Evolution of Antarctic Fauna
Extended Abstracts of the IBMANT/ANDEEP International Symposium and Workshop in 2003

Edited by Sven Thatje, Javier A. Calcagno
and Wolf E. Arntz

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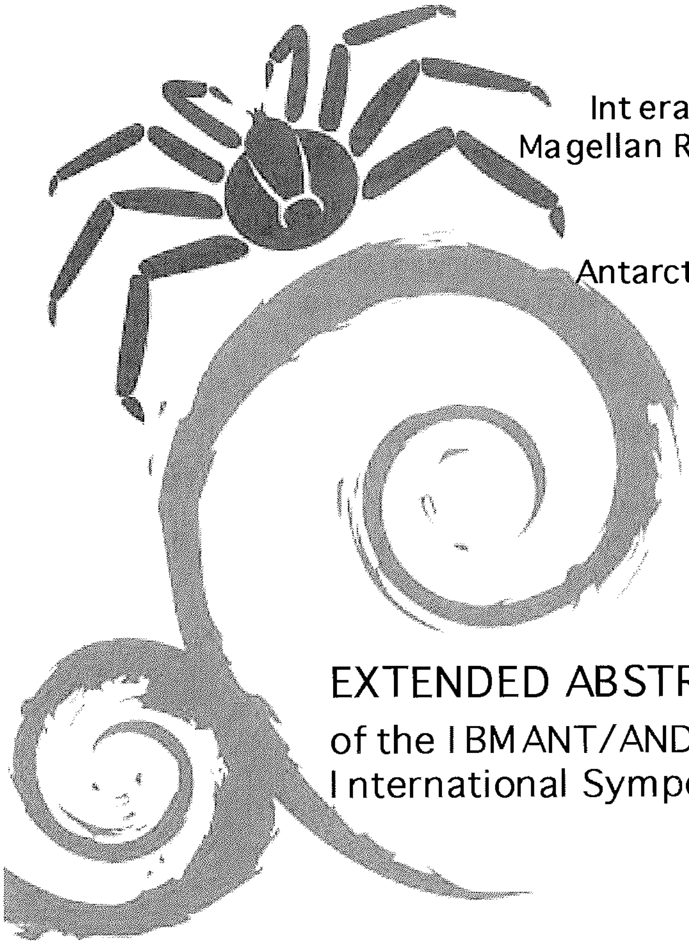

IBMANT
Interactions between the
Magellan Region and the Antarctic
*
ANDEEP
Antarctic Benthic Deep-Sea
Biodiversity

EXTENDED ABSTRACTS
of the IBMANT/ANDEEP International Symposium & Workshop

Edited by
Sven Thatje
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19 to 24 October 2003 - Ushuaia, Argentina

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Introduction to the IBMANT/ANDEEP Symposium & Workshop

The Antarctic cold-water ecosystem is of considerable age. Ice sheet formation on East Antarctica can be dated back at least to the Oligocene, about 35 million years ago. Since that time, water temperatures have been principally decreasing, however with much fluctuation caused by climate variability. Because of the antiquity of the Antarctic ecosystem, Southern Ocean organisms, especially those living on the continental shelf, have had a long time available to evolve. However, the long time span and decreasing water temperatures were not the only factors driving evolution. Glacial periods caused advances, interglacial times retreats of the ice sheet, with major implications for shelf species that got extinct or emigrated towards the continental slope during glaciation and may have re-conquered the shelf in warmer periods if they managed to survive. Africa, Australia and other remains of Gondwana had separated from Antarctica already before glaciation began, but South America continued to drift apart, until finally the Drake Passage got established as a deep-sea trench and the Circumpolar Current, driven by the West Wind Drift, developed as a mighty circular current around the Antarctic continent which further isolated Southern Ocean biota. The increasingly icy waters closer to the continent began to move in opposite direction, and between the two ring currents the Polar Front developed as another barrier, with a steep temperature gradient, which nowadays separates many "true" Antarctic organisms from those in the West Wind Drift and further north.

This historical background may explain many extinctions and adaptive radiation events observed in benthic or benthopelagic taxa (e.g., Notothenioidei, Amphipoda, Isopoda, Gastropoda). Antarctic waters have even been characterised as an 'evolutionary incubator' e.g. for certain amphipod taxa. These radiation processes, favoured by isolation and the long time span available for evolution, probably explain the high degree of endemism in taxa such as sponges, cnidarians, peracarid crustaceans, some gastropod families and fish, that characterises Antarctic communities. However, while the main picture emerging is isolation and radiation in situ, there has obviously also been some exchange with the surrounding continents and oceans. An example are the decapod crustaceans which got extinct in Antarctic waters some time during the Tertiary but recolonised them (in fact, only with two orders) more recently.

Unfortunately, almost all these observations apply specifically to shelf faunas. The deeper waters of the Scotia, Weddell and Ross seas include 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, South Atlantic and Indian Oceans. Hence, the faunas of bathyal and abyssal areas around Antarctica may be similar to those living at comparable depths elsewhere, and the degree of endemism may be much lower in the deep sea than on the shelf. For example, the Weddell Sea is potentially an important source for taxa presently living in the Atlantic and other neighbouring parts of the deep oceans. Periodic extensions and retractions of the ice sheet possibly enhanced rates of speciation on the continental shelf and slope around Antarctica, and eurybathy may have become an essential property for survival. Deep bottom water production in the Weddell Sea then may have acted as a larval distribution mechanism, driving Antarctic deep-water faunas northward into the Atlantic Ocean over evolutionary time scales.

So another important question concerns the potential faunistic links between Antarctica and the continents surrounding it, particularly South America, and whether faunal exchange is still possible today, either by "island hopping" or migration across the deep-sea basins. For example, do the islands of the Scotia Sea enhance faunal exchange, and does the Antarctic deep sea constitute a barrier or a route of faunal migration between the Antarctic Peninsula and South America? The formation of the Weddell Sea began during Jurassic time (165 million years ago), but a continental or shallow-water link between South America and Antarctica may have persisted until 20 million years ago or even less. Presently, the island chain of the Scotia

Arc is partly interrupted by deep sea, however the distances between them are much less than the width of the Drake Passage. Currents may be helpful particularly in a W-E direction whereas they may impede faunal exchange in the opposite direction. Climate change such as intermittent periods of global warming is likely to have influenced the movement of species in and out of the Antarctic region.

While the first hypothesis, faunal links on the continental shelves and "island hopping", was studied particularly during the recent LAMPOS cruise along the Scotia Arc but also during the EPOS and EASIZ "Polarstern" cruises, the second hypothesis, dealing with Antarctic deep-sea faunal characteristics and the role of the deep sea for faunal exchange, was the principal objective of the ANDEEP surveys. The IBMANT/ANDEEP Symposium and Workshop will provide a unique opportunity to discuss the rich data assembled during these and other (e.g., Spain's "Hespérides") expeditions in the light of these hypotheses.

Finally, the combined shelf + deep-sea approach may enhance our understanding of some important general issues in marine biology. The ANDEEP project will provide a wealth of new information on the scale and patterns of species diversity in the deep ocean, add to our knowledge of deep-sea species ranges and the relationship between local and regional diversity, and may ultimately lead to a better understanding of the origins of faunas inhabiting these remote regions. It has particular relevance to the controversial issue of global (latitudinal) diversity gradients, which have never been studied in the Southern Hemisphere deep ocean. Contrary to the traditional view that benthic diversity should decrease towards the poles, Magellan-Antarctic shelf samples rather point into the opposite direction. The LAMPOS samples will reveal the conditions in the Scotia Arc transition area, and the ANDEEP samples will provide a rich source material that can be used to test whether or not a latitudinal diversity gradient really exists in the Southern Hemisphere deep sea. A more precise and detailed description of latitudinal diversity trends may help to promote a better understanding of some fundamental controls on patterns of biodiversity in marine ecosystems over geological and ecological time scales.

Besides strengthening joint scientific work in the Southern Hemisphere and especially in the Cono Sur, the organising institutions hope to combine the traditionally separate fields of deep-sea and shelf biology to arrive at new conclusions on evolutionary processes that occurred between the remains of Gondwana as documented by biogeographic, biodiversity and other (e.g., ecophysiological) patterns. In this context the Antarctic-South America gradient is particularly interesting because the two continents separated a (geologically) relatively short time ago. It is also of special interest to the South American colleagues who are either doing Antarctic/Magellanic research or working on the same patterns further north towards lower latitudes. However, there is a great interest, too, in contributions of scientists from other continents that separated at an earlier time (Africa, Australia, New Zealand), and presentations that deal with latitudinal gradients in the Ross Sea. Beyond the direct interaction between Antarcica and its surroundings, which has been stressed in the ANDEEP and LAMPOS approaches, the event is expected to contribute to a better understanding of global biodiversity patterns in the Southern Hemisphere, large parts of which are still white areas in the maps of the biological oceanographers. Altogether, this context represents a singular case of ecosystem change and evolution on our planet, and a great challenge to research.

The call for papers to be presented during this Symposium, which will continue the approach initiated during the first IBMANT Symposium held in 1997 at the Magellan University, Punta Arenas (Chile), has met with considerable success. More than 100 contributions have been submitted for this meeting, authorship is truly international and often crosses country limits. Regionally the gradient from high Antarctic waters across the low and Subantarctic regions to cold-temperate areas is well considered, and presentations related to the deep sea contribute about a quarter of the total. Faunistics dominate, with a preponderance of benthic papers and biogeographic aspects, and some major taxa such as crustaceans are particularly well covered.

Important paradigms are challenged, and brand-new data are provided on formerly largely unknown areas as the deep sea. The impressive amount of information summarized in these extended Abstracts rises great expectations for a successful, interesting and most enjoyable conference.

Ushuaia, Argentina, October 2003 The organisers

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KEYNOTE PRESENTATIONS

The Antarctic-Magellan connection: Macrobenthic studies on the shelf and upper slope, a progress report

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Abstract

Work carried out on the Antarctic and Magellan shelves since the first IBMANT conference held at the UMAG, Punta Arenas in 1997 is summarized to identify areas where progress has been made and others where important gaps have remained in understanding past and present interaction between the Antarctic and the southern tip of South America. The information provided is complementary to similar progress reports dealing with the deep sea and refers principally to the international EASIZ and LAMPOS campaigns on RV „Polarstern". However, other relevant work is also included, much of which has been carried out in close cooperation with European and South American partners and – of course – by others e.g. within the EASIZ programme, who were not directly linked to German research initiatives.

Six years after the first IBMANT symposium we can identify a number of research topics where significant progress has been made, including

- latitudinal gradients in species distribution, zonation, biogeography and biodiversity
- new analytical and methodological approaches for comparative assessments of biodiversity
- latitudinal gradients in community structure and productivity
- latitudinal gradients in reproductive strategies, population dynamics, physiology and behaviour
- physiological tolerance related to mechanisms of adaptation
- susceptibility of living resources (decapods, scallops) to exploitation
- the role of natural disturbance and its significance for biodiversity
- pelagobenthic/benthopelagic coupling, trophic strategies and the trophic role of various major groups such as benthic suspension feeders, peracarid crustaceans, etc.
- trophic modelling using stable N isotope ratios
- new molecular results on peracarid radiation and extinction in the Antarctic
- the relative role of evolutionary and ecological factors in shaping present-day environmental conditions and species composition.

Particularly active research has been devoted to, e.g., amphipods, decapods, molluscs, cnidarians and macroalgae, and extensive samples have been collected (and are being analysed) of asteroids and polychaetes.

On the other hand, there still remain numerous gaps in our knowledge, some of which were already identified during the first IBMANT conference:

- the Scotia Arc is clearly undersampled, considering its potential significance as a transitory area between the high Antarctic and the Magellan region
- relations and interactions of the Antarctic with surrounding areas other than the Magellan region remain obscure; more „circumantarctic" species should be studied using molecular techniques

- major tectonic, oceanographic and climatological events that supposedly shaped Antarctic biotic evolution should be identified and related to the molecular genetic results
- further shallow areas should be sought in those high Antarctic regions where they are very scarce, to enable comparisons with shallow-water biota inside and outside the Antarctic and to elucidate their origin
- areas under permanent pack ice cover and areas recently disclosed by shelf ice calving should be studied and compared with polynya areas
- perturbation effects such as those from iceberg scour should be inflicted experimentally to enable verification of successional processes and their duration
- recolonisation experiments on soft and hard substrates should also provide data on the pace of succession and resilience
- further data on benthic invertebrate life cycles, reproductive strategies and physiological adaptations are badly needed
- meroplanktonic larvae, in particular, deserve greater attention in deeper shelf areas
- close cooperation between ecologists and physiologists, which has led to causal explanation of empirical finds, should be supported.

Similar to the finishing EASIZ programme, the upcoming SCAR programme EVOLANTA provides an excellent thematic background for the continuation of IBMANT research on the interaction between the Antarctic and other remnants of Gondwana. Furthermore, cooperation with ANDEEP may enable us to check those potential links via the deep sea, which have emerged from our research on the Antarctic and Magellan shelves.

Changing chain: past, present and predicted trends in Scotia Arc shallow benthic communities

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The Scotia Arc and Antarctic Peninsula have a dramatic geological, climatological and biological history. Amongst the strongest signals and fastest rates of air, land and fresh water climate change have been measured along this mountain chain connecting South America and Antarctica. It is a region where life experiences many extremes and contrasts: not least between the summer and winter, land and sea. Both experience an extreme light climate made more so by snow and ice coverage. Despite being the coldest environments of their type, land organisms in Antarctica may experience the greatest thermal ranges in nature whilst marine animals experience just 3°C. In summer the standing crop of algal blooms is as intense as anywhere on earth whilst in winter the water reaches unprecedented clarity as there is so little in it. The largest land animals are mites just a few mm long whilst the high oxygen content of the water has allowed isopods and amphipods to grow as big as an outstretched hand. Whilst few animal phyla or species are represented on land, phyletic richness and, in some groups, species richness rivals tropical regions. The isolation of Antarctica has lead to high levels of marine endemism, yet many of the terrestrial microbes and fungi may be cosmopolitan. One of the most important features shaping recent nearshore benthos is the intense summer disturbance from the greatest mean wind speed, wave height and ice-scour. This is contrasted by long periods of winter calm overlain by fast ice. Perhaps there is nowhere more appropriate to study the scales of change in time and space between Antarctica and the other southern continents than the only archipelago linking them.

I start with a model of Gondwana fragmentation with particular focus on Scotia Arc changes then look at characteristics of the physical environment today. Recent data on biodiversity across taxa is examined, coupled with smaller scale studies of encrusting benthos from

Falkland Is-South Georgia-Signy Is-Adelaide Is. Biogeographic links between South America and Antarctica are explored in an example taxa, the bryozoans. Few year-round studies of southern polar benthic recruitment have been carried out. Four of the only five have been at Signy Is., King George Is and Adelaide Is. and have shown low levels of colonisation and recruit diversity with respect to those at lower latitudes. Analysis of competition for space in encrusting communities suggests them to be structured in a highly hierarchical fashion. Without major disturbance a few dominant species could, therefore, come to monopolise space on hard surfaces.

Most shallow benthic fauna are sessile, sedentary or vagile – life in the slow lane. The rates of animal functions are much slower than temperate equivalents. Resting metabolic rates are low across southern polar taxa and seasonal factorial rises range from negligible to about 4. We know little yet about how metabolism might vary regionally. So stenothermal are elements of the benthos, that just a small temperature rise of 2-3 degrees is enough to prevent animals from performing critical activities. Thus higher critical temperature limits at which such animals expire may be unimportant; long before this they may become functionally incapable. This will inevitably lead to death through starvation or predation. Size of particles taken, duration and timing of feeding activity varies greatly - even within taxa. Some suspension feeders even attempt to feed all year round. Larger grazers, such as the limpet *Nacella concinna* and the echinoid *Sterechinus neumayeri*, are highly seasonal in both feeding activity and growth. With a few notable exceptions, growth of most polar invertebrates is slow but, at least in some taxa, may increase with increasing latitude inside the Southern Ocean. Growth rings on bivalves, brachiopods and bryozoans have illustrated seasonal and annual trends in growth as well as being receptors of environmental signals and they may yield more information with wider analyses.

Shipping, marine debris and other anthropogenic input into the Southern Ocean is increasing. With this and recent climate change the region seems to face an unprecedented threat from invasive species. Terrestrial angiosperms are booming on the Antarctic Peninsula and several insects have invaded recently. The Scotia Arc seems a good place to look for marine equivalents. The final theme is climate change and organism responses to regionalised warming and seasonally increased irradiation from UV light (mediated by decreased stratospheric deozonation) are discussed. I conclude with ideas for future science in the region and areas where our knowledge is lacking.

Interdisciplinary perspectives of ecosystem variability across the latitudinal gradient of Victoria Land, Antarctica

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Latitudinal gradients provide experimental frameworks for evaluating ecosystem responses to climate variations that otherwise would be recognized over time. In the western Ross Sea region of Antarctica, marine and terrestrial ecosystems extend from approximately 72°S to 86°S. Along this latitudinal gradient, three experimental zones have been identified based on ice extent as a controlling factor that influences the: energetics of coastal marine environments; water-vapor flux from the ocean to the land; and overall dynamics of coastal ecosystems (Fig. 1). Interdisciplinary research to assess this marine-terrestrial biocomplexity, as a global barometer of climate change, is being supported by the Italian, New Zealand and United States Antarctic Programs (Box 1). The purpose of this presentation is to assess the evolution, adaptations and deep-sea affinities of pectinid bivalve molluscs in coastal marine habitats along Victoria Land, particularly in relation to the hypothesis of 'polar emergence'.

Throughout most of the Cenozoic, pectinid bivalve genera (primarily *Chlamys*) inhabited Antarctic coastal environments as indicated by extensive deposits from the Eocene, Oligocene and Pliocene around the continent. Intact *Chlamys* specimens with paired valves were collected from Prospect Mesa in Wright Valley in the western McMurdo Sound Region. These Paleogene-Neogene pectinids had large (> 5 cm) thick shells that indicate that calcium carbonate precipitation was enhanced compared to subsequent cold-water pelecypods in the Southern Ocean, 70% of which are smaller than 1 cm today. The allometry of the *Chlamys* shells further indicates that these coastal species were bysally attached, which suggests that their thick shells also were adapted to high wave-energy habitats. Nonetheless, these large thick-shelled *Chlamys* species became extinct in the Southern Ocean during the Pliocene, apparently in conjunction with the spread and first appearance of their cold-water congeners in the mid-latitudes.

After the Pliocene, large wafer thin-shelled *Adamussium colbecki* emerged into coastal environments from the deep sea around Antarctica. In contrast to *Chlamys, Adamussium* is an highly mobile pectinid that thrives in quiet low-wave energy habitats that would have appeared in Antarctic coastal areas with increased sea-ice extent and persistence. This endemic monospecific genus originated during the Oligocene, as indicated by the CIROS drill core, and has been the only pectinid in Antarctic coastal areas during the Quaternary.

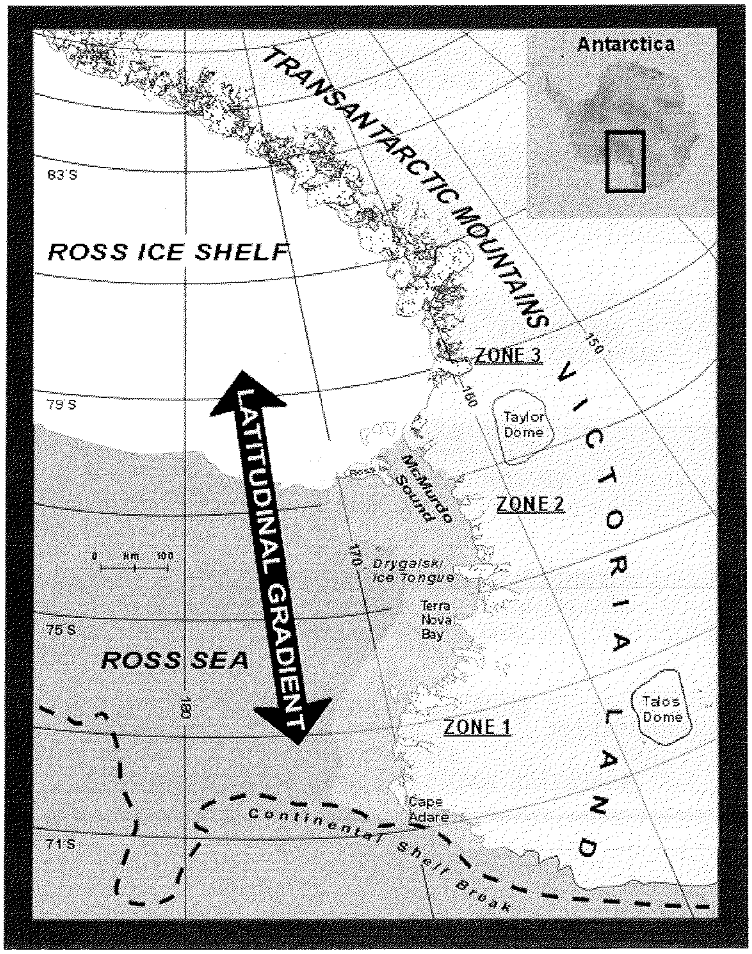
Toward the present, the latitudinal-gradient research program along Victoria Land is focusing on environmental events and ecosystem changes since the Last Glacial Maximum, when coastal habitats in the Ross Sea region became exposed after the ice sheet retreated. Occurrence of marine bivalves (primarily *Adamussium* and *Laternula elliptica*) in emerged beaches along Victoria Land, as well as other coastal regions around Antarctica, indicate that there was an environmental transition after 6000 years ago during the mid-Holocene warming period when the global climate system began stabilizing toward its present condition. Subsequent persistence of *Adamussium* populations along Victoria Land since the mid-Holocene is a reflection of their habitat stability. In an interdisciplinary context, mid-Holocene environmental and ecosystem changes along Victoria Land also are reflected by: (a) the Taylor Dome ice core transition identified in relation to methanesulfonic acid concentrations associated with sea-ice production; (b) percentages of the sea-ice diatom *Fragilariopsis curta* in Ross Sea sediment deposits; and (c) persistence of Adélie penguin (*Pygoscelis adeliae*) rookeries in the vicinity of the Drygalski Ice Tongue that would have been influenced by the Terra Nova Bay polynya and access to open water.

Today, species' responses to marine environmental variability across the latitudinal gradient of Victoria Land are reflected by the ecology of *Adamussium,* as the giant benthic mollusc (> 108 mm) of the Antarctic ice marine ecosystem. *Adamussium* shells precipitated in McMurdo Sound (which has maximum sea surface temperatures below 0°C) were significantly thinner and larger than those precipitated in Terra Nova Bay (which has maximum sea surface temperatures around 2°C). The stable carbon and oxygen isotope ratios of *Adamussium* shells also reflect significantly warmer seawater as well as enhanced coastal marine productivity in Terra Nova Bay than in McMurdo Sound.

In relation to their deep-sea origin, however, the most surprising result is the recovery of tagged Antarctic scallops that were alive after more than a decade. These animals, which were larger than 80 mm when they were released, grew less than 0.5 mm per year. Their nearly-century lifespan, which is an order of magnitude longer than previously interpreted based solely on shell growth-band analyses, demonstrates empirically that there is extreme longevity among nearshore marine invertebrates around Antarctica. Overall, the results for *Adamussium* reflect its adaptations and 'polar emergence' into cold, seasonally-dark, low wave-energy, stable coastal environments that lack primary production for significant periods like the analogous deep-sea habitats from which they evolved.

In conclusion, the Victoria Land latitudinal gradient provides a well-constrained experimental framework for assessing environmental coupling and climate-driven dynamics of marine and terrestrial ecosystems in a high-latitude region where water is at the transition between its liquid and solid phases. With nested variability across different time and space scales - records from Victoria Land can be used to address the legacy effects of past environments and ecosystems in relation to the distributions, abundances, adaptations and dynamics of extant biological assemblages in coastal marine habitats around Antarctica as well as in other southern-hemisphere regions.

Fig. 1. Along the latitudinal gradient of Victoria Land, Antarctica, it is hypothesized that the dynamics of marine and adjacent terrestrial ecosystems are influenced by ice extent (Box 1). In this region, the principal ecosystem zones from north to south are the: OPEN WATER ZONE-1 south of Cape Adare to the Drygalski Ice Tongue in the Terra Nova Bay region; FAST ICE ZONE-2 south of the Drygalski Ice Tongue to McMurdo Sound and the edge of the Ross Ice Shelf; and the ICE SHELF ZONE-3 south of the Ross Ice Shelf edge along the flanks of the Transantarctic Mountains to the southern-most terrestrial ecosystems on Earth.



BOX 1

INTERDISCIPLINARY RESEARCH ON LATITUDINAL ECOSYSTEM RESPONSES TO CLIMATE ACROSS VICTORIA LAND, ANTARCTICA

OVERARCHING CLIMATE HYPOTHESIS
CLIMATE-DRIVEN DIVERSITY OF PHYSICAL SYSTEMS
INFLUENCES THE STRUCTURE AND FUNCTION OF
BIOLOGICAL SYSTEMS ACROSS THE EARTH

↓

OVERARCHING HIGH-LATITUDE HYPOTHESIS
ICE-DRIVEN DYNAMICS CONTROL THE STRUCTURE
AND FUNCTION OF BIOLOGICAL SYSTEMS AT
HIGH LATITUDES

↓

RESEARCH FOCUS
ANTARCTIC ECOSYSTEM RESPONSES TO
CLIMATIC AND ENVIRONMENTAL VARIABILITY

↓

RESEARCH LOCALITY
LATITUDINAL GRADIENT
VICTORIA LAND, ANTARCTICA
(72°S - 86°S)

↓

PRINCIPAL ENVIRONMENTAL FORCING
MASS BALANCE OF MARINE, FRESHWATER
AND TERRESTRIAL ICE

↓

ECOSYSTEM RESPONSES
TERRESTRIAL ZONE COASTAL TRANSITION MARINE ZONE
← SPATIAL AND TEMPORAL LINKAGES →

Faunal patterns in the South Atlantic: the zooplankton

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To date, approximately 7000 marine zooplanktonic species have been described. When compared with other communities and habitats this is an extremely low number, and yet it is probable that this short inventory is nowhere near as far from completion as those achieved for most other organisms. Conservative estimates suggest that the proportion of species inhabiting our planet that has already been formally discovered is around 15%; in other words, of the ca. 10 million existing species only 1,500,000 have been described so far. Highest proportions are those for the most conspicuous plants and animals, like the chordates, where the fraction of known species climbs to ca. 50% of the expected total, whereas for the more obscure and less "appealing" ones, like the fungi, its is below 5%. Analysis of the species description rates thoughout time in various groups, among other indirect evidence, supports the notion that in this respect marine zooplankton stands closer to the conspicuous vertebrates, than to the fungi: the species so far described are probably a very sizable proportion of the total (>50%). Admittedly, application of molecular techniques will help identify independent taxa in many "species groups" and cryptic species, enlarging the present inventories; yet, on the other hand, traditional morphology-based approaches have created large numbers of synonyms, whose detection will bring the final count down. So far, in the South Atlantic 2500 of these 7000 worldwide species have been recorded (around 36%). However, the fact that highest proportions of World Ocean species present in the South Atlantic occur in the less diversified groups, as well as in those better researched locally, and because specific zooplanktonic inventories differ little across oceanic basins, it is anticipated that the South Atlantic hosts at least 50-60% of the species present worldwide. For half of the species recorded in the South Atlantic (ca. 1300) horizontal distributional information is sufficient for drawing a general idea of their basin-wide patterns. These patterns allow the boundaries of the 5 major biogeographic areas in the pelagic realm to be defined: Tropical, Subtropical, Transitional, Subantarctic and Antarctic; the limits in question are also supported by functional attributes of the systems defined, such as mixed layer depth, primary production levels, etc. Analysis of the occurrence of the species in these 5 areas shows that most distribution ranges are broad and species restricted to any one of the biogeographic divisions are few (only 10% of the 1300 taxa surveyed). Proportions of warmwater species (Tropical and/or Subtropical) in the overall inventories of each animal group covered are rather similar (65-95%), but those of coldwater taxa differ from 14% (Euphausiacea) to 67% (Appendicularia). Boundaries between areas are very permeable and proportions of taxa shared between areas are high (60-85%). The Tropical/Subtropical limit is the most leaky and quite diffuse in space. The Transition Zone, which can be considered as either a biogeographic area or a boundary, is the strongest major barrier present which separates the warmwater fauna from the coldwater one (only 20% of the 1300 species surveyed seem able to succesfully survive on both sides). The Subantarctic/Antarctic limit is better circumscribed horizontally but also quite leaky. These boundaries define major systems of cooccurring organisms that have been in contact with each other since at least the Miocene (ca. 20 my) and are therefore coadapted. Except for the Transition, recirculation mechanisms are known in these areas which facilitate maintenance of the geographic ranges of its inhabitants. No such mechanisms are known for the Transition; its populations are thought to be occasional cohabitants en route to expatriation and extinction, and are therefore not coadapted. Latitudinal occurrence of species distribution breaks (that is, species that start or end their range at a given latitude) confirm the above conclusions: highest numbers of breaks occur around 30-40°S, in the Transition. A second peak is located right next to the Polar Front, and the third one separates Tropical from Subtropical faunas. Comparison of the marine planktonic open-ocean domain with other domains (benthic, terrestrial, freshwater, etc.) points at several important differences. In the former biogeographic provinces are much fewer in number and large in size, internally more homogeneous, host far fewer species, and the boundaries between areas are often more diffuse, leaky, and less stable seasonally. In the marine planktonic open-ocean domain species restricted to one single province are very few and highest diversities occur in the Transition (rather than in the Equatorial belt, like in most terrestrial and freshwater systems). Abiotic conditions in the marine pelagic are much stabler and more predictable, physical settings varying within narrower limits.

Temperature, depth and glaciation: the origins of the modern Antarctic marine fauna

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The benthic marine fauna of Antarctica is generally diverse, but this diversity is not spread evenly across all taxa. Some groups are very low in diversity compared with lower latitude seas; these include neoselachian and teleost fishes, decapods, bivalves and gastropods. In contrast pycnogonids, amphipods and isopods all contain lineages which appear to have radiated. Two striking features of the Southern Ocean benthos are the importance of suspension feeding groups, and the lack of predatory groups typical of other seas. Our rapidly improving knowledge of the tectonic, climatic and glacial history of the Southern Ocean prompts questions concerning which groups have become extinct in the Cenozoic, and what might be the cause. Unfortunately the fossil record of shallow water marine invertebrates is poor in Antarctica, and there are gaps at many of the vital times. Nevertheless it is clear that many of the groups that are currently absent from the continental shelves of Antarctica were previously present, but it is not clear what were the factors that drove these to extinction. Cooling of the seas driven by oceanography and glaciation may be implicated in some cases, but the cause of others remains obscure. The modern fauna shows many signs of a relatively recent diversification, and modern molecular techniques allow us to pose testable hypotheses. One important area that remains unresolved is the role of orbital variability in driving environmental changes on time scales that could influence evolution. At present we remain ignorant of the relative importance of temperature, depth, glaciation and predation in shaping the modern fauna. These are important areas for future work, and the relationship between the Magellan and Antarctic Peninsula faunas in shallow water, and between the continental shelf and deep water faunas of Antarctica in general, will be critical to understanding the evolutionary history of Antarctica.

Biological and geological processes structuring surface sediments in the Scotia and Weddell Seas

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Sediment surface and sediment profile imaging were used to characterize the benthic boundary layer and surface sediments from the sediment-water-interface (SWI) down to 20-30 cm. The factors structuring surface sediments in the Scotia (160 to 5200m) and Weddell (770 to 6340m) Seas were found to be a combination of physical and biological processes. Bottom types ranged from boulder and rock at 1770m on the Shackleton Fracture Zone to hemipelagite clays at 4760m on the north Weddell Abyssal Plain. While geology and physical processes that delivered sediment to the bottom were the primary factors dictating substrate characteristics, biological processes were to varying degrees important in structuring the SWI and sediment fabric. There were gradients between the level of bioturbation and type of biogenic structure present with depth. At shallower depth, biogenic structures were more diverse but dominated at <50% of stations <1000m. At depths >1000m, biological processes were overall less diverse but dominated at >75% of stations with bioturbation being the major form of biological activity. The range of bottom types and dominant processes will be detailed and explained using still images and video clips.

Muscle growth in Antarctic and sub-Antarctic Notothenioid fishes

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The suborder Notothenioidei dominates the fish fauna of the continental shelf of the Southern Ocean. It comprises about 125 species divided into 8 families, with members of 6 of the families living outside Antarctic waters. The ancestral form of the Notothenioids is generally considered to have been a small temperate bottom-living species without a swim bladder. Morphological and molecular based phylogenies have been built in order to understand the impressive radiation the suborder accomplished in the last 10-15 Ma. Some of the families, especially Notothenidae, are likely paraphyletic and the phylogenetic tree of the suborder cannot be resolved at different levels. Nevertheless, the more basal families (Bovichthydae, Pseudaphritydae and Eleginopidae) and the more derived ones (Chanychthydae and Harpagiferidae) have a well-established position in the tree.

The axial muscle of the Notothenioids is unusual in containing low muscle fiber numbers and very large diameter muscle fibers in comparison to other teleosts. Fiber numbers differ significantly between species that belong to the more basal and the most derived families, suggesting a decreasing trend in fiber numbers during the evolution of the suborder. Moreover, the decrease in the number of fibers correlates with an increase in the diameter of the fibers. On the other hand, there is no evident relationship between the geographical zone and the maximum fiber diameter of the species. It seems therefore, that the special traits of the muscle of Notothenioids have a phylogenetical origin. Since muscle growth in teleosts involves the recruitment of new fibers (hyperplasia) and the increase in size of existing ones (hypertrophy), and the two processes are regulated through the activity of myosatellite cells, these two traits in the evolution of the suborder could be regulated through a single mechanism. Post-embryonic muscle growth involves two different stages, usually called stratified and mosaic hyperplasia. The latter is absent in all the species of the more derived families already studied, giving a clue about how muscle fiber number is regulated. Some insights on the regulation of hyperplasia and hypertrophy have been gained in other organisms and will be discussed in relation to further studies on the muscle characteristics of Notothenioids.

Biodiversity pattern in deep-sea benthic macrofauna: the importance of the Antarctic in understanding large-scale patterns

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Pattern in the diversity of deep-sea organisms are the result of historical evolutionary and modern ecological processes. These patterns are far from well understood and there is still controversy on basic issues such as whether the deep sea has a higher or lower diversity than coastal systems, let alone the theoretical explanations of such presumed patterns. Studies over the past two decades have focused on small-scale processes in order to try to test whether equilibrium processes such as niche specialisation and habitat structuring which assume a saturated occupation of habitat, or non-equilibrium processes such as intermediate disturbance and patch dynamics, are important in determining high species richness in deep-sea sediments. Results have been generally inconclusive, and the importance of small-scale habitat variability and patch disturbance has been demonstrated for only a small subset of, probably opportunistic, species. Deep-sea biologists are now looking to pattern expressed at the regional to global scales together with new palaeooceanographic data to help understand how biodiversity pattern is related to both spatial and historical environmental vairability. However, analysis of available data at ocean basin to whole-ocean scales is not easy, and like any data on the smaller-bodied animals of the deep-sea bed, any interpretation carries high levels of uncertainty. This results from limitations in sampling methodology, lack of statistical replication, severe defficiencies in taxonomic knowledge and very uneven geographic coverage. Some of these problems are slowly being overcome but in general what is available are data sets showing high variability which make it difficult for the investigator to detect real pattern in a sea of noise. But one the most serious problems is the sparseness of deep-sea data from the Southern Hemisphere, particularly the deep Southern Ocean. Until the recent ANDEEP expeditions on F/S *Polarstern* the Antarctic deep sea has consituted perhaps the major desert of uncertainty in a still sparsely populated landscape of knowledge on deep-sea benthic biology.

How can an increased knowledge of the benthic biological biodiversity from the Antarctic deep-sea basins contribute to deficiencies in our present knowledge?

One area of recent interest which has generated most controvery in our understanding of deep-sea benthic biodiversity is the discovery by Rex of what appear to be latitudinal species diversity gradients (LSDGs) in isopods, bivalves and gastropods in the Atlantic bathyal (500-4000 m). Such LSDGs are best known on land where it is thought they may be linked to ecological and evolutionary processes influenced by solar insolation. Similar LSDGs may exist in the seas, but particularly in the shallow sea benthos are contradictory and not well understood. This is in part the consequence of impact of other biodiversity pattern, such as that related to depth. In the deep ocean our understanding of the causation of such regional-scale patterns in benthic biodiversity is particularly problematic because of remoteness from the solar-driven processes at the surface. New data from a very large collection of 225 species of the percarid crustacean group Cumacea seem to contradict the classical terrestrial latitudinal pattern which is seen in isopods and gastropods, but may be similar to that in the bivalves and the meiofaunal Nematoda. But the data do not support the idea of structuring by a single set of solar-linked processes in the terrestrial sense, but rather that a variety of patterns operate. However, one single factor seems to be common to all, the expression of much reduced species richness in the isolated deep basins of the Arctic Northern Seas. This clearly seems to be the result of relatively recent extinctions caused by Quarternary glaciation and the massive Storegga slide with the present-day deep Arctic representing a community in an immature stage of recolonisation and in-place speciation. The extent to which this influences major taxon-level biodiversity is variable, yet sufficient to confound expression of latitudinal pattern caused by any other mechanism.

Only one taxon, the Foraminifera, demonstrates a similar trend in the South Atlantic, but lack of clear expression of a similar pattern among macrobenthos may not simply be the result of lack of data. If indications from preliminary results from ANDEEP and extrapolation from biodiversity from Antarctic shallow water are correct in pointing towards a highly diverse community with a long and ancient colonisation history then extant communities seen today are the product of a substantial and complex historical legacy. However, the benthic faunas of the Antarctic continental shelf may provide a dangerous basis for speculation. The long geological and hydrographic isolation, and persistent cold climate and high but intensely seasonal primary production experienced on the shelf may have encouraged development of some of their more unusual features such as extraordinarily high endemism, gigantism and slow rates of individual growth. The ANDEEP expeditions have recognised that this Antarctic diversity pump on the continental shelf that has generated high rates of in-place speciation may not be assumed also to operate in the contiguous deep sea basins of, for example, the Scotia and Weddell Seas. This is because, unlike the Arctic Northern Seas, the open confluence of the Antarctic deep sea with the three other major oceans means that these deep basins are in a state of evolutionary interaction with the global deep-sea benthic community.

Unlike the Atlantic Northern Seas, the lack of thermal structure may have encouraged colonisation into the deep-sea basins from the adjacent shelf, but many species probably have evolved in-place. These species may be the source of a substantial proportion of the modern-day deep-sea fauna. But to what extent has the Antarctic deep sea also absorbed a large number of lineages evolved elsewhere as well? Preliminary results of Brandt from Isopoda suggest radiation of deep-sea species from the Antarctic into the other ocean basins and that northwards colonisation of the Atlantic may be assisted by northwards spread of deep-water formed in the Southern Ocean. Deep thermohaline current systems as carrier mechanisms may be of particular importance in the Atlantic which is more laterally restricted, and likened to a peninsular, compared to the Pacific and Indian Ocean deep-sea areas and has an impoverished end-member in the Arctic Northern Seas. The isopods have so far provided the bulk of available data to explore this hypothesis. But in the Atlantic available data seem to suggest that a variety of large-scale biodiversity patterns exist for the different taxa so far investigated. This indicates that different processes are at work at both the ecological and evolutionary time scales. Some of the most likely of these are briefly discussed in the context of results from the Cumacea – another important peracarid taxon for which extensive data have become available for study.

Deep-water sedimentary environments of the northwestern Weddell Sea and South Sandwich Trench, Antarctica

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Two transects have been sampled using short cores (multi & box), seabed photography, video sequences and sediment profile images across the northwestern Weddell Sea and South Sandwich Trench, Antarctica. The most southerly (Weddell) transect extends from the northwestern Weddell continental slope and across the abyssal plain to the fracture zone 1100 m – 4500 m, (66°S 50° W – 60°S 27°W) and contained eight stations. The second extends across the western slope of the South Sandwich Trench, east of Montague Island from 2200 m – 6300 m, (60°S 25°W – 58°S 20°W) and contained four stations. All the core stations were examined for sediment structure, texture and composition to determine their depositional history. The three stations on the northwestern Weddell Continental Slope (1166-3055m) recovered glacial hemipelagites and contourites, the four stations on the Weddell Abyssal Plain (4060-4975m) recovered hemipelagites and the four stations from the South Sandwich Trench (2292-6326m) recovered turbiditic and pelagic sediments. Four of the core stations from the Weddell Continental Slope, Abyssal Plain and South Sandwich Trench were further examined for trace metal analysis (Ba, U, Mn and Pb) for sediment source and palaeoproductivity and ^{210}Pb for age profiles and depth of mixing by bioturbation. Station 131 situated in 3055m water depth at the base of the Weddell Continental Slope, recovered a 0.40m core which displayed laminated muddy-silty contourites with a thin (0.16 m) surface layer of hemipelagites with abundant ice rafted debris. This is interpreted as a medium energy depositional environment influenced by Weddell Sea Bottom Water alongslope current, reworking sediment. Sediment sources in this station include the direct input of clastic material from ice with variation in sediment sources from in situ current winnowing and alongslope transport reflected in the Mn/Li & Ba/Li ratios. Station 136 situation in 4760m water depth on the Weddell Abyssal Plain recovered 0.35m of core interpreted as hemipelagites. This is interpreted as a low energy depositional environment with sediment supplied both from direct ice rafting and pelagic settling during productive seasonal ice-free periods. The ^{210}Pb content and $^{206/207}$ Pb isotope ratios support this with a sediment source from sea ice. Station 141 is 2292m and recovered a 0.22 m box core and station 142 recovered a 0.19m multicore from 6326m of water from the floor of the South Sandwich Trench. The sediments in these regions are interpreted as predominantly pelagic and turbiditic in origin. This is interpreted as a high energy downslope depositional environment with high surface biogenic productivity and sediment supply leading to localised downslope mass-movements on the trench slope and floor. High levels of Mn/Li and elevated U/Li demonstrate strong concentration of Mn in organic-poor sediment. The Mn redoxcline is present at 10 cm depth. The high Ba/Li (500 ppm) in the trench floor core reflects some limited enhanced productivity. Sediment sources for the trench sediments may in part be derived from the northwest Weddell Abyssal Plain based on the $^{206/207}$ Pb isotope ratio data.

Reproduction in cold water: Paradigm changes in the 20th century

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Expeditions in the latter half of the 19th century revealed a wealth of animal life in polar and deep seas, stimulating questions about life in extreme cold marine environments. Several generalizations proposed during the early part of the 20th century dominated thinking about invertebrate reproduction—until tested during the second half of the century (as these environments became more accessible, and knowledge improved about oceanographic and tectonic history). Our goal in this paper is to review how earlier paradigms are being replaced as the 21st century begins. The past decade, in particular, has provided major insights into the reproduction of Antarctic invertebrates, and we will pay particular attention to developments since Pearse, McClintock, and Bosch published their review in 1991 (American Zoologist 31:65-80).

Early paradigms about reproduction in cold-water environments were based on work done in northern Europe. Correlations of the markedly seasonal temperature with the timing of gametogenesis and spawning led to a causative relationship ("Orton's rule"), with the corollary that where temperature remains constant, reproduction should continue year-around. Yet studies in the second half of the century revealed many polar and deep-sea species with well-defined seasonal reproductive periods. Such reproductive seasonality is not surprising; the markedly seasonal regimes of light and productivity in polar environments should select for reproduction during favorable times of the year. Effects of seasonality in surface waters also penetrate to the deep sea. Recently, photoperiod has been shown to provide the proximate cue for timing gametogenesis in one of the most abundant species in shallow Antarctic waters, the asteroid *Odontaster validus*, and is likely of general importance, perhaps even in the deep sea through entrainment of pelagic larvae.

Parental care of the young ("brooding") by echinoderms was first noted in the Antarctic during the Challenger Expedition in the 19th century. By the early 20th century this unusual reproductive mode was assumed to be characteristic of polar marine invertebrates. That assumption was extended to other groups, in both polar and deep seas, and became known as "Thorson's rule." Explanations centered on present-day conditions in these environments, such as the brief pulses of food (phytoplankton) available to pelagic larvae. However, many or most polar and deep-sea species are now known to have pelagic larvae. Most of these larvae are lecithotrophic, but some of the most abundant species, such as *Odontaster validus* and the echinoid *Sterechinus neumayeri,* have planktotrophic larvae.

Poulin and Féral (1996. Evolution 50:820-830) provide a persuasive explanation for the predominance of species with lecithotrophic pelagic larvae in Antarctic waters. They propose that during glacial maxima in the Pleistocene, phytoplankton productivity was dramatically reduced, resulting in many species with planktotrophic larvae going extinct, while those with lecithotrophic larvae survived. The same ecological factor, lack of food, may select for lecithotrophic larvae in the deep sea. How the relatively few species with planktotrophic larvae thrive today remains unclear; recent work indicates that they have extremely efficient metabolic systems requiring little energy.

Nevertheless, some relatively speciose clades in shallow Antarctic waters lack pelagic larvae completely, e.g., most echinoids and forcipulate asteroids. Pearse and Bosch (1994, In: Echinoderms Through Time, pp. 27-43, David et al., eds.) proposed that the strong unidirectional current, in place since the Antarctic continent separated from South America, separates reproductive individuals from parental populations, resulting in repeated speciation events. Phylogenetic analyses now being done on cidaroids will test this hypothesis. Brooding probably evolved only a few times during much warmer conditions, perhaps not in the Antarctic at all, and the unique current conditions over the past 20-30 million years may have generated the numerous brooding species that caught the attention of 19th century biologists.

Reproductive strategies, environment and latitude in invertebrates; evolution trends and biogeographic relationships in the South American tip and Antarctica

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Although it is not clear when the Magellan and Antarctic Provinces differentiated, there is some consensus that their respective benthic faunas differ considerably. However, similar trends can be observed in the reproductive modes of several invertebrate groups as latitude increases. In this case, we discuss the evidence given by Caenogastropoda. Comparing the frequency of occurrence of caenogastropod hatching modes along the latitudinal gradient from the South West Atlantic to the Southern Ocean, there is a remarkable scarcity of pelagic development. This is interpreted as reflecting the effect of near-continuous soft-bottom habitat of the South American Atlantic shelf on the prevalence of predaceous, soft bottom species with non-pelagic patterns of development. Despite the lack of sufficient available data, no substantial differences are observed between the reproductive mode of caenogastropods from the Southern Ocean and that from the South American Atlantic. Such findings contrast greatly with the South American pacific fauna, in which benthic, direct, non-pelagic development predominates as latitude increases. A discussion is given on the validity of the so-called Thorson´s rule in the South and on how factors other than latitude, such as habitat and phyletic constraints, should also be taken into account.

Phylogenetic and biogeographic relationships between the deep-sea faunas of two Gondwanan continents, Australia and Antarctica

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Australia and Antarctica have little in common today but this was not always so. When still connected as part of the super-continent Gondwana their climates and biota are assumed to have been similar. This paper reviews the geological history of the two continents, and the impacts this history has had on the distribution and biogeography of their terrestrial floras and faunas. I ask whether these discoveries and conclusions are applicable to marine environments, shallow shore and shelf, continental slope, and to abyssal faunas.

The evidence that the break-up of Gondwana influenced present-day distributions of terrestrial plants and animals is strong, derived from taxa such as southern beech, *Nothofagus*, ratite birds, passerine birds and the freshwater fish genus, *Galaxias*. Vicariance is only part of the explanation of present distributions. While there is only one true history of the continents, cladograms of relatedness of different taxa are not always coincident and transoceanic dispersal must be considered. The collision of Australia with south-east Asia allowed interchange of floras and faunas resulting in conflicting biogeographic patterns.

Gondwanan influence is evident too in some shallow marine taxa. But patterns are not meaningful, if the areas being compared are not homogeneous as is the case for Australia and Antarctica.

The Australian coast comprises two overlapping regions: the tropical north with water temperatures varying between 18° and 30°C; and the temperate south with temperatures in the range 11°–22°C. The northern fauna is part of the large Indo-West Pacific realm; the southern fauna is largely endemic. Turnover of species along the 3000-km-long southern coast is rapid, with only 17% of species in the west being found in the east. Antarctica may not be as uniform as some distributions suggest.

Australia shares very few, if any, species with the shelf of Antarctica. Some polychaetes are said to be shared but this could be doubtful. On the basis of polychaetes and other taxa, Antarctica and Australia are only remotely related, Australia and New Zealand are more so in spite of their much earlier geological divergence time.

Relationships can be sought by examining phylogenies. Serolid isopods are a group that was widespread on the Gondwana shelf before the separation of Australia, Antarctica and South America. Basal taxa in Australia exist in the tropics. Penetration into the deep sea from Antarctica has occurred more than once and rarely reaches the Northern Hemisphere. Such interpretations depend on a sound phylogeny.

Information about the Australian deep sea is scant. The continental slope and abyssal depths need to be discussed separately. Faunas at depths >200 m and certainly >400 m have a large abyssal component at the family level but the slope is geologically part of the continental mass and its fauna might be expected to behave like they do.

Slope fishes in the range 20°–35°S comprise many more species than in better sampled comparative areas. This is attributed to the overlap of rich independently-derived tropical and temperate faunas, as for shallow faunas. The most southern component of this fauna is part of a fauna that extends across longitudinal 65° of southern Australia and New Zealand.

Similarly, isopod crustaceans of the south-eastern slope are exceptionally rich. No species is in common with New Zealand or Antarctica. One family, Austrarcturellidae is endemic to Australia-New Zealand and locally speciose.

Three case studies that impinge on Antarctica use samples from slope and seamounts in Australia and New Zealand and around Macquarie Island:

1. *Acutiserolis* is an Antarctic serolid genus, now recognised as seven species in the Tasman Sea and eastern New Zealand, all different from Antarctic *A. bromleyana.*
2. Deep-water decapod crustacean families (Lithodidae, Parapaguridae, Pylochelidae, Parapaguridae, Galatheidae) contain species the same as or close to others from the Indo-West Pacific and disappear south of Australia. Their Gondwanan similarities are slight.
3. Subantarctic Macquarie Island supports 50 species of echinoderms that arrived by epiplanktonic dispersal from Kerguelen, and benthic migration along ridges from New Zealand and Antarctica.

It is concluded that:

1. affinities of deep sea faunas are only in a small part influenced by vicariant processes;
2. Australia may not be the place to look for simple relationships between cold water faunas; and
3. future success will depend on accurate taxonomies and phylogenies.

Physiological constraints involved in setting limits to biogeography and biodiversity?

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In linking molecular biology with ecology as well as evolutionary biology, functional, i.e. physiological analyses become increasingly important for an integrative understanding of life on earth and the patterns of evolution and ecology. This task is challenging especially at the highest levels of functional complexity found, in animals and plants. Integrative physiology, combined with molecular approaches, is expected to come to a deeper understanding of the evolution of molecular, cellular and organismic functions and the genetic basis of adaptability. By identifying the tradeoffs and constraints involved in environmental adaptation the principle reasons become accessible that limit each species to specific habitats. Such an approach will also give access to the mechanistic bases of organismic responses to environmental alterations, including climate change.

Accordingly, physiological studies at molecular, cellular and organismic levels should aim to clarify the mechanistic basis of bio-geographical patterns on large scales, i.e. in a latitudinal cline, or on small scales, e.g. within the intertidal zone, as they are determined by the temperature regime and its interaction with other abiotic factors, like water currents and oxygen levels, or salinity changes in the marine realm. Focusing on the effects of climate change on marine ecosystems, some key mechanisms as well as some constraints and tradeoffs involved in thermal adaptation and the setting of tolerance windows of ectothermic animals have recently been identified. This basic knowledge needs to be extended and tested in various environments. Ecological and physiological findings need to be integrated and the genetic basis of adaptability need to be defined.

The adjustments of mitochondrial densities and their functional properties on the one side, and of energy consuming processes like ventilation and circulation, mitochondrial maintenance, ion regulation or defence mechanisms on the other side, appear equally critical in setting thermal tolerance windows relevant at the ecological level. As the number of functional macromolecules far exceeds the number of genes, consideration of phenotypic plasticity is most important in the development of a comprehensive picture.

It has also become evident that the tradeoffs involved in the shift and the changing widths of thermal tolerance windows have important bio-energetic implications and thus further consequences at the level of the ecosystem. Energy budgets are modified with consequences for growth, reproductive output and, last but not least, the capacity for motor performance. The resulting constraints will characterize all species of an ecosystem, defining the limits of performance and productivity. In this context, an integrated view of gene functions at various complexity levels up to the whole organism is required for an identification of mechanistic links between environment, evolutionary history and the organism's survival and success. The combined view of genetic and environmental influences will allow understanding of the functional ranges covered by each phenotype as it develops through its ontogenetic history starting with the gametes and their fertilization. Considering the functional consequences of genetic diversity among populations may even contribute to an understanding of the mechanistic basis of biodiversity through the physiological features of the individual organisms and species involved.

Examples discussed will include the physiological reasons for the exclusion of most reptant decapod crustaceans from the Antarctic, the role of temperature stability in setting metabolic rate as well as the tradeoffs involved in setting energy turnover and the fractioning of energy availability into various molecular to systemic functions. Marine systems studied on macro-scales include European coastal waters from the North Sea to the Arctic, but also the latitudinal cline from South America to the Antarctic. Clines studied on smaller scales include the shaping of intertidal zones at various latitudes with different thermal regimes. Overall, the cause and effect understanding expected from an interdisciplinary blend of physiology, ecology, molecular biology and evolutionary biology will finally support a mechanistic, comprehensive understanding of ecosystem dynamics and characteristics like biodiversity and biogeography.

Living without frontiers: Marine top predators as travellers between different environments

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Land-based marine predators in the Southern Ocean are often confined to a limited number of breeding sites. However, despite constraints during parts of the breeding season, most make lengthy journeys away from these sites. Commuting distances during the breeding season, and (especially interbreeding) migrations can be very large. Their capacity to travel enables these species to cross distant oceanographic boundaries and to exploit diverse oceanographic habitats. The extent of their movements depends on a number of factors including season, breeding stage, gender etc. We illustrate this with various examples from the group of marine mammals and seabirds that inhabit the southwest Atlantic, particularly the waters south of the Antarctic Polar Front and the waters of the Patagonian Shelf. We include King penguins *Aptenodytes patagonicus* from the Falkland Islands, Rockhopper penguins *Eudyptes chrysocome* from Isla de los Estados, Argentina, Wandering albatrosses *Diomedea exulans*, Giant petrels *(Macronectes spp.)* and Antarctic fur seals *Arctocephalus gazella* from South Georgia.

The role of zooplankton in the pelago-benthic coupling

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The complex interactions between the pelagic and the benthic systems (pelago-benthic coupling) are related to the hydrographical and biological properties, and in polar seas also to the ice environment. Zooplankton organisms play a major role as they contribute in many ways to the pelago-benthic coupling (Fig. 1).

1. The phytoplankton leaves the surface primarily as sinking faecal pellets or as large aggregates. Hence, the faecal pellets of zooplankton are a major route of energy flow from the pelagial to the benthal, and a strong correlation between benthic biomass and pelagic productivity has been shown for different oceans of the world. Also, carcass and exuvia sinking to the sea bed contribute to the energy flow.
2. Many holoplankton organisms perform diel and ontogenetic migrations covering the whole water column, and hence connecting sea surface and sea bottom. Due to the downward migration, these species may come close to the sediment and provide a food source for benthic invertebrates.
3. Benthic organisms often reproduce via planktonic larvae (meroplankton) which contribute seasonally at high abundances to the zooplankton community.

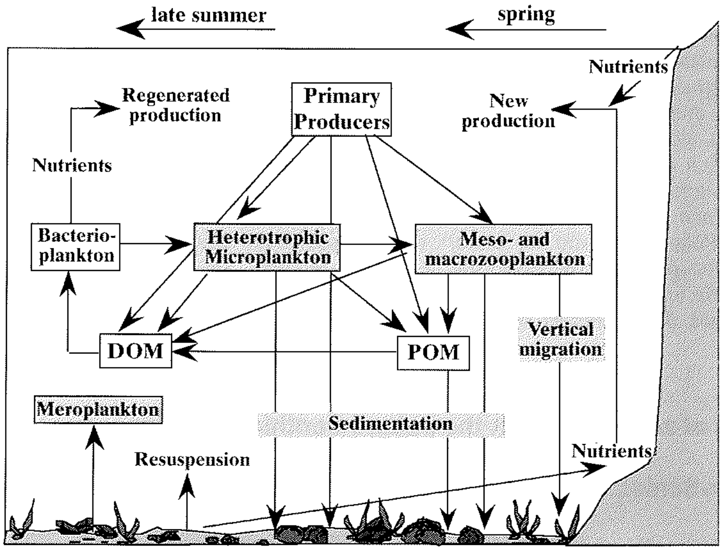

Fig. 1. Food web and pelago-benthic coupling (modified after Antezana 1999). Zooplankton elements are marked with grey.

Recently, sedimentation processes in the Antarctic have received considerable attention. In this area, the period of high productivity in the water column is short, and hence particle flux is characterized by high seasonality. The role of sea ice for the benthos may have been underestimated in the past and flux studies underneath the ice are rare. The number of organisms living in the pack ice may exceed that in the water column by several orders of magnitude, and ice algae blooms increase the biomass in the sea ice considerably before primary production begins in the open water. Detrital fallout, particularly during melting processes at the receding ice edge, may be a strong food pulse to the benthos.

In the Antarctic spring particulate matter beeing transported from the surface in deeper waters consists mainly of material of phytoplanktonic origin, and high fluxes are linked to the presence of marginal ice or to post-bloom conditions. During this time of the year, material of zooplankton origin is seldom found in sediment traps which probably mirrors the low density of zooplankton near the surface. In summer, faeces of zooplankton organisms seems to be the major vertical transportation of particulate organic matter through the water column and finally to the sea floor. It became evident that especially faeces of euphausiids and salps are important in summer, the time of their highest abundance in the surface layer, e.g. local mass sedimentation of faecal strings of *Euphausia superba* has been observed during grazing of a krill swarm. In the absence of krill swarms the relative role of small faeces, probably of protozoan origin, increases. In winter, vertical sedimentation of particles is extremely low and lateral advection and resuspension may contribute substantially to improving food conditions during times of low pelagic productivity.

Much of the sedimented material seems to be utilized immediately by the large stocks of epibenthic suspension feeders found along the Antarctic coastline. However, deposit phytodetritus on the shelves of the Weddell and Lazarev Seas indicates heavy sedimentation of phytoplankton largely unutilized by the benthos.

Meroplanktonic larvae, which contribute to pelago-benthic coupling in many other ecosystems, are not common in Antarctic waters. However, recently pelagic larvae of benthic species have been identified increasing the number of known species with pelagic development.

Our current knowledge of pelago-benthic coupling in the Magellan region is extremely limited. Up to now there are only a few references to particle flux in the Magellan region. Swarming of an euphausiid species, *E. vallentini* also occurs in the Magellan region, and it is likely that the sinking of their faecal strings will contribute substantially to the vertical flux in this area. As mentioned for the Antarctic, greenish mats frequently covered the sea floor also in the Magellan region indicating that not all the sedimented matrial is utilized by the benthos.

In contrast to the Antarctic, high abundances of invertebrate larvae in the zooplankton occur in the Magellan region, during spring and hence, spawning is coincidental with seasonal plankton blooms which implies a strong pelago-benthic coupling.

The role of zooplankton within the processes of pelago-benthic coupling is not yet fully understood. The identification of faecal pellet material is still problematic, and should be improved to evaluate the contribution of dominant micro-, meso- and macrozooplankton taxa to the coupling. General studies on all aspects of the pelago-benthic coupling during different seasons are required for the Magellan area. In the Antarctic, more detailed sedimentation experiments have to be conducted underneath different sea ice types (pack, fast, platelets) as well as underneath permanent ice cover.

The geological history of the Scotia Sea region and some biological implications – a discussion

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Although the idea of a previous physical land link between southern South America and the Antarctic Peninsula was first suggested in the nineteenth century, it was not until the latter part of the twentieth century and the advent of the theory of plate tectonics that technical reconstructions became feasible. Nevertheless, despite the availability of the powerful tools of the plate tectonic theory and the development of geophysical methods to image crustal structure and measure crustal processes, even today there is much debate as to the precise reconstruction of the link and the history of its break-up.

Proposed reconstructions of an Antarctic-Andean link have varied from earlier linear reassemblies of the continental fragments within the present Scotia arc to more recent ones involving either the juxtaposition of northern Antarctic Peninsula and south-eastern Chile, or a cusp-shaped reassembly of continental fragments with an eastward directed indentation in the area of the present-day Scotia Sea. It should also be noted that some, otherwise apparently satisfactory reconstructions of the Gondwana supercontinent as a whole resulted in continental overlap between the Antarctic Peninsula and some part of the southern South America-Falkland Islands/Malvinas region. This clearly unacceptable result was eliminated with the concept of a West Antarctica decoupled from East Antarctica and composed of several crustal blocks, each with its own movement history.

Whilst the precise form of the land connection may never be known, what is perhaps more important for our understanding of the distribution of both land and marine organisms is the previous existence of that connection in the first place. However, in the present context of possible relationships and differences between the marine faunas of the Magellan and Antarctic Peninsula regions, understanding the timing and the history of break-up of the connection, with its oceanographic and climatic consequences, is likely to have far reaching consequences.

There is an extensive geophysical and geological literature on the history of the Scotia arc and we need to review our knowledge of the biological history of the region in its light. Is there anything in the geophysical story than can answer some of the (palaeo) biological problems? Conversely, given the gaps in our knowledge of the timing of events, one may also ask if there is anything the palaeontologists and biologists can contribute to help clarify and answer some of the geological problems. For example, in several cases, the ages and movement histories of the constituent crustal blocks and areas of ocean floor are not as well constrained as might at first appear in the literature.

Sedimentary rock sequences in both the Magellan and northern Antarctic Peninsula regions locally contain rich shelly faunas which allow a degree of palaeontological comparison of Cenozoic faunas between the two regions. However, the Antarctic record is patchy. The best outcrop sections span the Paleocene-Eocene and Pliocene-Quaternary, whereas the critical Oligocene and Miocene periods, which saw the initiation and development of the Antarctic ice sheet (below), are represented on land only by a few local rock outcrops on King George Island (South Shetland Islands) and on James Ross Island. Whilst it is likely that relevant rock sequences are buried beneath the ice or occur below the sea bed, the only way these can be sampled satisfactorily is through drilling. If these were not problems enough, the fossil record itself is even patchier and any differences between the two regions may be enhanced by the non-preservation of particular rock sequences and fossils in one of them. Conversely, morphological similarities between shells from one region and another may not be all they appear to be. For example, DNA studies of modern bivalves (*Limopsis*) have shown that remarkably similar shells, hitherto regarded as belonging to the same species, in fact belong to different species. And some 'species' of modern brachiopods apparently have distributions ranging from a few to one thousand metres and more. Can that really be true?

The conventional view on the origin of the Antarctic Circum-polar Current (ACC) is that it was essentially a two-stage process brought about by the initiation of deep-water seaways, firstly between Australia and Antarctica around 30 million years ago, and then between South America and the Antarctic Peninsula by about 20 million years ago. However, some recent research is pointing towards an earlier timing for the establishment of a deep-water connection through the Scotia Sea that was closer in time to the formation of the deep-water channel between Australia and Antarctica. In addition, the general wisdom is that, although the development of the ACC is likely to have had a significant affect on the development of the Antarctic ice sheet, it was too late to have been a primary cause. There was a period of oscillatory ice-sheets between 34 and 15 million years ago, and the development of a more persistent ice sheet from about 15 million years ago. But, if both seaways were initiated at more or less the same (earlier) time, the onset of the ACC could have had very dramatic oceanic and climatic consequences, it would have been closer in time to the believed onset of ice-sheet development, and all these events may have been more closely interlinked that has been apparent until now.

Clearly, pinning down the timing of events related to the disintegration of the Antarctic-Andean link and the initiation of deep-water flow through Drake Passage and the Scotia Sea not only has important implications for our understanding of the region's biogeography and evolution, but it could also modify significantly our understanding of the development of the Antarctic ice sheet.

ORAL PRESENTATIONS

Larval and early juvenile development of *Lithodes santolla* (Molina, 1782) (Decapoda: Anomura: Lithodidae) reared at different temperatures in the laboratory

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Abstract

The southern king crab, *Lithodes santolla* Molina, is distributed in cold-temperate and subantarctic waters ranging from the southeastern Pacific island of Chiloé (Chile) to the Beagle Channel (Tierra del Fuego, Argentina/Chile). Recent investigations have shown that its larval development, comprising three zoeal stages and a megalopa, is from hatching to metamorphosis completely independent of food (full lecithotrophy). In the present study, larvae were individually reared in the laboratory at constant temperatures ranging from 1-18°C (initial n=48 larvae per treatment), and rates of survival and development through successive larval and early juvenile stages were monitored throughout a period of one year. The highest temperature (18°C) caused complete mortality within one week; only a single individual developed under this condition, 2 d after hatching, to the second zoeal stage, while all other larvae died in the first stage without moulting. At the coldest condition, 1°C, 71% of the larvae reached the zoea-III stage, but none of these moulted successfully to the megalopa. A temperature of 3°C allowed for some survival to the megalopa stage (17-33% in larvae obtained from two different females), but only a single individual passed successfully, 129 d after hatching, through metamorphosis to the first juvenile crab instar. At all other experimental conditions (6, 9, 12, 15°C), survival through metamorphosis varied among temperatures and two hatches from 29-90% without showing a consistent trend. The time of non-feeding development from hatching to metamorphosis lasted, on average, from 19 d (at 15°C) to 65 d (at 6°C). The relationship between the time of development through individual larval or juvenile stages (D) and temperature (T) was described as a power function ($D = a \cdot T^b$, or $\log[D] = \log[a] + b \cdot \log[T]$; the same model was also used to describe the temperature-dependence of cumulative periods of development from hatching. One year after hatching, the 7th (6°C) to 9th (15°C) juvenile crab instar was reached. Under natural temperature conditions in the region of origin of our materials (Beagle Channel, Argentina), *L. santolla* should reach metamorphosis ca. 2 months after hatching (taking place in Austral winter, July-August), i.e. in September-October. Within one year of hatching, the crabs should grow approximately to juvenile instars VII-VIII. Our results indicate that the early life-history stages of *L. santolla* tolerate cold stress as well as food-limitation, implying that this species is well adapted to subantarctic environments with low temperatures and short seasonal plankton production.

A survey of associations between amphipods and sea urchins, with description of two new species (genera *Lepidepecreella* (Lysianassoidea incertae sedis) and *Notopoma* (Ischyroceridae Siphonoecetini)) collected from Antarctic cidarid sea urchins

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Introduction

During the ANDEEP II expedition with the *Polarstern* to the Antarctic in March 2002 amphipods were collected as associates of cidarid sea urchins on two occasions. On both occasions previously undescribed taxa of amphipods were found. These are described here, and a survey of amphipod-echinoid associations is provided.

