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Population Dynamics of Epiphytic Diatom Communities on Common Seaweeds at Malvan Coast, District Sindhudurg, Maharashtra

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ABSTRACT

Epiphytic diatoms exhibit the least movement and are thus more likely to reflect long term environmental conditions for the particular area from which they are collected. Hence, could be used as environmental indicators more effectively than other conventional bio-indicators. In view of the above diatom communities epiphytic on dominant seaweeds were studied at Malvan District, Sindhudurg, Maharashtra. Benthic diatom community is dominated by entirely different genera such as *Rhizosolenia, Navicula, Nitzschia, Licmophora, Climacosphenia, Mastogloia, Amphora* and *Melosira*. In present study *Rhizosolenia curvata* was observed to be the most dominant epiphytic species. It was observed that epiphytic diatom species have a preference for host and different intertidal zones. This encouraged systematic studies of host and zone specificities of epiphytic diatoms.

Keywords Epiphytic diatoms, Seaweeds, Community structures, Bio-indicators.

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INTRODUCTION

Epiphytic diatoms are of special interest to the phycologist because of their attachment to a living substrate and the possibility of biological interactions occurring between epiphytes and their host. Most of the work done with epiphytic diatoms in marine waters has been restricted to fresh water macrophytes and seagrasses from brakish waters (Sullivan 1982). The seaweeds and their associated communities form complex and highly dynamic ecosystems, consisting of a diverse range of organisms (Holmstrom et al. 2002). Diatoms are the integral part of the physical environment of seaweeds and most diverse group among the primary colonizers such as bacteria and fungi, on algal surfaces (Hold et al. 2001, Lam et al. 2008). This assemblage is the base of most food webs in the littoral habitat and a source of dissolved and particulate organic matter to the water. Although attached algal assemblages are often the dominant producers in shallow intertidal systems, little is known about their geographical distributions, population dynamics and microhabitat utilization.

Moreover, epiphytic diatoms exhibit the least movement and are thus more likely to reflect long term environmental conditions for the particular area from which they are collected. Hence, could be used as environmental indicators more effectively than other conventional bio-indicators. In view of the above diatom communities epiphytic on dominant seaweeds were studied at Malvan District, Sindhudurg, Maharashtra, for period of one year during 2016-2017. Seaweed species were selected based on their dominance and frequency of occurrence.

Fig. 1. Map showing study area location.

Total 48 seaweed species (14 chlorophyceae, 14 phaeophyceae and 20 rhodophyceae) were recorded from Malvan during the study period. Based on these observations nine most dominant seaweeds were selected to study epiphytic diatom flora on them. Three Chlorophyta species (viz. *Ulva fasciata, Chaetomorpha media* and *Caulerpa peltata)*, three Phaeophyta species (viz. *Padina gymnospora, Dictyota dichotoma* and *Sargassumilici folium*), three Rhodophyta species (viz. *Gracilaria corticata, Hypnea cervicornis* and *Jania adherense*) were selected for study.

MATERIALS AND METHODS

Description of study area

The study location was selected along the Central West Coast of India. Malvan (16^0 03' N 73^0 27' E) represents a formation of rocky intertidal coast with no obvious sources for pollution and hence the near shore waters remain relatively clear. This location has large rocky cliffs, moderate intertidal expanse and numerous tidal pools which form the best suitable habitat for algal growth.

Sampling

Seaweed samples were collected monthly at selected stations (Fig. 1) during November 2016 –May 2017. Thalli of selected seaweeds along with hold fasts were collected from rocky shores and tide pools in mid intertidal zones, gently transferred in polythene bags so as to minimize the loss of epiphytes and were immediately stored at ~ 0 – 4^0C.

