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Research Article

Bioecological aspects of Marine and Mangrove Fungi

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Abstract

Biological diversity refers the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystem and ecological complexes of which they are part. Biodiversity encompasses all life forms, ecosystems and ecological processes and acknowledges the hierarchy at genetic, taxon and ecosystem level. The essential ingredients of biodiversity are phenotypic flexibility genetic variation within populations and ecotypic variations. Microbial biodiversity can be viewed from a variety of perspectives, including physiological diversity, interaspecific genetic diversity and phylogenetic diversity of species and higher taxa. Microbial diversity represents the largest untapped reservoir of biodiversity for potential discovery of new biotechnological products, including new pharmaceuticals, new enzymes, new special chemicals or new organisms that carryout novel process.]

Keywords: Biological diversity; Terrestrial; marine; aquatic ecosystem; Marine fungi; Mangrove fungi; Fungi in water; Sediment; Fungi on different substrata

Introduction

Most early studies on fungi colonizing mangroves were taxonomic and confined mainly to cataloguing fungi and describing new taxa collected in a given area (Cribb and Cribb, 1955; Kohlmeyer and Kohlmeyer, 1964 – 1969, 1971, 1977; Kohlmeyer, 1966, 1969a, 1981, 1984, 1985; Kohlmeyer and Schatz, 1985). Until recently, there have been few ecological studies on manglicolous fungi. Recent studies on inertial mangrove fungi have provided information on (a) frequency of occurrence (b) vertical zonation, (c) host and substratum specificity, (d) succession, and (e) seasonal occurrence (Aleem, 1980; Jones *et al*., 1988; Hyde, 1988a, 1989c, 1990b, 1991; Leong *et al*., 1991; Poonyth *et al*., 1999). Of these, considerable effort has been spent investigating the frequency of occurrence of manglicolous fungi (Jones and Tan, 1987; Borse, 1988; Hyde, 1988a,b, 1989a,b,c; Hyde and Jones, 1988; Jones *et al*., 1988; Jones and Kuthubutheen, 1989; Tan *et al*., 1989; Tan and Leong, 1990,1992).

Early studies on marine fungi on mangroves have focused on taxonomy of marine fungi including descriptions of new species and new genera, lists of fungi and surveys. This includes the marine fungi occurring in mangrove environments. Excellent reviews and vast amounts of information on marine fungi have appeared in several texts. (Johnson and Sparrow, 1961; Jones, 1976; Moss, 1986; Hyde and Lee, 1995; Jones, 1995; Jones and Alias, 1996). For several accounts on various aspects of marine fungi the following works, among others, are referable (Chinnaraj, 1993a; Jones and Tan, 1987; Hyde and

Jones, 1988; Hyde, 1990a; Hyde *et al*., 1990; Ravikumar, 1991; Leong *et al*., 1991; Kohlmeyer and Kohlmeyer, 1979; and Kohlmeyer *et al*., 1995). Ecological studies on manglicolous fungi are relatively recent i.e. from late 1980s onwards. A wealth of information is now available on different ecological aspects of fungi in mangroves including frequency of occurrence, vertical distribution, substrate preference, succession, seasonal occurrence and host specificity. However these are mainly from South East Asia (Hyde and Lee, 1995; Jones and Alias, 1996).

There are umpteen literatures on the ecology and taxonomy of soil fungi Most of the reports relate to the study of fungal flora from cultivated agricultural soils, uncultivated soil, pasturelands and forest soils. However, little is known about the microbial ecology of mangrove swamps. During the past several years, considerable work has been done on the taxonomy and ecology of mangrove swamp fungi in India (Padhye *et al.*, 1967; Pawar, *et al*., 1963; 1965 and Rai and Tewari, 1963).

Earliest studies on the ecology of mangroves fungi Kohlmeyer (1969a) encountered 3 common species of marine fungi in the mangrove habitat, namely *Lulworthia* spp (20% of all collections) *Leptosphaeria australiensis* (15%) and *Phoma* species (10%). 100 Mangrove species; only 8 have been examined for the occurrence of marine fungi and the latest Island research was conducted in Bermuda and collected 15 marine Ascomycetes, 1 Basidiomycetes, and 6 Deuteromycetes (Kohlmeyer and Kohlmeyer, 1977). Aleem (1980) reported that the Ascomycetes; *Halosphaeria viscidula*, *Rosellinia* sp and *Torpedospora radiata* were frequent on mangroves in sierra Leone and also found that the Mitosporic taxa. *Cirrenalia macrocephala*, *C. pygmea*, *C. tropicalis, Periconia* and *Zalerion* spp were abundant on mangrove wood. Kohlmeyar (1984) also reported that *L. australiensis* was a common species of mangroves. Although mangrove fungi of the West coast of India have been well studied, there have been few studies on the East coast (Bay of Bengal), despite the fact that its mangroves are more extensive compared to the west coast. (Untawale, 1987). Hyde and Jones (1988) observed the some fungi tend to occur configuration at certain levels and also reported that the greater species diversity occurred at the mid – littoral level.

