Editorial

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Whither marine mycology: the way forward

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First and foremost, we dedicate this special issue to three colleagues who have made an invaluable contribution to our knowledge of marine mycology: Frank H. Gleason, Jørgen Koch and Jan Kohlmeyer who passed away in recent years.

Several special issues of Botanica Marina devoted to marine mycology were published in the past few years: Recent advances in marine mycology (Pang and Jones 2017), Marine mycology: recent progress and future challenges (Pang et al. 2020), Marine zoosporic organisms: Labyrinthulomycota and Oomycota (Hassett et al. 2021) and Whither marine mycology: the way forward (this special issue). The number of marine fungi documented has increased along with the publication of these special issues from 1206 in 2017 (www.marinefungi.org) to 1257 species in 539 genera, 74 orders, 168 families, 20 classes and five phyla (Jones et al. 2019). Calabon et al. in this special issue have provided another update on the number of marine fungi: 1898 species, comprising 7 phyla, 22 classes, 88 orders, 226 families and 769 genera. Clearly many more can be expected as there is a resurgence of interests in the diversity study of marine fungi on a wider range of marine substrata and geographical locations. Prematunga et al. report a new species, Neocamarosporium aquaticum (Neocamarosporicaceae), on a drift dead stem of a halophyte at the Kench Nature Reserve, Hayling Island, UK. Devada-tha et al. describe two new species Paralarotospora marina (Phaeosphaeriacaeae) and Tremateia phragmitis (Didymosphaeriacaeae) on decaying Phragmites australis collected at Cardiff Bay Nature Reserve in Wales, UK. New marine fungal taxa are continued to be described, and a recent figure of 486 species associated with different salt marsh plant hosts suggests that salt marsh ecosystems are a treasure trove for marine fungi (Calabon et al. 2021). Wood (drift, intertidal, mangrove) has always been a popular substratum for marine fungi since the study by Barghoorn and Linder (1944), especially in temperate, tropical and subtropical areas. Marine fungi were also reported to be diverse on wood in much colder polar environments (Hagestad et al. 2019; Pang et al. 2011; Rämä et al. 2014). Adams and Walker studied the diversity of fungi on marine inundated wood from the intertidal zone along the Bay of Fundy coastline in Nova Scotia, Canada using a culture-based approach.

Marine fungi can also be isolated from a wide range of other substrata: animal exoskeleton, keratinaceous materials, sediments, sea foam and seawater (Vrijmoed 2000). Little is known on the fungal community associated with marine animals, except those that can cause infections/diseases, e.g., microsporidia on fish, dolphins, Crustacea (Bojko and Stentiford 2022; Stentiford et al. 2014), and especially in aquacultural settings (Pang et al. 2021). Potential pathogenic fungi of marine animals were cultured from the carapace of healthy individuals of the marine hydrothermal vent crab Xenograpsus testudinatus (Shaumi et al. 2021), and whether this niche is a carrier/vehicle for marine fungal diseases is a topic requiring further study. The fungal diversity obtained by Shaumi et al. on the marine crab Portunus sanguinolentus and Papan et al. on the coral species Pocillopora damicornis and Portites lutea has provided further evidence on the presence of pathogenic fungi on healthy marine animals.

Ascomycota is the dominant group of marine mycota while only 27 species of culturable Chytriomyctoca and allied taxa are documented (Jones et al. 2019). Advance ment of high throughput sequencing techniques in the last two decades enables the discovery of unculturale taxa, especially Chytriomyctoca and phylogenetically related groups, enhancing our knowledge on the diversity of fungi in the marine environment. However, the inability to isolate these groups in culture hinders our understanding on their ecophysiology and ecological roles in the marine environment. Guo et al. cultured multiple isolates of the chytrid species Alphamyces chaetifer and Gorgonomycetes haynaldii from freshwater/estuarine environments in Taiwan, and tested on their growth response under the combined effects of salinity and temperature. Growth rate of these two isolates were found to be sensitive to high salinities (>8). Culturing true marine zoosporic fungi will

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continue to be one of the many challenges in the study of marine fungi.

In the last few editorials of the special issue in *Botanica Marina*, a few key topics were brought up and suggested for further study, including ecological role(s) and economic/industrial potential of marine fungi and fungus-like eukaryotes, and the effect of climate change on marine fungi (Jones et al. 2022; Kumar et al. 2021). Saikia et al. have provided a review on the most advanced techniques (e.g., manoeuvre of fermentation condition, strain improvement) in the production of polyunsaturated fatty acids (PUFAs) in the Labyrinthulomycetes and the commercial prospects of PUFAs produced by this group of marine heterotrophic microorganism. Pang et al. listed further topics to investigate in marine mycology in the future: genome sequencing of marine fungi for basic and applied research, conservation of marine fungi to prevent extinction of species with potential prospects in industry or pharmaceutical and plastic pollution on fungal carbon flux in the marine environment. All these topics are multidisciplinary topics and require different expertise and collaboration from global marine mycologists. In the same paper, the history and current state of marine fungal research in 20 different countries were summarised by active marine mycologists working in these states, encouraging international transdisciplinary research collaboration.

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**Bionotes**

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E. B. Gareth Jones, graduated PhD University of Leeds, DSc University of Wales, is renowned for his 60-year study of marine fungi, the author of some 650 articles on their ecology, physiology and systematics and has co-edited a number of books and journal special issues. He has reported on marine fungi from around the world, in particular Asia, especially those found on mangrove substrates. He has supervised over 150 PhD/MSc students and is a highly cited scientis.