Associations between amphipods and echinoids

In Table 1 (below) all known amphipod-echinoid associations are listed, dividing the type of association into five different categories. First of all, there is a number of apparently obligate associates among taxonomically widely spread amphipod taxa. Their relationships to their echinoid hosts have in no cases been studied in any depth, but they do appear to be quite diverse: *Amphilochus*, *Dactylopleustes*, *Dulichia* and the new *Notopoma* all live on or among the spines of their host, while *Euonyx chelatus* and the new *Lepidepecreella andeep* seem to feed directly from their host tissues. Also the *Pontogeneia* that lives under *Strongylocentrotus franciscanus* on Californian shores may well feed on host tissues or excretions; this species, although well known to local workers, is apparently still undescribed (Chapman *in litt.*)

The *Urothoe* species that have been found on burrowing irregular sea urchins seem to be 'energy commensals' of generally low host specificity, i.e. amphipods that associate with various burrowing invertebrates that construct more or less permanent burrows, and that profit from the currents through the burrows provided by the host animal. This current may in turn provide protection, oxygenation and probably food enrichment of the sediment, on which the amphipods feed.

A number of amphipods regularly found on echinoids are in fact scavengers feeding on damaged or even dead sea urchins, and the species of the scopelocheirid genus *Aroui* appear even to have become specialized inhabitants of this niche and have rarely been found elsewhere.

Many more amphipods are known as regular associates of starfish than occur on sea urchins, and the habit seems to be especially widespread among the Caprellidea. A few of these species have occasionally also been reported on sea urchins, where their occurrence seems to be of a more incidental character.

Thus, summing up these data, the conclusions of the earlier survey by Vader (1978) seem still valid: associations between amphipods and sea-urchins seem not to be of any particular antiquity and occur scattered throughout the gammaridean and caprellidean amphipods, although e.g. the leucothoid-stenothoid lineage of amphipods remains unaccountably absent from echinoderm associations. The associations seem to be both taxonomically and ecologically widely dispersed, and there still have not been any studies focusing thoroughly on the nature of the associations between amphipods and echinoids.

Lepidepecreella andeep n.sp.

This new species was collected as an associate on *Aporocidaris incerta* in the Weddell Sea at 3000 meters' depth. *Lepidepecreella andeep* is the fifth Antarcic species of the genus, but the first to be collected in the abyss of the Southern Ocean. It is furthermore the first species in the genus to be found as an associate of sea urchins.

Notopoma cidaridis n.sp.

The genus *Notopoma* was split off from *Cerapus* by Lowry & Berents in 1996. Its 10 species are characterized by having a carpochelate male gnathopod 2 and an expanded peduncular article 1 on antenna 1. Most species are of southern distribution (hence the name), but the genus also contains tropical *(N. moorea)* and northern (*N. crassicornis, N. lutkini*) representatives. The new species described here is the first species of *Notopoma* from the Antarctic and the first to make fixed tubes on sea urchin spines (*Rhynchocidaris triplopora*).

Both new species are fully described and illustrated, and a key is provided for both genera.

AMPHIPOD SPECIES	HOST	AREA
I. SPECIALISTS (?)		
Amphilochus ?neapolitanus	*Lytechinus*	Bermuda
Dactylopleustes echinoicus	*Strongylocentrotus polyacanthus*	Commander Islands, NW Pacific
Dulichia rhabdoplastis	*Strongylocentrotus franciscanus*	NW United States
Euonyx chelatus	*Echinus esculentus*	Europe, France to Norway
Lepidepecreella andeep n.sp.	*Aporocidaris incerta*	E. of S. Sandwich Island, Antarctic deep sea
Notopoma cidaridis	*Rhynchocidaris triplopora*	N. of Elephant Island, Antarctic
Pontogeneia sp.	*Strongylocentrotus franciscanus*	N. California
'caprellids'	*Cystocrepis setigera*	Off Peru, 2500m
II. SCAVENGERS		
Aroui hamatopodus	spataginds	NSW, Australia
A. setosus	spatangids	Mediterranean Sea
Orchomenella nana	*Echinus melo,* *Echinocardium cordatum*	Bretagne, France North Sea
Scopelocheirus spp.	*Echinocardium, Brissopsis, Spatangus*	NE Atlantic, Mediterranean
III. ENERGY COMMENSALS		
Urothoe marina	*Echinocardium cordatum*	Atlantic coast of France
Urothoe poseidonis	*Echinocardium cordatum*	North Sea, Channel
IV. STARFISH ASSOCIATES		
Melita obtusata	*Echinus esculentus* *Echinocardium pennatifidum*	Bretagne (France), Irish Sea
Pariambus typicus	*Echinus esculentus*	West coast Scotland
V. STRAYS		
Caprella spp.	Sea urchins	NW Atlantic
Eurystheus maculatus	*Spatangus purpureus*	Firth of Clyde, Scotland
Temnophlias capensis	Sea urchin	Cape, South Africa
Various species	*Echinus esculentus*	West coast of Scotland

Table 1. Known associations between amphipods and echinoids.

On the distribution of decapod crustaceans from the Magellanic Zoogeograhic Province and the Antarctic region

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Knowledge of the distribution of decapod crustaceans in the southernmost areas of the oceans has increased recently. Studies have been based either on descriptions from the literature or on surveys designed for the purpose, or as a combination of both. More interesting is the direction of the latter type of studies in which some relationships between the Magellanic and Antarctic fauna has been the subject of discussion and some associations proposed. The common feature of these studies is that the Magellan region is referred to as the South American Ekman's Antiboreal region, and for that reason, some species cited belong to different Zoogeographic Provinces. In order to contribute to the clarification of this situation, this study refers to the Magellanic Zoogeographic Province. It extends from northern Chiloé Island on the Eastern Pacific Ocean, follows the Magellanic and Tierra del Fuego region through Cabo de Hornos, reaches the coastal area of the southwestern Atlantic Ocean off the Patagonian region, and includes the Islas Malwinas/Falkland Islands end north of the Península Valdés. The Province deflects from the continent at 43°-44° S going north, reaching 35° S at a distance of 100-150 Km from the coast, in 60-200 m depth.

This study analyses whether there is association between decapod crustaceans from the Magellanic Zoogeographic Province and those from the Antarctic region.

Methodology

Databases utilized included the species present in the Magellanic Province and those with circumantarctic distribution, updated from the literature. New records were also included in the species list, but those arranged or classified incorrectly were not considered. In this study, the southern tip of South America was set at 55° S. Species recorded were assigned to the following geographic regions: [1] Magellanic Atlantic (northern 55° S), [2] Magellanic Pacific (northern 55° S), [3] Southern Tip (southern 55° S), [4] Antarctica (continental shelf and islands of the Peninsula), [5] South Georgia, [6] Kerguelen Arc Islands, [7] South American deep fauna. Geographic regions were clustered using multivariate cluster analyses and the Bray-Curtis Similarity index was used.

Results and conclusions

It can be clearly observed that in both areas –Pacific and Atlantic- of the Magellanic Province, there is a higher number of species compared to those currently recognized for the Antarctic areas. The Anomura, Brachyura and Caridea are well represented in the Magellanic Province (Table1), while the only taxa present in the Antarctic areas are Caridea and anomuran Lithodidae with low species numbers. The total number of species cited for the whole study area is 94. In the Magellanic Province 17 species were only present in the Atlantic and 32 only in the Pacific. Nevertheless, there are 32 species present in both oceans.

At the Southern tip, 31 non-endemic species were recorded. They were also present either in the Atlantic or the Pacific area of the Magellanic Province north of 55° S (Table 1). Four of them, *Campylonotus vagans, Notocrangon antarcticus, Chorismus antarcticus* and *Paralomis spinosissima* are present also in Antarctica and at South Georgia. The distribution range of two

Antarctic species, *Lebbeus antarcticus* and *Pandalopsis ampla* is extended to the Southern tip of South America.

The dendrogram shows that there are two well-established clusters (A and B) (Figure 1). Cluster A involves the Pacific and Atlantic areas of the Magellanic Province and the Southern tip, with the highest similarity index between the Southern tip and the Atlantic area. Cluster B includes the Antarctica, South Georgia and the Kerguelen Arc islands, with the highest similarity index between South Georgia and the Antarctica.

These results suggest that there is little association among extant decapod species from the circumpolar region and the Magellanic Province. There is significant representation of various decapod groups with high species numbers compared to those of circumpolar distribution.

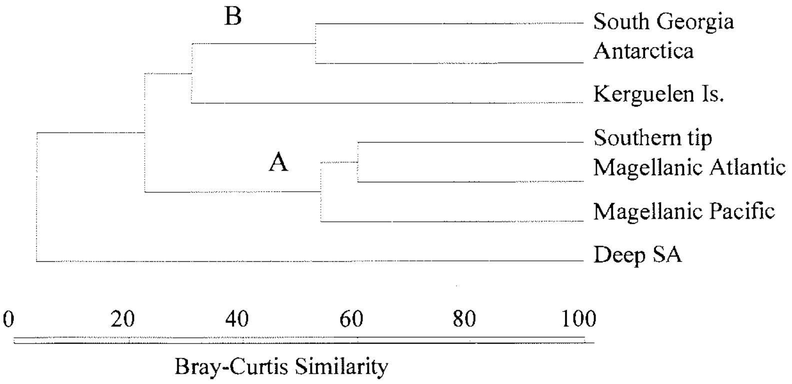

Fig. 1. Cluster analysis among geographic regions. Cluster A shows high similarity index between the Atlantic, the Pacific Magellanic and the southern tip of South America. Cluster B includes South Georgia, Antarctica and the Kerguelen Islands. Cluster A and B show high dissimilarity.

Table 1. Species list and geographic distribution of decapods in the Magellanic Zoogeographic Province and the Antarctic region. (MA: Atlantic Magellanic, MP: Pacific Magellanic, ST: Southern tip, A: Antarctica, SG: South Georgia, DS: South American deep species).

Infraorder	Family	Species	MA	MP	ST	A	SG	K	DS
Anomura	*Chirostylidae*	*Uroptychus parvulus*		*					
	Coenobitidae	*Coenobita compressus*		*					
	Diogenidae	*Paguristes weddelli*		*					
	Galatheidae	*Munida gregaria*	*	*	*			*	
		Munida spinosa	*		*			*	
		Munida subrugosa	*	*	*			*	
		Munidopsis aspera		*					
	Hippidae	*Emerita analoga*	*	•					
	Lithodidae	*Lithodes confundens*	*	*					
		Lithodes santolla	*	*	*				
		Lithodes turkayi	*	*	*				
		Lithodes murrayi				*		*	
		Paralomis aculeatus						*	
		Paralomis anamerae	*						
		Paralomis birsteini				*		*	
		Paralomis formosa	*				*		
		Paralomis granulosa	*	*	*				
		Paralomis spinosissima	*		•	*	*	*	

Infraorder	Family	Species	MA	MP	ST	A	SG	K	DS
		Paralomis tuberipes		*					
	Paguridae	*Pagurus comptus*	*	*	*				
		Propagurus gaudichaudii	*	*	*				
	Parapaguridae	*Sympagurus dimorphus*	*	*	*			*	
	Porcellanidae	*Liopetrolisthes mitra*		*					
		Petrolisthes laevigatus		*					
		Petrolisthes violaceus		*					
Astacidea	*Nephropidae*	*Thymops birsteini*	*	*	*				*
Brachyura	*Atelecyclidae*	*Bellia picta*		*					
		Corystoides chilensis	*	*					
		Peltarion spinulosum	*	*	*				
		Acanthocyclus albatrossis	*	*					
	Cancridae	*Cancer coronatus*		*					
		Cancer edwardsi		*					
		Cancer polyodon		*					
	Corystidae	*Gomeza serrata*		*					
		Pseudocorystes sicarius		*					
	Epialtidae	*Taliepus dentatus*		*					
	Geryonidae	*Chaceon notialis*	*						
	Grapsidae	*Cyrtograpsus affinis*	*						
		Cyrtograpsus altimanus	*						
		Cyrtograpsus angulatus	*	*					
		Hemigrapsus crenulatus		*					
		Planes cyaneus		*					
	Hymenosomatida	*Halicarcinus planatus*	*	*	*			*	
	Inachidae	*Eurypodius latreillei*	*	*	*				
	Inachoididae	*Inachoides microrhynchus*		*					
		Leurocyclus tuberculosus	*	*					
	Leucosiidae	*Leucosia planata*	*						
	Maiidae	*Leucippa pentagona*	*	*					
		Libidoclaea granaria	*	*					
		Libidoclaea smithi		*					
	Pinnotheridae	*Pinnaxodes chilensis*	*	*					
		Pinnixa valdiviensis		*	*				
		Pinnotherelia laevigata		*					
	Pisidae	*Pisoides edwardsii*		*					
		Rochinia gracilipes	*						
	Portunidae	*Coenophthalmus tridentatus*	*						
		Ovalipes trimaculatus	*	*					
	Xanthidae	*Eurypanopeus crenatus*		*					
		Gaudichaudia gaudichaudi		*					
		Homalaspis plana		*					
		Pilumnoides hassleri	*						
		Pilumnoides perlatus		*					
Caridea	*Alpheidae*	*Betaeus truncatus*	*	*	*				
		Synalpheus spinifrons		*					
	Campylonotidae	*Campylonotus semistriatus*	*	*	*				
		Campylonotus arntzianus				*			
		Campylonotus vagans	*	*	*	*	*		
		Campylonotus capensis						*	*
	Crangonidae	*Notocrangon antarcticus*	*	*	*	*	*		
	Hippolytidae	*Chorismus antarcticus*	*	*	*	*	*	*	
		Chorismus tuberculatus	*		*		*	*	
		Latreutes antiborealis		*					
		Nauticaris magellanica	*	*	*			*	
		Nauticaris marionis		*				*	
		Lebbeus antarcticus				*	*		
		Eualus kinzeri				*			
		Eualus dozei		*	*				
	Nematocarcinidae	*Nematocarcinus lanceopes*				*		*	
		Nematocarcinus longirostris						*	

Infraorder	Family	Species	MA	MP	ST	A	SG	K	DS
	Pandalidae	*Austropandalus grayi*	*	*	*				
		Pandalopsis ampla			*	*			
	Pasiphaeidae	*Pasiphaea acutifrons*	*	*	*		*		
		Pasiphaea dofleini		*					
Palinura	*Polychelidae*	*Stereomastis suhmi*		*	*				
Penaeoidea	*Benthesicymidae*	*Benthesicymus brasiliensis*	*						
	Penaeidae	*Artemesia longinaris*	*						
	Solenoceridae	*Pleoticus muelleri*	*						
Sergestoidea	*Sergestidae*	*Sergestes arcticus*	*	*	*				
	Sergestidae	*Sergia potens*	*						
Thalassinidea	*Callianassidae*	*Notiax brachyophthalma*	*	*					
		Notiax santarita			*				
	Ctenochelidae	*Anacalliax argentinensis*	*						
	Upogebiidae	*Upogebia australis*			*				
		Uroptychus insignis						*	

Total and organic phosphorus in the sediments of Admiralty Bay, King George Island, Antarctica

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Abstract

Admiralty Bay (King George Island), Antarctic region, represents a special region which has a restricted circulation in the west side, a central deep region and an eastern Brazilian presence. Total P reaches its highest values outside the main entry to the Bay, near the most important terrestrial input and in the direction of the Ezcurra inlet (values >700 μmol-P/g). The two high values were observed at the Mackellar inlet (794.9 and 838.9μmol-P/g). The high values correspond to phosphogenic contribution in this region. The highest value of organic P showed was found in front of the Brazilian base (264.9μmol-P/g). In general, the values of organic P were >200μmol-P/g in the major part of the Bay, except in the eastern part, especially at the eastern part of Martel inlet (44.0μmol-P/g). The sedimentation process associating the terrestrial input and the bathymetric formation of the Bay contributes to this P distribution. It is important to study the influence of human occupation in this context, mainly in the organic P signal.

Introduction

The P biogeocycle had been the subject of intense studies and the inventory and fluxes of P in marine regions, including mass balance and the P input rates to the ocean from extrapolations of P accumulation rates from the continental margin and deep sea sediments has been examined by several authors.

Previous studies showed that the phosphorus concentration observed in the continental margins with high rates of sedimentation varies from 8 to 108 μmol-P/g, in the ocean basins from 7 to 307 μmol-P/g and in the phosphogenic areas from 580 to 3,700μmol-P/g. Some marginal, non-phosphogenic, areas showed the following limits: 92 to 108 µmol-P/g (western Africa), 35 to 80 µmol-P/g (Peru coast), 23 to 33 µmol-P/g (California, USA).

Organic phosphorus in the transitional sediments showed values around: 16µmol-P/g (Mississippi delta, USA); 8µmol-P/g (Long Island, USA) and 26-32µmol-P/g (San Lourenço river, Canada).

The content of P in the marine sediments is linked to the nature of minerals that integrate the sediments, the sedimentation process and the terrestrial input. The organisms present in the marine ecosystem contribute to the content of the organic matter present in the sediment, and therefore the organic P present in the sediment is involved in life-cycle activity. Presently, the P content in organic matter is a sign of human activity in some regions and is important in detection of natural and anthropogenic influence in a region, especially in Bays with restricted circulation processes.

The Antarctic region is considered a pristine region that influences some characteristics of the southern ocean and the bottom conditions of some oceans to a large extent. Composed of some islands including some bays, there are some particular ecosystems located in each one, composed of different sediments and submitted to particular water dynamics and oceanographic processes. Unfortunately, minimal human occupation can modify some natural conditions, which are important to study.

Phosphorus accumulation rates appear to be controlled by sedimentation rates in the ocean sediments. Although P concentrations generally exhibit similar ranges, the large differences in sedimentation rates between various environments result in P accumulation rates which are several magnitudes higher in the continental margins (90-8,000µmol-P cm –2.Kyr-1) compared with the open sea sediments (2-75 µmol-Pcm-2 Kyr-1).

Material and Methods

On the occasion of the XXII Antarctic Brazilian Operation (2002/2003 - summer period) ten points in the Admiralty Bay (Fig.1) were sampled. The sediment samples were taken with Van Veen steel equipment. The samples were stored at -20 °C and sent to São Paulo University. The particulate total and organic phosphorus were analyzed following the Aspila method, which is based on extracting ashed (for total phosphorus) and unashed (for inorganic phosphorus) sediment with HCl 1M for 16 hours. The dissolved P under the sediment was determined following the recommendations of Grasshoff *et al*. (1983). Organic phosphorus was determined as the difference between total and inorganic phosphorus.

Results

The values of total phosphorus varied from 639.0µmol-P/g to 839.0µmol-P/g, while the organic phosphorus varied from 44.0µmol-P/g to 264.3µmol-P/g (Table I). Most of phosphorus in the sediment was represented by the inorganic fraction 65-93%. The horizontal distribution of total and organic phosphorus in the sediment of Admiralty Bay is represented in figures 1a and 1b, respectively.

Discussion

The content of total P had high values near the principal terrestrial input from the continent, maybe due to the displacement of the glacier from the soil to the water. The eastern part of the Bay had the lowest values. The highest concentrations of organic P were located in the center of the Bay and by the Brazilian and Polish bases. The west part of the Brazilian base showed the greatest organic P values and the eastern part showed the lowest values.

The concentrations of total P exceed the limit proposed by Filippelli (1997), for bays (307 µmol-P/g) and were located between the limits proposed for phosphogenic regions. The most important contribution of P in the sediment of this Bay come from mineral contributions as the inorganic part of the total P reveals.

The influence of anthropogenic activities associated with the efficiency of hydrodynamics is maybe responsible for a part of this deposition of organic matter in the sediment. More studies are necessary to understand these different processes of deposition of organic P in the sediment of the Admiralty Bay. In this region, it is important to know the natural content of organic P and the influence of human occupation for organic P levels in the sediment, and if the deposition process are different in the central, eastern and western part of the Bay.

Acknowledgements

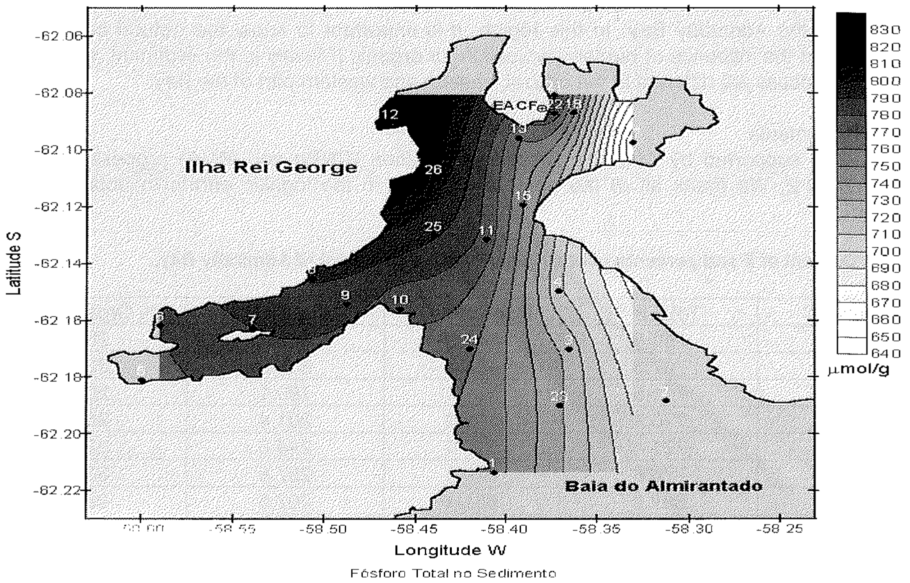
This work is supported by Antarctic Brazilian Operation (CNPq and MMA) process number 550437/2002-2. We thank all of the persons involved in the logistic efforts to obtain these samples.

Table 1. Content of P and percentage of Organic P, in the sediment of Admiralty Bay.

Stations	Total P *	Inorganic P *	Organic P *	% Organic P
1	753.8	546.0	207.8	28
3	727.3	494.7	232.6	32
4	711.5	531.4	180.1	25
6	770.4	569.0	201.4	26
10	771.4	527.4	244.0	32
11	776.8	519.3	257.5	33
12	838.9	631.4	207.5	25
13	760.2	495.3	264.9	35
17	639.0	595.1	44.0	7
21	794.9	548.5	246.3	31

- µmol-P/g

1.a) *Total Phosphorus*



1.b) *Organic Phosphorus*

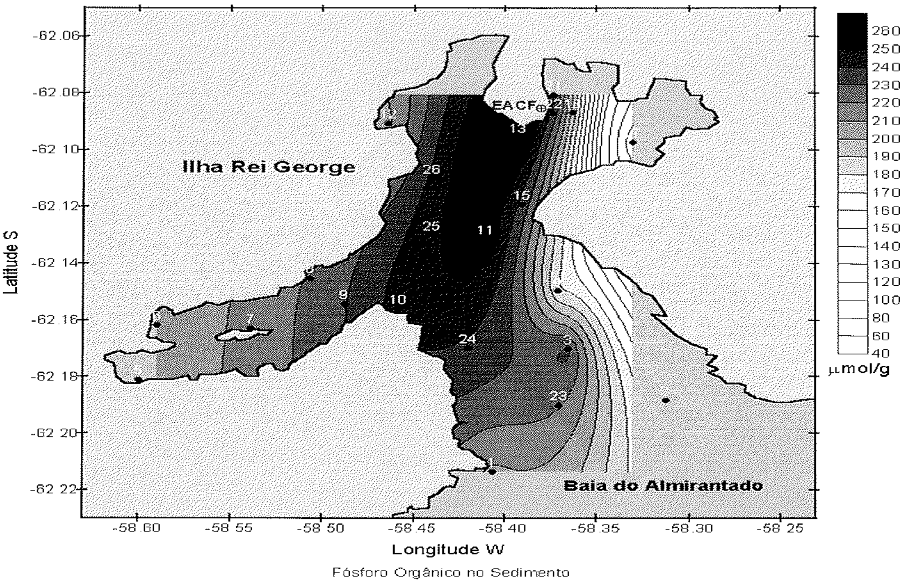


Fig. 1. Total (1a) and organic (1b) phosphorus concentrations (µmol/g) in the sediment of Admiralty Bay.

Abundance, diversity and community patterns of Isopoda (Crustacea, Malacostraca) in the Antarctic deep sea: Background and first results of the ANDEEP I & II expeditions

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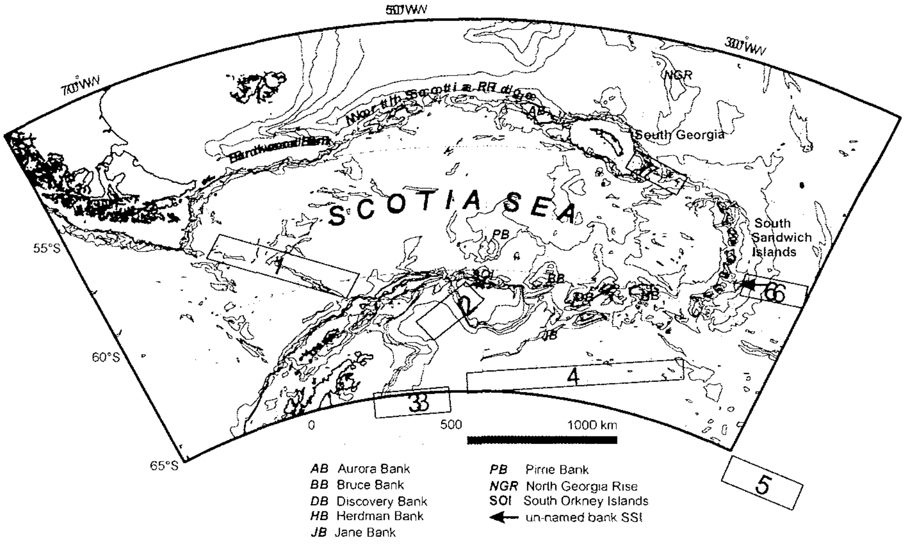
During the expeditions ANDEEP I & II (ANtarctic benthic DEEP-sea biodiversity): colonisation history and recent community patterns (ANT XIX/3+4), 22 stations were sampled in the deep Southern Ocean using different gears. ANDEEP is an international project to investigate the deep-water biology of the Scotia and Weddell seas using F/S *Polarstern*.

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 benthic animals that inhabit them. By contrast, we know that the present-day benthic animals of the Antarctic continental shelf share several characteristic and unusual features, including gigantism, longevity, an extraordinarily high degree of endemism, and absence of taxa which are abundant in similar environments elsewhere. Such attributes are believed to reflect the geographical and hydrographical isolation of the shelves and their special environmental characteristics, particularly the persistently cold climate combined with high and markedly seasonal primary production. Periodic extensions of the ice sheet may have enhanced speciation processes on the continental shelf - the Antarctic „diversity pump". Waters deeper than 1000 m, however, have broad connections with the Pacific, South Atlantic and Indian oceans and might therefore be expected to be much less isolated. Against this background, some of the general aims of ANDEEP were to conduct a first base-line survey of the deep-water benthic faunas of the Scotia and Weddell Seas, to investigate the evolutionary processes and oceanographic changes which have resulted in the present biodiversity and distributional patterns in the Antarctic deep seas, to investigate the influence of sea-floor habitat diversity on species and genetic diversity in the Antarctic deep sea, to investigate the colonisation and exchange processes of the deep sea fauna in relation to changes in sea-bed geography over geological time, and to assess the importance of the Antarctic region as a possible source for many of the deep sea benthic taxa in other oceans.

It is possible that the deep bottom water production in the Weddell Sea acts as a distribution mechanism, 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.

Furthermore, the more-or-less isothermal water column of the Weddell Sea and the surroundings of the Antarctic continent provide an obvious conduit for the migration of shallow-water species into the deeper waters, i.e. submergence processes.

To address these issues, some areas of the Southern Ocean deep sea have been selected for investigation.



Transect areas of ANDEEP. The map was kindly made available by John Howe, the transects were added by Mike Thomson.

For the present study of Southern Ocean isopod abundance, diversity, and community analysis, samples from epibenthic sledge (EBS) catches were completely sorted until the end of January 2003. Since then the material has been sorted to species level in order to identify the species richness of the different stations from the Antarctic deep-sea. Exact determination of species, identification of new species and new descriptions are still ongoing. For a number of probable known species from other deep-sea areas, the type material will have to be ordered and compared with the ANDEEP specimens. However, abundances of Isopoda are already available (Table). Composition and community patterns will be investigated in the Antarctic deep sea later this year using the computer package „Primer", and preliminary results will be presented during the IBMANT/ANDEEP workshop in Ushuaia.

Identification of ANDEEP I Isopoda already revealed that the Antarctic deep sea also bears its own fauna and is also characterised by numerous new species and some new genera. However, many species identified so far are also known from other deep-sea areas, mainly from the Atlantic Ocean. At present, the degree of endemism of Isopoda in the deep sea of the Southern Ocean seems to be lower than on the shelf where 88 % of the Isopoda are endemic. This result is certainly preliminary, as we generally know only very little about macrofaunal composition of deep-sea areas. Therefore many new species are currently described. The present situation that many species are new to science and have not been reported from elsewhere might also be due to the scarcity of deep-sea samples in general. Zoogeography of taxa investigated until now documents that most of the known isopod species sampled during ANDEEP are known from the Atlantic or Pacific deep sea, less from the Indian Ocean.

During ANDEEP I + II, 5525 Isopoda were sampled at 20 of the 22 EBS stations. Of these 97% belonged to the Janiroidea, Asellota. Flabellifera, which are the most important isopod taxon on the shelf in term of species richness, are rare in the deep sea of the Southern Ocean (2% of the ANDEEP material). It will be illustrated by W. Brökeland that most of the Janiroidea belong to the Munnopsididae (61%), followed by the Haploniscidae (15%), the Ischnomesidae (10%), the Desmosomatidae, Macrostylidae and Nannoniscidae which comprise 10%, the Munnidae and the Paramunnidae with 2% each, and the Acanthaspidiidae (1%). All other taxa, like the

Mesosignidae, the Dendrotionidae, the Janiridae, the Joeropsidae, the Janirellidae and the Stenetriidae only comprised 1% altogether.

First very preliminary data on the species numbers and abundances of some isopod taxa are included here, however, these numbers will most probably have changed by October when abundances, diversity and community patterns of ANDEEP Isopoda will be presented.

Station	Isopoda
41-3	216
42-2	905
43-8	197
46-7	1016
99-2	32
105-7	7
129-2	88
131-3	917
132-2	34
133-3	742
134-4	51
135-4	414
136-4	37
137-4	70
138-6	191
139-5	64
140-9	138
141-10	346
142-6	2
143-1	58
Sum	5525

family	species*	individuals
Munnopsididae	68	3445
Haploniscidae	34	772
Ischnomesidae	31	362
Munnidae	9	122
Paramunnidae	10	132
Haplomunnidae	1	15
Dendrotionidae	3	27
Mesosignidae	2	14
Acanthaspidiidae	5	34
Macrostylidae	7	58
Nannoniscidae	11	32
Desmosomatidae	30	393
Janiridae	1	5
Joeropsidae	1	38
Janirellidae	1	5
Stenetriidae	1	5

*** preliminary number of species, July 2003**

The above tables illustrate the numbers of Isopoda found at the ANDEEP stations sampled with the epibenthic sledge (left Table) and the numbers of species and specimens of the isopod families sampled during both ANDEEP expeditions (right Table). Not all specimens could be identified due to damage, but 5459 individuals have been identified from the 5525 samples.

Asellota in the Antarctic deep sea

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During the expeditions ANT XIX/3+4 (ANDEEP I+II) 22 stations in the deep Scotia Sea and the deep Weddell Sea were sampled with different gears. The isopod material obtained with the epibenthic sledge consisted mainly of species from the suborder Asellota, which is the dominant isopod taxon in the deep sea. The Asellote families Munnopsididae, Haploniscidae, Ischnomesidae, Desmosomatidae, Nannoniscidae, Macrostylidae, Acanthaspidiidae, Haplomunnidae, Dendrotionidae, Munnidae and Paramunnidae were frequently found in the samples. The families Janiridae, Joeropsidae, Janirellidae, Pseudomesidae and Stenetriidae were only found at one or two stations and each are represented by only one species.

The family Munnopsididae was most abundant in the samples (about 3100 individuals), followed by Haploniscidae and Ischnomesidae.

The family Ischnomesidae was represented by at least 30 species (more than 360 individuals) of the five genera *Haplomesus*, *Heteromesus*, *Ischnomesus*, *Stylomesus* and *Bactromesus*.

Several of these are new species. Most of these species are characterized by a specific pattern of dorsal and lateral lobes or spines. Two of the new species are neotenic; the adult specimens possess only six, instead of seven pereopods. Until now this phenomenon was unknown for the family Ischnomesidae, although it was reported for some species of the Asellote families Dendrotionidae, Haplomunnidae and Munnopsididae.

The family Haploniscidae is represented by at least 34 species and 770 individuals. Five of the seven known genera were found: *Antennuloniscus*, *Chauliodoniscus*, *Hydroniscus*, *Mastigoniscus* and the polyphyletic genus *Haploniscus*. This is the first record for *Mastigoniscus* in the Scotia Sea and in the Weddell Sea. Three species were found in the Scotia Sea, one species in the Weddell Sea. The distribution centre of the genus lies in the Southern Pacific; an immigration through the Drake Passage seems probable.

The *Haploniscus* material contains a species complex of several very similar species, which are characterized by a prominent rostrum. The rostrum is quite variable in size and shape. This species complex might be the result of a recent speciation event in the deep sea of the South Polar Ocean. A phylogenetic analysis of the family will help to answer this question and shall contribute to the revision of the genus *Haploniscus*.

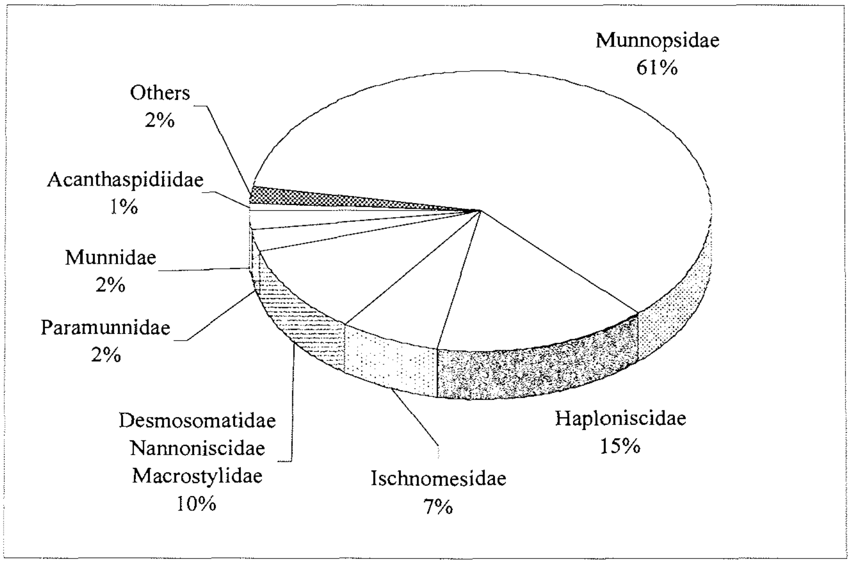

Fig. 1. Relative abundance of different Asellote families. Preliminary results

Spatial and vertical distribution of macrobenthic littoral communities in Terra Nova Bay

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An analysis of the distribution of soft-bottom epibenthic organisms in Terra Nova Bay has been conducted down to 320 m depth, between Tethys Bay and Adelie Cove, using ROV video transects. A total of 45 different taxa were taken into account, whenever possible down to species level, mainly sponges and echinoderms.

Quantitative data have been obtained using the ROV Romeo in the austral summer 1997/98, equipped with 4 laser beams to evaluate the width of the path, performing eleven dives. For each dive, density data of epibenthic species have been evaluated. These quantitative data have been mapped, in terms of density and species number.

Patterns of spatial scale variability have been investigated by uni- and multivariate analyses, according a multi-scale nested design.

Stations have been grouped by depth (5 depth ranges, from 20 to 320 m). Soft bottoms, starting from 20-30 up to 80 m depth, are constituted by coarse sands and gravel and the epibenthic community is characterised by the bivalves *Adamussium colbecki, Laternula elliptica* and the sea-urchin *Sterechinus neumayeri*. Moving deeper, from 80 to 150 m sediments are finer although largely interspersed with cobbles and boulders: herein sabellids of the genus *Perkinsiana* characterise the soft bottoms, together with gorgonians (*Thouarella* and *Primnoella* spp.) and *Gellius* spp. sponges. From 150 m onward, communities are not much different from the previous depth range, with gorgonians and sponges becoming dominant, mainly with the large Volcano sponges. Only a few structuring species show a clear bathymetric zonation and characterise quite different assemblages. These species are accompanied by several species, which show a broader distribution, in terms of depth and habitat The strongest change occurs around 80 m depth (Fig. 1; ANOSIM: R= 0.539, p< 0.1%), where the *Adamussium colbecki* community is replaced by that of sponges and gorgonians.

Each of the few identified communities, although having a broad common structure, show particular features locally, as stressed by replicate homogeneity at the level of the different sites.

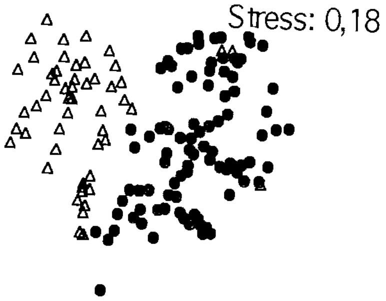

Fig. 1. Bubble plot nm-MDS of ROV observations. Superimposed factor: depth range (full circe: 20-80 m depth; open triangle: >80 m depth.

Recent distribution patterns of molluscs and echinoderms in Antarctica

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Molluscs and echinoderms represent some of the most relevant groups in Antarctic benthic fauna. These groups have been largely investigated since the beginning of benthic research in Antarctica. Most information regarding mollusc and echinoderm fauna comes from the Antarctic Peninsula-Scotia Arc, the Eastern Sector of the Weddell Sea, a large area between 40° to 170° E and the Ross Sea. Many data are also available for the fauna of Marion and Prince Edward Islands, the Kerguelen Islands and Macquerie Island.

Traditionally, three features are generally displayed: high occurrence of endemism, circumantarctic distribution and eurybathy. Such features mainly characterise the High Antarctic fauna, while the Antarctic Peninsula and the insular systems surrounding the continent present a higher degree of affinity with other land masses, mainly the tip of South America. In fact, being the most isolated of all the continents, *in situ* radiation has been favoured in High Antarctica and, consequently, a high number of endemisms characterises its fauna. Although the dominance of certain families may be traced back through late Oligocene-early Miocene, the origin of recent fauna is affected by the adjacent deep-water basins and migration via the Scotia Arc. Moreover, the Antarctic Coastal and Circumpolar Currents favour the dispersal of species, mainly those with a planktonic stage.

The aim of the present work is to contribute to the knowledge of the distribution of mollusc and echinoderm taxa all around the Antarctic continent (Tab. 1), arguing about the causes of the differences found in their species richness and distribution patterns.

In order to analyse distribution patterns, the Antarctic continent was divided into 6 sectors and an additional one containing all the insular systems. Among the continental sectors, 3 have been considered the most relevant, because of their amplitude, their opposite position and large study effort: the Ross Sea, the Weddell Sea and the Antarctic Peninsula.

Consequently, according to their records, species were divided into:

1. Continental species: species found only on the continent
2. Antarctic species: species found in the continent and the islands
3. Insular species: species found exclusively on the islands

The first group splits into:

1.a: Circum-Continental species: with a continuous distribution (reported in the 3 main sectors plus, at least, one of the other 3 Continental ones).

1.b: Local Continental species: present in1 or more sectors, but not fitting the conditions for being Circum-Continental.

1.c: Antarctic Peninsula species: found along the Antarctic Peninsula only.

The second group may split into:

2.a: Widespread Antarctic species: Circum-Continental species found also on the islands

2.b: Scattered Antarctic species: species found in one or more sectors of the continent and on the islands.

It is evident that some classes display a larger variability in family and species richness in single sectors (Tab. 2+3), although a straightforward comparison is biased by the different sampling effort of the investigated areas (sampling depth, coastal or off-shore data).

In general, a larger degree of eurybathy and a more circumantarctic distribution is displayed by bivalves and more local endemisms by gastropods, while echinoderms show the broadest geographical distribution.

		Families	Genera	Species
Molluscs	Gastropods	73	169	434
	Bivalves	28	46	93
	Polyplacophorans	5	6	7
	Monoplacophorans	1	2	2
	Scaphopods	3	4	4
	Cephalopods	4	7	9
Echinoderms	Asteroids	14	49	108
	Holothuroids	12	37	93
	Ophiuroids	9	46	96
	Crinoids	7	17	30
	Echinoids	6	13	73

Table 1. Total number of families, genera and species per class found in Antarctica, among molluscs and echinoderms

		Mawson	Davis	Ross	Bellingshausen	Antarctic Peninsula	Weddell	Islands
Molluscs	Gastropods	41	46	52	29	43	38	55
	Bivalves	21	21	22	22	22	23	26
Echinoderms	Asteroids	12	13	12	12	12	12	14
	Holothuroids	8	8	8	7	9	10	9
	Ophiuroids	6	7	6	6	5	6	9
	Crinoids	3	3	3	3	3	3	7
	Echinoids	4	5	4	4	4	4	5

Table 2. Total number of families of main classes found in single sectors

		Mawson	Davis	Ross	Bellingshausen	Antarctic Peninsula	Weddell	Islands
Molluscs	Gastropods	168	171	174	77	129	119	234
	Bivalves	50	53	51	50	56	49	67
Echinoderms	Asteroids	46	51	55	46	54	50	71
	Holothuroids	30	30	19	18	38	44	49
	Ophiuroids	46	35	46	24	28	50	48
	Crinoids	9	7	10	6	16	8	24
	Echinoids	31	19	19	6	16	29	57

Table 3. Total number of species of main classes found in single sectors

Sterechinus neumayeri population variability along the Victoria Land Coast

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Sterechinus neumayeri is the predominant echinoid in the Ross Sea and thus represents a model species for assessing how populations vary with location along the Victoria Land coast. *S. neumayeri* were sampled to investigate population structure at several sites in McMurdo Sound (Cape Evans, New Harbor, Spike Cape and Dunlop Island) and Terra Nova Bay that reflect broad-scale differences in water temperature, primary production and sea ice cover. Using a variety of strategies (SCUBA, ROV and splash cam) at each site, population density and size frequency distribution of this species have been evaluated and related to local habitat features.

At Terra Nova Bay, *S. neumayeri* has been found at all depths (0-320 m) investigated by videos, showing higher densities at 30-80 m depth (17 ind/m^2), mainly on boulders and very coarse sediments (up to 45 ind/m^2). Deeper, its density is largely scattered and averages 8 ind/m^2 between 80 and 150 m, while beyond 150 m depth, its density ranges between 0.2-0.4 ind/m^2.

In McMurdo Sound the sea urchin populations are shallower and generally less dense, ranging from extremely rare at New Harbor, up to 10 ind/m^2 at Spike Cape, 33 ind/m^2 at Dunlop Island and 20 ind/m^2 at Cape Evans, although at all locations except New Harbor, densities were highly variable between sites separated by about 50-100 m. Differences in spatial variability have been tested using ANOVA, stressing large and small scale variability in both locations.

Large-scale variability is also found in terms of reproduction: ripe individuals occur in Terra Nova Bay slightly earlier than in McMurdo Sound.

All these differences provide evidence of effects due to habitat features, mainly food availability, in terms of macroalgal detritus, encrusting red algae, and microbenthos.

'Live' (stained) benthic foraminifera in the deep Weddell Sea: trends in abundance, diversity and taxonomic composition in relation to water depth

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Foraminifera form a large and diverse part of the deep-sea meiobenthos in all oceans. Although there are numerous studies of deep-sea foraminifera in the Southern Ocean, many early studies were qualitative in nature. More recent investigations have yielded quantitative data but have focussed exclusively on hard-shelled multilocular species, both calcareous and agglutinated. In fact, single-chambered, soft-walled allogromiids (organic-walled) and saccamminids (fragile, agglutinated), as well as the macrofaunal komokiaceans, comprise a large and important part of deep-sea foraminiferal assemblages. Yet only one Antarctic study, focussing on a shallow water site in Explorers Cove (McMurdo Sound), has identified and quantified 'entire' live assemblages, i.e. including the soft-walled forms. The present investigation describes deep-sea foraminiferal assemblages from a poorly-known region of the Weddell Sea and includes these previously overlooked soft-walled taxa.

Multicorer samples were collected in March 2002 during "Polarstern" cruise ANT XIX-4 (ANDEEP II) along a transect extending from the Antarctic Peninsula upper slope onto the Weddell Abyssal Plain (1000 - 5000 m depth) at approximately 65°S. Subcores ($3.45cm^2$) were taken using a cut-off 20ml syringe and the upper 1cm layer sieved on 300, 150, 125 and 63µm meshes, stained with rose Bengal, and wet-sorted for 'living' (stained) foraminifera. Two to three subcores were analysed per station in order to obtain information on the small-scale patchiness of assemblages.

Usually, stained foraminifera accounted for 61%-83% of the total meiofauna, except in sample 134-8 from 4000 m where they constituted only 26%. The second most abundant meiofaunal group was the nematodes (12% - 32%, except in sample 134-8, where they constituted 69%), followed by harpacticoids (<1% - 5%). Foraminiferal assemblages contained a mixture of calcareous, agglutinated and organic-walled forms, the proportions of which changed with water depth. There was a clear decrease in the percentage of calcareous species with increasing water depth, from >70% at 1000 m to <7% at 5000 m. Agglutinated and organic-walled species increased correspondingly from, respectively, 19% and 3% at 1000 m to 40% and 24% at 4000 m. Saccamminids and komokiaceans were particularly important at 5000 m, where they comprised 22% and 19%, respectively. Overall, soft-walled species (saccamminids, allogromiids, komokiaceans) contributed the majority (50%) of the 207 species identified and most (>62%) of the assemblages on the abyssal plain.

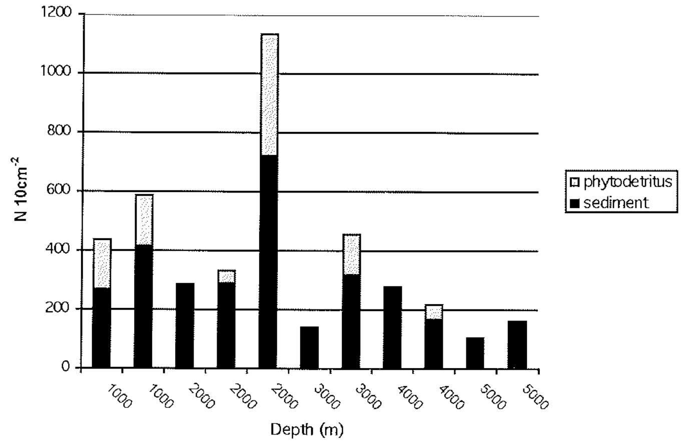
Mean abundances in the 0-1 cm layer peaked at the 2000 m station with 585 individuals $10cm^{-2}$, and then decreased with increasing water depth to 135 individuals $10cm^{-2}$ at the 5000 m station. However, the mean abundance at the 2000 m station is substantially raised by one sample (132-8) which yielded 1130 individuals $10cm^{-2}$, compared to 284 and 330 individuals $10cm^{-2}$ in the other samples from that depth. Two replicates from the 3000 m station also yielded substantially different standing stocks (139 and 452 individuals $10cm^{-2}$), suggesting a considerable degree of small scale spatial patchiness, possibly associated with the presence or absence of phytodetritus. Subcores from different deployments at other stations yielded generally similar numbers of stained individuals. Species numbers ranged from 20 to 50 per subcore and Fisher _ diversity values ranged from 13 to 44.

Small amounts of phytodetritus observed on core surfaces immediately after collection contained a phytodetritus-associated assemblage that included *Epistominella exigua*, *Alabaminella weddellensis* and *Tinogullmia riemanni*. These species are also associated with phytodetritus on the North Atlantic Porcupine Abyssal Plain, suggesting the existence of close faunal and ecological parallels between these two distant regions of the abyssal deep sea. In the Weddell Sea samples, these species were frequently found in fluff balls, making detection difficult. Many of these species were small or very small, ranging from 50-140 μm in diameter for *A.weddellensis* and *E.exigua*. Samples containing phytodetrital material generally yielded higher abundances than non-phytodetritus samples, mainly because of the large number of *E.exigua* specimens present (e.g. 58% of the 390 stained specimens from 132-8 were *Epistominella spp.*).

Table 1. abundance, diversity and assemblage data for 5 stations in the NW Weddell Sea.

Station no. & depth	Replicate	Abundance (10 cm^{-2})	Species no.	Fischer ± ∝	% calcareous
133 (1000 m)	133-6	435	40	19.2	69.3
	133-8	586	46	19.17	72.3
132 (2000 m)	132-5	284	37	29.45	45.9
	132-7	330	43	29.58	27.4
	132-8	1130	44	13.04	66
131 (3000 m)	131-7	452	48	29.96	24.3
	131-10	139	20	14.96	37.5
134 (4000 m)	134-6	275	50	44.06	23.2
	134-8	217	24	13.57	2.8
137 (5000 m)	137-6	159	28	27.15	9.1
	137-8	104	20	22.82	2.6

Fig. 1. abundance data and numbers of individuals on/in sediment and in phytodetrital fluff.



Towards a SCAR "Marine Biodiversity Information Network" (SCAR-MARBIN)?

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Recent international or national Antarctic research programmes have generated a wealth of new marine biodiversity data. These data may contribute significantly to a better knowledge of the Southern Ocean species taxonomy, distribution patterns and ecology but are often characterized by poor visibility and low accessibility.

The need to develop the knowledge of the world marine biodiversity and to make biodiversity data more accessible to science and society was emphasized by the Convention on Biological Diversity (CBD). As a follow-up the Global Biodiversity Information Facility (GBIF) was recently established by OECD to organize and promote the use of biodiversity data all over the world.

The CBD does not directly include the Antarctic region south of 60°S which means that initiatives to manage biodiversity data have ideally to be taken within the Antarctic Treaty System.

Antarctic terrestrial and limnetic biodiversity data as well as bird population data are currently managed by the Australian "Antarctic Biodiversity Database" and fish, krill and some top predator data are handled by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) databases. In addition, some world-wide taxonomic and biogeographic databases offer valuable information on Antarctic species of particular taxonomic groups.

To develop and manage the information about Antarctic marine organisms that is not covered by the current initiatives a proposal is made to establish within SCAR a "Marine Biodiversity Information Network" (SCAR-MARBIN).

The objectives of the SCAR-MARBIN are (1) to compile, integrate and disseminate Antarctic marine biodiversity information for scientific, management, monitoring and conservation purposes (2) to help SCAR contribute in a coordinated fashion to global biodiversity information initiatives, (3) to give feedback to marine biodiversity information requirements from the Antarctic Treaty and SCAR, and (4) to contribute to assess the present state of knowledge and to promote further marine biodiversity research in Antarctica.

The development of the Network includes two distinct aspects: (1) the set up of a Web Portal presenting and linking pertinent existing resources and the integration of the SCAR-MARBIN project in world biodiversity information initiatives, and (2) the contribution to the scientific assessment of Antarctic marine biodiversity.

Two complementary database networks could finally be achieved, respectively based on taxonomical groups and geographic reference zones around the Southern Ocean.

The assessment purpose will require (a) defining a framework and a strategy, (b) completing an inventory of the marine (benthic) biodiversity, in order to provide a reference state for i.e. "Global Change" monitoring purposes, (c) consolidating the existing (and sometimes vanishing) biodiversity information, (d) helping to stimulate biodiversity research and exploratory activities.

The development of a SCAR-MARBIN may be supported by the Belgian Antarctic Programme relying on expertise in related domains such as the CBD clearing house mechanism, the Belgian platform for GBIF or the "Biodiversity of the Antarctic Zoobenthos" (BIANZO) project.

In the framework of the BIANZO project three comprehensive biodiversity databases dealing with amphipod crustaceans (the most speciose animal group in the Southern Ocean), nematodes and echinoids have been build. These databases include extensive taxonomy, distribution, ecology and bibliography information relevant to these groups. They are being integrated into a common portal which may serve as a feasibility study for the development of the SCAR-MARBIN.

Biodiversity of Antarctic echinoids: a comprehensive and interactive database

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Among the 19 post-paleozoic echinoid orders, nine have been reported in the Antarctic, of which four are known only in the fossil record, and two are exclusively Recent. 15 families, with few variations on the whole, represent these nine orders in raw diversity (i.e. number of taxa) through time. However, there are rather important changes in the composition of the fauna at the order and family levels. Only two orders, the Cidaroida and Spatangoida, are present from the Mesozoic to the Recent. The Pedinoida and the Holectypoida are represented only in Mesozoic deposits, although both orders survive in the Recent seas outside Antarctica. The Cassiduloida and the Clypeasteroida have been collected in Cenozoic (Paleogene) formations, but thereafter they disappeared from the Antarctic waters, probably because of the cooling. Holasteroida are reported both from Mesozoic and Recent, but different families represent them in these two periods. This change corresponds to a disappearance of holasterids and corystids from Antarctic continental shelf waters, and to a colonization of the deep-sea austral ocean by other groups. The Arbacioida are poorly represented by a single species reported in a sole record on the tip of the Antarctic Peninsula, and they cannot be regarded as an authentic Antarctic group. If we consider the family level, there is still less resemblance between the fossil faunas (particularly the Cretaceous) and the Recent fauna. The extant echinoids today constitute an abundant and diverse component of the benthic communities in the Antarctic (81 species distributed in 10 families). This has been demonstrated over about a century of Antarctic expeditions and documented by numerous publications, as well as by important information available from unpublished literature and museum collections.

Gathering and ordering the data about Recent Antarctic echinoids led us to build a database and to conceive the idea to make this database a powerful tool for extracting and crossing synthetic information about the Antarctic echinoid fauna. The main aim of this database is to provide a tool for anyone (ecologist, biogeographer...) interested in Antarctic fauna, but not necessarily specialising in echinoids.

"Antarctic echinoids" is an interactive database synthesizing the results of more than 130 years of Antarctic expeditions. Data from 59 oceanographic cruises, starting in 1872, and from museum and private collections have been revisited, and have lead to a systematic revision of the Antarctic echinoid fauna.

The core of the information stored in the database includes (i) taxonomy, encompassing determination keys, morphological diagnoses, illustrations and glossary; (ii) geographic and bathymetric distributions; (iii) cruises and data sources, including museum collections. The database can be queried using two methods, which are available from the home page. (i) A static search allowing a simple browse of the data and displaying listings of taxa, geographic records, cruises, literature and collections, with the possibility to sort and print. With this method, a system of illustrated dichotomic keys allows step by step advancement in the determination of families, genus and species. (ii) An interactive search allowing connections and joined queries between taxonomy, geography, bathymetry, cruises and data sources. This latter method takes full advantage of the relational aspect of the database.

The database comprises information about 81 species gathered into 30 genera, 9 families and 7 orders. For every taxon, the database provides illustrations, diagnosis, geographic distribution map, and histogram of bathymetrical distribution. Localities are divided into quadrants of 5° latitude and 10° longitude in conjunction with depth. Only the localities situated South of the Antarctic Convergence have been considered. Two maps are available for geographic queries, one with cells corresponding to the quadrants, and another one with several sets of larger cells (including the four classical Antarctic quadrants, and rings of latitudinal range). A glossary of echinoid terminology is available to help people who are not familiar with echinoids to read the diagnoses. It includes 139 terms with precise, illustrated definitions. In addition, general documents dealing with the history of Antarctic cruises that have searched for echinoids, the Antarctic tectonic and climatic evolution and an extensive section on the biology of echinoids are provided. For each step, an help screen is available in order to explain and guide the user through the system.

Availability - The database has been built with the software 4D^{TM}. It is available in a compiled form, which does not require 4D to be installed on the user's computer. It works on Apple Macintosh computers, and is also available for Windows machines.

The scavenging crustacean guild in the Antarctic shelf and deep-sea communities: composition, distribution and eco-functional role

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The scavenger guild plays a key role in shelf and deep-sea bottom communities by quickly recycling dead organic matter, from small invertebrates to large cetaceans.

Systematic sampling using baited traps (39 operations) on the shelves of the Weddell Sea, the Scotia Arc and the Peninsula region as well as in the slope and abyssal zone of the Weddell and Scotia seas brought about 100 000 specimens belonging to more than 50 species of benthic and benthopelagic crustaceans and 3 fish species.

Lysianassoid amphipods appeared the most speciose and abundant group, followed by cirolanid isopods, among the crustacean scavengers regularly collected at shelf depths (amphipods, isopods, ostracods, leptostracans, copepods) or below 2000m (only amphipods and isopods).

Antarctic shelf and deep sea lysianassoids showed different degrees of adaptation to necrophagy as shown by the mandible morphology, food odour detection organs, swimming ability, capacity to ingest a large amount of food or the resistance to starvation (feast and famine strategy).

In terms of bathymetric distribution, the trap results indicated a faunal break for scavenger crustaceans between shelf and slope at a depth of about 800 to 1000 m in the eastern Weddell Sea. Only few shelf species extended their distribution below 2000 m. Most of the deep sea species collected appeared to belong to cosmopolitan abyssal taxa but further detailed morphological and molecular analysis should be conducted to firmly establish their taxonomic status.

The eco-functional role of the scavenging amphipod crustaceans was approached by experimental determination of their feeding rate in aquaria maintained in conditions close to those found in the field. These experiments showed that animals feed at a high rate after starvation, display a kind of rhythm in their feeding activity over several days (maybe an adaptation to a discrete food supply), and can resist starvation periods of several months. Their mean feeding rate was estimated at 3-4% body mass/day^{-1}.

Composition and biomass of shallow benthic megafauna along an annual cycle in Admiralty Bay, King George Island, Antarctica

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Introduction: Although Antarctic benthic communities have been described as one of the most stable marine ecosystems in the world (Cattaneo-Vietti et al 2000), it is recognized that the marked seasonality influences primary production at sea (Fogg 1977), and the benthic shallow maritime ecosystem, mainly due to winter resource limitation (Grebmeier & Barry 1991, Nedwell et al 1993, Arntz et al 1994, Clarke 1996). Seasonal benthic studies in Antarctica are relatively scarce, mainly because of difficulties in collecting during winter (Clarke 1996). Shallow studies are scarce and have been carried out mainly near maritime Antarctic stations (Hardy 1972, Brower et al 1995), especially in McMurdo Sound and King George Island (Smith et al 1986, Jazdzewski et al 1986, 1995; Sahade et al 1998). Year-round or comparative summer-winter samplings are few, reporting a high standing crop with little temporal differences in density and composition (Lowry 1975, Kauffmann 1977; Tucker 1988, Mühlenhardt-Siegel 1989, Battershill 1990). Zhang et al. (1986, p. 141), on the other hand, mention that "population density showed obvious seasonal variations".

We studied the megabenthic fauna in two shallow stations in Admiralty Bay, (King George Island) from March to December 1999 (Winter) and from December 2000 to march 2001 (Summer), along a discontinuous 12 month period, completing an entire seasonal cycle. The objective of this paper is to discuss the temporal composition and distribution of the shallow megafauna community along with the influence of physical factors.

Material and methods: Admiralty Bay (King George Island, Antarctica) is a T shaped bay with 122 km^2 and a maximum depth of approximately 535 meters. We selected two stations off-shore of the Brazilian station (12 m and 25 meters depth) for a 12 month study. Depths were selected based on previous summer work in the same area (Nonato et al 2000, Broomberg et al 2000) or in other areas of the Admiralty Bay (Sahade et al 1998), that reported high densities at 12 - 15 m and high diversity at 25 - 30 m. Six replicate samples were collected randomly for each station, using a 0,056 m^2 van Veen grab. Samples were carried out approx. every 22 days. Nine samples (with 6 replicates at each station) were collected between March and December 1999 (winter), and four samples (also with 6 replicates at each station) between December 2000 and March 2001 (summer). The six random replicates for each sample were considered together, resulting in an area of 0.336 m^2 for each sample. Organic matter was determined by combustion at 500°C. An ANOVA test was applied, using three temporal samples with three replicates each (early autumn, 16/03, 02/04 and 22/04/1999; late autumn, 10/05, 31/05 and 01/07/1999; winter 04/08, 25/08 and 20/09/1999) and one for summer, with 4 temporal replicates (29/12/2000, 12/01, 07/02 and 26/02 2001).

Results: Average organic matter content in the sediments was significantly different ($p<0.0001$) for 12 (4.02%) and 25 metres (4.88%) stations. This values also showed a seasonal variation (Fig. 2), with a significant difference between mid-winter samples (June/July samples, $p<0.01$) and late summer (March / april) and the end of the winter (31 august) samples ($p<0.001$), for each depth.

We found a total of 2,892 specimens distributed in 26 taxa (see table 1). Alcohol weight biomass values varied between 10.1 and 100.2 g/0.336 m^2 (average 55.6 g/0.336 m^2, SD: 27.3

g, N: 13) at 12 meters and between 17.4 and 143 g/0.336 m^2 (average 68.9 g/0.336 m^2, SD: 34.4 g, N: 13) at 25 meters.

Similarity analysis using either species abundance or biomass mainly linked stations located at 12 and 25 metres, even from different years. Principal component analysis distributed stations along the factor 1 axis in relation to depth, explaining 27.6 % of the variance. Summer and winter stations were slightly differentiated along the factor 2 axis, which explained 16.7 % of the variance. ANOVA showed no significant ($p<0.05$) variation in community composition, density or biomass for the winter 1999 or summer 2000/2001 period, or between years. Significant ($p < 0.05$) differences along the study period were all related to depth.

Discussion: Total biomass results are within the range of values described by Zamorano (1983), Mühlenhardt-Siegel (1988, 1989) and Jazdzewski et al. (1986) for Admiralty Bay. We found an average of 165.394 g / m2 (S: 81.29, n: 13) at 12 meters compared to 79 - 1,127.3 g / m2 at 15 metres found by Jazdzewski et al. (1986), and a average of 205.149 g / m2 (S: 102.451, n: 13) compared to 139 - 2,126 g / m2 at 30 metres found by these authors. Contrary to Broomberg et al (2000) for polychaetes and Nonato et al (2000) for the megafauna in the same area, we found that diversity values decreased with depth. Variation between sampled years was not significant, and seems to be very small. The lack of temporal significant variation during winter suggests that the megafauna is not affected by the decrease in primary production. Since metabolic adaptations to scarcity of food have not been detected (Arnaud 1977, Clarke 1980), mechanisms to overcome these processes seem to be related to the wide evolutionary spread of typical K-strategies (Clarke 1980), that can be characteristic of a light/production independent fauna (deeper shelf fauna).

Table 1. (continued on next page) Sampling date, name of stations, depth, number of individuals per square meter, number of taxa per square meter, biomass (wet weight) per square meter, and diversity found at each station during the study period.

Sampling date	Station name	Depth	Individuals/ m^2	Number of taxa	Biomass g/ m^2 (wet weight)	Diversity (H´)
16-Mar-99	1/12	12	27	7	125.33	1.72
2-Apr-99	2/12	12	63	8	222.62	1.79
22-Apr-99	3/12	12	32	11	91.08	2.53
10-May-99	4/12	12	114	8	229.17	1.96
31-May-99	5/12	12	111	6	228.01	1.28
1-Jul-99	6/12	12	21	7	30.06	2.49
4-Aug-99	7/12	12	88	5	206.55	1.86
25-Aug-99	8/12	12	59	7	227.99	1.60
20-Sep-99	9/12	12	31	4	79.17	1.22
29-Dec-01	1/12V	12	114	8	93.45	1.90
12-Jan-01	2/12V	12	90	6	216.96	1.08
7-Feb-01	3/12V	12	193	8	101.52	1.31
26-Feb-01	4/12V	12	81	9	298.22	2.14
16-Mar-99	1/25	25	87	10	223.13	1.80
2-Apr-99	2/25	25	145	5	306.25	0.80
22-Apr-99	3/25	25	80	7	151.22	1.29
10-May-99	4/25	25	103	9	162.80	1.57
31-May-99	5/25	25	178	10	190.51	1.08
1-Jul-99	6/25	25	79	4	71.43	0.44
4-Aug-99	7/25	25	27	5	51.79	0.68

25-Aug-99	8/25	25	396	5	285.42	0.30
20-Sep-99	9/25	25	217	5	102.08	1.00
29-Dec-01	1/25V	25	105	3	220.54	0.56
12-Jan-01	2/25V	25	121	6	215.48	0.89
7-Feb-01	3/25V	25	170	8	260.71	0.94
26-Feb-01	4/25V	25	160	8	425.60	1.38

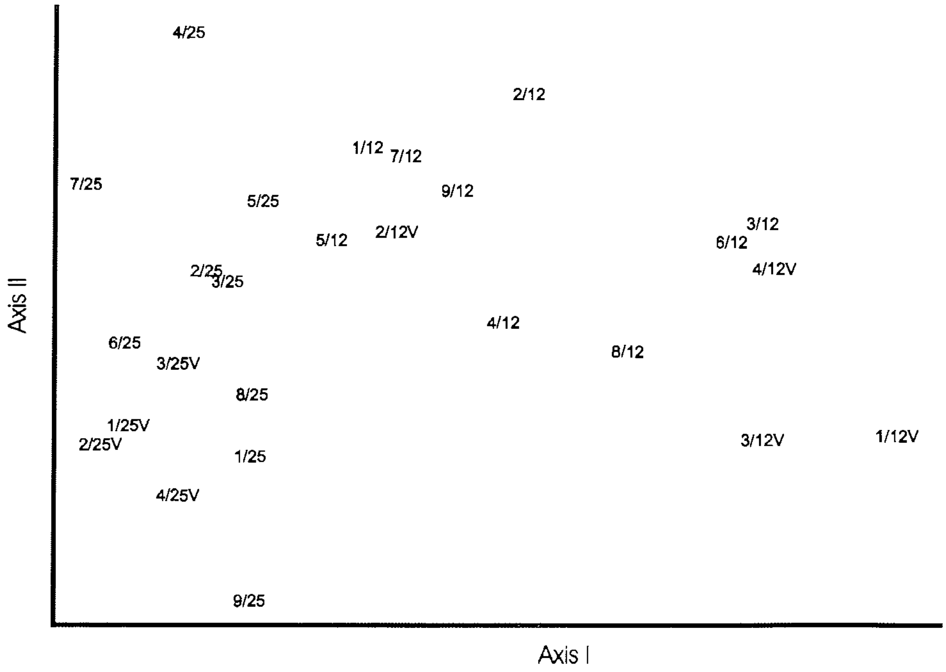

Fig. 1. PCA analysis showing stations of different depths grouped together by seasonal or interannual variations along Axis I. Date and depth of samples are shown in table 1.

Argentinean Patagonia, the northernmost range extension of Antarctic ichthyofauna? A biogeographical perspective

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Antarctica is perhaps the continent where fish diversity has strongly changed in the Cenozoic era. Important factors in this process are the tectonic and oceanographic changes in the Tertiary: the Antarctic shelf became isolated, colder and subject to ice scour, especially important was sea floor spreading that opened the Drake Passage to deep water. The circum-Antarctic current aided the thermal isolation in late Oligocene times, concomitant with the developing and expansion of the Antarctic Convergence and the continental ice pack in the Miocene times. The ecological constraint relating to food sources and habitat space is another important factor to be considered. The Southern Ocean comprises only 313 fish species in 50 families. Benthic fishes are the major component of the fauna on the continental shelf and upper slope of the Antarctic Region. Two perciform groups, the Notothenoidei, and the Zoarcidae, and the scorpaeniform family Liparididae are the most speciose taxa, accounting for 87.4% of the species. Such restriction of higher taxonomic diversity is unusual among shelf faunas. The scarcity of potential sites of high fish diversity, such as shallow waters, estuaries, reefs and intertidal zones, might explain such low biodiversity on the Antarctic shelf. Furthermore, shallow benthic habitats are covered with anchor ice to a depth of about 30 m and are scarred by icebergs to depths of several hundred metres. The absence of competition from taxonomically diverse fauna have allowed notothenioids to fill these niches and become a dominant benthic fish group. Their diversification centred on the evolutionary alteration of buoyancy and the morphology associated with swimming and feeding in the water column. Although they lack gas bladders, in some species density reduction to neutral bouyancy has been achieved through a combination of reduced skeletal mineralization and lipid deposition. Table 1 shows a list of notothenioid families with Antarctic and non-Antarctic fish species. Bovichthidae, Pseudaphritidae and Eleginopidae may have taken place by vicariance during the fragmentation of Gondwana and could have reached coastal Antarctica by ocean current dispersal. Remarkable is the high number of non-Antarctic species within the Antarctic Nototheniidae, a clade that appeared after the formation of the Drake Passage and the Antarctic Polar Front. Why do most of the non-Antarctic species of this family occur in the Patagonian shelf and slope? This region is connected to the Antarctic Peninsula by means of the Scotia Arc, the only topographic bridge-like connection between Antarctica and another mainland. The Southeast South American shelf is one of the widest in the world, with smooth relief; it is characterised by the presence of the Malvinas Current that contributes nutrients to the highly productive marine ecosystem that extends along the edge of the shelf-break.

