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Light and Scanning Electron Microscopic Studies Of Epiphytic Diatoms Associated With Mangroves

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Abstract: ***Epiphytic diatoms in two Mangrove estuaries of Pichavaram and Parengaipetai, Tamilnadu, India were documented based on samples collected from March to December 2014. All specimens were identified to species level under light and Scanning Electron Microscopy. Pneumatophores were collected, cut and scrabbed. 29 species of epiphytic diatoms were found and classified into the Division Bacillariophyta. Most of the species were in the Order Bacillariales (pennate diatoms) among these, Achnanthidium affine, Cymbella tumida, Diatoma sp, Diploneis puella, Martyana martyi, Navicula clavata, Navicula radiosa, Neidium bisulcatum, Stauroforma exiguiformis, Rossithidium linearis, Nitzchia communis were identified as the dominant species and described in terms of size, shape and the structural details of the frustules.***

Keywords: Mangroves, Pneumatophores, Diatoms, LM and SEM.

1. Introduction

The identification process of diatoms focuses on special cell structures known as frustules. The frustules are composed of two distinct parts called valves. One valve fits inside another valve, similarly to a Petri dish. The valve structure is called striae and includes a range of small pores of panctae, and also has longitudinal valves called raphe. This characteristic is a major consideration for the purpose of identification (Round, Crawford, Mann, 1990 D.M. John, Whitton, Brook, 2002). Presently, most epiphytic diatom studies have focused on the concept of ecology. Individual species of benthic diatoms are often restricted to specific ecological conditions H. Kalyoncu, *et al* 2009. However, some diatomists in Asia, Europe and America have been focusing continually on the aspects of the diversity and taxonomy of diatoms including the relationship to specific water properties. Wojtal, *et al* 2010 whilst in India; the research SEM studies of epiphytic diatoms have been much less common. Thus, this research was conducted to study and investigate the morphology of epiphytic diatoms in Pichavaram and Parengaipetai Mangroves using a light and Scanning Electron Microscope. (Hung et al., 1976; Kalidasan and Abdul Rahman, 1992). Kalidasan and Abdul Rahman (1992) reported that in the phytoplankton diatoms dominated and summer peak is also seen. The role of Diatoms in mangroves has been considered to be important in the development of mangroves since they form the major populations in Brazil and India (Cooksey, 1984). Krishnamurthy et al (1974) found that the number of microalgae species were poor and reported from a two years study that in Pichavaram pinnate diatoms were dominant and the diversity, richness and evenness of the species decreased from the edge to the centre. Low population diversity during monsoon and Premonsoon and summer peaks of Phytoplankton in Pichavaram mangrove. Phytoplankton which had a serve peak Alongi *et al.,* 1990 suggested that a close microbe – nutrient plant connection may serve as a mechanism for conserving scarce nutrients for their existence. Microalgae living on sediments are considered as principal source of food for crabs in queen land (Micheli, 1993). Among the physical and physico-chemical characteristics temperature, light, rainfall and salinity have been found to influence the abundance, of Microalgae (Krishnamurthy and Jayaseelan 1983) while negative correlation were obtained for nutrients and abundance of Phytoplankton (Hung et al., 1976; Kalidasan and Abdul Rahman,1992). Kalidasan and Abdul Rahman (1992) reported that in the phytoplankton diatoms dominated and summer peak is also seen. The present study is to describe the diversity of epiphytic Diatoms in terms of size, shape and the structural details of the frustules arrangement

2. Material and Methods

Diatom associated pneumatophores were collected from Pichavaram and Parengaipetai Mangrove forests, epiphytic diatom samples were scraped off pneumatophores using a toothbrush and kept in plastic boxes and cleaned by concentrated acid digestion method in boiling HNO_3 and peroxide. The acid solution was removed by washing with distilled water. The cleaned samples were mounted and examined under the light microscope I. Renberg, (1990) and Kelly, *et al* (1998). Prepare samples for SEM micrograph by dropping the cleaned diatom samples on a coverslip and drying it on hot plate. Kept it in desiccators overnight and fixed it stub and coated with gold. Scanning Electron Microscope was used for observations. G. Massea *et al.* (2001). The samples were identified according to Krammer and Lange- Bertalot (1986, 1988, 1991a, 1991a).

