collected from five stations located within the Mackellar Bay reported the polychaete group as the most important in number and biomass and the families Cirratulidae and Orbinidae as the most characteristic.

Objectives
- To describe and quantify soft-bottom macrozoobenthic communities of the Scotia Arc shelf.
- To carry out an inventory and distribution analysis of benthic species and study their communitarian structure (diversity, dominant species of the Antarctic Shelf ecosystem and relation to the environment).
- To evaluate the influence of substrate type (textural type determination), bottom type and other environmental factors on the macrobentos (temperature, bottom oxygen).
- To expand and correlate the Antarctic benthic macrofauna database with information obtained from research projects carried out during the Peruvian expeditions to the Antarctic region.

Biogeography and biodiversity of meiofauna between the Antarctic and Subantarctic with special emphasis on the nematodes (MFC, UGZ)

Description of research proposal
There seems to be a consensus among many biogeographers that the Antarctic benthic macrofauna is very old and that most of the Southern Ocean shallow-water marine fauna has evolved *in situ* since its isolation during the Creataceous. This view is supported by the high level of invertebrate endemism. However, contrary to the macrofauna, there seems to be no sign of a relict autochthonous Antarctic nematode community. 70% of the high Antarctic Weddell Sea genera with abundances over 1% match nematode assemblages in the world's ocean margins and the remaining 30% are less common, but none of them are endemic. In addition, many taxa in the Magellan communities resemble those of the Weddell Sea.

Our findings confirm that many nematode communities from comparable soft-bottom biotopes are alike irrespective of distance. Slow speciation with relict faunas in similar habitat conditions might be one explanation for this "meiofauna paradox". However, such geological mechanism is questionable (Giere 1993) and difficult to detect. Recruitment and colonization may be another explanation for present-day's distribution patterns of meiofauna. But then, how do nematodes with their limited swimming ability reach such broad geographical and latitudinal distribution considering they have no pelagic larval stages? A possible mechanism to reach suitable habitats in geographically distant areas is via shallow-water connections such as the Scotia Arc. Furthermore transport of sediments down the shelf and accompanying horizontal movements by near-bottom currents in the nepheloid

bottom layer might allow a widespread distribution irrespective of physiological barriers.

To test this hypothesis the affinities between the Antarctic and subantarctic meiobenthic fauna need to be investigated through a latitudinal gradient from the Subantarctic to the Antarctic. Deep-water samples from the Magellan region to the high Antarctic are already available for that purpose. However, the continental remnants of the Scotia Arc, which represent a possible link between South America and Antarctica have been ignored until now. Together with ANDEEP, LAMPOS will provide samples from this missing connection.

The study aims at: 1) recognizing geographical patterns in species composition along the connection between the Antarctic, Subantarctic and Magellan regions; 2) comparing nematode community structure from the Scotia Arc with that of other shallow-water communities in Antarctica, 3) obtaining an idea on local species richness (alpha biodiversity) at different sites on the Scotia Arc and to estimate the species turn-over (beta-diversity) on different spatial scales (from metres to thousands of kilometres).
The project is part of the national Belgian project which focusses on Antarctic and deep-sea biodiversity. It contributes to other initiatives on biodiversity research: Diversitas and SCAR EASIZ.

Work at sea
Sediment samples will be collected by means of a multicorer at all geographical target areas during LAMPOS. Each time several (2 to 4) replicate samples will be collected in order to estimate local variation. Samples will be processed on board at in situ temperature and fixed for further analysis back on shore.
The meiofaunal sized organisms will be extracted from the sediment, counted and prepared for microscopical analysis. The high regional species pool within the meiofauna will restrict our investigations to the most abundant nematode genera. Species identification will be facilitated by means of a digital database (NEMASLAN) on all known marine nematodes from Antarctica developed in a previous Antarctic research programme. New species will be added to the digital database.