Booth (1971b) observed on occurrence and taxonomy of aquatic fungi in saline habitats. Hyde (1989a) reported that the lignicolous materials were collected from 5 marine locations in Brunei; a rocky head land, a sandy beach, a man – made brackish lake, a healthy mangrove and an oil - polluted mangrove. Higher marine fungi present were identified and their percentage occurrence noted. There were significantly less diversity and number of fungi in the oil-polluted mangrove when compared to the healthy mangrove. Most attention to data has concentrated on assessment of fungal diversity, physiology and biochemistry (Kohlmeyer and Kohlmeyer, 1993). Hyde and Lee (1995) suggested that the diversity of marine fungi is greater in the tropics and attributed this to mangrove tree species richness. Jones *et al.* (1999) recorded all marine fungi from Marine habitats can be designated as micro fungi the “micro habitat predictor ” model appear to the applicable in the marine environments.

Diversity most simply can be expressed as species richness, that is the number of species (Magurran, 1988). However, since richness increase in direct relation to number of individuals, area and variety of habitats sampled. Ecological variation over the temporal and spatial dimensions of the sample may augment diversity because of the increased number of areas, habitats or seasons included. Hyde (1990c) recognized the different in the common species at study sites, a core group of fungi occurring in the mangrove ecosystem. The Majority of the species *Dactylospora haliotrepha*, *Leptosphaeria avicenniae* were also reported from Brunei and other tropical mangroves (Hyde 1989a). Alias *et al*. (1995) reported that more than 60 fungal species can be recorded as common to mangrove ecosystems of the West Indo Pacific region.

Chinnaraj (1993a,b) had earlier reported 63 species of higher marine fungi from the Andaman and Nicobar Islands, which are approximately 1000 km away from the mainland on the East coast.

Ravikumar and Vittal (1996) reported 48 species belonging to 37 fungal genera on *Rhizophora apiculate* at Pichavaram.

As diverse vegetation exists in mangroves, it is considered as a major niche of fungal repository. Mangrove fungal diversity is dependent on the age of mangrove, diversity of mangrove plant species and the physicochemical features of mangrove habitat (temperature, salinity and tidal range) (Hyde and Jones, 1988; Jones, 2000). Twenty-eight mangrove tree species yielded 120 higher marine fungi (Hyde, 1990b). Fifty-five mangroves and their associates yielded about 200 higher marine fungi (Jones and Alias, 1996). *Rhizophora apiculata* among the mangrove tree species harboured a maximum of 63 higher marine fungi (Sarma and Vittal, 2000).

Among the different geographical locations; South East Asia has been sampled most thoroughly (Hyde and Lee, 1995; Jones and Alias, 1996). There seem to be no discernible difference between mangrove fungi reported in the subtropics as compared to those found in tropical areas. Among 900 known marine fungi, 358 are recorded from the mangrove ecosystem (Jones and Alias, 1996; Jones and Mitchell, 1996). Out of 54 mangrove tree species and 60 mangrove associate plant species, up to 55 species have been studied for fungi (Jones and Alias, 1996). Studies on mangrove fungi from the Indian Ocean are limited compared to the Atlantic Ocean and Pacific Ocean and South – East Asian region. Although the Indian peninsula possesses about 6700 km^2 of mangroves (Natarajan, 1998) only a few studies dealt with fungal richness and diversity in Gujarat (Borse *et al*., 2000; Patil and Borse, 2001), Maharashtra (Borse, 1988), Karnataka (Ananda and Sridhar, 2003), Tamil Nadu (Ravikumar and Vittal, 1996) and Andra Pradesh (Sarma and Vittal, 2000).

Sarma and Vittal (2000) investigated the fungal diversity of proproots, seedlings and wood of *Rhizophora apiculata* and wood, roots and pneumatophores of *Avicennia* spp in deltaic mangroves of Godavari and Krishna rivers in the east coast of India. The number of fungi recorded on proproots (61) was much greater when compared to wood (24) and seedling (21).

