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An Assessment of Epilithic Diatoms and their Adhesive Strength in Rasthakadu, Kanyakumari District.

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ABSTRACT

The present study was carried out with Epilithic diatoms collected from rocky lithophytes on the Rasthakadu coast, Kanyakumari district. Numerous diatoms are adhesive to lithophytes. Diatom is a key component of marine ecosystems. Algal biomass and diatom species composition were good indicators of nutrient enrichment. Epilithic diatoms were all good biological indicators and also nutrient enrichment to industries that produce some cosmetic items in lithophytes. Marine ecosystem mixed with some industrial wastes; environmental condition produces changes in Diatoms populations. Species composition is often affected by climatic and spatial variables. The present work identified 44 diatom species and analyzed their adhesive strength, and composition, with the lithophytes. Also, the nature, and structure of diatoms and to understand the role of diatoms in the Rasthakadu marine ecosystem. To record the needed measures to be undertaken to protect the present epilithic diatoms.

Keywords: Epilithic, Diatom, Adhesive strength, Population density, Rasthakadu.

INTRODUCTION

During the 19th century, diatoms were studied for the first time in India by Ehrenberg Benthic diatoms, both edaphic and epiphytic are ubiquitous in shallow water environments and maybe the most taxonomically diverse proud of organisms in estuarine ecosystems (**Sullivan and Currin, 2000**). Many diatom species of polluted rivers are cosmopolitan, and therefore, it becomes appropriate to verify to which extent these indices are suited to tropical regions (**Bellinger et al. 2006**). Diatoms are the most important

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photosynthetic unicellular eukaryotes and aquatic primary producers on Earth, accounting for approximately 40% (**Falkowski et al. 2004**). The benthic diatoms are of particular value in the understanding of present ecosystems in shallow coastal areas and are very important tools for the monitoring and interpretation of environmental conditions of both the past and the present (**Stevenson and Pan, 1999**). Many diatoms are superior competitors for nutrients at lower temperatures and their temperature dependence is one of the important mechanisms influencing taxa composition (**Tilman et al. 1986**).

Globally, the marine rocky intertidal zone is considered one of the most biologically diverse environments, owing to the number of microhabitats harbouring communities, from microalgae to intertidal fauna (**Maggi et al. 2017**). Intertidal rocky shores remain well-studied habitats, with ecological studies covering the spatiotemporal variation of organisms along stretches of coastlines (**Underwood et al. 2008**). Epilithic diatom assemblages are laid low with a number of abiotic and biotic factors along with temperature, salinity, nutrients, and grazing (**Ulanova and Snoeijs, 2006**). Despite the fact that estuaries have diverse functions, which include offering habitat, purifying water pleasant, and producing marine merchandise, they're being destroyed by improvement initiatives concentrated in these regions (**Rho, 2014**).

Epilithic diatoms, together with bacteria, act as primary elements involved in the immigration of aquatic substrates and the formation of biofilm (**Meleder, 2007**). Human activities cause an increase in nutrients that trigger eutrophication marked by the proliferation of phytoplankton (**Piranti et al. 2021**). In the last decades, there has been a growing interest in microalgae due to their importance in ecology, particularly in ecosystem services, as well as in many possible commercial applications. Indeed, microalgae are responsible for the primary productivity in aquatic ecosystems, thus forming the basis of food webs and accounting for more than 50% of the oxygen produced (**Chapman, 2010**).

Study area

Since this District is situated at the extreme south of the Indian subcontinent, the coastline is fashioned nearly through three seas. The namely Arabian Sea, the Indian Ocean, and the Bay of Bengal. But the principle a part of the coast faces the Arabian Sea. The coastal landscape of Kanya Kumari District is mainly composed of beach ridges of rocky, sandy, and swampy nature in the estuarine regions. The sixty-eight-kilometer-long coast has a heavy concentration of fisher-folk, the shore is an intertidal rocky coast and it is an excellent place for the growth of seaweeds Field surveys were undertaken in the selected sampling stations of the Rasthakadu coastal area.