The role of the continental shelf benthos of the Scotia Arc as a link between the Antarctic and the South American fauna (AWI)

Objectives
Based on recent investigations of benthic communities on the high Antarctic SE Weddell Sea Shelf, at the Antarctic Peninsula and in the Magellan region directly north of the Drake Passage, the planned studies along the various islands of the Scotia Arc complement our comprehensive biodiversity studies from former cruises with ´Polarstern´, ´Victor Hensen´, and ´Vidal Gormaz´. All the regions have their origin in a common past as part of the Gondwana continent and their close vicinity up to the present day make comparative studies of their benthic realm especially interesting for ecological, zoogeographical, and biodiversity studies.

Research questions to be answered are
- Is the Scotia Arc a transitory area (with respect to the benthos) between Antarctic and Magellanic regions?

- Do the various shallows along the Arc serve as footsteps supporting faunal distribution and in which direction?
- Do there exist any clines/breaks in diversity, biomass, and faunal density from the high Antarctic to South America or vice versa?

Work at sea
The main collecting gear to document the composition and structure of the benthic communities for us is the multibox corer which up to now provided large collections from areas south and north of the Scotia Arc, thus allowing detailed comparisons and providing answers for the questions addressed above.

Infaunal communities in the Scotia Arc: bathymetric pattern of body size and diversity (UCC)

Objectives
Whereas intense studies have been done in southern Chile and Antarctic areas, data from the Scotia Arc are scarce. The overall objective of our work during this expedition therefore is to determine the biodiversity and bathymetric pattern of the body-size structure of macrobenthic communities from deeper shelf and upper slope areas of the Scotia Arc (South Orkney Islands, South Sandwich Islands, South Georgia and Burdwood Bank). Specific objectives are: i) to determine oceanographic conditions (temperature, salinity, density, dissolved oxygen), ii) to asses the biodiversity and biomass-size spectra of benthic communities, iii) to determine the relationships of sediment parameters and oceanographic conditions with density, biodiversity and biomass-size spectra.

Work at sea
- Support to the benthic group to obtain biological material (sieving and sorting onboard).
- Collection of oceanographic data (CTDO).

Visual documentation of the benthos by means of video equipped ROV and photo sledge (UMAG, AWI)

Extensive data sets on benthic community structure are available from Antarctic and Magellan regions based on ROV and photo sledge transects. The major goal of underwater video ROV studies during LAMPOS 2002 is the quantitative description of benthic diversity and the detailed evaluation of the distribution and abundance of highly motile organisms such as decapod crustaceans and fishes.

Work at sea
The ROV will be used at all those 7 stations where multi task gears will be employed. The multifunctional ROV that will be used aboard on "Polarstern" will provide visual documentation by means of high quality digital underwater video (3CCD), standard video (VHS - PAL, NTSC) and digital photography. An additional sensor will measure water temperature throughout the water column, when the ROV will be lowered to the sea floor, and horizontal temperature profiles will be obtained along the video transects. Apart from all recordings, the video signals and the temperature data will

be available online on the 2 surface unit monitors. Depending on local conditions such as weather, bottom topography and water currents, all video transects will cover a maximum area of 100 m2 each, which corresponds to about 45 minutes working with the ROV on the seafloor. Maximum water depth the ROV will reach is 350 m. Underwater photography by means of a photo sledge will complement this work and extend it to 600 m.

Demersal fish fauna of the Scotia Arc region - faunal exchange (AWI, ULM)

Rationale
In the Scotia Arc and especially around South Georgia we observe an overlap of distribution areas of Antarctic and Magellan fish species. Shallow shelf areas of the islands may connect South America and the Antarctic Peninsula and may be used by demersal fish to disperse north- and southwards, respectively. Within the Antarctic suborder Notothenioidei (Perciformes) some species, such as *Chaenocephalus aceratus*, *Gobionotothen gibberifrons*, *Notothenia neglecta* and *N. rossii marmorata*, are widely distributed from the Antarctic Peninsula over the South Shetlands, South Orkneys and South Sandwich Islands to South Georgia.

Work at sea
To analyze and compare the fish communities along the Scotia Ridge we will trawl the shelf areas of the different islands using an otter trawl as well as an Agassiz trawl. To ascertain if there is still a faunal exchange between the islands (e.g. by larval drift) comparative investigations on population and community structures, morphology and ecology of representative species are planned.