Site selection and Characteristics

Pichavaram is situated in the southeast coast of India in the Tamil Nadu State. It is located at about 225 km south of Chennai and 5 km north east of Chidambaram, Cuddalore district, Tamil Nadu, between latitude 11°20' to 11°30' north and longitudes 79°45' to 79°55' east (Fig.1). It is an estuarine mangrove situated at the confluence of Uppanar, a tributary of the Coleroon River. Fishing villages, croplands, and Aquaculture ponds surround the area. The Parangipettai (Lat 11°31′ N and Long 79°49′ E) and Pichavaram (Lat 10°46′ N and Long 79°53′ E) is located 3 km distance in both area along the Southeast coast of India (Fig. 1). The samplings

were carried out at a distance of 5 Km. Parangipettai coastal comprises three ecologically important biotopes viz., Vellar estuary, Killai back waters and Pichavaram mangroves which play a vital role in supporting the commercial fisheries, since many of them use these biotopes as nursery grounds

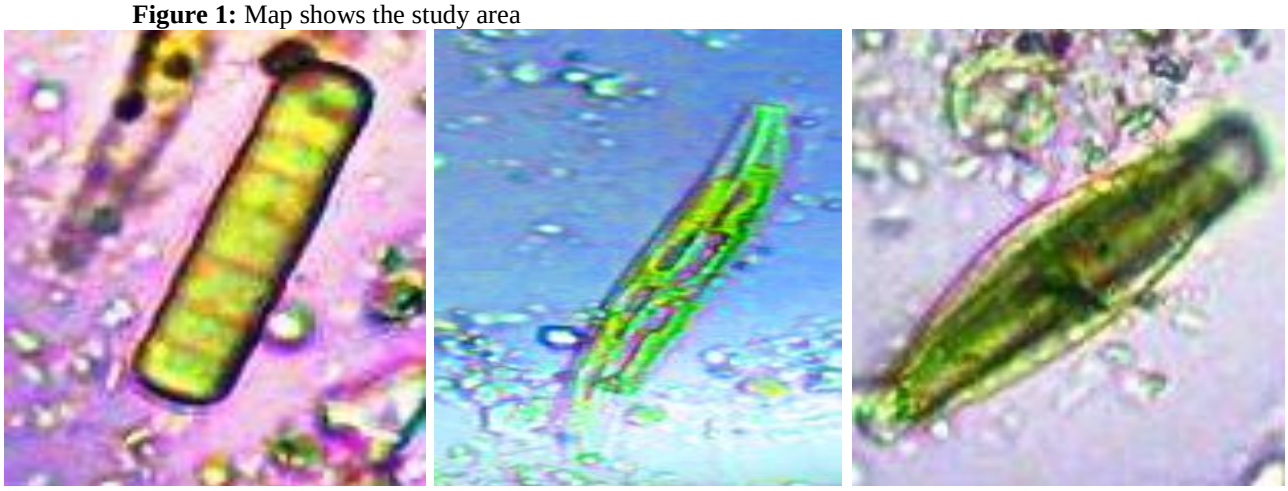
Table 1: Site Description

Name of the location	Parengaipettai	Pichavaram
Geographical position	(Lat 11°31′ N and Long 79°49′ E)	11˚.24'N, 79˚. 47'E
Annual mean range temperature	27°C-43°C	28˚C- 43˚C
Vegetation type	Estuarine mangrove	Estuarine mangrove
Epiphytic algae	Bacillariophyta	Bacillariophyta

Figure 1: Map shows the study area

3. Result and Discussion

Twenty nine species of epiphytic diatoms were found from two estuaries. Most of the species were in the Order Bacillariales (pennate diatoms). *Nitzschia* spp. was found to contain the highest number of species (6 species) followed by *Navicula spp*. (2 species), and *Achnanthes* spp., *Diploneis* spp., *Diatoma* spp., *Surirella* spp., *Fragilaria* (6 species), respectively. In this investigation, Fourteen species were identified as being the dominant species at both the stations (Table 4) and described in terms of size, shape and the structural details of the frustules (Table 3), such as *Achanthes longipes, Achnanthidium affine, Cymbella tumida, Diatoma sp., Fragilaria crotonensis, Fragilaria virescens, Gomphonema acuminatum, Gomphonema gracile, Navicula radiosa, Stauroforma exiguiformis, Staurosirella leptostauron, Synedra ulva, Tabellaria flocculosa* were dominated at both stations I and II (Table 4). These dominant species shows association with periderm layer of pneumatophores of mangrove *Avicennia marina* (Plate 1a)



