SCI. MAR., 63 (Supl. 1): 503-511 SCIENTIA MARINA 1999

MAGELLAN-ANTARCTIC: ECOSYSTEMS THAT DRIFTED APART. *W.E. ARNTZ and C. RIOS (eds.)*

Magellan - Antarctic: Ecosystems that drifted apart. Summary Review

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While the existence of close biotic relationships between the Magellan region and the Antarctic is beyond doubt, it is clear from the comprehensive review attempted by the IBMANT/97 workshop that there are still some substantial problems to be solved:

- The fundamental question as to exactly when the two marine ecosystems became separated is not easy to resolve, as can be seen from the variety of suggestions presented by different authors in the literature. The origin of the present day benthic marine faunas both of the Magellan and Antarctic Biogeographic Provinces may date as far back as the Early Cretaceous. However, they remained closely related for some considerable time, and as continents do not drift apart overnight, separation must have been a gradual process which started more than 30 Ma ago and may well have lasted until the late Miocene (some 10-12 Ma ago), when the present conditions were fully established (Crame*).

- Despite much taxonomic work scattered in the older literature, determination to species level is possible only for a few specialists, many of whom are usually engaged in working up material from other areas. For this reason, we often had to accept preliminary determinations on coarser taxonomic levels despite the referees' comments that a more ideal piece of work might arise "within a few years time". Clustering and calculation of diversity would no doubt be strongly improved by breaking all samples down to species level. However, the goal of these proceedings is to define the state of the art, and that is, unfortunately, still very incomplete. From the ecologist's point of view, we hope this volume may be a challenge to taxonomists, stimulating them to re-investigate those groups where our knowledge is obviously insufficient.

- Some areas are better studied than others. Although a comparison of the adjacent Magellan and Antarctic Peninsula regions would have been preferable in all cases, some authors have chosen the much better investigated Weddell Sea for comparison.

- Another source of problems is that the use of geographic subdivisions such as Antarctic, Subantarctic, Antiboreal, Magellan, etc. is inconsistent in the literature, with many authors making their own choice despite the fact that sound bases were created by, for example, Hedgpeth (1969), Deacon (1982) and De Broyer and Jazdzewski (1993, 1996). Even the limits of the Southern Ocean are interpreted in different ways. This significantly hinders the comparison of species richness along the latitudinal gradient (which is difficult anyway, as the inventory of many taxa is far from complete; see above), and particularly complicates comparisons of endemism. In any event, comparisons of species numbers between the immense area around the Antarctic continent and the much smaller individual subareas further north are subject to bias from the outset, and lumped species numbers for many larger areas are often unobtainable (however, see Gorny for an attempt).

- Results obtained from different types of gear can also be contradictory. Examples here would include the results from grabs and corers vs. trawls and dredges, vs. those from visual methods. Consequently, respective authors' conclusions as to which elements should be considered characteristic of the Magellan region or the Antarctic differ widely. However, only a combination of results achieved by the use of different methods will finally reveal true structures.

Despite these (and other) problems which were discussed in the group sessions, the compilation of results presented in this volume hopefully sheds some new light on the Magellan region as such, particularly on its benthos, and its present-day relations to the Antarctic fauna and flora. A cautious attempt to highlight some results emerging from our efforts might be summarized as follows:

Hydrography and plankton in the Magellan region

In the whole area from the Straits of Magellan to the Beagle Channel (for local names see the "Victor Hensen" cruise report; Arntz and Gorny 1996), salinity and temperature decrease towards the innermost regions. As a consequence of the influx of saline, warm Pacific water via Bahía Cook, warm water of high salinity was found to be entrapped below cold, brackish water in Brazo Noroeste and in the Straits of Magellan. In the connecting channels this water is successively mixed with cold water of low salinity from the zone of Cordillera Darwin. The strong stratification in the south decreases in the Brecknock and Cockburn channels, and is almost non-existent in Seno Magdalena and Paso Ancho in the Straits of Magellan. Based on these hydrographic data, and using data on bathymetry and species distribution, four microbasins were identified (Antezana). These microbasins connect the Straits of Magellan and the Beagle Channel, creating a semiclosed system, although there are openings to both oceans. Despite great heterogeneity of environmental conditions in the different microbasins, certain trends seem to exist on different spatial and temporal scales. The most important seasonal trend is the succession from a classic food web to one mediated by bacteria (Antezana). Temperature, salinity and density distributions by themselves could not explain changes in chlorophyll concentrations, and chlorophyll differences alone could not explain zooplankton distribution. Zooplankton in this ecosystem is characterized by relatively few species with a high dominance (i.e. a low diversity) and a high proportion of invertebrate larvae in spring (Hamamé and Antezana). South of the Straits of Magellan, highest numbers of mesozooplankton were found in the connecting channels north of the Beagle at stations with a mixed water column, whereas in the Beagle and Ballenero Channels, lower abundances were associated with a stratified water column due to melt water from glaciers. Holoplankton strongly dominated the assemblages, and copepods contributed more than 2/3 of the total zooplankton numbers. Differences were found in the vertical distribution patterns of the main taxa. Cluster analysis separated between a surface community covering all stations, a northern, and a southern deep community (Defren-Janson *et al.*). In Paso Ancho (Straits of Magellan), a well-defined, persistent zooplankton community was found in spring under homogenous water column conditions, and was dominated by copepods, their nauplii and a fairly diverse meroplankton. Generally, the microbasin plankton reveals distinct links to the Subantarctic, and less obvious connections to Antarctic plankton.