Fishes will be determined, counted, measured and weighed. Otoliths will be removed for age determinations and the stomachs with their contents, respectively, will be preserved for later analyses. For the investigation of population genetic structures, tissue samples of gills and muscles will be taken and partly be preserved in 90 % ethanol, partly be frozen at -20 °C.

Pelagobenthic coupling and structural properties of benthic communities

Pelagobenthic coupling and the role of benthic suspension feeders (ICM/CSIC, US, UBE, UMAG, AWI)

Scientific background
Benthic suspension feeder communities may play an overall regulatory role in marine ecosystems. While work in temperate ecosystems has shown that dense assemblages of suspension feeders have a strong impact on plankton communities, their role in Antarctic systems is still an open question.

Many benthic assemblages in Antarctica are rich in abundance and taxonomically diverse, and a large proportion of them consists of sessile suspension feeders, e.g. sponges, bryozoans, ascidians, cnidarians, and certain echinoderms. Average benthic biomass of these organisms in the Antarctic is higher than in temperate and subtropical communities. There are, however, considerable differences between high

Antarctic (Weddell Sea) and Antarctic Peninsula communities, and the position of the Scotia Arc has yet to be assessed.

This working group will study some hypotheses about the mechanisms of ecological success of benthic Antarctic suspension feeder communities. Therefore, aspects related to the trophic ecology of suspension feeders, to environmental conditions which facilitate energy transfer between the benthic and water column systems, and to reproductive biology are emphasized. Which processes are responsible for the availability of food to suspension feeders? What is the role of the Antarctic Convergence in these processes? To what extent are the abundance and patchiness of suspension feeder communities a consequence of biological and environmental factors? Which reproductive strategies are found in Scotia Arc suspension feeders in autumn, and how do they compare with those found at higher/lower latitudes?

Work at sea
Suspension feeder composition, distribution, trophic ecology and reproductive biology will be studied in samples from all benthic gear, and complemented by UW photos and video transects. Availability of food in the water column that can be used by suspension feeders will be studied from plankton catches as far as available.
Benthic cnidarians as one major group of suspension feeders will receive special attention, comprising the following investigations:

i) Taxonomy, systematics and biogeography of benthic cnidarians along the Scotia Arc.
ii) Reproductive strategies and quantification of gonad production and larval release in several species of gorgonians. Abundance and spatial heterogeneity of the more abundant species of this group.
iii) Stoichiometric and chemical (nutrients) analysis (lipids, proteins and carbohydrates) of several species of gorgonians in relation to their composition in the sediments and, if possible, in the water layer near the bottom.
iv) Sediment characteristics such as potential food for benthic communities (organic and inorganic particle concentration, microbial activity and organic nutrient concentration).

Demersal fish fauna of the Scotia Arc region - the role of demersal fish in the food web (AWI)

Rationale
As top predators demersal fish play an important role in the food web of shelf communities. Some knowledge is available as to the composition, abundance, biomass and diet of the fish fauna from the Antarctic Peninsula and the Weddell Sea. For these areas, preliminary attempts have been made to construct trophic models of energy flow. Corresponding data will be sampled from the fish fauna in the Scotia Arc, and existing records will be verified and completed.

Work at sea
Fish sampled by otter trawl and Agassiz trawl will be processed as described in chapter "Demersal fish fauna of the Scotia Arc region – faunal exchange" and stomach contents will be analysed. To understand the role of demersal fish in the

food web of Antarctic shelf communities, results will be compared with existing data and linked to records concerning the benthos and plankton. Thus, we will try to identify energy flows and to create trophic models for the Weddell Sea, Antarctic Peninsula and Scotia Arc shelf ecosystems.

Ecological and physiological adaptations of benthos and fish

A comparative analysis of ecophysiological parameters in notothenioid fishes from the Scotia Arc and the Magellan region: phenotypic adaptation vs. phylogeny (CADIC)

Scientific background
The fish fauna of Antarctica is dominated by notothenioids, 4 families and 27 species of which are found in the Beagle Channel and surrounding waters. In Antarctic waters, the lack of competition with other fish orders has resulted in an impressive radiation of the initially benthic notothenioids into benthic, pelagic, semipelagic and cryopelagic species. However, in Subantarctic environments, the notothenioids are confronted with a strong competition from non-notothenioid fish, limiting their distribution to demersal habitats. A special category of adaptations is related to swimming performance.