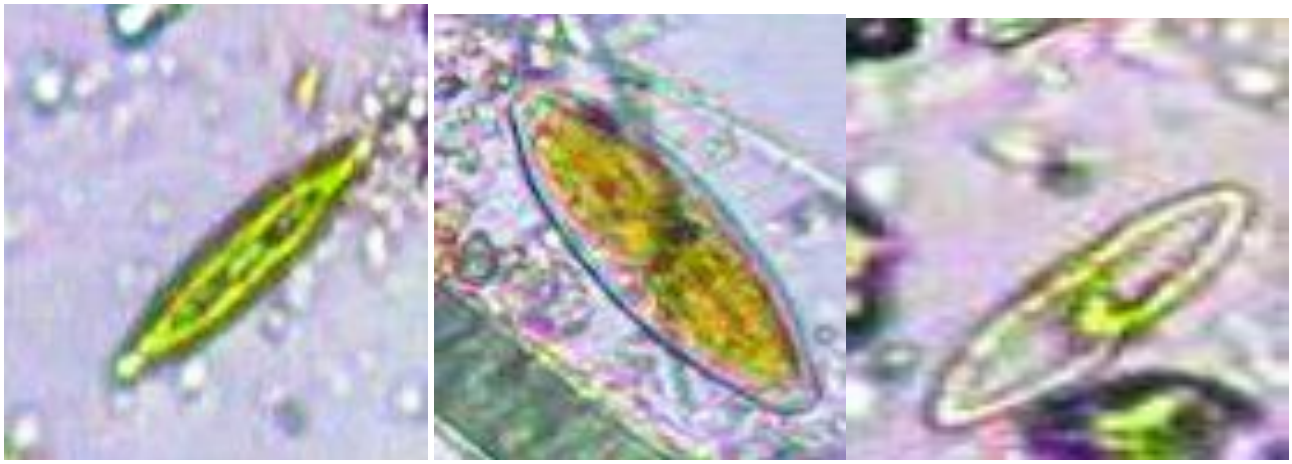


Plate 1: *Pinnularia sp. B) Pleurosigma sp.* C)*Navicula palaceae* d)Navicula rostellata *e) Navicula goersii*