Isolation and identification of diatoms

Epiphytic diatoms on seaweeds were isolated by adopting and slightly modifying the HCl digestion methods described for aquatic angiosperms (Shamsudin and Sleigh 1995, Tanaka 1986). Thalli collected for identification were weighed and added to 1.5% HCl at 30^0 C and rotated on shaker at 120 rpm for 20 minutes. Isolated epiphytes suspended in HCl solutions were then centrifuged at 4000 rpm for 15 minutes. Supernatants were discarded and pellets were re-suspended in 47 mm GFF filtered seawater. This procedure was repeated until most of the adhered diatoms were removed from the thalli. The final volume was adjusted to 100 ml with acidified formalin (Tomas 1997).

Cell counts were made using 1 ml of preserved samples, and 700 – 900 cells were counted from each sample. Total abundance was estimated as No. X 10^5 kg^{-1} wet weight of thallus. Diatom samples were identified as described by Desikachary et al. (1987), Tomas (1997).

RESULTS

Total 31 species of diatoms were found to be epiphytic on *Ulva fasciata* during entire study period. *Mastogloia fimbriata* was observed to be most dominant diatom species on *U. fasciata,* with average percent-

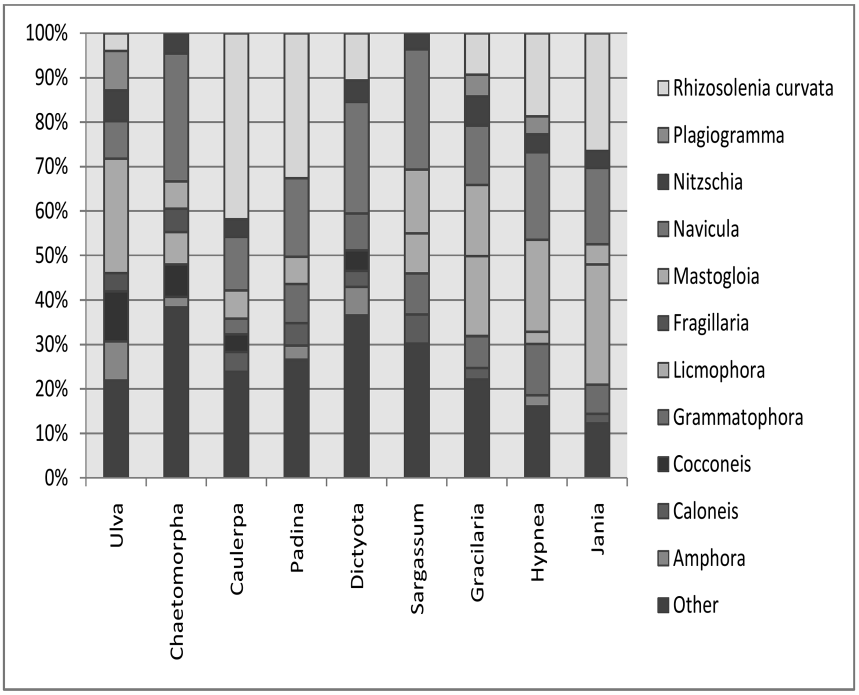

Fig. 2. Percentage composition of dominant epiphytic diatom genera on seaweeds.

age occurrence of 14.09% (Fig. 2). Other dominant diatom species was *Navicula halophila* (Avg 8.38%). Total cell count of diatoms was found to be in the range of 3.82×10^5 to 0.72×10^5 cells/kg of wet weight of thallus (Fig. 3).

Overall 40 species of diatoms were found to be epiphytic on *Chaetomorpha media*. *Navicula halophila* was observed to be most dominant diatom species on *C. media,* with average percentage occurrence of 11.00%. Total cell count of diatoms was found to be in the range of 5.88×10^5 to 1.59×10^5 cells/kg of wet weight of thallus (Fig. 3).