Our laboratory has performed comparative studies on physiological aspects of Antarctic and Subantarctic notothenioids, in particular on swimming capacity, muscle fibre growth, reproduction, oxygen consumption, buoyancy and energetic content. The exposure to variable temperatures limits the range of some physiological functions, like the contractile properties of the muscle fibres conditioning swimming responses and ecological fitness. The temperature also influences the recruitment rate of muscle fibres determining their number and the final body size of the fish. The maximum diameter of the muscle fibres has physiological constraints but in cold water notothenioids can reach values as high as 500µm. This indicates both a limitation of the recruitment of new fibres and the importance of hypertrophic growth. The presence of large size species in the families more closely related with the perciform stock (Eleginopinae, Bovichtidae) open an interesting controversy about the prevalence of phylogenetic or environmental constraints on final body size.

The understanding of subjacent evolutionary mechanisms influencing this body feature would improve from a comparative analysis between Antarctic and Subantarctic related species. To obtain data from notothenioid species inhabiting the grounds covered by the LAMPOS cruise will facilitate a comparative analysis of swimming capacity, buoyancy, muscle growth and development, reproduction, oxygen consumption and energy budget. The Scotia Arc environment could function as a transitory area or a break in the distribution of the mentioned physiological properties. A very important aspect in relation to the knowledge of muscle growth is to analyse the relationship between diameter and number of muscle fibres at different body sizes. This subject is supported by the possible capture of species that reach a large body size, such as *Dissostichus eleginoides*, as well as specimens of species living in sub-Antarctic waters, such as *Cottoperca gobio*, different species of Patagonotothen and Paranotothenia and the congeneric *Harpagifer bispinis* and *H.*

antarcticus. The analysis of physiological properties in a number of different species could produce relevant information on biogeographic and evolutionary links between the notothenioid fish on both sides of the Antarctic Convergence.

Work at sea
- Reproduction: Degree of sexual maturity, identification of post spawning specimens (detection of postovulatory follicles, POF), determination of absolute and relative fecundity. Estimation of reproductive effort.
- Energy budget: Energetic content in reproductive and storage compartments (gonads, liver, muscle, intraperitoneal fat).
- Buoyancy: Determination of flotability in living or dead specimens of different size for each species.
- Growth and development of muscle fibres: Two different approaches are proposed: a) quantification of muscle fibre diameter in fishes of different sizes by histological analysis; b) determination of the expression of different transcription factors (MyoD, myf-5, myf-6) responsible of muscle fibre differentiation and related to determination of final size of fish.
- Oxygen consumption: Oxygen consumption at different temperatures in fasted and fed fishes from different ecotypes. Effects of resting and forced swimming on O_2 consumption.

Studies on the adaptive competence of cold stenothermal teleostei *Pachycara brachycephalum* and *Lepidonotothen nudifrons* (AWI)

Scientific goals
In a cause and effect analysis, our working group is studying the physiological processes responsible for the temperature dependence of distribution boundaries found in marine organisms, especially ectothermal invertebrates and fish, and the shift of these boundaries in the context of global climate change. An analysis of stress situations on molecular, cellular and systemic levels yields information on the influence of temperature or other anthropogenic factors such as CO_2 on the distribution of different species and their specific adaptational performance.

Work at sea
- Catch of live cold stenothermal Teleostei in the Antarctic shelf regions of the Scotia Arc using releaser traps. Catch results are expected to allow conclusions on the northern distribution boundaries of the respective fish species.
- Measurements of the influence of increased CO_2 partial pressures (hypercapnia) on the energy metabolism of isolated fish hepatocytes.
- Transport of live animals (apart from fishes, especially cephalopods) to Bremerhaven for further physiological analysis within the context of the overall working programme of the AWI Department of Ecophysiology.

Ecophysiological adaptations of benthic organisms and Antarctic fish (IMARPE)

Scientific background
This project proposes continuing the ecophysiological impact studies of marine organisms initiated by the Peruvian scientific expedition ANTAR X during the austral summer of 1999, determining tolerance and physiological rates conforming to the environment. The Peruvian Marine Institute (*IMARPE*) began ecophysiological studies of the amphipod *Bovallia gigantea* during ANTAR X, estimating their average and specific oxygen consumption and acclimatization period.