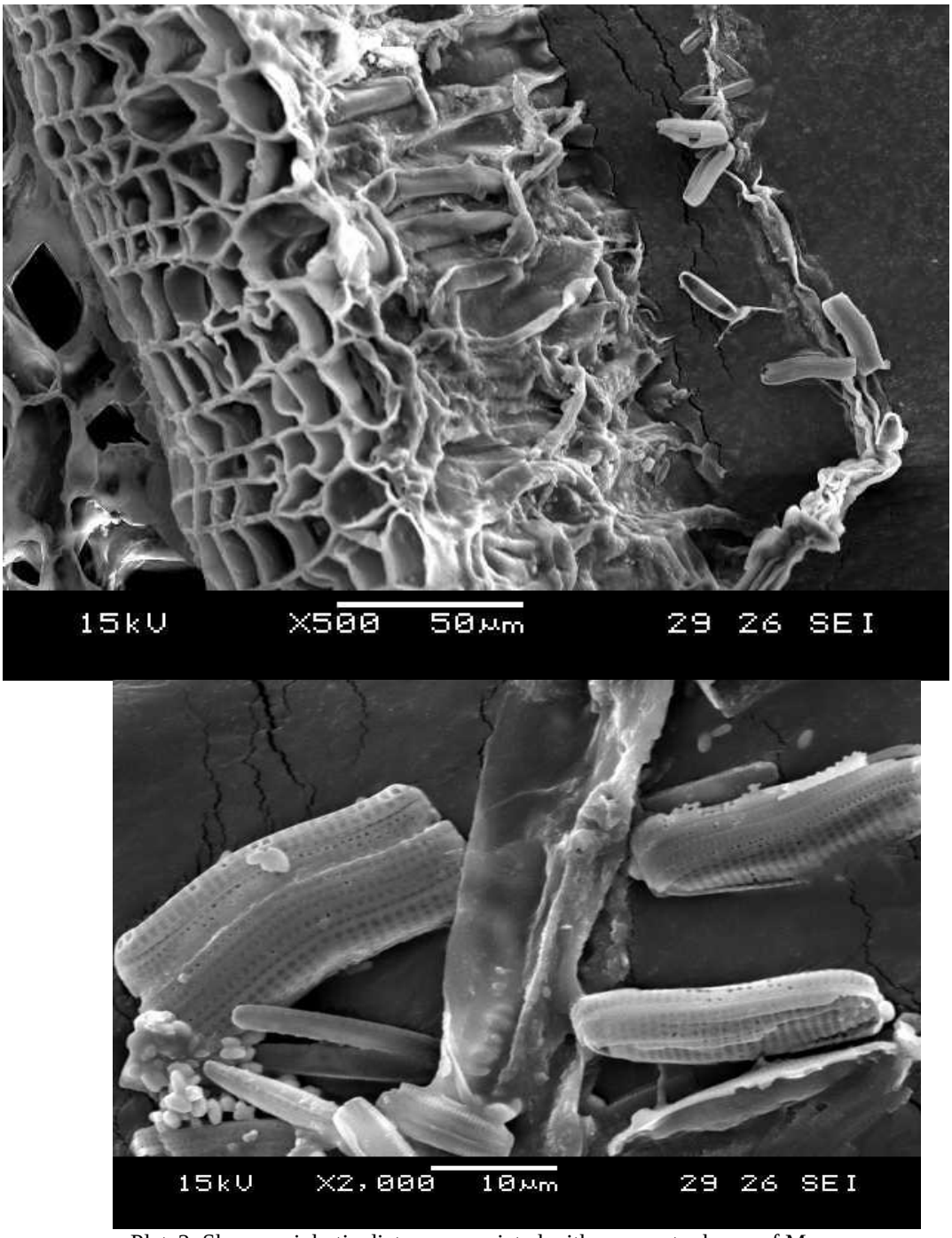


Plate2: Shows epiphytic diatoms associated with pneumatophores