Fourty one species of diatoms were found to be epiphytic on *Caulerpa peltata. Rhizosolenia curvata*

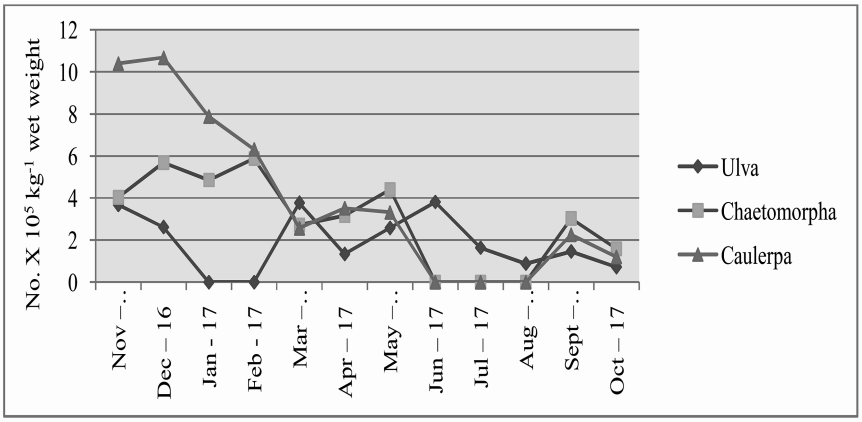

Fig. 3. Total abundance of epiphytic diatoms on Chlorophyta seaweeds.

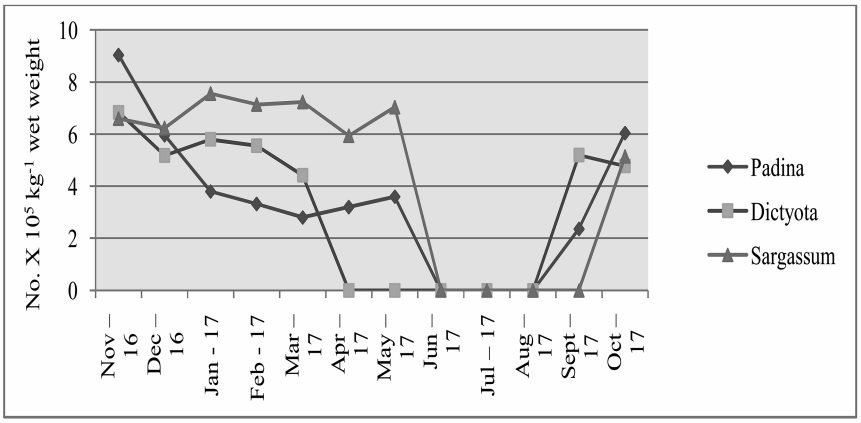

Fig. 4. Total abundance of epiphytic diatoms on Phaeophyta seaweeds.

was observed to be most dominant diatom species on *C. peltata,* with average percentage occurrence of 26.35% throughout the year. Other dominant diatom species were *Licmophora abbreviata* (Avg 3.02%) and *Grammatophora marina* (Avg 3.28%). Total cell count of diatoms was found to be in the range of 10.68 × 10^5 to 1.2 × 10^5 cells/kg of wet weight of thallus (Fig. 3).

Thirty nine species of diatoms were found to be epiphytic on *P. gymnospora.* Total cell count of diatoms was found to be in the range of 9.04 × 10^5 to 2.36 ×10^5 cells/kg of wet weight of thallus (Figs. 4 and 5). *Rhizosolenia curvata* was observed to be most dominant diatom species on *P. gymnospora,* with average percentage occurrence of 22.86% throughout the year.

Fifty six species of diatoms were found to be epiphytic on *D. dichotoma* during entire study period. Total cell count of diatoms did not show much variation and it was found to be in the range 0f 4.42 ×10^5 to 6.84 × 10^5 cells/kg of wet weight of thallus. All seaweeds in lower intertidal and subtidal zone showed dominance of *Rhizosolenia curvata* as epiphytic diatom.