Understanding the characteristics of these amphipods and other organisms with regard to adaptation, behaviour and physiology may indicate which mechanisms interfere in the possible changes occurring along the latitudinal gradient between the Antarctic, Subantarctic and the southern tip of South America. The adaptation of organisms to the Antarctic marine ecosystem over long geological time scales has played an important role in their evolution. Adaptation to low temperatures is essential to understand the physiological characteristics of the fauna of the Scotia Arc. Information on environmental parameters, such as temperature, salinity and dissolved oxygen shall be collected during the cruise, to make a connection between the variability of the marine environment and the organisms inhabiting these areas.

Objectives
The idea is to evaluate the rate of oxygen consumption of organisms inhabiting the Scotia Arc facing intermediate salinity and temperature conditions as compared to the Magellan region and high Antarctic waters, and to evaluate the mitochondrial density in these organisms and its relation to oxygen demand and variable levels of environmental stress.

Reproductive and energetic condition of decapod crustaceans in the Scotia Arc compared to the Magellan region (CADIC, AWI)

Scientific background
The Antarctic Convergence constitutes the distributional limit for most Magellanic and South Atlantic decapod species and represents the northern limit in distribution of those species of shrimps occurring in the Antartic only. Nevertheless, some congeneric species such as *Chorismus spp.* and *Paralomis spp* occupy the same distributional area around e. g. South Georgia. Therefore the relevance of restricting parameters in life history affected by environmental conditions is of scientific interest.

Work at sea
During LAMPOS 2002 we propose to investigate:

Munida spp. M. subrugosa and *M. gregaria* represent more than 50% of the benthic biomass in the Magellan region, and are also distributed on the Atlantic platform. We propose to:
- Estimate the proportion of galatheid species in each haul. Distributional range throughout the Scotia Arc.
- Estimate the energetic proportion invested into reproduction, storage and growth.

Reproductive output.
- In the stomach contents: estimate the energetic value, ratio of organic and inorganic matter (which defines the feeding habits).
Lithodids, e.g. *Paralomis* spp, *Lithodes* spp. Group commonly found north of the Antarctic Convergence, and some rare finds in the Antarctic.
- Estimation of energetic proportion invested into reproduction, storage and growth.
- Determination of ovarian condition to evaluate the frequency of the reproductive cycle. Reproductive output.
- Biogeographical analyses of distribution limits.
- Collection of live female specimens to be transported to the AWI for ecophysiological studies and the description of larval development.
Chorismus spp.
- Estimate the energetic proportion invested into reproduction, storage and growth in each species at different sampling sites.
- Comparison between the congeneric species *C. antarcticus* and *C. tuberculatus* as representative of the polar and subpolar region, respectively.
We propose to compare different parameters along the track of the LAMPOS cruise. Moreover, results will be compared with data already available from previous studies performed in the Magellan and Antarctic regions on these species.

„Reptant" decapods (except lithodids) do not occur in the Antarctic due to ecophysiological restrictions, such as magnesium metabolism. Energetic and reproductive parameters are assumed to serve as estimates for the ecological fitness of species. Therefore, we expect to resolve patterns of energetic use and features of reproductive strategies according to the distribution of decapods within the Scotia Arc and with respect to the Antarctic Convergence.

Comparison of the population dynamics of fish and decapods between Scotia Arc and Magellan populations (UMAG, AWI)

Scientific background
Abundance, species composition, biomass and biology of Antarctic fish and decapod crustaceans from the Scotia Arc region are relatively well known, and detailed information on life cycles, reproduction and population dynamics of notothenioid fish and shrimps is also available. However, these studies do not include comparisons with species from the Subantarctic Magellan region. For example, comparisons of decapod population dynamics and life cycles were made between shrimp species from South Georgia and the Weddell Sea, but similar comparisons are lacking between the Scotia Arc and the Magellan region. This is surprising because some species, and a large number of genera and families, from the southernmost tip of South America extend their distribution range into the Scotia Arc or even towards the high Antarctic regions.