of Mangroves.

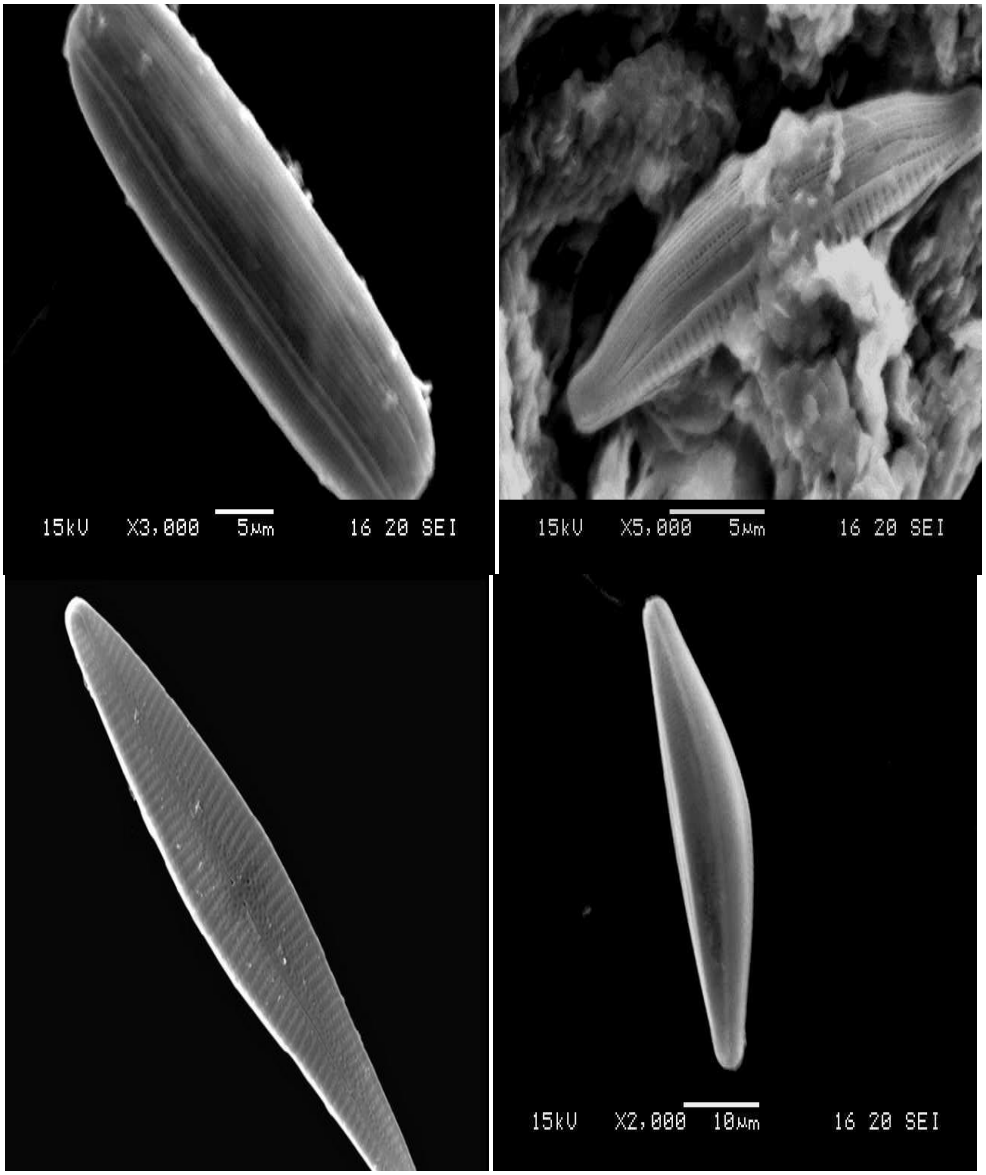
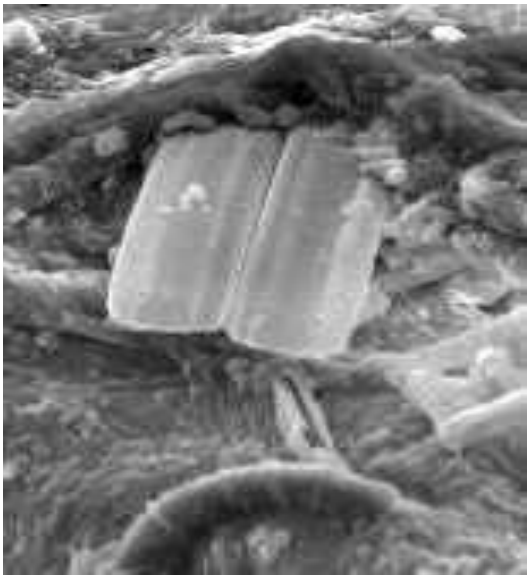


