Discussion
Of the hundreds of species present in a community, relatively few exert a major influence by virtue of their size, number or activities. Dominant species are those that are highly successful ecologically and determine to a considerable extent the conditions under which the associated species must grow (Krebs, 1985). In communities that are extremely species rich most species are likely to be sparsely distributed (Rabinowitz, 1981). Typically only a few fungi will dominate in a given area while other fungi will be rarely encountered (Cooke & Rayner, 1984). In the present study also each ecosystem, substrate, decaying plant host and location had its own most frequent, frequent, occasional and rare species. The number of most frequent fungi isolated along west coast in the present study is 2, namely *Verruculina enalia* and *Cirrenalia pygmea*. This lower number might be due to screening large number of plant hosts (10), substrates (10), ecosystem (9) and locations (40 sites from 8 locations), where as most of the previous works were concentrated on few host, substrates, habitats or locations. However, if observed separately the numbers of most frequent and abundant marine fungi from each location, ecosystem, substrate and plant host are greater than 2 (Table 4, 5, 15, 16, 37, 38, 49 & 50).

Sarma & Hyde (2001) recommended a sample size between 540-1060 for one season or 1000-2000 for 2 seasons (wet and dry) for a reasonable assessment of mycoflora from mangrove ecosystem. Here a total of 2346 samples were screened for marine fungi from 10 substrates and 10 plant hosts from 40 sites in 8 locations / 9 coastal ecosystems along west coast of India.

Kerala supported maximum number of marine fungi along west coast of India *i.e* 106 followed by Goa (47) and Mahe (38). Also, the average number of marine fungi from mangrove, beach and estuarine ecosystem were found maximum from Kerala *i.e* 2.16, 1.63 and 1.8 respectively (Table 65, 66 & 67). Diversity indices values also support the same (Table 74). This might be due to the fact that the 41 west-flowing rivers of Kerala carry with them innumerable
different varieties of dead-remains of plants and animals that are harboured at different coastal water bodies (such as brackish, backwater, estuaries and inshore waters) comparatively higher than other states of India. The physical features of Mahe and Goa are some what similar to Kerala when compared to other coastal states. Regarding coastal ecosystem, beach ecosystem supported maximum number of marine fungi followed by mangrove habitat and least by oceanic ecosystem. However, mean number of fungi was highest for backwater system *i.e.*, 2.39 followed by oceanic habitat (2.19) and least for beach *i.e.*1.45. For mangrove ecosystem it was 1.94 (Table 64). Backwater ecosystem has some what similar features of mangrove habitat. Both have high organic detritus subjected to tidal inundation and fluctuating salinity. However, mangrove ecosystem is mostly rich in mangrove detritus. While in the backwater system the detritus carried by the adjoining rivers gets harboured which also includes mangrove substrates. Hence the detritus rate will be comparatively higher in backwater than mangrove ecosystem. Usually the mean number of fungi recorded from the oceanic habitat is low (1.2 from Kanyakumari by Prasannarai & Sridhar, 2001; 1.5 from Kerala by Raveendran & Manimohan, 2007). A high value obtained in present study is due to the unique feature of the site selected for study *i.e.* Vivekananda rock - the meeting place of three gigantic water bodies: the Bay of Bengal, the Arabian Sea and the Indian Ocean. Here the water is almost stagnant when compared to other shore line. As far as the beach habitat is concerned, the exposure of samples to harsh dry conditions might influence the occurrence of marine fungi (Hyde, 1986; Prasannarai & Sridhar, 2001).