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Fig. 1: The map showing Rasthakadu region, Kanyakumari district.

Fig: 2. Study area

Materials and Method

The sampling was collected from Rasthakadu near Kanyakumari, coastal area (Fig. 1 and 2) from December 2018 to February 2019 for the isolation of epilithic diatoms during the study period. Accurate sampling was carried out by correct handling and preservation of the samples to obtain reliable results. Immediately after collection, sample bottles and bags were clearly labelled with waterproofing and the relevant details were recorded. The samples for biological analysis were taken to the laboratory as early as possible in a controlled condition and were protected from direct sunlight during transportation.

Collection and identification of epilithic diatom

Planktons are very sensitive to temperature, solar radiation, dissolved oxygen, and nutrient levels of the water. In the hydrographical region practically all the groups of phytoplankton are sensitive to light; therefore by and large their activities are brisk during the morning hours. The time coincides with the feeding time of the zooplankton which exhibits intense upward movement in the early hours of collecting phytoplankton has proved that the maximum plankton density was found between 6.00 to 8.00 hrs. The epilithic samples were collected during the study period in all stations were collected by scraping them from mucilaginous big stones with the help of a brush and the epilithic diatoms stuck onto the brush were washed with purified water and placed in sterile sample jars and were transported to the laboratory by fixing 4% formaldehyde for further studies. There was no pollution in all

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the stations and the seawater was very clean and clear. About twenty grams of the wet weight of each sample was put into a 500 ml glass bottle has 200 ml of distilled water and shacked vertically two times with hands. After shaking, distilled water containing separated epiphytes from macrophytes was taken out. Thereafter, 200 ml of new distilled water was added into the bottle, shaken five times, and taken out. It is very important to fix the diatoms as soon as the isolation was over to prevent the adverse effects of light and temperature as light causes rapid decay of organisms. Hence the collected and separated diatom samples were fixed with acidified formaldehyde solution for preservation. The preserved diatom samples were stored in laterally compressed glass bottles of about 500 ml and closed by a leakproof cork and the samples were stored in a cool, dark place. The collected and preserved concentrates of diatom samples were labelled for further analysis. The fractioned samples were identified and cells are counted and expressed as cell numbers per gram dry weight of fraction/seaweeds. For enumerating the diatoms, all the cells in the slide were counted and multiplied by an aliquot factor (**Sridharan, 1979**). The diatom taxa were identified using the classical works of **Boyer (1926-27); Cupp (1943)**; Desikachary (1986, 1987 and 1988) and others.

Analysis of Data

Epilithic diatom samples were collected from January 2020 to February 2021. Species diversity of the epilithic diatom community was analyzed using the formula given by **Shannon and Wicner (1949)**.

$$H' = -\sum Pi \ Log_2 \ Pi$$

where H' (Species diversity) is expressed as bits per individual and (ni) is the number of individuals of the i^{th} species, 'N' is the total number of individuals and 'S' Is the whole number of species in the pattern.

Species Richness (Gleason, 1922)

$$SR = \frac{S-1}{Log\ N}$$

where

S = Total number of species

N = Total number of individuals

Evenness index (J') equitability was calculated using the formula by **Pieiou (1966)**

$$J' = \frac{H'}{Log_2 S}$$

H' = Species diversity

S = Total number of species

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The dominance index was calculated using the formula of **McNaughton (1967)** as described by **Ignatiades and Mimicos (1977)**

$$D1 = \frac{(n_1 + n_2)}{N} \times 100$$

where $n_1 + n_2$ are the dominance index equal to the % of the total standing crop contributed by the two most important species.