Plate 3: a)*Neidium bisulcatum b) Cymbella tumida c) Gomphonema gracile d) Diploneis puella*



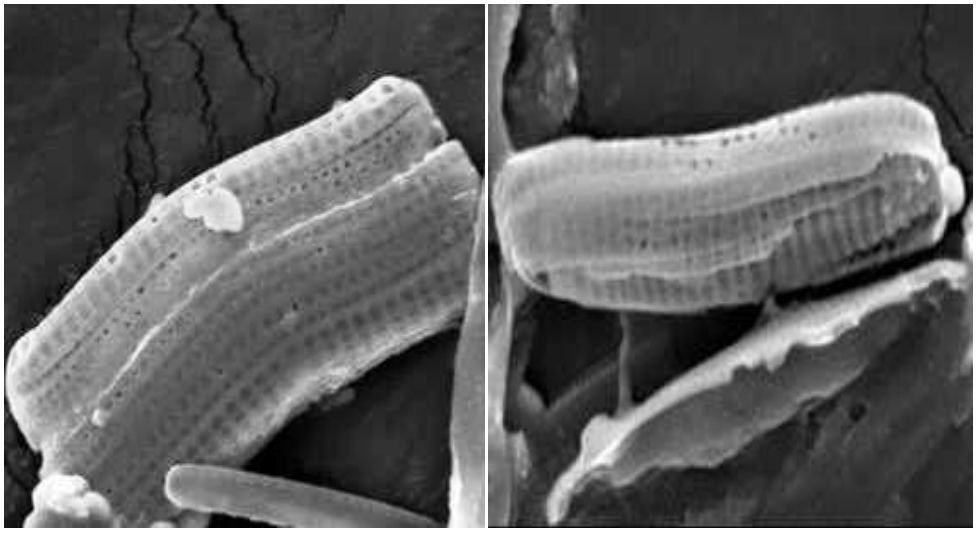


Plate 4: *a) Diatoma sp b) Stauroforma exiguiformis c) Achanthidium affine*

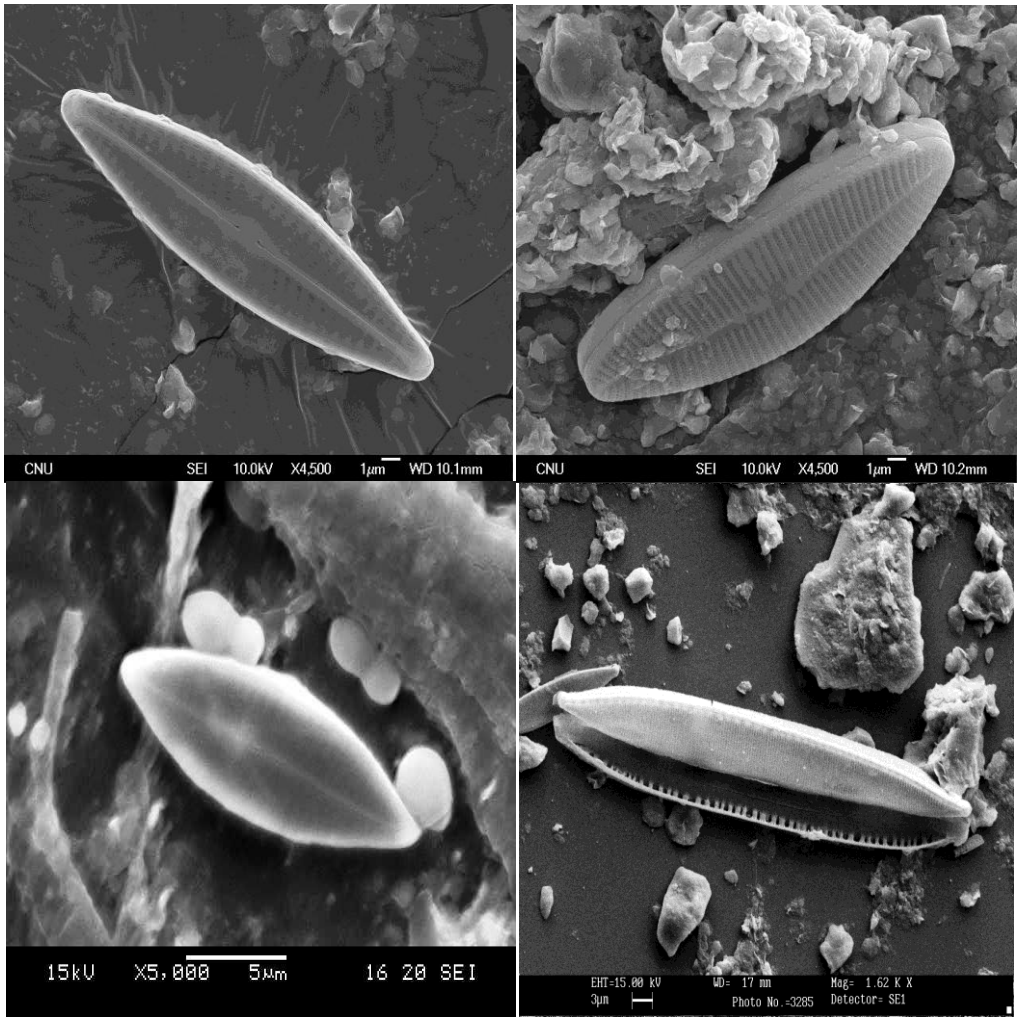


Plate 5: a)Navicula radiosa b) Rossithidium linearis c) Navicula sps. d) Nitzchia communis

Table 3: Morphological characters of dominant species of epiphytic diatoms associated with *Avicennia marina*.

Features					
Genus	*Shape*	*Striae*	*Areolae*	Valve length	Valve width
Fragilaria crotonensis	Linear, linear-lanceolate	Areolate regular	External vela	18-54	2-8
Staurosirella leptostauron	Elliptical, linear, or cruciform	Lineolate	Linear areolae, finely branched closing plates	34-50	6-12
Fragilaria	Elliptical, lanceolate, or linear; often	Areolate, regular, often continuous,	Simple vela	8-30	2-6