Gelatinous carnivores are a conspicuous and relatively abundant group of plankters in the Magellan region. At least 41 species were found during the "Victor Hensen" campaign, with hydromedusae as the most important group, followed by siphonophores. The distribution of most species is circumantarctic with gradual transitions between the Antarctic and Magellan regions. The Magellan region is characterized by Subantarctic and some endemic species (Pagès and Orejas).

Pelagobenthic coupling in the Magellan region and comparison with Antarctic conditions

Pelagobenthic coupling plays an important role in the microbasins and channels of the Magellan region. Particulate organic matter (POM) composition in the Straits of Magellan was used by Fabiano *et al.* to characterize different trophic areas. POM differs qualitatively and quantitatively in this region but is relatively low compared with Antarctic conditions. Amounts and quality of seston are mostly determined by physical events such as winds and currents.

An example of an Antarctic site (Potter Cove, King George Island) is provided by Schloss *et al.* Total phytoplankton biomass in this ecosystem is very low. Sedimentation rates and Chl a were measured daily by sediment traps between surface waters and the seafloor. Changes were caused mainly by phytoplankton dynamics, storms and freshwater runoff; traps close to the bottom also reflected resuspension events. POM strongly decreased from surface waters to the seafloor. Feeding conditions for the benthos turned out to be more favourable above than at the bottom. Short-term changes in the subsurface stratum caused in Paso Ancho (Straits of Magellan) by a phytoplankton bloom at slackening wind speeds were studied by Antezana and Hamamé. Only 0.5% of the available chlorophyll were grazed by zooplankton. Potential effects of increased UV radiation on phytoplankton ("worst case scenario") were investigated by Hernando and San Román. Phytoflagellates were more sensitive to UV-B radiation than diatoms.

Comparing directly an Antarctic site (Terra Nova Bay, Ross Sea) with the Straits of Magellan, Cattaneo-Vietti *et al.* conclude in their review that the Magellan system is environmentally much less stable than the high Antarctic system, as turbulent diffusion provides large amounts of detritus, and there is intense resuspension as well as a high input of inorganic material from glaciers. The result is poorer, less complex benthos communities composed mostly of deposit feeders, scavengers and omnivores, although bivalves - above all, scallops - and brachiopods make an exception. Conversely, the Ross Sea benthos is dominated by suspension feeders, and exhibits fairly stable conditions except for occasional iceberg scour and anchor ice development. Characteristic of this system is a strong food pulse for the benthos from phytoplankton blooms restricted to a few weeks. These two very different ecosystems resemble each other, however, in the high input of organic carbon by lateral advection from large macroalgae stocks (which is not the case in the Weddell Sea due to greater water depth in front of the ice shelves - editor).

Antarctic and Magellan benthos: species richness, endemism, distribution

The Magellan region reveals links both to the Peruvian-Panamanian Biogeographic Provinces and to the Antarctic. In the latter case, closest relations do not necessarily exist between South America and the neighbouring Antarctic Peninsula/Scotia Arc region. Obviously, however, this area has not yet received sufficient attention to allow a full comparison to be made. Recent efforts in the Peninsula/Scotia Arc region, mainly by Spain, Poland, the UK, Argentina and Germany, were acknowledged and may improve the state of knowledge for a variety of taxa. Latitudinal clines in species richness may exist in one or the other direction, thus revealing that the classic bivalve mollusc/foram gradient ("bell-shaped curve"; Clarke, 1992), which is shared by some crustacean groups such as decapods, stomatopods and cirripedes, is just one possibility. For some groups known species numbers (cf. Arntz *et al.*, 1997, for Antarctic data) in both areas are similar. For example, an inventory of benthic thecate hydroids yielded 126 species in the Magellan region and 104 species in the Antarctic, where endemism is, however, about twice as high. Relations are close with 23 species occurring in both areas; the dominant family is Sertulariidae in both areas (Peña and García). Only 11 Antarctic species have been found north of the Magellan region. Densities and species richness of recent molluscs per station in the Beagle Channel differ greatly; most species occur off the eastern mouth of the Channel. The number of gastropod species in the Beagle Channel was found to be lower, that of bivalves the same as in the Weddell Sea (cf. Hain, 1990); taxonomic diversity is high in both areas (Linse). The total number of molluscs known from the Magellan region, including the Falklands, amounts to 407 (without cephalopods and polyplacophorans); 253 are gastropods and 138 bivalves (Linse checklist). Powell (1960, fide Hain,1990) reported ca. 420 shelled molluscs from the Antarctic. Shells are much more brittle in the Antarctic and biomass is much higher in the Magellan region (Gerdes and Montiel), and except for a few species such as *Adamussium colbecki* which are regionally important in the Antarctic, bivalves play a much more dominant role in the Magellan region. As do the shelled gastropods (Linse 1997), Magellan nudibranchs overlap only slightly (10%) with relatives south of the Antarctic Convergence, which seems to be an effective distributional boundary.

Species number (35 in the Magellan Province) shows a slight decrease from the Peruvian Province towards the high Antarctic (Schrödl). Post-glaciation bivalve mollusc assemblages in the Beagle Channel do not show any kind of succession; communities 8000-4000 years ago were almost identical with those of present-day. This reflects a surprising persistence (Gordillo).