Result and Discussion

In the present study, the microfloral algae attached to the rocks were exclusively diatoms from the Rasthakadu Marine Environment and were isolated and tabulated. A total of forty-four diatom species were identified in ten sampling sites. At these diatom species, thirty pennate and fourteen centric diatom species are identified. During the study period, the nature of occurrence on the basis of fractional variation and adhesive strength of the epilithic diatom species were also recorded and listed above. There were nineteen common and 25 rare epilithic diatom species absorbed in the present study. Adhesive strength is thought to be one of the most important ecological characteristics. As they are generally sensitive to nutrients and other environmental perturbations. Epilithic diatoms in each fraction (A, B, and C) group showed close relation with their motility. Epilithic diatom species composition is pennate or centric in nature. The study reveals the average dominant species and their dominance index in all samples listed. A total of 60 species of algae 24 species of cyanobacteria, 28 species of diatoms, and 8 species of green algae were found (**Chandra and Geetha, 2019**).

Adhesive strength is thought to be one of the most important ecological characteristics for epilithic phytoplankton in the Kanyakumari region. In the present study, the microfloral algae attached to the rocks were the most commonly reported microalgal groups as epilithic components on the rock diatoms, chlorophytes, and cyanobacteria Dominance index is yet another important component of species diversity. A similar trend was also reported by in the Kovalam coastal regions of Tamil Nadu. Among the identified epilithic algae, pennate is dominant over centric diatoms due to their tolerance to the high organic content of the plant materials. Further, the pennate diatoms can move amidst the surface sediment particles as epiphytic forms. Since they possess a well-developed raphe system either on one or both valves of the plant (**Mathevan Pillai et al. 2011**). Epilithic phytoplankton is a part of the rock and is reported to have diverse effects and their contribution to the ecosystem, which includes the enhancement of primary productivity.

Table 1: Species composition of Epilithic Diatoms

Sl. No.	Name of the Epilithic Diatoms	FA	FB	FC	P\C	NO
1.	*Achnanthes brevipes* Ag.	+	-	-	P	R
2.	*Amphipleura lindheimeri* Grunow.	+	-	-	P	R
3.	*Amphora augusta* Var.zebrina	-	+	+	P	C

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4.	*Amhora laevis* Gregory	-	-	-	P	R
5.	*Amphora lincolata* Her.	-	+	_	P	R
6.	*Amphora osteraria* Breb.	+	_	+	C	C
7.	*Amphora ovalis* Kutz.	+	+	+	P	C
8.	*Amphora ventricose* Gregory	-	+	+	P	C
9.	*Biddulphia pulchella* Gray.	-	-	-	C	R
10.	*Biddulphia sinensis* (Grev.) Grun.	+	-	-	C	R
11.	*Biddulphia tridens* (Her.) Her.	+	+	+	C	R
12.	*Caloneis westii* W. (Smith) Handey.	-	-	+	C	C
13.	*Cerataulina bergonii* H. Peragallo.	-	-	+	P	R
14.	*Climacoshena moniligera* Hhr.	+	+	+	P	R
15.	*Climacosphenia elongate* Bailey.	-	+	-	P	C
16.	*Coscinodiscus centralis* Ehr.	+	-	-	C	R
17.	*Coscinodiscus gigus* Ehr.	-	+	-	C	R
18.	*Cyclotella stylorum* Btw.	+	-	+	C	C
19.	*Cymbella sp.*	-	+	-	C	R
20.	*Cymbella turgida* (Greg.) cl.	+	-	-	C	R
21.	*Dactylococcopis raphidiodes* Hansg.	-	+	-	P	R
22.	*Denticula vencheurckii* Brun.	-	+	_	P	R
23.	*Diploneis smithi* Brebisson.	+	-	-	P	R
24.	*Gammphonema purvulum* (Kutz, Grun)	-	+	-	P	R
25.	*Grammatophora udulata* Ehr.	-	+	-	P	R
26.	*Glyphodesmis rhombica* (Cl.) Simonson, Anton	+	_	+	P	C
27.	*Haslea indica* Desikachary & Prema.	-	+	-	P	R
28.	*Mastogloia exilis* Hustedt.	-	+	-	P	R
29.	*Melosira nummuloides* Ag.	-	-	-	C	R
30.	*Melosira varians* Ag.	-	+	+	P	C
31.	*Navicula hasta* Pantocsek.	+	-	+	P	C
32.	*Navicula popula* (Kuetz)	+	-	_	P	R
33.	*Navicula rhombica* W. Gregory.	+	-	+	P	C
34.	*Nitzschia interuptestriata* Simonson.	+	+	-	P	C
35.	*Nitzschia tryblionella* Hatzsch.	+	+	+	P	C
36.	*Pleurosigma directum* Grun. And C.	+	+	-	P	C
37.	*Rhaphoneis marginulata* C.L,	-	-	+	P	R
38.	*Rhizosolenia imbricata* Bwl.	+	-	+	P	C
39.	*Striatella unipunctata* (Lyngbye). Ag.	-	-	-	C	R
40.	*Synedra ulna* Ehr.	-	+	+	P	C
41.	*Thalassiothrix longissimi* Cl.&Grun	+	+	+	C	C
42.	*Thallassiothrix frauenfeldii* Grun.	+	+	+	P	C

