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Systematics and biodiversity of deep-sea sponges of the Atlanto-Mediterranean region

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Sponges are a key component of the deep-sea benthos, where they form structurally complex habitats and provide numerous ecosystem goods and services. However, there is still an enormous knowledge gap regarding the diversity, distribution and systematics of this group. This special volume presents the results of the 1st International Workshop on Taxonomy of Atlanto-Mediterranean Deep-Sea Sponges, whereby world experts worked together to start filling in this gap. Herein, new species are described, new sponge-dominated communities are reported, and diversity and distribution patterns are enlightened for this area.

Keywords: Porifera, sponge-dominated communities, vulnerable marine ecosystems, taxonomy, biogeography, ecology

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For centuries the deep-sea was perceived as an impoverished area barely contributing to the oceans biodiversity. However, the development of increasingly sophisticated remote sensing and survey technologies (e.g. AUVs and ROVs) revealed remarkable biodiversity hotspots among deep-sea ecosystems such as seamounts, hydrothermal vents, cold-water coral reefs and sponge grounds. The conservation and sustainable use of these ecosystems are among the most critical challenges today and have been recognized at the highest level of international policy. Urgent, knowledge-based action is required if we are to halt the expanding human footprint over such vulnerable ecosystems.

Sponges (phylum Porifera) constitute an important and dominant invertebrate group in both hard- and soft-bottom benthic communities of the deep-sea. In some areas sponges are by far the most dominant group forming structurally complex habitats, known as sponge grounds, aggregations, gardens and reefs. They provide key ecosystem services and goods, namely in terms of habitat and nursery provision for other organisms, biogeochemical cycling, climate regulation, and are also at the forefront of blue biotechnology in the field of drug discovery. However, on account of their presumed slow growth, high longevity and largely unknown reproductive and distribution patterns, deep-sea sponge aggregations are considered particularly vulnerable to ongoing (fisheries, oil and gas exploration) and emerging (mining) anthropogenic activities acting upon the deep-seafloor.

Despite their relevance and vulnerability, research into sponge-dominated communities of the deep-sea is scarce when compared with other taxonomic groups. Indeed, apart from the pioneer work of renowned sponge taxonomists such as Topsent, Carter, Arnesen, Lundbeck and Stephens from the late 19th to the mid-20th centuries, the Atlanto-Mediterranean deep-sea sponge fauna has been seldom studied, likely due to the difficulty posed by this group's taxonomic identification and a current shortage of sponge taxonomists. With the general goal of countering this impediment, a group of sponge taxonomists revived the sponge taxonomy workshops, a series started in 1983 (Ireland) and interrupted since 1995 (Brussels). The volume herein presented results from the 1st International Workshop on Taxonomy of Atlanto-Mediterranean Deep-Sea Sponges, held at the University of the Azores (Portugal) in June 2012, that brought together 26 taxonomists of 14 different countries to work side-by-side and discuss the taxonomy, systematics, biodiversity and biogeography of the Atlanto-Mediterranean deep-sea sponge fauna (Figure 1).

These studies cover the most representative deep-sea dwellers such as glass sponges (Class Hexactinellida), demosponges including rock ('lithistid' tetractinellids) and carnivorous sponges (Family Cladorhizidae), not forgetting also the less studied calcareous sponges (Class Calcarea). As is often the case when exploring deep-sea habitats, several new or otherwise poorly known species and communities have been discovered and are here fully described and illustrated. These include: new carnivorous sponges found at bathyal and abyssal depths in several areas of the Atlantic (Hestetun *et al.*, 2015) including a Lusitanian seamount (Cristobo *et al.*, 2015); new lithistid sponges from the deep Florida shelf (Pisera & Pomponi, 2015) and the Macaronesian islands (Carvalho *et al.*, 2015); new demosponges from the Northern Mid-Atlantic ridge (Cárdenas & Rapp, 2015); and sponge-dominated communities found during ROV surveys at the Gulf of St. Eufemia, in the Mediterranean (Bertolino *et al.*, 2015) and on the Great Meteor seamount (Xavier *et al.*, 2015). Some of the studies offer a more comprehensive overview of the sponge diversity in the deeper areas of the Atlanto-Mediterranean region (Bertolino *et al.*, 2015; Boury-Esnault *et al.*, 2015; Rapp, 2015) and the role (or the lack thereof) of physical and ecological barriers for its biogeography (e.g. Cárdenas & Rapp, 2015; van Soest & de Voogd, 2015). Lastly, the evolutionary history of the subclass Hexasterophora is investigated through a phylogenetic