Polychaetes were sampled in Aysén fjord, at the northern limit of the Magellan region, and compared with data from other Magellan sites and the Antarctic. The 38 species found in the fjord revealed little overlap with the areas further south. Most species in common were detected with the Antarctic Peninsula. However, distinct differences have developed in species and family composition in shallow soft-bottom communities between Antarctic and Magellan waters, although polychaetes seem to occupy a similar functional role in these two regions (Cañete *et al.*). In the Straits of Magellan, a mosaic of highly diversified soft-bottom biotopes favours the polychaetes, the known species number of which is now about 200. About 50% of these species overlap with the Antarctic and Subantarctic polychaete fauna. Work during the Italian "Cariboo" cruise in 1991 also showed polychaete species richness and densities to be higher on the Atlantic side of the Straits (Gambi and Mariani). Some major taxa such as the bryozoans, sponges, echinoderms, amphipods and certain isopods have particularly flourished in the Antarctic (Crame). Bryozoans show a latitudinal gradient in taxonomic richness on species, genus and family level increasing from northern Chile towards the Magellan region and further towards the Antarctic. Endemism increases in the same direction. There is a high number of vicariant species between the two areas which was presumably caused by several events (Moyano). Only 44 species of sponges have been found in the Straits of Magellan as compared to about 300 species described hitherto for the Antarctic (Koltun, 1970; Barthel and Tendal, 1994). Clearly, sponges are far more dominant in most parts of the Antarctic, but these 44 Magellan species were determined from only 150 specimens (Pansini and Sarà). It is important to differentiate even within taxonomic units. For example, whereas the number of sipunculid species doubles from the Magellan region towards the Antarctic, the number of genera decreases (Saiz-Salinas and Pagola-Carte).

Peracarid crustaceans from epibenthic sledge catches in Antarctic, Subantarctic and Magellan areas include a total of about 100 species, most of them being amphipods, isopods and cumaceans, plus a few mysid and tanaid species. The number of Magellan species in common with other areas decreases towards the Falkland Islands, and from South Georgia to the high Antarctic. Overlap between areas does not seem to follow a general rule for all peracarid taxa (Brandt *et al.*).

Within the isopods, the Serolidae and Arcturidae, contrary to most other families, have their strongest development within Antarctica. Among all groups of peracarid crustaceans phylogenetically old faunal elements occur both in the Magellan region and in the Antarctic (Brandt). In the case of cumaceans, the Antarctic shelf was not colonized from the Magellan region via the Scotia Arc. Species overlap is very low, especially between the Magellan and Subantarctic islands (Mühlenhardt-Siegel). The gammaridean amphipod fauna of the Magellan region is rich in species (>200) and predominantly endemic. Overlap with Antarctic and Subantarctic regions is never >5%; South American connections, with 8%, are only a little closer. Species richness along the Patagonian Ice Fields is low due to glacier impact; open sites are richer in species than the enclosed areas of the Straits of Magellan and the Beagle Channel. Stenothoidae and Lysianassidae are the two Magellan families richest in species; in the Antarctic the superfamily Lysianassoidea contributes about half of the species (De Broyer and Rauschert).

Recent Antarctic decapods cannot be directly related to the decapod fauna which inhabited that region in the early Tertiary. The Magellan region as a refuge area in glacial times has maintained a much higher number of species and a greater diversity of decapods compared with the Antarctic proper, which suffered extinction of many groups (Crame, Gorny). However, while caridean shrimps re-invaded the Antarctic with a low number of species (which can, however, be quite abundant), the reptant decapods remained north of the Drake Passage (except for two or three species of lithodid crabs). Presently, both anomuran and brachyuran decapods are among the dominant faunal elements in the Magellan region right down to the northern slope of the Drake Passage (Arntz *et al.*). The Southern Ocean up to the Subtropical Convergence houses 98 benthic and pelagic decapods, 6 of which are restricted to the deep sea. 34 pelagic species live south of the Subtropical Convergence, and a total of 24 benthic and pelagic species south of the Antarctic Convergence. About 50% of the benthic decapods, but only one pelagic species, are endemic in their respective sectors. The caridean *Eualus kinzeri* is the only endemic decapod on the Antarctic continental shelf. Clustering separates the Antiboreal South American decapod fauna (79 spp.) from their Antarctic and Subantarctic relatives. The northern limit of the latter should be drawn, however, at 55°30’ S, including species that live on the southern tip of South America. The restriction of the brachyurans to shallow silty and sandy bottoms may be one reason for their failure to return to present-day Antarctica. Southern South America and South New Zealand, where a much higher number of decapod species live, are two distinct Antiboreal regions in terms of decapod occurrence (Gorny).

As did bivalves, decapod crustaceans have declined in the Antarctic through time, and this may be true for other major taxa, too. Much more detailed phylogenetic work, including molecular genetics, is necessary to complete the faunal and floral inventory on the two sides of the Drake Passage. Recently physiological approaches have indicated that the failure of the reptant decapods to recolonize the Antarctic may be due to much higher magnesium contents in this group, causing lethargy (Frederich *et al.* in press).

Species richness of ophiuroids is almost twice as high in the Weddell Sea (42 spp.) as in Magellan waters (22 spp.). The two areas have five species in common (Dahm). Seven echinoids and 21 asteroids were determined from the “Victor Hensen” material (Larraín *et al.*). Unfortunately, no general Antarctic-Magellan comparison of macroalgae was made at the workshop. However, a study on coralline algae from Tierra del Fuego was presented, including comparisons with the Antarctic Peninsula (Mendoza).