The distribution of fungi in Muthupettai mangroves along the East coast of Tamil Nadu, India was studied in terms of species diversity, seasonal variation, and frequency of occurrence in five sampling stations at two different seasons. In this study, total of 118 species of fungi isolated, of which maximum 94 species from sediment samples followed by water with 83 species. Among the fungal isolates *Aspergillus* was the common genus followed by *Penicillium*, *Curvualria* and *Alternaria* (Sivakumar *et al*., 2006).

Fungal biodiversity in freshwater, brackish and marine habitats were estimated based on reports in the literature. The taxonomic groups treated were those with species commonly found on submerged substrates in aquatic habitats: *Ascomycetes* (exclusive of yeasts), *Basidiomycetes*, *Chytridiomycetes*, and the non-fungal *Saprolegniales* in the Class *Oomycetes*. Based on presence/absence data for a large number and variety of aquatic habitats, about 3,000 fungal species and 138 saprolegnialean species have been reported from aquatic habitats. The greatest number of taxa comprise the *Ascomycetes*, including mitosporic taxa, and *Chytridiomycetes*. Taxa of *Basidiomycetes* are, for the most part, excluded from aquatic habitats. The greatest biodiversity for all groups occurs in temperate areas, followed by Asian tropical areas (Shearer *et al.*, 2007).

Fungi in Marine, Mangrove water and sediment

Single species isolated from mangrove soils by Stolk (1955) on an *Emericellopsis* and *Westerdykellaornata* from East Africa and the paper by Swart (1970) on a *Pencillium* from Australia. The thraustochytrids comprise 7 genera and 31 species of marine fungoid protists has been found in estuarine, Littoral, and oceanic waters and sediments around the world. (Gaertner 1967a, 1968a,b; Bahnweg and Sparrow, 1974). Most fungi recorded from marine sediments use collected from coastal regions and are typical soil fungi, which are terrestrial in origin (Borut and Johnson, 1962;

Vrijmoed and Hughes, 1990). Ulken (1970, 1972) studied occurrence and physiology of lower fungi from marine sediment in Brazil.

Hyde *et al*. (1987) reported the techniques for obtaining sporulation of marine fungi, 65 Ascomycotina, 24 Deuteromycotina, ad 3 Basidiomycotina known to sporulating culture. Jones (1993) revealed the marine fungi appear to be distributed in relation to seawater temperature; arctic, temperate tropical; although others grew equally well over a range of temperature. Christopherson *et al*. (1999) reported that a total of 227 marine isolates of ubiquitous fungi were cultivated on different media and fungi were isolated include 18 different fungal species from 8 Ascomycetes genera from animals, plants and sediments of Venezuelan waters (0 – 10m) including mangroves and lagoon areas.

Occurrence of fungi on different substrata / tissue specificity (wood/twig, pneumatopores, seedlings, leaves and roots, sea foams and algal samples)

Mangrove substrates

Soft rot in terrestrial known since the middle of nineteenth century and this type of wood decay was later described and illustrated for fungi of marine habitats (Kohlmeyer, 1958). Ritchie (1959) has shown that common terrestrial fungi exist there on submerged wood and other similar substrates. Kohlmeyer (1969a) observed that among large collections, several fungi were encounted only in roots and stems of living *Avicennia* or *Rhizophora* and appear to be host specific. Terrestrial fungi develop on roots and branches above the high – tide line and on over lapping between marine and terrestrial species may occur at the water – air interface (Kohlmeyer, 1969b). Lee and Baker (1973) demonstrated some of the isolated fungi derived from dormant propagules of terrestrial species.

Johnson (1967) noted that the lignicolous fungi collected in the Neuse – Newport estuary were predominantly of terrestrial origin (73%) and majority of these were from water of less than 18% salinity (81%) while only 12% were recovered from whole estuary i.e. 0- 34 %. Kohlmeyer and Kohlmeyer (1971) listed 51 marine Deuteromycetes and 36 of these are lignicolous and the majority belongs to terrestrial genera (*Alternaria*, *Camerosporium*, *Dedryphiella*, *Diplodia*, *Humicola*, *Monodictys*), while other exclusively marine (*Cirrenalia*, *Orbimyces* and *Zalerion*).