Family	Antarctic species	non-Antarctic species	Total species
Bovichtidae	1	9	10
Pseudaphritidae	0	1	1
Eleginopidae	0	1	1
Nototheniidae	30	18	48
Patagonotothen	0	14	
Notothenia	3	2	
Paranotothenia	1	1	
Lepidonotothen	4	0	
Gobionotothen	4	0	
Trematomus	11	0	
Pagothenia	2	0	
Cryothenia	1	0	
Aethotaxis	1	0	
Dissostichus	1	1	
Gvozdarus	1	0	
Pleurogramma	1	0	
Harpagiferidae	6	0	6
Artedidraconidae	25	0	25
Bathydraconidae	16	0	16
Channichthyidae	15	0	15
Total	93	29	122

Table 1. Species diversity and geographic distribution within notothenioid families and among nototheniid genera.

The non-Antarctic Patagonian *Patagonotothen* genus has a level of speciosity not seen in another genus of the family, and successfully competes with an assemblage of fish families more diversified than in Antarctica. The Patagonian toothfish *Dissostichus eleginoides* is an important commercial fish in the Argentinean sea. Juveniles are pelagic predators and commonly captured in the continental shelf and upper slope, probably due to the amount of food available in those areas. In contrast, adults inhabit deeper waters and are benthic feeders capable of undertaking feeding migrations in pelagic waters (Table 2). Throughout its range, the Patagonian toothfish was captured up to the Peruvian coasts, and even beyond. The recent finding of an adult specimen in Greenland waters supports the theory that transequatorial migration can occur by isothermal submergence.

Region	Number	Length Ranges (cm)	Depths (m)	% of full stomachs
Argentinean shelf/slope	231	29-95	112-650	58.4
South Georgia shelf	155	18-90	113-306	83.1
South Georgia	3272	57-212	1050-1530	6.9

Table 2. Number, lenght ranges, depths and percentages of full stomachs of the Patagonian toothfish *Dissostichus eleginoides* from Argentinien continental shelf/slope, South Georgia Shelf and South Georgia deep water zone.

The orange throat notothen *Paranotothenia magellanica* inhabits the Magellanic region of South America, the Malvinas/Falklands, South Georgia and the South Orkney islands in the SW Atlantic. The recent finding of a specimen of *P. magellanica* in Buenos Aires Province (Figueroa and Díaz de Astarloa, in revision) a long distance from its usual area of occurrence is of much interest because this area belongs to the Bonaerensean district of the Argentine Province, characterized by the presence of fishes with subtropical affinities in summer, and the occurrence of fishes from the Patagonian district in winter. In addition, *P. magellanica* does not seem to be as strongly demersal as the majority of nototheniids. The spongy structure of the skull and pectoral girdle, as well as the adult pelagic coloration, can be associated with a less settled lifestyle. Adult specimens are frequently captured away from the coast in pelagic waters, while it is rarely caught in large bottom trawls and the diet consists of pelagic organisms. These characteristics could make *P. magellanica* a better migrant compared to other sub-Antarctic nototheniid species when the right conditions prevail. Nototheniidae could be considered as a family in expansion, exceeding all the geographic barriers that confined its Antarctic ancestral habitat; it has settled in the Patagonian continental shelf and slope, competing with new fish groups and seeking new habitats.

The south Chilean fjord region: preliminary results of a novel approach for structural analysis of shallow water benthic communities

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Fjord regions are areas at high latitudes, which exhibit a complex coastal structure and a high marine biodiversity. Due to the species richness, a high number of habitats and a comparably young biological history, fjord regions are ideal areas for the study of zoogeographic patterns and migration processes. The comparison of west Patagonian fjords with surrounding zoogeographic units may reveal important information on the origin of Antarctic and south east Pacific species and their connections. Despite this, the south Chilean fjords are among the least studied marine regions in the world. Up until now mainly the deeper and macro-biologically least diverse soft bottom habitats of the region have been sampled, in part because of the technical limitations of the few and almost exclusively vessel-based expeditions in this area. The highly diverse benthos on rocky substrata has, for the most part, remained unstudied.

Biocoenotic approaches generally offer a more complete picture of zoogeographic connections than pure species distribution patterns. Therefore there is an urgent need for structural analysis of the benthos in the south Chilean fjord region at the community level. The shallow water habitats in the Comao fjord in the northern Patagonian fjord region serve as the laboratory for an ongoing project for developing and applying an effective SCUBA diving-based sampling technique that allows the inclusion of rocky substrates. The method for subsequent data processing utilised techniques of terrestrial phyto-sociology and landscape ecology and is designed to create comparable and reproducible databases on benthic communities and to detect patterns. In the presentation the applied method is outlined and preliminary results on fjord communities and zoogeographic patterns are presented. Hypotheses to explain the distribution patterns are proposed and discussed.

Community analysis of selected Harpacticoida (Crustacea, Copepoda) of the Magellan Region

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During two international expeditions, the "Magellan Campaign" of RV "Victor Hensen" in 1994, and the ANT XIII/4 of RV "Polarstern" in 1996, three different Magellan sub-areas (Magellan Straits MS, Beagle Channel BC, and Patagonian Continental Slope PCS) were sampled with Minicorer (MIC) and Multicorer (MUC) to provide for the first time material of the Magellan sublittoral meiofauna for quantitative analysis. The areas mentioned can be distinguished from geographical, hydrographical and topographical characteristics. Within the framework of the main objective, which was to look for similarities or differences between the Magellan and the Antarctic invertebrate fauna, the aim of the investigation presented was to assess whether the above mentioned areas MS, BC, and PCS are characterised by particular communities of Harpacticoida (Crustacea, Copepoda), with respect to abundance, taxa composition, and species diversity. A total number of 20 stations were collected in the whole sampling area, providing 5,493 adult harpacticoid copepods, which belong to 24 different supraspecific taxa. For faunistic analyses, the representatives of 6 selected taxa had to be chosen, namely the Ancorabolidae, Argestidae, Cletodidae, Diosaccidae, Paramesochridae, and Paranannopinae. The corresponding 1,916 specimens could be assigned to 122 species in 52 "genera". More than 80% of the species are new to science.

From a geographical point of view, Harpacticoida show two "distribution centres": in the Southern MS, and in the Eastern BC. Bathymetric data revealed no gradual increase or decrease with increasing depth.

A detailed community analysis yielded the following results: qualitative comparison allows the distinction of all sub-areas. Each sub-area is represented by a considerable number of exclusive species. On the other hand, several taxa show overlapping distributions between at least two of the sub-areas, leading to similarities between them. It was observed that MS and BC are more similar to each other than to PCS.

However, the qualitative results were confirmed only partly by a quantitative similarity analysis. Multidimensional Scaling failed to show general differences between the three sub-areas. In particular, the stations of PCS could not be united. Also MS and BC can not said to represent self-contained entities with respect to Harpacticoida. In MS a northern group can be distinguished from a southern one, the latter showing greater similarities to stations of BC than to those of the northern MS. BC itself can be split into an inner and an eastern group of stations. The data suggest that the observed distribution patterns are due to small-scale, local conditions, rather than to geographical or bathymetrical, large-scale ones.

Diversity analyses, in particular the Rarefaction Method, reveal MS and BC to present nearly equal species diversity. However, comparisons of all stations indicate strong influences of small-scale variables, as mentioned above, which may overlie possible latitudinal, large-scale ones.

These results refine the hypothesis of a high inter-regional variability in the Southern Hemisphere, expanding such variability to intra-regional and even local levels, at least for representatives of the meiofauna.

Southwest Atlantic mesoscale eddies

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Observational evidence of mesoscale eddies in the southwest Atlantic (SWA) suggests that mesoscale circulation variability plays a fundamental role in the transport of properties along and across the Antarctic Circumpolar Current (ACC) system of fronts and jets. Satellite and ship observations to be presented, show that mesoscale turbulence is more common in this region than usually thought. The main ocean current in the SWA, the Falkland-Malvinas Current (FMC) (see Figure 1), exhibits numerous embedded eddies which contribute to the patchiness, transport and mixing of passive scalars by this strong, turbulent current. Large eddies associated with meanders are generated in the ACC fronts, some of them remaining stationary for long periods. Two particular cases to be examined using satellite altimeter in combination with *in situ* observations, suggest that cross-frontal eddy transport and strong meandering occur where the ACC flow intensifies along the fronts.

The view of ocean currents as smooth, streamlined flows in geostrophic balance has been replaced with the modern view of the ocean as a geostrophic turbulent fluid. Remote sensing and satellite-tracked drifting buoys have reinforced this view by resolving the broadband temporal and spatial variability associated with turbulent scales of motion. Mesoscale turbulence arising from baroclinic and barotropic instability, wind forcing and topographic interactions influence the variability of ocean currents and generate eddies, fronts and jets, which are significant phenomena in the transport of properties such as heat, momentum or nutrients.

Mesoscale processes also have a large influence on the development and diversity of biological species at different trophic levels, from phytoplankton blooms to the life cycle of whales. For instance, according to recent findings by Thatje and Fuentes, planktonic larvae from South America may have reached Antarctic waters by an intrusion of Sub-Antarctic warm-water rings across the ACC fronts. Moreover, the study of mesoscale phenomena is crucial in our understanding of ocean circulation and climate change, and may determine the location and variability of fisheries

There is ample evidence that eddies are widespread phenomena in the SWA. This comes from SeaWiFS color images of the ocean surface, where phytoplankton acts as a tracer that allows the visualization of a wide range of mesoscale structures, and also from maps produced by blending TOPEX and ERS-2 altimetry data, an invaluable means to detect and monitor eddies and their associated currents in near-real-time, particularly for a remote region like the SWA that is often covered by clouds.

The most plausible mechanism involved in the generation of eddies in the SWA is the partial blocking of the ACC by submarine topographic features, which would generate highly barotropic standing and transient eddies and eddy dipoles, similar to those we have observed. It is also possible that the amplification of instabilities into sharp meandering and eddy spin off from the ACC fronts east of the Drake Passage, may result in a cross-frontal exchange of water properties. In the Yagan Basin, continental slope eddies are likely to mix water properties between shelf and oceanic environments, moving across the bathymetry.

The examples to be presented show that there is agreement between the sea surface signature of eddies in the SSH anomaly maps and the vertical structure revealed by the XBT and CTD measurements, and also between altimetry maps and SeaWiFS imagery. This evidence improves understanding and encourages the use of altimeter data in future research of mesoscale eddies in the SWA.

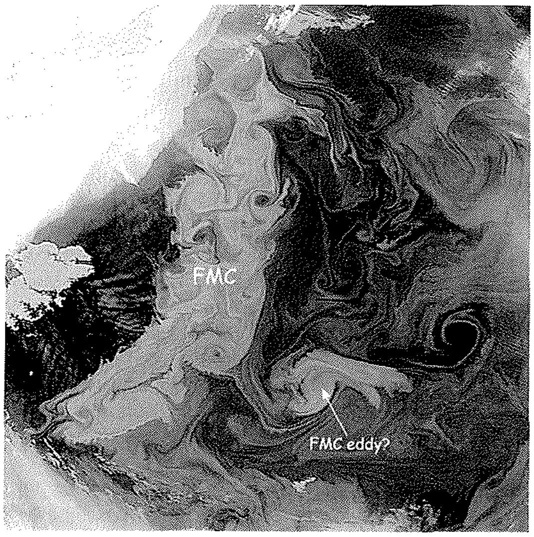

Fig. 1. SeaWIFS true-color image for 11 Nov 2001 of the Falkland-Malvinas Current (FMC), which flows along the shelf edge, offshore from the Falkland-Malvinas Islands. The abundance of eddies is highlighted by the presence of phytoplankton. White areas on the top- and bottom-left of the image are clouds. Image provided by the SeaWIFS Project, NASA/Goddard Space Flight Center, and Orbimage.

Antarctic seals on the coasts of Tierra del Fuego, Argentina – review and update

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Although Antarctic seals spend most or all of their lives in Antarctic waters, a few individuals of certain species occasionally appear on coasts far to the north of their normal habitat. Goodall and Schiavini (1987) presented preliminary data on Antarctic seals found on the beaches of Tierra del Fuego (TF), Argentina. Now, 16 years later (and after 28 years of beach surveys) we bring this information up to date.

Hydrugra leptonyx. The leopard seal is the Antarctic species most often found on our coasts. This seal is circum-Antarctic on the ice shelf and is usually found south of the Convergence. By 1985, we had found 18 cranial specimens on TF, ranging in age from 4 to 25 years (n=7, based on a study of growth layers in teeth) and from juveniles to physically adult animals. We now have a total of 40 specimens for TF. Live, but emaciated, animals have been seen at several localities. The northernmost records known for this species are from Brazil, South Africa and the Cook Islands in the Pacific.

Lobodon carcinophagus. The crabeater seal is also an inhabitant of the barrier ice shelf and the ice pack. Its numbers have multiplied greatly in the Antarctic in recent years, but not many animals have been found on TF beaches. There have been sporadic records to the north, such as Brazil, South Africa and Australia. Our former list registered nine specimens for TF; we now have 18, none of them found since 1994.

Ommatophoca rossi. The Ross seal is confined to the fast ice around Antarctica. The only former records north of 55°S were from Heard Island (53°S) in the Indian Ocean and two specimens from Tierra del Fuego, found in 1976 and 1977. These were both young animals; one of three years of age. No further specimens have been found.

Leptonychotes weddelli. The Weddell seal is circumpolar along the Antarctic ice edge, with isolated sightings from Uruguay, Patagonia, Islas Malvinas (Falklands) and Islas Juan Fernández. Our former record was of a sighting (with photograph) of an animal at Los Chorrillos. In 1998 we found a dead animal near the tip of Península Páramo, in an area actively fished with shore-based trammel nets.

Arctocephalus gazella. The Antarctic fur seal breeds on the islands of the Antarctic Peninsula. Five specimens have been found on TF, four from the north coast and one from the southern, all since 1992.

The pinniped species that are regular residents of Fuegian waters are the South American sea lion, *Otaria flavescens*, and the South American fur seal, *Arctocephalus australis*. Other visitors to these shores are the elephant seal, *Mirounga leonina*, which inhabits waters from 16° S to the Antarctic, and the Subtropical fur seal, *A. tropicalis*, usually found north of the Antarctic Convergence. The elephant seal was considered uncommon in TF, known from a few sightings and several specimens of unknown precedence. A small colony is known from Seno Almirantazgo, Chile. A settlement was discovered in november 1995 at Isla Observatorio, with 49 animals, mostly juveniles.

Crossing barriers – Subantarctic small cetaceans south of the Convergence

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Tierra del Fuego, at nearly 52° to 56° S, has a unique position in the Southern Ocean, stretching farther south than any other regularly humanly inhabited land mass. The waters of the Antarctic Circumpolar Current, Malvinas/Falkland and Humboldt Currents, and its broken, abrupt topography, islands and submerged banks make it an unique area of a highly dynamic oceanography, with varied food for major predators.

Only nine species of smaller cetaceans had been recorded for the Subantarctic and five for Antarctic waters before we began long-term opportunistic beach surveys in Tierra del Fuego.

We now have strandings or sightings of 22 species of the smaller Odontocetes for the Fuegian Archipelago. At least 11 of these have now been recorded south of the Convergence, but only four are found in the High Antarctic, south of 60°S.
The Tierra del Fuego species can be divided into four main distribution groups.

1) Those that are commonly occur south of the Convergence:
southern bottlenose whale, *Hyperoodon planifrons*;
Arnoux's beaked whale, *Berardius arnuxii*;
killer whale, *Orcinus orca*;
hourglass dolphin, *Lagenorhynchus cruciger*.

2) Those which occasionally are found south of the Convergence:
pilot whale, *Globicephala melas*;
southern right-whale dolphin, *Lissodelphis peronii*;
Cuvier's beaked whale, *Ziphius cavirostris*;
spectacled porpoise, *Phocoena dioptrica*;
with only one or two extralimital records of
Commerson's dolphin, *Cephalorynchus commersonii*;
Layard's beaked whale, *Mesoplodon layardii*;
Gray's beaked whale. *Mesoplodon grayi*.

3) The cetaceans commonly found around Tierra del Fuego include all of the above, as well as:
Peale's dolphin, *Lagenorhynchus australis*;
dusky dolphin, *Lagenorhynchus obscurus*;
Chilean dolphin, *Cephalorhynchus eutropia*;
Hector's beaked whale, *Mesoplodon hectori*;
Shepherd's beaked whale, *Tasmacetus shepherdii*;
Burmeister's porpoise, *Phocoena spinipinnis*.

4) Animals from temperate waters, which seldom or only recently have reached the Subantarctic:
bottlenose dolphin, *Tursiops truncatus* (one specimen before 1975, three in 2003);
pygmy right whale, *Caperea marginata*, (one, in 1978);
Risso's dolphin, *Grampus griseus* (none before 1981, now over 70 specimens);
false killer whale, *Pseudorca crassidens* (mass stranding in 1989, five more in 1994);
common dolphin, *Delphinus sp.* (one, in 2002);
Andrew's beaked whale, *Mesoplodon bowdoini* (one, in 2003).

Our records reveal that many species appear to be extending their ranges southward in recent years. This may be merely the effect of much more traffic (increased scientific expeditions and more tourist ships, often with observers onboard) between Tierra del Fuego and the Antarctic Peninsula. It also may reflect changes in the environment that affect distribution of prey and therefore distribution of top predators. These changes may be periodical, and associated with mid-term cycles like the Antarctic Circumpolar Wave or El Niño Southern Oscillation, or may reflect longer time frames beyond the time extension of our studies.

Late Quaternary micromollusc assemblages from the southernmost tip of South America: a paleoenvironment history after the Last Glacial Maximum

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Introduction

Present and fossil marine molluscs from the Magellan region are of considerable interest to life and earth scientists studying faunal change in these latitudes and nearby: the Antarctic region. Late Quaternary macromolluscs are by far the most common taxa recovered and described in raised marine deposits along the eastern and southern coasts of the major island of Tierra del Fuego. Contrarily, beds containing fossil micromolluscs - due to biases in preservation - are unusual in this region. In a previous work on recent molluscs from Tierra del Fuego, mollusc assemblages dated between 8ka - 4 ka B.P. with equivalents in modern communities were recognized. This is interpreted as reflecting a period of climatic stability during the past 8,000 years. However, episodes of minor climatic fluctuations that slightly affected these associations composed of wide ecological amplitude taxa can not be ruled out. The new micromollusc records presented in this study attempt to strengthen the Late Quaternary paleoenvironmental interpretation in the Beagle Channel area. In this way, geomorphological, oceanographical, sinecological and fossil evidence in a radiocarbon-dated chronology must be analysed. The microfossil assemblage study attempts to clarify questions such as: Do Fuegian mollusc assemblages, previously radiocarbon dated as Holocene, reflect the Holocene environmental changes? How do mollusc assemblages and environmental changes of that age compare with those of Antarctica?

Material and Methods

Small specimens (tiny shells) were recovered from a few selected localities along the Beagle Channel in December 2002. Additional information was obtained in previous palaeontological and geomorphological fieldwork carried out by the staff of the Laboratorio de Geología del Cuaternario at CADIC (Ushuaia) and other authors. Palaeontological work was concentrated on a few sites along the northern Beagle Channel coast (almost 54° 55´S): Lago Roca, Río Ovando, Bahía Golondrina and Río Varela (between 68° 34' W - 67° 11' W). These sites are considered as suitable for the preservation of small, thin shells. Thus, biases in selective solution affecting small shells more than larger/thick shelled taxa is not likely to occur in these sediments. Specimens recovered are deposited in the Quaternary molluscs collection from Tierra del Fuego (TDF-Q), in the Cátedra de Paleontología, Escuela de Biología, Universidad Nacional de Córdoba (Córdoba, Argentina).

Molluscan death assemblages

Micromollusc assemblages are mostly composed of small taxa and juvenile specimens of gastropods and bivalves. Each taxa is presently extant within the Beagle Channel. Most of them are eurybathic, occurring in shallow or deeper waters. Other preserved groups represented include chitons, brachiopods, cirripeds, ostracodes, foraminifers, echinoid remains and small fish vertebrae. Despite the bias in preservation due to taphonomic processes, these assemblages retain useful information pertaining to life habit and habitats of the marine benthos from which they are derived. The dominance of gastropods against bivalves appears to be related to natural ecological conditions in these environments. Some taxa were common to the four sites considered, but others were restricted to one or two localities. It appears that there were early migrants around 8-7.5 ka B.P., while others arrived later, apparently during a period of milder climate around 4.5 ka. B.P. These taxa were able to survive in the area, even at climatic deterioration phases during the Holocene.

The presence and dominance of suspension feeders, which belong to different species, showed that marine conditions were fully established around 8 ka B.P. The predominance of epifauna in the Lago Roca site (7.5 ka BP) could be explained by the interaction of environmental parameters such as the prevalence of firm ground substrates more suitable to these groups.

Little changes in faunal composition were detected at the Río Varela site (6.2 ka BP). The non-representation of Pectinidae is noteworthy, but it is plausible that its absence is more related with the distinctly patchy distribution of epifaunal communities in the Magellan region than to a regional or local absence of this group due to a retraction associated with minor climatic changes.

Extensive beds of Veneridae and other macromolluscs in growth position characterize the Archipelago Cormoranes area. It appears that the Río Ovando associations (4.4-4.1 ka B.P.) correspond to warmer waters. This is due partly to the greater diversity and partly to the presence of some taxa. The appearance of the Carditidae in these beds, which were absent in the older ones, is the most notable addition. Finally, further evidence of warmer conditions is perhaps the incidence of drilling (25% tiny shells are bored). Predation by boring gastropods is apparently less effective in higher, colder latitudes. However, to ascertain whether variations in drilling (from place to place as well as among species at single sites) are related to temperature and latitudinal patterns needs a more extensive survey.

An impoverishment in the Bahía Golondrina association (yet undated; based on a second dated site in its vicinity it could be estimated around 1.4 ka B.P.) is noted. Buccinulidae, Muricidae, Cerithiopsidae or Malletidae are lacking. These differences do not necessary reflect advances or retraction of these taxa associated with minor climatic fluctuations. It is more plausible that their absence is related to taphonomic biases (noise) or to the nature of the substrate and patchy distribution of benthic communities as presently occurring along the Beagle Channel.

Palaeoenvironmental considerations

Based on multiple kinds of data (geomorphological, stratigraphical, and palaeontological studies, radiocarbon dates and isotopic analyses) the environmental evolution of the northern coast of the Beagle Channel microbasin could be interpreted. The chronology and deglaciation history of this area has been summarized in previous works.

The major events during the Late Quaternary could be pointed out as follows:

Phase 1: Deglaciation after the Last Glacial Maximum.

Evidence supports that the conclusion that the Last Glacial Maximum in the Beagle Channel area and in the surrounding mountains took place ca. 24-20 ka BP. By 12 ka BP the ice would have disappeared from the southern coast (Puerto Williams, Isla Navarino, 54° 56'S, 67° 38'W) and from the northern coast at Ushuaia (54° 47' S, 68° 20'W). Large volumes of meltwater were discharged into the Beagle valley not only from the main receding glacier, but also by the meltwater streams coming from the valley glaciers on both coasts. Incoming freshwater and the consequent influx of continental organic matter must cause a suppression in the marine water circulation and in the nutrient regeneration, creating food-limited benthic habitats, especially for suspension feeders. The rapid clastic sedimentation that characterizes these environments forms "soupground" substrates.

Phase 2: Early Holocene conditions.

From 10 ka B.P. meltwater influx into the Beagle Channel decreased sharply. Mean sea temperature has been estimated at 3-6° C lower than the present. The maximum transgressive episode occurred between 9 ka-7 ka BP. Around 8 ka BP –under cold-temperate conditions- the present Beagle Channel, as one of the inland passages in the complex net of channels, inlets and islands of the Fuegian Archipelago, was occupied by marine waters, which flooded progressively via constricted waterways connected to the open ocean. This episode might correlate with the oldest and the highest sea levels within the Lago Roca-Lapataia valley, where the Río Ovando site is also located. This area was part of a complex marine inlet during the Early to Middle Holocene. First was a valley-glacier system during the Last Glacial Maximum, but after the deglaciation it was flooded by sea waters from the Beagle Channel. Around 8 ka B.P., the Lago Roca-Lapataia area was a low energy, freshwater estuarine environment, but around 7.5 ka B.P., during the Holocene marine transgression, the whole area turned into a fjord, and Lago Roca and Río Ovando became a shallow marine environment. Dynamic sedimentary conditions or temporary sea-level changes could be interpreted from outcrops with alternating gravel-sand stratification.

Phase 3: Middle Holocene climatic deterioration.

Several palaeoclimatic records have demonstrated that cold climatic conditions occurred ca. 6 ka B.P. along the Beagle Channel. In the Río Varela site (54° 52′ S, 67° 11′ W) marine waters flooded its present mouth area at ca. 6.2 ka B.P., developing a shallow, low energy, near shore environment, strongly fluvially influenced and seasonally ice-covered. Apparently, a phase of climatic deterioration in the region took place between 6.5 and 5.5 ka B.P., but its origin remains yet unclear.

Phase 4: Middle Holocene climatic ameliorization.

In the interval 5.5- 3.5 ka, warmer conditions arose. Data support that around 4.5 ka B.P. marine conditions persisted within the Lago Roca-Lapataia area, and it conformed to a true marine archipelago. Sea level continued its relative regression until reaching present conditions: i.e. the development of the lake from a sheltered marine inlet with invertebrate fauna to a fresh lake in a freshwater archipelago. Thus, this is a unique ice-marine-freshwater archipelago in the region.

Phase 5: Late Holocene neoglacial events.

Neoglaciation is represented in this phase by several ice readvances or glacial episodes after 3.5 ka B.P. above 900 m a.s.l. in the surrounding mountains. Measurements of palaeotemperatures in the Beagle Channel by other authors also showed a depletion at about 3-3.5 ka B.P. The western (i.e. Lago Roca and Río Ovando) and eastern (Río Varela) sites became gradually isolated along the Beagle Channel coast –as it is at present- according to climatic and environmental changes (e.g. progressive formation of gravel ridges), but neotectonic activity also contributed to isolation. In that sense, it was considered previously that different tectonic activity eastwards of the NW-SE Lasifarshaj fault explains why paleoenvironments located to the west of this fault (i.e Bahía Lapataia or Bahía Golondrina) are today at a higher position than similar features located to the east of this fault (i.e. Río Varela).

Comparison with Late Quaternary assemblages from Antarctica

When the studied region is compared with Antarctic environments similarities are found. After Late Pleistocene deglaciation, the oldest Holocene beaches were developed ca.7-8 ka B.P. In both regions, the mollusc group represents the most consistent fossil record; and all the recovered taxa are extant species, with wide ecological range within their respective surrounding waters. Related to species composition these palaeofaunas overlap slightly, with a considerable number of genera in common. These affinities and relationships are best explained on the basis of more recent migrating taxa originating at the higher southern latitudes around Antarctica, rather than on the basis of ancient connections when the two regions formed part of the Wedellian Province.

Summary and conclusions

Interdisciplinary research makes it possible to interpret changes in the species composition of Holocene microfossil assemblages. Differences in faunal composition during the Holocene are firstly related to patchy spatial distribution of local communities or different local environmental situations (diversified space); and secondly related to changes in faunal composition following oceanographic episodes after deglaciation (temporal successively changes).

Finally, life scientists studying biodiversity might integrate the historical context of the modern benthic assemblages. Some events (i.e. speciation, extinction and immigration) might be anticipated to vary during the Quaternary as a great number of changes took place. A response to questions such as: "Did Antarctica provide immigrant stocks to slightly less cool or cool-temperate regions?" can be reinforced from the fossil record. It was recently demonstrated that at least 13 glacial events, associated with climatic deterioration, had occurred in the Southern Patagonian Andes from the Late Miocene (5-7 Ma) to Late Glacial times (16-10 ka B.P.). Thus, we can expect that the "geologically recent times" are also a key to the present.

A comparative analysis of megabenthos biodiversity between the Magellan region and the Scotia Arc by means of visual methods

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Visual documentations by means of underwater video and photography were used for a qualitative and quantitative analyses of the mega-epibenthic community structures of selected areas from the Magellan region and from some of the islands located along the Scotia Arc. In detail; 6 ROV transects were analyzed from the CIMAR 8 expedition in the fjords and channels of the Taitao Peninsula, southern Chile (44°-47°S), during June 2002. Another 6 transects were chosen from a survey which was carried out during February 2003 in the Strait of Magellan, and 6 ROV transects, carried out during the LAMPOS cruise in April/May 2002, provided the data from the Scotia Arc. Water depths of all ROV transects varied between 15 and 300 m (10 - 50 m: Strait of Magellan; 100 - 200 m: Taitao Peninsula; 200 - 300 m: Scotia Arc). Additionally, at 8 stations along the Scotia Arc, and between 291 and 574 m of depth, a photo sledge was used. Sessile filter feeders were dominant in the depth range 100 to 300 m, such as bryozoans and anthozoans in the channels and fjords of the Taitao Peninsula, and hydrocorals, sponges and actinians along the Scotia Arc. However, along the Scotia Arc, the sessile fauna seems to be more abundant north of the Antarctic Convergence when compared to the islands next to the Antarctic Peninsula. On the other hand, decapod crustaceans and echinoderms dominated all shallower locations of the Taitao Peninsula and in the Strait of Magellan. The poster will give detailed results of the ongoing analysis, such as species composition, diversity and abundances from all ROV transects, and a preliminary comparison of the community structures of the three investigation areas.

Molecular systematic of calanoid copepods: Do super families exist or not?

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Based on morphological characteristics Andronov (1974 & 1991) organized the phylogeny of calanoid copepods into ten superfamilies. Although Ohtsuka & Huys (2001) confirmed this construct, there is still a contrary discussion on the existence of superfamilies within calanoid copepods. To answer this question on the molecular level sequences from about 14 species were taken to generate phylogenetic trees by three different methods (maximum parsimony, neighbor joining, maximum likelihood). Specimens of dominant and common copepod species were collected in the antarctic and subantarctic Zones, which are stable in environmental conditions in relation to other climatic zones. We sequenced fragments from about 650 basepair (bp) lengths of two genes, the 18S ribosomal RNA gene and the mitochondrial (mt) Cytochrome oxidase I (COI) gene. Both have no direct relation to morphological characters. The morphological phylogeny of Andronov (1974) is equal to our results, while Park (1986) separates the superfamily Spinocalanoida from the superfamily Clausocalanoida. Separation of Spinocalanoida is not found either in trees of the rRNA 18S gene or in trees of the mtCOI gene, which is more variable and useful for the phylogenetic estimation of more closely related species. High similarity in the main pattern of morphology and molecular trees supports the existence of four superfamilies.

Distribution patterns of South American and Antarctic sea anemones (Cnidaria: Anthozoa)

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The South Chilean Archipelago is known for its abundant and diverse fauna. In spite of strong currents and thermal fronts, conditions in the sublittoral are astonishingly stable and show few latitudinal and seasonal changes. Shallow water species have temperate characteristics and show quite a high level of endemism for the west coast of South America. As an eye-catching and abundant element of the fauna, sea anemones are suitable objects for a biogeographic analysis. Their sessile lifestyle and their, for invertebrates, longevity make them possible objects for long-term monitoring. The distribution of some sublittoral species is known to be correlated with the temperature regime. For South American coastal species, there are two clear frontiers, where the fauna changes quite abruptly: the region around Chiloe Island (42° S) in the Pacific Ocean and the Rio de la Plata (approx. 38° S) in the Atlantic. Generally the shallow-water fauna differs significantly from the deep-water fauna: the latter are typical inhabitants of the Patagonian cold water archibenthal and thus regularly found in the South West Atlantic and in the West Antarctic. Some of these deep-water species can be found in relatively shallow water in South Chilean fjords. Two sea anemone species are distributed all around the southern tip of South America; a few species have a disjunctive distribution and can be found on both sides of southern South America. It seems that only one species managed to cross the Strait of Magellan. But several of the species described for South Chile and the Antarctic are of uncertain taxonomic status. For a complete biogeographic analysis, subantarctic sea anemones have to be more intensively and continuously sampled and taxonomic uncertainties have to be resolved.

Antarctica's contribution to Southern hemisphere biodiversity: An isopod's tale

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Over geological times Antarctica has been the province of Gondwana that has experienced the most severe changes since the Cretaceous. Following its poleward migration and changes in global water currents, Antarctica and the Southern Ocean experienced a transition from mild subtropical climates to an extreme polar environment. While the glaciation of the Antarctic continent resulted in the almost complete loss of terrestrial life, the situation for the marine realm is far less clear. The fossil record indicates mass extinctions and massive shifts in faunal composition around Antarctica, and yet the Southern Ocean has a rich and diverse benthos compared to Arctic waters. However, the question of whether this rich fauna is simply the result of receiving imports from lower latitudes for a longer time than in the Arctic or if it represents the outcome of an evolution *in situ* has remained controversial.

The Serolidae are one of the dominant members of the peracarid crustaceans, which apparently benefited most from the changes. The family Serolidae evolved in shallow waters around early Gondwana and the break-up of Gondwana and the climatic change of the Southern Ocean has critically influenced their phylogeny. A phylogenetic tree based on four nuclear and mitochondrial genes reflects several key points regarding the history and origin of Southern Ocean biodiversity.

There is indeed evidence for large-scale extinction, which eradicated most basal serolid species from the Antarctic shelf, leaving survivors only outside the Southern Ocean on the continental shelves of Australia and South America. This loss of diversity was subsequently compensated by a radiation of Serolidae on the Antarctic shelf during the Miocene with Antarctic Serolidae outnumbering tropical and temperate species today. The simultaneous and independent submergence of serolids from the Antarctic shelf into the deep-sea suggests that glacial cycles on the Antarctic shelf have been instrumental not only in shaping the distribution of species but also in the formation of the species itself.

The phylogeny of the Serolidae suggests that a substantial part of the Southern hemisphere biodiversity has evolved at high latitudes and under polar conditions with some of it now contributing to the diversity of deep-sea environments at lower latitudes.

Recent molecular data indicate that this Antarctic biodiversity may still underestimated because many species previously believed to be circumpolar consist in reality of a series of cryptic species.

Polychaetes of the deep Weddell and Scotia Seas – composition and zoogeographical links

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Polychaetes from quantitative box core samples taken in the deep Weddell and Scotia Seas during ANDEEP I and II were analyzed to elucidate the species composition, abundance, density and dominance in both basins below Antarctic waters. The results are discussed with respect to differences (or similarities) among the stations downslope and at the bottom of each basin, between the two Antarctic basins, and in a wider zoogeographical context of deep-sea basins worldwide. The continental slope down to 2000 m of the Weddell Sea has been sampled during a previous expedition (ANT XV/3, 1998), which, like other comparable studies, revealed that the continental shelf communities of the Antarctic extend much further down than in other areas. However, a distinct shift toward a true deep-sea community was not observed, but can now be documented based on the first quantitative dataset from Antarctic deep-sea basins. Furthermore, comparisons with the near-by Angola Basin in the southern Atlantic can be made. Apparently the sills between basins are no obstacle for many polychaetes, resulting in widespread distribution patterns, although interestingly there are differences among polychaete families as to the extent of species areas. The results of this study will help to give a better estimate of deep-sea species richness on the one hand and some ideas about the colonization of the deep Antarctic waters on the other.

The sponges of the Weddell Sea slopes and abyssal plain: A normal deep-sea fauna with some surprises

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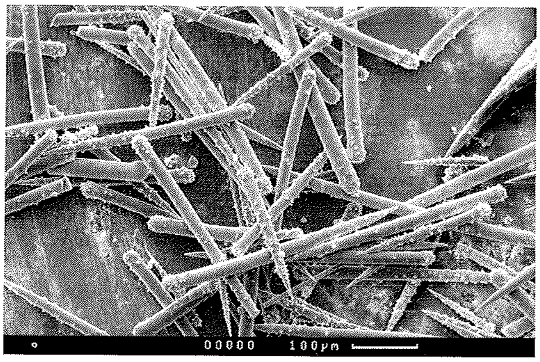
Most deep-sea sponge species are fragile and unspectacular as to form, colour and size. For these reasons they are often more or less fragmented during sampling, and easily overlooked in benthic videos and photographs. Nevertheless, more than 100 years of deep-sea investigations all over the world have shown the group to be ubiquitous and relatively diversified on continental slopes and abyssal plains.

During the ANDEEP II-expedition, the Agassiz trawl was used successfully on 12 stations of which 11 gave sponges, an unusually high share. The sponges in best condition were taken by the epibenthic sledge, an experience we also have from other sampling programs. All together, ca. 180 specimens were collected of which 2% belong to Calcarea (2 species, 1 new), 24% to Hexactinellida (15 species, 3) and 74% to Demospongiae (45 species, 1 new, Fig. 1), quite a normal picture as compared to the catches of other deep-sea expeditions. Material from 3 deep Weddell Sea stations taken during ANT VII/4 (EPOS leg 3) 1989 and ANT XIII/3 1995 (EASIZ I) will be included in this study, adding further 1 calcareous, 1 hexactinellid and 16 demospongid, bringing the total number of species treated to 61. At least 10 species are new to the Antarctic region, and for many of those known we could largely extend their depth range. The Calcarea are worked up by D. Janussen, H.T. Rapp & O.S. Tendal, the Hexactinellida by D. Janussen, K. Tabachnik & O.S. Tendal, and the Demospongiae by D. Janussen & O.S. Tendal.

We see a tendency of decreasing numbers of species and abundance with increasing depth and from the western towards the eastern northern Weddell Sea. On the slopes the catches contained many robust, eurybathic and sometimes large demosponges, especially of the genera *Suberites*, *Polymastia* and *Radiella*. Most of the sponges found are shelf species showing the well known Antarctic large depth range downslope, and this to an exceptional degree. The largest diversity of Hexactinellida is found at around 1000 m, and this group shows a remarkable change in species composition between the different stations, which makes the characterisation of the assemblage difficult. From about 3000 m the true deep-sea representatives dominate, some of them extending into shallower depths. For the demosponges these are members of the family Cladorhizidae, especially supposedly carnivorous species of the genera *Asbestopluma* and *Chondrocladia*, for the hexactinellids members of the family Rossellidae, mostly species of the genera *Bathydorus* and *Caulophacus*. The deep Weddell Sea is still heavily undersampled in terms of sponges, this is particularly evident for the Hexactinellida: Several genera and species described from the Weddell Sea were reported only once, and this is the reason for their apparent "endemism". A real surprise was the occurrence of 3 genera and species of calcareous sponges at depths from 1100 to 4000 m. Members of this class are rare in most deep-sea areas, and have not been reported in Antarctica from depths larger than 850 m before.

Fig. 1. Spicules of *Clathria* (*Thalysias*) n. sp. From c. 1120 m depth (ANDEEP II, st. 33-3)



The deep sea – shelf connection: What Antarctic bivalves can tell us

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Marine invertebrates of the Southern Ocean are thought of to have low diversity and large geographic and bathymetric ranges. To test this hypothesis phylogenetic relationships among Antarctic species of bivalves were investigated using partial sequences of the 28S rDNA, ITS rDNA regions and a combined dataset. Studies on marine invertebrate species in other regions of the globe with wide bathymetric ranges show evidence of depth related isolation and speciation among slope species, for example in amphipods, molluscs and echinoderms. If this is the case in Antarctic invertebrates then estimates of species diversity in the benthic fauna may have to be increased with implications to our understanding of global patterns of biodiversity in the ocean.

The bivalve specimens were collected during the Antarctic *Polarstern* cruises ANT XV/3 (EASIZ II), ANT XXI/3+4 (ANDEEP I & II) and ANT XXI/5 (LAMPOS) along the Scotia Arc from the Burdwood Bank along the Scotia Arc to the Antarctic Peninsula and in the Weddell Sea. The sample depth varied between 260m on the shelf and 6300m in the deep-sea trenches. The specimens and specimens included in this study belong to the families Cuspidariidae, Limidae, Limopsidae, and Philobryidae. Here evidence is presented that some circum-Antarctic species represent a species complex consisting of several clades. The relationships within the species complex indicate that clades are separated bathymetrically.

Reproductive isolation on the continental slope may have occurred as a result of speciation along environmental gradients correlated with depth and suggests that dispersal among groups is limited vertically. Gene flow occurs along isobaths over distances of ~2000km (deep sea groups) to ~5000km (shallow group), equivalent to entire Scotia Sea and to Marion Island. The molecular data suggest a deep-sea origin for some Antarctic bivalves (e.g. Limopsidae) and molecular clock estimates support the hypothesis of recent radiation in Antarctic invertebrates.

Shallow-water late Middle Eocene crinoids from Tierra del Fuego: New southern record of a retrograde community structure

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The Mesozoic marine biotic revolution is thought to have caused irreversible changes in the life habits of many invertebrates. The stalked isocrinid crinoids exemplify this. Today they are only known in deep-water environments but since their appearance in the Triassic, isocrinids were mostly restricted worldwide to shallow-waters and, with few exceptions, during the late Cretaceous they migrated to deep-water settings. Crinoids have been found in Tierra del Fuego since the beginning and middle of the last century in the La Despedida and Leticia beds, originally dated as Cretaceous-Early Cenozoic or Late Cretaceous, respectively. However, research in progress by the authors indicate that fossil crinoids from the Argentinean portion of the Tierra del Fuego Island are all isocrinids restricted to the shallow-water Leticia Formation of the late Middle Eocene age (Fig. 1). The palaeoecologic and stratigraphic implications of these anomalous, shallow-marine isocrinids are addressed and compared with similar records, mainly from Antarctica.

Stalked crinoids, frequently preserved almost perpendicular to the stratification (Fig. 2) are relatively common to abundant in certain fine, glauconitic, sandstone beds of the Leticia Formation in different localities from the central and coastal parts of the Isla Grande de Tierra del Fuego (Fig. 1). Short segments of the column, up to 10 cm long, are the only preserved parts; isolated cups or partial broken arms were not recorded and specimens preserved almost perpendicular to bedding planes never present a radix. The section of the column is pentagonal or less frequently cylindrical and the nodals bear three small, subcircular cirrus sockets. Based on these features the material is assigned to *Isselicrinus* sp.

The megafauna associated with *Isselicrinus* sp. includes solitary corals, gastropods, bivalves, rare nautilids, shark teeth, penguin bones and ophiuroids. Particularly, well preserved specimens of *Ophiura elegantoides* Furque and Camacho were described for the Leticia Formation. The associated foraminifera are characterized by the great abundance of large Nodosariacea, commonly reaching up to 4 mm in length being the largest multilocular foraminifera found in Argentina. Research results from sedimentology, ichnology, and foraminiferal palaeoecology all indicated shallow marine to marginal marine settings, including estuarine and tidal channels environments, for the crinoid-bearing Leticia Formation. The record of the first appearance of the planktonic foraminifera *Globigerinatheka index* (Finlay), just below the crinoid horizons, indicates a late Middle Eocene age for the Leticia Formation (not older than 42.9 Ma).

Recent studies in Tierra del Fuego recognized a rather complete Upper Cretaceous-Middle Miocene stratigraphic column. The Upper Cretaceous, part of the Palaeocene, and Lower Eocene are relatively deep-marine deposits; the Oligocene-Lower Miocene deep-marine deposits; and parts of the Palaeocene and Eocene, and the Middle Miocene, shallow marine deposits. Isocrinid crinoids and ophiuroids are only known from the Leticia Formation. They are apparently absent from the rest of the stratigraphic column in Tierra del Fuego and, with the exception of some scarce columnal records from the Danian, not belonging to the genus *Isselicrinus,* crinoids are also apparently absent in the rest of the shallow marine Patagonian Cenozoic Argentinean deposits. In the Chilean portion of the Austral Basin, there is only a mention of *Balanocrinus*, in the Paleocene Chorrillo Chico Formation.

Post-late Cretaceous, shallow-water records of fossil isocrinids are exceedingly rare and they are only known in the Southern Hemisphere. A few specimens of isocrinids were recorded in shallow-water deposits from New Zealand (*Metacrinus* sp. in Paleocene conglomerates and indeterminate isocrinids in Oligocene limestones) and Australia (?*Nielsenicrinus* sp. in late Paleocene limestones). In contrast, abundant specimens of *Metacrinus fossilis* Rasmussen and ophiuroids are known from the late Eocene tidal deposits of the La Meseta Formation in Seymour Island, Antarctica. The abundance of *M. fossilis* in the late Eocene shallow-water, tidal deposits of Antarctica is particularly significant as the only reliable known fossil species of a modern isocrinid genus widespread in deep-water settings in the Indo-Pacific region. Modern species of the genus *Isselicrinus* are also restricted to deep-water settings. In parallel with *M. fossilis* from Antarctica the record of *Isselicrinus* sp. in the late Middle Eocene of Tierra del Fuego demonstrated the shallow water occurrence of taxa now restricted to deep-water settings.

Only the cups and the first proximal attached columnal are preserved in *M. fossilis* from Seymour Island and this was interpreted as a secondary stalkless condition following autotomy of juvenile stalks during ontogeny. On the contrary, only part of the stalk is preserved in *Isselicrinus* sp. from Tierra del Fuego. Isocrinids never have a radix and they are attached to the bottom by distal cirri. However, during highly energetic events they can lose the basal hold and drift away until the cirri grasp a new surface; during this process part of the distal column may break off and it could remain buried if followed by a sudden, high-rate sedimentation event. Moreover, given the recent finding that stalk fragments detached and isolated from a living crinoid in aquaria can survive more than one year, the burial chances of parts of the remaining column could be very high. This mechanism is probably the best taphonomic explanation for the isolated, almost perpendicular to bedding preservation of part of the column of *Isselicrinus* sp. in the Leticia Formation.

Shallow-water, suspension feeder benthonic communities with abundant stalked crinoids were dominant in the Palaeozoic and their success was correlated with the lack of an intensive predation pressure. The success of bivalves and gastropods with defensive structures as the dominant benthonic, shallow-water communities in the Cenozoic was related to the Mesozoic marine revolution, characterized by the increasing dominance since the Jurassic of durophagous predators, including sharks, teleostean fishes and crustacean decapods. The abundant record of isocrinids and ophiuroids in localized horizons in the late Eocene from Antarctica was considered an anomaly and explained as a retrograde community. Palaeozoic conditions of low-predation levels for the late Eocene were interpreted as driven by global cooling and changes in productivity associated with increased upwelling in Antarctica.

The finding that the isocrinid crinoids from Tierra del Fuego are stratigraphically restricted to the late Middle Eocene has significant paleoecologic implications as it clearly indicates a regional extension of anomalous, suspension-feeding communities with abundant stalked crinoids in the late Middle and Late Eocene of the southern ocean. The anomalous success of retrograde, dense, suspension-feeding echinoid populations in the late Eocene of Antarctica has been explained by the joint combination of three critical conditions: low predation pressure; low rates of sediment resuspension; and a high flux of particulate organic mater. The accelerated cooling trend during the Late Eocene was linked to the disappearance or marked diminution of durophagous predators and to the high productivity of particulate organic matter promoted by increased upwelling.

Similar outstanding associated characteristics are inferred for the late Middle Eocene of Tierra del Fuego. Abundant crinoid columns are recorded in glauconite-rich intervals, suggesting localized periods of low sedimentation rates. Recent observations demonstrate that the phosphatic concretions, so common in different Late Eocene-Miocene conglomerates in Tierra del Fuego, have been reworked from late Middle Eocene sediments, suggesting nutrient-rich ocean waters during this time. The excellent preservation of the foraminifera associated with isocrinids at La Despedida section is linked to disaerobic bottom conditions, suggestive of a high flux of particulate organic matter. In addition, a striking feature is the absolute dominance and diversity of Nodosariacea in certain horizons. Absolute dominance of this superfamily is typical for the Jurassic and early Cretaceous, with a declining relative dominance in the Paleocene, and thus the dominance of Nodosariacea in the late Middle Eocene can also be considered as a retrograde feature.

Extant isocrinids are stenothermal; living generally within a short range of temperatures and in the deep-sea their bathymetric distribution is controlled by temperature. Fossil isocrinid were probably also stenothermal, and it seems reasonable to assume that the declining temperature of the seawater during the late Middle to Late Eocene not only produced a decline in predation pressure but also favoured the preferred range of temperature for different isocrinid groups at slightly different times, allowing for the bloom of shallow-water, isocrinid populations in the southern oceans.

This study was partly financed by ANPCYT-FONCYT PICT 07-8675. We thank T. Oji, University of Tokyo, for helping with the systematic of isocrinids and valuable comments.

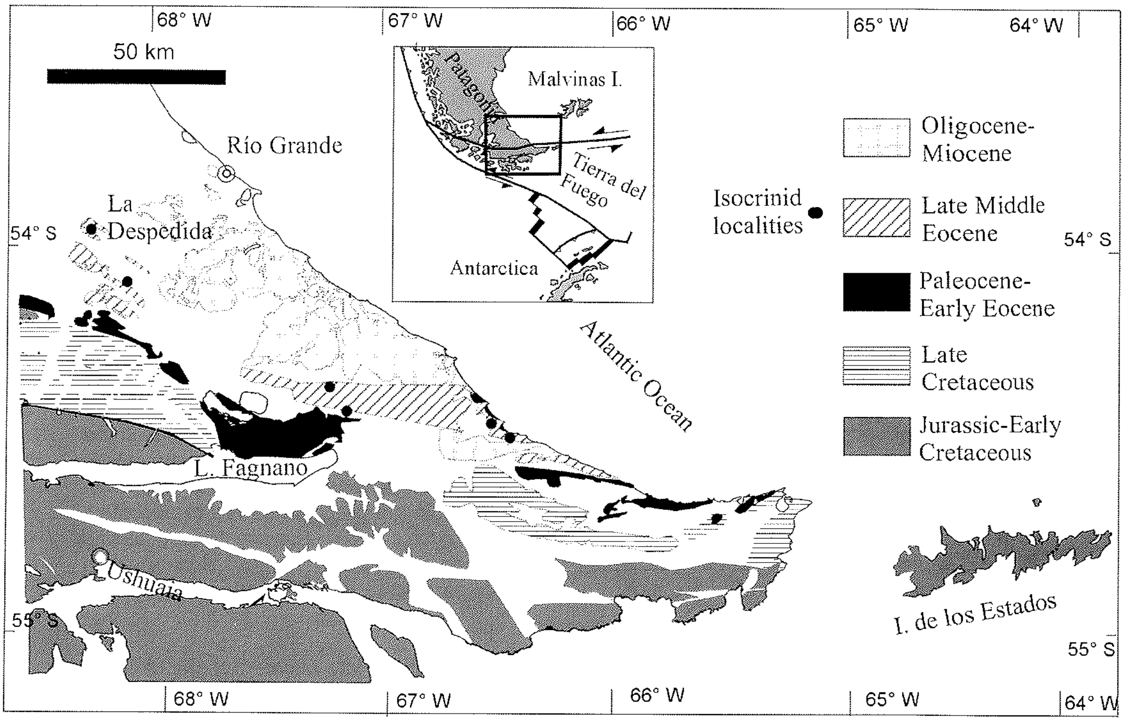

Fig. 1. Schematic geology of Tierra del Fuego, distribution of upper mid Eocene rocks, and localities with the fossil isocrinid *Isselicrinus* sp.

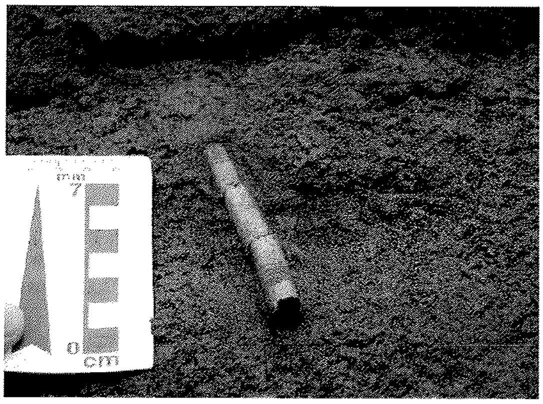

Fig. 2. Vertical column of *Isselicrinus* sp. preseved almost perpendicular to the stratification in glauconitic sandstones from the late Middle Eocene of Tierra del Fuego.

Fish of the Bellinghausen Sea area compared with adjacent regions of Antarctica

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The aim of this paper is to analysis the composition, abundance, biodiversity and the biogeography of the benthic fish communities of the Bellingshausen Sea. The fish were collected during the "BENTART03" expedition in January-March 2003, using an epibenthic sledge Agassiz and traps with bait. A total of 770 specimens weighing 36247 g were caught. 12 families and 29 genera are represented in the samples examined. Almost all samples were obtained with the sledge Agassiz (59% in weight and 71% in number of specimens). The rest of material was caught with three-four traps (40% in weight and 27% in number of specimens).

Due to the high number of species collected during this survey, which are still under study, we can show some results. The most important species in terms of richness and abundance were the family Nototheniidae (43% in terms of weight and 66% in terms of abundance), represented by six genera; most of them were caught with the Agassiz. However, the family Zoarcidae is the second most important group (26% in terms of weight and 25% in terms of abundance), and almost all of these were caught with traps. A few individuals distributed among different genera represent other families, which means that this zoological group is very diverse. A comparison between this fauna and that from adjacent regions of Antarctica is being made.

Diatom assemblages of the Weddell and Bellingshausen Sea, Marguerite Bay and Gerlache Strait during Austral summer

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Data of the taxonomic composition of Antarctic phytoplankton is particularly well documented in the literature. The qualitative composition of phytoplankton in Antarctic waters presents many interesting features. Distinct biogeographical zones can be identified by phytoplankton species. Furthermore, qualitative studies are helpful in the comprehension of size structure of the phytoplankton community from the Southern Ocean and lead to questions such as nanoflagellate versus diatom dominance, which has implications for the carbon fluxes through the water column.

Scanning electron microscopy has become a technique regularly used for precise taxonomic identification of phytoplankton cells. Nevertheless it is not practical for using on large suites of samples, therefore the inverted microscope is recommended.

This work constitutes an attempt to make a taxonomic survey of diatoms from the Atlantic sector of the Southern Ocean.

Original data presented here were collected during XIX and XX Brazilian Antarctic cruises, both conducted in mid-austral summer, in 2001 and 2002, respectively. The XIX expedition covered the northwestern area of the Weddell Sea and the XX expedition collected samples from the

Bellingshausen Sea, Marguerite Bay and the Gerlache Strait. Figure 1 shows the area and the locations of stations.

Water samples were collected from the surface using 5 L Niskin bottles mounted on a CTD rosette deployed from the Brazilian RV *Ary Rongel*. For electron microscopy, 50 ml of water were filtered through Nuclepore polycarbonate filters of 1 μm pore-size. Filters were washed free of salt crystals in distilled water and air dried. For inverted microscopy, aliquots of 100 ml were immediately preserved in 4% formalin (final concentration) and kept away from light.

Taxonomic investigation was carried out using scanning electron microscopy for both cruises and inverted microscopy was also used for the samples from the XX Brazilian Antarctic expedition.

The organisms were identified to the species level when possible. In order to avoid misidentification and perpetuation of erroneous data, a higher classification was assigned for doubtful specimens.

A total of forty-four taxa of diatoms were identified, including twenty generic taxa, twenty-three species and 1 category of resting spore (Table 1).

Most of the data presented here have often been cited as important components of diatom flora from the Antarctic ecosystem. The local phytoplankton community consisted of cosmopolitan and southern cold water species. However, the species *Minidiscus chilensis* was reported for the first time in Antarctic waters according to literature used for this work.

The Bellingshausen Sea region presented the highest richness. Twenty-eight species were observed in this region including *Thalassiotrix antarctica, Actinocyclus* sp., *Grammatophora* sp., and *Lioloma* sp. which were found only in this region. Twenty-six species were registered in Marguerite Bay. Three of them, *Asteromphalus hookeri, Leptocylindrus* sp. and *Licmophora* sp., were constrained to this area. Twenty-four species were found in the Gerlache Strait , of which *Banquisia belgicae*, *Chaetoceros criophilus, Nitzchia longissima, Rhizosolenia chunii, R. curvata,* and *R. setigera* were identified in this area only. The Weddell Sea presented fifteen species. *Pseudo nitzchia turgidula*, *Thalassiosira gracilis* var. *expecta* and *Chaetoceros* resting spores were restricted to this region.

Chaetoceros spp., *Navicula* spp., *Pseudo-nitzchia* spp., *Thalassiosira* spp., and one species *Fragilariopsis kerguelensis* were observed in all studied areas.

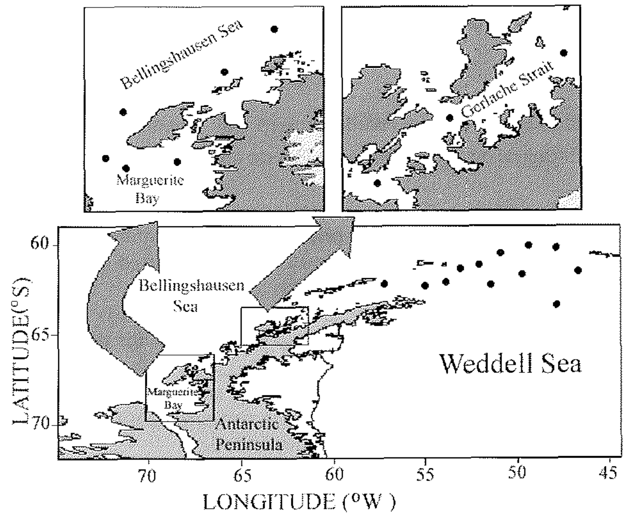

Fig. 1. Location of the sampling stations in Weddell and Bellingshausen Sea, Marguerite Bay and Gerlache Strait.

Taxa	Weddell Sea	Marguerite Bay	Bellingshausen Sea	Gerlache Strait
Actinocyclus actinochilus	+	+		
Actinocyclus sp.			+	
Asteromphalus hookeri		+		
Banquisia belgicae				+
Chaetoceros atlanticus		+	+	
Chaetoceros criophilus				+
Chaetoceros spp.	+	+	+	+
Corethron criophilum	+		+	+
Coscinodiscus sp.		+	+	
Cyclotella sp.		+	+	
Cylindrotheca closterium	+		+	
Dactyliosolen antarcticus	+	+	+	
Eucampia antarctica		+	+	+
Eucampia spp.		+	+	
Fragilaria sp.		+	+	
Fragilariopsis kerguelensis	+	+	+	+
Fragilariopsis rhombica			+	+
Fragilariopsis spp.		+	+	+
Guinardia sp.		+	+	
Grammatophora sp.			+	
Haslea trompii	+			+
Hemiaulus sp.		+	+	
Leptocylindrus sp.		+		
Licmophora sp.		+		
Lioloma sp.			+	
Minidiscus chilensis	+	+		+
Navicula spp.	+	+	+	+
Nitzschia longissima				+
Nitzschia spp.		+	+	+
Odontella sp.		+	+	+
Proboscia alata		+		+
Pseudo-nitzchia turgidula	+			
Pseudo-nitzchia spp.	+	+	+	+
Rhizosolenia chunii				+
Rhizosolenia curvata				+
Rhizosolenia setigera				+
Rhizosolenia spp.		+	+	+
Thalassionema sp.		+	+	+
Thalassiosira dichotomica	+		+	+
Thalassiosira gracilis var. *expecta*	+			
Thalassiosira gravida		+	+	+
Thalassiosira spp.	+	+	+	+
Thalassiotrix antarctica			+	
Chaetoceros resting spore	+			

Table 1. Diatoms species list and distribution.

Ant'Phipoda as a cornerstone of Bianzo: from data-center to distributed information center.

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In the framework of the EASIZ programme a set of databases was developed as part of a 'Reference Center for Antarctic Marine Biodiversity', especially devoted to amphipod crustaceans, otherwise known as Ant'Phipoda. From the beginning, consistency and sustainability were the main objectives of the database structure. As data from a century of exploring the Antarctic had to be assembled in the same format, a comprehensive relational database scheme was created. Furthermore, as many researchers are creating their own datasets based on different metadata, giving rise to distributed and replicated databases, the need for a central portal to cross-interrogate the different datasets arose.

Three comprehensive biodiversity databases (concerning Amphipoda, Nematoda and Echinoidea), dealing with Antarctic data, were already built and regrouped in "Biodiversity of the Antarctic Zoobenthos", or BIANZO, project. From the conceptual model to the real-time implementation of this new-born project, different platforms needed to be concurrently built and continually checked to keep the coherency of the global picture. The course of this presentation will be limited to three important focal points concerning database administration and application development. Bottom-up, they handle the data collected during the expeditions, the metadata of the containers and the technical platform that provides the stability for it all.

As we are not the first and we won't, for sure, be the last to tackle the problems of biologically oriented data management, we try to keep up with current accepted standards both in the life sciences and in the information technology community. Global initiatives like GBIF, ITIS and WOD, and SCAR initiatives like JCADM and MARBIN, providing us with standards and tools to facilitate global sharing, integration and dissemination of biodiversity data, should therefore be integrated into the resulting information system. Even so, the 'carrier' of our data should be considered as important as the value of the data itself and keeping track of current IT protocols should therefore be an important management factor.

Last but not least, the role of the end user as the driving force of the information system should be considered at any step along the way. Often, when considering database management, the first concern is to obtain data and all the following steps tend to be forgotten. As databases are less accessible than spreadsheets, scientists use the latter a lot more compared to the former. The continuity of data and much useful information for future investigations are lost in this way. To keep the motivation for data input, decent outputs should be generated in a way the research gains by using and reusing the data entered through the information system. Monitoring use and queries of this system can be a big asset for evaluation of the existing workspace and further developments.

The establishment of the Magellan polychaete fauna: when and from where?

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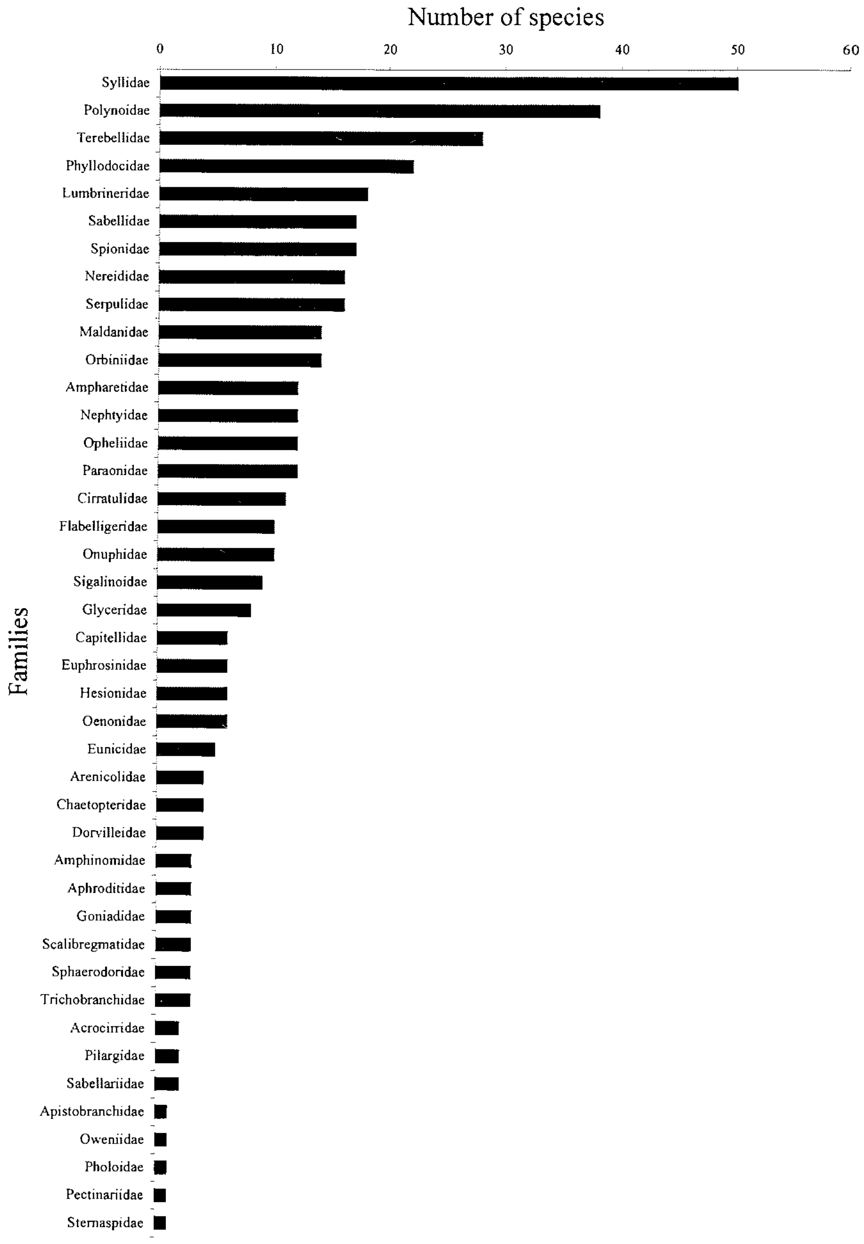
During the last glaciation the South Patagonian Icefield formed a single continuous ice shield from about 35 to 56 °S, thus totally covering the whole Magellan region. After the retreat of these ice masses the present-day complex web of channels, inlets, basins, and coast lines developed. Invasion of benthos into these complex habitats was possible only since the mid-Holocene (8000 – 4000 ^{14}C.yr. BP) after the rise of sea level, i.e. the benthos of the Magellan region can be considered as being relatively young.

Based on 377 species from 42 polychaete families (Fig. 1), including material collected on three expeditions between 1994 and 1996 and complementary literature information, we suggest ways of colonization from adjacent shallow - and deep - water areas.

We believe that speciation processes did not happen in the present-day polychaete fauna of the Magellan region due to its relatively young age. All existing species therefore are similar to those still living in the source areas from where they conquered the Magellan waters when the glaciation period finished thousands of years ago.

Via the composition of the polychaete fauna in different depth ranges of the Magellan waters and adjacent areas we are able to describe the likely routes of migration from different source areas leading to the diverse polychaete fauna in the Magellan region nowadays.

Fig. 1. Species richness of individual polychaetes families in Magellan region.



On the zoogeography of the Asteroidea of the Scotia Arc

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Abstract

The Asteroidea fauna of the southern tip of South America and from the areas surrounding area Antarctica is composed of three main groups of species: Magellan Region, Subantartic region and Antarctic region. Knowledge of the Asteroidea fauna started in Magallanes with Agassiz in the 18th century, increasing to the Antarctic and surrounding areas at the end of the XIX and the early XX with the input of the European scientific expeditions. Currently, more than 200 species of Asteroidea from the Antarctic Region are known. In the Magellan Region about 37 species have been described and for the Scotia Arc about 10 species. This fauna has shown a higher richness to the south in comparison with the Magellan region and an increasing endemic species in the same direction.