Magellan related to Antarctic benthos: structure, abundance, biomass

Within the Magellan region a gradient of increasing similarity to the Antarctic is found from north to south, making the transition rather a gradual than an abrupt one. After about 20 million years of separation there are, however, distinct differences in species composition and community structure between the two ecosystems. The rich, three-dimensional suspension feeding communities typical of many parts of the Antarctic shelves and slopes (e.g., Dayton, 1990) have no counterpart in the Magellan region where sponges, bryozoans and crinoids seem to play a minor role altogether. The niche of the reptant decapods, which are so common down to the Beagle and the area south of it, may have been occupied in the Antarctic to some extent by amphipods and isopods, several of which attain “giant” sizes. Molluscs are far more common on the Magellan side although *Adamussium colbecki* is a dominant element in some areas of the Ross Sea (and other areas in the Pacific sector of Antarctica). In the shallow parts of the Magellan region, *Macrocystis* kelp forests predominate and structure the communities. Their holdfasts provide a substratum and shelter for 68 animal taxa in the Beagle Channel, with a much higher diversity than that of the fauna on the fronds (Adami and Gordillo). Macroalgae are dominant structures and may attain large size *(Himantothallus)* in some Antarctic areas, too (see, e.g., Klöser *et al.*, 1994), but they never establish kelp forests of the Magellan kind, and they are totally absent in those parts of the high Antarctic where ice shelves prevent bottoms shallower than 100 m. There are, however, also taxa such as echinoids and asteroids, which besides having narrow taxonomic relations (Larraín *et al.*), seem to occupy a similar role in the two ecosystems.

Megabenthic epifaunal communities in the Magellan region exhibit a distinctly patchy distribution which is determined more by medium-scale environmental conditions than by large-scale regional differences (Gutt *et al.*). Based on underwater photography, a clear difference was, however, detectable between shallow and deep stations. Judging from this method, the benthos was not more homogenous in deep water, and little difference could be detected between the wide Magellan Straits and the narrow Beagle Channel. On the other hand, species richness of some taxa along the Patagonian Ice Fields was found to be distinctly lower than elsewhere in the Magellan region. Only 13 benthic and one pelagic decapod species were found, and even less inside the fjords where silt from the glaciers prevents a richer fauna. The much higher species number outside the fjords (46) suggests a high colonisation pressure if the glaciers keep receding (Mutschke and Gorny). Species richness was also found to be low in the fjords for gammaridean amphipods (De Broyer and Rauschert). Densities and biomasses of southeastern Weddell Sea and Magellan macrobenthos as a whole are in the same order of magnitude, but the major dominant taxa and their biomass shares are different. Whereas sponges are dominant by weight in the Weddell Sea, molluscs are in the Magellan region, where bivalves contribute almost 75%. Echinoderms, in particular holothurians, are of great importance in both areas (Gerdes and Montiel). These differences are responsible for different macrobenthic productivity in the two areas despite similar biomasses. From multibox corer samples, Brey and Gerdes calculated annual production and P/B to be higher in the Magellan region than in the Weddell Sea (5.1 g C $m^{-2}yr^{-1}$ vs. 3.6 g C $m^{-2}yr^{-1}$ and 0.7 yr^{-1} vs. 0.3 yr^{-1}, respectively). A large number of benthic bycatches was studied from bottom trawls taken in the Scotia Arc area by the Spanish vessel "Hespérides". Major similarities in benthic fauna composition were found between the eastern shelf of South Georgia and the South Orkneys, as well as between Elephant Island and the South Shetlands. This revealed a predominance of sessile suspension feeders and certain motile faunal elements, whereas the northwestern shelf of South Georgia, the South Sandwich Is. and Shag Rock were more similar to the Magellan region, and characterized by an abundance of hydrozoans and lithodid decapods (Ramos). Deglaciation some 12,000 yrs ago produced boulders and cobbles on the Tierra del Fuego coast which host a few numerically dominant mollusc, polychaete and amphipod species, 17 species of macroalgae (mostly red algae and *Ulva lactuca),* and a large number of rarer faunal species. Total macrofauna in this community may amount to at least 110 species, although at the specific study site only >60 species were found. Densities were between 145 and 1677 m^{-2}, biomasses (wet wt.) between 336 and 3301gm^{-2} (Ríos and Mutschke).

For scarcely investigated meiofaunal groups such as the harpacticoid copepods, which reveal a relatively high similarity on genus level with the northern hemisphere (George and Schminke), the presented data seem to be the first from the Chilean sublittoral. First qualitative comparisons with the Antarctic indicate an overlap of 17 taxa at family level; 7 families occur exclusively in the Magellan region (George 1999). The dominant taxon in the Magellan region, as in other areas, is nematodes. Densities as compared to Antarctic sites were found to be lower than at Signy Island but higher than on the eastern Weddell Sea shelf. A larger percentage of the Magellan (especially Beagle) meiofauna lives at depths >5cm in the sediment (Chen *et al*.).

Benthic invertebrate life cycles in the Magellan region

Various studies presented within the framework of IBMANT/97 dealt with life cycle aspects of benthic species from the Magellan region, contributing to the scarce information that is available from this area in comparison with the Antarctic (see, e.g., reviews by Picken, 1980; White, 1984; Pearse *et al*., 1991; Arntz *et al*., 1994). Similar to its Antarctic and Subantarctic relatives, the limpet *Nacella deaurata* has pelagic larvae in the Beagle Channel which appear with the spring phytoplankton bloom (Morriconi). This genus is an exception within high-latitude prosobranchs which mostly have non-pelagic development (Hain and Arnaud 1992).