Ritchie (1968) submerged wood of 8 tropical trees in the Panama canal zone and examined wood sections and found green heart (*Ocotea rodiaei*) and red mangrove (*Rhizophora mangle*) preactically fungus – free after about 6 weeks of exposure and one marine fungi *Lulworthia* species in addition to some 20 Deuteromycetes of terrestrial origin was isolated Kohlmeyer (1969b) reported that the ascocarps of *Keissleriella blepharospora* develop between cork cells of roots or submerged seedling of *Rhizophora* spp. Fell and Master (1973) reported that the senescence of leaf materials, they support a very different fungal community, which are responsible for their degradation.

Marine fungi like *Leptosphaeria* species, *Mycosphaerella* species, and *Cirrenalia macrocephala* were for the first time recorded only by direct microscopic observation of the pneumatopores of *Avicenia officinalis* from Indian mangrove habitat by Garg (1982). Hyde (1989c) reported that the decayed archids *Acrostichum speciosum* (Mangrove fern) were collected from Kampong Kapok mangrove, Brunei and examined for higher marine fungi (A new bitunicate ascomycete, *Massarina acrostichi).* Hyde *et al*. (1990) investigated the distribution of fungi on *Sonnertia griffithi* and showed that some fungi were common on pneumatophores (*Aigialus grandis* and *Massarina velatospora*) while others were common on twigs (*Saccarcloella mangrovei* and *Savoryella longispora*).

Kohlmeyar and Vittal (1986) studied marine fungi of the mangal in Belize and India, encounted independtly a common Ascomycete (*Lophiostoma* sp.) growing at the upper intertidal level on bark ad wood of mangrove trees. Mouzouras *et al*. (1988) reported the ability of microorganisms to decay wood submerged in the sea and 42 marine fungi, belonging to the Asomycotina and Deuteromycotina have been shown to cause soft - rot decay of wood while 3 Basidiomycotina caused white rot - decay. Pena *et al*. (1996) reported that the first contribution to the knowledge of lignicolous marine fungi from Mardal plata, Argentina .10 species were collected from submerged wood panels, intertidal wood and driftwood.

Studies on marine and mangrove fungi of Indian ocean is quite recent and has been less well explored compared to the Atlantic and Pacific Oceans (Koch, 1986; Borse, 1988, Zainal and Jones; 1986; Hyde, 1988a; Steinke and Jones, 1993). Although Indian sandy beaches, mainland mangroves and some islands have been studied for mangrove and marine fungi, there are few quantitative studies (Borse, 1988; Ravikumar and Vittal, 1996; Prasannarai and Sridhar, 1997, 2000-2001, 2001; Sarma and Vittal, 2000, 2001; Sarma *et al*., 2001; Maria and Sridhar, 2002). Sarma and Hyde (2001) have reviewed factors affecting the frequency of occurrence of fungi in mangroves. A few studies are available on the impact of incubation of lignocellulosic materials collected from different habitat on the occurrence of fungi (Hyde, 1992b; Prasannrai and Sridhar, 1997).

Marine substrata support different fungal assemblages, for example the mangrove palm *Nypa fruticans* and woody tissue of mangrove trees such as *Rhizophora apiculata* and *Avicennia marina*. Typical fungi on *N. fruticans* included *Astosphaeriella striatispora*, *Linocarpon appiculata, L. nypae, Oxydothis nypae* and *Trichocladium nypae*, taxa never recorded from mangrove wood (Hyde and Nakagiri, 1989; Hyde, 1992a; Hyde and Alias, 2000; Pilantanapak *et al*., 2005).

Hyde (1991) reported *Phomopsis mangrovei*, coelomycetous fungus on proproots of *Rhizophora apiculata* from Ranong mangrove, Thailand. Kohlmeyer and Kohlmeyer (1993) revealed the comparison of the marine mycota of recently introduced *Rhizophora* species (Hawaii and Moorea) with that of long established *Rhizophora* stands from the Caribbean (Belize) and 43 species are known from *Rhizophora* in Belize and only 7 and 21 species were collected from Moorea and Oahu respectively.

Ravikumar and Vittal (1996) reported on the fungi colonizing different substrata of *Rhizophora apiculata* and *R. mucronata* from Pichavaram mangroves of Tamil Nadu, East coast of India and concluded that different substrata of the same host plant are colonized by different frequently occurring fungi. According to Hyde *et al*. (1990b) bark was an important factors in determing the mycota present on *Rhizophora apiculata* particularly when small diameter roots were examined. Young roots surrounded by bark were invariably colonized by *Leptosphaeria* sp., *Lulworthia grandispora*, *Massarina ramunculicola*, *phomopsis* sp. and *Rhizophila marina*.