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43.	*Thalssiosiraaugustee.* (Grun) E. Jorgesen	+	+	-	P	C
44.	*Tropidoneis Lepidoptera* (Greg.) Cl.	+	-	-	C	R

Table: 2 Fractional variations of Epilithic Diatoms, Species Diversity, richness, and evenness on the basis of their adhesive strength in the studied samples.

Sl. No.	Samples	DI			SR			SE		
		FA	FB	FC	FA	FB	FC	FA	FB	FC
1.	S1	2.63	2.13	3.03	1.06	0.59	1.51	0.83	0.91	0.84
2.	S2	2.13	1.41	0.92	0.65	0.29	0.19	0.91	0.98	0.91
3.	S3	2.19	0.67	-	0.63	0.37	-	0.94	0.34	-
4.	S4	2.98	1.38	0.88	0.13	0.30	0.15	0.95	0.87	0.88
5.	S5	1.37	0.97	1.00	0.26	0.17	0.15	0.86	0.97	0.99
6.	S6	1.50	-	0.99	0.32	-	0.41	0.94	-	0.99
7.	S7	1.54	1.89	1.49	0.43	0.47	-	0.77	0.94	0.70
8.	S8	0.25	0.82	-	0.11	0.13	-	0.25	0.82	-
9.	S9	-	0.65	1.51	0.14	0.14	0.43	0.55	1.52	-
10.	S10	0.43	0.65	-	0.14	-	-	0.65	-	0.97

Table: 3 Variation of epilithic diatoms population density (PD) and species diversity (SD) richness and evenness on the basis of adhesive strength in the studied samples

Sl. No.	Samples	PD	SD	SR	SE	DI
1.	S1	4132	7.72	1.05	0.86	33.30
2.	S2	1504	4.42	0.37	0.93	26.25
3.	S3	3502	2.83	0.3	0.42	77.16
4.	S4	2940	3.24	0.19	0.91	53.18
5.	S5	2752	3.37	0.19	0.94	94.54
6.	S6	1313	2.49	0.15	0.64	90.47
7.	S7	3064	4.8	0.10	0.80	65.27
8.	S8	7813	1.07	0.08	0.35	93.60
9.	S9	2688	1.5	0.09	0.69	69.75
10.	S10	2814	2.5	0.19	0.54	57.74

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Abbreviation:

FA - Fraction A, FB - Fraction B, FC - Fraction C, P/C - Pennate/Centric, NO - Nature of Occurrence, + (Present); - (Absence). PD - Population Density; SR - Species Richness; SE -Species Evenness; DI - Dominance Index, SD - Species Diversity.

CONCLUSION

The community structure and the role of diatoms in the marine environment is importance to learn about the ecosystem as they act as biological indicators. Also, the basic studies of diatoms and their importance are needed nowadays for conservation, protection and maintenance measurements in his coastal region. To study the nature and structure of diatoms. To provide the basic information for future projects. To increase the understanding of the epilithic diatom communities inhabiting springs. To illustrate their most characteristic diatom taxa beneath light and electron microscopy.

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