The sabellid polychaete *Perkinsiana antarctica* in the Straits of Magellan, contrary to all other congeners (except one) which lay free eggs, is a brooder. Considering its size, it produces little offspring (up to 374 embryos and 222 larvae) (Gambi and Patti). Reproduction studies in the Beagle Channel revealed different growth and fecundity of the two lithodid crabs, *Lithodes santolla* and *Paralomis granulosa*. *L. santolla* produces two generations in the time span *P. granulosa* requires to produce only one (Lovrich and Vinuesa). The food of *P. granulosa* in the Beagle was investigated by Comoglio and Amin. All brachyuran and anomuran larvae in the Beagle Channel hatch once a year, in spring. Of *Lithodes santolla*, no larvae have ever been found; of *Paralomis granulosa,* only a few are known, suggesting that these larvae may be benthic or hyperbenthic (Lovrich). A latitudinal gradient in egg size of majid brachyuran crabs seems to emerge from egg sizes in the Magellan region compared to those at other Chilean localities. In general, the reproductive biology of Majidae in the Magellan region resembles that of related species in temperate zones of the northern hemisphere (Navarrete *et al*.).

The latitudinal cline in reproduction of *Austropandalus grayi* (Caridea) follows the formerly described pattern of egg size increase towards higher latitudes (cf. Gorny *et al*. 1992). However, it differs from patterns in other pandalid carideans in also showing increased energy allocation for reproduction towards the pole (Wehrtmann and Lardies). The echinoid *Loxechinus albus* supports one of the main fisheries in the Magellan region. Regional differences in the reproductive cycle of this species seem to be caused by differences in food availability. The cycle exhibited in the Magellan region does not follow the latitudinal pattern observed in other areas of Chile (Oyarzún *et al.*). The food of the ophiuroid *Ophiuroglypha lymani* was compared with the diets of three closely related Antarctic brittle stars of the same subfamily, revealing different feeding strategies. Growth performance was higher in *O. lymani* than in its Antarctic relatives (Dahm).

Other contributions: fish and seabirds

Only few studies on vertebrates (fish and seabirds) were presented during the IBMANT/97 workshop despite their great potential for elucidating Magellan-Antarctic relations. There are >110 marine fish species living between 42 and 57° S, and these reveal a distinct pattern of depth zonation. The southern sector is characterized by - partly endemic - cold water species. The Straits of Magellan are an important exchange zone between fish communities of the South Atlantic and the South Pacific (Sielfeld and Vargas).

Three species of Moridae (Gadoidea) found in "Polarstern" catches south of the Beagle Channel had been described for Magellan waters before, but revealed a considerable southward range extension (Meléndez and Pequeño). Swimming muscles of Subantarctic Notothenioidea revealed no specific adaptations to buoyancy as their Antarctic relatives do (Fernández *et al.*). Age was validated and growth was studied in larvae of the nototheniid fish *Patagonotothen tesselata* from the Beagle Channel. Diel rings turned out to be distinguishable. The hatching of the winter cohort just before the spring phytoplankton bloom was advantageous in comparison with the summer cohort (Rae *et al.*).

Five of the 17 existing penguin species breed regularly in the Magellan region. Two of them (Southern Rockhopper and Magellan penguins) are restricted to this area; whereas 20% of the total population of the Gentoo penguin live on the Falkland Is., there are only small populations of King and Macaroni penguins in this area. Gentoo and Southern Rockhopper penguin populations have undergone heavy fluctuations on the Falklands, and these may have been caused by the increase of fishing around the islands (Bingham and Mejías).

Mercury and organochlorine compound contamination of Kelp Gull eggs showed a geographical pattern from north to south in Chile but did not reveal concentrations that might cause negative effects on reproduction (Muñoz and Becker).

This attempt at a short overview is by no means exhaustive; not even all the papers presented in this volume have been included. The purpose of IBMANT/97, combining original research data and contributions of a review nature, was to arrive at a compilation of the present state of knowledge. For some taxa this has been highly successful, and our view has certainly been improved and widened; however for others, we have only had a very first glimpse, and much remains to be done. The use of identical gear in the Antarctic and the Magellan region has at least made our results more comparable. However, many of the species richness and endemism figures published to date will be subject to notable changes while sampling is intensified and extended into the deep sea, and to the thousands of channels of the southwestern part of the Magellan region, or while different gear is used (as in the case of the peracarids, where the epibenthic sledge increased sampling success enormously). As an example, the number of Magellan amphipod species known to science has been increased during recent cruises by one-fifth (De Broyer and Rauschert). Hopefully, another IBMANT workshop will fill many of the gaps that have remained despite all efforts.

ACKNOWLEDGEMENTS

Thanks are due to Drs. Eike Rachor and Tom Brey, and to Dr. Alistair Crame for helpful suggestions concerning the contents and the English, respectively.

REFERENCES

(*Note: Authors without years mentioned in the text refer to the "Magellan-Antarctic" volume)

Arntz, W.E. and M. Gorny .- 1996. Cruise report of the Joint Chilean-German-Italian Magellan "Victor Hensen" Campaign in 1994. Ber. Polarforsch., 190: 1-113.

Arntz, W.E., J. Gutt and M. Klages.- 1997. Antarctic marine biodiversity: an overview. In Battaglia, B., J. Valencia and D.W.H. Walton, eds. Antarctic Communities. Species, Structure and Survival. Cambridge Univ. Press, Cambridge: 3-14.