Borse *et al*. (2000) reported that the higher marine fungi in foam and intertidal wood and dead submerged wood of *Avicennia marina* from Daman coast. In this study 13 species of higher marine fungi (10 Ascomycetes,3 Deuteromycetes) were recorded. Borse (2000) studied that the 83 species (62 Ascomycetes, 3 Basidiomycetes, 18 Deuteromycetes) of higher marine fungi from Maharashtra Coast (The Arabian sea) including 19 species as new records for the fungi of Maharashtra from the substrates include driftwood, intertidal wood harbour timber and dead submerged parts of the mangroves.

Fungi on Seaweeds and Seagrasses

Some of the leaf – inhabiting saprobes occur on rhizomes of the same host as well; for instance, *Lulworthia* species, on rhizomes of *Zostera marina* (Kohlmeyer, 1963) and *Thalassia testudrinum*, (Kohlmeyer and Kohlmeyer 1971). Tubaki and Asano (1965) recorded 16 imperfect fungi on seaweeds most of them as saprophytes like *Dendryphiella qrenaria*, *D. salina*, *Alternaria maritima* and *Monodictys austrina*. *Leptosphaeria* sp., *Pleospora* sp., and *Sphaerulina pedicellata* are all very common on *Spartina* culms by Johnson and Howard (1968). The sporadic occurrence of algicolous fungi may be explained by antibiotic substances produced by healthy algae (Sieburth, 1968).

The rhizoid of Phycomycetous fungi and the ectoplasm that elements of Thraustochytrids penetrate the host cells and draw nutrients and they may also be endoparasites (Chandralata, 1986, 1987). Recent work on *Juncus roemerianus* (Kohlmeyer and Kohlmeyer, 1995, 1996; Kohlmeyer *et al.*, 1995, 1996, 1997) and on *Phragmites australis* (Poon and Hyde, 1998) have resulted in the discovery of a number of species new to science.

Fungi on Sea foams

Recently, Bandoni (1972) reported the occurrence of some of these conidial fungi in terrestrial habitats and 40 conidial fungi were identified and assigned to 20 genera. Kirk *et al*. (1973) reported that the collection ,identification of ecological groups of lignicolous, arenicolous, graminicolous and endocommansalic fungi within the sea foam ,wood and marsh grass plants. The role of conidial fungi in processing of an aquatic litter, energy flow, productivity and experimental aspects of these fungi have been worked out by Barlocher and Kendrick (1974, 1976), Suberkropp and Klug (1976) and Suberkropp and Thomas (1984). Ingold (1975) reported that conidia of most of them accumulate in foam, which acts as a spore trap, and " the examination of a foam samples can very quickly give a picture of the species present in a particular stream above the point of collection". The ecological studies of concerning conidial fungi have emphasized their role in processing litter, energy flow, and productivity in aquatic ecosystems (Suberkropp and Klug, 1976). Conidiogenesis has been worked thoroughly in some conidial fungi colonizing submerged leaves and foam by Descals *et al*. (1977) and Ingold (1975).

Seafoam generally contains the highly distinctive spores of *Corollospora* sp., C*arbosphaerella* sp., *Varicosporina ramulosa* in tropical and *Asteromyces cruciatus* in temperate areas, *Alternaria* and other terrestrial and marine fungi depending upon climate and local conditions, (Kohlmeyer and Kohlmeyer, 1979; Boyd and Kohlmeyer, 1982). Microscopic counts of fungi, algae, protozoa and in liquefied sea foam demonstrated the potential of the simple and direct approach information of the ecological roles, seasonal and geographic distribution of marine microorganisms (Kohlmeyer and Kohlmeyer, 1979). New geographical limits for several species, the seasonal distribution of tropical *V. ramulosa* and the vertical zonation of *Corollospora* species, deposited by sea foam were less active physiologically than geo fungi and calcicolous marine species in the upper 30cm of the strand line. (Kirk, 1983). A new marine Ascomycte, *Lindra obtusa* and its anamorph, *Anguillospora marina* isolated from sea foam samples on some shores of Japan and appear to be adapted to marine habitats was described by Nakagiri and Tubaki (1983).