Zoogeographically the starfishes fauna from the Magellan region share species with the Falkland Island to the east, with the Scotia Arc and Antarctic Peninsula to the south and Australia and New Zealand to the west. Nevertheless, the main relationship should be between South America and Antarctica through the Scotia Arc.

The aim of this presentation is re-evaluate the zoogeographical connections through the Scotia Arc as a natural bridge for faunal exchange between South America and the Antarctic Continent.

For this lecture we use information from the Victor Hensen Expedition in 1994 and the Lampos expedition in 2002 and former information about Antarctica.

Fifty-nine species were identified during the Victor Hensen and Lampos campaigns. Magellan species (Pacific and Atlantic) make up 36% of the total. Subantarctic species make up 50% and 14% comprise the Antarctic species.

As a result of cluster analysis (Fig. 1) we can distinguish a strong relationship between the subantartic region (Weddell), South Atlantic, South Pacific and Magellan Region. According to this figure, the Scotia Arc seems to be a transitional area between the Subantartcic and Antarctic. This connection is obvious if we look carefully at the species of starfishes and their distributions from south America to the Antarctic Peninsula through the Scotia Arc, for example a) the Asteroids of widest distribution range in Antarctica (e.g. *Diplasterias brucei*, *Kampylaster incurvatus* and *Notasterias armata*); b) Asteroidea from the Weddell and Ross Areas (e.g. *Leptychaster magnificus* and *Lysasterias belgicae*); c) Asteroidea from the circumantarctic occurring in Magellanes Region (e.g. *Bathybiaster loripes* and *Solaster regularis*); d) Asteroidea from the Magellan region (e.g. *Doraster qawashqari*). Nevertheless, while the Scotia Arc is included in the Antartcic region, the presence of several endemic species (e.g. *Granaster nutrix* and *Perknaster charcoti*) indicates a zoogeographical peculiarity of this subregion that should suggest that this zone, due to its geological history and to west wind drift, is the drift-route for the Asteroidea fauna colonizing the Antarctic Region. Therefore, the Magellan-Antarctic connections are more notable than others, such as Australia-Antarctica, and this situation could explain the presence of groups of congeneric generas like *Porania* spp., *Acodontaster* spp. *Diplasterias* and others.

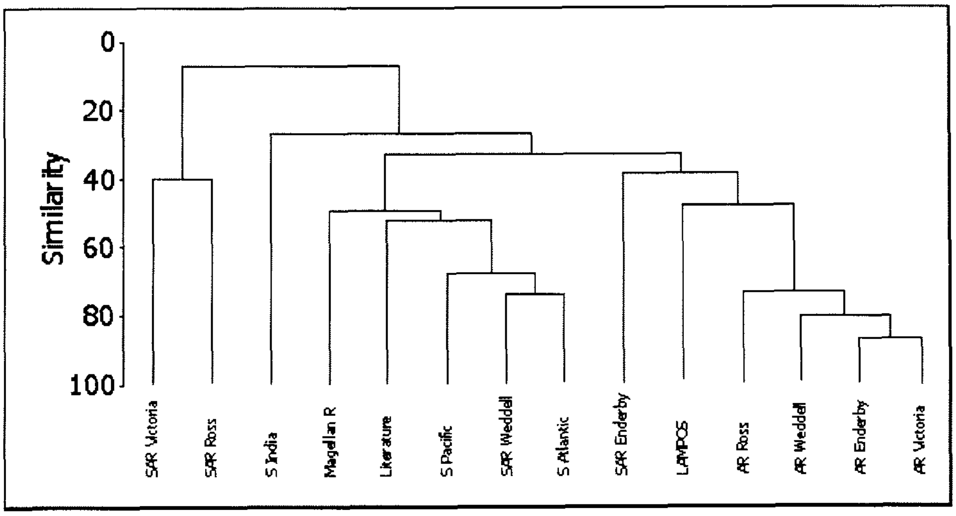

Fig. 1. Affinity cluster analysis from the different areas of study.

Stable isotopes and fatty acids used as biomarkers to distinguish Antarctic amphipod trophic guilds

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Peracarid crustaceans and amphipods in particular are an important group in the Southern Ocean and one of the most diverse in the macrozoobenthos.

As part of a multidisciplinary study of the amphipods ecological roles in Antarctic benthic systems, about 150 specimens belonging to 25 species of 10 of the most common amphipod families occurring in the Southern Ocean were selected for this study of amphipod trophic patterns. Beside "classical" stomach content analysis or field observations, the use of naturally occurring stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) has recently provided new insights into food web ecology. This method is based on the direct relationship established between the isotopic signature of an organism and that of its prey. Nitrogen-15 typically shows a step-wise increase with trophic level within a food chain. Closer to the value of the diet, carbon-13 is preferentially used to assess the relative proportion of potential primary sources in a trophic web (e.g.: pelagic vs benthic contribution to food intake). Furthermore, for several species, the lipid signature – which has already been used successfully to help understand marine trophodynamics – and more particularly the fatty acid composition has been investigated as trophic biomarkers to reveal more precisely to which trophic guild they belong.

The family Epimeriidae can be chosen to illustrate the use of stable isotopes to study trophic characteristics of organisms. Three species bellonging to this family have been sampled: *Epimeria similis* (n=15), *Epimeria georgiana* (n=16) and *Epimeria macrodonta* (n=1). For carbon as well as for nitrogen, *E. similis* and *E. georgiana* are significantly different (*E.similis* $\delta^{13}C$= -25 ± 1.45 ‰, $\delta^{15}N$= 7.6 ± 0.51 ‰; *E. georgiana* $\delta^{13}C$= -23.2 ± 1.47 ‰, $\delta^{15}N$= 8.6 ± 0.95 ‰; $p<0.01$), the unique specimen of the third species excluding it from any statistical analysis. *E. macrodonta* appears less enriched in nitrogen, followed by *E.similis*, whereas the highest nitrogen ratios are displayed by *E.georgiana* (Fig. 1). The position of those different species in the graph, which illustrates the portion of the food web in which they are coincides rather well with their presumed trophic level. Indeed, analyses of *E. georgiana* gut contents revealed a wide variety of food items identifiable by hard remnants: crustaceans (mysids and amphipods), polychaetes and holothurioid ossicles. Otherwise *E. similis* is considered as a specialist feeding mainly on cnidarians and, more precisely, their stomach contents are essentially composed of hydroid perisarcs. Preying on suspensivore organisms which are depleted in ^{15}N (hydrozoan $\delta^{13}C$= -26.9 ‰, $\delta^{15}N$= 4.9 ‰), it seems quite logical that *E.* similis occupies a lower position than *E.georgiana* in the food web. The single specimen of *E.macrodonta* doesn't allow any conclusion and has to be completed with more samples.

In other families as for the Lysianassidae, the trophic patterns are less evident: the different species display a continuum of values rather than bellonging to well defined trophic categories.

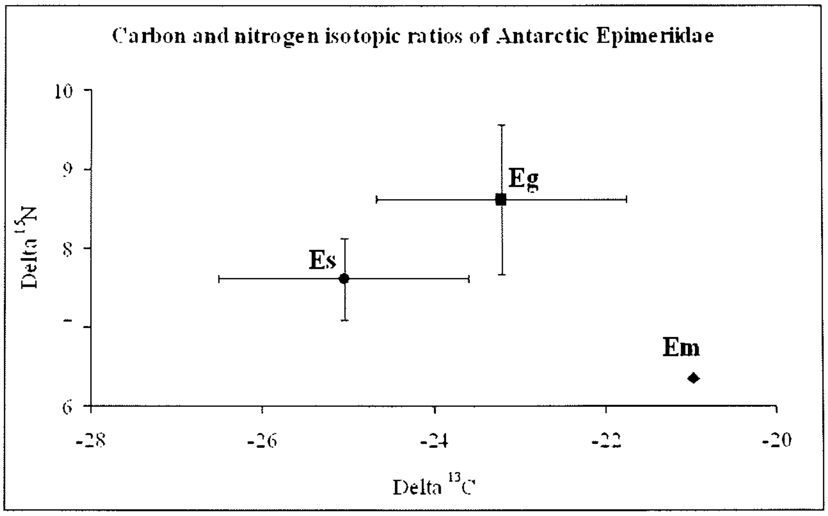

Fig. 1. Carbon and nitrogen isotopic ratios of Antarctic Epimeriidae *E. georgiana.*

Extreme sensitivity of biological function to temperature in Antarctic marine species

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Biological capacities to respond to changing environments dictate the success or failure of populations and species over time. The major environmental characteristic in this context is often temperature, and organisms across the planet vary widely in their capacity to cope with temperature variation. Antarctic marine species are more sensitive to temperature variation than groups elsewhere, having survivable temperature envelopes in experiments between 5°C and 12°C. Their medium to long-term physiological limits are set by transfer of tissues to anaerobic metabolism, which occurs 3-4°C below their experimental upper limits. Here we show that for biological functions important to long-term survival of populations and species, as well as at the individual level, these animals are even more tightly constrained. The Antarctic bivalve mollusc *Laternula elliptica* and limpet *Nacella concinna* both survive in experiments to between 9°C and 10°C, but suffer 50% failure in essential biological functions at 2-3°C and complete loss at 5°C. In *L. elliptica* the measure used was the ability to rebury when removed from sediment, and in the limpet the measure used was the ability to right itself when turned over. This loss of biological capacity is caused by a reduction in aerobic capacity for work. A 2°C rise in sea temperature would markedly reduce population scale ability to perform biological functions, and hence survival capability in these species, which are amongst the most temperature tolerant so far known from Antarctica.

Evolutionary versus ecological success of brooding among Antarctic benthic marine invertebrates

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The unusually high proportion of brooding compared with broadcaster species among coastal Antarctic invertebrates has traditionally been interpreted as an adaptation to local environmental conditions. However, species with a planktotrophic developmental mode are generally ecologically dominant (in terms of abundance of individuals) along Antarctic coastal areas. We argue that the present shallow Antarctic benthic invertebrate fauna is the result of two processes acting at different temporal scales. First, the high proportion of brooding species compared with coastal communities elsewhere may corresponds to species-level selection occurring over geological and evolutionary times. Second, the ecological dominance of broadcasters may be the result of processes operating at ecological timescales that are associated with the advantage of having pelagic larvae under the current highly disturbed conditions of the Antarctic shallow benthic environment.

Oxidative stress in invertebrates

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A number of biochemical alterations have been described and, in turn, proposed as a basis for the irreversible injury that may follow exposure of cells to partially reduced oxygen species (ROS) generated under stressful environmental conditions. The addition of electrons to oxygen generates the superoxide anion, hydrogen peroxide and the highly reactive hydroxyl radical. The best known catalysts for the reduction of hydrogen peroxide are transition metals, particularly ferrous ions. Lipid peroxidation has been proposed to be among the reactions involved in the irreversible cellular injury due to reactive oxygen species. ROS can be scavenged by molecules such as carotenoids, and tocopherol compounds. Temperature is the major factor modulating metabolic processes in ectothermal animals. Species of the North Sea intertidal areas, such as the mud clam *Mya arenaria* (Myoidea), experience annual fluctuations between 0 and 18°C in its intertidal habitat. Species, such as *Nacella (Patinigera) deaurata*, from the lower intertidal and the sublittoral zone of the Beagle Channel, experience low environmental stress conditions but annual temperature fluctuations are between 3 and 10°C. In comparison, the Antarctic bivalve *Laternula elliptica* (Laternulidae) has a more stable temperature regime (-1.9°C to +2°C in coastal areas). The aim of the present study was to assess lipid peroxidation in *M. arenaria, N. (P.) deaurata,* and *L. elliptica*, by detecting the content of lipid radicals by electronic paramagnetic resonance (EPR). Iron content, iron reduction rates and lipid soluble antioxidant content (α -tocopherol, ß -carotene) were compared among the three species. *M. arenaria* compares well with *L. elliptica* in size, feeding mode and its general ecology, and *N. (P.) deaurata* is one of the most conspicuous limpet species in the Beagle Channel, Argentina.

Individuals of *L. elliptica* were collected from 5-12 m depth in Potter Cove, King George Island, Antarctic Peninsula, 62°15'S, 58°44'W. The clam *M. arenaria*, abundant on the German North Sea coast, was collected from an intertidal mudflat near Bremerhaven, Germany in March 2000. The limpet *N. (P.) deaurata* sampling was carried out in July 2002 in Punta Occidental (54°50'S, 68°20'W) in the Beagle Channel.

Lipid radicals combined with the spin trap POBN resulted in adducts that gave a characteristic EPR spectrum with hyperfine coupling constants of a^N= 15.8 G and a^H= 2.6 G, in agreement with computer spectral simulated signals obtained using those parameters. Table 1 shows a significantly higher content of lipid radicals in *L. elliptica* as compared to *M. arenaria* and *N. deaurata*. Higher levels of lipid peroxidation may correlate with elevated accumulation of transition metals in animal tissues. Table 1 shows that iron content in L. *elliptica* is significantly higher than in the other two species. The higher lipid radical formation in *L. elliptica*, compared with N. *deaurata* and M. *arenaria*, could be mainly ascribed to the higher concentration of catalytic active iron in *L. ellipitica* or to a higher conversion rate of bound to bioavailable forms of iron since reduction of bound iron might be the key primary event for lipid peroxidation. No significant differences are shown between *M. arenaria* and N. *deaurata*.

α -Tocopherol and ß -carotene are also higher in *L. elliptica* than in *M. arenaria* and N. *deaurata* (Table 2). Still, the increased content of α -tocopherol in *L. elliptica* as compared to *M. arenaria* and N. *deaurata* seems to be insufficient to limit lipid peroxidation, probably due to the increased Fe^{2+} content that could effectively catalyse free radical reactions. Thus, increased deterioration of the membranes in cold adapted organisms could be also partially related to catalytically active iron content in sediment-dwelling animals from vulcanic areas of the Antarctic.

Table 1. Lipid radical content, iron reduction rate, and iron content in the three molluscs.

Species	Lipid radical content (pmol/mg FW)	Fe content (nmol/mg FW)	Fe reduction rate (pmol/min/mg FW)
M. arenaria	114±21	1.1±0.2	72±8
N. (P.) deaurata	192±32	1.9±0.3	84±4
L. elliptica	422±47a	5.0±0.6a	188±33a

a significantly different from values for *M. arenaria* tissue at $p \leq 0.01$ (ANOVA).

Table 2. Lipid soluble antioxidants in the three molluscs species.

Species	α-tocopherol (nmol/mg protein)	ß-carotene (pmol/mg protein)
M. arenaria	2.7±0.8	nd
N. (P.) deaurata	5.3±0.8	14±2
L. elliptica	10±2a	43±8a

a significantly different from values for *M. arenaria* tissue at p≤ 0.01 (ANOVA).

nd stands for non-significant

An abundance and structural comparison of epibenthic and infaunal communities from the South Shetland Islands to Admundsen Sea

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Introduction

Despite of the fact that various expeditions have collected benthic material from the southern Antarctic Peninsula and Bellingshausen Sea during the last two centuries, our knowledge regarding the distribution and composition of benthic fauna in these Antarctic sectors is quite poor, and based on only a few studies. In contrast to the Weddell Sea, where many expeditions have been carried out and the benthos has been more thoroughly investigated, only some isolated megabenthos sampling, using Agassiz trawl and underwater video images, have been carried out at Peter I Island and in the Bellingshausen-Amundsen Seas. To date, no expedition has focused its research efforts only on studying the Pacific High Antarctic sector.

To fill this gap, the Bellingshausen-Antarctic Peninsula area was chosen as a subject for Spanish research into the Antarctic benthos during the second cruise on board the R/V Hespérides. The use of a methodology and gear types identical to those developed during the 'Bentart-95' survey in the South Shetlands zone, with an integration of infaunal, epibenthic and suprabenthic compartments within the water column and sediment conditions, was aimed to enable us to compare the structure and composition of the macrobenthic assemblages of both areas.

Numerical abundances and biomass data were obtained during both surveys with three sampling gears in order to 1) compare abundances of larger taxa, 2) explore whether there was any latitudinal distribution pattern, and 3) characterize the composition of the macrobenthos assemblages.

Due to the fact that the 'Bentart-2003' expedition finished in March 2003, a major effort has been made to present a preliminary comparative approach to the IBMANT-ANDEEP Workshop.

Material and Methods

During the 'Bentart-2003'cruise, carried out on board the R/V Hespérides in January-February 2003, 25 stations were sampled, covering an area from the Bellingshausen Sea to the Antarctic Peninsula continental shelf, from depths of 48 m to 2045 m. These sites were distributed along several transects perpendicular to the coastline, (one located at Peter I Island), at six depth strata, ranging from 20 m to more than 2000 m.

In each sampling site, quantitative macrobenthic data were collected using a combination of different sampling gear: the Agassiz trawl for epibenthic fauna, the epibenthic sledge for suprabenthic crustaceans, and a box corer for the benthic infaunal fraction. Furthermore, several sediment parameters were collected; CTD profiles were taken at 18 stations to study the vertical distribution of temperature, salinity, and fluorescence; and water samples were obtained, at selected depths, for the determination of inorganic nutrients, dissolved oxygen, nitrogen concentrations, chlorophyll *a* and production. Due to the presence of pack-ice, on the continental shelf of Bellingshausen Sea, only the stations deeper than 400 m could be sampled; moreover, storms made it impossible to sample in shallow waters on those Antarctic Peninsula transects.

Identical gear and the same sampling methods were used during the 'Bentart-95' survey at 31 stations along a transect placed along both the north and south coasts of Livingston Island, covering a study area from the Drake Passage to the Antarctic Peninsula.

In both surveys, the material collected by Agassiz trawls and vertical dredges was sieved through a 10 and 5 mm mesh and separated into several major taxonomic groups. For each of these groups, the numerical abundance and wet biomass were determined.

For comparison, data on numerical abundances from the suprabenthic sledge (the sum of all three nets) have been used, whereas from the vertical dredges, means of 3 replicates have been used, standardized to the square metre; finally, wet-mass data standardized to 5 minutes trawling time and estimated from a 50-l subsample, have been considered in the case of the Agassiz semi-quantitative samples.

A triple approach has been used. First, a variance analysis was conducted separately on the three total numerical abundances or biomasses by station data-set and latitude, longitude and depth parameters. Then, a multivariate approach was used to obtain density by station values (individual number per m^2) of 35 taxa collected with the Van Veen grab or box corer; and a standardized and log(x+1) transformed matrix data set was used to calculate the faunistic similarities among stations by means of a Bray-Curtis index; a non-metric multidimensional scaling (MDS) was used to plot the similarities among stations on a two-dimensional plan. Finally, the three similarity matrices constructed with 33 stations where Agassiz, suprabenthic sledge and a vertical dredge were taken during 'Bentart-95' and 'Bentart-2003' surveys were correlated using the Spearman's rank coefficient ρ_s, to test whether the spatial distribution patterns of epibenthos, suprabenthos and infaunal macrobenthos assemblages were significantly related in terms of their faunistic similarity. For this purpose, a non-parametric permutation procedure, RELATE from the PRIMER Package Program, was used.

Results and Discussion

Abundance distribution pattern

In spite of the differences of abundance values in the three benthic compartments at a mesoscale level, these were clearly higher in the South Shetlands than in the Bellingshausen Sea–Antarctic Peninsula zones (Figure 1). Abundances of suprabenthic crustaceans and infaunal macrobenthos and epibenthic wet biomass presented significant differences ($\rho>0.001$) along latitude and longitude, as well as identical distribution patterns of epibenthic abundances related to depth in both zones, presenting their highest densities around 100 m and with a markedly decreasing shelf-slope gradient.

Numerical abundances of infauna reached values of 44,000 ind./m^2 and mean densities of 12,000 ind./m^2 in the South Shetlands, whereas in the Bellingshausen Sea they did not exceed 1000 ind./m^2 per station, with an average of 600 ind./m^2. The same result was observed for the epibenthos biomass, which reached up to 230 kg per station in the South Shetlands area, while the biomass barely reached 5-6 kg on the Bellingshausen shelf. For suprabenthic crustaceans, the densities were 6 times lower at southern latitudes than in the northern area, with mean values of 162 individuals per station in the south and 1040 in the north.

All of this indicates that there is an abundance distribution cline (gradient) in the Pacific Antarctic, whether linked to latitude or related to other, unknown factors.

Assemblages and faunistic composition

The MDS plot of 44 Van Veen grab and box-corer stations and 36 major taxa clearly illustrate the pronounced differences that exist among the macrobenthic compositions of the South Shetland and Bellingshausen - Antarctic Peninsula zones (Figure 2), which is also indicated by the suprabenthos, and mainly by the epibenthic fauna.

A compact cluster (on the left Figure 2) grouped the 13 stations on the Bellingshausen shelf-slope, the sole station in the Admunsen Sea (from depths of 400 m to 2050 m), and three stations on the Antarctic Peninsula (110-1060 m); close by, another cluster of 6 stations (4 from Peter I and two from Paradise Bay) was found at depths from 90 to 400 m. The first cluster is characterized by low macrobenthos densities, ranging from 60 to 1530 ind./m^2 and 625 ind./m^2 of mean; the Bellingshausen assemblage seems dominated by polychaetes (66%), followed by bryozoans (9.5%), foraminiferans (6.4%) and ophiuroids (5%). The Peter I stations presented the highest density values, from 1200 to 5940 ind./m^2 and a mean of 2395 ind./m^2, with dominance being shared among polychaetes (47%) and bivalves (35%). The South Shetland infaunal macrobenthos presented the highest densities, up to 44,000 ind./m^2 off the southern part of Livingston Island, and a mean of 12,000 ind./m^2, and, although polychaetes constituted the same proportion as in the Bellingshausen Sea, these assemblages were characterized by bivalves and ascidians.

Despite the fact that three macrobenthos compartments were similarly characterized by a latitudinal and depth gradient, the non-parametric RELATE test from the PRIMER package indicated that the patterns of epibenthos and infaunal macrobenthos distribution were not significantly correlated. This finding requires further exploration.

As the results of the Agassiz trawls show, suspension-feeders are almost absent on the Bellingshausen shelf, motile fauna being the main component of the epibenthic biomass, with decapods (18.2%) and cephalopods (17.6%) contributing to this figure, together with regular echinoids (14.4%) and holothuroids (11.2%). On the other hand, the ascidians are the main filter-feeder group, constituting 70% and 50% of the total epibenthic biomass in the remaining areas (Peter I Island, Antarctic Peninsula, and South Shetlands).

The fact that pack ice covers the sea surface almost all year, and the high sedimentation rate coming from iceberg scouring, together with a very low primary production in the water column (as indicated by the CTD data), and also presumably slow bottom currents and reduced horizontal transport, provide unfavourable conditions for filter-feeders on the Bellingshausen shelf, as has been suggested by Starmans *et al.* in 1999.

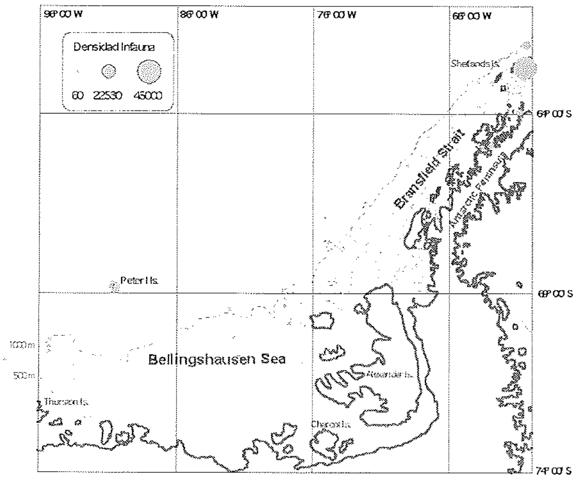

Fig. 1. Distribution of macrobenthic densities (number of individuals per m^2) from Van Veen grab and box-corer sampling during 'Bentart-95' and 'Bentart-2003' surveys

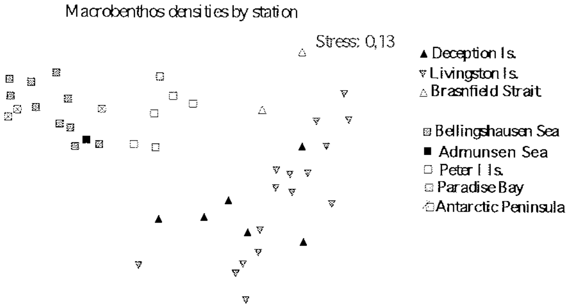

Fig. 2. MDS plot (stress=0.13) showing similarities among the macrobenthic fauna (densities in individuals per m^2) from Van Veen grab and box-corer stations during the 'Bentart-95' (Deception Is., Livingston Is. and Bransfield Strait, right stations) and 'Bentart-20032 surveys (Bellingshausen Sea, Admunsen Sea, Peter I Is., Paradise Bay and Antarctic Peninsula, left stations).

Macrobenthos biodiversity along the Livingstone Island transect, from Drake Passage to the Antarctic Peninsula: First global taxonomic results of the 'Bentart-95' survey

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Introduction

As pointed out by Arntz *et al.* (1999), although our current knowledge about biodiversity seems to indicate that there is no common pattern for species richness in the different ecosystems, or for taxonomic groups, in the Southern Ocean, the fact is that not much data, much less comparable data, is available regarding diversity and evenness in the Antarctic.

This paper presents data on the macrobenthos biodiversity along a transect placed at the longitude of Livingstone Island, from the Drake Passage to the Antarctic Peninsula, with depths ranging from 40 to 850 m. Quantitative –or semiquantitative—data were collected during the 'Bentart-95' survey at 31 stations using three different sampling methods: Agassiz trawl for epibenthic fauna, epibenthic sledge for suprabenthic crustaceans, and Van Veen grab for infauna. In addition, qualitative sampling was carried out using rock-dredge and scuba-diving techniques. The samples were sieved using three mesh sizes (5, 1 and 0.5 mm, for Van Veen, and 10, 5 and 1 mm for Agassiz). In this study only specimens retained on a 1.0 mm (Van Veen) or 10 mm mesh (Agassiz) have been used.

The material has been studied during the last 8 years, and although the taxonomical determination of some taxa remains unfinished, we present the first global results on biodiversity from the 'Bentart-95' cruise.

Results

The biodiversity of 37 major taxa, which were mainly collected with Agassiz trawl, suprabethic sledge and Van Veen grab, has been analysed.

A total of 47,293 specimens have been studied, belonging to Algae (Rodophyta, Phaeophyta, Chlorophyta and Chrysophyta), Porifera (Hexactinellida and Demospongiae), Hydrozoa, Anthozoa (Stolonifera, Alcyonacea, Gorgonacea, Pennatulacea, Actiniaria and Scleractinia), Bryozoa, Echiurida, Nemertini, Mollusca (Opistobranchia, Gastropoda Prosobranchia, Bivalvia, Scaphopoda and Solenogastra), Polychaeta, Crustacea (Isopoda, Mysidacea, Amphipoda, Cumacea, Tanaidacea, Euphausiacea, Decapoda, Leptostraca, Copepoda and Ostracoda), Pycnogonida, Echinodermata (Ophiuroidea and Asteroidea), Ascidiacea and Pisces.

The total number of species determined thus far is 871; however, it should be taken into account that not all of the taxonomic work is finished yet, and these values will surely increase.

Different measures of diversity have been calculated by main taxa and station for each sampling method and for the total. These measures included species number, numerical abundances, and the indices of Margaleff species richness (d), Shannon-Wiener diversity (H') and Pielou's evenness (J').

Taxonomical diversity

Among the 871 taxa determined, 390 species corresponded to epifauna collected by Agassiz trawl, 306 species were mainly peracarid crustacea taken by the suprabenthic sledge, and only 144 were infaunal species caught with a Van Veen grab. The rock- dredge collected a total of 112 epifaunal species.

Considering the total area, Margalef species richness was maximum for the suprabenthos (85.59), whilst presenting mid-range values for epibenthic fauna (34.72) and the lowest figures for the infaunal benthos (11.40) (Table I).

By taxonomical group, the highest diversity corresponded to Amphipoda (125 sp.), followed by the Bryozoa (98 sp.), Polychaeta (89 sp.), Isopoda (80 sp.), Pycnogonida (60 sp.), and Hydrozoa and Porifera (both with 51 sp.) (Figure 1). These taxa also offered the highest richness (Margalef index), calculated based on total numerical abundances by station for the more effective sampler: Bryozoa (16.92), Amphipoda (12.87) and Isopoda (11.11); these were followed by Hydrozoa (8.26), Polychaeta (7.26), Pycnogonida (6.59) and Demospongiae (5.56). The lowest richness corresponded to Echiurida, Solenogastra, and Decapoda. For colonial groups, these figures must be considered with caution, since it is difficult to estimate their numerical abundances. These results are in accordance with the traditional species-rich and species-poor taxa concept in the Antarctic Sea.

At individual levels, the highest abundances were found amongst the infaunal polychaetes of the Maldanidae family, *Maldane sarsi antarctica* (>100,000 ind.), followed at a great distance by *Asychis amphiglypta* (>25,000) and by the Sternaspidae, *Sternaspis scutata* (>16,000). The epifauna of the South Shetlands zone seemed dominated—as shown previously by Sáiz-Salinas *et al.* (1997), Arnaud *et al.* (1998), Piepenburg *et al.* (2002) and others—by brittle-stars, mainly *Ophionotus victoriae* (10,000 ind.); the ascidians, *Molgula pedunculata, Ascidia challengeri* and *Aplidium sp.* (7,000 ind.) and pycnogonids. In the suprabenthic communities—as in the work of San Vicente *et al.* (1998)—amphipods and mysids dominated; the main species among the amphipods were *Djerboa furcipes* (3,414 ind.) and *Rhachotropis antarctica*, and among the mysids, *Antarctomysis maxima* and *Mysidetes poston* (>2,000 ind.). These abundances were to be expected, given the dominance of soft sediments throughout nearly all of the South Shetlands and Bransfield area.

Pattern diversity distribution

The diversity measures by station for each one of the benthic compartments –epibenthos, suprabenthos and infauna, and total—are presented in table I. For comparison, we considered only the 16 stations where the three main sampling methods were used

In the entire South Shetlands benthic ecosystem, total numerical abundances oscillated between 4,300 and 53,000 individuals; the species number from 38 to 195; Margalef's richness index from 10.07 to 19.15; Shannon's diversity index from 0.67 to 3.02; and Pielou's evenness between 0.13 and 0.72. The global index values were: 626 (Sp. nb.), 63.89 (Margalef), 3.24 (Shannon) and 0.50 (Pielou).

As can be seen in table I, there are major differences among stations on all diversity indices in relation to the different benthic subsystem exits, which would indicate that there is no latitudinal cline of biodiversity. Nevertheless, some distribution patterns of diversity stand out:

1) The highest richness zones seem to be located off southern of Livingstone Island, where global values from 100 to 150 species per station were found, mainly at st. 19, which showed high species numbers and specific richness, globally and for suprabenthic and epibenthic subsystems, but also the lowest evenness. In the area closest to the Antarctic Peninsula and in the northern zone of Livingstone Island, high values of diversity were also found.
2) The poorest area, as previous analysis of the main taxa had showed (Sáiz-Salinas *et al.*, 1997; Arnaud *et al.*, 1998; San Vicente *et al.* 1998), was located at inner Deception Island, in Foster Bay, where the diversity indices were lowest.

3) In spite of local differences, and strong dominance of some particular species, similar mean values of evenness (J') were found for the three benthic subsystems (0.42-0.59) (0.5 for total benthic communities); this would seem to indicate that, in general, individual abundances are more or less evenly distributed among the species in the South Shetlands benthos.
4) Preliminary analysis regarding the relationships between diversity measures and environmental parameters indicates that depth is the main factor, significantly affecting distribution patterns.
5) Multivariate analysis is now underway, and these results will be presented in October 2003 at the IBMANT-ANDEEP Symposium.

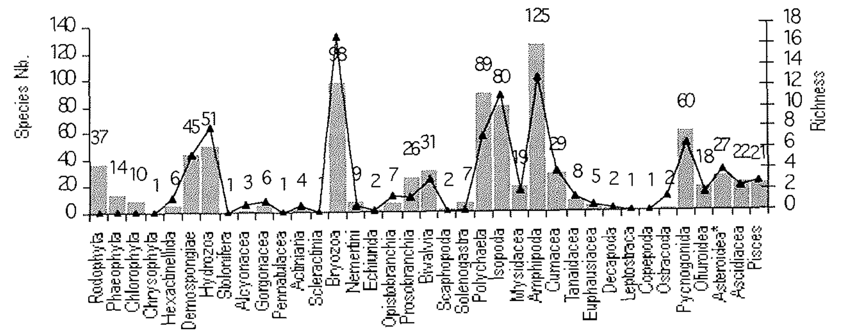

Fig. 1. Species number (histograms) and species richness (Margalef's index, line) of 37 taxa. Material collected at 31 stations during the 'Bentart-95' Survey. 871 species; 47,267 determined specimens

	Dept	Epibenthos (Agassiz trawl)					Suprabentos (Sledge)					Infauna (Van Veen grab)					TOTAL		
Station	(m)	Sp.	Nb	d	H'	J'	Sp.	Nb	d	H'	J'	Sp.	Nb.	d	H'	J'	Sp.	d	H'
D1	40	17	622	3.01	1.70	0.60						22	14567	2.19	2.48	0.80	39	3.84	
D2	146	14	2180	1.91	1.47	0.56	13	1522	1.63	1.22	0.48	16	4900	1.77	2.10	0.76	**38**	4.53	**2.62**
SLI3	92	56	10486	5.58	1.60	0.40	64	962	9.16	3.18	0.76	26	8500	2.76	2.15	0.66	**139**	**14.54**	**2.89**
SLI4	161	68	2700	7.47	1.98	0.47	44	946	6.27	2.16	0.57	21	15357	2.07	1.50	0.49	**127**	**13.31**	**2.42**
SLI5	256	53	10181	6.90	1.88	0.47	26	909	3.67	1.30	0.40	16	16400	1.55	0.73	0.26	**89**	9.10	**1.24**
SLI6	49	68	42216	8.26	2.33	0.55	61	2383	7.72	2.75	0.67	24	8600	2.54	1.81	0.57	**146**	**13.88**	**3.02**
SLI7	80	72	12244	7.50	2.23	0.52						39	33408	3.65	2.61	0.71	111	**10.07**	
SLI8												43	14533	4.38	2.80	0.74	43	4.38	
SLI9	162	42	23072	4.99	2.21	0.59	50	2543	6.25	2.05	0.52	24	12233	2.44	1.69	0.53	**112**	**10.81**	**2.70**
SLI10	220	64	14807	7.76	2.34	0.56	35	299	5.96	2.57	0.72	12	16000	1.14	0.95	0.38	**111**	**10.54**	**1.59**
D11	167	41	1935	6.35	1.72	0.46	15	847	2.08	1.17	0.43	11	1855	1.33	1.96	0.82	**66**	7.63	**2.62**
D12	167	25	2545	3.75	1.41	0.44	10	673	1.38	1.07	0.47	18	4033	2.05	2.38	0.82	**52**	5.74	**2.79**
SLI13												27	11733	2.77	2.27	0.69	27	2.77	
SLI14												19	10667	1.94	2.11	0.72	19	1.94	
SLI15	335	21	2312	2.77	1.93	0.63	36	534	5.57	2.21	0.62	15	6600	1.59	1.46	0.54	71	7.65	**2.18**
SLI16	429	52	2075	11.14	1.92	0.49	63	585	9.73	2.85	0.69	26	11759	2.67	2.46	0.76	**130**	**14.41**	**2.70**
D17	106	23	35346	2.46	0.92	0.29	34	3331	4.07	0.87	0.25	15	6333	1.60	2.28	0.84	**70**	6.53	**2.47**
D18	109	14	6858	1.74	1.02	0.39	12	97	2.32	1.65	0.67	19	8805	1.98	2.40	0.82	**42**	4.35	**2.62**
SLI19	214	108	1484	14.80	2.28	0.49	80	1803	10.54	2.81	0.64	20	43800	1.78	0.29	0.10	**195**	**19.15**	**0.67**
SLI20												22	9233	2.30	1.83	0.59	22	2.30	
B21							48	1182	6.64	1.66	0.43	5	2400	0.51	1.48	0.92	53	6.35	
B22A	330	22	53	5.10	1.28	0.41	24	183	4.35	2.18	0.69						46	8.05	
B23	141	89	1140	12.54	2.48	0.55	9	33	3.22	2.09	0.95	28	6033	3.10	2.60	0.78	**123**	**13.96**	**2.99**
B24	234	103	1589	15.65	2.20	0.47						3	2967	0.25	0.96	0.87	106	**12.35**	
B25							27	133	6.46	3.02	0.92						27	5.32	
NLI27	70	42	295	7.33	2.12	0.57	9	2907	1.68	1.37	0.62						51	6.07	
NLI28	125	35	120	6.02	1.90	0.53	26	895	4.08	2.17	0.67						61	8.52	
NLI29	237	70	4690	8.38	2.08	0.49	32	457	6.02	2.82	0.81	20	10467	2.05	1.70	0.57	**118**	**10.46**	**2.33**
NLI30	710	65	12885	10.33	2.44	0.58	48	580	8.42	3.23	0.84						113	**11.67**	
NLI31	850	32	8348	6.16	2.00	0.58											32	3.32	
31		390	200182	34.72	2.52	0.42	306	23804	85.59	3.40	0.59	144	280599	11.40	2.79	0.56	871	63.89	3.24

Table 1. Measures of macrobenthos diversity by station along the Livingstone Island transect (from Drake Passage to the Antarctic Peninsula), for epibenthic species (Agassiz trawl), suprabenthos (sledge), infauna (Van Veen grab), and total. Species number (Sp); Total numerical abundances (Nb); Margaleff's species richness (d); Shannon-Wiener diversity; (H') and Pielou's evenness (J') (D: Deception Is.; SLI: South Livingston Is.; B: Bransfield Strait; NLI: North Livingston Is.)

The Asellota (Peracarida: Isopoda): Successful invaders of the deep sea

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The Isopoda and especially the Asellota are one of the most numerous and important elements of the benthos in all oceans. They are the dominating taxon among crustaceans in the deep sea and display a range of morphologies which is spectacular and bizarre.

However, Antarctic Asellota are little known, and no molecular data are available up to now for phylogenetic studies. First results of ssu rDNA-gene analyses support the monophyly of many typical deep sea families, e.g. the Munnopsidae, Ischnomesidae and Haploniscidae. On the other hand there is no evidence for the monophyly of the Janiridae. In addition the molecular data indicate a multiple colonization of the Antarctic deep sea. This ecosystem has to be considered as a special case, because it was colonized not only by Asellota from the neighbouring deep sea basins but also by shelf forms.

The relatives of some blind deep-sea forms, e.g. in the family Acanthaspidiidae, possess eyes and are endemic to the Antarctic shelf. Therefore it can be concluded that some deep-sea species have evolved from immigrating shelf forms, a phenomenon called polar submergence. Interestingly, a great number of typical deep sea species can also be found on the Antarctic continental shelf (polar emergence). Since both emergence and submergence can be observed in Antarctica, the evolution of the shelf fauna is closely related to the annexed deep sea. The molecular data give evidence that specialization of populations to certain depths leads to speciation in Antarctica. Furthermore, it is possible to identify cryptic species, e.g. in the family Haploniscidae, which could not be distinguished with morphological characters.

Oceanographic habitats of southern rockhopper penguin (*Eudyptes chrysocome chrysocome*) from Staten Island during the winter dispersion

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We characterized the movements and oceanographic habitats of southern rockhopper penguins during the winter dispersion. Also, we tried to highlight whether these species use predictable habitats, and if so, to define the factors influencing their marine distributions. Ten southern rockhopper penguins from Staten Island were fitted with platform terminal transmitters in March 2002, to determine foraging behaviour throughout the winter dispersion in relation to oceanographic data.

Analyses of satellite telemetry data in conjunction with remotely sensed sea surface temperature (SST) and bathymetry revealed two main foraging areas: one situated to the north of Staten Island off the coast of Tierra del Fuego and the other to the south of Staten Island in the vicinity of the Antarctic Polar Front. Most of the birds commuted between the two zones. The area to the south of Staten Island seemed to be of particular importance for wintering rockhopper, because five out of nine birds initially headed towards it, and two other followed later in the season. However, rockhopper penguins from Staten Island did not leave their breeding colony in any preferred direction, since they headed, variously, northwest, northeast or south.

In the area to the north of Staten Island birds used shallower coastal waters characterized by predictable tidal fronts, which is a well-known highly productive region. Moreover, penguins spent 47% of their time at sea in those areas. By contrast, the area to the south included pelagic waters (> 3000m) and penguins spent 43% of their time in those waters. This area, in the region of the Drake Passage, included the Polar Frontal Zone (PFZ), an important water mass with high phytoplankton concentration, specially in its southern and northern limits (polar front PF and sub-Antarctic front SAF, respectively). Oceanic fronts were identified by sharp temperature gradients between water masses of 1.35° C. Penguins seemed to take advantage of those highly productive areas. The majority of them spent most of the time within the PFZ in water mass boundaries (eddies, fronts) that enhance water column mixing, stimulate localized production and aggregate planktonic prey at secondary convergence zones. Moreover, one of them at the beginning of its winter dispersion went directly to the southern boundary of the Antarctic Circumpolar Current, an extremely highly productive area. Another penguin followed the SAF during the whole winter dispersion.

Water masses greater than 8°C SST were preferred in March and April (along the Atlantic coast of Tierra del Fuego), but in addition two birds spent a large amount of time in waters less than

–2 °C (Antarctic waters) in April. From May to July penguins spent more than 50% of time in water masses of 4-6°C (PFZ based on the published and widely used locations of water masses and fronts).

However, when considering only the values of SST for the definition of water masses and fronts, the PFZ would be extending into the Patagonian shelf (especially during June and July), although this is unlikely due to bathymetry restrictions in this region of the Antarctic Circumpolar Current. This difficulty is overcome when gradients in SST are considered for defining fronts. Our analysis of fronts is consistent with the fact that the fronts and zones move to the north during winter time, even though constrained by the restriction in the circumpolar circulation by the opening of the Drake Passage.

These results highlight the significance of macro-mega scales of (1000 to 3000 km) water mass distribution and smaller coarse-meso scale of (10 to 100 km) hydrographic processes for the winter dispersion of rockhopper penguins, and underscore the need to identify and understand how these oceanographic processes and features develop (especially during winter time).

Macrobenthic diversity in the marine system of the Magellan region: More on the subject but at the species level

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One of the major patterns related to marine ecosystems is the well-known polar-tropical gradient in biodiversity, remarkable for its pervasiveness, its lack of a general agreed explanation, and for the plethora of explanations put forward. However, according to recent data some authors are suggesting that this may only hold true for the northern hemisphere, with an increase of species richness from the Arctic to the tropics. In order to evaluate the significance of biodiversity gradients along the southern tip of South America in comparison with Antarctic areas and also northern regions, available information about the biotic assemblages inhabiting the sublitoral areas of the Magellan region make it difficult to predict the amount of ecological univariate values one can reasonably to expect for these specific habitats. For instance, some studies indicate a low richness in species and diversity for some intertidal sites in the Straits of Magellan, but for the subtidal zones highest diversity values have been suggested. In addition, recent data show that for a number of taxa, species numbers increase from the Magellan area towards the Antarctic continent.

As has been concluded from the IBMANT'97 Workshop related with Magellan-Antarctic comparison: a) Preliminary community structure evaluations based on coarser taxonomic levels have had to be accepted; and b) Clustering and calculations of diversity would no doubt be strongly improved by breaking all the samples down to species level. However, to date, determination to species level is possible only for a few specialists, a fact which can be considered a bottleneck for a fair comparison or an assessment of within and between-regions biodiversity variability to better document diversity patterns.

The aim of the present study was to analyze the macrobenthic diversity of sublittoral assemblages along the Straits of Magellan, based on a more complete taxonomical analysis for the area. The analysis includes the determination of univariate ecological indices as measures of attributes of community structure, including species richness, diversity and equitability, calculated from quantitative sampling procedures. In addition, temporal variability of the indices is considered for one of the sampling sites. The study area is a natural confluence of water masses from the Pacific and Atlantic Oceans and is closely linked to the Antarctic ecosystem. Along the main axis of the Straits different sills and shelves separate specific basins, which include several environmental gradients related with recent glacial-interglacial events and the influx of different water mass circulation and current patterns.

The index reveals a spatial variability in community structure, with a gradient in species richness likely related to the effects of glacial events. Identified species numbers varied between 100–320 macrobenthic species, but taxonomical difficulties remain with some specific groups. Polychaeta was the taxa more represented both in number of species and abundance in all the study sites. The indices used to analyze diversity indicate intermediate evenness from few species, with high values of diversity index. The macrobenthic community structure exhibited evidence of temporal variation when the indices are analyzed through time (Fig. 1).

Our results suggest the necessity of obtaining quantitative values of diversity not only considering spatial variability: Further studies must include the determination of parameters with a temporal basis in order to define ranges of diversity values in both scales, because biodiversity is a function of time and space at varying levels of scale.

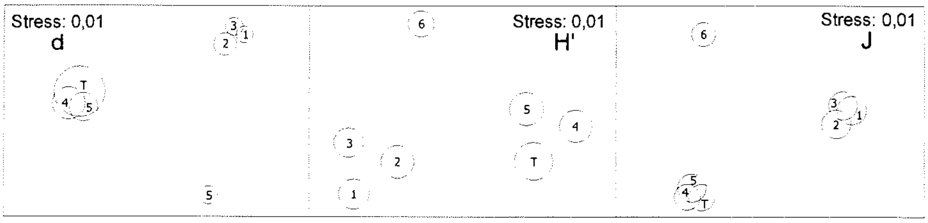

Fig. 1. MDS ordination of six sampling periods (1 – 6) related with the values of species richness (d), evenness (J) and diversity (H`) determined for one sampling location at the Straits of Magellan, Chile. T represent values calculated with the summation of S and N for all sampling periods. Data were transformed to fourth root before Bray-Curtis matrix similarities calculations.

Energetic conditions in decapod crustaceans along the Scotia Arc

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The Magellan region is the geographically closest Subantarctic province to Antarctica. Both regions remain geographically connected by the islands and shallows of the Scotia Arc, which is assumed to constitute a transitional area for the benthic fauna of each side, and may therefore also be found to be a transitional area from an ecophysiological point of view. Hitherto, the literature has focused on reproductive strategies of invertebrates, mainly along latitudinal gradients. The energetic investment in reproduction – namely reproductive effort – has been difficult to determine. Hence, the reproductive output (RO, the ratio between gonad and body masses) has been used as a proxy for reproductive effort. The aim of this study was to determine the energetic investment in reproduction in different decapod species along the Scotia Arc. However, different species from different sites are expected to be at different stages of their reproductive cycle, and consequently the RO will not reflect the actual energetic investment into reproduction.

During the LAMPOS cruise in April 2002, females of the most abundant decapods were sampled along the Scotia Arc. Additionally, 3 different species from the Beagle Channel were sampled in March and May 2001 and May 2002 (Table 1). Females were dissected and their gonads, egg clutch and hepatopancreas were removed and dried to constant weight at 55°C. The energetic contents were determined with an adiabatic calorimeter. We calculated two different indices to estimate the energetic condition associated with reproduction. Indices were calculated as ratios between the energetic contents of (a) ovary or egg clutch and female (REI_a), as compared to the RO, and (b) ovary or egg clutch plus hepatopancreas and female (REI_b). We decided to include the energetic content of the hepatopancreas, since it is known that this organ supplies energy to ovary development. Hence, the latter index would better reveal changes in the reproductive investment at different reproductive stages.

Along the Scotia Arc, the female reproductive statuses were different (Table 1). For example, in *Notocrangon antarcticus* the proportion of ovigerous females was significantly larger in South Georgia than in the South Orkney Islands. This clearly demonstrated a delay in the egg extrusion in the latter location. A similar situation applies to *Munida spp.* from the Burdwood Bank and the Beagle Channel. Likewise, an index like REI_a is not useful to compare species at different stages of their reproductive cycle, and therefore does not reflect the actual differences in the reproductive output. By contrast, when including the hepatopancreas in the index, REI_b values provided a more realistic measure of reproductive output among different species in a different reproductive status (Table 1).

The reproductive output (REI_b) was independent of the sampling location. Furthermore, the REI_b reflected no clear trend along the Scotia Arc. We hypothesize that, despite the environmental constraints, in decapods the energetic investment into reproduction is species-specific rather than dependent on geography.

Species	Site	REI		OF (%)
		EC_O/EC_S	$(EC_O+EC_H)/EC_S$	
Anomura				
Munida subrugosa	B. Channel	0.02 ± 0.01	0.20 ± 0.12	0
M. subrugosa	B. Channel	0.03 ± 0.02	0.15 ± 0.07	0
M. spinosa	B. Bank	0.13 ± 0.03	0.20 ± 0.05	80
Caridea				
Campylonotus vagans	B. Channel	0.18 ± 0.04	0.24 ± 0.04	69
C. semistriatus	B. Channel	0.23 ± 0.05	0.30 ± 0.05	50
Notocrangon antarcticus	S. Georgia	0.18 ± 0.04	0.21 ± 0.05	98
N. antarticus	S. Orkney I.	0.10 ± 0.02	0.22 ± 0.04	35
Nematocarcinus lanceopes	Sandwich I.	0.11 ± 0.01	0.31 ± 0.03	0

Table1 Reproductive energetic indices (REI) and proportion of ovigerous females (OF) of six species of decapod crustaceans in different sites of the Scotia Arc. EC: energetic contents; $_O$: ovary or egg clutch; $_S$: body; $_H$: hepatopancreas. Indices in bold were calculated with the energetic content of the egg clutch instead of ovaries (in regular font).

Genetic differentiation between populations of the ascidian *Aplidium falklandicum* from South Georgia and South Orkney Islands

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The genetic structure of populations of sessile marine animals depends largely on the dispersal abilities of the larval stages, and in the case of oviparous species the dispersion of gametes and embryos should be considered as well. It is expected that species with higher dispersal capabilities will present less genetic structure than those with larvae that disperse only relative short distances, which in turn would present small scale genetic differentiation. Among the factors that could affect the dispersion of the free-living stages, and therefore the gene flow between populations are the variable spawning and recruitment success, habitat availability, oceanographic conditions and physical barriers.

The Polar Front and the abyssal depths that surround Antarctica can be considered as the main physical barrier isolating the Antarctic system, particularly effective for shelf benthic species. It has been hypothesized that the Scotia Arc Islands could act as a bridge, or stepping stones, between the Magellan and Antarctic Regions.

In this work we will test this hypothesis on *Aplidium falklandicum,* an ascidian species that, due to its reproductive behaviour, short lived and lecithotrophic larvae, common to all the group, can be a good model for testing possible gene flow through the Scotia Arc in sessile benthic species.

Genetic population structure of two populations of *A. falklandicum* at South Georgia and the South Orkney Islands will be determined using simple sequence repeats (ISSR). ISSR are semi-arbitrary markers amplified by PCR. This technique is similar to RAPD-PCR because it does not require genome sequence information. However, unlike RAPDs, ISSR primers are longer and consist of a di-, tri- or tetranucleotide simple sequence repeat that can have a 5′or 3′anchoring sequence of 1 to 3 nucleotides, allowing for a higher primer annealing temperature which results in greater band reproducibility. Primer sites are dispersed throughout the genome so that there is a high chance of the primer binding to two sites located on opposing DNA strands within an amplifiable distance. Thus, single-primer amplifications often result in a high degree of polymorphic bands, which is useful in population studies. Seven ISSR primers were evaluated in order to find adequate genetic markers to assess variability and structure of populations of *A. falklandicum*; results obtained after the analysis of samples will be discussed in this context.

Ascidians (Tunicata, Ascidiacea) collected during the LAMPOS cruise along the Scotia Arc

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Ascidians are benthic animals, whose presence is common in all seas. In Southern Oceans, the Polar Front determines, as in many organisms, strong barriers to the ascidian distribution. The Northern Magellan and Southern Antarctic regions separated by this barrier could be linked by the Scotia Arc, as was pointed out by Monniot & Monniot (1983) who found a faunal gradient between these regions through the Scotia Arc. Knowledge of the species composition and endemisms is, nevertheless, limited to fragmentary trawl samples. Our objective is to extend the knowledge about species composition and to establish affinities between the ascidian fauna at the different stations visited during the LAMPOS cruise.

Ascidians were collected by Agassiz (AGT) and bottom (GSN) trawls, at depths between 250-600 m, on different substrate types. Animals were relaxed in current seawater and later fixed in buffered formalin seawater 4%. Morphological features were analyzed under binocular and microscope, to identify the different species. The reproductive status of colonial species was taken in account, recording the presence of tadpoles. Photographs were taken of living animals using a digital camera, to document the coloration, which is usually lost after fixation. A total of 25 species was found along the different stations sampled during the cruise, with solitary species being less abundant. Two species are new to science, whereas 8 species were collected in new localities, extending their known area of distribution. Ascidian was a very common group in the samples, being present in more than 80% of captures. A total of 10 families was found, the more abundant being Polyclinidae (5 species), Polycitoridae, Styelidae and Pyuridae (4 species). Associations between or with other benthic groups were found, such as those of incrusting Didemnidae on sponges and bryozoans or the epibiosis by small ascidian specimens on the tunic of large Styelidae. Muddy bottoms supported higher species richness than hard bottoms, like gravel, pebbles and volcanic stones. The South Georgia Islands are the northward distribution limit for some Antarctic species, such as *Pyura discoveryi* and *Molgula pedunculata* and also an area of endemisms, like the species *Pyura georgiana*. Some geographic considerations can be stressed in relation to the ascidian distribution (e.g., some affinities between South Georgia with South Orkney and South Shetland, or the separation of the South Sandwich stations). Nevertheless, analyses done on species and stations revealed also the influence of substrate type, which could overwhelm the biogeographic discussion.

Challenging the cold: crabs return to the Antarctic

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The impoverished high Antarctic benthic decapod fauna with only 5 caridean shrimp species left still comprises one of the unsolved mysteries in marine biodiversity research. Faunal impoverishment and particularly the extinction of crabs about 15 to 20 Ma ago are considered to be mainly a result of Antarctic cooling, which started less than 40 Ma years ago as a consequence of continental drift. Cold tolerance requires an adjustment of the functional capacity of oxygen supply mechanisms. In brachyuran crabs this process is hampered due to their poor ability to reduce Mg^{2+} levels in the haemolymph below those in the water. Consequently, their scope for aerobic activity is minimized and they are narcotised by a combination of temperatures below 0°C and high Mg^{2+} levels; this physiological constraint has been hypothesised to be the main factor explaining the absence of reptants from Antarctic waters. However, king crabs have recently been discovered off the Antarctic continental shelf, at $T > 0°C$, re-opening the debate about a potential return of anomuran crabs. Lithodids, which evolved only about 13 to 23 Ma ago, show adaptations in life history traits to the cold such as prolonged brooding periods of up to 22 months, extended hatching rhythms and lecithotrophic larval development, thus minimising the need for activity in both adults and larvae. Food-independent larval development at low temperatures provides independence from the polar mismatch of distinctly seasonal food availability and prolonged larval development. Since environmental conditions prevailing in polar seas should particularly affect the more sensitive early life history stages, we conclude larval developmental traits in lithodids to be key adaptations to sustain these conditions. We hypothesise re-colonisation of the Antarctic by lithodid crabs via the deep sea, facilitated by similar environments found in both regimes. Nevertheless, insufficient cold adaptation to temperatures below 0°C typical of high Antarctic shelves still explains the absence of crabs from these areas. The record of non-lithodid crab larvae at the Antarctic Peninsula suggests that there may be a strong colonisation pressure also from those decapod taxa which presently remain excluded.

Influence of temperature on routine metabolic rates of Subantarctic teleosts

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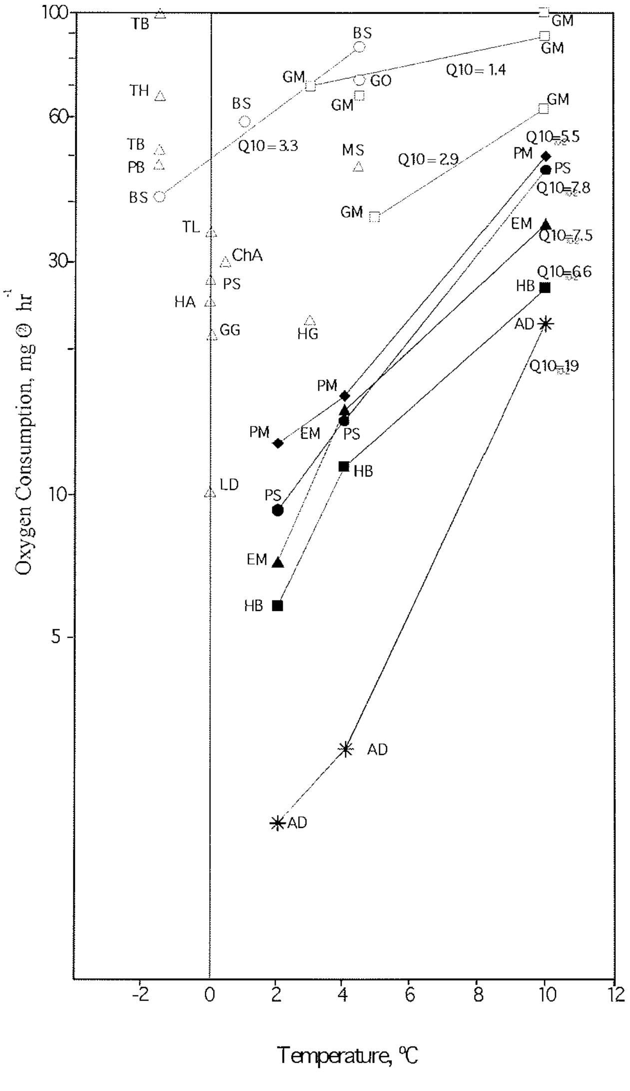
The influence of temperature on metabolic activity of poikilotherms varies according to the evolutionary history of each species. Subantarctic notothenioids are exposed to wider variations in temperature than those encountered in the Antarctic, the ancestral environment of the group.
In this study the influence of temperature on the routine metabolic rate of Sub-Antarctic Teleosts was described and the results were compared with routine metabolic rates of species with different geographical distributions, exploring the existence of Metabolic Cold Adaptation (MCA).

Oxygen consumption (VO_{2R}) was determined as an estimate of the routine metabolic rate for the following subantarctic Notothenioids: *Paranotothenia magellanica*, *Patagonotothen sima*, *Eleginops maclovinus, Harpagifer bispinis* and the Zoarcidae *Austrolycus depressiceps.* Because of the allometric ratio between live mass and metabolic rate, a general design of repeated measurements was followed.
Each specimen was acclimated at a temperature of 10°C for ten days in a respirometric chamber. After VO_{2R} was measured, the temperature was lowered 1°C per day down to 4°C. This temperature was maintained for ten days before determining VO_{2R}. The same procedure was followed for the determination at 2°C. *E. maclovinus* did not tolerate prolonged confinement; therefore an independent sample design was followed.
The VO2R and live mass of each fish showed positive correlation ($p < 0.05$) in all species and temperatures tested. Lowering the temperature from 10 to 2°C produced a significant reduction ($p < 0.05$) of VO2R values with a Q10 (10-2) varying between 5.5 and 19.
At temperatures of 2 °C (Fig. 1) both Sub-Antarctic notothenioids and the zoarcid species studied showed VO2R values 2 or 3 times lower than those of Antarctic species with similar habits living at temperatures near or below 0°C.
Temperature affected VO2R differently depending on the living habits of the species studied. Between 10 and 4°C, the oxygen consumption rate for the sluggish, benthic A. depressiceps descended more than that of the more active notothenioids. Between 4 and 2°C the VO2R of E. maclovinus (bentho-pelagic) and H. bispinis (benthic) descended more than the VO2R of P. magellanica (pelagic) and P. sima. We can conclude that the metabolic rates of these species of Subantarctic fish do not present MCA. However, this metabolic adjustment may be present in other polar teleosts.

Fig. 1. Comparison of VO_{2R} between Subantarctic, Antarctic, Arctic and Temperate teleostean fishes. Oxygen consumption values standardised for a 100 g fish and expressed in mg/kg/h. Δ Antarctic teleosts: MS: *Myxocephalus scorpius*; PB: *Pagothenia borchgrevinki*; TB: *Trematomus bernacchii*; TH: *Trematomus hansoni*; HA: *Harpagifer antarcticus*; HG: *Harpagifer georgianus*; GG: *Gobionotothen gibberifrons*; LD: *Lycodichthys dearborni*. ○Arctic teleosts: BS : *Boreogadus sadia*; GO: *Gadus ogac*.

□ Temperate teleosts: GM: *Gadus morhua*. Subantarctic teleost (previous work):HG: *Harpagifer georgianus*. Subantarctic Teleosts (present work): ✪: *Harpagifer bispinis* ; ♦: *Paranotothenia magellanica* ; •: *E. maclovinus* ; ●: *P. sima* ; ♌: *A. depressiceps*.



Digging in the deep Southern Ocean: Meiofauna and nematodes

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The Antarctic benthos in its present composition and diversity has evolved as a consequence of typical characteristics of the polar environment (low temperature and high seasonal food deposition). Features like high level of endemism, circumantarctic distribution, high species richness, complete lack of certain higher taxa, seasonal growth and reproduction, brood protection and large adult size are largely characteristic for macrofaunal species in Antarctica. They make the Antarctic macrobenthos a very characteristic fauna. While Antarctic macrobenthos has been relatively well known for several decades, knowledge of Antarctic meiobenthos (sediment-inhabiting metazoans in the size class 32 to 1000 μm) has only recently been established.

Deep-water Antarctic meiofauna was first investigated by Herman & Dahms in 1992, who reported high abundances when compared to similar deep environments at temperate latitudes. The nematodes were a major component of the Antarctic meiobenthic ecosystem, particularly in the deep sea (e.g. 82-97%). These observations were expanded with other continental margin studies in the Weddell and Scotia Seas from 200 to 6000m, which generally suggested similarly high nematode abundances (up to 3000 ind. per 10 cm^2) and high genus diversity (158 genera). Natural carbon isotopic signatures of the nematodes, ranging from -34.6 to -19.3 ‰, pointed towards the detritivorous role of this sediment inhabiting interstitial fauna. However, large disturbances led in extreme situations to a decrease of more then 95% in nematode abundance (on average from 1234 nematodes/10 cm^2 in an undisturbed reference site to 73 specimens). An extremely low diversity (60 genera per reference station to less then 20 in an iceberg disturbed sediment) and a drastic change in nematode generic composition (*Desmoscolex*, *Leptolaimus*, *Acantholaimus* and *Tricoma* in undisturbed to *Monhystera*, *Neochromadora*, *Daptonema*, *Cervonema* and *Prismatolaimus* in iceberg-disturbed) and trophic structure (from selective deposit feeders in undisturbed to non-selectivity in disturbed) elucidated that the nematode communities are very fragile toward disturbance by icebergs. New findings from deeper down at the 1000-2000m line bring interesting insights concerning deep-sea nematode biomass and trophic trends (with a remarkable shift towards the higher size classes and an equal sharing of epistrate and deposit feeding modes compared to other deep-sea communities worldwide). The remarkable trends are discussed in the light of the highly seasonal but extremely entense food deposition after short-term blooms, characteristic for the Antarctic environment.

The objective of this presentation is to condense the current "state of the art" focussing on 1 decade of taxonomical and ecological research on the metazoan nematodes along the Antarctic continental margin, from the shelf down to abyssal depths. This presentation will present a summary of these themes as a basis for discussion on biogeographical and diversity issues from the nematode point of view. Especially the genera *Dichromadora* and *Acantholaimus* draw our attention to their extremely high degree of diversification and radiation (e.g. all observed *Dichromadora* species were new to science; 65 *Acantholaimus* species were retrieved in only 16 nematode samples). The review should enable us to draw preliminary conclusions: 1) Can we generalize our findings to define "Diversity of deep-sea nematodes in Antarctica"? 2) What does Lampos-Andeep teach us to this respect?

Abundance and biomass of harpacticoid copepods in a shallow Antarctic bay

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Meiofauna samples were collected by scuba diving in the course of two stays at the German Dallmann-Laboratory connected to the Argentinian Jubany Station at King George Island (62°14'12"S 58°39'48"W) in 1994/95 and 1995/96.

The study included abiotic and biotic factors such as grain size, determination of total organic matter, organic carbon and nitrogen as well as chloroplastic equivalents represented by the sum of chlorophyll a and pheopigments.

Correlations between abundance and biovolume of harpacticoids and the mass of organic material in the sediment represented by the total organic matter were detected by Spearman-rank analyses. Only the number of harpacticoids is connected to the quality of the organic material as represented by the C/N ratio. There exists a correlation between the concentration of chloroplastic pigments and their decomposition products and the abundance of harpacticoids, when the 5m station in the central cove transect is omitted. The very high CPE values at this site are due to a high density of cyanobacteria, a local event that has been detected by both pigment analyses and personal observation. The existence of these bacterial mats, most probably caused by the - at this time still active - station drainage obviously creates conditions not suitable for copepods. At the other stations the main component of the organic material is macroalgal detritus, especially at the 10m station at the cove entrance, where a depression serves as detritus trap. But microphytobenthos could also be detected in great abundance. Physical disturbances such as iceberg influences and wave action negatively influence individual density of harpacticoid copepods and biomass. Therefore abundance and biovolume of harpacticoid copepods are correlated with water depth.

The two species *Pseudotachidius jubanyensis*, Veit-Köhler & Willen 1999 and *Scottopsyllus (S.) praecipuus*, Veit-Köhler 2000 have been described from Potter Cove. Their adults are the largest harpacticoids to be found at the deeper stations of the transects. Obviously they prefer the calmer, undisturbed zones of the bay, as their distribution does not seem to be related to other environmental factors (Fig. 1).

This study represents the first investigation on harpacticoid copepods in Potter Cove with special emphasis on their habitat preference and spatial distribution. In addition to the normally given individual numbers, the measured biovolume of the copepods sampled shows great variety due to habitat preferences of the different species and copepodid abundance at the different sites.

Table 1. (next page) Mean grain size, total organic matter (TOM), carbon:nitrogen ratio (C/N), chloroplastic equivalents (CPE), number of harpacticoid copepods per 10cm^2 and biovolume of harpacticoid copepods per 10 cm^2 along two depth transects in the centre and the entrance of Potter Cove.

