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Editorial

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Editorial: Deep-sea taxonomy — a contribution to our knowledge of biodiversity*

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> "How painfully (to me) true is your remark that no one has hardly a right to examine the question of species who has not minutely described many." Charles Darwin in a letter to Joseph Hooker (1845)

It is with great pleasure that we finished the compilation of this, the second special volume on deep-sea taxonomy in the year commemorating Darwin (2009). It is exactly 150 years after the publication of Darwin's most notable work "On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life". This remains the basis of our understanding of the history and diversity of life, the latter of which is expressed by the immense number of species inhabiting our planet in past and present.

Once thought to be bare of life, the deep sea has turned out to host plenty of species (cf. Sanders & Hessler 1969, Brandt & Hilbig 2004, Martínez & Schminke 2005, Martínez Arbizu & Brix 2008), of which a large part might remain to be discovered. Estimates of species living in the deep sea, the world's largest habitat, range from 500,000 to 10,000,000 (Grassle & Maciolek 1992, May 1992, Lambshead 1993, Rex *et al*. 1993, Martínez & Schminke 2005). Every expedition undertaken within the scope of CeDAMar ("Census of the Diversity of Abyssal Marine Life", a field project of the "Census of Marine Life") in recent years yielded numerous new species. To gain a better understanding of deep-sea biodiversity, zoogeography, speciation and phylogeny, not only the description of these new species is required, but also redescriptions of numerous known species are needed to provide crucial information on species morphology and allow accurate identification.

This presents an enormous challenge for biologists and especially taxonomists. This task has become even greater because of the growing loss of taxonomic expertise (Mallet & Willmott 2003, Wheeler 2004, Zhang 2008). On one hand the need for protection and conservation of biological diversity has become a focus of public and political awareness, but on the other hand a considerable indifference concerning the inventory of this diversity seems to exist. Taxonomy, the one science that contributes to this inventory of biodiversity (Wheeler 2004, 2007, Zhang 2008), is faced by growing impediments: a decrease of taxonomic chairs in universities, resulting in a lack of junior taxonomists, growing difficulties to publish taxonomic papers in high impact journals, lack of funding for taxonomic projects and lack of positions for taxonomists (Zhang 2008).

The increasing popularity of DNA-based taxonomy presents a further challenge to traditional taxonomy since it has been claimed to provide a faster and less time consuming method for species identification (e.g. Hebert et al. 2003, Tautz et al. 2002, 2003, Savolainen et al. 2005). However, entirely DNA-based taxonomy does not provide us with much information beyond DNA sequences, and neglects the whole range of valuable morphological information. It is certainly a useful addition to morphological methods but must not be

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regarded as a substitution for traditional taxonomy (e.g. Lipscomb *et al.* 2003, Seberg *et al.* 2003, Moritz & Cicero 2004, Ebach & Holdredge 2005).

Admittedly, species estimates of 10,000,000 may suggest that any attempt of an inventory must be doomed and that the limited financial resources are best diverted elsewhere, but what is the alternative? The past has shown that ignorance in the handling of environmental issues holds no protection against the consequences. The deep sea is increasingly threatened by human impacts, such as deposition of waste, deep-sea mining or the recently discussed iron fertilization of the oceans in attempts at climate change amelioration (e.g. Ahnert & Schriever 2001, Glover & Smith 2003, Proelß 2007). It is currently impossible to predict the effects of such an action on the deep-sea fauna. Life in the abyss has adapted to low nutrients, so a significant increase in surface production and the resulting input of nutrients into the deep sea may have drastic consequences (Smith et al 2008).

Although recently some initiatives were taken to promote taxonomy and to raise funds for this neglected field of science, (e.g. the Partnerships for Enhancing Expertise in Taxonomy (PEET) in the USA, funded by the National Science Foundation, or the Global Taxonomic Initiative (GTI), which is part of the Convention on Biological Diversity and devoted to advocate taxonomy), funding for purely taxonomic projects is still rare. One of the stated aims of CeDAMar is to promote deep-sea taxonomy, and the intention to describe and redescribe 500 species up to 2010. To support descriptive taxonomy CeDAMar funds taxonomic exchange and the organisation of workshops.

Deep-sea taxonomists often find themselves faced by some additional problems: Not only does sampling require more logistic and financial support than in most other habitats, but also the mere size of the deep sea rather impedes adequate sampling. Besides, abundances are low in the deep sea and species are often rare or patchily distributed. This means that while nearly every sample may contain species new to science, these are often represented by just one or few individuals, generally not considered to be ideal for a comprehensive description. However, resampling an area to increase the number of available specimens is often prevented by logistic constraints.

In the light of these problems it is all the more pleasing that the CeDAMar call for papers on deep-sea taxonomy found so much resonance. During the compilation of the first Zootaxa special volume on deep-sea taxonomy (Martínez Arbizu & Brix 2008) it soon became evident that a single volume was not enough to accommodate the high number of articles submitted. In view of the numerous new taxa reported from the deep oceans, a second volume was assembled.

This second volume contains 28 articles by 45 authors dealing with various taxa of meio-, macro- and megafauna in the deep sea, based on material collected during expeditions to all major oceans. Most new species described herein belong to the meiofauna (33 species), the remaining eleven species represent peracarid crustaceans (six species) and holothurians (five species). With the 18 species described in seven different articles Nematoda are the best represented meiofauna taxon in this volume, followed by Copepoda with 11 species described in seven articles. This is the first volume of Zootaxa to contain descriptions of the enigmatic taxon Loricifera. Beyond the descriptions of the 44 new species, the volume contains several redescriptions and seven new genera from various taxa.

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