Among the substrates, mangroves supported maximum number of fungi while corals supported the minimum. However, mean number of fungi was higher for foliicolous group (4.25) and least for corals (1.05) (Table 69). The fragile nature of leaves favours easy degradation while the calcareous nature of corals and animal substrates prevent the easy decomposition of these
substrates by marine fungi (Kohlmeyer & Kohlmeyer, 1979). Earlier studies on foliicolous marine fungi were concentrated only on mangrove habitat. Due to the wet condition of the mangrove ecosystem, the fragile leaves were degraded mostly by mitosporic fungi (Kohlmeyer & Kohlmeyer, 1979; Maria & Sridhar, 2002; Maria et al., 2006). In the present study the number of ascomycetes (11) and the mitosporic fungi (12) obtained from the decaying leaves were almost similar. It is quiet contradictory to the earlier reports. This might be due to the fact that in the current study, leaf samples were collected only from the beach habitat. As the wet condition is not continous, the degradation rate is slow. Also, the sandy beach supports the growth of arenicolous marine fungi on leaf samples.

Regarding the plant hosts, *Avicennia* supported maximum number of marine fungi (44) and minimum by *Salvinia* (6). However, mean number of marine fungi was highest for *Rhizophora* (2.57) and least for *Acrostichum* (1.06) (Table 68). Diversity indices also support the rich diversity of marine fungi on *Avicennia* and *Rhizophora*. This is because these two plants are among the dominant mangroves of west coast.

Ecological observation of the marine fungi obtained in the present study is compared with those reported from India and other parts of world (Table 84 & 83).

The average number of fungi per sample is one of the major yardstick to compare different habitats or substrates (Maria & Sridhar, 2002). In the present study the average isolates of fungi per sample along west coast of India was 1.73 (Table 63). It is higher than Malaysia (1.3) (Jones & Tan, 1987), Seychelles (1.1, 1.5) (Hyde & Jones, 1988), Mauritius (1.1-1.4) (Poonyth et al., 1999) and lower than Singapore (2.2) (Tan et al., 1989), Malaysia (1.2-2.2) (Alias et al., 1995).
The greater number of marine fungal assemblage during postmonsoon season along west coast of India in the present study contradicts the report of Prassannarai & Sridhar (2003b). They obtained maximum assemblage, frequency of occurrence, species richness and diversity during monsoon season along south west coast of India. The increase in number of fungal colonies during postmonsoon season might be due to favourable salinity, temperature, pH and wet condition. Although monsoon period is during June-September, the south west coast of India receives rain also in October-November from north – east winds. During this period salinity, pH and temperature is comparatively higher than monsoon. Moreover, the large scale debris carried out by the west flowing rivers towards the Arabian Sea during monsoon will start decomposing during postmonsoon. Similar condition is seen in almost all the coastal wetlands. In certain wetlands like mangrove ecosystem, backwater habitat, brackish water environment and pokkali fields the salinity shows a drastic decline during monsoon (even less than 5ppt) favouring fresh water and terrestrial fungi. Moving towards the north west i.e. Maharashtra and Gujarat, the temperature and salinity is comparatively higher than the south west coast of India. The report of Prasannarai & Sridhar (2003a, b) was mainly based on beach ecosystem. Here, almost all the coastal wetlands have been studied. Hence, the physical features of the study area should also be considered while studying the ecology of marine fungi.

Overall percentage colonization of marine fungi in the samples along west coast of India was 80%. It was higher than those reported from the beach habitat (71.72%) along west coast of India by Prassannarai & Sridhar (2001) and lower than 100% in Malaysian mangroves (Alias & Jones, 2000), 99% in Udayavara mangrove site of Karnataka, India (Maria & Sridhar, 2003) and 85% in Singapore mangroves (Tan et al., 1989). In all these reports either the beach habitat or the mangrove ecosystem were studied from lesser number of locations. However in the current study the percentage colonization ranged
from 68-83% in various locations in the west coast, 69-95% in different coastal wetlands and 69-90% in various seasons (Table 71-73)

Certain fungi encountered in the present study were previously reported from restricted hosts. However, current study supports the records of many species from new hosts thereby extending the host range of these species. Eg. *Lineolata rhizophorae* was recorded for the first time from bamboo and *Bruguiera*; *Saccardoella mangrovei* from *Kandelia candel*; *Halosarpeia kandeliae* from *Avicennia*.