Station and depth [m]	Mean grain size [μm]	TOM [% dw]	C/N	CPE [μg/g dw]	Harpacticoida [Ind 10cm^{-2}]	Harpacticoida [nl 10cm^{-2}]
Central cove						
5	27	5,13	6,63	14,15	3	33,6
10	12	5,23	7,2	3,96	5	24
15	11	4,79	6,42	2,57	42	243,6
20	7	5,48	6,52	3,25	78	452,4
Cove entrance						
5	40	4,4	7,23	7,84	21	105
10	22	6,15	8,36	20,6	216	648
15	32	5,13	7,99	9,94	92	285,2
20	15	5,4	8,07	5,77	68	387,6

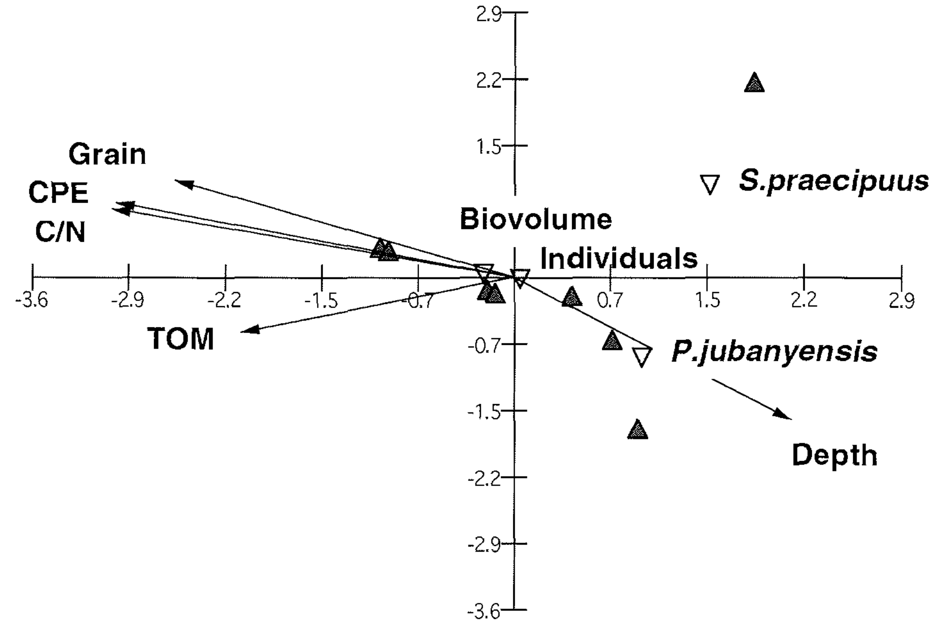

Fig. 1. The joint plot of the canonical correspondence analysis of the non-transformed data shown in table 1 and additional data for *Pseudotachidius jubanyensis* and *Scottopsyllus (S.) praecipuus* shows the relation of variables (stations – triangles; animal data – upside-down triangles) from biotic and abiotic environmental factors (vectors).

Meiofauna from the South Sandwich Trench: Andeep meets Lampos

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Among deep-sea environments, hadal trenches are the most inaccessible, and knowledge of their biology and ecology is still scant. We report the unique sampling of meiofauna towards the (sub) Antarctic South Sandwich Trench (7235m), associated with a volcanically active group of islands and characterised by high primary production at the surface.
Six stations are considered along a bathymetric gradient from 750 to 6300m depth where LAMPOS and ANDEEP expeditions of RV Polarstern met each other in 2002 (table1, fig.1). The aim of the investigation is to detect biogeographical and biodiversity patterns within the nematodes, generally the most abundant metazoan component of the deep-sea meiobenthos. Endemism, circumpolarity, role of Scotia Arc as a connection between South America and Antarctica, deep-sea diversity, species identifications, faunal affinities between Antarctic-subAntarctic are the keywords within this research.

A first step is devoted to the meiofauna at higher taxon level.

Analysis of the meiobenthos showed the highest density at 1100m depth (1708,9 ± 278,2 ind/10cm_). From this point on the meiofauna decreases with decreasing and increasing depth with, at 747m depth, 932 ± 171,5 ind/10cm_ and, at 6300m depth, 627.4 ± 257.5 ind/10cm_. In total, 23 taxa are encountered. Seven groups (Harpacticoida, Nauplii, Nematoda, Oligochaeta, Ostracoda, Polychaeta, Tanaidacea) are present along the complete gradient. Out of these groups, the nematodes are the most abundant taxon (85-97%), followed by the harpacticoid copepods (1-6%).

Analysis of the nematode taxa and their biomass is in progress.
The first results show that, at 747m depth, Desmodoridae (25.9%), Chromadoridae (22.4%), Oxystominidae (8.8%) and Xyalidae (8.2%) are the most important families. The deepest station (6300m) is dominated by Monhysteridae (28.9%), Chromadoridae (11.8%) and Microlaimidae (10.5%). The most abundant genera at 747m depth are Molgolaimus (22.4%), Halalaimus (8.2%) and Dichromadora (8.2%) whereas at 6300m the abundant genera are Monhystera (27.0%), Acantholaimus (11.2%) and Microlaimus (10.5%).
The mean individual nematode biomass of the shallowest station is clearly higher than at 6300m depth (0.140µgCind.$^{-1}$ resp. 0,076µgCind.$^{-1}$).

Low and deep-water abundances and biomasses, and first genus identifications will be integrated to come to general conclusions about meiobenthos in an Antarctic Trench. This will be related to environmental properties. The trench zone is characterised by very fine sediment which mainly consists of silt (>75%) and very fine sand (4-9%). The sediment composition along the bathymetrical gradient showed no large differences. CN and pigment analysis are in progress. Phytodetritus deposition has in many cases been addressed for explaining meiobenthic standing stocks, in accordance with a decreasing trend of total density and biomass of benthic assemblages with increasing depth. In the total darkness of the trench environment, the nearest source of primary production is at or close to the surface, 6 km or more above. So the biota are very remote from their primary supplies of energy. Trenches characterised by high primary production have been observed to have several grammes of living organisms per square metre of surface –e.g. 8.8 g per m_ at 6875 m in the South Sandwich Trench. They can display high meiofaunal stocks. Reduced body size and diversity compared to bathyal surroundings are also recognized.

Table 1 : Overview of the stations along the bathymetric gradient of the South Sandwich Trench

Station	Coordinates	Depth (m)
199	S57°37,9; W26°27,5	747
211	S57°35,6; W26°23,7	1095
141	S58°25,0; W25°00,9	2285
140	S58°16,1; W24°53,7	3000
139	S58°14,7; W24°20,5	3933
142	S58°50,8; W23°58,6	6300

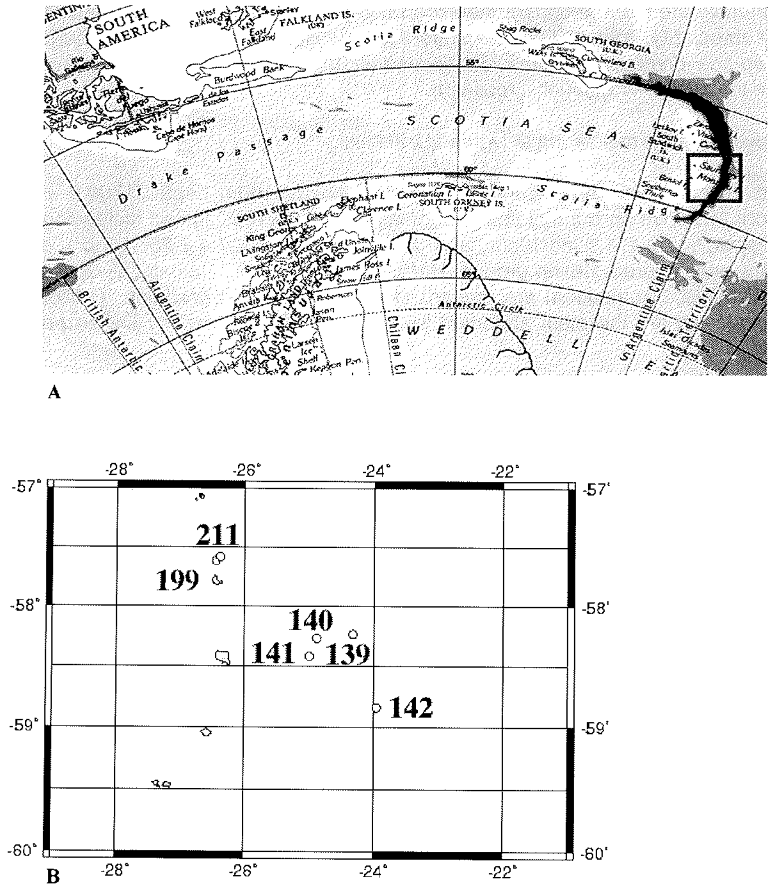

Fig. 1. A) Map of the Scotia Arc with indication of the South Sandwich Trench; B) Studied stations along the bathymetrical gradient of the South Sandwich Trench

Egg production in porcellanid crabs: a comparison between Chile and Costa Rica, Central America

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Introduction

Porcellanid crabs are anomuran decapods, usually of small size, constituting 26 genera with approximately 240 species. Most of these species can be encountered in tropical waters and temperate zones of the western hemisphere. Porcellanid crabs inhabit a great variety of habitats, however, most species occur in coastal waters in the tropics, typically in the rocky intertidal with complex systems of cavities. Due to their abundance, these decapods can play a predominant role among the macrofauna inhabiting such cavity systems.

The eastern Pacific comprises considerably more porcellanid species (approximately 90 spp.) compared to the western Atlantic (48 spp.). Recently, the number of species of porcellanid crabs inhabiting the eastern tropical Pacific has been estimated to be 68, and a total of 31 species have been reported from the Pacific coast of Colombia. Regarding Costa Rica, a total of 54 species has been collected on both coasts, with 12 and 42 species occurring along the Caribbean and Pacific coasts, respectively.

The species number of porcellanids crabs in Chilean waters is clearly reduced when compared to tropical zones: a total of 16 species have been reported from Chilean coasts with representatives of the genera *Pachycheles*, *Megalobrachium*, *Petrolisthes*, *Allopetrolisthes*, and *Liopetrolisthes*.

Despite a considerable body of literature regarding porcellanid crabs of the Americas, our knowledge on the ecology of these crabs is still limited. Most publications concern the taxonomy of these decapods, and for several species a description of the larval stages exists. However, information on reproduction, and especially concerning egg production, is scarce.

The purpose of the present study is to summarize and compare new as well as published information on egg production of porcellanid crabs from two different climatic zones: central-southern Chile and Costa Rica, Central America. Such information may help us to understand latitudinal trends in the reproductive ecology of marine decapods inhabiting mainly the intertidal zone.

Material and Methods

Costa Rica. Porcellanid crabs were collected between January 2002 and June 2003 from eight different sites along the Pacific coast. Most of the samples were taken by hand between and under rocks during low tide, and some specimens were obtained by washing rocks, which were collected by SCUBA diving at depths ranging from 1 to 5 meters. Crabs were preserved in 10% formaldehyde and were transferred later on to 70% alcohol. For the identification of the crabs the keys proposed by Haig (1960) were used. The collected individuals were sexed, and the carapace length (CL) measured. Regarding the ovigerous females, eggs were carefully separated, and the stage of the embryonic egg development was examined under a microscope equipped with a calibrated occular micrometer. The embryo was divided into three sub-stages according to criteria published elsewhere. All eggs were counted, and the width and length of 15 eggs of each ovigerous female were measured to calculate the average egg volume. An analytical balance was used to determine wet and dry mass of the eggs; samples were dried for approximately 24 hours at 50°C until a constant dry mass was obtained; females were dried 48 hours at the same temperature. The reproductive output (RO) was estimated for dry mass applying the following formula: RO = mass of the total number of eggs of the female / mass of the female without eggs.

Chile. Specimens of *Petrolisthes laevigatus* were collected between 1993 and 1994 around Valdivia, central-southern Chile. Methods to measure and weight eggs and females were the same as described for the porcellanid crabs collected in Costa Rica. Additionally, published and unpublished data for other porcellanids from the Chilean coasts were included.

Results

Costa Rica. The material collected (ovigerous females) comprised a total of 13 species: ten species of the genus *Petrolisthes*, two species of *Pachycheles*, and one species of *Megalobrachium*. The mean CL of ovigerous females varied between 4.23 mm (*Petrolisthes lewisi austrinus*) and 7.42 mm (*Petrolisthes edwardsii*). The smallest egg-bearing female was of *Pachycheles vicarius* (2.53 mm CL), the largest *Petrolisthes armatus* (9.68 mm CL). The average number of recently produced eggs ranged from 43 (*P. tridentatus*) to 405 in *P. armatus*. Average egg volume of recently laid eggs fluctuated between 0.026 mm^3 (*Petrolisthes polymitus*) and 0.073 mm^3 in *Petrolisthes edwardsii*. Preliminary data indicate that the RO ranges from 0.042 (*P. spinidactylus*) to 0.344 (*P. haigae*).

Chile. Data of nine porcellanid crab species are presented herein: three species of the genus *Allopetrolisthes*, one species each of *Liopetrolisthes* and *Pachycheles*, and four species of *Petrolisthes*. The smallest ovigerous females were recorded for *P. granulosus* (4.7 mm CL), *A. angulosus* (5.0 mm CL) and *L. mitrax* (5.0 mm CL). The species with the largest ovigerous female (39.4 mm CL) was *A. punctatus*. Maximum egg number varied between 225 (*P. granulosus*) and 16380 (*A. punctatus*). Average egg volume of recently-produced embryos, which was available for six species, fluctuated between 0.083 mm^3 (*A. angulosus*) and 0.226 mm^3 (*P. laevigatus*). During embryogenesis, eggs increased their volume between 40% (*P. laevigatus*) and 83% (*P. tuberculatus*). The RO ranged from 0.074 (*P. laevigatus*) to 0.561 (*P. granulosus*).

Discussion

In the species considered, ovigerous females of porcellanid crabs were considerably smaller in the tropics compared to those from Chilean waters. At a CL of 7.0 mm, females of most species collected along the Chilean coast carried eggs. In contrast, the same size constituted the upper limit of ovigerous females. Thus, there is a clear tendency in porcellanid crabs to increase size toward higher latitudes.

Body size presents an important factor determining the quantity of eggs that can be carried by the females. Despite substantial differences in CL of ovigerous females collected in Chile and Costa Rica, in most species egg numbers from tropical porcellanids were only slightly elevated when compared to those reported from Chilean waters (although some temperate-water species produced up to several thousand embryos). The similarity in the egg number might be explained by the differences in the egg volume: porcellanid crabs collected in Costa Rican waters were substantially smaller than those reported from Chilean species. Thus, the smaller crabs from the tropics produce smaller eggs, which results in a similar egg number when compared to those from temperate zones of the southern hemisphere. As a consequence, RO of porcellanid crabs from Chile and Costa Rica are in a similar range, indicating that these species invest a similar proportion of their body mass in egg production.

The biogeographic position of the South Georgia Islands: New evidence from marine molluscs

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The South Georgia Islands represent an ancient archipelago, which originated from the fragmentation process of the southernmost South America mainland and the Antarctic Peninsula during the end of the Mesozoic. Presently, they occupy the north of the Scotia Sea, about 2,000 km away from the mainland from which they originate. Several works concerning the faunistic affinities of the islands were analyzed, revealing different opinions about their biogeographic position. They have been regarded either as related to both the Magellan and Antarctic regions, representing a transitional area between these regions, or as a distinctive biogeographic unit. In the present study, a revision of the biogeographic position of the South Georgia Islands, based on the composition of the bivalve and gastropod assemblages, is conducted. The need for a systematic revision of many of the species previously reported as occurring in waters off the South Georgia Islands was first recognised and, consequently, the revision was carried out.

Bivalves and gastropods from 33 sampling stations obtained by the R/V Eduardo L. Holmberg during from 1995 to 1997 cruises to South Georgia and by the R/V Polarstern during the 2002 Latin American Polarstern Studies (LAMPOS) were studied. Additional samples from South Georgia deposited in collections at the Museo Argentino de Ciencias Naturales "Bernandino Rivadavia" were examined. Previously published records were critically reviewed and compiled.

153 nominal species of gastropods were reported from the South Georgia Islands; in the present study, 22 of them were considered as synonyms and 14 considered as doubtfully present. The occurrence of 5 species is reported for the first time, and the presence of 21 species is confirmed by a second finding. Thus, 122 gastropod species (comprising 43 families) were recognized. Among bivalves, 56 nominal species had previously been reported from the South Georgia Islands. In this study, 18 of them were considered synonyms or doubtfully present, 3 species were recognized as new to science, 3 species were reported for the first time as occurring at the South Georgia Islands and the presence of 3 species was confirmed by a second finding. Thus, 44 bivalve species (comprising 22 families) are recognized to occur in the South Georgia archipelago.

Representative species of both Magellan and Antarctic faunas were found in the South Georgia Islands, which represented the northern distribution boundary for 45 Antarctic species (34 gastropods and 11 bivalves), and the southernmost extension limit for 15 Magellanic species (11 gastropods and 4 bivalves). This fact would, at first glance, indicate a transitional character for the area. However, after the present revision, a high number of species (54 gastropods and 8 bivalves) are still only known from these islands. This high degree of local endemism particularly evident in the gastropod fauna strongly suggests that the South Georgia Islands should be considered as a distinctive biogeographic unit within the Antarctic Region instead of a transitory area between Magellan and Antarctic Regions.

POSTERS

Microzooplankton structure and annual fluctuations in Potter Cove (King George Island, Antarctica)

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Potter Cove is a coastal and shallow Antarctic ecosystem that has been object of several multidisciplinary studies. Most of the previous works on its microplanktonic community were carried out on primary producers, and their results have shown that, in general terms, the low primary productivity that is typical of this environment is due to high terrigenous inputs of freshwater runoff during summer and the quasi-permanent strong winds that cause low stability of the water column. However, no research has yet been done on heterotrophic microplankters, which usually constitute a significant fraction within the Antarctic microbial loop, acting as a link in the transfer of organic matter, bacteria and nanoplankton to macro- and ichthyoplankton.

In order to better understand the structure and dynamics of Potter Cove's ecosystem, an annual cycle sampling focussing on microzooplanktonic components (20-200 microns; provided with a rigid structure) was performed. A total of 21 subsurface (1 m) samples was collected by means of sampling bottles roughly every 15 days from March 1996 to February 1997 at the inner sector of the Cove (Site 1, Fig.1A), near Jubany-Dallman Station. Seawater temperature was measured form March to November (Fig.1B). Each 20-liter sample was filtered through an 18 µm-pore filter and preserved with formaldehyde. Absolute abundance of the different groups present in the material was estimated by utilizing an inverted microscope. Silicoflagellates were also counted in order to have an autotrophic reference.

The general microzooplanktonic structure and the numbers recorded in the present study suggest that the annual cycle of inner Potter Cove involves two different situations with a marked stage of transition in between.

The Summer season (January-March) is characterized by the dominance of dinoflagellates and tintinnids, which reach concentrations of up to 1180 and 1033 ind./l, respectively (Fig.1C,E). The peak of tintinnids, which seems to precede that of dinoflagellates, is coincident with the highest concentrations of crustacean larvae (30 ind./l). The latter show, however, a much less fluctuating cycle (Fig.1F). Although much more scarce and even absent during the second half of the cycle, silicoflagellates also exhibit a summer peak (26 ind./l). The record of low numbers of freshwater rotifers (not illustrated) during this season, and their presence in the water column, is interpreted as being due to melt water stream discharge.

Environmental conditions during April were characterized by strong winds (20 knots) and by the first record of temperatures under 0°C (Fig. 1A). This setting was accompanied by a noticeable change in the microplanktonic community structure, which involves: a) a sharp decrease in the two summer dominant components; b) maximum numbers of cysts (Fig. 1H; their absence during February '97, in coincidence with the peaks of dinoflagellates and tintinnids, suggests that they may belong to these taxa); c) highest concentrations of unidentified protists, category comprising mainly benthic organisms -foraminiferans, diatoms, shelled amoebae, and other presumable cysts; Fig.1G); d) a second, minor peak of crustacean larvae.

A pronounced decrease in abundance of all the groups is recorded from May to December, with the exception of certain periods during which the partial ice coverage allows strong winds to force the incorporation of unidentified (benthic) protists into the water column. The spring season was not reflected in an increment of the microzooplankters under study.

The results outlined above suggest that the general environmental conditions of inner Potter Cove facilitate the input of inorganic and organic particles from the continent and from the cove's bottom into the shallow water column. This leads protists provided with arenaceos or agglutinated structures (more evident in tintinnids, cysts, benthic foraminiferans, shelled amoebae) to prevail within the microzooplankton, and results in an atypical, mixed microplanktonic community due to the permanent incorporation of benthic protists and the contribution of freshwater ones during Summer. On the other hand, when compared with highly productive areas of the Southern Ocean (e.g., SW Weddell Sea, Bellingshausen Sea), silicoflagellates of Potter Cove are two orders of magnitude less abundant (in agreement with the low primary productivity previously reported for the area), while numbers of dinoflagellates and tintinnids are similar or even higher. The numerical contribution of the latter to Potter Cove's ecosystem must be significant as a food source for upper trophic levels. In addition to this, the average size of these organisms suggests the presence of a numerically important pico- and nanoplanktonic community for their sustenance. Such a trophic structure is thought to be more of the microbial loop type rather than the typical autotrophic-based system.

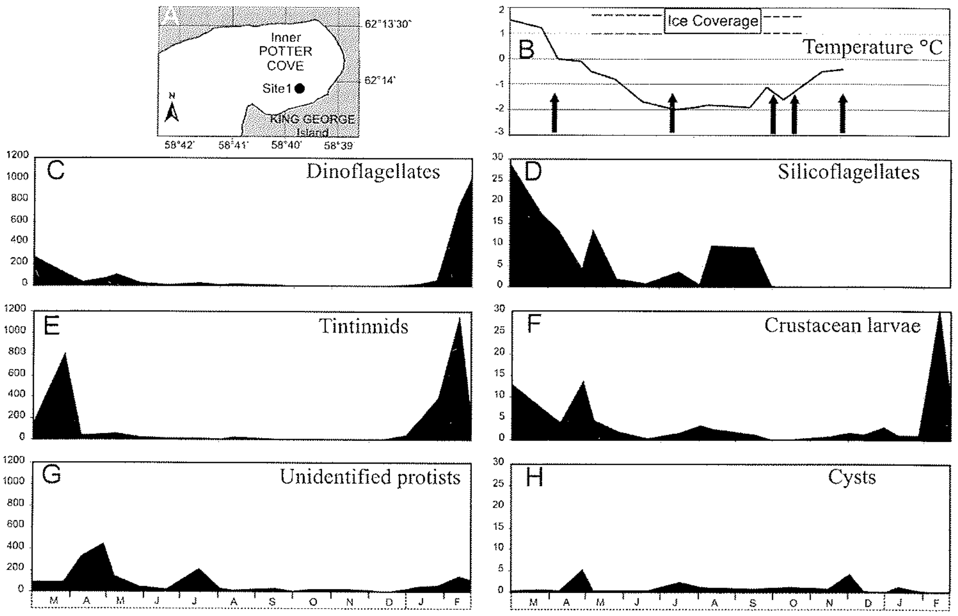

Fig. 1. (A) Location of the studied site at inner Potter Cove (King George Island). Temporal fluctuations of microplanktonic components (ind./l) from March '96 to February '97. Arrows (B) indicate wind intensities of or above 20 knots.

Bacterioplankton abundance in relation to environmental factors in the Argentine Sea, Drake Passage and Antarctic Waters during April 2002

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Research on marine picoplankton has received special attention mainly due to the relevance of bacteria within biogeochemical cycles. Despite the large amount of knowledge acquired from many diverse and vast oceanic environments, very few studies have focussed on the topic of bacterial abundance in the Argentine Sea. Previous available information consists only, on the one hand, of a high spatial resolution set of data on bacterial production and, on the other hand, of results on bacterial abundance and composition in two selected geographic locations. Both studies focus on the comparison between slope waters of the Southwestern and North Atlantic; none, however, has given a detailed analysis of the bacterial abundance patterns in coastal waters nor described the numerical transition towards the Southern Ocean. The present study thus intends to offer a general overview on the environmental factors that typify these hydrologically heterogeneous areas and to find their relationship with bacterial distribution patterns. For this purpose, samples from a long transect covering neritic waters of the Argentine Sea, the Drake Passage and coastal waters West of the Antarctic Peninsula (Fig. 1A) were quantitatively examined.

A total of 54 oceanographic stations were performed at 9 m depth between 40^0 S and 68^0 S (April 10 to 16, 2002) on board the icebreaker "Almte. Irizar" (CAV 2002, Leg II), by means of a suction pump and at a rate of one station per 15 minutes of latitude. At each station, two samples were collected, one for the assessment of bacterioplankton abundance (23 ml), and the other for the analysis of the content of nitrate, nitrite, silicate and phosphate (100 ml). At the same time, continuous measurements of in situ fluorescence, temperature and salinity were being taken as part of the Argau Project. Bacterial samples were preserved with 1% formaldehyde and stored in the dark at 4°C. In the laboratory, 3 ml were stained with DAPI (final conc. 0.3 μg DAPI/ml) and filtered onto black 0.2μm Nucleopore filters. Total numbers of bacteria were estimated by means of a fluorescence microscope.

As shown in Fig. 1B, temperature decreases gradually in a N-S direction from approx. 19.7 °C (Sta. 2) to -1.6 °C (Sta. 58). Salinity, nitrate, silicate and fluorescence, on the other hand, show an inverse pattern: Values are low or medium in the Argentine Sea but increase from 57-58°S towards Antarctic waters. Fluorescence, however, presents two similar peaks, one at approx. 43°S (Sta. 7), in coincidence with a strong increase of salinity, and the other at 68°S. Nitrite reaches slightly higher concentrations at 45-50°S, within the Argentine Sea, and remains rather stable in the Drake Passage and in Antarctic waters.

Bacterial abundance follows the meridional temperature profile between 40° and 68°S, which is confirmed by their significant positive covariation. In general terms, and based on bacterial abundance values, three different zones (Zone I, Zone II and Zone III, which hosts high, intermediate and low concentrations, respectively) can be distinguished along the transect (Fig. 1B): Within the first zone, the highest abundances were found south of the Valdez Peninsula (Sta. 7-11; temperature range: 14-15°), in which a maximum of 1.6 x 10^6 cells/ml (Sta. 8) is reached. The second zone extends along the coast of the Santa Cruz and Tierra del Fuego provinces (the highest values were detected between Sta. 19 and 27; temperature range: 11-9°C; Mx: 1.0 x 10^6 cells/ml at Sta. 21).

Among other factors, the influence of the North Patagonian gulfs (Golfo San Matías, San Jorge, Nuevo), which are reported as "close ecosystems", in combination with the increment of the distance to the coast, could explain the bacterial decline found at 40-42.5°S and at 46.5°S, where numbers reached are similar to those encountered in Antarctic Waters.

According to the total set of physico-chemical variables considered, the Polar Front is thought to be located between 57.5-59°S, and its presence seems not to be correlated with a significant bacterial decrease, as suggested in previous reports. Instead, a more clearly numerical variation occurs at 55°S, in coincidence with the sharp increment of bottom depth. This point constitutes the northern limit of the third zone, which is characterized by its lowest bacterial densities and includes the Southern Ocean. Drake Passage waters south of the Polar Front were found to host the minimum value (147 cells/ml) recorded during the period studied.

Bacterial abundance along the whole transect covaried negatively with salinity, depth, nitrate, silicate and phosphate, while no correlation was observed with nitrite and fluorescence. As to the latter, positive correlation with bacterial numbers could be confirmed when restricting the analysis only to continental shelf waters (40-55°S).

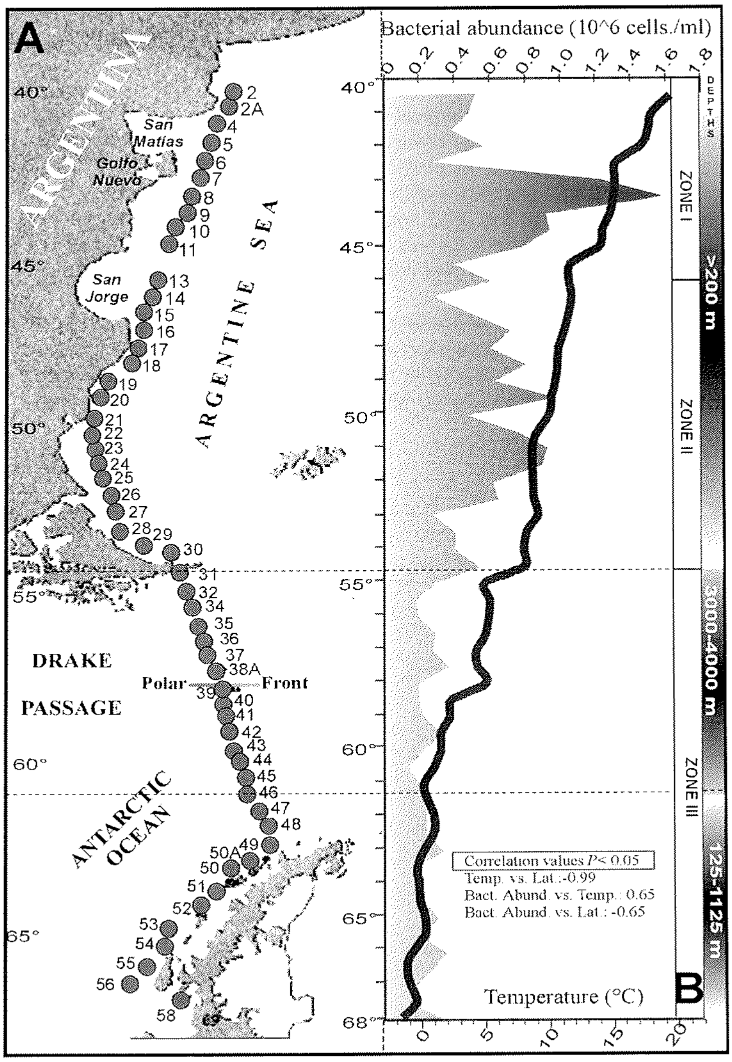

Fig. 1. - A) Geographic location of the samples examined; B) Spatial fluctuations of bottom depth, temperature and bacterial abundance, and zones observed along the transect during April 2002.

Thaumeledone and *Bentheledone*: deep-water octopodids from the Southern Ocean

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Recent trawling opportunities aboard *RV Polarstern* during CCAMLR fish surveys, the CS-EASIZ programme and ANDEEP and during fisheries surveys around South Georgia have yielded an unusual collection of octopods initially identified as belonging to the genera *Thaumeledone* and *Bentheledone*. Both genera are poorly described and we have undertaken a revision, examining all the type material.

Within the two genera, six names are available (Table 1), none of which is thought to be synonymous. Most deep water *Thaumeledone* specimens from the Southern Ocean have been attributed to the species *T. brevis* even though the type locality of the latter is off Montevideo. Unfortunately, the type material of all except the most recently described species is in extremely poor condition and much of it is of juvenile specimens.

Nonetheless, initial examination of the holotype of *Eledone rotunda* leads us to believe that this species in fact belongs in the genus *Thaumeledone*. This has consequences for the genus *Bentheledone*. It is also extremely likely that deep-water specimens from the Southern Ocean previously attributed to *T. brevis* are in fact specimens of *T. rotunda*.

Based on new material collected (Table 2) we are able to redescribe all the Southern Ocean species and describe a new species of *Thaumeledone* from the Antarctic Peninsula.

Table 1. Species assigned to either *Thaumeledone* or *Bentheledone*

Species	Type locality	Accepted placement (and type of genus if applicable)
Eledone brevis Hoyle 1885	off Montevideo	*Thaumeledone* (type)
Thaumeledone gunteri Robson 1930	53°S 35°W	*Thaumeledone*
Thaumeledone marshalli O'Shea 1999	42°S 175°E	*Thaumeledone*
Thaumeledone zeiss O'Shea 1999	44°S 179°E	*Thaumeledone*
Eledone rotunda Hoyle 1885	53°S 108°E	*Bentheledone* (type)
Moschites albida Berry 1917	64°S 127°E	*Bentheledone*

Table 2. Specimens captured during recent trawling

Species	Number of specimens	Capture locations
Thaumeledone gunteri Robson 1930	25	South Georgia, 400-900 m
Thaumeledone rotunda (Hoyle 1885)	4	approx 60°S 54°W, 2900-3200 m
Thaumeledone sp.	16	60-62°S 57-60°W, 800-1400 m
"Bentheledone" albida (Berry 1917)	7	approx 60°S 54°W, 2900-3200 m

On the confusion surrounding shallow water octopods in the Scotia Arc

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In the Southern Ocean, shallow-water (to approximately 400 m depth) incirrate octopods with a single series of suckers on each arm are nearly always referred to as *Pareledone* sp., although there is considerable diversity within this group. This paper examines the confusion within the group.

Until recently all papillated specimens of *Pareledone* were ascribed to the species *Pareledone charcoti* (Joubin, 1905). Re-examination of all the papillated type material of *Pareledone* coupled with extensive fishing over several years off the Antarctic Peninsula has led to a revision of this position. Seven species of papillated *Pareledone* are identified from the Peninsula region. Subtle taxonomic characters such as colour patterns and skin texture identify them, particularly by the morphology of their papillae, although traditional indices often fail to separate the species. Although apparently sympatric, some evidence indicates niche separation of these species with respect to depth.

Two other species of *Pareledone* (*turqueti* and *polymorpha*) have previously been reported from the Antarctic Peninsula. Both have been found to be abundant in shallow waters around the Peninsula. However, *polymorpha* has been shown not to belong in the genus *Pareledone* at all and a new genus is being erected for this species.
The genus *Megaleledone* is often mistaken for *Pareledone* although adult specimens cannot be mistaken because of their large size. This monotypic genus has recently been redescribed and the specific name *setebos* given nomenclature precedence. A species of an undescribed genus is also abundant in shallow waters.

A key is provided for the identification of all the above genera and species.
Full descriptions of all the undescribed species and genera are either in press or in preparation; however, we cannot reveal the new names at this time as nomenclature rules would then deem these names *nomina nuda*!

The diversity at the Antarctic Peninsula is not mirrored around South Georgia. Here, only two species inhabit the shallow waters: *Pareledone turqueti* and *"P." polymorpha*. Of these, the range of only one, *P. turqueti*, extends to Shag Rocks.

Pareledone specimens have been reported previously from around the Falkland Islands and South America. However, we have not found any museum specimens correctly assigned to *Pareledone*. The majority have been misidentifications of *Eledone* species and we conclude that South Georgia and Shag Rocks act as a transitional area to which just a few species extend, and that South America is beyond the range of these endemic Southern Ocean octopods.

Key to the shallow water octopods of the Scotia Arc with single sucker series.
[Where a species number is given rather than a name, the species description is not yet published. The number has been used in *Polarstern* cruise reports (in *Berichte zur Polarforschung*) and will appear in the published synonymy with the description.]

1a.	Web deep, greater than 30% of arm length	2
1b.	Web shallow, less than 30% of arm length	3
2a.	No anal flaps, 10-14 gill lamellae per demibranch	*Megaleledone setebos*
2b.	Anal flaps, 6-8 gill lamellae per demibranch	New genus, sp. 17
3a.	Stylets absent, upturned rostrum on lower beak	*"Pareledone" polymorpha*
3b.	Stylets present, rostrum of lower beak not upturned	4
4a.	Papillae clearly raised and close set on dorsal mantle	5
4b.	Not as above, although scattered papillae may be present	*Pareledone turqueti*
5a.	Papillae compound	6
5b.	Papillae simple	7
6a.	Supraocular papillae present	*Pareledone sp. 19*
6b.	No supraocular papillae	*Pareledone sp. 29*
7a.	Papillae round	8
7b.	Papillae irregularly shaped	11
8a.	Pattern of larger papillae on dorsal mantle	9
8b.	No larger papillae on dorsal mantle	10
9a.	Papillae coverage extends to edges of ventral mantle	*Pareledone sp. 26*
9b.	Papillae stop abruptly at lateral ridge	*Pareledone sp. 12b*
10a.	Supraocular papillae present	*Pareledone sp. 12a*
10b.	No supraocular papillae	*Pareledone sp. 33*
11a.	Papillae coverage extends to edges of ventral mantle	*Pareledone sp. 15*
11b.	Papillae stop abruptly at lateral ridge	*Pareledone charcoti*

Comparison of blood antioxidant responses among *Catharacta maccormicki* (South Polar skua) and *Catharacta antarctica lönnbergi* (Brown skua).

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Both Brown and South Polar Skuas nest sympatrically in a few areas, mostly along the Antarctic Peninsula between 61° and 65° S. At these sites, there appears to be a sharp partitioning of food resources. South Polar Skuas (*Catharacta maccormicki*) forage almost exclusively at sea, whereas Brown skuas (*Catharacta antartica lonnbergi*) monopolize the terrestrial food source of penguin eggs and chicks. Skuas, like other Antartic organisms, are exposed to severe environmental conditions such as extremely low temperature and high UV radiation levels, that can increase the flux of reactive oxygen species (ROS) and loss of cellular redox homeostasis that exert oxidative stress. Oxidative stress is an important biochemical condition and is characterized by the presence of unusually high concentrations of toxic reactive species, principally consisting of ROS that are highly oxidizing, readily destroying redox-sensitive proteins and enzymes as well as attacking membranes and DNA. Under normal conditions, cellular homeostasis is incessantly challenged by stressors arising from both internal and external sources. To counterbalance these stressors, the cell has evolved its own protective processes, loosely termed defense mechanisms to neutralize the oxidative effects of oxygen and its reactive metabolites. Their task is to protect cellular homeostasis from oxidative disruption by free radicals and other reactive molecules created during the reduction of oxygen. These antioxidants function most efficiently when the activity of their individual components is coordinated. Some studies in rats have shown the influence of nutritional factors and age on glutathione (GSH) metabolism. The intracellular redox state is a tightly regulated parameter that provides the cell with an optimal ability to counteract the highly oxidizing extracellular environment. Intracellular redox homeostasis is regulated by antioxidants, particularly by thiol-containing molecules such as glutathione. This antioxidant has been shown to protect cell membranes against oxidative stress, and cellular content and enzyme activities related to the GSH redox cycle normally decrease with age.

The aim of this work was to investigate the combined effects of the nature of dietary nutrients, different sources of food and aging on the antioxidant defense system in blood samples of both species of skuas.

Blood samples were collected from adults and chicks of skuas nesting on Potter Peninsula (King George Island, South Shetland Islands, Antarctica), during the breeding season of 1999-2000. A total of 33 skuas were studied, 18 of which were *C. maccormicki*, (6 adults and 12 chicks), and 15 *C. antarctica lönnbergi*, (7 adults and 8 chicks). Approximately 5 ml of blood were drawn from the brachial vein of the seabirds using an heparinized 22 gauge needle. Whole-blood samples were centrifuged for 15 min at 3000 rpm to separate red blood cells from plasma and immediately frozen at –20 °C.

Superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GPx) activities as well as total glutathione, total antioxidant capacity (TRAP) and total antioxidant reactivity (TAR) were measured.

Specific activities of antioxidant enzymes are shown in Table 1. CAT and GPx were both significantly lower in the *C. antarctica lönnbergi* species. However, in the younger skuas (chicks) the CAT activity of both species was reduced by 19 % and 33 % compared with their adults in *C. maccormicki* and *C. antarctica lönnbergi* respectively. The age-dependent decrease in the GPx activities was thus more marked with *C. maccormicki* skua species. Nevertheless, in *C. antarctica lönnbergi*, the decrease in GPx activity was no larger in chicks than in adults. No change was observed in SOD activity. When endogenous antioxidants were studied (Table 2), the total GSH content in blood was significantly lower in chicks by 70 % in *C. maccormicki* and 86 % in *C. antarctica lönnbergi*, respectively. TRAP and TAR were not significantly different as a consequence of diet or aging.

Changes in GSH redox status reflect the equilibrium between the generation of oxidative challenge and the production of reductive equivalents to counteract such a challenge. Furthermore, the synthesis of metabolites that act as antioxidants can be impaired in old cells, our results show that different food intake by the two different species can help to maintain the antioxidant defense system. The antioxidants that are found naturally in tissues represent a potential class of longevity determinants that could be associated with species. The SOD activity in both species is a constant indicating that the mechanisms of oxygen metabolism are remarkably similar in both groups of skuas. The total amount of oxygen that blood of both group uses is proportional to the amount of SOD protection that a tissue has against the toxic by-products of oxygen metabolism. GSH is thought to be one of the most important tissue antioxidants. The levels of antioxidants are under compensatory or homeostatic control by the regulatory adjustment of each antioxidant. The different antioxidant status between chicks and adults could be explained because it is the net protective level of a tissue that would be expected to determine aging rate, i.e. it is this net level and not the level of individual antioxidants. This compensatory model of maintenance of tissue levels of antioxidants is based on the concept that they have overlapping capabilities by which one antioxidant can partially replace another. If this model is correct, different content of antioxidants in diet at unusual levels would similarly depress the levels of other antioxidants. Over a wide range of dietary uptakes of antioxidants or oxidative stresses, the net tissue antioxidant protection level would be expected to remain fairly constant as is reflected in TRAP and TAR values.

The different response observed in CAT and GPx activities between *C. maccormicki* and *C. antarctica lönnbergi*, could be due to the different type of endoperoxides generated as a consequence of oxidizing metabolism. Our results clearly indicate that the antioxidant defence system was modified by both aging and dietary food type in Antarctic skuas. As compared with adults, chicks show lower cytosolic GSH levels and CAT and GPx activities in *C. antarctica lönnbergi*, but higher GPx activity in *C. maccormicki*. We found an alteration in the total GSH content related to age. Moreover, we observed a dietary influence either in the adult or in chicks in antioxidant enzyme activities of CAT and GPx. The lipid-oxidation products ingested with food or produced endogenously represent a health risk. Of particular relevance, GPx activities were lower with land diet in *C. antarctica lönnbergi* than in the *C. maccormicki* skuas group. The observed decrease in GPx activity with food intake may thus be related to the oxidative stress condition in *C. antarctica lönnbergi* and it can be compensated by GSH blood levels.

Dietary nutrition and age can affect antioxidant systems. These enzyme activities were significantly correlated with microsomal membrane fatty acids. The variation in GPx activity was different in both skua species depending on the type of dietary nutrients related to the origin of food intake. It is noteworthy that the nature of dietary nutrition directely influenced the way these antioxidant enzyme activities changed with age.

In conclusion, our results indicate that the reducing capacity related to GSH content in blood changes with age in skuas, as reduced GSH is known to decrease with age, the increase observed in total GSH content could be due to an increase in the oxidized GSH content and it is higher in *C. antarctica lönnbergi*. The higher oxidative state observed in older animals may lead to an increase in the activities of some antioxidant enzymes. However, this study suggests that the type of diet or food plays a role in controlling the activity of the GSH-related antioxidant system.

Table 1. Antioxidant enzyme activities in blood of chicks and adults skuas. Data are expressed as mean values ± SEM. Number of animals between brackets. Multiple comparisons among species and stages: values followed by different letters are significantly different at *p*< 0.001.

		SOD (U/mg protein)	CA (pmol/mg protein)	GPx (nmol NADPH/min/mg protein)
C. maccormicki	Chicks	2261.2 ± 256.7 (12)	0.525 ± 0.060 ^{a} (12)	0.231 ± 0.035 ^{a} (11)
	Adults	1609.5 ± 212.0 (7)	0.650 ± 0.056 ^{a} (6)	0.150 ± 0.019 ^{b} (6)
C. lönnbergi	Chicks	2582.4 ± 521.1 (8)	0.257 ± 0.030 ^{b} (7)	0.039 ± 0.009 ^{c} (8)
	Adults	1455.3 ± 372.0 (7)	0.386 ± 0.040 ^{c} (7)	0.063 ± 0.012 ^{c} (7)

Table 2. Total glutathione, total antioxidant capacity and total antioxidant reactivity in blood of chicks and adults skuas. Data are expressed as mean values ± SEM. Number of animals between

brackets. Multiple comparisons among species and stages: values followed by different letters are significantly different at $p < 0.001$.

		Total Glutathione (μM)	TRAP (μM Trolox)	TAR (μM Trolox)
C. maccormicki	Chicks	11.3 ± 3.7 ^{a} (12)	321.4 ± 56.8 (12)	13.0 ± 2.6 (12)
	Adults	38.4 ± 9.2 ^{b} (7)	341.3 ± 56.2 (6)	13.1 ± 3.7 (6)
C. lönnbergi	Chicks	9.0 ± 1.5 ^{a} (8)	389.4 ± 77.4 (8)	11.3 ± 3.7 (8)
	Adults	62.5 ± 12.1 ^{b}(7)	507.6 ± 85.9 (7)	11.7 ± 2.0 (7)

Seasonality in the maxima of Total Particulate Matter vertical flux in an Antarctic coastal shallow environment

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Shallow coastal environments of Antarctica present high densities of benthic organisms. In some of them pelagic primary production is not sufficient to sustain the profuse macrozoobenthic biomass found. Therefore, it has been hypothesised that other sources of organic matter such as resuspended benthic and/or allochthonous material could be the main energy source for benthic organisms. This research is part of a wider study of the amount and quality of suspended particles as a potential food source for benthic filter feeders in Potter Cove. In this presentation we only show the variability of TPM corresponding to the events with maximum particle fluxes, and its relation with winds, tides and seasonal ice cover. In this context, temporal variability in the sedimentation rates of total particulate matter (TPM) was studied in Potter Cove, King George Island (South Shetland Islands, Antarctica) between February 2002 and Febraury 2003, using an automated sequential sediment trap. The trap was placed on the bottom of the cove at 12 m depth and sampling frequency was set to represent short (hourly) and medium (daily) term varability. Twenty-seven field experiments were performed during different seasons. Daily sedimentation rates were calculated for TPM and its organic fraction (OM), as well as for chlorophyll content. Results show a strong seasonality in TPM, with the highest values during summer and fall (115 g m^{-2} d^{-1}) and much lower concentrations during winter (around 3 g m^{-2} d^{-1}). During spring, TPM sedimentation rates gradually increased again. The %OM was very variable, regardless of TPM amount. Chlorophyll-a showed maximum values during late December, with sedimentation rates as high as 2.13 mg m^{-2} d^{-1} (Table I).

High wind speeds are typical in the Potter Cover area. In the summer and fall samplings, wind played a central role in the TPM sedimentation and resuspension processes. When strong winds blew during the sampling event, as on January 3 (Table I), high TPM with low %OM and low Chlorophyll-a sedimented. However, when strong winds (> 10 m s^{-1}) blew 1-2 days before sampling, trap contents showed high TPM concentrations, but with a high OM content as well. This can be related to the fact that inorganic material sediments faster than OM, which remains suspended in the water column even a day after the strong winds. During both these seasons, tidal amplitude did not show any correlation with TPM sedimentation dynamics. When sea ice covered the waters in the cove, the ice "cap" isolated the waters below, probably minimising resuspension of the fine sediments that characterise the inner cove sea bottom. During this season, the relative increment in TPM coincided with maximal tidal amplitudes. The low air temperatures maintained sea ice cover until September. Once the "cap" was removed, TPM increased (Table I, experiments on 7-8/11/02 and 13-14/11/02). However, much higher TPM sedimentation rates were measured once the air temperature increased (to values >0°C) so that the snow on the coast melted forming two creeks, and fresh water entered the cove carrying high concentrations of particles, which entered the sediment trap.

The results analysed show that wind is the major factor controlling TPM sedimentation, except when the ice "cap" is present. Allochthonous input, although important, apparently added less TPM to the traps than wind resuspension did.

Table I: Some selected field experiments of the automated sequential sediment trap displayed at Potter Cove, King George Island. MaxTPM: TPM corresponding to the maximum sedimentation rate measured during the different experiments. MOMax: OM concentration corresponding to MaxTPM; Chl-aMax: Maximum Chlorophyll-a sedimentation rate measured during the experiment; Amplit: Tidal amplitude; d: day

Date	Duration d	MaxTPM $g\ m^{-2}\ d.^{-1}$	MO Max %	Chl-a Max $mg\ m^{-2}\ d^{-1}$	Wind Speed $m\ s^{-1}$	Max. Amplit. m
5-6/3/02	1	50.00	32.76	0.51	2.5	0.75
14-15/3/02	1	7.40	6.45	0.12	10	1.57
17-18/3/02	1	12.80	?	1.78	7.5	1.3
29/4 - 11/5	12	13.75	6.39	0.30	10	1.21
22/7 - 3/8	12	6.49	14.72	0.80	5	1.45
7-19/9/02	12	4.62	16.98	0.21	20	1.3
7-8/11/02	1	35.81	14.67	0.00	12	1.67
13-14/11/02	1	28.17	13.56	0.00	3.5	0.75
22-23/12/02	1	27.69	15.52	0.22	2	2.01
23/12/02-3/1/03	12	49.42	3.86	2.13	10	2.12
30/1-10/2/03	12	28,13	4.80	0.56	2.2	1.92
18/2/03	1	115.10	9.61	0.00	10	0.27

A new biogeographic approach to the Lithodid distribution considering their southernmost records

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Throughout the first half of the last century lithodid distribution was considered as derived from a biogeographic centre located in the northern hemisphere. This idea was based on the early studies of Makarov and it was supported by the number of genera and species that were recorded up to that time. Haig also emphasized this criterium based on new records obtained from the Eastern Pacific Ocean. Nevertheless, since the sixties many lithodid fisheries started in the southern hemisphere, namely Australia, New Zealand, Chile, Peru, Argentina, and South Africa. Associated with these fisheries many new records of lithodid coming from southern oceans appeared. Therefore, the number of species recorded from the southern hemisphere almost equalled that recorded from the northern and the possibility of new records coming from the south surpassing those from the north appeared as an argument against the previous idea of a Northern centre of lithodid dispersion.

Although, from a palaeontological perspective, the family Lithodidae probably evolved about 13 – 25 million years ago in the North Pacific Ocean, the group, totaling 105 species, now has an almost global distribution with many species concentrated in shallower waters from the Arctic and Antarctic regions and some other species from deeper waters distributed in more temperate and tropical areas. At least for some of them the distribution of both groups of species is connected by the distribution of colder water masses that increase their depths towards lower latitudes. New insight into the idea that at least some lithodid species occupied the cold regions arose with the more recent lithodid findings in the Antarctic, an area always considered as very poor in decapod species. This situation allows us to consider a new biogeographic approach for the present day lithodid distribution, in which a more dynamic situation including changes in movements of waters masses from a geological perspective should be considered.

Pallenopsis notiosa, a deep water pycnogonid from Magallanes

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Material from benthic samples gathered during 1994 in the southern region of Chile on the German R/V Victor Hensen (Stations: 976, 1° NOV, Paso Ancho, 460 m; 1042, 4 NOV, Garibaldi, 190 m; 1209, 14 NOV, off Isla Barnevelt, 65 m, and 1316, 23 NOV, Canal Magdalena Punta Sanchez, 274 m), and the Chilean R/V Vidal Gormaz during the CIMAR Fiordo cruises: 1, Campo de Hielo Sur (AUG, 1995: AGT – 14, Stn. 25, Seno Penguin, 232 m; AGT – 18, Stn. 39, Bahia Chubretovic, 110 m); 2 (OCT, 1996: AGT – 12, Stn. 10, Canal Baker, 298 m; AGT – 62, Stn. 49, Canal Smith, 620 m); 3 (OCT 1997: AGT – 1, Stn. 1: 52° 27,40'S, 68° 35,00'W, 70 m) has been sorted. All samples were collected with an Agassiz Trawl in very soft mud in sea-waters with a temperature of 7 – 8 ° C.

Until now a total of 39 pycnogonid species have been recorded from Chilean coastal waters, and the group needs to be updated. Among the Chilean records, there are some species that are probably synonyms and others that have been recorded only once. Most species are recorded from deep waters and very few are coastal.

Pallenopsis notiosa is a deep-water pycnogonid that was found in all the cited samples, with a total of 40 specimens, from which a morphometric analysis was carried out. Another specimen from an unidentified species was found, which is presently under study. *Pallenopsis notiosa* had been recorded only from the type locality further north in Chilean waters, from deeper waters than those from the Magellan area where the present samples were obtained. Probably both environments where this species has been found are related through the influence of the Antartic Intermediate Water Mass.

Two new Antarctic stegocephalid (Amphipoda) species, with implications for the phylogeny and classification of the two genera *Pseudo* and *Schellenbergia*

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Introduction

During the ANDEEP II expedition with the *Polarstern* to the Antarctic in March 2002 one stegocephalid amphipod of the genus *Pseudo* was collected. This was the first record of the genus from the Southern Hemisphere, the three other species in the genus were reported from the North Atlantic, North Pacific and the Mediterranean. Later, a second new species of this group was discovered, collected during the Eltanin expedition to the Ross Sea in 1968. Although neither of these two new species will be formally described here, as they are only known by one single immature specimen each, they cause some changes in the phylogeny and classification of the Stegocephalidae proposed by Berge & Vader in 2001.

The two new species

Pseudo sp. 1

This new species was collected in the Weddell Sea at 1166 meters depth (ANDEEP station 133-3). It seems to be a sister taxon to the North Atlantic species *P. bioice*, mainly separated by the elongate labrum and mandibles, in addition to the two-articulate palp of the first maxilla. Otherwise, it shows all the characteristics of the genus *Pseudo s.s.*

Pseudo sp. 2

This species was collected in the Ross Sea during the *Eltanin* expedition in 1968 at 350 meters depth. The morphology and setation of the maxilliped and the reduced number of ST on the first maxilla are characteristics that unequivocally link it to the genus *Pseudo.* The species is, on the other hand, also characterised by a short and rounded telson and a short accessory flagellum. Neither of these characteristics is easily associated with the genus *Pseudo*, but both were considered as synapomorphies for the *Phippsia*-group in the latest revision of the family (Berge & Vader 2001). Moreover, the strongly serrate epimeral plate three, the unexpanded basis on pereopod 6 and the relatively narrow coxa 4 are all characters that suggest close relationship to *Schellenbergia.*

Relationships between the genera *Pseudo* and *Schellenbergia*

In Table 1 (below) a comparison is made between the six taxa *Pseudo*, *Schellenbergia, Stegocephalus,* the *Phippsia*-group (consisting of the genera *Austrophippsia*, *Phippsia* and *Tetradeion*, see also Figure 1), and the two new species. It is first of all *Pseudo* sp. 2 that provides a link between *Pseudo s.str.* and the clade consisting of *Schellenbergia* and the *Phippsia*-group. Until now, the strong similarities between *Pseudo* and *Schellenbergia* in the morphology of the maxilliped were considered as a homoplasy, as the two were separated on e.g. the morphology of basis of pereopod 6 and the number of ST on the first maxilla. The two new species, in combination, show a total mixture of these character states, indicating a much stronger relationship between the two genera than previously assumed. Furthermore, *Pseudo* sp. 2 possesses two characteristic features (accessory flagellum and telson, see above) that further suggest a close relationship to the *Phippsia*-group; both have previously been considered synapomorphies for the *Phippsia*-group. *Pseudo* sp. 1 is a more typical member of the genus *Pseudo s.s.*, and appears to be a sister taxon of the North Atlantic *P. bioice,* although its elongate labrum also suggests a closer relationship with the *Phippsia*-group.

Accordingly, as no clear distinctions could be made between the two genera, the genus *Schellenbergia* is herein amalgamated with the genus *Pseudo* (under the latter name). *Pseudo* is thereby established as a genus consisting of seven species, three of which are found in the Southern Ocean. Furthermore, it is now, contrary to the proposed phylogeny by Berge & Vader 2001, considered to be more closely related to the *Phippsia*-group than to *Stegocephalus* (see Fig.1).

Character	*Pseudo*	*Schellenbergia*	*Pseudo* sp. 1	*Pseudo* sp. 2	*Stegocephalus*	*Phippsia* - group
1.	A	A	A	B	A	B
2.	A	A	B	A	A	B
3.	A / B	A	B	B	B	A
4.	A	A	A	A	B	A
5.	A	A	A	A	B (A)	A
6.	A	B	A	B	A	B
7.	A / B	A	A	A	B (A)	B
8.	A	A	A	B	A	B

Table 1. Characteristics of the genera *Pseudo* and *Schellenbergia* in addtion to the two new species and the two related taxa *Stegocephalus* and the *Phippsia*-group (herein defined as consisting of the three genera *Austrophippsia, Phippsia* and *Tetradelon*). Characters: 1, Antenna 1 accessory flagellum: A - long (usually as long as flagellum article 1), B – short (rudimentary or half the length of flagellum article 1); 2, Labrum: A – as long as broad, B – elongate (longer than broad, triangular); 3, Maxilla 1 outer plate: A – ST in traditional 6/3 arrangement, B - ST in 4/2 or 5/3 arrangement; 4, Maxilliped inner plate: A – long, rectangular and distally concave, B – different; 5, Maxilliped palp article 2 distally: A – produced, B – not prouced; 6, Basis pereopod 6: A - broad, B – unexpanded or rudimentary expanded; 7, Epimeral plate 3 posteriorly: A – strongly serrate, B – smooth (may be serrate ventrally); 8, Telson: A – longer than broad, pointed, strongly cleft, B – as long as broad, rounded, weakly to not cleft.

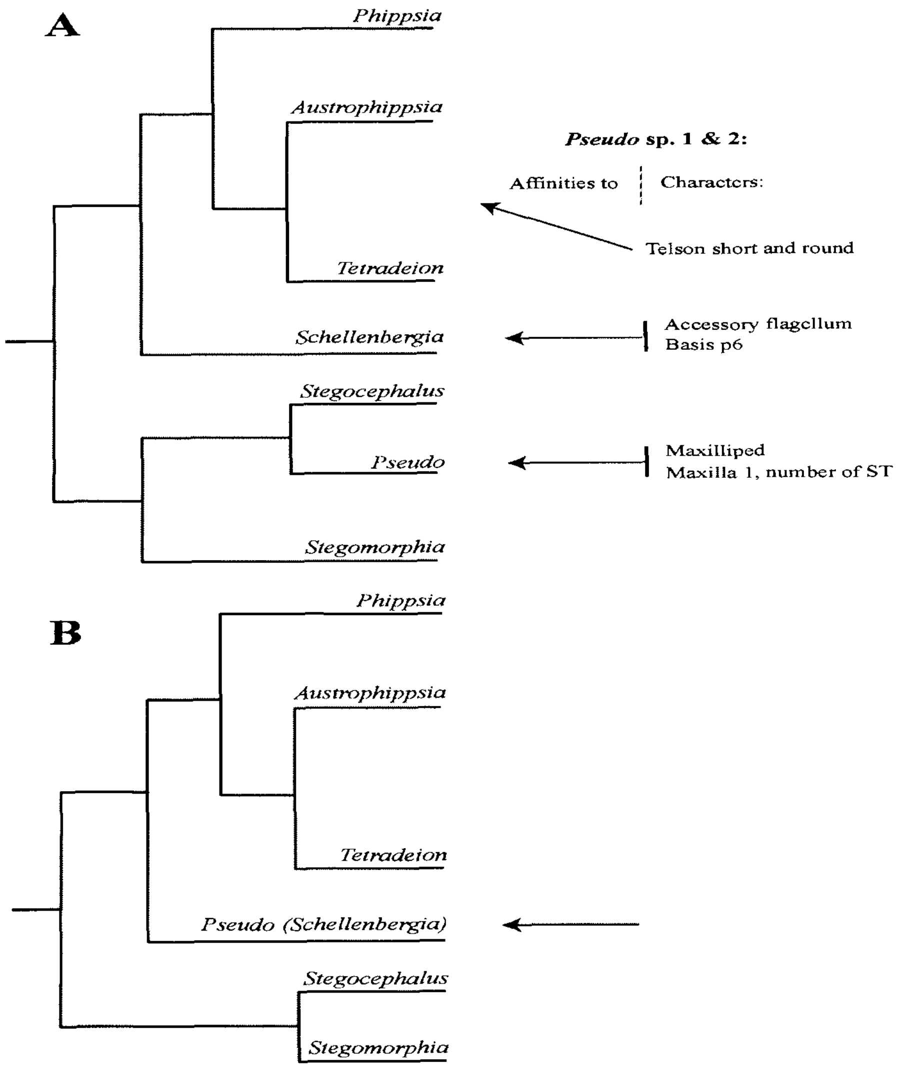

Fig. 1. A: Proposed phylogenetic relationships among selected genera after Berge & Vader 2001, B: Proposed phylogenetic relatioship among the same genera following the inclusion of two new Antarctic species.

Native and alien flora of Isla de los Estados (Tierra del Fuego, Argentina) and its relationships with subantarctic islands

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Introduction

Southern oceanic islands are currently subject to considerable attention. The effects of alien fauna and flora on the native biota, the impact of past and present climatic changes on the vegetation and fauna of these islands, and the conservation threats resulting from human activities are the main topics under study.

Isla de los Estados (54° 45' S, 64° 30' W) is a southern oceanic island of continental origin; it lies on the northern limbs of the Scotia Arc and is the ending of the Andean Cordillera. The characteristic vegetation formations are the Magellanic evergreen forest and the Magellanic moorland. This island has suffered little disturbance by man. Since the transfer of the penal colony from Puerto Cook to Ushuaia in 1902, the number of permanent human occupants has been 0-4 (currently 4 at Puerto Parry).

Here, I present an updated revised vascular flora of Isla de los Estados and compare its native and alien flora with that of 9 temperate and subantarctic islands or archipelagoes. This knowledge is necessary to develop efficient management and environmental policies to minimize human impacts on the island.

Results

Data obtained during 1998-2001 are combined with records from previous surveys to provide a baseline description of the flora of Isla de los Estados. A total of 179 species was found on the island. A summary of these findings is presented in Table 1. One remarkable aspect was that Isla de los Estados contains an unusually small number of exotic plant species. The number of exotics is five times smaller than the number predicted for a temperate island.

The native flora of the island is a subset of the flora of the main continent. It includes one species (*Senecio eightsii* Hook. & Arn.) restricted to Isla de los Estados and the easternmost extreme of Isla Grande de Tierra Fuego and one endemic subspecific taxa (*Armeria maritima* (Mill.) Willd. var. *goodalliana* T.R. Dudley). Between 17 and 117 species are shared with near subantarctic islands and 4 to 14 with distant islands (Table 2). One of the species that lives in Antarctica (*Colobanthus quitensis*) is present in Isla de los Estados. All the exotics present in the island are European - Eurasian common ruderals and weedy species throughout most temperate regions of the world, but none of them became dominant. Three exotic species (*Poa annua*, *Cerastium fontanum* and *Stellaria media*) are present in most subantarctic islands checked.

Discussion

The native flora of Isla de los Estados is clearly derived from that of Tierra del Fuego. One group of native species has wide a distribution in the Subantarctic, probably as a result of long distance dispersal. Currently, the exotics have little impact on the ecosystem, but it is necessary to monitor the status of alien species and prevent new introductions that, under the predicted climate change and increase in tourism pressure, could alter the native communities.

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Class	Fam No.	Gen No.	Sp No.	Natives	Exotics
Pteridophyta	9	10	23	23	0
Monocotyledoneae	8	28	49	47	2
Dicotyledoneae	36	68	107	102	5

Table 1. Summary of the floristic composition of Isla de los Estados (Argentina).

Island (or group of islands)	Distance from Isla de los Estados (km)	Natives	Exotics
Falkland Is. (Islas Malvinas)	490*	89 / 162	7 / 89
Cape Horn Arch.	240*	117 / 146	2 / 3
South Georgia	1740*	17 / 23	7 / 52
South Sandwich Is.	2290	0 / 1	0 / 0
Pr. Edward & Marion Is.	6560	11 / 23	5 / 15
Crozet Arch.	7280	14 / 28	6 / 99
Kerguelen Arch.	7680	14 / 29	7 / 86
Heard Is. & McDonald Is.	7420	4 / 10	1 / 1
Macquaire Is.	7260	11 / 36	3 / 6

Table 2. Shared taxa between Isla de los Estados (Argentina) and the subantarctic islands checked. Second number is the total number of species in each island or group of islands. * Nearest islands from Isla de los Estados.

Growth of juvenile-of-the-year subantarctic king crabs, *Lithodes santolla* and *Paralomis granulosa*, at different temperatures

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Reptant decapods, including king crab (Lithodidae), are principally absent from high Antarctic waters, such as the Weddell Sea. Massive extinctions of the marine Antarctic fauna -especially decapod crustaceans- were due to Antarctic cooling, a process which may have finished about 20 Ma ago. Recent records of king crabs (*Paralomis birsteini* and *Lithodes murrayi*) prove their presence in waters off the Antarctic continental shelf. Furthermore, recent studies of early life history have shown that the larvae of *P. granulosa* and *L. santolla* can complete their development at 3°C. These observations pose the question about possible adaptations allowing survival south of the Antarctic convergence.

We studied effects of temperature on early juvenile growth of *Lithodes santolla* and *Paralomis granulosa* in the laboratory. The rearing experiments were conducted throughout one year at temperatures of 3 (only *Paralomis granulosa*), 6, 9, and 15°C. Ovigerous females were obtained from the Beagle Channel (55°S), and larvae hatched in the laboratory from different females. Larvae and juveniles were kept individually in 100 ml-flasks. Larvae are endotrophic and therefore were not fed. Juveniles were fed with *Artemia* sp. nauplii. Crabs were checked daily for molts and mortality. Once crabs had molted, the standard size, carapace length (CL), was recorded in the exuvia and in the live animal.

Juvenile instar I had ca. 2.4 mm CL in *P. granulosa* and ca. 2.5 mm in *L. santolla*. One year after hatching, juvenile crab instars II (at 3°C) to VIII (at 15°C) were reached. The size in each instar was independent of the female (2 hatches compared in *L. santolla*, 3 in *P. granulosa*) or the experimental temperature. At least up to juvenile instar IV (ca. 3.9 mm CL) the size in equal instars was similar in both species. Growth rates (expressed as size increments per unit of time) increased with increasing temperature associated with decreasing intermoult periods (Table 1). The size increment per moult varied among temperatures and between species (Table 1). In *P. granulosa*, it showed positive allometry at 15°C and 9°C, but it was isometric at 6°C. At 9°C, increment per moult was significantly higher in this species than at 15°C. In *L. santolla*, it was only at 9°C positive allometric but isometric at the other temperatures.

In the typical range of water temperatures found in the Beagle Channel (5-9°C), our data suggest that both king crab species should reach ca. 5 mm CL within one year of hatching. Since both the sizes in equal instars and the rates of growth are similar in the two subantarctic species studied here, we presume that the growth of Antarctic lithodids living at ca. 2°C, e.g. *P.birsteini* and *L. murrayi*, must be very slow. *Lithodes santolla* and *P. granulosa* are known to have a life span of ca. 20 years in the Beagle Channel. Hence, we suggest that the longevity of lithodids living south of the Antarctic convergence should be significantly higher than in their subantarctic relatives.

Table 1. Growth of early juvenile stages of *Paralomis granulosa* and *Lithodes santolla* reared at different temperatures in the laboratory through the first year of their life: maximum instar number attained within ca. 300 days; maximum size in these instars; intermolt period (range). Regression equations for size increments per moult (I) as a function of premolt size (CLi); F: F statistics for linear regression; P: probability for the null hypothesis (slope = 0)

Paralomis granulosa	Maximum crab instar	Maximum size (mm CL)	Intermolt period (range, in days)	Size increment per molt	F	P
15°C	VII	5.86	26.4 - 53.5	I = 0.28 + 0.07 CLi	7.85	0.007
9°C	V	4.61	33.8 - 74.8	I = 0.11 + 014 CLi	15.7	0.0002
6°C	IV	4.00	48.4 - 88.4	I = 0.5 - 0.006 CLi	0.009	0.92
3°C	II	2.38	102.3			
Lithodes santolla						
15°C	VII	5.71	20.5 - 36.0	I = 0.38 + 0.04 CLi	1.75	0.19
9°C	V	5.40	30.0 - 56.0	I = -0.14 + 0.25 CLi	10.65	0.003
6°C	IV	4.12	42.8 - 66.9	I = 0.5 + 0.01 CLi	0.005	0.94

Diversity of Gammaridea (Amphipoda) from southern Tierra del Fuego, Argentina: preliminary results

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The Gammaridea are highly diversified in the Magellan Region where a total of 206 species has been reported. However, most of the studies deal with the fauna from Chile and just a few with that from Argentina. The objective of the present contribution is to analyse the diversity and the faunistic affinities of the Gammaridea from southern Tierra del Fuego, Argentina.

Samples were collected at 7 stations, at about 30 m depth, along the Beagle Channel (between Bahía Ushuaia and San Pío Cape) and in Bahía Aguirre and Bahía Buen Suceso. A total of 3,823 specimens, including 18 families, 43 genera and 61 species, was identified.