virescens	undulate	sternum very small			
Stauroforma exiguiformis	Elliptical to lanceolate, sometimes sub-rostrate ends	Aerolate, regular, often continuous, sternum very reduced	Simple vela	20-56	4-7
Synedra ulva	Linear, lanceolate	Aerolate, uni or biseriate	Simple vela	20-54	8-20
Diatoma sp.	Elliptical-linear or lanceolate	Striae in groups, separated by costae	Not known	15-130	5-9
Martyana martyi	Ovate-elliptical, depression at head pole	Areolae slit like, striae sunken between transapical ridges	Not known	22-57	9-28
Tabellaria flocculosa	Elongate, capitate, wider at center	Uniseriate, irregularly spaced	Simple	23-32	10-14
Achanthes longipes	Linear to lanceolate, flexion along transapical axis, raphe valve concave	Uni-bi-or- triseriate	Poroids with complex cribra bearing valve	11-19	11-17
Achnanthidium affine	Narrow, linear lanceolate with rounded to rostrate to capitate ends; noticeably curved with concave raphe valve; often 3 to 6 times longer than wide	Striae usually near 30 in 10 µm, finer toward the apices, mantle pores of narrower dimension than the striae; valves of similar structures; raphe valves may have central interruption in striae; aerolae aligned within internal depression	Simple round to transapically elongate aerolate with internal hymens	10-32	7-11
Cymbella tumida	Valves dorsiventral and symmetrical to the transapical axis with rounded to subrostrate ends.	Striae coarse, punctuate and radiate.	Simple	35-120	12-25
Gomphonema hebridense	Valves slightly asymmetrical to the transapical axis, symmetrical to apical axis. Cells wedge- Shaped in girdle view	Striae are coarse and punctuated, often with one shorter stria in the central area.	Simple vela	30-60	4-8
Navicula radiosa	The valves are narrow and lanceolate with acutely rounded ends. The central area is rhombic	The striae are strongly radiate. Striae are bent in the valve center and convergent near the pole	simple	8-12	5-11
Nitzchia communis	Valves are linear with rounded apices. Fibula are relatively large and distinct, about 10-13 in 10 µm	. Striae are resolved in the light microscope but very fine. Individual areolae within striae are not visible.	Simple to round	20-55	2-5

Species	**Station 1**	**Station 2**
Achanthes longipes C.Agardh	+	+
Achnanthidium affine (Grunow)	+	+
Amphipleura lindheimeri (Keutz.)	+	+
Amphora spectabilis (Greg)	+	-
Asterionella Formosa Hassall	+	-
Cymbella tumida (Brébisson) van Heurck	+	+
Diatoma sp.	+	+
Diploneis puella (Schumann) *Cleve*	+	+
Fragilaria crotonensis Kitton	+	+
Fragilaria virescens Ralfs	+	+
Gomphonema acuminatum Ehr.	+	+
Gomphonema gracile Ehrenberg	+	+
Gyrosigma compactum (Grev.) Cl	+	+
Martyana martyi(Héribaud-Joseph) Round	+	-
Navicula clavata (Gregory)	+	-
Navicula radiosa Kutzing	+	+
Neidium bisulcatum Lagerstedt Cleve	+	+
Nitzchia distans (Greg) W	+	-
Nitzchia inconspicua (Grunow)	+	-
Nitzchia rabenhorstii (Grum)	-	+
Nitzchia communis (Keutz) W.Smith	+	+
Nitzchia sigmoidea (Nitz.)W.Sm	+	-
Nitzschia filiformis (W.Smith)Hustdt	+	-
Stauroforma exiguiformis (Lange-Bertalot) R.J.Flower	+	+
Rossithidium linearis (W.Smith)	-	+
Staurosirella leptostauron (Eher.)	+	+
Surirella angustata (Skvortzov)	-	+
Synedra ulva(Nitzch) Ehrenberg	+	+
Tabellaria flocculosa(Roth)Kutzing	+	+

4. Conclusion

A total twenty nine species of diatoms were found as epiphytes in the two estuaries. Among these, twelve species were identified as being the dominant species in this investigation. In addition, the dominant species such *Achanthes longipes, Achnanthidium affine, Cymbella tumida, Diatoma sp., Fragilaria crotonensis, Fragilaria virescens, Gomphonema acuminatum, Gomphonema gracile, Navicula radiosa, Stauroforma exiguiformis, Staurosirella leptostauron, Synedra ulva, Tabellaria flocculosa* were presented their distribution and described in terms of size, shape and the structural details of the frustules.

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