Marine discomycetes: A review

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In common with basidiomycetes, few discomycetes occur in the marine environment as they do not have the ability to withstand being submerged in seawater for long periods or exposure to wave action. Most marine basidiomycetes are agarics, which have adapted to life in the sea and evolved a reduced basidiome. Marine discomycetes include Dactylospora canariensis, D. haliotrepha, D. mangrovei, Gloniella clavatispora and Vibrissea nypica from tropical or subtropical mangroves as well as Lachnum spartinae and Laetinaevia marina on the marsh-grass Spartina or various brown seaweeds in temperate latitudes. Marine discomycetes have leathery apothecia and can withstand constant wetting by brackish to fully saline water. Further studies are warranted of marine discomycetes especially in brackish water habitats.

[Key words: Discomycetes, mangrove wood, fungi, biodiversity]

Introduction

The marine environment imposes limitations on fungi able to colonize available substrata. For example, oceanic fungi (e.g. Halosphaeriales) that grow on submerged substrata generally have asci that deliquesce early and release their ascospores passively. They also possess ascospores with elaborate appendages that aid in floatation, and entrapment and attachment to suitable substrata. Mangrove fungi on the other hand, tend to be intertidal, their ascospores may have mucilaginous sheaths, but generally lack the elaborate appendages found in oceanic fungi. Ascospores in bitunicate ascomycetes, which are the most frequently encountered in mangrove habitats, are actively discharged from the asci. A wide range of substrata are available in the sea for colonization by a number of fungi. Jones has reviewed the factors that affect their occurrence and distribution. Wave action may restrict the occurrence in the sea of fungi with large fleshy putrescent fruit bodies, but those with small (often microscopic) fruit bodies are able to tolerate such conditions, e.g. the marine basidiomycetes Digitatispora marina, Halocyphina villosa and Nia vibrissa. However, these fungi tend to occur in the intertidal mangrove zone, although the basidiomycete Mycaureloa dilsea occurs on submerged thatli of the red seaweed Dilsea carnosa. Therefore, to withstand repeated submergence, many fungi have leathery, or carbonaceous or enclosed fruit bodies, e.g. carbonaceous ascomata of areniculous ascomycetes. However, salinity and temperature are the major factors affecting the distribution of marine fungi. The oceans of the world vary greatly in intertidal amplitude and salinity of the water, all features that can dramatically affect fungal biodiversity. Early physiological studies of marine fungi concentrated on their salinity requirements in the belief that they had a requirement for sodium chloride at concentrations found in seawater. Zoosporic fungi such as Althornia, Haliphthoros and Thraustochytrium species have a sodium requirement for growth at the macronutrient level. However, Schizochytrium species have been repeatedly isolated from mangrove habitats with low salinities, while Halophytophthora species exhibit a wide tolerance to salinity in nature and under laboratory conditions. These organisms are well adapted to the varying salinity in mangroves, such as the Mai Po mangrove, Hong Kong SAR.

Cai et al. are of the opinion that few discomycetes occur in freshwater habitats in the tropics. So what of the marine habitat?

Material and Methods

Mangrove wood was collected from various locations in Hong Kong, Malaysia, Singapore, Philippines, Taiwan and Thailand over many years,
and the discomycetes present were documented. Collections were returned to the laboratory and incubated as described by Jones et al., Hyde & Jones and Vrijmoed document methods for the examination of substrata for marine fungi.

Results and Discussion

Eight discomycetes have been reported from marine habitats so far, as listed in Table 1.

**Dactylospora** spp

Of the marine discomycetes, *Dactylospora* species are the most commonly encountered, especially *D. haliotrepha*. This species is widely distributed on mangrove wood in subtropical and tropical locations. Jones et al. have published a world map showing its distribution in old and new world mangroves. Schmidt & Shearer listed this species from the Atlantic, Middle-east, Indian and Pacific Oceans, with collections from 32 countries and this is one of the most commonly reported mangrove fungi. In an intensive study of mangrove fungi in Malaysia over ten years, 297 collections were made of *D. haliotrepha*

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*Table 1—Discomycetes reported from marine habitats.*

*Vibrissa nypicola*

This species was described from decaying fronds of the palm *Nypa fruticans* and is known from Brunei and Malaysia (the type locality). We recently collected this species at a small *N. fruticans* mangrove at Koh Chang Island, Thailand. Morphological features were in agreement with the holotype material.