The following families showed the highest number of species (number of species in brackets): Corophiidae (8), Phoxocephalidae (7), Eusiridae (7), Gammarellidae (6), Iphimediidae (6) and Lysianassidae (5). Furthermore, Corophiidae, Stenothoidae, Lysianassidae and Eusiridae were the most abundant families (1,010; 887, 565 and 458 specimens, respectively). Although Stenothoidae is the most specious family in the Magellan Region, only 3 *Probolisca* species (all of them very abundant) were recognized during this study. The remaining 11 families exhibited a relatively low abundance and species diversity.

Gondogeneia (Gammarellidae) and *Gammaropsis* (Corophiidae) were the most diversified genera, with 5 and 4 species, respectively. *Cephalophoxoides* and *Parafoxiphalus* (Phoxocephalidae), *Ceradocopsis* (Gammaridae *s.l.*) and *Photis* (Corophiidae *s.l.*) are recorded for the first time in the Magellan Region. Moreover, 3 species belonging to the genera *Atylus*, *Ischyrocerus* and *Photis* appear to be new to science.

The gammaridean fauna studied here was compared with those from Antarctica, Scotia Sea, Sub-Antarctic Islands, and localities North to the Magellan Region in Argentina and Chile. The following results were obtained: 17 species (40.5%) are only known from the Magellan Region; 10 species (23.8%) present in the Magellan Region are also found in the Antarctic, Sub-Antarctic Islands or Scotia Sea; 6 species (14.3%) are distributed from the Magellan Region towards the North; 4 species (9.5%) from the Magellan Region were reported both towards the North and South; and 5 species (11.9%) were also found in areas other than those here analysed.

Cumaceans from the Bellingshausen Sea and neighbouring waters

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Introduction

Peracarids (amphipods, isopods, mysids, cumaceans and tanaids) are, together with copepods and euphausiasids, the most successful group of crustaceans in Antarctic waters. Although cumaceans do not show the diversity observed in amphipods and isopods, they have a high level of endemism (up to 91%). Antarctic cumaceans have been studied since the earlier expeditions, however, the fauna of some areas (including East Antarctica and the Bellingshausen Sea) is still poorly known.

Results

During BENTART-03 cruise, 19 stations ranging from 87 to 2086 m depth were sampled using a modified version of the Macer-GIROQ sled. This sled was equipped with an opening-closing system and with three superposed nets of 0.5 mm mesh size that sampled in three water layers: 10-50 cm, 55-95 cm and 100-140 cm above the sea floor. The stations were located in the Bellingshausen Sea and neighbouring waters (Thurston Island, Peter I Island and W Antarctic Peninsula). Additional data were obtained from box-corer samples.

A total of 106 specimens belonging to 16 species of five families were collected in 13 of 19 stations sampled with the suprabenthic sledge and in six box-corer samples (Table 1). *Cumella australis, Vaunthompsonia laevifrons/inermis* and *Eudorella gracilior* showed the highest abundances (22, 19 and 13 specimens respectively) and *Vaunthompsonia laevifrons/inermis* was the most frequently collected species (in four sledge and two box-corer samples). Cumaceans showed a clear vertical distribution gradient with a decrease in abundance from 10-50 cm (75%) to the 100-140 cm water layers (6%), and 8 species were only collected in the nearest bottom water layer (10-50 cm).

Three species, *Cumella australis, Vaunthompsonia laevifrons* and *Campylaspis* sp. A, were only collected at stations shallower than 400 m, and the rest of species were only collected on deeper bottoms.

Discussion

The sampling with the suprabenthic sledge provided a low number of cumaceans. However, the number of species (16) was comparatively high. Cumaceans found during the BENTART-03 cruise show different biogeographic patterns (Figure 1). Two species are widely distributed: *Hemilamprops pellucidus* has been recorded from South Africa, Australia and New Zealand, and *Campylaspis quadriplicata* from High Antarctic and Subantarctic waters including the Magellan region. *Cyclaspis gigas, Cumella australis, Leucon antarcticus* and *Eudorella gracilior* are circumpolar species also recorded from Subantarctic Islands of the Scotia Arc. Three other species, *Diastylis anderssoni, Diastylis mawsoni, Leptostylis crassicauda* and *Vaunthompsonia laevifrons/inermis* show a similar distribution but have not been recorded in the Ross Sea. *Procampylaspis compressa* and *Campylaspis breviramis* show at the moment a more restricted distribution (Weddell Sea, Antarctic Peninsula and Bellingshausen Sea). Finally, three apparently undescribed species belonging to the genera *Cumella, Campylaspis* and *Paralamprops* are recorded for first time in this study.

Most of these species show a wide range of geographical distributions and have been recorded from nearly all High Antarctic waters. The absence of some species from the Ross Sea may be better explained by a low research effort in this area than by true differences in the cumacean assemblages. That the affinity between the Antarctic and Magellan cumacean fauna is very low was also supported by this study, where only one species distributed in both regions, *Campylaspis quadriplicata*, was collected. Such a low affinity may be explained by both environmental and behavioural reasons. Circumantarctic current affect faunal interchange between both areas. Moreover, cumaceans only occasionally move into the water column, and its early life stages are sheltered in a marsupium, therefore, there is little opportunity to disperse.

Table 1. Bathymetric, regional and near-bottom distribution of cumaceans collected during the BENTART-03 cruise in the Bellingshausen Sea and SW Antarctic Peninsula waters. TI, Thurston Island; PI, Peter I Island; BS, Bellingshausen Sea; AP, W Antarctic Peninsula; N_1, abundance in the 10-50 cm near-bottom layer; N_2, abundance in the 55-90 cm near-bottom layer; N_3, abundance in the 100-140 cm near-bottom layer; T, total suprabenthic sledge abundance; B, additional data from box-corer samples; (*), damaged specimens.

	Depth	Regional distr.				Near-bottom distr.				B
	range [m]	TI	PI	BS	AP	N_1	N_2	N_3	T	
Cyclaspis gigas	492-608			•		2	-	-	2	1
Vaunthompsonia laevifrons	87-390	•	•		•	16	1	2	19	2
Cumella australis	87-363		•		•	21	-	1	22	-
Cumella sp. A	657				•	1	-	-	1	-
Campylaspis breviramis	492			•		1	-	-	1	-
Campylaspis quadriplicata	492			•		1	-	-	1	-
Campylaspis sp. A	363		•			3	-	-	3	-
Procampylaspis compressa	743	•				1	-	-	1	-
Procampylaspis spp.	492-743	•		•		6	1	-	7	-
Leucon antarcticus	1052				•	-	2	-	2	-
Eudorella gracilior	1052				•	3	8	2	13	-
Diastylis mawsoni	608-1480	•		•		1	-	-	1	1
Diastylis andersoni	107				•	-	-	-	-	1
Leptostylis crassicauda	540-1052			•		-	2	-	2	-
Leptostylis cf *antipa*	498-743	•		•		6	-	-	6	-
Diastylis sp. (*)	540-1052			•	•	1	1	-	2	-
Hemilamprops pellucidus	492-608	•		•		2	1	-	3	-
Paralamprops sp. A	534-608	•		•		9	-	-	9	1
Cumacea indeter. (*)						4	-	1	5	-

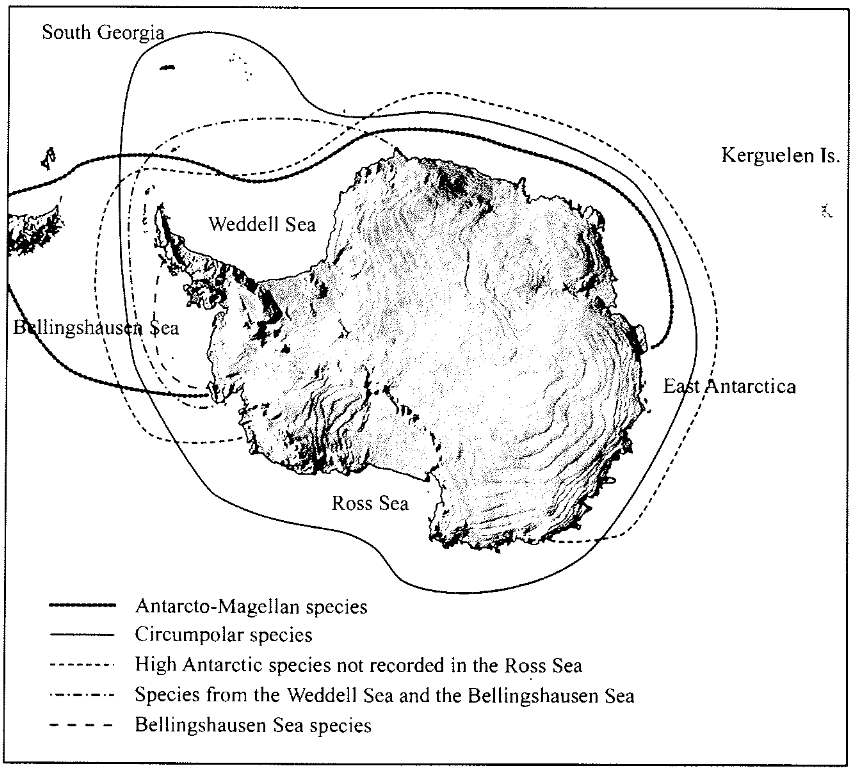

Fig. 1. Geographical distribution patterns of cumacean species collected in the Bellingshausen Sea during BENTART-03 cruise.

Shallow-water Asellota (Isopoda) from the Beagle Channel: an approach to diversity and faunistic affinities

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The shallow-water Asellota from the Beagle Channel are poorly known, with only six species previously recorded. In order to increase our knowledge of the Asellota, four localities along the Beagle Channel were sampled between 2001-2002. The material studied was collected with a small dredge on Gable Island, Moat Mount, San Pío Cape and Sloggett Bay, at 30 m depth.

Among the 3,085 specimens sorted, 23 species and 2 "species complex" were identified. These species belong to the following six families: Paramunnidae, Janiridae, Joeropsidae, Munnidae, Acanthaspidiidae and Santiidae.

The Paramunnidae showed the highest diversity and abundance (Fig. 1). The species included in this family belong to the following genera: *Allorostrata* (2 species), *Antennulosignum* (1 species), *Austrosignum* (2 species), *Paramunna* (4 species, 1 "species complex") and *Pleurosignum* (1 species). Until now, *Allorostrata* was only known for a single species from the Magellan Strait; a second species of this genus is reported in the present study. Additional specimens of *Antennulosignum*, a genus known by just one species from the Islas Malvinas/Falkland Islands, is mentioned here for the Beagle Channel. For *Austrosignum* two new species are reported. The *Paramunna* material contains four distinctive species as well as many specimens of questionable taxonomic position, some of which are provisionally identified as *P. kerguelensis* and *P. menziesi*.

The Janiridae comprises the genera *Austrofilius* (2 species), *Caecianiropsis* (1 species), *Ianiropsis* (2 species), *Notasellus* (1 species) and *Neojaera* (1 species). For the genus *Caecianiropsis* the first record for the Magellan Region is provided.

The remaining four families, Joeropsidae, Munnidae, Acanthaspidiidae and Santiidae, are represented each by a single genus: *Joeropsis* (3 species), *Munna* (1 species, 1 "species complex"), *Ianthopsis* (1 species) and *Santia* (1 species), respectively.

After combining our data and those compiled from literature the following biogeographic patterns arise: (1) The Beagle Channel and the Magellan Strait have the same number of shallow-water Asellota (<100 m depth): for each area 28 species have been recorded; (2) In both areas the family Paramunnidae totals almost half of the Asellota; (3) Besides being well represented in the Magellan Region (39.1% of the Asellota reported), the Paramunnidae are also common in the Antarctic Peninsula and Weddell Sea (32.3%), but remarkably scarce in the Scotia Arc Islands (13.8%). Further samples are required to confirm whether the low number of Paramunnidae known from the Scotia Arc is a reliable figure.

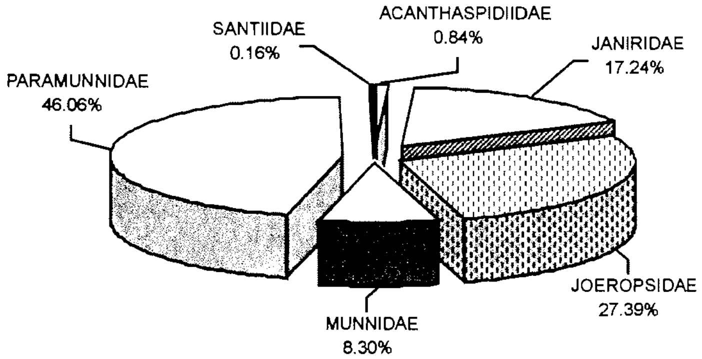

Fig. 1. Relative abundance of the Asellota families collected in the Beagle Channel (n = 3,085 specimens).

Atlas of Antarctic Mollusca" - towards a monographical revision and illustrated guide to molluscs south of the Convergence

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Our book project is an attempt to cover the biodiversity of extant Mollusca from Antarctic waters south of the convergence, with special emphasis on the Weddell Sea, Scotia Sea including South Sandwich, and Antarctic Peninsula. A multi-author approach (Engl & Schrödl, eds) including 10 international experts for the different molluscan subgroups (classes) shall achieve 1) inclusion and thorough documentation of as many species as possible (> 400), 2) guarantee of high scientific quality over the various groups, 3) make species accurately identifiable for non-specialists, i.e. provide a guide to Antarctic Mollusca. For our new book, vast museum material and specimens collected during various Antarctic expeditions, mainly the ANT XV, XVII-3, XIX-3-5 expeditions with RV "Polarstern", have been examined. So far, 10 scaphopod, 60 bivalve, and 270 gastropod species have been described and illustrated. Type material of 150 species has already been re-examined, with regard to many species for the first time. Taxonomically highly problematic groups such as the gastropod genus *Prosipho* are revised with a consideration of subantarctic species. Up to now we found more than 20 new synonyms, and even more Antarctic species have still to be described as new. Our new "Atlas of Antarctic Mollusca" (Conchbooks) is scheduled for publication in 2004; it will significantly supplement our guides to shelled Magellanic Mollusca (Linse, 2002; Költz) and to Magellanic Nudibranchia (Schrödl, 2003; Conchbooks).

The various molluscan subgroups will be represented by:

- Caudofoveata & Solenogastres: K. Linse
- Polyplacophora: E. Schwabe & B. Sirenko
- Monoplacophora: M. Schrödl & K. Linse
- Bivalvia: K. Linse & W. Engl
- Scaphopoda: K. Linse
- Cephalopoda:
  Octopoda: L. Allcock
  Sepiida: U. Piatkowski & M. Vecchione
- Gastropoda:
  "Prosobranchia": W. Engl, K. Linse & E. Schwabe
  Opisthobranchia: M. Schrödl, W. Engl, K. Linse, A. Martynov & H. Wägele

Mesozooplankton composition and abundance in Ushuaia and Golondrina Bays (Tierra del Fuego, Argentina)

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Introduction

The mesozooplankton from the Straits of Magellan, Chilean channels and fiords and the Beagle Channel have been well studied in relation to oceanographic and bio-ecological environmental conditions. Different assemblages constituted by a variable proportion of holoplanktonic and meroplanktonic forms have been observed. In comparison, little is yet known of the mesozooplankton from the eastern Beagle Channel and the coastal environments such as Ushuaia Bay and Golondrina Bay, which are two small bays on the northern coast of the Beagle Channel (Fig. 1). In this study we present the first results collected on the composition and abundance of the upper layer mesozooplankton in these bays from samples taken during January 2001.

Results and discussion

Twenty-nine taxa were observed in the mesozooplankton (Table 1), 20 of which were common in both bays, only 7 were present in Ushuaia Bay, and the remaining 2 were observed in Golondrina Bay. Ushuaia Bay showed a higher specific richness than Golondrina Bay (29 against 22). In both bays, the proportion of holoplankton was higher than 50% whereas the remaining percentage comprised meroplankton and ticoplankton forms. Within the holoplankton, calanoid copepods were the group that contributed most to the total abundance but medusae from the genus *Obelia*, marine cladocerans (*Podon leuckarti*), freshwater cladoceran (*Bosmina* sp.), amphipods and polychaetes were also present. The highest abundance in both bays was registered for copepodids, nauplii and eggs of calanoid copepods which were computed within the same group although they probably correspond to the species: *Clausocalanus brevipes*, *Drepanopus forcipatus* and *Ctenocalanus citer*. Meroplankton was represented by bryozoan cyphonautes, cirripede nauplii and cypris, decapod zoeae, euphausiid nauplii and other immature stages, and benthic nechtochaets (Polychaeta).

The species observed in the present study are, in general, indicative of cold Subantarctic, Antarctic or cold-temperate coastal waters of South America. The presence of the exotic copepod *Eurytemora americana* (typical of estuaries and coasts of the northern hemisphere) which was previously detected in Bahía Blanca estuary and is considered a species introduced accidentally in ballast water of ships, is relevant. *E. americana* probably develops a short planktonic pulse in these bays during summer according to its range of tolerance to temperature (approximately 8-9 to 16-17°C).

Relative abundance was completely different between between the two bays (Table 1). While in Ushuaia Bay the values of total mesozooplankton abundance at each station varied between low and high ranks, in Golondrina Bay the values were lower by one order of magnitude (low-medium rank of abundance). In Ushuaia Bay the numerical dominance was represented by *Oithona similis*, *C. citer*, *Obelia* spp., and *C. brevipes* whereas, in Golondrina Bay, polychaete larvae and *O. similis* were dominant.

Although the results obtained in the present study are based on preliminary counts, the obvious differences between zooplankton abundance in both bays were statistically corroborated by tests for mean and variance differences ($t = 2{,}24$ *; $F = 1532{,}42$ * *), respectively. Cluster analysis showed the presence of two groups in Ushuaia Bay, one constituted by stations 2, 5 and 19 (on eastward) and the other by Sts 11, 8 and 15 (on westward). In Golondrina Bay two groups could be observed, one with Sts1 and 4, and the other with St 7. Sample groups in both bays denote different mesozooplankton assemblages surely regulated by depth, benthos diversity, temperature, salinity and freshwater run-off, as well as phytoplankton, and microzooplankton densities. Due to the extremely coastal location of the stations, mesozooplankton can be also indirectly affected by anthropogenic environmental perturbation.

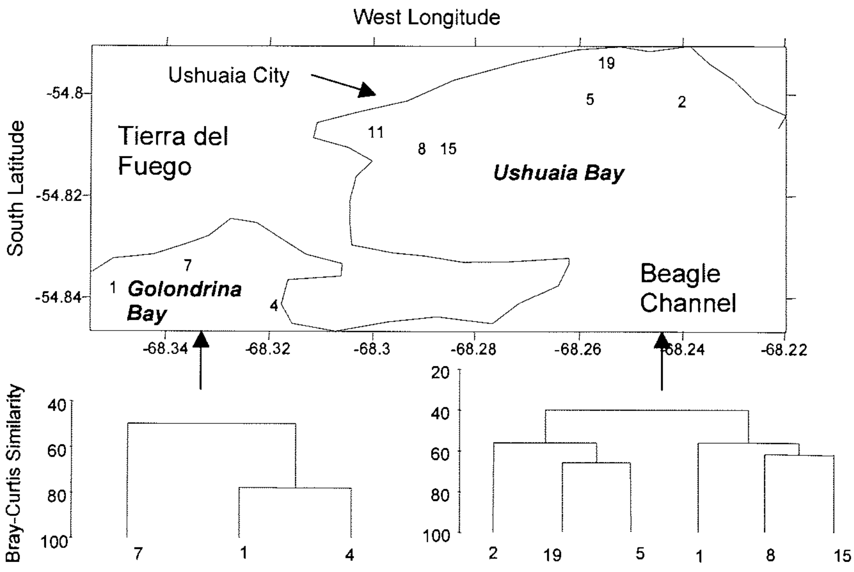

Fig. 1. Locations of sampling stations in Ushuaia and Golondrina bays (top). Sample clusters for each bay (bottom).

	Ushuaia Bay							Golondrina Bay			
Species	St. 11	St. 19	St. 8	St. 5	St. 15	St. 2	Abundance	St. 1	St. 4	St. 7	Abundance
Calanus australis	a	a	a	a	a	p	low	a	a	a	-
Centropages brachiatus	p	a	a	a	a	p	low	p	p	a	low
Drepanopus forcipatus	p	a	a	p	a	p	low	p	p	p	low
Clausocalanus brevipes	p	p	a	p	p	p	medium	p	p	a	low
Acartia tonsa	p	p	p	a	p	p	medium	p	p	p	low
Eurytemora americana	p	p	p	a	p	a	low	a	a	p	low
Paracalanus parvus	p	a	p	a	p	a	low	a	a	p	low
Ctenocalanus citer	p	p	p	p	p	p	medium	p	p	p	low
Calanoida copepodids	p	p	p	p	p	p	high	p	p	p	medium
Calanoida nauplii	p	p	p	p	p	p	medium	p	p	a	low
Calanoida eggs	p	p	p	p	p	p	medium	a	a	a	-
Oncaea curvata	p	p	a	a	a	a	low	a	a	a	-
Oithona similis	a	p	p	p	p	p	medium	p	p	p	low
Tisbe varians	p	a	a	a	a	a	low	a	a	p	low
Harpacticus furcatus	p	a	p	a	p	a	low	a	a	p	low
Parathalestris clausi	a	a	a	a	p	a	low	a	a	a	-
Harpacticoida	p	a	p	a	a	a	low	a	a	p	low
Monstrilloida	a	a	p	a	a	a	low	a	a	a	-
Podon leuckarti	p	p	p	a	p	p	low	a	a	p	low
***Obelia* spp**	p	p	p	p	p	p	medium	p	p	p	low
Cirripedia spp. (L)	p	a	p	a	p	a	low	p	p	p	low
Bryozoa (L)	p	a	p	p	p	a	low	p	p	p	low
Polychaeta (L)	p	a	p	a	a	a	low	p	p	p	medium
Euphausiacea (L)	p	a	a	a	a	a	low	a	a	a	-
Decapoda (L)	a	p	a	a	a	a	low	a	a	a	-
Polychaeta	a	p	a	a	a	a	low	a	p	a	low
Amphipoda	a	a	a	a	a	p	low	a	a	a	-
Bosmina longirostris	a	a	a	a	a	a	-	p	a	a	low
Bivalvia (L)	a	a	a	a	a	a	-	p	p	p	low
Autolytus sp.	a	a	a	a	a	a	-	a	p	a	low

Table 1. Taxa and their abundance in Ushuaia and Golondrina bays (p: present, a: absent). Logarithmic abundance ranks (low = 1-10 ind.m^{-3}, medium = 11-100 ind.m^{-3} and high = 101-1000 ind.m^{-3}).

Recovery of a disturbed community in a rocky intertidal community in Southern Patagonia: does time matter?

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Resilience is the capability of a system to return to the equilibrium following disturbance. At high latitudes, low rates of colonization constrain long-time experimental studies. In communities with low growth rates and competitive exclusion the diversity may be high. This effect is observed at minimum intensity and/or disturbance frequency. At high growth rates, the maximum diversity is observed at medium levels of disturbance.

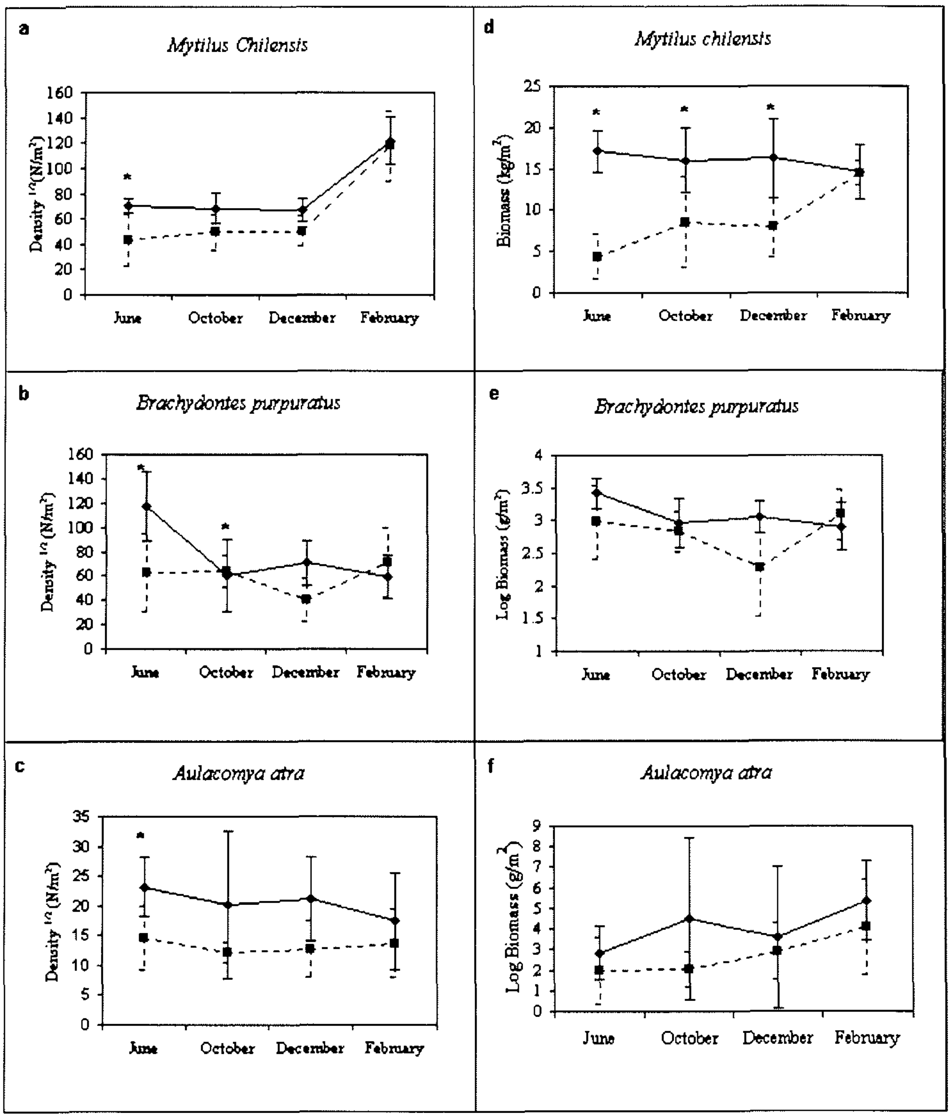
We studied the recovery of an intertidal community subjected to two different disturbance levels. The study area is located on the Atlantic coast of Tierra del Fuego, Argentina (53° 35'S; 67° 58'W). The particular characteristic of this community is that the community occurs exclusively on top of boulders, the lateral sides of which are completely cleared of sessile organisms by sediment movement and deposition. The experimental design consisted of a control and two disturbance treatments: (a) total removal (by extracting manually and cleaning with 20% HCl), and (b) partial disturbance, by impacting with a weight of 10 kg over the entire boulder surface. An initial sample and treatments were performed in February 2001. Five samples of 169 cm^2 each were extracted from the control and treatments at 3-months intervals. Samples were fixed in 3-5% formalin and macrobenthic organisms enumerated and weighed.

The community was mainly composed of 3 bivalve species: *Mytilus chilensis* (the dominant species), *Brachydontes purpuratus* and *Aulacomya atra.* The bivalve community yielded a maximum of about 15 cm height, while the lower layer was mainly sediment and shell debris. Barnacles, amphipods, isopods, polychaetes, gastropods, microbivalves and anthozoans were found associated with the community.

One year after disturbance, surfaces of the total removal treatment revealed no recruits. The density of the 3 dominant bivalves in the disturbance experiment was lower than in the control (Fig. 1). However, only 3 months after the initial disturbance significatntly different densities were found. In terms of biomass, the disturbance significantly affected to the dominance of *M. chilensis.* Successive densities following disturbance were significantly lower, and were comparable to the control in February 2002. Biomass of the other 2 bivalve species was always lower in the disturbed boulders than in the control, but no statistically significant differences were found.

One year after the total removal the community did not recover. By contrast, in the partial disturbance experiment the dominant species *M. chilensis* seemingly recovered to its original biomass values. Densities of *M. chilensis* significantly increased from ca. 60 to ca. 100 units one year after the disturbance. This is attributed to new recruits settling in both the control and disturbed sites.

Fig.1. (next page) Density $^{1/2}$ (N/m^2) and biomass (Kg/m^2) or Log biomass (g/m^2) of *Mytilus chilensis* (a,d), *Brachydontes purpuratus* (b,e) and *Aulacomya atra* (c,f) between June 2001 and February 2002. Filled lines represent control and dotted line represent partial disturbance. Asterisks show significant differences ($p<0.05$) between the control and disturbance.


a
Mytilus Chilensis
Density $^{1/2}$(N/m^2)
160
140
120
100
80
60
40
20
0
*
June
October
December
February
d
Mytilus chilensis
Biomass (kg/m^2)
25
20
15
10
5
0
*
*
*
June
October
December
February
b
Brachydontes purpuratus
Density $^{1/2}$(N/m^2)
160
140
120
100
80
60
40
20
0
*
*
June
October
December
February
e
Brachydontes purpuratus
Log Biomass (g/m^2)
4
3.5
3
2.5
2
1.5
1
June
October
December
February
c
Aulacomya atra
Density $^{1/2}$(N/m^2)
35
30
25
20
15
10
5
0
*
June
October
December
February
f
Aulacomya atra
Log Biomass (g/m^2)
9
8
7
6
5
4
3
2
1
0
June
October
December
February

Abundance of *Calanus propinquus* and *Calanoides acutus* in an Antarctic coastal environment: comparing the inner and outer Potter Cove (King George Island, South Shetland Islands, Antarctica)

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Calanus propinquus and *Calanoides acutus* are two of the most important and largest copepods in areas around the Antarctic Peninsula. *C. propinquus* is widely distributed throughout the northernmost region whereas *C. acutus* is mostly found in the south, both copepods showing a clear distributional pattern with areas where either *C. propinquus* or *C. acutus* dominates, and a transitional area in which both species coexist with similar abundance levels.

Several studies have highlighted their ecological relevance in Antarctic waters. However, regarding zooplankton from coastal environments like Potter Cove and the adjacent Maxwell Bay (King George Island, South Shetland Is), little is known about the seasonal abundance and biomass of these two copepods. The aim of the present study was to analyze the presence of *C. propinquus* and *C. acutus* populations in the upper water column in the vicinity of Jubany Station, in Potter Cove (62°14´33 S, 58°43´81 W) during summer-autumm 2002 at three sampling stations. Sampling was carried out weekly (from February to April). Zooplankton samples were collected with a 200 μm-mesh net, at three stations: one in the inner Cove (St 1) where maximal depth may reach 50 m (average 30 m), another in the middle of the cove (St 2), and the last one in Maxwell Bay (outer cove, St 3), with depths exceeding 100 m. Additional samples were collected for determination of physical as well as chemical variables.

C. propinquus and *C. acutus* abundance and biomass values evidenced very large variations within the temporal and spatial scales considered (Figure 2). *C. propinquus* abundance values ranged between 7 and 369 ind 100 m^{-3} in St 1. In St 2 and St 3, values were similar to those in St 1, reaching a minimum of 25 ind 100 m^{-3} (St 2) and a maximum of 853 ind 100 m^{-3} (St 3). The highest biomass values for this species were registered in St 2 (28 March 2002: 1636 and 29 March 2002: 3696.77 mg 100 m^{-3}) whereas the lowest values were registered in St 1 (6 March 2002: 4.16 mg 100 m^{-3}). In St 1, biomass values were lower than those registered in St 2 and St 3.

C. acutus abundance and biomass reached values which were lower than those of *C. propinquus* at the three stations during the whole period of study. At St 1, *C. propinquus* was present only at the end of the summer, i.e. during April, whereas at St 2 and St 3 it was present in all the samples but with abundances, which were variable at both stations.

The age structure and monthly average abundances of both species is presented in Table 1. The *C. propinquus* population comprised copepodids CI to female CVI while *C. acutus* was made up of CII to CVI female.

The abundance of the two species at St 1 and St 3 is generally inverse, i.e. when abundance is high at St 1, it is low at St 3 and vice-versa. This phenomenon could be related to the cyclonic currents in the cove. Water enters the cove from St 3 to St 1 from the north and leaves the cove close to the southern coast. St 3 waters may contain organisms from neighbouring areas such as the Bransfield Strait, leading to the accumulation of these waters at St 1. This is in agreement with the fact that these species are characterized as being more oceanic than coastal. Their presence in the waters of the cove may not be constant and may depend on the dominant currents, which in turn are influenced by the wind and tides.

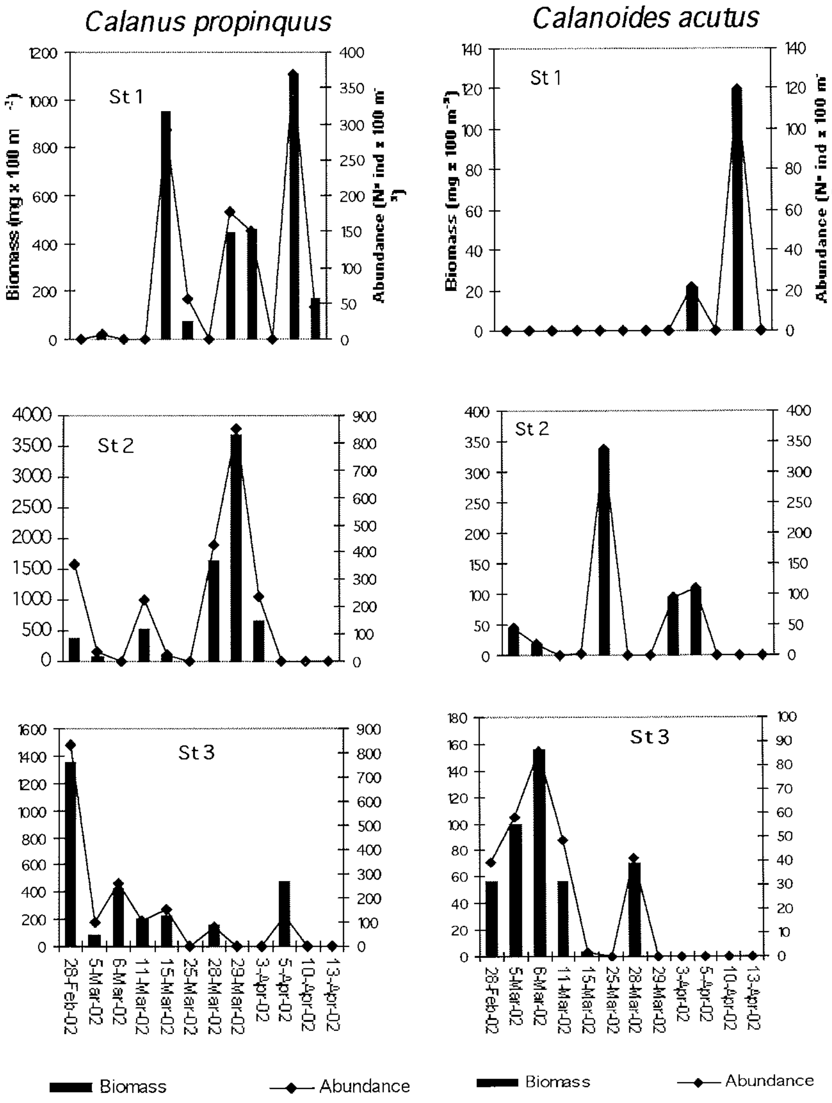

Figure 1: abundance (ind 100 m^{-3}) and biomass (mg 100 m^{-3}) of *C. propinquus* and *C. acutus* at the sampling stations in Potter Cove and Maxwell Bay. Summer-Autumn 2002; y-axis= Biomass (mg x 100 m^{-3}).

Station	Stage	*Calanus propinquus*			*Calanoides acutus*		
		February	March	April	February	March	April
1	CI						
	CII		4.00	2			
	CIII		17.00	44			
	CIV		42.00	48			21.00
	CV		92.00	124			52.00
	CVI H		7.00	2			
2	CI		6.00				
	CII	14.00	49.00				
	CIII	175.00	72.00	26		3.00	
	CIV	151.00	123.00	82		114.00	
	CV	13.00	207.00	129	20.00	23.00	
	CVI H						
3	CI	4.00	3.00				
	CII	54.00	9.00			1.00	
	CIII	236.00	37.00			3.00	
	CIV	388.00	74.00		25.00	22.00	
	CV	152.00	25.00		15.00	30.00	
	CVI H		4.00			3.00	

Table 1. Monthly average abundances (ind 100 m^{-3}) of *C. propinquus* and *C. acutus* copepodids at three sampling stations in Potter Cove and Maxwell Bay. Summer-Autumn 2002.

First report on the trophic ecology of the macrophagous ascidian *Cibacapsa gulosa* Monniot & Monniot, 1983

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With the aim of establishing the trophic ecology of the macrophagous ascidian *Cibacapsa gulosa* Monniot & Monniot 1983 (Ascidiacea, Octacnemidae), microscopic analyses were performed both on stomach contents and the inner wall of the postpharyngeal digestive tract. Octacnemids represent a different pathway in the evolution of the typical suspension-feeding strategy in ascidians. A total of three specimens were collected during the LAMPOS cruise in the area of the South Sandwich Islands at the depth of 580 m. Specimens were immediately fixed in buffered formaldehyde 2.5% in sea water. The different prey items found in the gut contents were identified and counted under stereomicroscope using a Bogorov 10 ml counting chamber. Additional microscopic observations were performed on slides containing cuts corresponding to different sections of the gut (esophagus, stomach and intestine). A high diversity of prey items was found: from harpacticoid and calanoid copepods, lumbrineriform polychaetes, halacarids, eusirid and gamaroid amphipods, isopods and ophiurids to diverse crustacean fragments (Table 1). All these items had a wide range in size: from 100 μm in the case of small calanoid copepods, up to 4 mm of some amphipods and ophiurids. High quantities of oil drops, orange coloured, were also observed in the gut cord. The wall of the postpharyngeal digestive tract is lined by cylindrical monoestratified epithelium which reposes on a wide mesenchyme with blood sinus and extravascular blood cells. The external epithelium along the whole postpharyngeal digestive tract is mainly formed by cubic cells. At the level of the esophagus, the inner epithelium is ciliated and shows an intense basophilia in the apical region, while abundant vacuoles appeared in the anterior third. The stomach is characterized by an epithelium with microvillii; cells with apical basophilic granules, 2 nucleolus and supranuclear vacuoles. There are also many concretion cells. The final portion belonging to the intestine showed microvillii, cells with oval (intense basophilia) or rounded nucleus (less basophilia) and supranuclear vacuoles. Capture of this wide variety of prey (some of these having a great mobility), indicates a special behaviour of these sessile animals. Although prey items were of benthic and pelagic origin, the presence of components from the zooplankton could explain the high quantities of oil drops found in the contents: lipid storage has been stressed in amphipods and copepods living in polar environments, with lipids making up an important percentage of dry weight all year. Moreover, findings of crustacean fragments indicate that enzyme secretion must be intense in the esophagus and stomach. Regarding the scarcity of plant material that could reach this benthic environment, this special feeding ecology (based in the capture of very energetic, but occasional prey items) must ensure enough energy to maintain metabolic functions.

Table 1. Different prey items found in the gut contents of the ascidian *Cibacapsa gulosa.*

	Habitat	Frequency (mean± SD)	Frequency (mean, %)
Crustacean parts			
Crustacean cuticula type I ("ring-shaped")		94.7 ± 56.4	
Crustacean cuticula type II ("tube-shaped")		4.7 ± 4.5	
Crustaceans (mandible parts)		32.7 ± 14	
Eusirus antarcticus (gnathopods)	Pelagic/bent	4.3 ± 7.5	
Hyperid amphipods (head)	Benthonic	0.3 ± 0.6	
Calanoid copepods (part of prosome and urosome)	Pelagic	0.3 ± 0.6	
Halacaroidea (leg)	Benthonic	0.3 ± 0.6	
Crustacea (complete animals)			
Calanoid copepods	Pelagic	16 ± 4.4	34
Harpacticoid copepods	Benthonic	0.3 ± 0.6	0.7
Gammarid amphipods	Benthonic	0.3 ± 0.6	0.7
Echinodermata			
Ophiurids	Benthonic	0.3 ± 0.6	0.7
Annelida			
Lumbrineriform polychaetes	Benthonic	0.7 ± 1.2	1.4
Polychaete Type I	Pelagic	20.3 ± 33.5	43.3
Polychaete Type II	Pelagic	1.3 ± 2.3	2.8
Mollusca			
Possible gastropod	Benthonic	2.3 ± 4	5
Coelenterata			
Medusa (*Euphysora*)	Pelagic	1.3 ± 1.2	2.8
Other			
Faecal pellets		1.3 ± 1.2	2.8
Fish scams		3.3 ± 5.8	7.1

Hermaphroditism in Loricifera – as evidenced by *Rugiloricus doliolius* sp. n. from the Antarctic deep sea.

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Introduction

Loricifera were discovered 20 years ago and are still the least known group of the marine benthic fauna. They are of microscopic size and were first discovered in shallow water habitats. In the deep sea many new taxa of Loricifera have been discovered but this is only the beginning. Loricifera inhabit the oligotrophic, well-oxygenated uppermost layers of the sediment. Loricifera are characterized by complex life cycles, but in deep-sea species these are even more complex and include modified stages unknown elsewhere. The normal life cycle includes sexually dimorphic adults of both sexes, seven larval stages as well as a juvenile or postlarval stage. In some of the newly discovered life cycles there are dormant stages resulting from modified postlarvae or reduced last larval instars.

Results

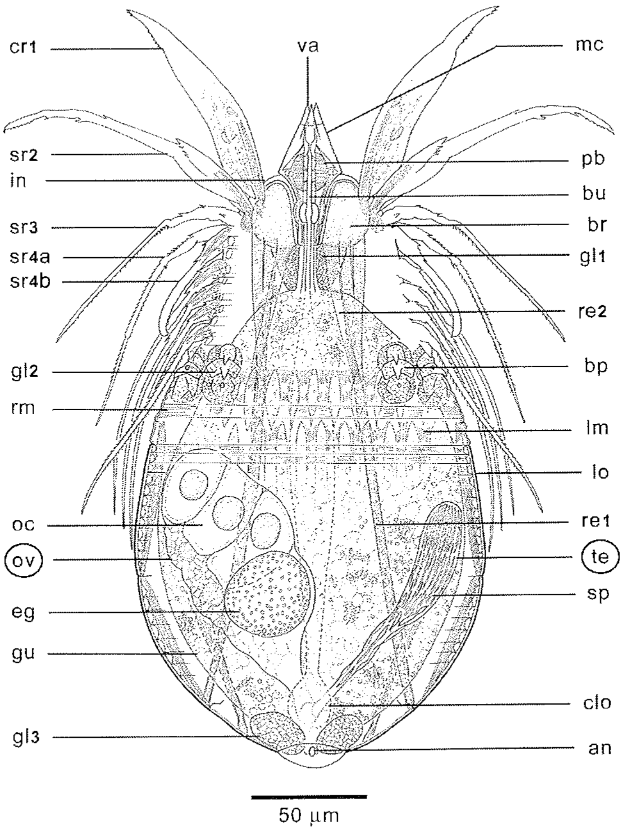
Species belonging to the *Rugiloricus cauliculus* Higgins & Kristensen, 1986 group are common and abundant in samples taken during the ANDEEP expedition in 2002. Apart from several new species new life stages have been found. These indicate the existence of hermaphrodites among Loricifera. Some adults of the new species *Rugiloricus doliolius* sp. n. (Fig. 1) have a widely extended abdomen containing both ovary and testis. In bisexual species of the *Rugiloricus cauliculus* – group males have two testes and females a single ovary. Additionally, there issexual dimorphism in the copulatory spicules and the length of the trichoscalids: In males, single trichoscalids do not differ as clearly in length as in females. The hermaphroditic specimens have long trichoscalids like the males and spicules are not observed. They originate from an aberrant postlarva, which has an unfinished adult morphology and is transformed into a dormant instar. Bisexual adults instead moult from a totally reduced postlarva only represented by a layer of pure cuticle. Both together are enclosed in a newly discovered simplified Higgins-larva. The observation that sperm-filled testes exist in some *Rugiloricus* specimens is not new and was first made in an undescribed species from the Mozambic channel (RV "Le Suroit" BENTHEDI I, DS84, 3,400 m, 1977). It was assumed, however, that the inactive branch of the ovary functions as a receptaculum seminis filled with sperm after copulation.

Evidence of hermaphroditism is now given by the fact that all adults are found in metamorphosis or moult while still enclosed in the specialised dormant postlarva but also have a single testis filled with sperm and not only an ovary containing a large oocyte, even before there was a possibility for copulation. This observation adds new details to the known complex life cycle of *Rugiloricus* species, which is now supposed to have three phases: (1) bisexual adults with fast metamorphosis, moulting from a reduced postlarva in a simplified as well as modified Higgins-larva, (2) hermaphroditic adults with delayed metamorphosis, originating from a postlarva modified as a dormant stage, (3) paedogenetic larvae, producing non-fertilized eggs and representing a morphologically totally different type of larva as compared with the preceding free-living larval instars. However, it remains unclear whether all three phases belong to the life cycle of a single species, as seems to be the case in *R. doliolius* sp. n.

Discussion

The complex life cycles found in deep-sea Loricifera appear to be linked to food availability. At stations with a rich local food supply, the fast paedogenetic and bisexual phases of life cycles without dormant stages dominate. The phases with dormant stages prevail where less food is available. It seems that deep-sea Loricifera respond directly with changes in their life cycle to small-scale changes in environmental conditions. Paedogenetic reproduction with rapid maturation of larvae and hermaphroditic adults along with dormant stages are a good insurance against any crisis and allow rapid recolonization after such an event. One single drifting larva or dormant postlarva containing a hermaphroditic adult has the potential to quickly build up a new population. This combination of reproductive possibilities therefore predisposes Loricifera to finding and using patchy resources, and it predestines them for a wide distribution.

Fig. 1. *Rugiloricus doliolius* sp. n., anatomy of hermaphroditic adult: an anus, bp basal plate, br brain, bu buccal tube, clo cloaca, cr_1 clavoscalid of first row, eg egg, gl_1 salivary gland, gl_2 neck gland, gl_3 caudal gland, gu gut, in introvert, lm longitudinal muscle, lo lorica, mc mouth cone, oc oocyte, ov ovary, pb pharyngeal bulb, re_1 main retractor of introvert, re_2 neighbouring retractor of introvert, rm ring muscle, sp spermatozoa, sr_2 spinoscalid of second row, sr_3 spinoscalid of third row, sr_4a type-a spinoscalid of fourth row, sr_4b type-b spinoscalid of fourth row, te testes, va oral valve.



First record of Lithodidae (Crustacea Decapoda Anomura) on the Antarctic continental shelf

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Introduction

The species richness of decapods in Southern Ocean waters is strikingly poor, although some shrimps can reach high densities locally (Arntz and Gorny, 1991; Gutt *et al.*, 1994). Reptant decapods had never been collected on the Antarctic continental shelf.

An Anomura species, *Lithodes murrayi* Henderson, 1888, had been collected previously by Agassiz trawl and observed using ROV off Peter I Island at a depth of 200 m (Klages *et al.*, 1995) in the Bellingshausen Sea. The closest northern locality at which lithodid species had been found was South Georgia Island, where two species, *Paralomis spinosissima* and *Paralomis formosa,* were taken during the Spanish survey 'Antártida 8611' (López-Abellán and Balguerías, 1991).

During the 'Bentart-2003' cruise, carried out in January-February 2003 on board the *R/V Hespérides,* 25 stations were sampled, covering the Bellingshausen Sea, Peter I Island and Antarctic Peninsula continental shelf, from depths of 48 m to 2045 m. Different sampling methods, such as Agassiz trawls and traps, were used for the collection of sessile and motile fauna, mainly demersal fishes and crustaceans.

Five specimens of Decapoda: Anomura belonging to the Lithodidae family were found during the 'Bentart-2003' survey. Since the biological material from this expedition arrived in Spain in June 2003, we have yet to finish a detailed taxonomic study. However, we consider this to be one of our most important findings, the preliminary results of which should be presented at the IBMANT-ANDEEP Workshop.

Preliminary results

The station characteristics (geographical zone, coordinates, depth and bottom type), as well as the catch gear and other data for specimens of lithodid species are presented in Table I.

Three individuals , probably belonging to the genus *Lithodes*, were collected on muddy bottoms at depths of 218 m and 375 m at stations 6 and 7 around Peter I Island, using baited-traps and Agassiz trawls. This was the taxon's second record for this locality, after the capture of four specimens of *Lithodes murrayi* in the same area at depths of around 200 m (Klages *et al.*, 1995). The individual at station 7 was an ovigere female weighing 390 g.

Another two specimens were collected using Agassiz trawls at stations 15 and 17-2, located on the Bellingshausen continental shelf, close to Alexander Island, on a mixed bottom basically comprising blocks, rocks, and gravels, with some mud. The specimen at station 15 was caught at 1400 m, and was an adult male weighing 1035 g. The specimen at station 17-2, collected at a depth of 1947 m on the same transect, was a small juvenile female (83 g).

The finding of these two specimens of stone crabs, possibly belonging to the genus *Paralomis*, on the Bellingshausen continental shelf should be considered a transcendent event in Antarctic benthic research, which will surely contribute to a very interesting debate about the biogeographical evolution of Decapoda Anomura and its possible relationship with Lithodidae species from the Subantarctic Islands, particularly from South Georgia (López-Abellán and Balguerías, 1993) and the Magellan region.

Specimen	Probable genera	Sex	Weight (g)	Zone	Stat.	Gear	Latitude	Longitude	Depth (m)
1, 2	Lithodes	-	-	Peter I Is.	6	Trap	68.83500	90.82250	218
3	Lithodes	F	390	Peter I Is.	7	Agassiz	68.70200	90.68950	375
4	Paralomis	M	1035	Bellingshausen	15	Agassiz	68.95250	78.23350	1408
5	Paralomis	F	83	Bellingshausen	17-2	Agassiz	68.91933	78.23550	1947

Table I. Data of lithodid specimens (probable genera, sex and weight), and station characteristics (gear, geographical zone, coordinates and depth)

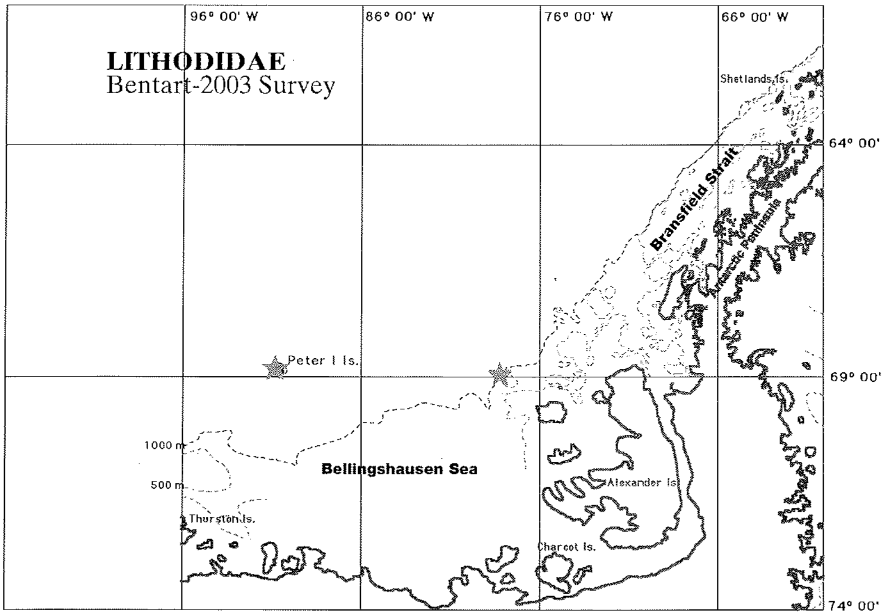

Fig. 1. Position of stations where the stone crabs were found during Bentart-2003' Survey.

Past and present mollusc biogeography in the Southern Ocean

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SOMBASE (Southern Ocean Mollusc Database) is a comprehensive biogeographic database of Southern Ocean and Antarctic Mollusca. SOMBASE contains distribution, ecological and taxonomic records of living Antarctic, Magellanic, and Sub-Antarctic gastropods and bivalves as well as records for many further species from the Southern Hemisphere (Australia and New Zealand). Containing information about over 1,400 species from 3,300 locations, the database is a powerful tool for assessing biodiversity. The database is linked to a Geographical

Information System (GIS), which enables the display, analysis and interpretation of data within its spatial context.

After initially concentrating on recent species our attentions have also turned to extinct species and groups. The addition of age and stratigraphic data to the design of SOMBASE has enabled fossil biogeography to be investigated. With the GIS it is now possible to examine spatial and temporal trends in the data, enabling us to investigate changing environments and community structures through time and space.

The data for the living species has been analysed using multivariate statistical techniques to examine the similarity of community structures within predefined geographic areas. The results of these analyses are then displayed using the GIS to enable any patterns to show up within their spatial context. This technique can be used in conjunction with environmental data to identify areas of interest, distribution constraints and trends across environmental gradients.

Using similar techniques on the fossil data it should be possible to produce results for different time periods and comparisons through time. This would allow us to identify the periods of major extinction, radiation and when different geographic areas evolved significantly different communities. Identifying when Antarctic communities became different to South American ones, for example, could be used to constrain geological and palaeo-oceanographic models of the opening of the Drake Passage. The GIS can also be used to track the movements of families and genera through time as their ranges move, expand or contract.

Using large databases and the latest advances in GIS technology and spatial analytical techniques allows us investigate biodiversity and the factors which affect it over a range of geographic, temporal and taxonomic scales. In an area such as the Antarctic and Magellanic regions this is particularly important because of the major geological activity, which has altered the environmental conditions on numerous occasions including the opening of the Drake Passage, the forming of the Circumpolar Current, sea level changes, volcanic activity and glaciations.

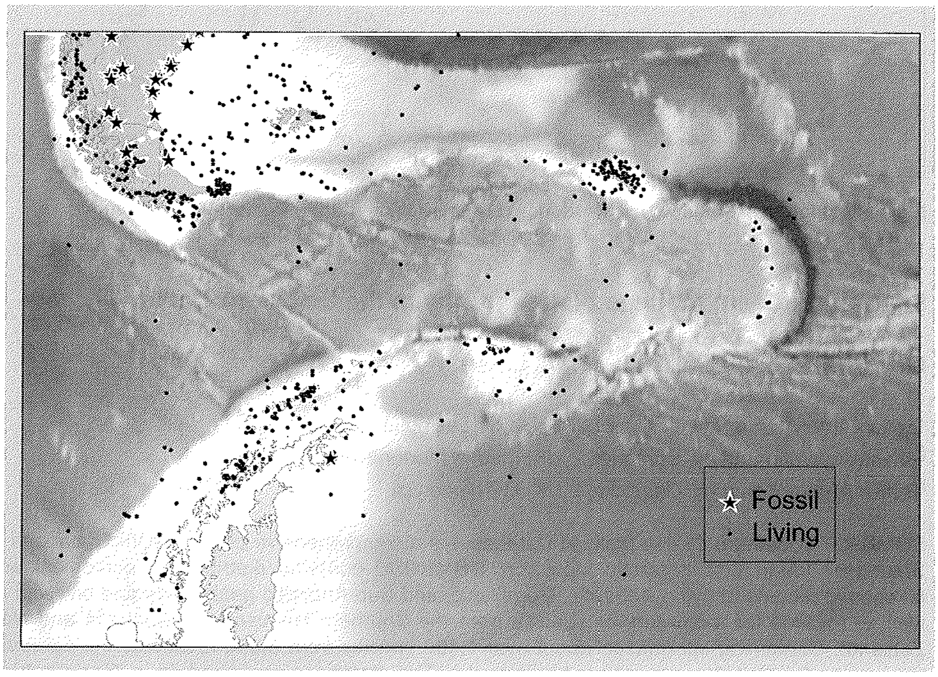

Fig. 1. A map of the Scotia Arc showing the site localities for the fossil and living mollusc records in SOMBASE.

Composition and Abundance of the abyssal antarctic meiobenthos along a depth gradient in the Drake Passage (ANDEEP-1)

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Previous studies of composition, abundance and spatial distribution of antarctic deep-sea meiobenthic assemblages only contributed data from depths no more than 2000m. During the ANDEEP-1 expedition we where able to sample soft sediments using a multiple corer along two depth gradients, one east and one west of the Shackleton Fracture Zone. In total, 7 stations were sampled ranging from 2274m to 5194m depth (Fig. 1). Two to three replicate MUC deployments per station yielded altogether 166 sediment cores. After meiofauna extraction, specimens were sorted for major taxa and counted. Further taxonomic work will take place focussing on benthic copepods in detail.

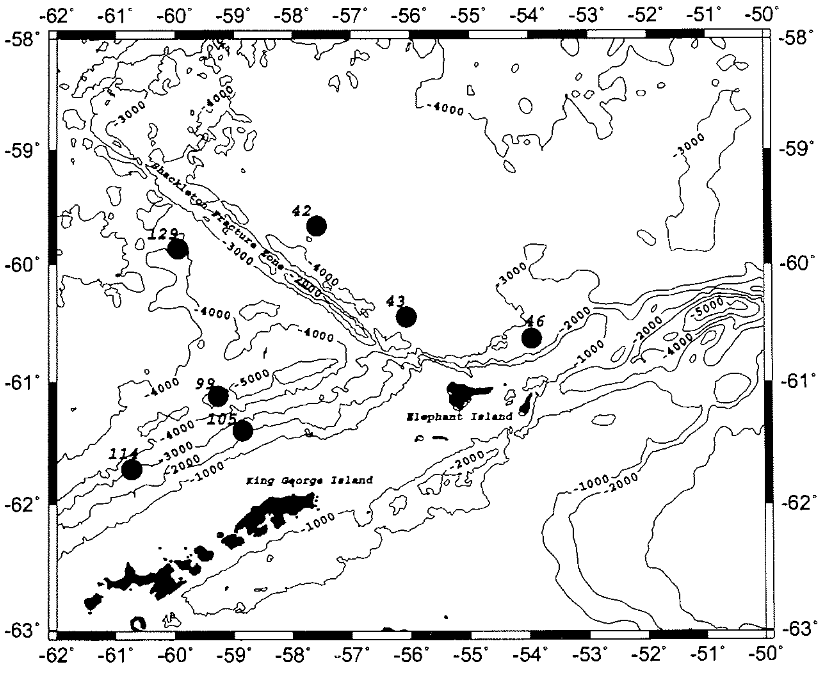


Fig. 1. Map of the study area showing the position of the stations

Samples were rich in higher level taxa. Remarkably, nematodes, copepods, kinorhynchs, loriciferans, tantulocarideans, ostracodes and tardigrades were found at every station. Acari, rotifers, and gastrotrichs were found sporadically. A slight tendency toward decrease in higher taxa density with increasing depth was observed.

Nematodes were the dominant meiofauna group at all stations. Their relative dominance accounts for 84 – 94 %. Together with copepods they comprise approximately 91 – 99% of overall meiobenthic abundance.

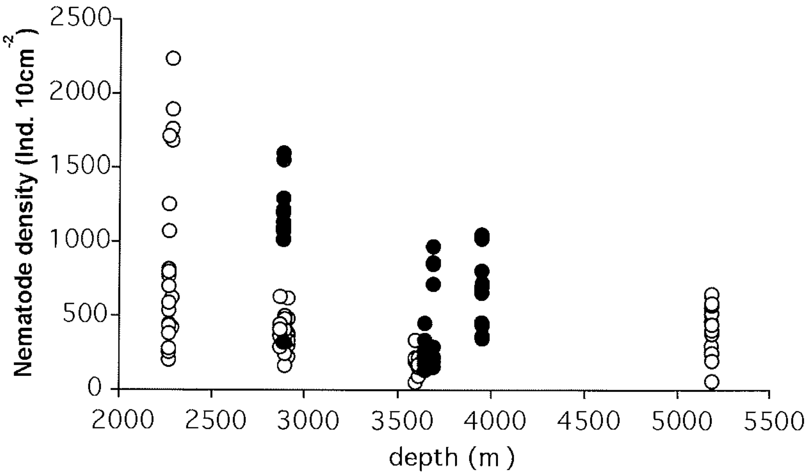
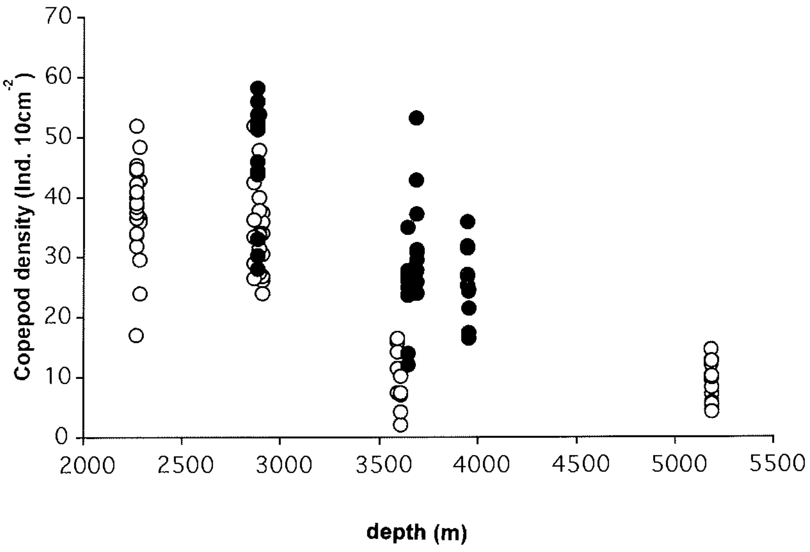


Fig. 2. Nematode density along depth. Black dots: eastern transect, white dots: western transect.



A decrease of nematode (Fig. 2) and copepod (Fig. 3) abundances with increasing depth could be observed in both transects. In addition, the eastern transect showed slightly higher standing stocks than the western transect at comparable depths.

Antioxidant defences against UV radiation in Antarctic and sub-Antarctic marine phytoplankton

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The reduction of the Antarctic stratospheric ozone resulted in significant increases in ultraviolet B radiation (UVB, 280-320 nm) reaching the surface of the ocean. This contrasts with ultraviolet-A (UVA, 320-400 nm) and photosynthetic available radiation (PAR, 400-700 nm), which were not significantly modified by this reduction.

Biological effects of UVB involve endogenous photosensitization and formation of reactive oxygen species (ROS). The main goal of this study was to examine the responses of different species of marine phytoplankton to UV radiation on the content of lipid-soluble antioxidants as well as their growth rate. Specifically, we compared the UV responses of species from Sub-Antarctic and Antarctic waters [a centric diatom (*Thalassiosira sp.* AT) and a phytoflagellate (*Prasinophyceae*) isolated from natural phytoplankton assemblages of the Beagle Channel (SP) (Ushuaia, 54° 52'S, 68° 18'W), and the same taxonomic groups from Antarctic waters (AP) (Potter Cove, Jubany Station, 62Υ14'S, 58Υ38'W)].

AP showed exponential growth rate inhibition at day one (Fig.1A) for UVA (exposed to UVA+PAR) and UVB (exposed to UVB+UVA+PAR) treatments compared with PAR (exposed to PAR). On days two and three only the UVA treatment produced inhibition and no inhibition was observed until the end of the experiment. β-carotene showed a significant decrease ($P<0.05$) on day one with respect to 3 h of exposure in all treatments. In contrast, on day three there was a significant increase ($P<0.05$) with respect to day one. β-carotene did not show any differences between treatments during the whole experiment. This contrasted with α-tocopherol, which showed a significant increase in UVA and PAR treatments compared with UVB treatments for the whole incubation period. α-Tocopherol was significantly higher than the content of β-carotene. The content of this antioxidant increased significantly ($P<0.05$) on days one, three and five with respect to 3 h exposure considering all treatments (Fig. 2).

Growth rate in SP was significantly inhibited for UVA treatment on day one (Fig. 1B). Inhibition was also observed on day four for UVB and UVA treatments and on day five for UVB treatment. No UVR inhibition was observed on days six, seven and eight. The content of β-carotene was significantly higher ($P<0.05$) on day three for UVB treatment and for UVB and UVA treatments for α-tocopherol compared to the PAR treatment (Fig. 2). Moreover, the maximum values measured considering all treatments pooled corresponded to the same day.

No significant differences in growth rate were observed between treatments for AT ($P>0.05$) during the whole experiment (Fig. 1C). The content of β-carotene showed a significant increase after 3 h of exposure in all treatments. This result was in contrast with that for α-tocopherol, which did not show differences ($P>0.05$) between t_0 and 3 h of exposure (Fig. 2). However, there was a significant decrease ($P<0.01$) on days one, three and five for both antioxidants. The content of lipid soluble antioxidants for AT was the same ($P>0.05$) in all treatments.

The results of this research suggest the presence of species-specific antioxidant responses to PAR and UVR stress. This is evidenced by their relative proportion in the different species studied, as well as by the time scale of synthesis and consumption. In the Antarctic species (AP and AT) α-tocopherol was more abundant than β-carotene, while the opposite was observed for

SP. On the other hand, both phytoflagellate species showed a lag in reaching the maximum of both antioxidants in relation to AT, which presented the maximum concentration within a short time scale (3 h) suggesting a more rapid response to oxidative stress. AT was more tolerant to UVR stress than both phytoflagellate species, but the latter were able to cope with UVR after 5 days of exposure. Overall, our results show that UVR damage/repair balance involves the combined action of several internal factors in the cell.

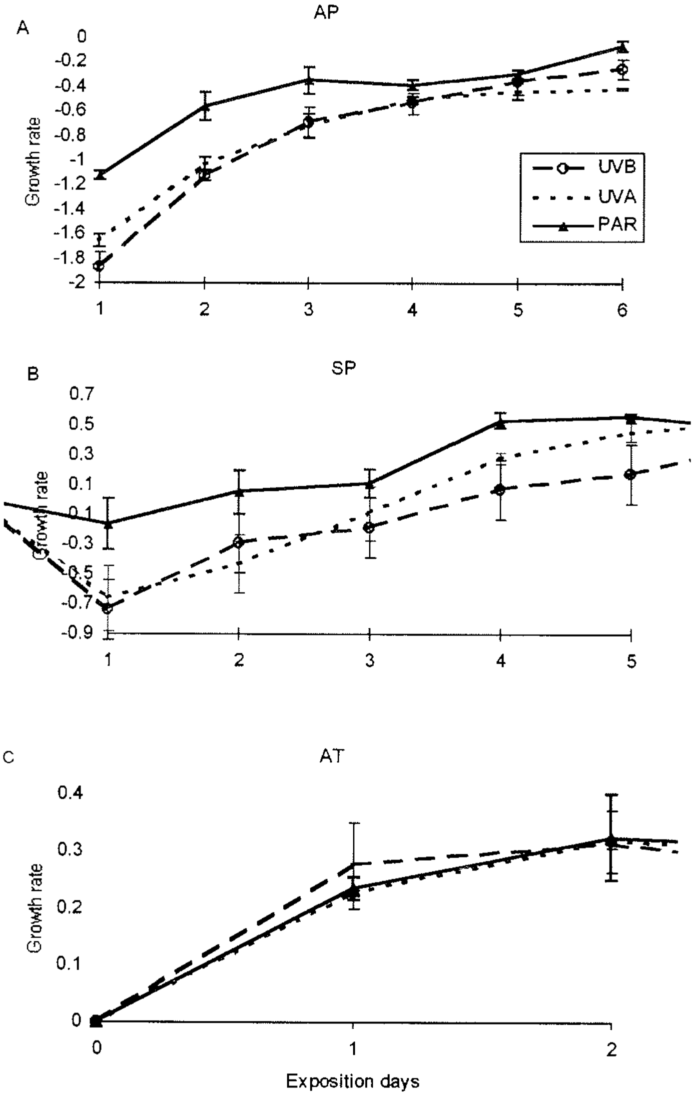

Fig. 1. Exponential growth rate using cell number when exposed to natural solar radiation as a function of exposure days.

