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Bathypelagic Fish Association with the Mid-Atlantic Ridge

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bathymetric groups (at 325 and 500 m). Dominant taxa determined from video frame analyses included Stromateidae, Serranidae, Trachichthyidae, Congridae, Scorpaenidae and Gadiformes. The zeiform micro-predator, *Grammicolepis brachiusculus*, was important over *Lophelia* reef habitat at the deeper horizon and may be reef-dependent. Typical soft-substrate open-slope taxa (e.g., Macrouridae and Squalidae) began to replace hardground species on the deeper horizon. Large mobile predators dependent on visual foraging were limited mainly to the shallower horizon. Sit-and-wait and hover-and-wait strategists (e.g., Scorpaenidae, Congridae, Trachichthyida) predominated at both depth horizons, along with generalized foragers (Gadiformes). Although *Lophelia* thickets were extensively developed on the deeper depth horizon, fish abundance was low, only 95 fish/hectare.

Dynamics of epibenthic megafauna on the deep West Antarctic Peninsula shelf viewed from time-lapse photography

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The deep West Antarctic Peninsula shelf is characterized by an intense deposition of phytodetritus during spring/summer months. We deployed a time-lapse camera at 600 m depth for a period of nearly one and a half year in order to observe the dynamics of epibenthic megafauna in response to the arrival of organic matter at the seafloor. Photographs were taken every 12 or 24 hours and the camera array was recovered and deployed every 3 months during five cruises to Antarctica on board RV Laurence M. Gould and RV Nathaniel B. Palmer from November 1999 to March 2001. Density and movement rates were measured for the main epibenthic megafauna, including holothurians and sea urchins. Identifiable echinoderm species included the echinoids *Amphipneustes* spp. and *Ctenocidaris perrieri* and the elasipod holothurians *Protelpidia murrayi* and *Peniagone vignoni*. The latter were the most abundant megafaunal organisms in the area and important surface deposit feeding species. Fecal cast production, including total number, size and volume, was estimated for *P. murrayi* as a measure of feeding intensity and sediment reworking capabilities. Mean life times of fecal casts were measured in order to have an estimate of the time microtopographic features persist on the bottom. The phytodetritus arrival at the seafloor was qualitatively measured. There was no apparent deposition of phytodetritus from spring/summer 1999/2000 to winter/2000. A huge pulse of phytodetritus was observed on spring/summer 2001 on photographs, corroborating data gathered from sediment traps and megacorers.

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The bathypelagic zone, Earth's largest living space, is essentially boundless in three dimensions for most of its extent, structured only by fluid features (e.g., salinity, temperature) of the seawater itself. However, near certain topographic features this zone intersects the seafloor. The mid-ocean ridge system is by far the largest of these features. Unlike the ecosystems of the continental margins, the mid-ocean ridge systems do not receive terrigenous nutrient inputs. Thus, the deep-water fauna associated with mid-ocean ridges ultimately depend on the generally limited local surface production. Despite this limited surface production, there is evidence that near-ridge demersal fish biomass is increased above the mid-Atlantic Ridge (MAR). Two processes by which organic matter can be transferred to the benthic boundary layer include: 1) sinking of aggregates and the carcasses of larger animals, and 2) vertical migration of living animals. To understand the dynamics of the latter process, deep-pelagic and demersal fishes were studied during the 2004 G.O. Sars Expedition, a field campaign of MAR-ECO. MAR-ECO, a Census of Marine Life project, is an international study of the animals inhabiting the northern Mid-Atlantic. Utilizing multiple technologies the water column (to 3500 m) and benthic realms were sampled. Taxonomic analysis to date has revealed over 300 fish species, with ongoing analysis expected to reveal more species, some new to science. Pelagic sampling collected 207 species, with typical orders dominating. Bottom trawling collected ca. 175 species, with typical demersal families, but also pelagic families occurring in numbers higher than would be

expected by contamination alone. Discrete, near-bottom pelagic trawls confirmed this observation. In all, 84 species were caught in both pelagic and bottom trawls, with some species showing enhanced abundances in the near-bottom boundary layer, suggesting that overlap of deep-pelagic and demersal faunas is likely a key process regulating mid-ocean ridge community structure.

The deep-sea connection: past climate change and the colonization of Antarctica

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Living in Earth's largest freezer has challenged marine life since the onset of Antarctic cooling as late as about 35 million years ago. As a consequence of Antarctic cooling, many taxa became extinct or were strongly reduced in diversity due to their failure to adapt their physiology and life history to the selective harsh polar conditions. In particular the disappearance of large pelagic and benthic predators, such as sharks, skates, teleost fish, and true crabs, has contributed to the unique benthic community structure characteristic of today's shallow and deep waters in Antarctica. Despite a general overview of the long-term consequences of Antarctic cooling on marine biodiversity at southern high latitudes, our understanding of the effects of climate oscillation at shorter Milankovitch timescale of thousands of years, characterized in glacial-interglacial cycles, on Antarctic ecosystems is far from being understood. During the present interglacial, iceberg-scouring reaching down to about 500 m on the Antarctic continental shelf is the main physical impact, locally devastating benthic communities. Contrarily, it is now becoming evident, from geology and geophysics that during past glacial periods the physical impact of ice was an order of magnitude than seen today. The glacial periods were a time of mass destruction, as continental ice sheets advancing across the continental shelf wiped out whole seafloor communities, whilst mass wasting and turbidity flows around Antarctica impacted the continental slope fauna. Previously, it was assumed that whole seafloor ecosystems somehow dodged extinction by re-colonizing from nearby habitats such as the Antarctic continental slope that had escaped obliteration. It is now postulated that most benthic animals might have only been able to survive in deep-sea shelters or around Southern Ocean islands, facilitated by floating life history stages or active adult migration. Some species might have survived in local shelters of the Antarctic continental shelf, considering that ice advance and retreat must have taken place indeed diachronously. However, due to permanent sea ice cover, such shelters exposed environmental conditions similar to those of the deep sea (except pressure) and should have required similar ecophysiological adaptations.

Protection of Scientific Investments - Science Priority Areas

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Attested right is the freedom of the high seas and this pertains to much of the deep sea, concerning both, the seafloor and/or the water column. Although the area is of enormous dimensions, competition for space may occur and may disturb scientific investments. Various stakeholders may be interested in the same region, but prior consultations and advance notices should allow settled regulations. Particularly for studies with repeated observations and measurements at permanent stations and with long-term character specific provisions should be accepted. Science Priority Areas (SPAs) should be established to secure scientific investments like installations of technical equipment, but also to warrant undisturbed natural conditions. Research in the deep sea and beyond national jurisdiction is supported by national funding organizations and also requested by the United Nations Convention on the Law of the Sea. In the interest of society at large, scientists are responsible to secure optimal results from the intrinsically high investments. Other stakeholders may come from the mining, oil and gas drilling or fishing industries, from industrial and community waste treatment, but also from nature protection, a well justified goal. Within less than a decade many Marine Protected Areas may be established, and the NGOs strive for the protection of 20 - 30 % of the oceans. This may severely limit scientific activities, because the knowledge necessary for the establishment of Marine Protected Areas (MPAs) covers only a rather small area in total. Science as stakeholder with the interest in deep-sea regions beyond national jurisdiction should be aware of such effects, establish Science Priority Areas and organize them independently from Marine Protected Areas. A special legal status needs to be proposed to and applied for at various discussion and decision levels of the United Nations.