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Editorial

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Editorial: Diversity of Southern Ocean deep-sea benthos between cosmopolitism and cryptic speciation: new species from the ANDEEP expeditions

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The richness of life in parts of the earth that to us appear inhospitable and remote never fails to fascinate scientists and non-scientists alike. The largest ecosystem of the planet, the abyssal plains of the world ocean, makes up about 90 percent of the seafloor and thus nearly 78 percent of the Earth's surface, yet only a minor fraction of this huge environment has been investigated. Authors have questioned repeatedly "how many species would live on earth and in the ocean" (Mora *et al.* 2011; May 2011), and recent estimations predict ~ 8.7 million (+/- 1.3 million SE) eukaryotic species globally, with 2.2 million of these being marine (Mora *et al*. 2011). To date, 91 % of all marine species still await description. Other authors concluded that marine biodiversity is grossly underestimated (Bouchet 2006) because so far, only one-third of all species descriptions concerns marine biota (Reaka-Kudla 1997; Groombridge & Jenkins 2000, Grassle 2001, Boltovskoy *et al*. 2005). We know that marine live thrives even in hadal trenches (Jamieson *et al*. 2009), that biogeographic ranges in the deep sea are dynamic (McClain & Mincks Hardy 2010) and that the origin of the modern deep-sea fauna is ancient (Thuy *et al*. 2012). For example, the origin of Isopoda dates back to Permo-Triassic times (232–314 mya; Lins *et al*. 2012).

The deep-sea basins of the southern hemisphere, including the abyssal plains surrounding Antarctica, belonged to the least explored regions on Earth until about the turn of the millennium. During ten years of exploration under the umbrella of the Census of Marine Life (CoML) and its field projects CeDAMar and CAML (Census of the Diversity of Abyssal Marine Life and Census of Antarctic Marine Life), some sampling gaps have been closed, and an overwhelming wealth of hitherto unknown species from the deep-sea floor was discovered. The process of formally describing these new species, however, is still slow because the common realization that taxonomy is very much in need has not translated sufficiently in research positions especially for young scientists. The collection of new species presented in this volume is all the more valuable even though it is only a comparably small contribution to the Southern Ocean species inventory. Descriptions of 21 new species are provided within this volume. These cover five new species of Porifera (Rossellidae, Demospongiae, Cladorhizidae), one of Ostracoda (Polycopidae), three of Nematoda (Ethmolaimidae), eight of Polychaeta (Ampharetidae) and four of Isopoda (Acanthaspidiidae, Antarcturidae, Macrostylidae).

The high diversity of the Southern Ocean benthos, and the role of the abyssal plains around Antarctica as a diversity pump for the world oceans, has been subject to many ANDEEP publications. The origin of the benthic fauna is of great interest (e.g., Brandt 1991; Thatje 2005; Thatje *et al*. 2005; 2008; Wilson & Hessler 1987) as Antarctica has experienced pronounced climatic fluctuations particularly during the Holocene. Both emergence and submergence processes during the evolutionary history of certain taxa have been postulated (Brandt 1991; Riehl & Kaiser 2012; Strugnell *et al*. 2008; 2012)

As human induced climate change is becoming an issue of increasing urgency for action (e.g., Brandt & Gutt 2011; Ingels *et al*. 2012), reliable methods to detect and predict ecosystem changes are in high demand (Griffiths 2010). However, as very little is known about biological traits of deep-sea species, it is difficult to identify changes in benthic communities as response to a particular threat. This is especially true for the abyssal plains which may be affected only indirectly as the only anthropogenic stresses other than global warming in Antarctica—fisheries and tourism—concern mostly coastal and shelf regions. Nonetheless, because of the dependency of deep-sea benthos on marine snow for nutrient input, we may see a signal there much earlier than in shallower waters. On-going climate change-related investigations in less remote areas of the ocean suggest that responses from whole ecosystems may be less detectable

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than those of single species. These in return may serve as very useful and reliable proxies once their ecology is understood. Obviously more is known about the biology of coastal and shelf species than abyssal organisms, for example, reproduction, food webs and energy flow to the bottom. Some food web analyses of deep-sea species in the Southern Ocean have been carried out, for example amphipods (Nyssen *et al*. 2005) and several other taxa (Würzberg *et al*. 2011) sampled during ANDEEP expeditions, but this kind of research is still in its infancy.

Once again it appears that taxonomy is at the hub of biological science rather than in the dusty back room of a forgotten archive. Only if the species comprising benthic communities are clearly defined and reliably recognized can we begin to investigate their demands on their environment and their responses to change. The species inventories of the Southern Ocean, such as RAMS (Register of Antarctic Marine Species) (DeBroyer & Danis 2010) will likely have to be updated many times. On the one hand, many cryptic species are being discovered with molecular methods (Schüller 2011), and on the other, the existence of cosmopolitan as well as endemic species is questioned as we gain knowledge about dispersal potential.

Although it is somewhat laborious to compile a volume like this one because of the lack of funding, we sincerely hope that it will not be the last one of its kind as so many newly discovered, genetically defined, and locally restricted species await our thoughtful attention.

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Of course, we are greatly indebted to all authors, not only for contributing their results, but also for believing and investing into Antarctic deep-sea taxonomy. We know that with the little material available, the sometimes poor condition of samples and the often lacking external support and acceptance of taxonomy it is very hard to keep up the motivation, and even harder to encourage young scientists to engage in taxonomic studies. Therefore, we are extremely happy to find a great number of graduate students and early career scientists among the list of authors.

Many thanks are due to all participants (scientists and RV *Polarstern* crew members) of ANDEEP I–III and ANDEEP-SYSTCO, as well as everybody handling, sorting and caring for our precious samples until now – without you the new species would neither have been discovered nor recognized. Also, we would like to thank all financial and representative supporters of the ANDEEP research, such as the German Science Foundation (DFG), CoML (Census of Marine Life) and its field projects CeDAMar (Census of Abyssal Marine Life) and CAML (Census of Antarctic Marine Life).

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