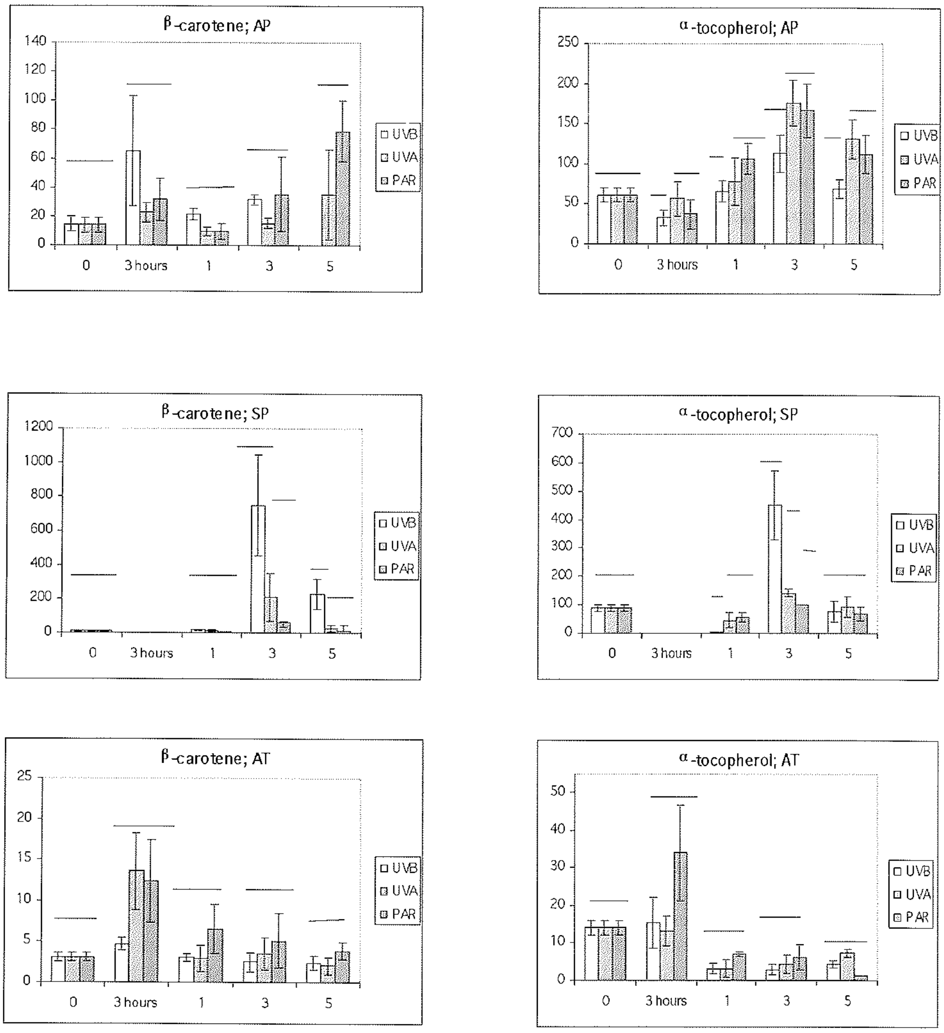

Fig. 2. Mean values and standard deviations of of antioxidant concentration (pmol/10^4 cell) as a function of time. Horizontal bars represent homogeneous groups at p>0.05 level for each experimental day, as determined by ANOVA analyses and Tukey test

Comparative biodiversity of ectosymbionts in two Antarctic cidaroid echinoids, *Ctenocidaris spinosa* and *Rhynchocidaris triplopora*

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Cidaroid sea urchins are unique in echinoids as their primary spines are usually covered by numerous ectosymbionts. This biological interaction between the sea urchin and other organisms is related to the absence of epithelium on the major part of the spines (the shaft). This colonization can lead to a noticeable increase in biodiversity, mainly on soft bottoms where possibilities of fixation for benthic animals are rare. This situation is particularly relevant for deep sea and Antarctic environments where cidaroids are frequent.
The morphology of cidaroid spines is highly diverse both between species and among the different areas of the test. The nature as well as the intensity of colonization by ectosymbionts could thus depend of the size and fine topography of the spines, that is to say of the characteristics of the substrate offered by the sea urchin. The aim of this paper is to compare ectosymbiont biodiversity in two morphologically contrasted Antarctic cidaroid species, *Ctenocidaris spinosa* and *Rhynchocidaris triplopora*, sampled in the same geographic area and across the same bathymetric range in the Weddell Sea. Three main questions are explored: Does the ectosymbiont biodiversity differ between the two species? Are ectosymbionts installed preferentially on certain zones of the tests? Are the choices of the host species and the localization on the host related to some aspect of the biology of ectosymbionts?

Twenty specimens of each species have been studied. Three areas of the test have been distinguished: oral, ambital and apical, and two spines have been sampled in each of these zones. Therefore, six spines and their ectosymbiont coverage have been depicted on each specimen. So far, the different observed symbionts have been reported to large taxonomic groups and then to morphological types rather than to species that are not yet fully identified.

C. spinosa – The mean ambital diameter of the test (and corresponding standard deviation) is 30.86 ± 8.27 mm, the height is 19.77 ± 5.28 mm, and the length of the large apical spines is 46.79 ± 9.84 mm. The aboral primary spines are coarsely thorny with very sharp spinules arranged in about eight longitudinal series that may fuse into spiny ridges. The oral primaries are spear-shaped. They usually bear aligned spinules slightly fused into two lateral wings so that serrations become somewhat less conspicuous. *C. spinosa* bears a total of 63 types of ectosymbionts: 25 sponges (among those 5 are also present in *R. triplopora*), 13 bryozoans (3 are common with *R. triplopora*), 7 annelids (only one of these has been reported on *R. triplopora*), 6 echinoderms, 6 cnidarians, 3 mollusks, 2 crustaceans, and a single foraminifera also present in *R. triplopora.* When the different areas of the test are considered, it appears that ectosymbionts are much more numerous on the apical and ambital zones rather than in the oral area that faces the sea floor. 14.3% of the 63 types of symbionts are present on the oral primary spines, 60.1% on the ambital spines, and 79.4% on the apical spines.
R. triplopora - The mean ambital diameter of the test is 21.31 ± 2.13 mm, the height is 12.02 ± 1.57 mm, and the length of the large apical spines is 23.48 ± 2.70 mm. The aboral primary spines are simple and acuminate, with fine thorns. The oral primaries are flattened. R. triplopora displays a total of 31 types of ectosymbionts: 10 sponges, 7 bryozoans, 5 annelids, 2 echinoderms, 3 cnidarians, 2 mollusks, 1 crustacean, and 1 foraminifera. A rather similar distribution as in *C. spinosa* is recorded between the different zones of the test: 12.9% of the 31 types are present in the oral zone, 58.1% in the ambital zone, and 90.3% on the large apical spines.

The comparison of a large species bearing strongly ornamented spines (*C. spinosa*) with a smaller species with less ornamented spines (*R. triplopora*) leads to contrasting results.

- 1 - *C. spinosa* appears to support a much greater ectosymbiont biodiversity than *R. triplopora.* The fine morphology of the spines may explain this difference, *C. spinosa* offering more asperities for attachment. Another explanation could be related to the size of the species. Indeed, the test height and the length of the large primary spines are about twice as large in *C. spinosa* than in *R. triplopora,* a situation that provides a wider access to the water column for suspensivorous animals. Moreover, a large host is more likely to be colonized, particularly by opportunistic symbionts.

- 2 - The proportions of the ectosymbiont taxa are quite similar in *C. spinosa* and *R. triplopora.* The three most abundant ectosymbiont taxa (sponges, bryozoans and annelids) are the same, and they count for 71.7% and 70.9% of the morphological types encountered on *C. spinosa* and *R. triplopora* respectively. This abundance mirrors the diversity observed in the surrounding benthos, and suggests that most of these symbionts could be opportunistic rather than specific.

Holothuroid symbionts deserve particular attention. They correspond to two dendrochirotes psolids (*Echinopsolus acanthocola*; *E. parvipes*) and to one aspidochirote synaptid (nov. sp.). The first two have been previously reported in the Antarctic, always in association with cidaroids (*Notocidaris mortenseni, Ctenocidaris perrieri*). They are suspensivorous, and seemingly need the sea urchins to gain access to the water column. The new synaptid species is detritivorous, and occurs on the two studied host species.

Scotia Arc, a bridge between Antarctic and South American microfauna distributions?

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The Pangaea breakup and the Gondwana disruption have motivated researchers of different zoological groups to research the impact on fauna distribution.

Nowadays, endemic benthic foraminifers (PROTOZOA: FORAMINIFERA) of the Antarctic continent are known, and some of them are present in the subantarctic area, the South Atlantic and South Pacific Oceans, which suggests that microfauna use the Scotia Arc as a bridge between continents.

In the present work, the presence of this group in marine sediment found in 17 samples from the Antarctic Ocean, 104 samples from the channels and fjords region of Chile and 6 samples from the Scotia Arc was analysed for similarities between these areas.

Results show that the Pacific fauna in channels and fjords is dominated by calcareous foraminifers: *Angulogerina angulosa, Cassidulina laevigata, Globocassidulina crassa, Discanomalina vermiculata, Quinqueloculina seminula* and *Discorbina isabelleana.* On the other hand, Antarctic sediments are abundant in arenaceus species such as *Globocassidulina biora, Portatrochammina malovensis* and *Miliammina arenacea.*

The Scotia Arc has scant microfauna, dominated by arenaceous species: *Miliammina arenacea, Reophax pilulifer* and *Portatrochammina malovensis.* Nevertheless, calcareous foraminifers are almost absent.

Globocassidulina rossensis is the only specie with an important abundance in both continents, however, it's totally absent in the Scotia Arc.

Finally, we can infer that lately some Antarctic foraminifers have been able to use the Scotia Arc as a bridge to migrate to the South Pacific region. However, for most Antarctic species, the Scotia Arc is an obstacle to migration to this area.

Biological state of krill (*Euphausia superba* Dana, 1852) in the coastal waters of the Argentine islands (Antarctic)

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Ukraine began to conduct independent hydrobiological research in the Antarctic Region in 1996. The Ukrainian Antarctic Station (UAS) "Akademik Vernadsky" (former English Station "Faraday") became the base for realization of this research. The station is located on Galindez Island at 65°15'S, 64°16'W. Galindez Island is positioned to the west of the Antarctic Peninsula in the Argentina islands Archipelago.

This region is an area of interaction between South America and Antarctic water masses and is characterised by high biological production. Markedly high biodiversity and numbers of seabirds (24 species) and mammals (8 species) are found here. Besides being an area of high biological productivity, it is the southern border of distribution and reproduction of many bird species - Gentoo Penguins *Pygoscelis papua* (Forst.) and Adelie Penguins *Pygoscelis adeliae* (Hombr). A. Jacquin).

The development of life in the Argentine Islands region is defined by the quantitative distribution of Antarctic krill. Therefore, knowledge of the state of the krill population (size-sexual structure, reproductive cycle) is necessary for comprehension of biological processes in the region. Research into krill state was conducted over a whole year (2002-2003) at station "Akademik Vernadsky".

«Antarctic krill» is an aggregate of 11 euphausiid species, which live to the south of 60-th parallel. Only one species, *Euphausia superba* Dana, 1852, dominates in number, biomass and distribution. In coastal waters of Argentina Island this species is the food of numerous representatives of the highest trophic levels. Many indigenous species (Weddell seals, terns, Adelie penguins, snow petrels) feed on these crustaceans. Two euphausiid species were found in coastal waters of the Argentina Islands. One of these species is infrequent: *E. triacantha* and one predatory: *Thysanoessa macrura*.

Krill is present in coastal waters of the Argentina Islands all year. Krill population is present in two "bunches" which differ in size-sexual structure, behaviour and other biological characteristics.

Solitary ("dissipated") krill, which do not form the aggregations, present the reproductive part of a population. Usually they are large, mature specimens, which are held along the ice-edge or by old icebergs. "Aggregation" krill forms dense aggregations and are present as single-sized (even-aged) specimens.

The size-sexual structure of krill varied within the year. In the Antarctic spring (November December) "solitary" krill were represented by shallow, juvenile or maturing crustaceans of length no more than 26 mm. Large mature crustaceans formed the aggregations. In the Antarctic autumn (April-May) and in winter the basis of the aggregations was shallow pre-adolescent crustaceans, and large, mature krill meets simplify. The blended aggregations are characteristic for the Antarctic summer.

The number of krill in the aggregations ranged from 4 to 11 ex/ m^3, and the average biomass increased from 480 mg/ m^3 in the spring to 2000 mg/m^3 in the autumn. The number of "solitary" krill was practically constant over the year, at 2-4 ex/ m^2.

The stomach contents were high over the year. Krill feeds mainly phytoplankton. Only in the spring (September-October) was the role of detritus components significant in krill feeding.

Thus, coastal waters of the Argentina Islands are an area of reproduction and fattening of krill. Significant resources of krill ensure existence to numerous seabirds and mammals in these waters.

Composition and temporal changes of an intertidal soft-bottom community in Golfo Nuevo, Patagonia, Argentina

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The Golfo Nuevo is one of the main north-Patagonian gulfs, located in the north end of the Magellanic biogeographic province (42° 45' S - 64° 55'W). The main current affecting this region is the cold, northward flowing Patagonian current, wich originates in the area of the Magellan Strait. Water temperature in this current ranges from 5-8 °C in winter to 10-16°C in summer. The warm Brazil Current may also have an influence, especially during the summer time.

The main objective of the present study was to characterise the structure and analyse the seasonal changes of an intertidal soft bottom community in Cerro Avanzado, a protected beach on the south west coast of the gulf; sediment is composed predominantly of fine sand (59 %) with a low organic content (1.4 %). The tidal regime is semi-diurnal and the mean tidal range is 4.62 m.

The benthic community was sampled monthly, between August 1995 and July 1997; ten samples (0.25 m^2, 15 cm deep) were obtained at 0.6 m above mean low water. The macroinfauna was obtained by sieving the sediment samples through a 1-mm screen. Organisms found in the sample were identified to species level as far as possible, quantified and feeding habitats recorded.

Subsurface water temperature was recorded monthly with a mercury thermometer; productivity was measured monthly as chlorophyll "a" by the fluorometric method. Diversity values were obtained by means of the Shannon-Wiener index using natural logarithm and the evenness was calculated according to Pielou (1969).

A correlation analysis between diversity values, evenness, water temperature and productivity was performed.

Seasonal water temperature ranged from approximately 9 to 20 °C. Minimum values were recorded in August-September each year and maximum values in February/96 and March/97.

Chlorophyll "a" minimum values were registered in January and June-July each year increasing to a maximum during spring (October-November) with a second smaller peak in late summer-early fall (April).

The benthic community was composed of 15 macroinvertebrate species; 22% are Magellanic species living at the northern limit of their distributions. Mollusca, Polychaeta and Crustacea constituted more than 99 % of the specimens collected. Other taxa were infrequent (Actiniaria, Ostracoda, Tanaidacea and Cumacea).

The community was dominated by the bivalve *Tellina petitiana*, the polychaetes *Aricidia sp.*, *Scoloplos sp.* and *Glycera americana*; the gastropod *Buccinanops globulosum* and the amphipods *Microphoxus sp.*, *Monoculopsis vallentini* and *Puelche orensanzi*.

The bivalve *Tellina petitiana* d'Orbigny was the most abundant species (76.93 % of total macroinfauna) when pooling data from all the samples, with a mean density of 600 indiv/m^2. 75% of the most abundant species were deposit feeders, except for *Glycera americana* Ehlers and *Buccinanops globulosum* (Kiener) which are carnivores.

Shannon-Wiener diversity index values (H') ranged from 0.91 to 1.65 and faunal evenness (J') from 0.33 to 0.60.These two parameters were positively correlated ($r = 0.999$; $p<0{,}001$). The H' variation was not related to changes in the water temperature ($r = 0.234$) or to productivity ($r = 0.063$).

The results of this study indicate that species composition of the macroinfauna community remained very stable during the study period without changes in the relative proportions of dominant species. The mean abundance of dominant species shows an increment in number simultaneously with juvenile occurrence, in spring and summer each year.

Growth and productivity of the venerid bivalve *Tawera gayi* (Hupé, 1854) in the Ushuaia Bay, Beagle Channel.

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Abstract

Growth, productivity and potential for exploitation of the clam *Tawera gayi* from Ushuaia Bay were investigated. Mean abundance and biomass in the study area were 1091 ± 737 ind.m^{-2} and 901.83 g SFWM.m^{-2} (shell-free wet mass) respectively. Individual growth was described best by the von Bertalanffy growth model, H_∞= 28.03 mm, K= 0.288 y^{-1}, t_0= -0.34 (r^2= 0.83). Annual production of the population was 120.45 g SFWM.$m^{-2}y^{-1}$, corresponding to a P/B ratio of 0.134 y^{-1}. The single negative exponential mortality model does not fit the population mortality pattern, but predation by gastropods appears to be the major cause of mortality. These highly mobile predators together with the comparatively slow growth of *T. gayi* in Ushuaia Bay limits its potential for more intense commercial exploitation or aquaculture at this site.

Introduction

The littoral venerid *Tawera gayi* is found from the Beagle Channel (54°50'S) to 33°S along the Pacific coast, and to the province of Buenos Aires (36°S) along the Atlantic coast. *T. gayi* is commercially exploited in some regions of Chile, although this fishery is not managemed and only few studies have been carried out so far. Currently, the Beagle Channel population of *T. gayi* is subject to a low level artisanal fishery for personal consumption only. Therefore we have the opportunity to carry out a baseline study of population dynamics which will facilitate adequate stock management during potential future commercial exploitation.

Materials and Method

Monthly samples (n= 4118) of clams were collected in Ushuaia Bay between August 2001 and July 2002. Randomly selected cores were dug out. In all individuals we measured shell height (H), length and width (±0.1mm), and determined total mass, shell mass and shell-free wet mass (±0.01g). Individual age was inferred from shell growth bands of 285 specimens using the acetate peels technique.

A mark-recapture field experiment was carried out. 96 animals were collected, measured, marked and returned to the tidal flat. After one year the animals were recovered and annual growth lines were examined.

The von Bertalanffy growth model was used to describe growth. Somatic production was calculated by the mass-specific growth rate method and production-to-biomass ratio (P/B) was computed. Total mortality rate Z was estimated by a size-converted catch curve.

Results and Discussion

The shell growth pattern of *T. gayi* in Ushuaia Bay showed alternating narrow translucent and broad opaque bands. The translucent bands showed a pink to purple color, similar to the internal part of the shell. In *T. gayi* the translucent bands corresponding to slow or halted growth are formed in winter, *i.e.* temperature and/or food availability are most likely to affect shell growth.

The von Bertalanffy function of *T. gayi* was estimated to be H_t=28.03 mm*(1-$e^{-0.288*(t + 0.34)}$); n= 285; r^2= 0.83 (Fig.1). They can reach a maximum age of 14 years. Other maximum age estimates for *T. gayi* appear to be unreliable owing to non-representative sampling as well as non-validated aging methods.

Individual production was highest (0.42 gSFWM.ind^{-1}) at 19.5 mm height. The somatic production (Fig.2) was 120,45 gSFWM.m^{-2}y^{-1} with a mean biomass of 901.83 g.m^{-2}, corresponding to a P/B ratio of 0.134 y^{-1}. This value is among the lowest ever reported for other Venerids.

Mean density was 1091±737 ind.m^{-2}. Recruits (<12 mm height) were present year-round, with a major peak occurring in summer. The analysis of reproduction indicates that the observed recruitment pattern corresponds to the continuous presence of mature gonads throughout the year with a major spawning event during November.

The mortality model of *T. gayi* does not apply and hence we cannot provide a population mortality estimate. The size-converted catch curve plot indicates, however, that mortality is quite high in small specimens and lower in larger specimens, which may be able to outgrow their predators to some extent. The dead shell assemblage along the coastline as well as our field experiment strongly indicate that gastropods are the major predators of *T. gayi* from Ushuaia Bay. *T. gayi*, and other species of the genus *Tawera*, are usually found close the sediment surface. Thus, they are easier prey for snails than deeper dwelling venerids.

If *T. gayi* is indeed the major prey species of these snails, then any prospective commercial fishery of this clam will have to cope with the strong competition from natural predators. The same holds true for any aquacultural developments which would have to be protected from the highly mobile predatory snails.

Fig. 1. Von Bertalanffy growth curve of *T. gayi* based on internal rings reading of 285 specimens (y-axis= height (mm).

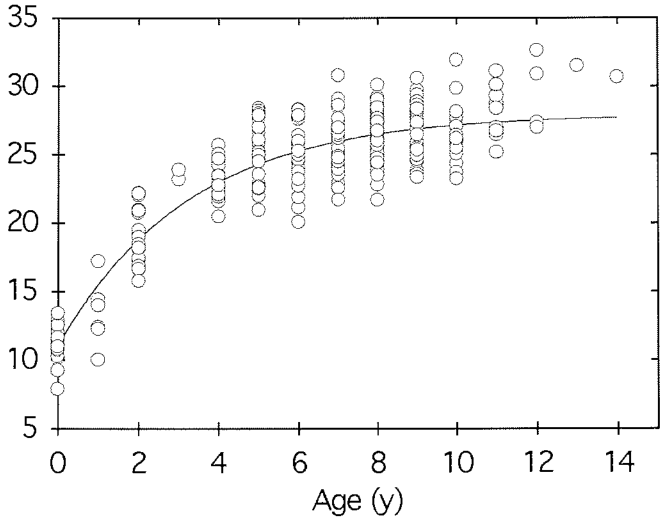
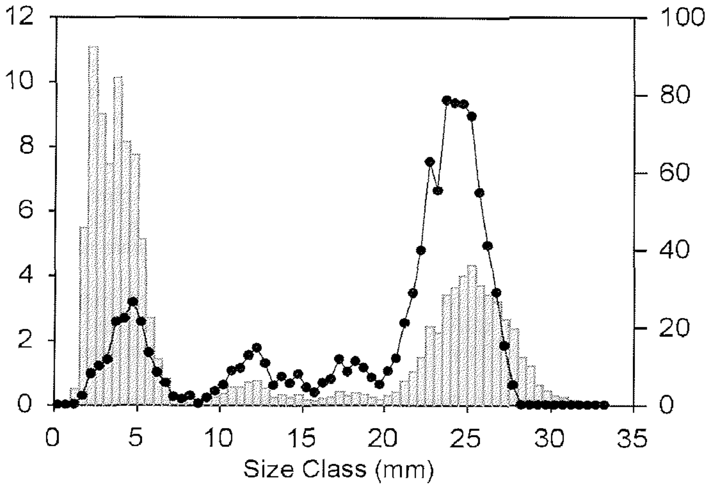


Fig. 2. Height-frequency distribution and corresponding distribution of annual production (SFWM) of *T. gayi* in Ushuaia Bay; y-axis (left)= P_{class} (g SFWM class^{-1} m^{-2} y^{-1}); y-axis (right)= N_{class} (m^{-2}).



Seasonal changes in biochemical composition of the clam *Eurhomalea exalbida* (Bivalvia: Veneridae) from the Beagle Channel (Argentina)

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Seasonal variations in growth and reproduction have been correlated with changes in the energy content of different organs, thereby reflecting the spatial and temporal energy distribution within the organism. This distribution closely reflects the seasonality of the cost of reproduction and growth, and the capacity to accumulate reserves within the organism. Thus, the aim of the present work was to describe the seasonal biochemical changes (protein, glycogen and lipid content) in different organs (FV: foot-visceral mass, M: adductor muscles and GMS: gills-mantle-siphons) of the clam *Eurhomalea exalbida* from Bahía Ushuaia (54°50'S, Beagle Channel, Tierra del Fuego) and the relationship between the observed variations with the gametogenic activity and the maximum growth season.

The analysis of the relative condition index for FV over time showed the highest values in January in both sexes, whereas the lowest values occurred in June, September and November for females and in September, November and March for males ($p<0.05$). These seasonal variations were correlated with the gametogenic cycle and the monthly relative condition index previously observed for this species. For M and GMS no significant changes ($p>0.05$) in mass were observed though the year.

A maximum level of protein content (Table 1) was observed during winter in all tissues ($p<0.05$), with increases also during the spawning event (November) in FV and in November and January in GMS. In the adductor muscle, the protein content shows low variability during the year, except in June, suggesting that all these tissues are involved in the storage of proteins, which are thought to play a role in gamete maturation.

The percentage of glycogen content for FV, M and GMS showed low values (0.03 to 4.7% ash free dry weight) throughout the year, which suggests that these components did not have an important function as substrate for energy reserves. Low values of lipid content for FV were found in November with increased levels in the summer season ($p<0.05$). Thus, the lipid content variations can be related principally to gamete emission in November and to gamete maturation in the summer. The proportion of lipid content (with the higher calorific value) in the gonads can be expected to decrease due to the emission of gametes and increase with vitellogenesis. The high levels of lipid content in FV over the rest of the year were correlated with the presence of mature gonads throughout the major part of the year. The lowest values of lipid content in June in all tissues were correlated with the protein storage in this month.

In *E. exalbida* from Bahía Ushuaia, shell growth (observed previously) in spring occurred during spawning. In summer, the growth slowed down and a gamete proliferation was found, whereby energy was allocated to reproduction rather than to growth. In contrast, juvenile organisms grew such as in spring and in summer whereby energy was allocated to growth in both seasons. The differences detected between juvenile and adult organisms could be related to the energy partition between growth and reproduction.

Therefore, our results suggest that in *E. exalbida*: (a) proteins are the most important component stored; (b) the relative content of protein, lipid and glycogen of the adult specimens vary seasonally in accordance with the reproductive cycle and the season of maximum growth, when the organism reaches reproductive maturity (summer) growth slows down because of reproductive investment.

Table 1. Biochemical composition of *Eurhomalea exalbida* body tissues (mg g^{-1} AFDW) in females and males individuals from Bahía Ushuaia. Data presented are means over time.

	Foot-Visceral mass		Adductor Muscles		Gills-Mantle-Siphons	
	Females	Males	Females	Males	Females	Males
Protein						
Jun.	888	808	704	927	927	701
Sep.	446	325	591	598	595	539
Nov.	540	476	556	595	791	658
Jan.	451	311	592	586	799	795
Mar.	495	443	624	609	617	600
Glycogen						
Jun.	3	3	4	6	2	3
Sep.	10	10	4	6	5	4
Nov.	7	13	6	17	5	5
Jan.	26	24	10	18	8	9
Mar.	13	11	12	6	7	6
Lipid						
Jun.	109	118	292	66	71	296
Sep.	544	664	405	395	400	457
Nov.	453	509	438	389	204	337
Jan.	523	665	398	395	193	195
Mar.	492	546	364	385	377	394

Biodiversity and distribution patterns of soft bottom polychaetes from South Shetland Islands to Bellingshausen Sea. Preliminary results of BENTART-2003

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During the Antarctic summer of 2002-2003, the Spanish cruise BENTART-2003 was conducted on board R/V Hesperides. The study area was divided in two sectors: the Bellingshausen Sea (including Peter I Island) and the western coast of the Antarctic Peninsula. Samples were collected from depths ranging from 490 to 2043 m. The epibenthic polychaetes were studied by means of an Agassiz trawl (gate 2 m wide and 1.12 m high, 10 mm gauge net) that was pulled over 5-10' after reaching the bottom. When the sediment sample was too large, a randomly taken sub-sample of 50 l was studied. Polychaete infauna was collected using a box-corer grab that sampled 50 x 50 cm quadrats (maximum sediment depth 60 cm). This device was used twice at each station and three replicates of 25x25 cm were selected from the two boxes extracted; thus the data obtained could be used for a statistical analysis to assess geographic patterns on polychaete distributions. In order to characterize the vertical allocation of the polychaetes within the sediment, each replicate was divided into two sub-replicates, one representing the first 10 cm of sediment and a second one from 10 to 40 cm depth. Due to bad weather, the box-corer grab was used only at 20 stations, whereas the Agassiz trawl was used at 25 stations.

Regardless of the sampling device used, the material was sieved through 10, 5 and 1 mm gauge meshes on board and the specimens sorted to family level, counted and weighted (when weight was over 0.1 g); then fixed in 4% formaldehyde in seawater buffered with borax. After transformation to $\log_{10}(x+1)$, the abundance data were used to compute Bray-Curtis similarity coefficients between each pair of stations. The matrix yielded was used to perform a clustering analysis using UPGMA as amalgamation method and a MDS analysis, both plotted using the PRIMER statistical package.

In this contribution, preliminary data on diversity and distribution of polychaetes collected in the BENTART-2003 cruise are presented, and the affinities with the polychaete fauna collected in the South Shetland Island during the Spanish cruises BENTART-94 and BENTART-95 are analyzed. A comparison analysis is also made with previously published data on the soft-bottom polychaete fauna from other Antarctic and Subantarctic areas, such as the Magellan region, the Weddell Sea and Scotia Arc Islands.

Results

in all, the samplings provided 4655 polychaetes belonging to 31 families. In the epifauna, Maldanidae and Polynoidae (the two occurred at 15 stations) were the most conspicuous families, followed by Terebellidae (14), and Flabelligeridae (13) (Table 1); the most abundant families were Maldanidae (1577 specimens), Ampharetidae (454) and Flabelligeridae (387) and Oweniidae (300) (Table 1). In terms of biomass, the highest value corresponded to Aphroditidae (*Laetmonice producta* Grube, 1876, is, by far, the largest of the polychaete species collected), followed by Flabelligeridae and Maldanidae.

In the infauna, the most frequent and abundant family was also Maldanidae (603 specimens, at 17 stations), followed by families Cirratulidae (159 specimens, seven stations), Spionidae (145 specimens, 14 stations), and Ampharetidae (128 specimens, six stations). Other frequent, although less abundant, families were Lumbrineridae (69 specimens, 12 stations), and

Capitellidae (45 specimens, 11 stations) (Table1). The study of the vertical distribution of the infauna in the sediment reveals that higher values of polychaete abundance are located in the most superficial layer of the sediment (0-10 cm).

A biogeographic division arose from the similarity analyses. The stations were clustered in three different groups. The first included the samples from Peter I Island together with those of the Antarctic Peninsula, whereas the second and third were formed by the samples from the shelf and slope of the Bellingshausen Sea (Fig. 1).

	NI Agassiz	NS Agassiz	NI box-corer	NS box-corer
Maldanidae	1577	15	603	17
Polynoidae	186	15	10	7
Terebellidae	69	14	67	7
Flabelligeridae	387	13	19	5
Ampharetidae	454	10	128	7
Oweniidae	300	1	1	1
Aphroditidae	98	12	0	0
Cirratulidae	22	3	159	7
Spionidae	22	5	145	14
Lumbrineridae	34	8	69	12
Capitellidae	13	6	45	11
Others	353	-	218	-

Table 1. Semi-quantitative data. NI Agassiz = number of specimens of the family collected by Agassiz trawl. NS Agassiz = number of stations where the family was collected by Agassiz trawl. NI box-corer = number of specimens of the family collected by box-corer grab. NS box-corer = number of stations where the family was collected by box-corer grab.

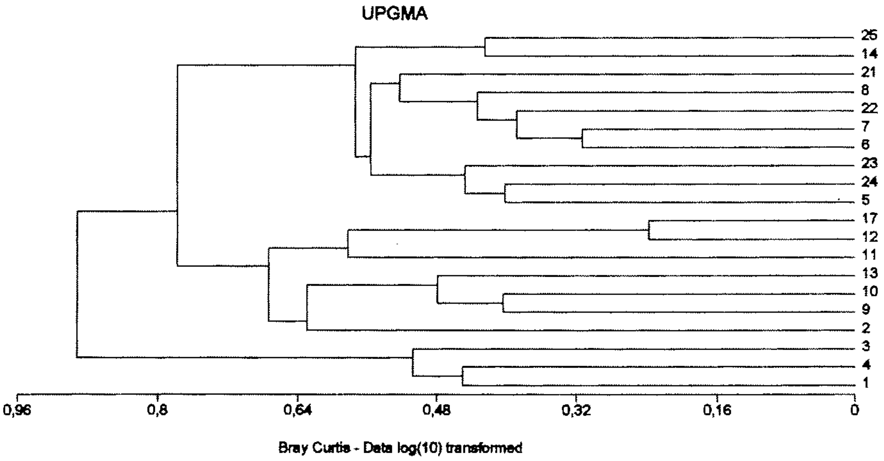

Fig. 1. Dendrogram resulting from clustering analysis; axis represents Bray-Curtis distance (dissimilarity). Samples from Bellingshausen Sea: 1-4, 9-17. Samples from Peter I Island: 5-8. Samples from Antarctic Peninsula: 21-25.

Two new dimorphic soft-coral species (Anthozoa: Octocorallia) from the Scotia Arc

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The genus *Sphaeralcyon* López-González & Gili, 2000 was proposed based on the study of three specimens collected in the Eastern Weddell Sea. These authors diagnosed this genus on the basis of the description of *Sphaeralcyon weddellensis*. In the original description, this genus was compared to the other dimorphic alcyonid genera with capitate or mushroom-shaped colonies: *Anthomastus* Verrill, 1878, *Malacacanthus* Thomson, 1910, and *Verseveldtia* Williams, 1990. During the recent Antarctic cruises ANDEEP-I and LAMPOS, some colonies belonging to two undescribed octocoral species were collected at the Southern branch of the Scotia Arc. That material is described here and assigned to the monotypic genus *Sphaeralcyon*. The diagnosis of this genus has been slightly modified to accommodate some of the features showed by the new species.

Studies of the populations of *Macrocystis pyrifera* (L) C, Agardh in Tierra del Fuego, Chile

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Abstract

The aim of this study is the characterization of *Macrocystis pyrifera* populations in the coastal waters of Tierra del Fuego (Chile). Standing stock and standing crops (kgm^{-2}), length frequency, mean plant size and number of stipes by square meter were evaluated using 0.25m2 quadrants in perpendicular coastal transects. Detailed information is necessary to establish a future plan of management to preserve this marine resource, since the explotation of macroalgae increased lately, meanly due to the as food for aquaculture, predominately of salmonid fishes.

Key Words: *Macrocystis*, Tierra del Fuego, standing stocks

Introduction

Macrocystis pyrifera is distributed bipolarly in South America and North America mainly at the Pacific coasts, south of Australia and at the extreme south of Africa (North, 1987). It is also found in South Argentina, South Australia, New Zealand and Tasmania. In Chile *M. pyrifera* is distributed towards Cape Horn (Hoffmann y Santelices, 1997). Due to the high abundance in the Magellan region, this area is considered as an important worldwide reserve of *M. pyrifera*, and as a dense forest with remarkable commercial potential (Alveal, 1982).

In the Strait of Magellan individuals can reach lengths of 30 metres and more, and can weigh over 100kg with holdfasts of more than 80 cm diameter and 70 cm height. The *M. Pyrifera* forests serve as refuges, food and breeding grounds for many species of molluscs, fishes, crustaceans, polychaetes and so forth (Cariceo-Yutronic, et al., 2002). Apart from its ecological importance we can emphasize the economical perspectives of this species as a nutritional supplement for ovine and bovine cattle, fishes in captivity, as fertilizers for agricultural purposes and for extraction of ficocoloids with a wide range of uses in the medical and nutritional industry (Barletta, 2003).

Materials and Methods

Since june 2002, biomass estimations (wet weight) have been made in the *Macrocystis* forests, situated in Bahía Chilota 53° 18` S; 70° 24' W, Tierra del Fuego, Chile. Standing stock and standing crops (kgm-2), length frequency, mean plant size and number of stipes by square meter were evaluated, using 0.25m2 quadrants in perpendicular coastal transects.

Results

Table 1. Population structure of two forests of *M. pyrifera* in Tierra del Fuego, Chile.

Forests	Variable	Transect 1	Transect 2	Transect 3	Mean ± S.D.
Forest 1	Standing Stock (kg m^{-2})	114,2 ± 6,81	98,34 ± 3,7	96,25 ± 6,74	102 ± 9,93
Area: 37.110 m^2	Length frequency (m)	≤ 1-60 ≥	≤ 2-7 ≥	≤ 30 cm -5 ≥	≤ 1.1 -24 ≥
	Density Ind.m^{-2}	338 ± 131	760 ± 256	367 ± 258	488 ± 281
Forest 2	Standing Stock (kg m^{-2})	77,748 ± 4,67	86,64 ± 1,94	86,048 ± 2,41	83,48 ± 5,14
Area: 11.410 m^2	Length frequency (m)	≤ 0-2 ≥	≤ 2-8 ≥	≤ 0 -12 ≥	≤ 0.6 –7.3 ≥
	Density Ind. m^{-2}	162 ± 36	216 ± 21	249 ± 241	209 ± 45

Table 2. Seasonal variation of length (m), number of stipes (N° ind.m^{-2}) and biomass (kg.m^{-2}) of a population of *M. pyrifera* in Tierra del Fuego, Chile.

		Transect 1	Transect 2	Transect 3	Mean ± S.D.
Spring	Lenght (m)	7,48 ± 1,31	6,27 ± 1,62	8,76 ± 0,68	7,50 ± 1,24
	Number of stipes (Ind.m^{-2})	133,33 ± 34,01	42,44 ± 20,44	169,33 ± 30,02	115,03 ± 65,39
	Biomass (Kg m^{-2})	317,33 ± 237,86	80,44 ± 74,70	170,66 ± 16,16	189,47 ± 119,56
Summer	Lenght (m)	5,16 ± 2,40	6,03 ± 2,19	5,33 ± 1,81	5,50 ± 0,46
	Number of stipes (Ind.m^{-2})	42,90± 25,34	126,66 ± 125,8	154,66 ± 78,92	108,08 ± 58,15
	Biomass (Kg m^{-2})	16,53 ± 4,766	116,41 ± 127,85	60,66 ± 45,00	86,93 ± 61,23
Winter	Lenght (m)	5,01 ± 1,40	6,82 ± 1,42	5,62 ± 0,93	5,81 ± 0,92
	Number of stipes (Ind.m^{-2})	50,2± 8,90	134,66 ± 120,95	60,88 ± 11,18	81,89 ± 45,95
	Biomass (Kg m^{-2})	90,06 ± 41,88	157,33 ± 93,75	76,0 ± 24,97	107,79 ± 43,46

Conclusion

- Populations in open sea comprise plants of larger size; in contrast in protected areas only smaller plants and less juveniles are found.
- The presence of juvenile plants suggests the existence of fertile plants throughout the year.
- Both the number of stipes and the biomass were high during spring time possibly because of higher temperature and more light.
- Open seas favour growth possibly because of higher content of nutrients and oxygen, due to the impact of water current and swell.

Distribution of demersal fish species along the Scotia Arc islands

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For approximately 20 million years the Antarctic marine fauna has been isolated in a constantly cold environment, which led to an unique evolution of fish species with high endemism and one suborder, the Notothenioidei (Perciformes), dominating the whole ichthyofauna (Eastman 1991). The isolation of species is caused by long distances to the other continents, deep waters in-between and surrounding strong currents and oceanic fronts, which are associated with strong changes in water temperature. The only existing connection with water depths mostly less than 2000 m is given by the Scotia Ridge, which builds an arc of several islands between South America and the Antarctic Peninsula. The investigation of demersal fish species showed that the entirety of shelf areas (between 250-380 m) in this region is dominated by the suborder Notothenioidei by more than 90 %. Considering species composition the Scotia Arc can be divided into a northern and a southern part. The northern part comprises the area around Burdwood Bank and Shag Rocks (north of South Georgia) and communities are distinctly dominated by the small notothenioid species *Patagonotothen guntheri*, which is a common species on the southern Argentine Patagonian shelf.

Another characteristic part of the fish communities in the northern area is the commercially exploited Patagonian toothfish, *Dissostichus eleginoides*. Total species number in this area is relatively low with 7-8 species per haul. The southern part of the Scotia Arc includes the islands south and southwest of South Georgia and the Antarctic Peninsula. This region is characterized by the occurrence of the species *Chaenocephalus aceratus*, *Champsocephalus gunnari* (Channichthyidae) and *Gobionotothen gibberifrons*, *Lepidonotothen kempi* and *L. larseni* (Nototheniidae). All these species are widely distributed along the islands in the southern part of the Scotia Arc. Species richness in this southern part generally accounts for 9-11 species per haul, except for the South Sandwich Islands, where only 2 and 4 species were found (most abundant species was *L. kempi*), respectively, probably due to geo-morphological conditions. At Elephant Island and on the Peninsula shelf the channichthyid species *Chionodraco rastrospinosus* was also common.

Hence, according to their distribution along the Scotia Arc, species can be assigned by their main area of occurrence either to be part of the Magellan or of the Antarctic fauna, with *P. guntheri* and *D. eleginoides* as typical members of the Magellan communities and *C. aceratus* and *L. kempi* as examples of Antarctic species. Although fishes are very motile organisms, South Georgia acts as a form of border for northwards and southwards dispersion of most species. Following the hypothesis of Andriashev, who assumed that oceanic fronts represent a strong ichthyogeographical barrier, this pattern of distribution is probably related to the course of the Antarctic Polar Front, which apparently runs south of South Georgia. Given that most notothenioid species are highly adapted cold-stenotherm organisms, the change of water temperature at the Antarctic Polar Front is likely to limit their distribution possibilities.

The question of whether the populations of widely distributed species on the particular island shelves are genetically separated or not is still open, but since most notothenioid fishes are known to have pelagic larvae that are found offshore in the Scotia Sea it can be assumed that there persists a genetic exchange between populations by larval drift. Furthermore, most of the species occur over a wide depth range, and hence there are opportunities of migration for adult demersal fish between the islands. So it is likely that the islands of the Scotia Arc are still used by demersal fish species as stepping stones for dispersing southwards and northwards, respectively.

Comparisons of echinoderm biomass values from the Bellingshausen Sea, the South Shetlands Islands, and Bransfield Strait (Antarctica)

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This study presents data on the biomass of echinoderms collected with an Agassiz trawl in the different zones sampled during two cruises, the 'Bentart-95' survey (North and South Livingston Island, Deception Island and the Bransfield Strait), at depths ranging from 40 to 850 m; and the 'Bentart-2003' survey (Thurston Island, Admusen Sea, Peter I Island, Bellingshausen Sea, Margarita Bay, Gerlache, and Paradise Bay), at depths of 48 to 2045 m.

During the 'Bentart-95' survey, 33,610 echinoderms were collected with a total biomass of 167 kg, whereas during the 'Bentart-2003' survey, only 4,185 individuals were caught from this taxon, comprising a biomass of 80 kg. These data would seem to show a low abundance of echinoderms in the Bellingshausen Sea, compared with the South Shetland Islands abundances. However, given the relatively slight difference in biomass, it could be concluded that the difference was not so important. The presence of large asteroids, such as *Macropchitaster* and *Perknaster,* may explain this. On the other hand, it could be interesting to consider the high abundance of holothuroids in the Bellingshausen Sea, which also increased the total biomass notably, because the presence of this taxon in the 'Bentart-95' catch was also important, but the high abundance of *Ophionotus victoriae* brought down its contribution to total weight.

Ophiuroids represented the highest abundance (75%) of echinoderms collected during the 'Bentart-95' cruise, followed by regular echinoids, which represented 19%. Ophiuroids presented a richness of 1 to 18 species per station, and the highest abundances in the deepest stations of the bays of South and Walker (South Livingston) and Deception, related to mud bottoms and a semi-closed basin shape (Manjón *et al.*, 2002). This high abundance of ophiuroids in the Antarctic benthos communities has been also cited in other areas (Fell, 1961). Regular echinoids presented high densities, up to 4,000 individuals per station, although only at Deception, at a depth of 100-120 m on sand substrates. In the rest of the area studied they failed to exceed 150 individuals per station. These dominances were considerably different for the 'Bentart-2003' cruise.

The highest abundance corresponds to Holothuroids at 57.6%. However, the rest of the class followed the same dominance order (Ophiuroidea: 29.2% and Regular Echinoidea: 7.1%). Also, there is a general decrease in abundance, especially in the asteroids, although they represent the second most important group in terms of biomass, after the Holothuroids.

Results are still pending for the sediment sampling and the water column data from 'Bentart-2003', and so *a priori* we cannot establish a relationship between the abundances of the different taxa and the depth, although the distribution of each class at the different stations seems to be more related to the type of bottom. Asteroids, ophiuroids and regular echinoids present higher biomasses at stations near Thurston Island and the Admusen Sea; however, both crinoids and irregular echinoids have a clear preference for the Gerlache zone. Holothuroids are the only group with a preference for the Peter I littoral, where their abundances were so high that they single-handedly determined the abundance and dominance of echinoderms found overall during the 'Bentart-2003'cruise.

Scotia Arc Bryozoans: a narrow bridge between two different faunas

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The known Magellanic bryozoans exceed 220 species. Those of the Antarctic Peninsula also reach similar values. Endemism of the Magellanic bryozoans is about 55% whereas that of the Antarctic bryozoans is higher, from 65% to more than 90% depending on the depth and latitude at which they are growing.

The physical link among both bryozoan faunas is the Scotia Arc archipelagos: Shag Rocks, South Georgia; South Sandwich, South Orkney and South Shetland. These might constitute the stepping stones between South America and the Antarctic for the dispersal and interchange of faunal elements. If this was the case a mixing of Antarctic and Subantarctic bryozoan species could be discovered, demostrated and evaluated, but the research carried out so far shows an altogether different picture.

This and other problems concerning the role of the Scotia Arc archipelagos in the interactions between the Antarctic and Subantarctic ecosystems lead to the LAMPOS cruise on board the German research vessel Polarstern during April-May 2002. The bryozoan collection gathered include some 70 species that belong to two completely different sets: one Subantarctic to the west and north of Shag Rocks and the other Antarctic obtained at the east and south of that archipelago.

Both sets are dominated by large flexible bryozoan colonies, namely flustriform, buguliform and cellariiform plus some rigid ones like eschariform and reteporiform. The encrusting species are less abundant, forming calcareous sheets on small pebbles. Most species were known previously, with the exception of two new ones. One of these belongs to a new flustran genus to be described and the other to the cribriline genus *Parafigularia*.

Systematically the links of Antarctic and Subantarctic Bryozoa are more at the generic than at the specific level. There are some species, mostly from shallow waters, like *Celleporella bougainvillei*, *Inversiula nutrix* and *Beania inermis* living in Magellanic South America and in the Antarctic Peninsula. More abundant are vicarious species

v. gr. *Parafigularia magellanica* and *P. discors*, *Aulopocella petiolata* and *A. brachyrhyncha*, *Adelascopora stellifera* and *A. secunda*, *Austroflustra australis* and *A. vulgaris*. Also more abundant are endemic species from both faunas. These statements result from a comprehensive analysis of all known bryozoan species; both Magellanic and Antarctic. In terms of the bryozoans collected by the LAMPOS cruise, connections among both faunas are almost non-existent, probably because the collecting depths surpassed 200 m. In this context all the archipelagos show a typical Antarctic bryozoan fauna.

An interdisciplinary study of *Psolus patagonicus* Ekman, 1925 (Psolidae, Dendrochirotida) from the Magellan Province and its northern Atlantic distribution

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Marine biologists and natural products chemists have collaborated to produce a complete taxonomical revision and study of geographical distribution, presence of secondary metabolites and antifungal activity on the holothurian *Psolus patagonicus* Ekman, 1925. This sea cucumber is a poorly known Magellan species since the original descriptions and subsequent taxonomical redescriptions. Recently, a study on reproductive aspects was carried out by Giménez and Penchaszadeh, describing the interesting behaviour of these holothurians, which incubate their eggs and embryos under the sole.

In the present work, we provide information about the biology of living specimens and the external morphology and structures (calcareous skeletal ossicles, plates, etc) studied under optical and scanning electron microscope. The study was based on specimens collected from intertidal rocks (0-2 m) of Bahia Ensenada (Magellan Region, Ushuaia) and from scallop beds of *Zigochlamys patagonica* by bottom trawling at depths of some 110mts in the South Atlantic Ocean (39° 27 10S, 55° 56 76W). *Psolus patagonicus* is well adapted to living attached to a hard substrate (rocks, shells, *Macrocystis* fronds) and extends far into the Atlantic following the cold Antarctic deep water current. The presence in the Magellan Province of two other species of *Psolus*: *P. squamatus* and *P. antarcticus* (Philippi, 1857) is considered (Table 1), with emphasis on bringing a taxonomical revision of them up to date.

The "saponins" present in the skin of the sea cucumbers are thought to have a primarily defensive function. The new triterpene saponin, Patagonicoside A, was isolated from complete specimens of *Psolus patagonicus* from the two localities mentioned, and its chemical structure elucidated (Fig. 1). The bioactive compound found, iPatagonicoside A, exhibits an important antifungal activity tested with three different fungi of the genera *Cladosporium*, *Fusarium* and *Monilia.* The presence of similar chemical compounds in other sea cucumbers and the role as a chemical defence in these marine invertebrates are discussed.

Acknowledgements: This work was supported by a grant from Fundación Antorchas to the first author for the Project: "Location of active metabolites, origin and biochemistry activity on Marine Invertebrate".

Table 1. Distribution, size, presence of bioactive metabolites and references of the holothurians Psolidae present in the Magellan Province.

Species	Type Locality	Size/ Chemical Defense	Distribution/ Habitat	References
Psolus squamatus (Koren, 1844)	Mission of Cape Horn (Station 41) Holotype: Museum of Paris (?).	10-80mm.	From 41°30'05''S (West) to 42°S (East). Straits of Magallan. Burdwood Bank and Falklands Islands. Stones, shells. 7-207m.	Pawson, 1969
Psolus antarcticus (Philippi, 1857)	Straits of Magallan. Holotype: probably lost.	50mm	Magellanic Region, Antarctic Peninsula, Isla Dawson, Straits of Magallan. 35-310m.	Pawson, 1969, Deichmann, 1947
Psolus patagonicus Ekman, 1925	46°S latitud, 110m. Holotype: Museum of Hamburg.	19-30mm Presence of bioactives metabolites (Patagonicoside A)	Straits of Magallan. Puerto Eden (49°09'02"S, 74°25'10"W)Tierra del Fuego, Bahia Ensenada. Atlantic Distribution (39°27' 10"S,55°56'76"W). *Macrocystis* fronds and holdfasts. Granitic rocks. Intertidal to about 110m.	Ekman, 1925, Pawson, 1964, 1969 <u>Present study</u>

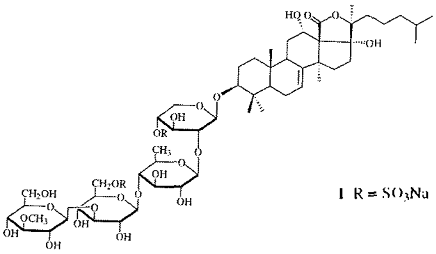

Fig. 1. The structure of the main component, Patagonicoside A, a disulfated tetrasaccharide triterpene.

General trends of phytoplankton (20-200 μm) components of the Argentine Sea and Antarctic Ocean during austral summer 2002, with emphasis on diatom species

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Microphytoplanktonic distribution patterns are known to greatly influence the distribution of other organisms, and their study is considered relevant for research fields such as biogeography, palaeoclimatology and biogeochemical cycles.

There are many previous studies about microphytoplankton of the Southern Ocean, but more extensive studies considering this phytoplankton size fraction in the Argentine Sea are required. The present research focuses on the subsurface distribution patterns of the microphytoplanktonic groups (with emphasis on diatoms) registered along an extensive transect covering the Argentine Sea south of 50°S, the Drake Passage, waters adjacent to the Antarctic Peninsula, and the Weddell Sea down to 77°S. Samples were collected aboard the Argentine icebreaker "Almte. Irizar" between 1 February and 4 March 2002.

Quantitative estimations of diatoms, silicoflagellates and dinoflagellates were based on counts under inverted microscope of 45 samples collected at 9 m water depth by means of a suction pump and subsequently filtered (180-300 l) through a 20 μm-pore net. Identifications at the specific level were made in the former two groups. A sample fraction was treated by oxidation in order to identify diatom species. The abundances were expressed in cells/l. A biogeographic zonation was performed by multivariate analysis of diatom species densities.

Along the transect temperature ranged between 12.66°C and -1.76°C and salinity between 33.44 and 34.38 P.S.U. The Polar Front was detected at 58°S.

Total phytoplankton density ranged between 19 and >778,000 cells/l. Lowest values were recorded in the Argentine Sea, in the northernmost sector of the research area (50-55°S, sites 1-10) and near the northern and southern extremes of the Weddell Sea (Fig. 1). Densities over 10,000 cells/l were recorded between the Subantarctic Front and the Polar Front (56-58 °S, sites 13-16), within the Antarctic Divergence at 62°S, 62°W (site 36), on the tip of Antarctic Peninsula at 64°S, 56°W (site 34, maximum: 778,154 cells/l), in the vicinity of Orkney Islands (76,000 cells/l) and in the Weddell Sea between 67 and 72 °S (220,000 cells/l).

highest diatom densities were found at sites 34 (>776,000 cells/l); 40; and 41 (200,000 cells/l), while dinoflagellates peaked at site 33 (14,000 cells/l) and silicoflagellates at sites 20; 25; 40; and 41 (2,000 – 4,400 cells/l).

A sharp change of the relative dominance between dinoflagellates and diatoms was observed along the transect. In the first three sites within the Argentine Sea (50-51.5 °S), dinoflagellates represented 80-90% of the total phytoplankton density, while in southern sites diatoms reached up to 95%.

High densities found in the vicinity of fronts and near the coast are presumably due to physico-chemical processes that increase concentrations of macro- and micronutrients, such as Fe. In the present study, a general north-to-south increase of phytoplanktonic density was associated with a remarkable increase in nutrients. Nitrates and silicates increased on average from 1.52 μM and 4.7 μM, respectively, in the northern sites to 10.82 μM and 32.5 μM near the Peninsula.

Grouping analysis of the samples based on the densities of diatom species resulted in two differentiated biogeographic zones:

ZONE 1, from 50 to 55°S, defined by the presence of subantarctic, antarctic and subtropical species, such as *Thalasionema nitzschioides, Coretron criophilum, Rhizosolenia calcar-avis, Fragilariopsis kerguelensis.*

ZONE 2, from 55 to 77 °S, characterized by cold water species. Four subareas were identified:

2A: subantarctic and antarctic Drake Passage waters. The presence of the Polar Front was reflected in an increase in total phytoplankton density and a shift of species composition, with dominance of *Rhizosolenia antarctica.*

2B: coastal waters surrounding the tip of the Antarctic Peninsula, defined by *Porosira glacialis* and *Chaetocerus tortissimus.*

2C: oceanic waters surrounding the Antarctic Peninsula and the northern Weddell Sea, including the south Orkney Islands, with *Chaetoceros criophilus, Chaetoceros neglectus* and *Chaetoceros socialis.*

2D: the southernmost sites in the Bellingshausen Sea and also in the Weddell Sea, with *Fragilariopsis curta, Chaetoceros dichaeta.*

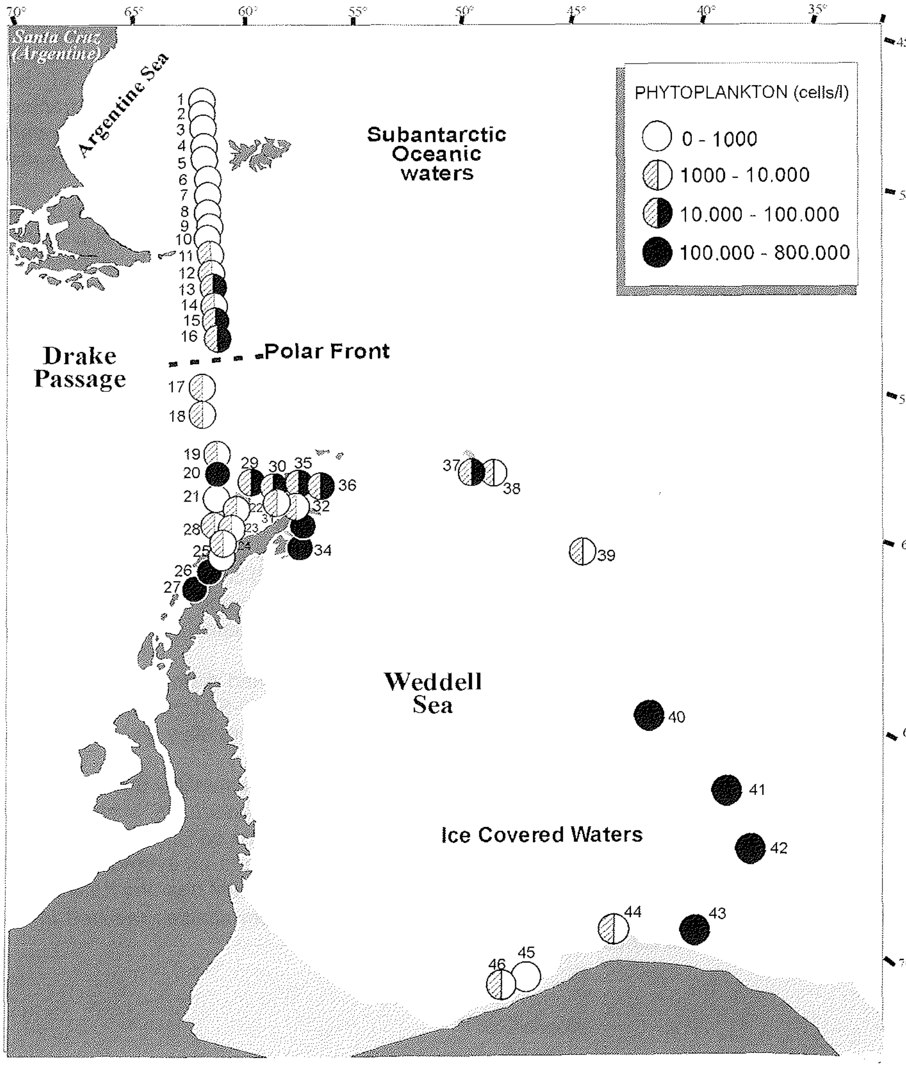

Fig. 1. Total phytoplanktonic abundance (diatoms, dinoflagellates and silicoflagellates comprised within 20-200μm) at the sites sampled during austral summer 2002.

Oceanographic features of the Sub-Antarctic and Polar Fronts in the south-western Atlantic Ocean during summer 2001

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The present work analyzes the distribution of some chemical (inorganic nutrient), physical (temperature and salinity) and biological (chlorophyll-*a*) parameters in the Sub-Antarctic Front (SAF) and the Polar Front (PF) in the South-Western Atlantic Ocean. This oceanographic information was collected during summer 2001 in the frame of a joint Argentinean-French Project (Argau I) to relate the above parameters to CO_2 dynamics, onboard the icebreaker "Almirante Irizar".

Both fronts can usually be identified surrounding the Antarctic continent, approximately between 48° and 60° S, depending on longitude. The SAF separates the Sub-Antarctic Zone from the Polar Frontal Zone, while the PF separates this last zone from the Antarctic Zone.

The area was visited on four occasions during Argau I, between January and May 2001. Data corresponding to an area 2° North and 2° South of the fronts are presented. Temperature and salinity were measured with a Seabird probe connected to a continuous sampling system, which pumped sea surface water (10 m) from the bow of the ship. Nutrient analysis was carried out on GF/F filtered seawater; the filters were frozen for chlorophyll-*a* analysis. Inorganic nutrients were analyzed by means both of an automatic analyzer (NO_3^-, NO_2^-, and SiO_3^{2-}) and in manual form (PO_4^{3-}). Chlorophyll-*a* was measured spectrophotometrically on extracts.

The four transects crossed the fronts at four different longitudes. Three different situations were found: in the easternmost transect, the SAF and the PF were clearly distinguished, while in the westernmost transects the SAF was either not encountered at all or the fronts crossed displayed mixed characteristics of both fronts (here named SAF+PF), with characteristics that could be an average of both fronts.

The SAF was identified around 49°S 50°W, with salinities changing from values >34.4 psu to <34.1 psu and 3 °C difference in surface temperature, while in the PF it was distinguished by the temperature which changed from values >1.7°C to below 0.1°C and salinity, changing from 34 psu to values below 33 psu. The SAF+PF structure was met around 57°S, with N-S changes in average values of all the parameters between both fronts. All nutrient salts analyzed showed different concentrations across the fronts, but only silicate was significantly different when the northern and southern parts of the different fronts were compared, always showing higher values in the southern part of the fronts. Chlorophyll-a mainly changed in the SAF and SAF+PF, with concentrations that changed from values <0.08μg L^{-1} to >0.35 μg L^{-1}.

Our results indicate that surface physical and chemical data may only on occasions allow to clearly identify the position of the SAF and PF in the Drake Passage area, which can merge together as happens in other areas surrounding the Antarctic Continent. On the other hand, close to 49°W both fronts are well separated and both physical and chemical parameters could act indicators of their presence.

Fig. Study areas and localization of SAF, PF and the combined SAF+PF. In continuous lines the different transects crossing the fronts during the Argau 1 campaign. Circles indicate the crossing points of the fronts identified in this study.

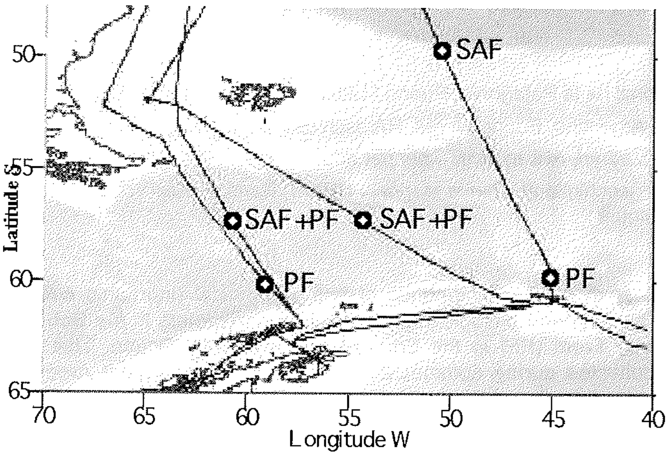

Table. Average concentrations and standard errors of means of the stations corresponding to 2° at the north and at the south of the different fronts.SAF: SubAntarctic Front; PF: Polar Front; Fr.: results of the ANOVA contrasting the different fronts as factors. N-S: results of the ANOVA contrasting the northern and southern stations. Int: results of the ANOVA for the interaction among fronts and N-S position. *: significant at $p<0.05$; **: significant at $p<0.01$

Front	**SAF**						**ANOVA**		
			PF		***SAF+PF***				
Position (N-S)	**N**	**S**	**N**	**S**	**N**	**S**	**Fr.**	**N-S**	**Int.**
Latitude (°S)	48.41	49.73	59.63	60.78	56.39	57.91			
Longitude (°W)	51.13	50.46	53.12	51.37	58.26	56.13			
Temperature (°C)	10.65	7.00	1.71	0.07	5.67	3.07	**	**	
	(0.67)	(0.67)	(0.67)	(0.65)	(0.42)	(0.41)			
Salinity (PSU)	34.46	34.10	33.96	33.38	34.05	33.78	**	**	
	(0.11)	(0.11)	(0.11)	(0.11)	(0.07)	(0.07)			
NO_3^- (μM)	11.55	20.20	24.28	25.68	23.27	18.37	**		*
	(1.18)	(1.32)	(1.86)	(1.86)	(1.32)	(1.18)			
NO_2^- (μM)	0.32	0.28	0.21	0.23	0.26	0.24			
	(0.05)	(0.05)	(0.03)	(0.04)	(0.03)	(0.03)			
$PO_4^{\equiv}$ (μM)	2.45	1.79	2.73	2.94	1.42	1.51	**		*
	(0.19)	(0.19)	(0.12)	(0.13)	(0.12)	(0.12)			
$SiO_3^{=}$ (μM)	1.60	4.74	25.94	52.75	5.44	21.02	**	*	
	(4.88)	(5.45)	(7.71)	(7.71)	(4.88)	(4.88)			
Chl.-*a* (μg/l)	0.08	0.35	0.59	0.54	0.09	0.26	*		
	(0.12)	(0.13)	(0.18)	(0.18)	(0.12)	(0.12)			

How closely related are Arctic and Antarctic benthic Foraminifera?

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Recent studies suggest that marine protists have a wide capacity for dispersal and that their geographical distribution depends on such factors as water temperature or productivity. For example, a molecular study of subpolar planktonic Foraminifera demonstrated that populations of the same morphospecies in the Northern and Southern hemispheres are genetically identical, suggesting a continuous gene flow across the tropical regions. To test whether this is also true for polar benthic protists we have compared genetically the monothalamous (i.e. single-chambered) foraminiferans collected in the Arctic (Svalbard, Greenland Sea) and the Antarctic (McMurdo Sound, Weddell Sea). Our study based on partial SSU rRNA gene sequences shows that the majority of examined morphospecies are endemic to one of the Polar regions. In the case of two species, however, Arctic and Antarctic populations possess very similar sequences, diverging by less than 1%. This suggests that the polar populations of both species were separated relatively recently. Attempts to calibrate the foraminiferan tree and to infer the divergence times of two populations are in progress.

Benthic hydroids (Cnidaria: Hydrozoa) from the South Shetland Islands and Antarctic Peninsula

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During the Spanish Antarctic expedition Bentart 95, a sampling survey of the benthic communities inhabiting the sea bottoms of Livingston and Deception islands, in the South Shetland Islands, and of Trinity Island, in the Antarctic Peninsula, was carried out. Amongst the benthic samples an important collection of hydroids was present. A total of 61 species, most of them thecate hydroids, has been recorded. Only three species of athecate hydroids are present, belonging to the families Eudendriidae and Hydractiniidae. The thecate hydroids are represented by the families Campanulinidae, Tiarannidae, Lafoeidae, Haleciidae, Halopterididae, Kirchenpaueriidae, Plumulariidae, Sertulariidae and Campanulariidae. The family Plumulariidae, represented by one species of *Nemertesia*, is recorded for the first time from Antarctic waters. Sertulariidae is by far the most diversified family with 26 species, followed by Haleciidae with ten species and Kirchenpaueriidae with six. At the generic level, the predominant genera are *Symplectoscyphus* with ten species, *Halecium* with nine, *Staurotheca* with seven and *Oswaldella* with six species.

How rich is the deep-sea Antarctic benthic hydroid fauna?

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To elucidate the richness of the deep-sea Antarctic benthic hydroid fauna at present, a study of the bathymetric distribution of the known species of benthic hydroids inhabiting the Antarctic Region has been carried out. Most of the 149 known species, even those with wide bathymetric ranges and reaching great depths, must be considered shelf species, since the Antarctic continental shelf-break occurs two to four times deeper than in other oceanic areas. Only 34 species are found below the continental shelf-break, and consequently can be considered inhabitants of the Antarctic deep-sea. Of these, only seven could strictly be considered inhabitants of that environment at present, since the remaining are eurybathic species present in the deep-sea as part of a wide bathymetric distribution.

Munida gregaria vs. *M. subrugosa* (Decapoda: Anomura): the beginning of the end of two different species?

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Despite the central importance of species and speciation to biology there is no consensus on what exactly a species is. Under the phylogenetic or evolutionary species concept, species are defined as the smallest diagnosable monophyletic group. Nevertheless, species in practice are recognized and defined by morphologic characteristics.