Murthy and Manoharachary (1981), Manoharachary and Madhusudhan Rao (1983), Madhusudhan Rao and Manoharachary (1984), Sridhar and Kaveriappa (1982) and Subramanian and Bhat (1981) have studied the conidial fungi associated with foam and submerged leaves. Sridhar and Kaveriappa (1982) have studied the conidial fungi associated with foam and submerged leaves. Mahusuhan Rao and Manocharachary (1984) have reported the association of conidial fungi on diversified submerged leaves.

Patil (2003) reported that the submerged leaves of *Memmeaylon umbellaun* and *Mangifera indica* were colonized by species of *Alastospora*, *Beltrana*, *Flagellospora*, *Ingolidiella*, *Lemonniera*, *Lunulospora*, *Monosporella* and *Triselophorus* along with these fungal forms of species of *Actinospora*, *Angiullospora*, *Cameroporium*, *Caluariopsis*, *Spelroplis*, *Tetrachacum* and *Tetraploa* are also isolated in foam samples. These conidial fungi play important role in processing aquatic litter, energy flow and productivity.

Isolation of Fungi by Baiting technique

The studies of Gold (1959), Hughes (1960), Johnson (1967), Schaumann (1968) and Shearer (1972) have been concerned with the colonization of wood in estuaries and Gold using bars wood and sycamore panels as bait, established six sites of various salinities in the Newport river estuary, North Carolina. Johnson and Sparrow (1961) reported that the submerging the panels for certain periods of time, followed by removal of the fouling organisms after recovery and incubation of the wood in moist chambers. Newell (1973) studied from the 460 wash plate, disc plate and damp chamber and the 95 baited dish observations conducted dump the 13 months study periods in Southern Florida, 947 occurrences of fungi were recorded, representing 84 species of fruiting fungi. Hasija and Miller (1970) reported for Chytridiomycetes and the techniques of baiting of Saprolegniaceous and Phythiaceous fungi. Gessner and Goos (1973) employed the bag method to investigate the mycoflora of *Spartina alterniflora* in a Rhode Island Gidal marsh. Gaertner (1967b) reported that the occurrence and distribution of lower marine pollen baitable fungi were investigated in the surface water of the South Western part of the North Sea, near the Shetland Islands, the Faeroe Islands and the Norwegian Sea up to the Scolpen bank.

Newell (1976) utilized untreated and injured seedlings of *R. mangle* submerged in nylon mesh bags. The direct observation combined with damp chamber incubation yielded 14 marine and 18 terrestrial fungi (Gessner, 1977). Kohlmeyer and Kohlmeyer (1979) studied pieces of wood, living or dead algae, marine phanerogams collected in marine habitats are incubated in moist chambers like Petridishes or large containers lined with wet filter paper and mycelium or fruiting bodies developing on the surface of the substrates can be used for the isolation of fungi.

Studies by Kohlmeyer (1984), Zainal and Jones (1984, 1986), Hyde and Jones (1988) and Tan *et al*. (1989) have demonstrated the presence of a distinctive mycota for wood exposed in mangroves and sawn wood submerged in the open sea as test panels and the fungi were studied by direct microscopic observation of living and dead standing plants and by litter bag method. Differences have been observed in the species composition and frequency of occurrence of fungi between natural samples and pre – sterilized panels submerged in waters for succession studies (Vrijmoed *et al*., 1986; Leong *et al.*, 1991). Tan *et al.* (1989) reported that the data obtained with wood baits differed markedly from those sampled randomly in mangroves.

A number of marine mycologists have used baits for ecological studies of fungi in particular habitat. Mangrove fungi in mangroves (Tan *et al*., 1989; Leong *et al*., 1987; Alias *et al*., 1995) lignocellulosic substrates in open coastal waters (Miller *et al*, 1985; Vrijmoed *et al*., 1986), specific substrates like Mangrove seedlings (Newell 1976) and herbaceous stems of *Acanthus ilicifolius*, a mangrove associate (Sadaba *et al*., 1995). Kohlmeyer and Kohlmeyer (1993) recorded 7 species of higher marine fungi in Hawaiian Islands and for Molokai (10species) society Islands (23 species, 21 of there new records) and Fiji (31 species, 15 of these new records) were obtained form sub-tidal wood or washed – up detritus from the beach was incubated with moist sand in plastic bags for several months – Furthermore, submerged dead roots and branches of shoreline trees and mangroves (*Rhizophora*) were stored in sterile plastic bags. Prassananrai and Sridhar (2001) studied diversity and abundance of higher marine fungi on woody substrates along the West coast of India.

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