

Editorial: corals, reefs and marine biodiversity

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Received: 11 January 2013 / Accepted: 16 January 2013 / Published online: 29 January 2013
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2nd World Conference on Marine Biodiversity

This issue of Marine Biodiversity contains a selection of papers that were presented as a talk or digital object during the session “Biodiversity of Coral Reefs” at the 2nd World Conference on Marine Biodiversity in Aberdeen (26–30 September, 2011). During the 1st World Conference on Marine Biodiversity in Valencia (11–15 November, 2008) a similar session on coral reefs was organized: “The Coral Triangle: patterns and processes in marine species richness and habitat diversity” (Miloslavich and Klein 2009). Coral reefs are well-known for their high biodiversity (Paulay 1997; Bouchet 2006; Hoeksema 2007), and therefore it was clear that sessions on biodiversity of coral reefs were apt for these conferences.

For the session “Biodiversity of Coral Reefs” a total of 23 oral presentations and 16 digital objects was accepted. The participants who presented their research came from various countries around the world: Australia (4), Bangladesh, Colombia, France, Greece, India (4), Indonesia (2), Iran, Italy (3), Japan (3), Mexico, the Netherlands (2), Norway, Oman, Portugal (2), Thailand (2), the United Kingdom (4), and the United States of America (5). The research on which they reported concerned corals and reefs in various parts of the world: Indo West-Pacific (19), W Atlantic / Caribbean (5), Mediterranean (4), E Atlantic (2), general/global (9).

Topics on corals and coral reefs in the journal marine biodiversity

History

Marine Biodiversity is a continuation of *Senckenbergiana maritima*, which was published between 1969 and 2008

(Volumes 1–38). *Senckenbergiana maritima* published papers on all aspects of marine sciences, in particular on marine biology, palaeontology, geochemistry, oceanography, geology and sedimentology. This ‘International Journal of Marine Sciences’ was published by the Senckenberg Gesellschaft für Naturforschung, Frankfurt am Main (Germany), and had two sister journals, *Senckenbergiana lethaea* with articles on palaeontology and geology, and *Senckenbergiana biologica* with contributions on zoology and botany. All three *Senckenbergiana* titles ceased publication in December 2008.

As successor of *Senckenbergiana maritima*, *Marine Biodiversity* started in 2009 with Vol. 39, devoted to all aspects of biodiversity research in marine ecosystems. It encourages contributions dealing with the understanding of the evolution and maintenance of biodiversity in marine systems and the role of species in structuring marine ecosystem functioning. In comparison to its predecessor, *Marine Biodiversity* appears to be less oriented toward Western Europe and has become more of a global forum, which is illustrated by the increasing frequency of papers on corals and coral reefs in the last years (Fig. 1).

Various special volumes and issues in the past concerned geographical areas where corals and coral reefs do not occur: Vol. 4 Georgia coastal region, Sapelo Island, U.S.A.: sedimentology and biology; Vol. 7 Estuaries of the Georgia coast, U.S.A.: sedimentology and biology; Vol. 16 (1–6) Experimental investigations about effects of crude oil and dispersed crude oil in tidal flat environments; Vol. 24 (1–6) Tidal flats and barrier systems of continental Europe; Vol. 27 (3–6) Workshop of the Ecosystem Research Wadden Sea; Vol. 29 (1–6) 9th International Scientific Wadden Sea Symposium; Vol. 31 (2) 14th International Senckenberg Conference on Burning Issues of North Sea Ecology; Vol. 33 (1–2) North Sea 2000 (I): state of the art in marine biology at the end of the 20th century; Vol. 34 (1) North Sea 2000 (II): state of the art in environmental parameters at the end of the 20th century; Vol. 39 (3) The Atlántida 2008 Cave Diving Expedition; Vol. 41 (1) Arctic Ocean