Arntz , W.E., T. Brey and V.A. Gallardo.- 1994. Antarctic zoobenthos. Ocean. Mar. Biol. Ann. Rev., 32: 241-304.

Barthel, D. and O.S. Tendal.- 1994. Antarctic Hexactinellida. In: Wägele, J.W. and J. Sieg, eds. Synopsis of the Antarctic Benthos. Koeltz Scientific Books, Königsstein, vol.6: 1-154.

Clarke, A.- 1992. Is there a diversity cline in the sea? Trends in Ecology and Evolution, 9: 286-287.

Dayton, P.- 1990. Polar benthos. In Smith, W.O., ed. Polar Oceanography. Part B: Chemistry, Biology, and Geology. Academic Press, London: 631-685.

Deacon, G.E.R.- 1982. Physical and biological zonation in the

Southern Ocean. Deep-Sea Res., 29: 1-15.

De Broyer, C. and K. Jazdzewski.- 1993. Contribution to the marine diversity inventory. A checklist of the Amphipoda (Crustacea) of the Southern Ocean. Doc. Travail Inst. roy. Sci.nat. Belg., 73: 1-155.

De Broyer, C. and K. Jazdzewski, 1996. Biodiversity of the Southern Ocean: towards a new sysnthesis for the Amphipoda (Crustacea). Boll. Mus. civ. St. nat. Verona, 20: 547-568.

Frederich, M., FJ. Sartoris, W.E. Arntz and H.-O. Pörtner, in press. Haemolymph magnesium regulation in decapod crustaceans: physiological correlates and ecological consequences in polar areas. J. exp.Biol.

George, K.H.- 1999. Gemeinschaftsanalytische Untersuchungen der Harpacticoidenfauna der Magellanregion, sowie erste similaritätsanalytische Vergleiche mit Assoziationen aus der Antarktis. Diss. Univ. Oldenburg

Gorny, M., W.E. Arntz, A. Clarke and D.J. Gore.-1992. Reproductive biology of caridean decapods from the Weddell sea. Polar Biol., 12: 111-120.

Hain, S.- 1990. Die beschalten benthischen Mollusken (Gastropoda und Bivalvia) des Weddellmeeres, Antarktis. Ber. Polarforsch., 70: 1-181.

Hain, S. and P. Arnaud.- 1992. Notes on the reproduction of high Antarctic molluscs from the Weddell Sea. Polar Biol, 12: 303-312.

Hedgpeth, J.W.- 1969. Distribution of selected groups of marine invertebrates in waters south of 35° S latitude. Antarctic Map Folio Ser, Am. Geogr. Soc., Folio 11: 1-4, pls. 1-29.

Klöser, H., G. Mercuri, F. Laturnus, M.L. Quartino and C. Wiencke.- 1994. On the competitive balance of macroalgae at Potter Cove (King George Island, South Shetlands). Polar Biol., 14: 11-16.

Koltun, V.M.- 1970. Sponges of the Arctic and Antarctic: a faunistic review. Symp. zool. Soc. Lond., vol. 25: 285-297.

Linse, K.- 1997. Die Verbreitung epibenthischer Mollusken im chilenischen Beagle-Kanal. Ber. Polarforsch., 228: 1-131.

Picken, G.B.-1980. Reproductive adaptations of Antarctic benthic invertebrates. In W.N. Bonner and R.J. Berry, eds. Ecology in the Antarctic. Academic Press, London: 67-75.

Pearse, J.S., J.B. McClintock and I. Bosch.- 1991. Reproduction of Antarctic benthic marine invertebrates: tempos, modes and timing. American Zoologist, 31: 65-80.

Powell, A.W.B.-1960. Antarctic and sub-Antarctic mollusca. Rec. Auckl. Inst. Mus., 5: 117-193.

White, M.- 1984. Marine benthos. In Laws, R.M., ed. Antarctic Ecology, Vol. 2. Academic Press, London: 421-461.

Contributions to the "Magellan-Antarctic: Ecosystems that drifted apart" volume (in alphabetical order)

Adami, M.L. and S. Gordillo. – Structure and dynamics of the biota associated with *Macrocystis pyrifera* (Phaeophyta) from the Beagle Channel, Tierra del Fuego. *Sci. Mar.*, 63(Supl. 1): 183-191.

Antezana, T. – Hydrographic features of Magellan and Fuegian inland passages and adjacent Subantarctic waters. *Sci. Mar.*, 63(Supl. 1): 23-34.

Antezana, T. – Plankton of Southern Chilean fjords: trends and linkages. *Sci. Mar.*, 63(Supl. 1): 69-80.

Antezana, T. and M. Hamamé. – Short-term changes in the plankton of a highly homogeneous basin of the Straits of Magellan (Paso Ancho) during spring 1994. *Sci. Mar.*, 63(Supl. 1):59-67

Arntz, W.E., M. Gorny, R. Soto, M.A. Lardies, M. Retamal and I.S. Wehrtmann. – Species composition and distribution of decapod crustaceans in the waters off Patagonia and Tierra del Fuego, South America. *Sci. Mar.*, 63(Supl. 1): 303-314.

Bingham, M. and E. Mejias. – Penguins of the Magellan region. *Sci. Mar.*, 63(Supl. 1): 485-493.

Brandt, A. – On the origin and evolution of Antarctic Peracarida (Crustacea, Malacostraca). *Sci. Mar.*, 63(Supl. 1): 261-274.

Brandt, A., K. Linse and U. Mühlenhardt-Siegel. – Biogeography of Crustacea and Mollusca of the Subantarctic and Antarctic regions. *Sci. Mar.*, 63(Supl. 1): 383-389.