DISCUSSION

Epiphytic microalgae contribute significantly to

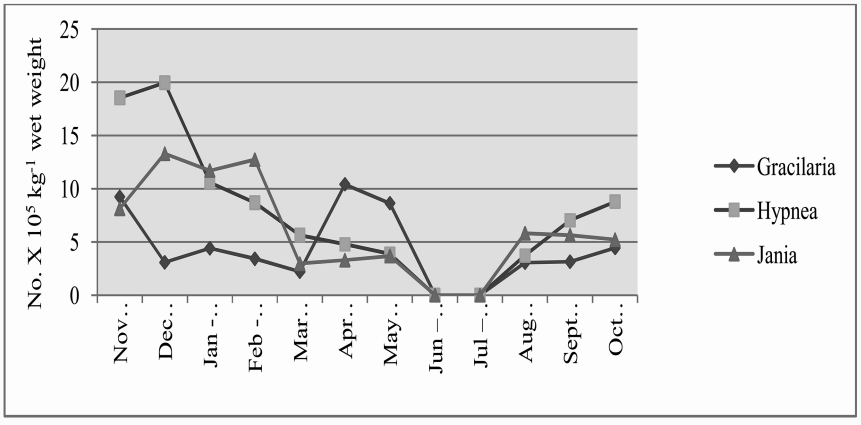

Fig. 5. Total abundance of epiphytic diatoms on Rhodophyta seaweeds.

overall primary production in coastal areas (Stowe and Gosselink 1985, Pinckney and Zingmark 1991). Epiphytes in marine coastal area are found primarily attached to seaweeds and are comprised of eukaryotic microalgae and macroalgae, diatoms, cyanobacteria and heterotrophic bacteria (Currin and Paerl 1998). Among these, epiphytic diatom community has been less studied than other primary producers in marine environment e.g. phytoplankton, micro phyto benthos and seaweeds , but is recognized as an important structural and functional component of coastal ecosystems (Sullivan and Currin 2000).

As in most of the intertidal environments benthic diatoms are a significant component of the microalgae communities and are responsible for sediment stabilization and avoiding desiccation (Cahoon and Safir 2002). Benthic diatoms are present on almost all stable substrata (Lowe and Laliberte 1996) for example, rocks (epilithic), sand (epipsammic),woody debris (epidendric), sediment (epipelic) and aquatic vegetation (epiphytic). Hence, benthic diatoms are considered as major source of epiphytes on seaweeds.

Diatom communities at West Coast of India exhibited significant variations in benthic and planktonic assemblages (DeCosta and Anil 2010). *Coscinodiscus, Cyclotella, Thalassiosira, Thalassionema, Triceratium, Pleurosigma, Skeletonema, Chaetoceras* and *Surirella* are dominantly occurring planktonic diatom genera along West Coast of India. Benthic diatom community is dominated by entirely different genera such as *Rhizosolenia, Navicula, Nitzschia, Licmophora, Climacosphenia, Mastogloia, Amphora* and *Melosira*.

In present study *Rhizosolenia curvata* was observed to be the most dominant epiphytic species at Malvan. However, its distribution was principally detected in mid and lower intertidal zones. Host seaweeds like *Padina, Hypnea, Dictyota* and *Jania,* holded *Rhizosolenia curvata* as dominant epiphyte. Genera like *Navicula, Nitzschia* and *Licmophora* were also dominant on seaweeds from mid intertidal zone. Other genera like *Grammatophora, Caloneis, Diploneis* and *Amphora* were commonly observed. Few genera like *Cocconeis, Mastogloia, Climacosphenia* and *Synedra* exhibited seasonal dominance over few hosts.

It was observed that epiphytic diatom species prefer tranquil conditions to get attached with host. Maximum epiphytic diversity was observed on hosts like *Caulerpa, Hypnea* and *Dictyota* which grow in tide pools. Even total epiphytic cell count was considerably higher on these hosts. Host species such as *Ulva* and *Chaetomorpha* from upper intertidal zone demonstrated dominance of *Navicula, Mastogloia, Melosira* and *Cocconeis* genera. However, *Ulva* and *Chaetomorpha* showed less epiphytic richness as well as low cell count. This could be attributed to prolonged exposure as these seaweeds occur in upper intertidal zone. Due to less sub-mergence of upper intertidal zone, abundance of benthic diatoms could be less. Hence, number of benthic diatoms attaching to *Ulva* and *Chaetomorpha* as epiphytes was observed to be low.