Research goals
Major goal of the interdisciplinary working group of the UMAG and their counterparts during LAMPOS 2002 will be an intensive study on life cycles, population dynamics and adaptations of selected benthic and demersal fish and decapods of the Scotia Arc region in comparison with populations from the Magellan region. Our working hypothesis is, that those fish and decapods, which are distributed from the Magellan

region towards the Scotia Arc reveal gradients of delayed reproduction, abbreviated larval development and slower growth, but these gradients will be less distinct than between populations from South Georgia and the high Antarctic Weddell Sea. In detail we plan to study:

- abundance and population structures,
- life cycles and growth,
- development of larvae and juveniles,
- diet composition and feeding ecology of larvae, juveniles and adults,
- trophic links between fish, decapods and other benthos,
- biochemical adaptations (lipid metabolism) of larvae and juveniles.

To relate the data from the Scotia Arc with those from the Magellan region, the following families, genera and species are of particular interest: *Nototheniidae, Dissostichus* (fishes), *galatheid* crabs such as *Munida subrugosa,* lithodid stone crabs of the genus *Paralomis*, and caridean shrimps. A trophic relationship study will focus on the collection and identification of benthic predators, and studies on the abundance and population dynamics of common epi- and infaunal species.

Reproductive strategies of marine benthic invertebrates at high latitudes: an evolutionary link for Antarctic fauna? (AWI, CADIC)

Scientific background
Reproductive strategies of marine benthic invertebrates at high latitudes have been discussed controversially during the past two decades, but few attempts have been undertaken to check the comprehensive Arctic and boreal work of Thorson (1936) for the southern hemisphere. So far, „Thorson´s rule" has been confirmed for only few taxa, e. g., for echinoderms, prosobranchs and especially decapods.

Most of this discussion resulted from the lack of information on meroplanktonic larvae at high latitudes, and therefore most conclusions are based on comparatively small datasets, which obviously do not allow scientific generalization. The Scotia Arc serves as a transitional area between South America and the Antarctic, and for this reason must be seen as a keyzone for the study of reproductive patterns, phylogenetic relationships in congeneric species of each side, as well as it could explain distributional limits of species. Since larval development, life history and larval distribution reflect best the evolutionary state of an area, we believe the study of meroplankton communities to be especially valuable for the reflection of present and past evolutionary tendencies at high latitudes.

The sampling of meroplanktonic larvae in the Scotia Arc will complement a comprehensive dataset on larvae in the southern hemisphere, based on previous studies and time series over several years from the Magellan region. These data were obtained from zodiacs, the vessels „Victor Hensen" and „Polarstern", and from environmental studies performed on board vessels of the local ENAP company. In addition, the applicants already published data and are working up meroplanktonic material from Atlantic waters obtained during cruises of RVs „Walther Herwig" and „Shinkai Maru", which extend the latitudinal comparison to the continental shelf of Uruguay. Further material from the high Antarctic was obtained on RV „Polarstern"

during the expedition ANT XVIII/b in April/May 2001. These data from the Bellingshausen Sea are completed by samples from the Weddell Sea obtained some years ago during cruises of the Argentine RV „Almirante Irizar". The complementation of this latitudinal transect with samples from the Scotia Arc would provide the first overview on meroplankton occurrence and distribution, and help to understand diversity patterns and phylogenetic relationships at least in some groups.

Work at sea
Vertical plankton samples will be taken with a multinet at all stations along the Scotia Arc. Decapod larvae will be dissected for stomach content analyses and lipid studies. Since time and space on board will be extremely limited during LAMPOS, we believe a slightly modified Rauschert dredge might serve as an adequate method for at least qualitative sampling of demersal drifters.

Other topics

Scotia Sea bathymetry and potential field (GEOCHI, IKG, AWI)

The shape of the sea floor topography of the Scotia Sea plays a decisive role for investigating and interpreting the opening process of the Drake Passage. For this reason it is essential to perform systematic bathymetric and gravimetric surveys, and sub-bottom profiling in this region.

Information on the earth's potential field in the western Scotia Sea is available only from satellite altimetry data and magnetic information is available. This a priori information is used to plan the systematic multibeam and marine gravimetric surveys, and sub-bottom profiling during the expedition.