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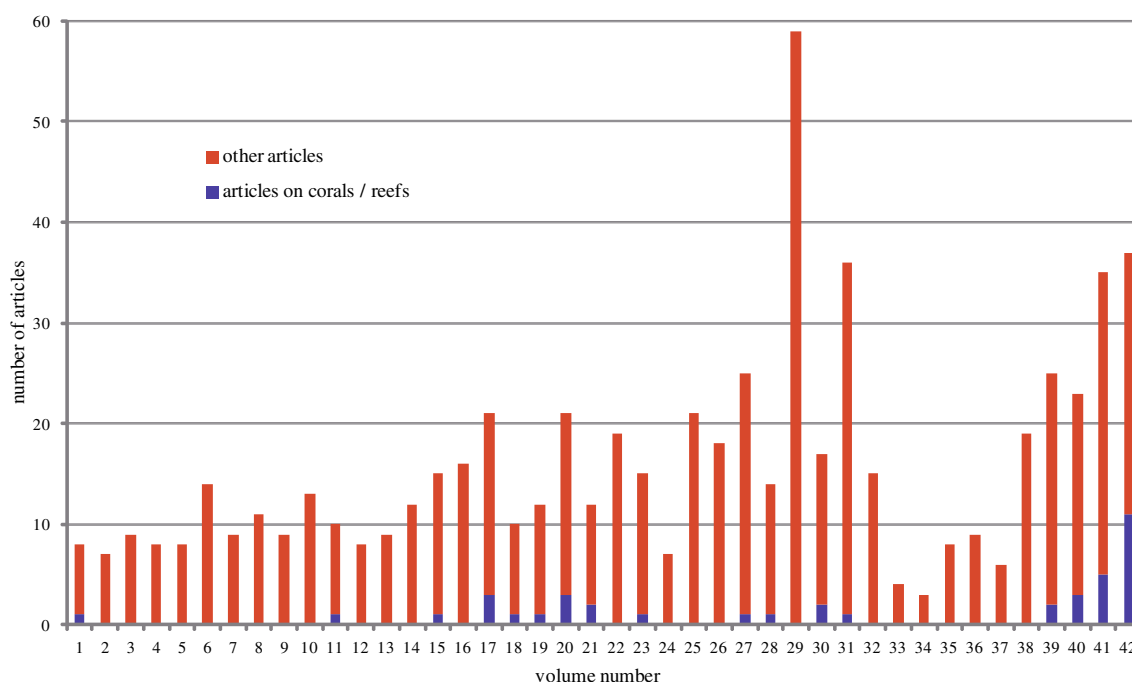


Fig. 1 Volumes 1–42 (1969–2012) of *Senckenbergiana maritima* (1–38) and its successor *Marine Biodiversity* (39–42), with total numbers of articles and particularly those dedicated to corals or coral reefs

Diversity: Synthesis; and Vol. 41 (3) Arctic Marine Biodiversity under Change.

It is obvious that the number of coral-related articles will be relatively high in the current Vol. 43, particularly thanks to the present special issue. Articles published and in press in both journals (1969–present) are categorized according to taxon, topic, and geographical area (Tables 1, 2 and 3).

Taxa

Cnidaria (Coelenterata) constitute the most common subject in articles on coral reef biodiversity in *Marine Biodiversity* and *Senckenbergiana maritima* (Table 1). This is noteworthy because stony corals (Scleractinia) consist of only ~1,500 globally described species, soft corals and gorgonians (Octocorallia) of ~3,200, and stylasterids of ~250, out of a total of ~225,000 known marine species worldwide (Appeltans et al. 2012). Crustaceans (~50,000), molluscs (~47,500) and fish (~17,500), which together comprise ~50 % of all known marine species (Costello et al. 2010; Appeltans et al. 2012), rank lower in frequency (Table 1). Scleractinians receive much attention, particularly the zooxanthellate and reef-building species in shallow water. In the long term, many of the shallow-water corals are threatened with extinction (Carpenter et al. 2008). The azooxanthellate scleractinians (about 50 % of all species) are less easily studied because many of them occur in deep water (Cairns et al. 1999; Cairns and Kitahara 2012). These deep-water corals may be threatened as well (Miller et al. 2009;

Santodomingo et al. 2013), but this may well be less detectable than in shallow-water reef corals. For the latter, baseline data from museum collections can be obtained relatively easily (van der Meij et al. 2010; Hoeksema et al. 2011) as well as detailed distribution data from marine biodiversity databases, such as the World Register of Marine Species (WoRMS, see Costello et al. 2013).

Coelenterates are important as reef-builders and as habitat and food for other organisms, but they do not have special journals dedicated to them, such as the species-rich molluscs (e.g. *Journal of Molluscan Studies*, *Molluscan Research*, *Nautilus*, *Malacologia*) and crustaceans (*Crustaceana* and *Journal of Crustacean Biology*). The journal *Coral Reefs* deals with various kinds of reef studies, but does not have an outspoken preference for articles on corals. *Marine Biodiversity* shows much emphasis on taxonomy while covering research at gene, species and ecosystem level as well as focusing on describing the actors (genes and species), the patterns (gradients and distributions) and understanding of the processes responsible for the regulation and maintenance of diversity in marine systems. Also included are studies of species interactions (symbioses, parasitism, predation) and the role of species in structuring marine ecosystem functioning.