Host seaweeds like *Sargassum, Gracilaria* and *Jania* mainly occur in lower intertidal zone where nature of water is relatively turbulent. Richness and abundance of epiphytes was relatively less on these hosts as that of hosts from tide pools. *Mastogloia, Navicula, Diatoma* and *Plagiogramma* were dominant epiphytic diatoms on *Sargassum. Gracilaria* and *Jania* showed dominance of *Rhizosolenia curvata.* It was observed that diatom species have a preference for host and different intertidal zones. This encouraged systematic studies of host and zone specificities of epiphytic diatoms.

REFERENCES

Cahoon LB, Safir KA (2002) Distribution and biomass of benthis microalgae in Manukau Harbor, New Zealand. New Zealand J Marine and Fresh Water Res 36 : 257—266.

Currin CA, Paerl HW (1998) Environmental and physiological controls on diel patterns of N_2 fixation in epiphytic cyanobacterial communities. Microbiol Ecol 35 : 34—45.

DeCosta PM, Anil AC (2010) Diatom community dynamics in a tropical, monsoon-influenced environment: West Coast of India. Continental Shelf Research 30 (12) : 1324—1337.

Desikachary TV, Prasad AKSK, Hema P, Sreelatha M, Sridharan VT, Subrahmanyan R (1987) Marine diatoms from the Arab Sea and Indian Ocean. In : Desikachary TV (ed). Atlas of diatoms. Fasc IV. Madras Science Foundation, Madras 1 (7) : 332—400.

Hold GL, Smith EA, Rappe MS, Maas EW, Moore ERB, Stroempl C, Stephen JR, Prosser JI, Birkbeck TH, Gallacher S (2001)

Characterization of bacterial communities associated with toxic and non-toxic dinoflagellates: *Alexandrium* spp. and *Scrippsiella trochoidea*. FEMS Microbiol Ecol 37: 161—173.

Holmstro[m]m C, Egan S, Franks A, McCloy S, Kjelleberg S (2002) Antifouling activities expressed by marine surface associated *Pseudo alteromonas* species. FEMS Microbiol Ecol 41 : 47—58.

Lam C, Stang A, Harder T (2008) Planktonic bacteria and fungi are selectively eliminated by exposure to marine macro-algae in close proximity. FEMS Microbiol Ecol 63 : 283—291.

Lowe RL, Laliberte GD (1996) Benthic stream, algae : Distribution and structure. In : Hauer FR, Lamberti GA (eds). Stream Ecology Academic Press, USA, pp 269—293.

Pinckney J, Zingmark RG (1991) Effects of tidal stage and sun angles on intertidal benthic micro-algal productivity. Marine Ecol Progress Series 76 : 81—89.

Shamsudin L, Sleigh MA (1995) Seasonal changes in composition and biomass of epiphytic algae on the macrophyte *Ranunculus penicillatus* in a chalk stream, with estimates of production and observations on the epiphytes of *Cladophora glomerata.* Hydrobiologia 306 : 85—95.

Stowe WC, Gosselink (1985) Diatoms epiphytic on the emergent grass *Spartina alterniflora* in a *Louisiana* salt marsh. Transac Am Microscopical Soc 101 : 162—173.

Sullivan MJ (1982) Similarity of an epiphytic and edaphic diatom community associated with *Spartina alterniflora*. Transac Am Microscopy Soc 101 : 84—90.

Sullivan MJ, Currin CA (2000) Community structure and functional dynamics of benthic micro-algae in salt marshes. In : Weinstein MP, Kreeger DA (eds). Concepts and Controversies in Tidal Marsh Ecology. Kluwer Academic Publishers, Dordrecht, pp 81—106.

Tanaka N (1986) Adhesive strength of epiphytic diatoms on various seaweeds. Bull Japnese Soc Sci Fish 52 (5) : 817—821.

Tomas (1997) Identifying Marine Phytoplankton. Carmelo R. Tomas (ed). Academic Press, pp 858.