Brey, T. and D. Gerdes. – Benthic community productivity in the Magellan region and in the Weddell Sea. *Sci. Mar.*, 63(Supl. 1): 145-148.

Cañete, J.I., G.L. Leighton and F.F. Aguilera. – Polychaetes from Aysen Fjord, Chile: distribution, abundance and biogeographical comparison with the shallow soft-bottom polychaete fauna from Antarctica and the Magellan Province. *Sci. Mar.*, 63(Supl. 1): 243-252.

Castelló, J. – Taxonomic study of the isopod crustaceans from the Spanish expedition "Antártida 1986-11" in the Scotia Sea, South Atlantic. *Sci. Mar.*, 63(Supl. 1): 275-279.

Cattaneo-Vietti, R., M. Chiantore, C. Misic, P. Povero and M. Fabiano. – The role of pelagic-benthic coupling in structuring littoral benthic communities at Terra Nova Bay (Ross Sea) and in the Straits of Magellan. *Sci. Mar.*, 63(Supl. 1): 13-121.

Chen, G.T., R.L. Herman and M. Vincx. – Meiofauna communities from the Straits of Magellan and the Beagle Channel. *Sci. Mar.*, 63(Supl. 1): 123-132.

Comoglio L.I. and O.A. Amin. – Feeding habits of the false southern king crab *Paralomis granulosa* (Lithodidae) in the Beagle Channel, Tierra del Fuego, Argentina. *Sci. Mar.*, 63(Supl. 1): 361-366.

Crame, J.A. – An evolutionary perspective on marine faunal connections between southernmost South America and Antarctica. *Sci. Mar.*, 63(Supl. 1): 1-14.

Dahm, C. – Ophiuroids (Echinodermata) of southern Chile and the Antarctic: Taxonomy, biomass, diet and growth of dominant species. *Sci. Mar.*, 63(Supl. 1): 427-432.

De Broyer, C. and M. Rauschert. – Faunal diversity of the benthic amphipods (Crustacea) of the Magellan region as compared to the Antarctic (preliminary results). *Sci. Mar.*, 63(Supl. 1): 281-293.

Defren-Janson, K., S.B. Schnack-Schiel and C. Richter. – Mesozooplankton communities in the Magellan region. *Sci. Mar.*, 63(Supl. 1): 43-50.

Fabiano, M., P. Povero, R. Danovaro and C. Misic. – Particulate organic matter composition in a semi-enclosed Periantarctic system: the Straits of Magellan. *Sci. Mar.*, 63(Supl. 1): 89-98

Fernández, D.A., J. Calvo and I.A. Johnston. – Characterisation of the swimming muscles of two Subantarctic notothenioids. *Sci. Mar.*, 63(Supl. 1): 477-484.

Gambi, M.C. and S. Mariani. – Polychaetes of the soft bottoms of the Straits of Magellan collected during the Italian oceanographic cruise in February-March 1991. *Sci. Mar.*, 63(Supl. 1): 233-242.

Gambi, M.C. and F.P. Patti. – Reproductive biology of *Perkinsiana antarctica* (Kinberg) (Polychaeta, Sabellidae) in the Straits of Magellan (South America): Systematic and ecological implications. *Sci. Mar.*, 63(Supl. 1): 253-259.

George, K.H. and H.K. Schminke. – Sublittoral Harpacticoida (Crustacea, Copepoda) from the Magellan Straits and the Beagle Channel (Chile). Preliminary results on abundances and generic diversity. *Sci. Mar.*, 63(Supl. 1): 133-137.

Gerdes, D. and A. Montiel. – Distribution patterns of macrozoobenthos: a comparison between the Magellan region and the Weddell Sea (Antarctic). *Sci. Mar.*, 63(Supl. 1): 149-154.

Gordillo, S. – Holocene molluscan assemblages in the Magellan region. *Sci. Mar.*, 63(Supl. 1): 15-22.

Gorny, M. – On the biogeography and ecology of the Southern Ocean decapod fauna. *Sci. Mar.*, 63(Supl. 1): 367-382.

Gutt, J., E. Helsen, W.E. Arntz and A. Buschmann. – Biodiversity and community structure of the mega-epibenthos in the Magellan region (South America). *Sci. Mar.*, 63(Supl. 1): 155-170.

Hamamé, M., and T. Antezana. – Chlorophyll and zooplankton in microbasins along the Straits of Magellan-Beagle Channel passage. *Sci. Mar.*, 63(Supl. 1): 35-42.

Hernando, M.P. and N.A. San Román. – Preliminary data on chronic effects of ultraviolet radiation on the growth of some phytoplankton species of the Beagle Channel, Argentina. *Sci. Mar.*, 63(Supl. 1): 81-88.

Larraín, A., E. Mutschke, A. Riveros and E. Solar. – Preliminary report on Echinoidea and Asteroidea (Echinodermata) of the Joint Chilean-German-Italian Magellan "Victor Hensen" Campaign, 17 October - 25 November 1994. *Sci. Mar.*, 63(Supl. 1): 433-438.

Linse, K. – Abundance and diversity of Mollusca in the Beagle Channel. *Sci. Mar.*, 63(Supl. 1): 391-397.

Linse, K. – Mollusca of the Magellan region. A checklist of the species and their distribution. *Sci. Mar.*, 63(Supl. 1): 399-407.