Topics

It is obvious that corals, which host many other organisms and therefore play an important role in species-rich coral

Table 1 Taxa ranked according to frequency of their representation in articles dealing with corals or reefs in the journal Marine Biodiversity and its predecessor Senckenbergiana maritima (1969-present)

Cnidaria, Coelentera (28): Grasshoff (1979, 1985, 1989), Grasshoff and Zibrowius (1983), Türkay and Schuhmacher (1985), Kleemann (1986, 1990), Lawniczak (1987), Dullo and Hecht (1990), Heiss et al. (1993), Fabricius (1996), Heiss et al. (1999), Camillo et al. (2011), García-Matucheski and Muniain (2011), Reimer et al. (2011), Aharonovich and Benayahu (2012), Carranza et al. (2012), Grossowicz and Benayahu (2012), Hoeksema (2012), Hoeksema and Waheed (2012), van der Meij and Reijnen (2012), Davies et al. (2013), Kamezaki et al. (2013), Ohara et al. (2013), Santodomingo et al. (2013), van der Meij and Hoeksema (2013), Waheed and Hoeksema (2013), Yeemin et al. (2013)
Mollusca (7): Kleemann (1986, 1990), García-Matucheski and Muniain (2011), Harrison and Smith (2012), Hui et al. (2012), van der Meij and Reijnen (2012), Chavanich et al. (2013)
Crustacea (6): Türkay and Schuhmacher (1985), Senn and Glasstetter (1989), Burukovsky (2000), White (2012, 2013), van der Meij and Hoeksema (2013)
Chordata, Vertebrata, Pisces (4): Fishelson (1989), Uiblein et al. (1998), Malcolm et al. (2010), Ahmadi et al. (2012)
Unspecified / general (4): Schäfer (1969), Barnes et al. (2009), Miloslavich and Klein (2009), Alexander et al. (2011)
Plantae (3): Reimer et al. (2010, 2011), Kamezaki et al. (2013)
Porifera (3): Schönberg (2000, 2001), Aguilar and Reimer (2010)
Chordata, Ascidia (2): Hoeksema and Waheed (2012), Shenkar (2012)
Echinodermata (2): Fabricius (1996), Alvarado (2011)
Bryozoa (1): Bijma and Boekschoten (1985)

reefs (Paulay 1997; Stella et al. 2011; Hoeksema et al. 2012), should constitute an important topic in Marine Biodiversity. Nevertheless, symbionts in marine ecosystems are vastly undersampled and understudied (Bouchet 2006). This is also visible in the present overview. Among major topics of coral-related research, the category “Trophic and other interspecific relations” is ranking only fourth after topics related to morphology, distribution patterns and taxonomy (Table 2). Nevertheless, Marine Biodiversity welcomes reports on species interactions.

Geography

Another interesting analysis concerns the geographical areas where the reported coral and coral reef studies were carried

out (Table 3). The Indo-Pacific is well known for its rich coral diversity, especially the central part at the Indo-Pacific convergence, which applies to both deep-water and shallow-water corals (Cairns 2007; Hoeksema 2007). This is also reflected in the numbers of studies from that area as compared to the Atlantic (Table 3). Research on corals and coral reefs in the East Atlantic and in the East Pacific so far appears to be underrepresented in Marine Biodiversity, which hopefully will change in the future.

The conference papers

This special issue is composed of six coral and reef-related research papers, dealing with a variety of topics. In line with

Table 2 Topics ranked according to frequency of their representation in articles dealing with corals or reefs in the journal Marine Biodiversity and its predecessor Senckenbergiana maritima (1969-present)

Morphology, growth and physiology (16): Schäfer (1969), Grasshoff (1979), Grasshoff and Zibrowius (1983), Bijma and Boekschoten (1985), Kleemann (1986), Lawniczak (1987), Fishelson (1989), Dullo and Hecht (1990), Heiss et al. (1993), Uiblein et al. (1998), Heiss et al. (1999), Schönberg (2001), Aharonovich and Benayahu (2012), Grossowicz and Benayahu (2012), Hoeksema (2012), Kamezaki et al. (2013)
Regional and temporal distribution and diversity patterns (16): Grasshoff (1979), Grasshoff and Zibrowius (1983), Senn and Glasstetter (1989), Barnes et al. (2009), Malcolm et al. (2010), Alvarado (2011), Ahmadi et al. (2012), Carranza et al. (2012), Harrison and Smith (2012), White (2012), Chavanich et al. (2013), Ohara et al. (2013), Santodomingo et al. (2013), van der Meij and Hoeksema (2013), Waheed and Hoeksema (2013), Yeemin et al. (2013)
Taxonomy, phylogeny, genetics (13): Grasshoff (1985, 1989), Senn and Glasstetter (1989), Burukovsky (2000), Schönberg (2000), Aguilar and Reimer (2010), Reimer et al. (2010), Camillo et al. (2011), Aharonovich and Benayahu (2012), Hui et al. (2012), Shenkar (2012), Chavanich et al. (2013), Davies et al. (2013)
Trophic and other interspecific relations (10): Türkay and Schuhmacher (1985), Kleemann (1986, 1990), Fabricius (1996), Reimer et al. (2010, 2011), García-Matucheski and Muniain (2011), Hoeksema and Waheed (2012), van der Meij and Reijnen (2012), van der Meij and Hoeksema (2013)
Marine biodiversity general (2): Miloslavich and Klein (2009), Alexander et al. (2011)
Methodology (2): Aharonovich and Benayahu (2012), White (2013)