The bathymetric work programme covers the following three aspects:

1. Survey of a circum Scotia Sea bathymetric profile using the multibeam system Hydrosweep DS-2 in order to compile a closed depth profile including slope data of the distinctively structured ridges and their deep incisions, which are considered as possible transport ways of cold Antarctic bottom water from the Weddell Sea into the South Atlantic. For this reason, multibeam data recording using the Hydrosweep DS-2 parallel to sub-bottom profiling with the Parasound-System and gravimetric surveys will be performed along the transits between the biological sampling areas. These measurements will serve as a high resolution data set for the modelling of oceanic circulation processes in this region. Also sidescan and backscatter data will be recorded. Furthermore the bathymetric data will be utilized for the compilation of bathymetric and nautical charts in this region.

2. The most pronounced sea floor structures in the south-western part of the Scotia Sea, as seen from satellite radar altimetry data, are the South Shetland Trench (SST) with depths of more than 5000 m and its eastern margin, the Shackleton Fracture Zone (SFZ). The major part of the SST was already surveyed by "Polarstern" and "Akademik Boris Petrov" during ANT XV/2 and GAP 98 in the frame of geokinematic investigations of the Antarctic Peninsula

region (Fig.). In order to fully understand the geological processes in the intersection region of the SST and the SFZ, a systematic geophysical survey (multibeam, sub-bottom profiling and marine gravity) will be performed in this area.

The area planned for this survey is directly adjacent to the NEside of the ANT XV/2 area, and is delimited by the following coordinates:

61°30' S	57°30' W	60°15' S	59°00' W
60°00' S	58°00' W	61°15' S	56°30' W

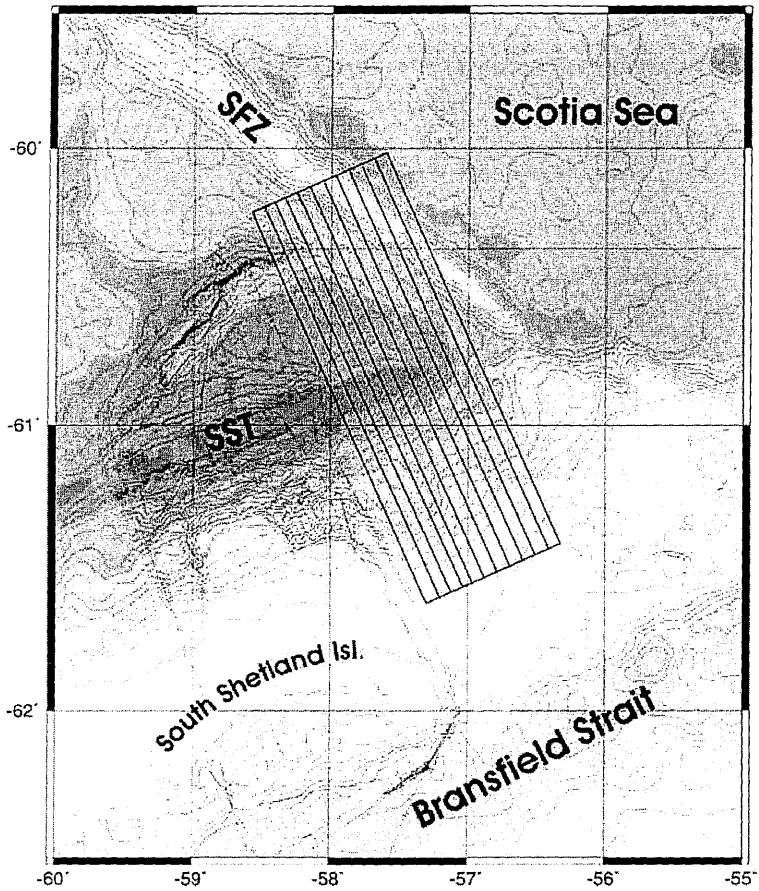
The size of the area is approximately 10.000 km^2.

3. High resolution multibeam bathymetry of biological sampling stationsThe sea floor topography is a major oceanic boundary that has a critical importance for many marine processes. The characteristics of the water column, the underlying sediments, and the sea life can be strongly affected. As knowledge of its importance has grown, research on benthic processes and features has become increasingly important.