Lovrich, G.A. – Seasonality of larvae of Brachyura and Anomura (Crustacea Decapoda) in the Beagle Channel, Argentina. *Sci. Mar.*, 63(Supl. 1): 347-354.

Lovrich, GA. and J.H. Vinuesa. – Reproductive potential of the lithodids *Lithodes santolla* and *Paralomis granulosa* (Anomura, Decapoda) in the Beagle Channel, Argentina. *Sci. Mar.*, 63(Supl. 1): 355-360.

Meléndez, R. and G. Pequeño. – New records of Morid fishes (Teleostei: Gadiformes) from the southernmost tip of South America. *Sci. Mar.*, 63(Supl. 1): 465-467.

Mendoza, M.L. – State of knowledge of the Corallinales (Rhodophyta) of Tierra del Fuego and the Antarctic Peninsula. *Sci. Mar.*, 63(Supl. 1): 139-144.

Morriconi, E. – Reproductive biology of the limpet *Nacella* (*P.*) *deaurata* (Gmelin, 1791) in Bahía Lapataia (Beagle Channel). *Sci. Mar.*, 63(Supl. 1): 417-426.

Moyano, H.I. – Magellan Bryozoa: a review of the diversity and of the Subantarctic and Antarctic zoogeographical links. *Sci. Mar.*, 63(Supl. 1): 219-226.

Mühlenhardt-Siegel, U. – On the biogeography of Cumacea (Crustacea, Malacostraca). A comparison between South America, the Subantarctic Islands and Antarctica: present state of the art. *Sci. Mar.*, 63(Supl. 1): 295-302.

Muñoz, J. and P.H. Becker. – The Kelp Gull as bioindicator of environmental chemicals in the Magellan region. A comparison with other coastal sites in Chile. *Sci. Mar.*, 63(Supl. 1): 495-502.

Mutschke, E. and M. Gorny. – The benthic decapod fauna in the channels and fjords along the South Patagonian Icefield, Southern Chile. *Sci. Mar.*, 63(Supl. 1): 315-319.

Navarrete, N., R. Soto, E. Quiroga, M. Vargas and I.S. Wehrtmann. – Egg production in *Eurypodius latreillii* Guérin, 1828 (Decapoda: Majidae) in the Straits of Magellan, southern Chile. *Sci. Mar.*, 63(Supl. 1): 333-337.

Oyarzún, S.T., S.L. Marín, C. Valladares and J.L. Iriarte. – Reproductive cycle of *Loxechinus albus* (Echinodermata: Echinoidea) in two areas of the Magellan region (53°S, 70-72°W), Chile. *Sci. Mar.*, 63(Supl. 1): 439-449.

Pagès, F. and C. Orejas – Medusae, siphonophores and ctenophores of the Magellan region. *Sci. Mar.*, 63(Supl. 1): 51-57.

Pansini, M. and M. Sarà. – Taxonomical and biogeographical notes on the sponges of the Straits of Magellan. *Sci. Mar.*, 63(Supl. 1): 203-208.

Peña Cantero, A.L. and A.M. García Carrascosa. – Biogeographical distribution of the benthic thecate hydroids collected during the Spanish “Antártida 8611” expedition and comparison between Antarctic and Magellan benthic hydroid faunas. *Sci. Mar.*, 63(Supl. 1): 209-218.

Rae, G.A., N.A. San Roman and D.E. Spinoglio. – Age validation and growth of yolked larvae of *Patagonotothen tessellata* (Richardson, 1845) (Pisces: Nototheniidae) from the rocky littoral of the Beagle Channel, Argentina. *Sci. Mar.*, 63(Supl. 1): 469-476.

Ramos, A. – The megazoobenthos of the Scotia Arc islands. *Sci. Mar.*, 63(Supl. 1): 171-182.

Ríos, C. and E. Mutschke. – Community structure of intertidal boulder-cobble fields in the Straits of Magellan, Chile. *Sci. Mar.*, 63(Supl. 1):193-201.

Saiz-Salinas J.I. and S. Pagola-Carte. – Sipuncula of the Magellan area compared with adjacent regions of Antarctica. *Sci. Mar.*, 63(Supl. 1): 227-232.

Schloss, I.R., G.A. Ferreyra, G. Mercuri and J. Kowalke. – Particle flux in an Antarctic shallow coastal environment: a sediment trap study. *Sci. Mar.*, 63(Supl. 1): 99-111.

Schrödl, M. – Zoogeographic relationships of Magellan Nudibranchia (Mollusca: Opisthobranchia) with particular reference to species from adjacent regions. *Sci. Mar.*, 63(Supl. 1): 409-416.

Sielfeld, W. and M. Vargas. – Review of marine fish zoogeography of Chilean Patagonia (42°-57°S). *Sci. Mar.*, 63(Supl. 1): 451-463.

Soto, R., E. Quiroga, M. Vargas and N. Navarrete. – Size structure and sex composition of *Eurypodius latreillii* Guérin, 1828 (Brachyura) and *Pagurus comptus* White, 1847 (Anomura) in southern Chile. *Sci. Mar.*, 63(Supl. 1): 339-345.

Vinuesa, J.H., G.A. Lovrich and F. Tapella. – New localities for Crustacea Decapoda in the Magellan region, southern South America. *Sci. Mar.*, 63(Supl. 1): 321-323.

Wehrtmann, I.S. and M.A. Lardies. – Egg production of *Austropandalus grayi* (Decapoda, Caridea, Pandalidae) from the Magellan region, South America. *Sci. Mar.*, 63(Supl. 1): 325-331.