Table 3 Geographic areas ranked according to frequency of their representation in articles dealing with corals or reefs in the journal Marine Biodiversity and its predecessor Senckenbergiana maritima (1969–present)

Indo-Pacific (35):	Schäfer (1969), Türkay and Schuhmacher (1985), Kleemann (1986, 1990), Senn and Glasstetter (1989), Fishelson (1989), Dullo and Hecht (1990), Heiss et al. (1993), Fabricius (1996), Uiblein et al. (1998), Heiss et al. (1999), Burukovsky (2000), Schönberg (2000, 2001), Barnes et al. (2009), Aguilar and Reimer (2010), Malcolm et al. (2010), Reimer et al. (2010, 2011), Camillo et al. (2011), Aharonovich and Benayahu (2012), Ahmadiya et al. (2012), Grossowicz and Benayahu (2012), Harrison and Smith (2012), Hoeksema and Waheed (2012), Hui et al. (2012), Shenkar (2012), van der Meij and Reijnen (2012), White (2012), Chavanich et al. (2013), Kamezaki et al. (2013), Ohara et al. (2013), van der Meij and Hoeksema (2013), Waheed and Hoeksema (2013), Yeemin et al. (2013)
Atlantic (13):	Grasshoff and Zibrowius (1983), Bijma and Boekschoten (1985), Grasshoff (1985, 1989), Kleemann (1986), Lawniczak (1987), Kleemann (1990), Alvarado (2011), García-Matucheski and Muniain (2011), Carranza et al. (2012), Hoeksema (2012), Davies et al. (2013), Santodomingo et al. (2013)
Worldwide (5):	Grasshoff (1979), Fishelson (1989), Miloslavich and Klein (2009), Alexander et al. (2011), White (2013)

the trend observed in the previous volumes of Marine Biodiversity (Table 1), Cnidaria / Coelenterata form the most frequently represented taxa.

Santodomingo et al. (2013) present an updated overview of the distribution and diversity of azooxanthellate corals (hard corals, soft corals and black corals) in the Colombian Caribbean, and analyze their distribution patterns through a geographic gradient and along a bathymetric range. The results suggest that the boundaries of the local ecoregions may have to be reconsidered, which may have consequences for conservation strategies.

Yeemin et al. (2013) report on a long-term decline in *Acropora* species (Acroporidae) at Kut Island, eastern Gulf of Thailand, in relation to coral bleaching events in 1998 and 2010. The studied reef sites showed a reduction in live coral cover of 80–90 % following the 1998 bleaching event. Recruitment of juvenile *Acropora* colonies remained low. Since 2010, several *Acropora* species seem to be at risk for local extinction or may already have disappeared. Chavanich et al. (2013) report on the diversity and occurrence of nudibranchs in Thailand. The highest diversity, based on a 10-year survey, was recorded for the Andaman Sea (adjacent to the Indian Ocean), when compared with the Gulf of Thailand (bordering with the South China Sea under Pacific Ocean influence).

Waheed and Hoeksema (2013) studied species richness patterns of reef corals (Agariciidae, Euphylliidae, Fungiidae) around the Semporna peninsula in Malaysia. This area is known for its high coral diversity. Two main species clusters can be discerned, which reflects a difference in reef exposure with a gradient in increasing coral diversity from the exposed barrier reef to the relatively sheltered nearshore reefs. For the same area, van der Meij and Hoeksema (2013) discuss the distribution of gall crabs (Cryptochiridae) inhabiting mushroom corals (Fungiidae). High occupancy rates were almost equally distributed over the sheltered and exposed sites, whereas sites without gall crabs were wave-exposed and predominantly under the influence of disturbances, such as blast fishing or relatively high nutrient loads.

Kamezaki et al. (2013) studied the relationship between *Symbiodinium* and zooxanthellate zoanthid colonies along the west coast of Okinawa, Japan. They show that *Zoanthus sansibaricus* has some genetic variation in its symbiosis with *Symbiodinium*, potentially allowing the species to colonize different depths on the subtropical coral reef.

This small, but diverse, collection of papers is expected to add to our understanding of the biodiversity of corals reefs. We hope that this special issue stimulates the publication of more papers on coral reef biodiversity in Marine Biodiversity.

Acknowledgements We are grateful to the editor of Marine Biodiversity and the publisher for allowing us to compile contributions for this special issue on Biodiversity of Coral Reefs. We want to thank the organizing committee of the 2nd World Conference on Marine Biodiversity in Aberdeen (26–30 September 2011) for their support.

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