   The marine biological programme of this cruise includes intensive studies and sampling of selected areas around the Scotia Sea. In order to geocode, map, and describe the samples correctly and for safe operation of the sampling instruments in this ecologically sensitive environment, a large scale multibeam survey will be performed in its vicinity beforehand. Thus, depending on the general water depth around the sampling area, a short multibeam survey of the site's surrounding will be carried out. The survey will cover in general, depending on the depth, an area of approx. 15 by 15 km^2.

   During the expedition postprocessing of the multibeam data in the areas of local bathymetric surveys will be performed in order to prepare working sheets as a basis for the biological work to assist and support biological sampling.

   In addition to the multibeam surveys continuous sub-bottom profiling using the Parasound system and marine gravity recording will be performed. The goal of these investigations is to derive, beside information on the shape of the sea floor, also data on sediment structure and the gravity field. These data will be used to investigate the structure of the upper crust.


SFZ
Scotia Sea
SST
South Shetland Isl.
Bransfield Strait
-60°
-61°
-62°
-60°
-59°
-58°
-57°
-56°
-55°

Beteiligte Institutionen / Participating Institutions

AWI	Alfred-Wegener-Institut für Polar- und Meeresforschung Columbusstrasse 27568 Bremerhaven, Germany
BAS	British Antarctic Survey High Cross, Madingley Road Cambridge CB3 0ET, Great Britain
CADIC	Centro Austral de Investigaciones Científicas CC 92 – V9410BFD Ushuaia Tierra del Fuego, Argentina
DWD	Deutscher Wetterdienst Jenfelder Allee 70a 22043 Hamburg, Germany
FCNYM	Museo de la Plata-FCNyM Paseo del Bosque s/n, (1900) La Plata, Argentina
GEOCHI	Vernadsky Institute of Geochemistry and Analytical Chemistry 19, Kosygin Street Moscow 117975, Russian Federation
HSW	Helicopter Service Wasserthal GmbH Kätnerweg 43 22393 Hamburg, Germany
ICM/CSIC	Institut de Ciències del Mar Passeig Marítim de la Barceloneta, 37-49 08003 Barcelona, Spain
IKG	Institut für Kartographie und Geoinformatik Universität Hannover Appelstr. 9a 30167 Hannover, Germany
IMARPE	Instituto del Mar del Peru Apartado 22 Callao, Peru
INIDEP	Instituto Nacional de Investigación y Desarollo Pesquero Paseo Victoria Ocampo 1 7600 Mar del Plata, Argentina

IRSNB	Institut Royal des Sciences Naturelles de Belgique Rue Vautier, 29 1000 Bruxelles, Belgium
MFC	Ministry of the Flamish Community Administratie Wetenschap en Innovatie Boudewijnlaan 30 1000 Bruxelles, Belgium
UBE	Universidad de Barcelona Diagonal 645 08028 Barcelona, Spain
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UCC	Universidad de Concepción Casilla 160-c Concepción, Chile
UGZ	University of Gent K. L. Ledeganckstraat 35 9000 Gent, Belgium
ULM	Universidad Nacional Agraria La Molina Apartado 456 Lima 100, Peru
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UNP	Universidad Nacional de la Patagonia S. J. Bosco Ciudad Universitaria (9000), Comodoro Rivadavia Provincia de Chubut, Argentina
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(Stand November 2001 - Änderungen vorbehalten)

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Electron.	Dimmler, Werner
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A. B.	Winkler, Michael
Storek.	Beth, Detlef
Mot-man	Fritz, Günter
Mot-man	NN
Mot-man	Krösche, Eckhard
Mot-man	Dinse, Horst

Mot-man	Arias Iglesias, Enrique
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Cooksmate	Martens, Michael
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2. Stwdess	Streit, Christina
2. Stwdess	Deuß, Stefanie
2. Stwdess	Schmidt, Maria
2. Stwd	Wu, Chi Lung
2. Stwd.	Tu, Jian Min
Laundrym.	Yu, Chung, Leung
Trainee	Rumler, Etienne