*Patellaria* spp

Ascomata in this species arise singly or in groups, are at first closed and immersed, later open by a pore or by a wide longitudinal cleft in the early stages of development to expose a flat or convex black disc. The ascomata are apotheciod, sessile, circular or elongate, subgelatinous when moist, 0.3-1(-1.5) mm diam, 0.2-0.3 mm tall (Fig. 1A, B). Hamathecium is representing 5.8% of total fungal collections, and ranked 17(ref no.27). Sarma & Hyde, in a review of the frequency of occurrence of mangrove fungi in a wide range of studies, grouped them into very frequent (>10%) and frequent (5-10%). In most of the studies *D. haliotrepha* was present as a frequently occurring species (12 studies) and very frequent in 4 studies. In succession studies of submerged mangrove wood test blocks, *D. haliotrepha* does not play a major colonizing role. On *Avicennia marina* it was absent at all stages in the colonization sequence (1-90 weeks), but on *Bruguiera parviflora* it occurred at the intermediate stage (26-54 weeks) and late stages (72-90 weeks) suggesting a host preference. However, there is no indication that it is host specific, Schmidt & Shearer having reported it from decaying wood of 21 mangrove trees. In a similar study in Singapore *D. haliotrepha* was a late colonizer of *Bruguiera cylindrica* and *Rhizophora apiculata* test blocks submerged in the sea but was classified as an infrequent species (<10 occurrence). In a study of the vertical distribution of marine fungi on *Rhizophora apiculata* in Malaysia, *D. haliotrepha* was shown to occur in the upper and middle intertidal zones and was absent at the lower level.
initially made of paraphysoid netted filaments and later of slender and septate upward-growing filaments, branched above, hyaline, 20-25(-40) µm (Fig. 1 C, F). Asci are cylindric-clavate, with a distinct stipe, bitunicate, with a fissitunicate dehiscence and are 4–8-spored (Fig. 1 D, E). Ascospore are irregularly biseriate, clavate, often slightly curved, 5-11-septate, not constricted at the septa, hyaline, without a gelatinous sheath, and measure (20-) 30-45(-58) x (6-) 7-9(-12) µm. (Fig. 1H-J). Collections have been made mainly on Kandelia candel from Hong Kong, Malaysia and Thailand.

Gloniella clavatispora

This species is known only from a collection made on Avicennia marina in South Africa and is superficially similar to the Patellaria species reported above. Both taxa have dark brown to black apothecia, asci bitunicate, short pedicellate and ascospores that are hyaline, clavate and smooth walled. They differ in the nature of the paraphyses, those of Patellaria being distinctly branched, and cells club-shaped and in ascospore dimensions and septation.

Lachnum spartinae

This discomycete occurs on the upper parts of Spartina alterniflora leaves and appears late in the succession of fungi towards October to November, and prefers low temperatures for growth in nature and in the laboratory. It is doubtful if this species is subject to inundation by seawater, until the culms fall into the marsh floor in the spring. Lachnum palearum and L. controversum have also been reported from the intertidal grasses Spartina townsendii and Phragmites sp., respectively. Cantrell et al. suggest that L. spartinae plays an important ecological role in the decomposition of Spartina culms in salt marshes.

Other marine discomycetes

The discomycetes discussed above are those fully described and most frequently recorded from marine habitats. Jones & Abdel-Wahab recorded 6 unidentified discomycetes from the Bahamas, but insufficient material was available for fuller treatment.

None of the discomycete genera reviewed in this paper has been subject to a phylogenetic study at the molecular level. As many are variously referred to different families and orders, this is a topic that warrants attention. The placement of the Dactylosporaceae in the order Lecanorales is an example. While many mangrove fungi have been shown to have the potential for the production of bioactive compounds (Aigialus parvus; Halorosellinia oceanica), no results are available for any of the marine discomycetes.

Only Dactylospora species have been studied at the ultrastructural level with scanning electron microscopy revealing the surface ornamentation of the ascospores: longitudinal striations in D. haliotrepha, convoluted ridges in D. mangrovei. Au et al. showed that the longitudinal ridges in D. haliotrepha were outgrowths of the mesosporial ascospore wall layer and formed late during ascosporogenesis. They also demonstrated that the ascospore was ensheathed by the exosporium with mucilaginous material between the spore ridges.

Another group that warrants further attention is marine lichens, which also produce apothecial ascomata.

Mangrove discomycetes generally occur on well-decayed wood in the upper littoral zone and possess leathery apothecia that survive in this environment of varying salinity and often in highly organically polluted waters. It is a group that deserves further investigation, especially with regard to their adaptation to the marine brackish water milieu.

Acknowledgement

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References