It is interesting to note that most of the marine ascomycetes obtained from the beach, estuary, harbour, thuruth and oceanic habitat have asci that deliquesce early before the ascospores mature and the ascospores are released passively into the marine ecosystem. Also these spores possess well developed appendages (e.g. *Corollospora*). While the marine ascomycetes isolated from mangrove, backwater, brackish water and pokkali fields have persistant asci and showed an active mechanism for the spore dispersal. Similar observations have been reported by earlier workers also, although there is major variation in the percentage occurrence of these species from one location to another (Hyde & Jones 1988, Hyde 1990a, Fazzani & Jones 1997, Jones *et al.*, 1988, Sarma & Vittal 2002). Besides this, ascospore with the ability to discharge spores through apical pore is also notable (eg. *Lignincola*). This implies the intermediate position of these ascospores between the terrestrial and marine form (Jones & Kuthubutheen 1989, Sarma & Vittal 2001). This further indicates and emphasis that the coastal ecosystems have a distinct group of mycota.

The frequency of species isolated in the present study varies from earlier reports including those from other parts of peninsular India. Species like *Cringera maritima*, which was reported as the most dominant from beach ecosystem of Goa, Karnataka and Kerala by Prasannarai & Sridhar (2001),
*Julella avicenniae* from mangrove substrates and *Aschochyta salicornea* and *Kallichroma tetyts* from salt marshes of Gujarat by Borse et al., (2000) were completely absent in the present study. The dominant species reported from Kerala during 1991-93 (Raveendran & Manimohan, 2007) were obtained either occasional or rare. Similarly, a decrease percentage frequency was obtained for *Corollaspora maritima* and *Torpedospora radiata* from beach ecosystem of Amini dweep of Lakshadweep. Both fungi showed maximum percentage occurrence in Minicoy Island of Lakshadweep during 2003 (Ananda & Sridhar, 2003). *Antennospora quadricornuta*, which was most frequently isolated from Goa, Kerala and Kanyakumari during 2001 (Prasannarai & Sridhar, 2001) was obtained rare and occasional from Kerala and Goa respectively while it was frequently encountered from Kanyakumari. However, *Verruculina enalia* and *Periconia prolifica*, the most dominant species isolated from west coast of India in the present study were recorded most frequently from mangrove substrates of west coast (Kerala, Karnataka, Goa and Maharashtra) by Maria & Sridhar (2002). Sarma et al., (2001) and Chinnaraj (1993b) reported *Verruculina enalia* as the most frequent fungi from mangrove ecosystem in the deltas of Krishna-Godavari, Andhra Pradesh and Andaman and Nicobar island respectively. Similarly, *Periconia prolifica* was recorded as dominant species from Tamil Nadu (Gayatri & Raveendran, 2009b; Gayatri et al., 2008b) and Orissa (Borse, 2002).

A range of fungi occur frequently in the marine ecosystem. However, it is surprising to note that frequency and relative abundance of the same marine fungus present in the same ecosystem at various locations along west coast of India is showing differences in their value (Table 18, 19, 21 & 22). Also, none of the species obtained were common to all the 10 substrates or all the 10 decaying plant hosts that were studied in the present work. This clearly supports the substrate and host preference of the marine fungi in the saline ecosystem (Table 36 & 48). This might be due to a number of factors that
influence the distribution of marine fungi either individually or synergistically. These factors include temperature, salinity, tidal amplitude, pH, dissolved organic nutrients, seasonality, nature of the host, availability of the substrata, ecological niches, position of intertidal region, nature of floor, incubation period etc (Kohlmeyer & Kohlmeyer, 1979; Sarma & Hyde, 2001). The absence or decreased frequency value obtained in the present study for certain previously reported dominant marine fungi along west coast could be attributed to global warming. This is because salinity and temperature are among the most important factors that influence the distribution pattern of marine fungi, so also are the factors that influence the global warming. Increase salinity in Indian mangroves especially after the tsunami in 2004 is also well documented (Sandilyan et al., 2010).