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Fig. 1. Participants of the 1st International Workshop on Taxonomy of Atlanto-Mediterranean Deep-Sea Sponges, held at the University of the Azores in 2012. Back row (from the left): Gisele Lobo-Hajdu, Magdalena Lukowiak, Julie Reveillaud, Joana R Xavier, Jean Vacelet, Hans Tore Rapp, Eduardo Hajdu, Paco Cárdenas, Claire Goodwin, Rob Van Soest, Megan Best, Pilar Rios, Andreia Cunha, Javier Cristobo. Front row (from the left): Raquel Pereira, Francisca Carvalho, Andrzej Pisera, Francisco Pires, Sigal Shefer, Nicole Boury-Esnault, Iosune Uriz, Dorte Janussen, Shirley Pomponi. Other participants (not in the picture): Maurizio Pansini, Marzia Bo.

reconstruction based on morphological characters (Henkel *et al.*, 2015).

With a total of 19 newly described species and many new records reported, this volume is still a rather small contribution to the filling of an enormous knowledge gap on the diversity and distribution of Atlanto-Mediterranean deep-sea sponges.

REFERENCES

Bertolino M., Bo M., Canese S., Bavestrello G. and Pansini M. (2015) Deep sponge communities of the Gulf of St Eufemia (Calabria, southern Tyrrhenian Sea), with description of two new species. *Journal of the Marine Biological Association of the United Kingdom* 95, 1371–1387.

Boury-Esnault N., Vacelet J., Reiswig H.M., Fourt M., Aguilar R. and Chevaldonné P. (2015) Mediterranean hexactinellid sponges, with the description of a new *Sympagella* species (Porifera, Hexactinellida). *Journal of the Marine Biological Association of the United Kingdom* 95, 1353–1364.

Cárdenas P. and Rapp H.T. (2015) Demosponges from the Northern Mid-Atlantic Ridge shed more light on the diversity and biogeography of North Atlantic deep-sea sponges. *Journal of the Marine Biological Association of the United Kingdom* 95, 1475–1516.

Carvalho F., Pomponi S.A. and Xavier J.R. (2015) Lithistid sponges of the upper bathyal of Madeira, Selvagens and Canary Islands, with description of a new species of *Isabella*. *Journal of the Marine Biological Association of the United Kingdom* 95, 1287–1296.

Cristobo J., Rios P., Pomponi S.A. and Xavier J.R. (2015) A new carnivorous sponge, *Chondrocladia robertballardi* sp. nov. (Porifera: Cladorhizidae) from two North-east Atlantic seamounts. *Journal of the Marine Biological Association of the United Kingdom* 95, 1345–1352.

Henkel D., Borkenhagen K. and Janussen D. (2015) Phylogeny of the Hexactinellida: phylogenetic reconstruction of the subclass Hexasterophora based on morphological characters. *Journal of the Marine Biological Association of the United Kingdom* 95, 1365–1369.

Hestetun J.T., Fourt M., Vacelet J., Boury-Esnault N. and Rapp H.T. (2015) Cladorhizidae (Porifera, Demospongiae, Poecilosclerida) of the deep Atlantic collected during Ifremer cruises, with a biogeographic overview of the Atlantic species. *Journal of the Marine Biological Association of the United Kingdom* 95, 1311–1342.

Pisera A. and Pomponi S. A. (2015) New data on lithistid sponges from the deep Florida shelf with description of a new species of *Theonella*. *Journal of the Marine Biological Association of the United Kingdom* 95, 1297–1309.

Rapp H.T. (2015) A monograph of the calcareous sponges (Porifera, Calcarea) of Greenland. *Journal of the Marine Biological Association of the United Kingdom* 95, 1395–1459.

Van Soest R.W.M. and de Voogd N.J. (2015) Sponge species composition of north-east Atlantic cold-water coral reefs compared in a bathyal to inshore gradient. *Journal of the Marine Biological Association of the United Kingdom* 95, 1461–1474.

and

Xavier J.R., Tojeira I. and Van Soest R.W.M. (2015) On a hexactinellid sponge aggregation at the Great Meteor seamount (North-east Atlantic). *Journal of the Marine Biological Association of the United Kingdom* 95, 1389–1394.

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