In the Beagle Channel, *Munida subrugosa* and *M. gregaria* constitute >50% of the benthic biomass and in terms of numbers they are the most important benthic species. The specific status of *M. gregaria* (Fabricius, 1973) and *M. subrugosa* (White, 1847) has long been discussed. Williams postulated that *M. gregaria* and *M. subrugosa* from Otago (New Zealand) are two forms - pelagic and benthic - of *a* single species. However, in the Beagle Channel both species are benthic, and specimens of similar sizes can be easily differentiated using certain morphologic characteristics.

The use of only morphology in species diagnosis has limitations. Phenotypic plasticity, phenotypic polymorphism, and cryptic speciation can hamper or mislead the identification of species. Therefore, molecular genetic techniques such as the study of DNA sequence polymorphisms can be used as a complementary approach to morphology, enabling a more accurate resolution of phylogenetic relationships.

In this study we use molecular genetic techniques to investigate the status of both species of *Munida, M. gregaria* and *M. subrugosa.* Our objectives are to study partial sequences of the mitochondrial and nuclear genomes of the material classified as *M. gregaria* and *M. subrugosa*, in order to validate morphological distinctions with molecular data.

Samples of *M. gregaria* and *M. subrugosa* from the Beagle Channel, the Strait of Magellan and the Burdwood Bank were used for this analysis. Gills were preserved in 95% EtOH. DNA was extracted using the standard digestion in CTAB lysis buffer and phenol/chloroform:isoamylalcohol protocol. Portions of three mitochondrial genes with different rhythms of evolution: 16S (417 bp), COI (566 bp) and ND1 (498 bp), as well as the nuclear ITS1 (425 bp) were amplified (Table 1). Amplification products were cycle sequenced and run in an ABI 3100 genetic analyzer (Applied Biosystems). Phylogenetic analyses were conducted in MEGA version 2.1 and in TCS 1.13.

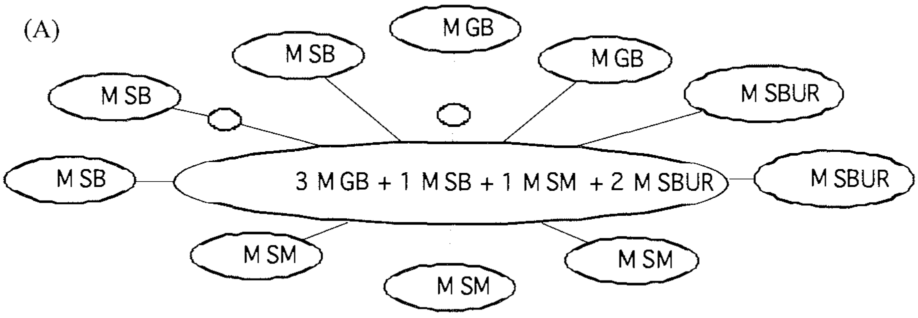
ITS1 sequences for all *M. gregaria* and *M. subrugosa* individuals were identical, and showed only one transition when compared to the *M. subrugosa* sequence found in GenBank (Accession Number: AF439382). The same results were obtained for 16S (GenBank Accession Number: AY050075). COI and ND1 showed 12 and 15 variable sites, respectively; although none of these differences were parsimony informative.

Average interspecific Tamura-Nei distances between *M. gregaria* and *M. subrugosa* were 0.240 ± 0.077% and 0.396 ± 0.112% for COI and ND1, respectively; and were not significantly different from intraspecific distances (Kruskal-Wallis test: p=0.49 and p=0.97, for COI and ND1 respectively). Statistic parsimony networks (Figure 1) for both COI and ND1 showed a star-like shape, compatible with a recent population expansion. No correspondence with geographical location or morphology was apparent.

Overall, the molecular genetic analyses carried out in this study found no genetic differences to validate the phenotypic differentiation of individuals of *M. gregaria* and *M. subrugosa* in two different species. Two alternative explanations can be given for our findings. Either the molecular markers used in this study don't have adequate resolution to detect a recent speciation event; or we are dealing with two morphological forms rather than two different species.

Table 1. List of taxa, collection sites, and sequences obtained.

Species	Collection locality	Number of specimens sequenced			
		16S	COI	ND1	ITS1
Munida gregaria	Beagle Channel	3	5	4	4
Munida subrugosa	Beagle Channel	3	4	4	4
Munida subrugosa	Straits of Magellan	5	4	4	3
Munida subrugosa	Burdwood Bank	4	4	3	8



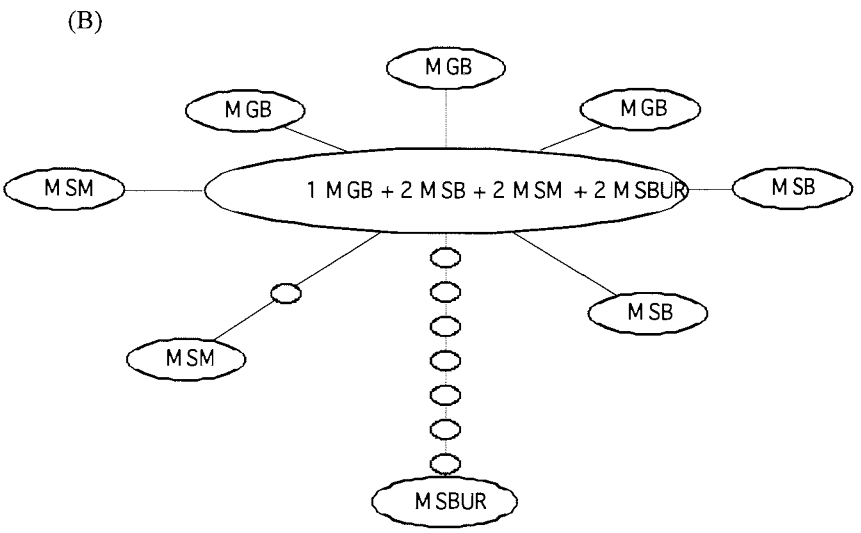


Fig. 1. Statistic parsimony networks for: (A) COI and (B) ND1 sequences. MGB: *M. gregaria* from the Beagle Channel, MSB: *M. subrugosa* from the Beagle Channel, MSM: *M. subrugosa* from the Strait of Magellan, MSBUR: *M. subrugosa* from the Burwood Bank.

Long-lived filter-feeder communities off the Scotia Arc islands, living witnesses to a continental rupture: An eco-geological approach

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The Scotia Arc is a series of trenches and elevations spread between the southern tip of South America and the Antarctic Peninsula, ranging over more than 1500 km (Acosta *et al.*, 1989). Although its geological history has yet to be definitively established, this zone is particularly important for understanding the history of the Southern Ocean's marine fauna (Clarke and Crame, 1989).

It is known that during the Early Cretaceous (130 Ma), the Scotia Arc islands, except for South Sandwich, formed part of a complex that linked southern South America with the Antarctic Peninsula. Although it is not clear whether this system was a true gateway or only a structure of islands linked by shallow shelves, there are several established evolutionary facts:

- Before the break-up, the South Georgia shelf remained directly linked to the South American continent immediately south of Estados Island and east of Cape Horn. After that, the island groups moved eastward—along a fault transformant system during the formation process of Scotia Arc—to their present position (Headland, 1984).
- The South Orkneys shelf was attached to the Antarctic Peninsula (Dalziel, 1983; Headland, 1984). Even though its position, on the whole, remains uncertain, its platform was then located south and east of Elephant Island, and most likely rotated away from the tip of the Antarctic Peninsula in a clockwise direction.

- Fossil foraminifera fauna of the western Orkneys' shelf are very similar to those off South Georgia (Mateu, 1989), which indicates that the archipelagos were closer.
- The South Sandwich were not part of the oldest continental mass that linked America and Antarctica because these islands developed much later, only 4 m.y. ago (Acosta *et al.,* 1989); as did the Bransfield Strait, which separated the South Shetlands from the Antarctic Peninsula.

The 'Antártida-8611' expedition enabled us to confirm that, at least in 1986-87, the most genuine components of the high Antarctic epibenthos, the rich communities of sessile filter-feeders, were spread throughout the Scotia Arc archipelagos. Large and abundant specimens of long-lived sponges, calcareous bryozoans and serpulids, were collected on the Clerke Rocks shelf, east of South Georgia Island; north of Laurie and Coronation Islands, and south of Signy Island, in the South Orkneys; and north-east of King George Island, in the South Shetlands (Ramos and Sobrino, 1991; Ramos and San Martin, 1998; Ramos, 1999).

Although these assemblages do not seem to have reached north-west Georgia Island, the South Sandwich and the Shag Rocks, their presence off northern Scotia Arc islands would show that some privileged areas exist that may reproduce environmental conditions of some habitats of the high Antarctic. The 'Antártida-8611' data show that these large sponge communities are mainly located at depths of 100 - 300 m, on hard bottoms and in areas with high primary productivity.

If the we accept the hypothesis that the current oceanographic situation, given the convergence barrier, added to the limited dispersal ability of many life forms, it is likely that exchange through the Scotia Arc islands was very slow (Clarke and Crame, 1989),.The finding of these communities at such 'northerly' latitudes would add an exciting series of questions to the already fascinating geological history of Scotia Arc:

- What could be the origin of these species assemblages in such remote areas?
- If it is accepted that most of the Antarctic benthic fauna is very old, originating from propagules that moved with the continents (Picken, 1985; Dayton, 1990), have these fauna remained isolated since the Cretaceous on the island shelves of Scotia Arc, and experienced *in situ* the dangerous evolution of this area?
- Could this fauna be a relic, present in the Scotia Arc islands before the opening of Drake Passage?
- As living fossils, were they witness to a continental rupture?

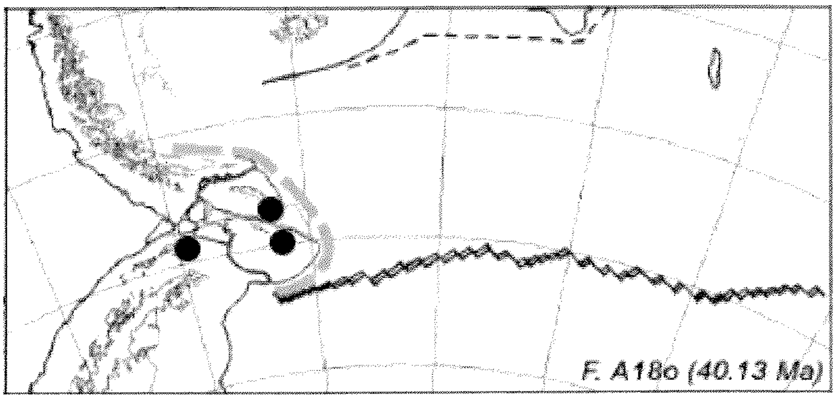
It is still more intriguing that these characteristic suspension-feeder communities are absent in the South Shetlands (Gallardo, 1992; Jazdzewski *et al.*, 1986; Sáiz-Salinas *et al.*, 1997; Arnaud *et al.*, 1998), except for their northeast area (Ramos, 1999), in the Bransfield Strait, and in the recently explored Bellingshausen Sea (Ramos *et al.*, this Symposium).

In light of more recent knowledge regarding the geology and geophysical marine conditions in this zone, the authors propose several hypotheses:

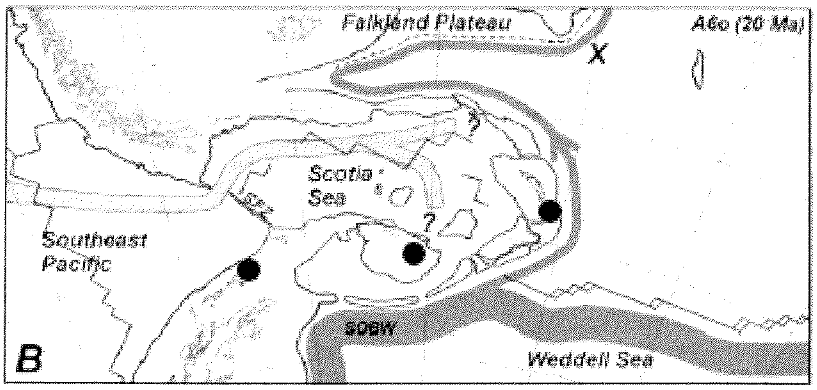
1. The dense suspension-feeder communities off the Scotia Arc islands (Georgia, Orkneys, Elephant, and Shetlands) are relics, and have existed on these shelves since, at least, the Cretaceous period.
2. The present-day location of these assemblages could be related to the original position that the islands' platform occupied within the ancient structure, which linked South America with western Antarctica, before the Drake opening.
3. It is possible, if highly hypothetical, that being located on one or the other side of the ancient gateway (present Atlantic or Pacific) was decisive for the establishment, or not, of this fauna.

Taking into account the reconstruction of the southern continents during the Cretaceous (Crame, 1999), these hypotheses would explain the existence of these three-dimensional suspension-feeder assemblages in the Weddell and Ross Seas, and in certain areas off the Scotia Arc islands, as well as their absence off western Antarctica and other zones off the Shetlands, Orkneys and South Georgia.

The current distribution of these communities, isolated in different continental blocks, has depended of the continental rupture evolution and not on the resultant climatic changes or of circumantartic current development; besides, being witness to this geological evolution, they would be also an indicator for reconstruction of the oriental coast of the ancient link between South America and Antarctica.



a)



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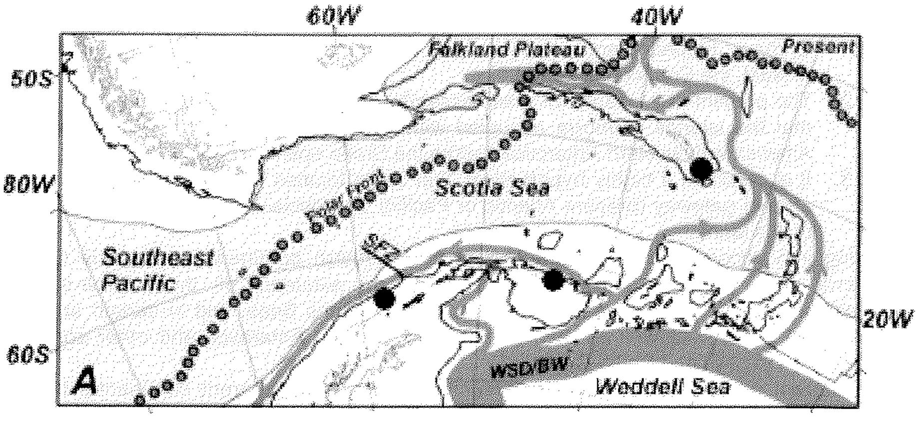

c)

Fig. 1. (previous page) Geological evolution of the Scotia Sea region and possible location of filter-feeder communities. a: 40 M.a.; b: 20 M.a.; c: present-day. In b and c schematic diagram of ocean circulation. From Barker (2001).

Zoogeographical relationships between the ascidiofauna of the Scotia Arc, the Antarctic Islands (Western Antarctica) and the Magellan region

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Abstract

The ascidians (Chordata: Urchordata) represent an excellent taxon for the study of zoogeographic relationships, with a high percentage of endemisms. The sessile adult phase and the short pelagic larval life stage (including a lecithotrophic mode of development) involve a very localised distribution. The present work analyses the zoogeographic relationships of the ascidiofauna from the islands of the Scotia Arc, the Antarctic Peninsula (South Shetland Islands), and the Magellan region. The material resulted from trawl sampling and dredging, as well as from SCUBA diving. Sampling was carried out during the Spanish cruises Ant'86, Bentart'94 and Bentart'95, between 0-800m water depth, including hard and soft bottoms.

Distribution of *Isodictya* (Porifera, Poecilosclerida) in both sides of Drake Passage

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Isodictya (Family: Isodictyidae Dendy, 1924) represents a genus rich in number of species and with wide geographic distribution and ecological radiation. Species of *Isodictya* are characterized by flabellate or digitate erect growth forms, a choanosomal skeleton reticulate or plumoreticulate; megascleres are mostly diactinal, usually oxas; microscleres palmate isochelae, frequently with plate-like inner extensions of the falxes. The large size of most specimens provides a special habitat for colonization by other organisms, such as pycnogonids, ophiuroids and crustaceans.

A large number of species has been found around the world; endemisms are frequent and only a few species have been found in different regions. It has been the focus of some different assignments in the poriferan classification. In the recent Systema Porifera, Hajdu & Lôbo-Hajdu (2002) included this family in Suborder Mycalina with the other valid genus *Coelocarteria*.

Desqueyroux & Moyano (1987) selected 92 species for a primary zoogeographic study of Chilean Demospongiae, but no *Isodictya* and Desqueyroux-Faundez (1975, 1989) mentioned three species from Antarctica. Sará et al, (1992) studied the biogeography of Antarctic Demosponges with 11 *Isodictya* in their checklist.

Specimens of this genus collected in three Spanish Antarctic expeditions (Bentart 94, Bentart 95 and Bentart 2003) from the Antarctic Peninsula and Bellingshausen Sea are included in this work.

The aim of the present study is to examine the composition of *Isodictya* fauna existing in both regions of the Drake Passage and to discover whether these species have distinct geographic distribution patterns.

Sagartiogeton antarcticus Carlgren, 1928: redescription of a deep-sea Antarctic sea-anemone, with a discussion on its familiar and generic placement

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Sagartiogeton antarcticus Carlgren, 1928, is an Antarctic deep-sea species of sea anemone only known from its holotype. Since it was described, its generic position has been changing between the genera *Sagartiogeton* and *Kadosactis,* and recent studies even placed this species in a new family. During the R/V Polarstern ANT XIX/3 (ANDEEP-I) cruise to the Scotia Sea and off the South Shetland Islands (Antarctica) 10 specimens of this deep-sea species were collected. This new material has allowed further insights into the familiar and generic placement of the species, including the redescription of this species in order to establish the variability of the characteristics currently used in sea anemone taxonomy. Furthermore, these new data enlarge the known distribution of the species.

Oxygen consumption associated with feeding habits of *Munida subrugosa* (Crustacea, Decapoda) in the Beagle Channel

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In the Beagle Channel *Munida subrugosa* constitutes up to 50% of the benthic biomass and 85% of the density of anomuran and brachyuran crabs. This species represents an interesting case study because it has two different and simultaneous feeding habits: predator, chasing prey, and deposit feeder, gathering particulate organic matter by sweeping the benthic surface layer. In the majority of studies of decapods, metabolism, indicated by oxygen consumption, increases with both temperature and animal size. However, there is only scarce information available about oxygen consumption of decapods related to their feeding habits. The objective of this work was to determine the basal metabolism of *M. subrugosa* at 8°C, and the oxygen consumption with each feeding habit.

Animals were caught in the Beagle Channel with an epibenthic trawl at <40 m depth. A subsample of 20 females and 20 males was randomly selected and transported to the laboratory. The mean carapace lengths (CL) were 21.6 ± 1.1 and 23 ± 1.9 mm, for females and males respectively. The oxygen consumption was measured with an oximeter of polarographic electrodes (Clarke type). Animals were placed in individual respiration chambers of volume 490 ml, at 8 ± 1°C. Two kinds of food were offered: isopods (CRU) and pulverized fish-food (ABP), to reproduce the predator and deposit feeder feeding habits, respectively.

The basal metabolism is the minimum of energy consumption needed for maintainance, without considering muscle activity or processes such as feeding or food digestion. The basal metabolism of *M. subrugosa* was obtained 25.8 ± 5.0 h after animal manipulation. The basal metabolism was similar for females and males (t-Student, t= 0.65, n= 20, p= 0.26), at 14.4 ± 3.8 and 15.4 ± 5.9 $\mu lO_2 \cdot h^{-1} \cdot g^{-1}$, respectively. The oxygen consumption for females and males of *M. subrugosa* under stress conditions after manipulation was similar (t-Student, t= -1.03, n= 20, p= 0.16), at 35.8 ± 10.8 and 32.0 ± 11.2 $\mu lO_2 \cdot h^{-1} \cdot g^{-1}$, respectively.

The oxygen consumption significatively increased (t-Student, t= -12.9, n= 40, p< 0.001) when *M. subrugosa* assimilated food. The maximum values of oxygen consumption were similar for both types of feeding habits (ANOVA, F= 1.55, p= 0.22) but different between sexes (ANOVA, F= 5.1, p= 0.03). Females consumed less oxygen per unit time to assimilate both food types than males (Table 1). Nevertheless, there was no statistical interaction in the maximum oxygen consumption between food and sexes (ANOVA, F= 1.92, p= 0.18).

The total oxygen consumed by *M. subrugosa* under both feeding habits was similar (ANOVA, F= 3.97, p= 0.054), but females and males consumed more oxygen to assimilate CRU than ABP (Table 1). Differences in the total oxygen consumed appeared between sexes (ANOVA, F= 23.91, p< 0.0001). Females consumed less oxygen to assimilate either food than males (Table 1). Nevertheless, there was no statistical interaction in the total oxygen consumed between food and sexes (ANOVA, F= 0.45, p= 0.51).

On average, the basal metabolism of *M. subrugosa* was 14.9 ± 4.9 $\mu l\_h^{-1} \cdot g^{-1}$. The oxygen consumption increased significantly after feeding or stress manipulation. The increase in oxygen consumption and the total of oxygen consumed to assimilate food as a predator or as a deposit feeder were similar, but females consumed less oxygen than males. Therefore, the female energetic cost of feeding is lower than that of males. This would be advantageous because the more energy economy in food assimilation, the more energy assigned to other processes like reproduction.

	CRU		ABP	
	Females	Males	Females	Males
Maximum oxygen consumption	21.2 ± 3.6	39.3 ±10.0	29.2 ±1.3	31.9 ± 8.7
Total oxygen consumption	318.2 ± 98.5	520.0 ±183.3	190.6 ± 122.4	456.9 ± 182.7

Table 1. *Munida subrugosa.* Maximum values ± 1 SD of oxygen consumption ($\mu lO_2 \cdot h^{-1} \cdot g^{-1}$) and total oxygen consumption ($\mu lO_2 \cdot g^{-1}$) after feeding. Diet CRU (isopods) and diet ABP (pulverized food fish) represent a predator or a deposit feeder habits, respectively.

Benthic invertebrates by-catch of demersal fisheries: a comparison between Subantarctic and Antarctic shelf waters (45°S-57°S)

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Introduction

Subantarctic and Antarctic demersal fish stocks have been intensively exploited during the last twenty-five years. Target species in the Argentinean continental shelf are mainly *Macruronus magellanicus*, *Merluccius australis*, *Micromesistius australis*, *Genypterus blacodes* and *Salilota australis*, while around Shag Rocks and on the South Georgia shelves are *Notothenia rossii*, *Champsocephalus gunnari* and *Dissostichus eleginoides*, among others. It is well documented that trawling activities can affect benthic communities by removing or injuring living organisms in the path of the gear or by digging into the sediment, affecting both the epifauna and the infauna. In a fisheries context, the objective of the benthic by-catch sampling is to characterize different fishing grounds and to recognize possible effects of trawling.

The information obtained about invertebrate by-catch, during four cruises carried out by INIDEP and one INIDEP-IAA joint cruise aimed at the assessment of fish stocks, is used here to identify possible relations between the Argentinean continental shelf -Subantarctic Region, and the north-east area of the Scotia Arc – the Antarctic Region - and to determine whether transitional zones – gradual or abrupt - are present, through the analysis of community structure (distribution, composition, feeding guilds). This is the first analysis of a benthos database which includes more than 300 stations distributed between 45°S and 57°S, sampled between 1992 and 1994.

Materials and methods

Invertebrate by-catch was obtained during the cruises EH-01/92, EH-03/92, EH-09/92, OB-06/93 (INIDEP, R/V "Dr. Eduardo Holmberg", R/V "Cap. Oca Balda") and EH-02/94 (INIDEP-IAA, R/V "Dr. Eduardo Holmberg"). 325 fishing hauls (Figure 1) were carried out with an Engel net (24 mm cod-end mesh, 18-22 meters mouth width, 3.5-4 knots trawling speed, 15 minutes duration). The depth range was 45-306 metres. The area swept per haul was nearly 0.015 nm^2.

The invertebrate fractions obtained incidentally during the fishing hauls were sorted and identified on board. The spatial distribution of macrobenthos by-catch assemblages, as a part of the benthic community, is described using PRIMER 5.2 applying cluster analysis to presence-absence data. Total wet weight of macrobenthos, number of species and maximum dominance in terms of weight were estimated for each station. Feeding habits of species were taken from the literature.

Results

Macrobenthos by-catch was present in 220 (70%) of the hauls. A total of 11 phyla and 151 taxa were identified throughout the study, corresponding 85 taxa (11 phyla) from the Argentinean continental shelf (ACS) and 82 taxa (8 phyla) from Shag Rocks and the South Georgia shelves (SR-SGS). Echinodermata and Porifera were the most diverse groups, with similar numbers of species, nearly 30 and 20, respectively, followed by 9 species of Coelenterata in both study areas. In ACS, Mollusca and Crustacea were represented by 9 species each, while in SR-SGS these groups was represented by a few species. Brachiopoda, Bryozoa and Nemertea were only collected from the ACS.

In the ACS, carnivore species made up 46%, suspensivores 41%, deposit feeders 11% and herbivores 2% of the total fauna recorded, while in SR-SGS suspensivores were the most abundant species representing 47% of all species found, followed by carnivores 34%, deposit feeders 13%, and herbivores 5%.

Cluster analysis showed two well-defined macrobenthos assemblages. One of them corresponds to the Magellan Region and the other to the Antarctic Region, both characterized by representative species. Different subgroups were also identified in the ACS, considering latitude, depth and water mass movements.

In the ACS, the mean biomass of by-catch per haul reached 5,42 kg (by-catch total weight = 1195 kg) ranging between 0,08 kg and 211 kg. The number of species per haul varied between 1 and 17. *Gorgonocephalus chilensis, Tedania* sp.1 and colonial Ascidiacea 4 were the most frequent species in this area.

In SR-SGS the mean weight of by-catch per haul reached 10,5 kg (by-catch total weight = 672 kg) ranging between 0,3 kg and 50 kg. The number of species per haul varied between 2 and 27. *Astrotoma agassizii, Ctenocidaris speciosa* and *Labidiaster anulatus* were the most frequent species in this area.

Discussion

These results refer to a fraction of the macrobenthos communities in the study area; the invertebrate species that constitute the by-catch of demersal fisheries. Consequently, many other smaller species are not included in this analysis. However, we consider the whole database as representative for our objectives.

The present study shows a clear difference between the composition of fauna collected in demersal fishing grounds during 1992-94 in the ACS and SR-SGS. This information can be completed to include the northern sector of the Scotia Arc by considering the benthic fauna sampling carried out with similar gear (GSN) and AGT trawls during ANT XIX/5 LAMPOS in 2002. In this area, representative species of both biogeographical regions were found, i.e: *Munida subrugosa, Diplasterias brandti* and *Labidiaster radiosus* (characteristic fauna of the Magellan Region); *Astrotoma agassizii, Sterechinus neumayeri,Diplasterias brucei* and *Labidiaster anulatus* (characteristic fauna of the Antarctic Region), among others. On the other hand, other species are widely distributed and were collected in the ACS, SR-SGS and the northern sector of the Scotia Arc, i.e: *Magellania venosa, Lithodes confundens, Ophiacantha vivipara, Thouorella* spp., *Rosella recovitzae* and *Ophiuroglypha lymani*, among others.

Our observations, coinciding with previous studies and preliminary results of ANT XIX/5 LAMPOS, show that the northern sector of the Scotia Arc seems to represent a transitional area, with faunistic influence from both biogeographical regions. Some magellanic species reach South Georgia, and southwards, following the Arc, mainly Antarctic species are found. Only a few Antarctic species reach the southern sector of the Magellan Region in the ACS.

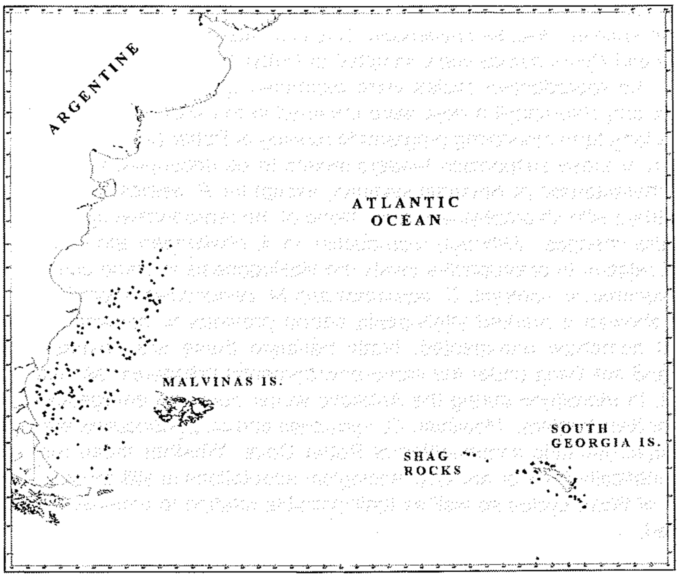

Fig. 1. Location of the sampling stations on the Argentine Continental Shelf, Shag Rocks and South Georgia.

Reproductive seasonality of five Antarctic ascidian species at Potter Cove, South Shetland Islands

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Primary production pulses and temperature have been identified as being among the most important factors in determine reproduction traits, especially in benthic fauna. Although temperature changes are slight over the year it has been argued that, due to the evolutionary history of Antarctic organisms, even such variations are detectable and could regulate reproductive cycles. On the other hand, the strong seasonal nature of energy input to the system has also been identified as the driving force behind all seasonal processes in the Southern Ocean, particularly important in organisms situated in the first levels of the food chain. It has also been suggested that different development strategies would determine reproductive cycles in benthic organisms. Thus, reproduction in animals with planktotrophic larvae should be coupled to primary production pulses, while those with lecithotrophic larvae or direct development should be independent of these pulses and can reproduce aseasonally.

Ascidians are common members of the Antarctic benthic communities and reproduce via lecithotrophic larvae. This study intends to answer the question whether reproduction of ascidians at Potter Cove is continuous, as can be expected from the lecithotrophic nature of ascidian larvae and/or the low annual temperature amplitude, or whether it is limited to the summer, as would be expected from the distinct seasonality in primary production.

Five ascidian species, *Ascidia challengeri*, *Cnemidocarpa verrucosa*, *Corella eumyota*, *Molgula pedunculata* and *Pyura setosa* were sampled at Potter Cove over a ca 15 month period during 1996/1997. The reproductive cycles were examined by histological analysis of the gonads. Temperature and chlorophyll-a data were obtained in the water column between 20 and 30 m depth from a long term monitoring programme running at Potter Cove.

Reproduction of these suspension feeders seems to be decoupled from the pulses of primary production characteristic of Antarctic systems, except for *P. setosa* which showed reproductive peaks coincident with chlorophyll-a pulses. None of the reproductive cycles studied were related to temperature changes. Although reproduction in *A. challengeri* and *C. eumyota* did not show a significant relation to chlorophyll-a levels the vitellogenesis in these species took place during the austral summer. In contrast, *C. verrucosa* and *M. pedunculata* reproduced during the austral winter and showed a marked vitellogenic period previous to spawning. These results were striking and somehow unexpected, firstly because these are phylogenetically very close organisms and are living under the same environmental pressures, secondly because, at least at first sight, to reproduce during the Antarctic winter could be energetically disadvantageous, especially for filter feeders. However, *C. verrucosa* and *M. pedunculata* are two of the dominant species of macrobenthic communities at Potter Cove. Whether these reproduction strategies are phyllogenetically fixed or are local ecological adaptations is still an open question. Energetic implications of these cycles as well as their possible relation to small-scale distribution patterns are discussed.

Effects of solar ultraviolet-B radiation on coastal ecosystems (marine plankton and salt – marsh vegetation) in Tierra del Fuego and Antarctica (Argentina)

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The influence of ozone depletion and increased levels of ultraviolet-B radiation (UV-B) on phytoplankton, icthyoplankton and salt marsh vegetation in subantarctic coastal ambients and the Antarctic Peninsula have been studied since 1997.

We have addressed two general problems: a) fluctuations in UV-B levels under the Antarctic "ozone hole" and the related stationary waves on south Patagonia and b) what are the long-term effects of UV solar radiation on the coastal marine ecosystems.

We will provide an overview of progress of our research, explaining the methodology used and preliminary results obtained.

As regards radiation data at ground level we have found that the UV-A and PAR radiation were not affected by changing levels of ozone concentration and that the opposite occurred with UV-B radiation. Highest UV-B doses at ground level were registered during December and January; highly significant decreases in the ozone levels (50%) were recorded over Ushuaia in some austral spring days.

In the Beagle Channel, since spring 1995, phytoplankton photosynthesis inhibition was significantly higher ($p<0.05$) under decreased ozone levels. The relative amount of 8 um diameter centric diatomea, located in the Beagle Channel, also decreased when exposed to UV-B radiation. Furthermore it was observed that the growth rate of Skeletonema species (in sub-Antarctic waters) and Thalasiossira species (in Antarctic waters) was lower when exposed to UV-B radiation.

There was a higher (100%) concentration of sunscreen mycosprine-like amino acid (MAAs) in the Antarctic phytoplankton than in the Beagle Channel.

With respect to icthyoplankton, when Patagonotothem tesellata larvae were exposed to UV-B radiation, the mortality rate was very high.

On perennial Salicornia salt-marshes, a minor number of live shoots, a greater number of dead shoots, less biomass weight and an increase of pigment contents and cuticle thickness were produced by the inhibitory effects of natural UV-B radiation.

Reproductive output of *Munida subrugosa* (Decapoda: Anomura) from two localities of the Sub-Antarctic Magellan region: a latitudinal comparison

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The relationship between the reproductive strategy and the latitudinal habitat of invertebrates has been a subject of many studies. A shortened larval development and reduction in egg numbers with an increase in both larvae and egg-size with latitude was shown for several taxonomic groups, such as decapods, echinoderms and prosobranch molluscs. Differences in egg size likely reflect differences in maternal investment per embryo because a significant relationship between egg dimension and nutrients has been observed. Thus, reproductive patterns would serve as an ecological rule for adaptations at low temperatures and to seasonally pulsed food input at higher latitudes. However, these adaptations were mainly shown in taxonomically–related species, and the possible inter-specific variability was not considered as a bias factor. Therefore, the galatheid crab *Munida subrugosa*, with a geographical distribution range of 20° of latitude, was selected for a latitudinal comparison on fecundity, reproductive output, and size and organic matter of eggs.

During July 2001, samples of ovigerous female crabs were caught with an epibenthic trawl in the Beagle Channel (54° 52'S, 68° 15'W) and Golfo San Jorge (47° 50'S, 67° 50'W). After sampling, all crabs were immediately fixed in 6% buffered formaline seawater. In the laboratory, the carapace length (CL) was measured with a digital caliper. Fecundity – indicated by the number of eggs per brood– was determined, and the diameters of 15 eggs per female were measured. Egg clutches and individuals were dried at 55°C and combusted at 550°C. The organic matter of egg-clutches and crabs were calculated as the difference between ash and dry masses. The reproductive output (RO) was determined as the ratio between the organic matter of the brood and the female. Since fecundity, egg diameters, and mass and organic matter of eggs may change during the embryonic development, ovigerous females were selected to have clutches at the same stage of development (eggs recently extruded, uniform yolk and no ocular pigment visible).

Fecundity of *M. subrugosa* was positively correlated with crab size, and similar in both sampling locations: the Beagle Channel and Golfo San Jorge (ANCOVA test; $P_{Slope}=0.115$; $P_{Ordinate}=0.928$). However, eggs produced by *M. subrugosa* in the Beagle Channel were significantly larger (Student's t-test; $P<<0.01$) and of higher organic matter content than those produced in the Golfo San Jorge (Student's t-test; $P=0.014$). Finally, the RO also correlated positively with crab size, and was higher in the Beagle Channel than in the Golfo San Jorge (ANCOVA test; $P_{Slope}=0.629$; $P_{Ordinate}<0.001$).

Notwithstanding the similar fecundities of the two populations of *M. subrugosa*, our results reinforce the hypothesis of increasing egg size and organic matter towards high latitudes. Our results indicate that the reproductive investment of *M. subrugosa* increases with latitude because the RO was higher in the Beagle Channel. Consequently, we hypothesize that larval survival at high latitudes, where food availability is limited to short periods, should increase due to higher energetic contents of eggs.

No longer the last frontier: discovery of the North Atlantic spider crab *Hyas araneus* (Linnaeus, 1758) in the Antarctic Peninsula.

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The Southern Ocean around Antarctica is no longer free of invasive marine species. The North Atlantic spider crab *Hyas araneus* (Linnaeus, 1758) (Crustacea: Decapoda: Majidae) is here recorded for the first time from the Antarctic Peninsula. Isolated for at least 25 million years, the endemic Antarctic Southern Ocean marine fauna is now being exposed to human-mediated influx of exotic species. Unrestricted transportation of invasive species and polar warming combined can foster the probability of arrival and colonisation by non-indigenous species, with unpredictable consequences for the Antarctic marine biota.

Influence of temperature and diet on the postprandial increase of the metabolic rate of *Harpagifer bispinis*

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Activity patterns, specific ecological habits and environmental temperature determine the metabolic rate of poikilotherms. Subantarctic fish such as *Harpagifer bispinis* are subject to wide variations in temperature and daylight hours throughout the year and would be expected to exhibit changes in their activity patterns. This study analyses the influence of temperature on Gastric Evacuation Time (GET) and the increase of the metabolic rate after a feed in this species.

Specimens of *Harpagifer bispinis* (mean total length: 76.9 ± 8.5 mm; mean body mass: 6.1 ± 1.6 g) captured in the area of Bahía Ushuaia were kept in individual plastic containers submerged in a controlled temperature tank. The fish were distributed in two groups, fed with amphipods and isopods, respectively. The calorific content, water content and ash content of amphipods and isopods, similar to those used as food, was determined. Oxygen consumption was determined using a Clark-type polarographic oximeter cell. After ten days of acclimatisation at 10°C, when the fish showed stable oxygen consumption, interpreted as routine consumption (VO_{2R}), they were fed and oxygen consumption was determined periodically until routine levels were reached. The temperature of the aquaria was then lowered at a rate of 1°C per day to reach 4°C when VO_{2R} was measured once more. Once the values stabilised the fish were fed and oxygen consumption levels were measured again. This procedure was repeated at 2°C. In other fish gastric evacuation time (GET) was determined for each diet (amphipods and isopods), following the same acclimation program as that used for the oxygen consumption experiment.

After feeding the fish at each experimental temperature, the oxygen consumption (VO_{2M}) increase doubled the resting values (VO_{2R}).

After feeding with isopods the specific dynamic action (SDA) remained high for 81-178 hours. When amphipods were used, the levels remained high for 64-79 hours. Sham feeding procedures maintained routine metabolic rates.

Gastric evacuation time (GET) for *Harpagifer bispinis* was significantly shorter at higher temperatures, lasting approximately 4 days for both food types at 10°C. At 2 and 4°C the GET lengthened to approximately 8 days in fish fed with amphipods and 12-14 days in fish fed with isopods.

Feeding produced an increase in oxygen consumption at all experimental temperatures with both food types for this species. However, at lower experimental temperatures the proportion of energy used (SDA coefficient = (Energy equivalent SDA (kJ) / Energy ingested (kJ)) x 100) for both food types fell.

SDA Energy values and SDA Time were lower in fish fed amphipods as compared to those fed isopods. This could be due to the higher content of ash and the lower energetic content of the latter. The VO_{2R} of *H. bispinis* was lower than that of other Antarctic notothenioids with similar lifestyles.

Table 1. Feeding metabolism of *H. bispinis* (Means ± SD). Alive Mass of fish: Isopod group: 6.32 ± 0.55 g; Amphipod group 5.68 ± 1.55 (g). Te: Experimental temperature. VO_{2R}: O_2 resting consumption (mg/h). VO_{2M}: maximum O_2 consumption after feeding. %M eaten: amount of food eaten as % fish body. SDA Time: time between feeding and the return of metabolic rate to routine values (h). Energy ingested: caloric value of each alimentary item plus quantity of dried food taken. SDA Energy: Energy used during SDA = caloric equivalent of additional oxygen consumed as result of feeding (kJ); SDA Coefficient: ((SDA Energy (kJ) / Energy ingested (kJ)) x 100.

Food Item	TE	VO_{2R}	VO_{2M}	% M eaten	SDA Time (h)	Energy Ingested	SDA Energy (kJ)	SDA Coefficient
Isopods	10	0.18 ± 0.04	0.49 ± 0.11	3.80 ± 0.85	81 ± 3	1.40 ± 0.43	0.28 ± 0.06	20.5± 2.4
	4	0.08 ± 0.01	0.22 ± 0.04	6.53 ± 1.32	186 ± 19	2.38 ± 0.46	0.29 ± 0.06	12.2 ± 0.7
	2	0.07 ± 0.02	0.16 ± 0.04	5.51 ± 1.26	178 ± 54	2.03 ± 0.58	0.19 ± 0.07	10.1 ± 4.8
Amphipods	10	0.27 ± 0.06	0.47 ± 0.12	4.44 ± 1.95	57 ± 20	1.67 ± 0.74	0.18 ± 0.057	14.6 ± 6.5
	4	0.09 ± 0.03	0.21 ± 0.03	6.79 ± 1.79	56 ± 40	1.81 ± 0.86	0.09 ± 0.07	8.2 ± 6.7
	2	0.04 ± 0.02	0.08 ± 0.05	4.14 ± 1.02	76 ± 29	1.86 ± 0.55	0.06 ± 0.04	2.9 ± 1.5

Energy content and reproduction of Antarctic fish from the Scotia Arc

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Low temperatures and highly seasonal productivity, both characteristics of the Antarctic marine environment, influence the energy budget of Antarctic fish and their reproductive timing.

This study analyses the histological characteristics of gonads and the energy contents of muscle, liver and gonads of several species of Notothenioids. Previous studies on this subject are scarce and most reproductive studies have been limited to macroscopic descriptions of gonads.

The fish used in this research were collected during the LAMPOS survey in April 2001. Testes and ovaries were staged following histological maturity criteria and oocyte frequency diameters and fecundity values were estimated. The calorific value (kJ/g) of the axial muscle, liver and gonads were determined using a microcalorimetric bomb.

The gonads from both sexes of *Dissosticus eleginoides* and *Pseudochaenichthys georgianus* were immature as the specimens collected had not reached first maturation size. Ovaries obtained from *Chaenocephalus aceratus* and *Gobionotothen giberifrons* showed yolked oocytes

(secondary advanced vitellogenesis) and most of the specimens had a considerable amount of atretic oocytes. The testes of the latter species showed a large number of spermatocyte cysts. *Lepidonotothen larseni* ovaries were found to be in secondary advanced vitellogenesis. *Champsocephalus gunnari* ovaries contained totally mature oocytes while the testes were practically all completely mature. Smaller specimens of *Lepidonotothen kempi* had gonads in an advanced state of maturation, while the larger specimens showed histological characteristics typical of postspawning. Fresh postovulatory follicles, corresponding to recent spawning, were present in *Chionodracus rastrospinosus.* A mature female of this species was also found.
Nototeniidae fecundity is notoriously superior to that of *Channichthyidae.*
In the different species the liver energy content (kJ/g) reached the highest levels, followed by the gonads and axial muscle. Energy content values for axial muscle of the different species were the same except for *Dissosticus eleginoides* which reached values 20% above average. *Chionodracus rastrospinosus* and *Pseudochaenichthys georgianus* livers showed the highest values of energy content. *Gobionotothen giberifrons* liver energy content values were significantly higher in specimens from the northern stations as compared to those from southern stations.
Few comparative studies have analysed Southern Ocean fish species for calorific content and none have compared the values obtained from different organs in each species. The variability expressed in these results indicates the need to continue these studies including a larger amount of specimens and species.

The depositional environment in the Scotia/Weddell Sea and off the Northern Peninsula: Overview of benthic environmental data gathered from LAMPOS-ANDEEP

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Many zoobenthic studies can only properly be understood with background sedimentary data. During LAMPOS and ANDEEP cores were collected to monitor sedimentary data, namely; sediment texture, interstitial pigments and organic matter.
ANDEEP 1 samples were taken for the analysis of sedimentary data in the Drake Passage and north of the Peninsula (off South Shetland Islands, Elephant Island). At each of the 7 stations one core (62 mm diameter, 10 cm length) was recovered from a Barnett-Watson multiple corer (MUC) and deep frozen in its core tube (-30°C). At the laboratory cores were sliced into intervals of 0-1 cm, 1-3 cm, 3-5 cm and 5-10 cm and sub-sampled for additional fungi analysis.
During ANDEEP 2 sub-samples of the same MUC (sliced as in ANDEEP 1) were taken for the analysis of sedimentary data along the Peninsula transect, at the Weddell Abyssal Plain and along the Sandwich Trench transect. All slices were stored at –30°C.
LAMPOS samples were taken using the same MUC (with similar methods as for ANDEEP) or Multibox corer (MG) when the sediment was not appropriate for use of the MUC.
Sediment texture is assessed on a Coulter Counter, interstitial pigments on HPLC / Flurometer and organic matter on a CHN analyzer. Methods can be obtained on request. Integration of the environmental data should help zoobenthic researchers to understand observed patterns of abundance, biomass, diversity, dispersal (migration) and recruitment in the deep Weddell Sea (ANDEEP 2) and along the Scotia Arch (LAMPOS). They can be related to existing CTD, sediment and other environmental data.

ANDEEP 1

Offshore stations, Drake Passage	South Shetland Islands	Elephant Island
Sta 42[*] : 3700m Sta 129[*1] : 3600m [*]east of Shackleton Fracture Zone [*1]west of Shackleton Fracture Zone	Sta 99 : 5200m Sta 105 : 2300m Sta 114 : 2900m	Sta 43 : 4000m Sta 46 : 2900m

ANDEEP 2

Peninsula transect	Weddell Abyssal Plain	South Sandwich Trench
Sta 133 : 1000-1100m Sta 132 : 2000m (green fluff) Sta 131 : 3000m Sta 134 : 4000m; green fluff	Sta 134 : 4000m; green fluff Sta 135 : 4700m Sta 136 : 4700m; fluff Sta 137 : 5000m; fluff Sta 138: 4500m; lumps of degraded phytodetritus	Sta 141 : 2300m Sta 140 : 3000m Sta 139 : 4000m; silt, bazalt Sta 142 : 6300m

LAMPOS

	Sta.	Depth [m]	Gear	Character
Burdwood Bank	PS61-154	395	MG1	Overpacted clay with stones
Shag rocks	PS61-176	278	MG3	clay with fluff on top
South Georgia	PS61-178	277	MUC1	
Saunders Island	PS61-198	550	MG5	coarse stone debris with thin fluff layer
	PS61-199	747	MG6	thin fluff layer with vulcanic stone debris
Saunders Island	PS61-211	1095	MUC2	
Herdman Bank	PS61-222	374	MG8	stones of different size with clay
				stones with mud and fluff on top
Signy Island	PS61-242	307	MUC3	
	PS61-243	310	MG9	fine sand, silt and clay in deeper layers
Elephant Island	PS61-254	281	MG10	
	PS61-255	280	MUC4	

Biodiversity of Antarctic Nematodes : recent database developments within "NeMys"

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Biodiversity research reveals that more then 50% of the free-living marine nematode species found in previously unexplored environments, such as Antarctica, are new to science. Too few taxonomists remain to describe them all. Additionally, there are problems with the quality control of the identification of nematode samples since fewer labs possess all the literature (and manpower) required to verify the morphological characteristics of the animals.

A recent development of the original "NEMASLAN" and "TAXONLAN" databases is now established as NeMys (developed primarily for nematodes and mysids). In NeMys all data are stored in a relational database hosted on an SQL server. The user interface, making use of recent web technologies (ASP and SVG), combines all separated datasets in a user-friendly format. NeMys is a methodological approach for improving identification, classification and description of specimens in difficult taxonomic groups. It seeks to serve as an easy research tool for central management of information of the taxon concerned, and this for people with little training in database technologies. The main philosophy behind the Nemys project is that a biological information resource must be able to handle all kinds of information and that this information must be accessible by anyone, anywhere and at any time. This implies a centralized database with online data consulting (http://intramar.rug.ac.be/taxondata/) and data entry (with permission) possibilities.

STRUCTURE

Taxonomic structure: the hierarchy of the taxonomical tree is parent-children related (cfr. ITIS). Taxon rank, taxon authority, taxon name, taxon parent, accepted taxon, taxon data source are entered. To this taxonomic tree all kinds of information can be linked directly or indirectly:
Directly linked information: [1]digital sources (e.g. PDF documents of original descriptions, text documents, photographs, etc). The link is enriched with additional information. [2]pictorial information (e.g. scanned drawing, scanning electron microscope picture) enriched with all kinds of information. [3.] Notes, which can hold any kind of information not immediately fitting in the structured information.
Indirectly linked information: [1]Morphological data from the species identification (e.g. *shape and/or position* of amphid, cuticle, buccal cavity, tail, oesophagus, caudal glands and spinneret; *feeding type*; *numerical fields* of de Man ratios, length, setae, nerve ring, excretory porus, spicule, gubernaculum, male supplements). [2.] Geographical data from the species distributions (e.g. depth, geographical coordinates, region, etc), with the use of a well-documented geographical gazetteer and SVG mapping facility [3.] Ecological data from the species (e.g. biotope, population structure, related species, (a)biotic interactions, sensitivity to disturbance, importance in carbon flow, personal morphospecies drawings, etc).
Geographic, morphological, ecological, and ecological data on species are linked to a record in the database. The records are directly linked to the taxonomical tree.

The Nemys database can be used for all kinds of taxa in all regions. The included Antarctic nematode dataset consists of an archive of all numerical and nominal information for each species ever described in the Southern Ocean. About 350 original descriptions have thus been digitized. Geographical input has been started. The collaboration of three laboratory pioneers in Antarctic biodiversity databases (e.g. nematodes, amphipods and echinids, see seperate presentations) will seek for further developments such as the construction of a common portal on Antarctic Biodiversity as the nucleus of the new SCAR Information Network on Marine Biodiversity. This will be done within the framework of the OSTC project on Antarctica – BIANZO (BIodiversity of three representative groups of the ANtarctic ZOobenthos). It will contribute to the ITIS, DIVERSITAS, SA 2000, CoML-OBIS and GBIF initiatives.

A typical shallow water harpacticoid copepod in the Antarctic deep sea

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The members of the meiobenthic harpacticoid family Paramesochridae are typically small interstitial animals, cylindrical in shape, inhabiting sandy beach ground-water, the intertidal and shallow water sandy sediments. Recently some new species have been recorded from the deep sea but the genus *Kliopsyllus* with its 28 species seemed to be restricted to shallow areas. Two international scientific deep sea cruises (ANDEEP and DIVA) to the Scotia Arc and the northern Weddell-Sea as well as the Angola Basin have now contributed new species to the genus.

The new species sampled during the ANDEEP cruise, *Kliopsyllus* spec. 1, is recorded from the South Sandwich Islands (PS 138 – 11/2, depth: 4541 m). Its nearest relatives within the genus *Kliopsyllus* are only two species, bearing the same strange appendages on the anal segment as the here presented specimen (Fig. 1).

Kliopsyllus furcavaricatus Kunz, 1974 is described from 3 m depth on coral sand in a coral reef north of the port in Tanga (Tansania, East Africa). It has strongly developed dorsally flexed thorns on the anal somite. Its furcal rami can be spread out laterally due to a pair of strong muscles observed in the 4th abdominal segment by Kunz (1974). The flexed thorns, being an elastic component of the exoskeleton, serve as antagonistic structures, pushing the furcal rami back to their former position, when the muscles relax. Kunz states two possible explanations for the furcal rami spreading system: Firstly the animal could use the mechanism for its movements through the interstitial habitat, thus supporting itself on the grains behind it. A sensory structure at the tip of each thorn could be used for backward orientation. Secondly the animal could hold on inbetween the sand grains when interstitial water moves due to wave action. Unluckily he could not provide live observations, neither do we for the new species. Only one other known species, *Kliopsyllus longisetosus* (Krishnaswamy, 1951) from Madras (India), bears the same thorns on the anal somite, but the simple description gives no hint on the existence of the muscles.

Kliopsyllus spec. 1 from the Antarctic is supposed to live in the organic fluff layer covering the muddy sediments of the deep sea site sampled. There is no need for holding on inbetween the sand grains, firstly as there is no insterstitial habitat, secondly as there is no wave action. Until now no specimens with spread furcal rami have been found either in the ANDEEP or in the DIVA material. This is not very surprising as those animals do not seem to have the strong muscle observed by Kunz in the interstitial shallow water species.

Kunz, H. (1974): Zwei neue afrikanische Paramesochridae (Copepoda Harpacticoidea) mit Darstellung eines Bewegungsmechanismus für die Furkaläste. Mikrofauna Meeresboden 36: 1-20

Krishnaswamy, S. (1951): Three new species of sand-dwelling copepods from the Madras coast. Ann. Mag. nat. Hist. 12 (4) : 273-280

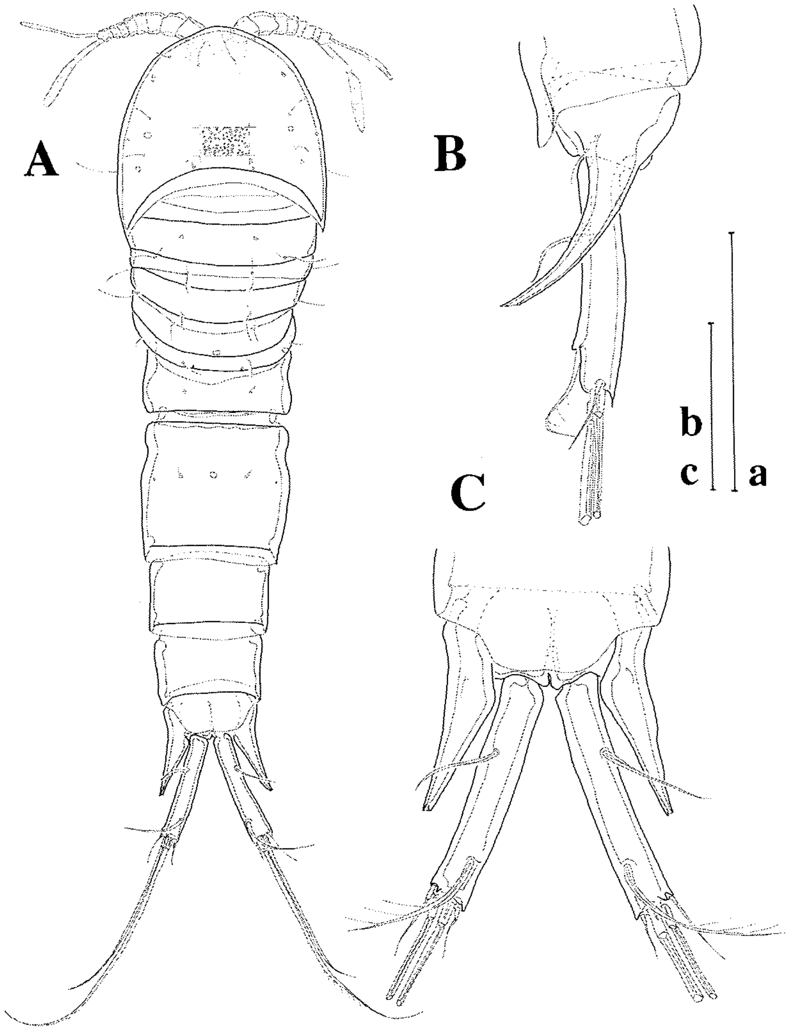

Fig. 1. *Kliopsyllus* spec. 1 from the antarctic deep sea. A. Female habitus, dorsal view. B. Armature of anal somite and furcal rami, lateral view. C. Armature of anal somite and furcal rami, dorsal view. Scale bars = a, 0.1 mm; b,c, 0.03 mm

A preliminary approach of the origin and evolution of lysianassoid amphipod biodiversity in Antarctica

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The Antarctic shelf benthic fauna is characterized by a high level of species richness and endemism. Despite a few pioneer molecular studies, the origin of the Antarctic benthic fauna and its evolution remains largely unknown. Three, non exclusive, hypotheses have been proposed so far for the malacostracan crustaceans: (1) an *in situ* radiation within the Southern Ocean possibly starting at the late Cretaceous time, (2) a colonisation from the deep-sea and (3) an immigration from South America *via* the Scotia Arc.

In this study, we aim at obtaining a robust molecular phylogeny for a selection of representative taxa of lysianassoid amphipods from the Antarctic shelf and abyssal depths, inferred from the analysis of complementary gene fragments. This phylogeny should constitute a tool for a better understanding of the biogeography and the evolution of the group, and for a clarification of its systematics and taxonomy, especially in comparing molecular and morphological data.

In a first approach, sequences of COI gene fragments were obtained for representative taxa of the *Orchomene* complex of genera and were used to build a preliminary phylogeny. The genus *Orchomenella* in its present concept appeared to be probably paraphyletic. The genera *Orchomenopsis* and *Pseudorchomene* appeared to be probably much closer than suggested by the current interpretation of their morphology and could derive from the genus *Abyssorchomene*. The morphological characteristics analysis suggested that some of the characteristics currently used in the systematics of the *Orchomene* complex are probably homoplasic. Despite the fact that valuable phylogenetic information could be inferred for closely related taxa, the gene proved to be too variable and homoplasic to be useful in resolving relationships between distantly related taxa. As a result, the 18S rRNA gene, acknowledged as being very conservative, was selected. Its sequencing was recently initiated and will hopefully provide us with phylogenetic reconstructions in the short-term.

Biogeography of Antarctic deep-sea nematodes: species turn-over in dominant genera of the family Chromadoridae

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Antarctica, situated on the southern pole, is completely isolated from the rest of the world and possesses its own old, low temperature ecosystem. This is reflected in its specific fauna. The current study focusses on the meiobenthos. This benthic size class (32μm – 1mm) is different in many aspects from counterparts in similar systems all over the world. This trend is first observed at community level (*i.e.* total meiobenthos density, nematode abundance, genus diversity and individual nematode biomass are significantly higher in Antarctica than anywhere else in the world) and now extended to species level.

Up to now scientific research on Antarctic meiobenthos has only focussed on the littoral zone, continental shelf and upper slope. The Antarctic deep sea is an unknown area. This study considers the nematode fauna of the deeper slope (1000-2000m). This zone is both the "well-stocked cellar" of the habitat-rich bathyal, as well as the "ceiling" of the uniform deep sea. Two nematode genera *Dichromadora* (Kreis, 1929) and *Neochromadora* (Micoletzky, 1924) are being studied in detail. The species of both genera are described as all specimens recovered

are new to science.
A first reference and occurrence list of deep-sea nematodes is composed in order to deduce the biogeography of Antarctic deep-sea nematodes. The most important conclusion drawn from this list is that endemism at nematode species level is high in the deep sea in general and probably extremely high in Antarctica (in contrast to an apparent lack of endemism at genus or higher taxonomic level, cf. meiofauna-paradox). A similar trend was found for the harpacticoid copepods *Metahuntemannia* and *Talpina*. The findings for the two most abundant meiofauna taxa suggest a general remarkable degree of meiofaunal endemism in Antarctica.
Large differences in species composition among the stations also suggest a high species turn-over at local scale with a different composition of generalist and specialist species. The biggest contrast has been found between the Southern and the Arctic Ocean.

The brachyuran crab *Halicarcinus planatus* (Fabricius) in the estuary of Puerto Deseado, Santa Cruz Province, Argentina.

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The genus *Halicarcinus* is the largest of nine genera in the Indo Pacific family Hymenosomatidae. *H.planatus* is one of the three species occurring in the Atlantic Ocean, but it is the only one that inhabits cold subantarctic waters.
The Deseado estuary is completely marine. Water temperature ranges from 13°-16°C in summer to a winter minimum of 4°-5°C and the salinity is nearly 33 ‰ throughout the year, while the tidal range exceeds 5 m.
The aim of this study was to analyze the annual intertidal dynamics of *H. planatus* in this location. Sampling was carried out between January, 1978 and November, 1981 (N=2195) and new samples were obtained between May 2002 and May 2003 (N=2941). The population is segregated by sex: only females occupy the intertidal zone and the upper subtidal fringe. Males were absent in all the samplings carried out between the intertidal and the kelp level.
After juvenile stages, female abdomen began a differential growth. Immature stages show a gradual increase in abdomen width and the pubescent abdomen is nearly quadrangular. *Halicarcinus planatus* has a pubertal/terminal moult, which is distinguished by its pronounced changes: the female abdomen expands laterally and anteriorly, and becomes very convex, and the pleopods broaden and become more setaceus. The relative size and morphology of the female abdomen permits determination of the following relative ages: immature (IMM), pubescent (PUB) and adult females (ADU or OVI) (Table 1).
Using demographic information from 1978 to 1981, a matrix population model was developed. The model represents the intertidal female dynamics with a 6 month time step. The model considers three stages: I (IMM + PUB), II (OVI) and III (ADU) and assumes the existence of an annual migration of stage I during May – June. So, calling n the population vector and M the projection matrices, the model (of order two) can be expressed as:
$n_t = M_1 \cdot n_{t-1} + M_2 \cdot n_{t-2}$

Comparing predicted (y) and observed values (x) for the different stages we obtained a very good fit: Stage I: $y = 0.8619x + 9.2985$, ($R^2=0.912$); Stage II: $y = 0.839x + 17.892$ ($R^2=0.961$); Stage III: $y = 0.9736x + 10.872$ ($R^2=0.636$).

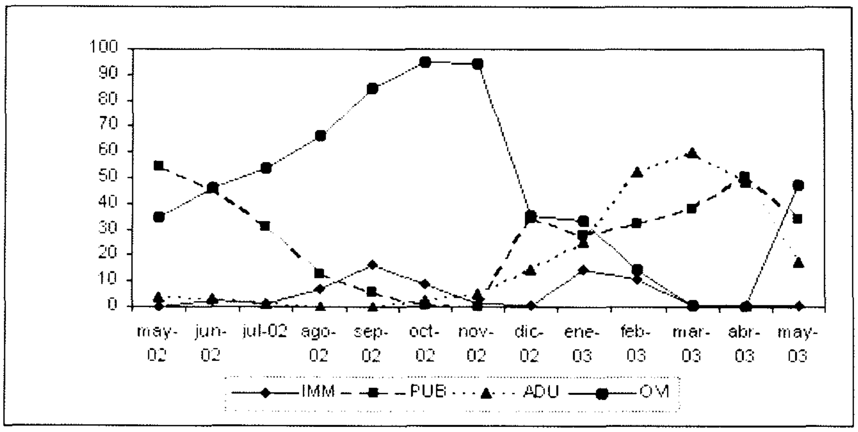
Although correlation coefficients are good, the slopes are less than one, indicating a slight underestimation. This fact is probably due to the existence of other migration phenomena, not included in the model, or to a mortality overestimation of stages II and III. The population structure during 2002-03 has been analyzed according to relative age composition and expressed as proportion in the graph. Juveniles are excluded from the analysis (FIGURE 1).

The variation in the proportions of the different relative ages was associated to growth process, reproductive period and vertical movements of females. Between May and October a permanent decrease in the proportion of PUB was observed. In the same period an increase in the proportion of OVI occurs, due to the existence of the pubertal molt and subsequent oviposition. A pronounced decrease of OVI was observed during spring and continues during summertime. In late spring the PUBs begin to appear again, migrating from deeper subtidal levels. Non-ovigerous (ADU) females are really post-ovigerous during the spring and early summer. During late spring and early summer the OVI migrates to subtidal levels. IMM occurred mainly in subtidal levels, with sporadic migrations to intertidal during the winter and early summer. Mature females live for more than 12 months. The analysis of this last year shows that a vertical migration takes place: ovigerous females migrate to the subtidal in spring and some post-ovigerous females came back to intertidal levels in summer. These facts support the conclusions obtained from the matrix model.

Table 1

		Cephalotorax Width		Abdomen Width	
Relative Age (sampled years)	n	x ± SD	max - min	x ± SD	max - min
IMM (1978-81)	37	5.87 ± 0.76	7.44 - 4.81	2.46 ±0.58	3.38 – 1.3
PUB (1978-81)	380	8.87 ± 1.35	12.87 – 5.2	5.58 ± 1.16	8.88 – 2.6
ADU (1978-81)	103	9.12 ±1.35	13.65 – 6.5	9.49 ± 1.31	14.43 – 7.02
IMM (2002/03)	60	4.58 ± 0.19	5.5 –3.6	1.82 ±0.31	2.5 – 1.1
PUB (2002/03)	60	9.11 ± 1.67	14.2 – 4.9	5.55 ± 1.39	9.3 – 2.4
ADU (2002/03)	60	9.17 ± 1.64	12.6 – 5.5	9.28 ±1.73	12.8 – 5.4

Fig. 1



Does the Scotia Arc represent a transitional area between Magellan and Antarctic Regions? Evidence from Bivalve Molluscs

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The historical land connections among South America, the Antarctic Peninsula and some of the Scotia Arc Islands, the present situation of geographic separation, and the additional isolation imposed by oceanographic conditions (i.e. deep waters, current systems) make these areas attractive for biogeographic studies.

Based on data coming from different invertebrate taxa, several biogeographic scenarios for this area, sometimes strongly divergent, have been proposed. The sets of data analyzed by different authors were non-homogeneous. Moreover, the available information on species diversity and their geographic distribution is still fragmentary. Both facts seem to be the origin of these discrepant interpretations.

Keeping this in mind, the goal of this study is to improve the quality of the information on systematics and distribution of a particular taxon: The bivalves. The species richness of bivalves from the Scotia Arc Islands was re-assessed by reviewing current information and searching for new data from recent samplings, in an effort to clarify the faunistic affinities of these islands with both the Magellan and Antarctic Regions. Hence, this study intends to find clues to establish the actual biogeographic status of the Scotia Arc Islands, i.e. do they represent continuity, a brake or a transitional area between southernmost South America and the adjacent Antarctic sector.

The bivalves collected by the R/V Polarstern during the 2002 LAMPOS cruise in 17 sampling stations were studied. Additional information from 31 sampling stations taken at South Georgia and 20 sampling stations from the Beagle Channel, the Straits of Magellan, east off Tierra del Fuego Island and Isla de los Estados, were included, as well as the critically reviewed information from the Magellan Region. The available published information from the Antarctic Weddell Sea was also critically reviewed and added to the analysis.

The main outcomes of the present study are 18 still undescribed species and 37 new records for bivalves. The greatest number of species was found on the southern South America mainland and the Islas Malvinas/Falkland Islands, where 77 and 66 species were recognized, respectively. The number of species at South Georgia was lower (48 species), and similar to that of the adjacent Antarctic Weddell Sea (47 species). The lowest number of species corresponded to the South Sandwich Islands, where only 27 species of bivalves were recognized. A genus-level analysis also showed the greatest diversity off the southern South America mainland and the Islas Malvinas/Falkland Islands (52 and 45 genera, respectively), and the lowest number of genera (20) was also found in waters off the South Sandwich Islands. The topology of the three areas, obtained from the UPGMA similarity analysis of the species matrix, showed two clearly defined groups: The first group corresponded to the bivalve associations from the southern South America mainland and the Islas Malvinas/Falkland Islands; and the second group corresponded to the Scotia Arc Islands and adjacent Antarctica. Within the latter group, the South Georgia bivalve assemblage appears to be different from those on the remaining Scotia Arc Islands and Antarctica as well. At the generic level, similar results were obtained. This study clearly reveals that bivalve assemblages from the Scotia Arc Islands have a great similarity with those from the western Antarctic, supporting their placement within the Antarctic Biogeographic Region. Due to the peculiar position of the bivalve fauna from South Georgia in some of the topologies obtained, it seems necessary to perform a particular study to clarify the biogeographic position of this archipelago.

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