ISSN No:-2456-2165

Epibionts Assemblage of Macroalgae in Mangroves Area at Bhavnagar District, Gujarat, India

Nirali Mehta[1], Shailesh K. Mehta[2]
[1] Research Scholar, Botany Department, Sir P. P. Institute of Science, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar 364002, Gujarat, India
[2]Head & Guide, Botany Department, Sir P. P. Institute of Science, Maharaja Krishnakumarsinhji Bhavnagar University, Bhavnagar 364002, Gujarat, India

Abstract:- Mangroves are a multifunctional and unique component of marine ecosystem as it provide nursery to marine animal, protection from high waves, floods, cyclone, as store blue carbon. Mangrove forest support diversified macroalgae in their community. Typically mangrove occurs near shoreline, in intertidal zone of coast, deltas, estuaries, lagoons and muddy flats. This study conducted to assess the habitat characteristics of mangrove macroalgae at Gopnath coast Bhavnagar District, Gujarat, India. Coast of Gopnath contains 1 true mangrove species *Avicennia marina* (Forsk.) Vierh. One group of macroalgae were recorded to be growing on mangrove root and mangrove field, total 4 species of green algae recorded during this study.

Keywords:- *Macroalgae, Mangroves, Habitat characteristic, Diversity*

I. INTRODUCTION

Mangroves are a multifunctional and unique component of marine ecosystem grow in tropical and subtropical coast (Hoque et al.,2015) and as it provides nursery to marine animal, protection from high waves, floods, cyclone, as store blue carbon. Mangrove forest support divers' macroalgae in their community. Mangrove's dead branches, prop roots, pneumatophores, branches and roots prop up distinct macroalgal assemblages as epibionts in the intertidal zone. (Dawes et al., 1999; Zhang et al., 2014).

This marine macroalgae and mangroves association provide carbon to the primary consumers in the aquatic food web (Koch & Madden, 2001) making them a considerable contributor in the marine ecosystems (Stoner &Zimmerman, 1988). Root structure of mangrove provides hard substrate for some variety of marine flora and fauna.

The height of pneumatophores, surface texture, distance of pneumatophores, and canopy of mangroves affects the distribution of macroalgae in mangroves area. Environmental parameter such as temperature, salinity, dissolved oxygen, pH etc. have been considered to be controlling factor that influence the presence and absent of macro marine algae in mangrove habitat (Fermandes & Aives 2011).

II. OBJECTIVE OF RESEARCH WORK

The main purpose of this study is to investigate role of marine algae and mangrove species to maintain marine environment, coastal area, marine faunal diversity, coastal economy. As the marine algae and mangroves are primary producer of ecosystem that maintain the food chain and provide nursery to marine fauna. This study will help to know the current status of marine diversity. This data are useful for the future reference in field of climate change effect, effect of sea level rise, environmental engineering, coastal engineering, marine engineering to making strategies for conservation and protection.

III. MATERIAL AND METHOD

A. Study Site

Study was carried out at Gopnath Coast (21°12'31"N 72°6'34"E) located in Bhavnagar District, Gujarat, India. The intertidal area was rocky to muddy. Mangrove habitat only present in muddy and sandy region at Gopnath coast. *Avicennia marina* (Forsk.) Vierh is a single mangrove species present at Gopnath coast.

Fig 1: Map of Gopnath coast, Bhavnagar, Gujarat, India.

B. Sample Collection

Sample was collected seasonally (summer, monsoon, post monsoon, winter) in year of 2021 to 2022. Macroalgal data collected randomly in every season by using 1 m^2 quadrat. Pneumatophores of mangrove covered with macroalgae were collected for the identification purpose. Length of pneumatophores measure by using measuring tap, sharp blade and knife used to collect pneumatophores from the

field during low tide, physicochemical parameter of seawater such as Temperature, pH, Total Dissolved Solids, Electrical Conductivity, Salt Concentration recorded during all four seasons by using multi-parameter kit.

C. Statestical Analysis

The frequency (F) for each algal species were calculated as the number of pneumatophores on which that species was detected (∑N) and total number of pneumatophores (N) studied.

Frequency= ∑N / N (Phillips et al., 1996)

Abundance calculated by standard formula:

$$\frac{\text{Total number of individual species in all qudrats}}{\text{Total number of quadrats in which species occures}}$$

IV. RESULT AND DISCUSSION

➢ *Diversity of Mangrove:-*

Only single species of mangrove *Avicennia marina* (Forsk.) Vierh observed during this investigation from the Gopnath beach. These white mangrove species will be found dominantly at study site from all quadrate in form of herb as well as in a form of shrub. Some plant present in muddy, sandy area and some also present on hard surface like rock. *Avicennia marina* (Forsk.) Vierh bearing pneumatophores for breathing activity**.** pneumatophores present in much numbers while in hard surface area its present in less number.

Fig:2 Strucutre of *Avicennia marina* (Forsk.) Vierh

➢ *Taxonomic Classification of Avicennia marina (Forsk.) Vierh:-*

Domain: Eukaryota
Kingdome: plantae
Phylum: spermatophyte
Subphylum: angiospermae
Class:dicotyledonae
Order: lamiales
Family: acanthaceae
Genus: *Avicennia* L.
Species:*Avicennia marina* (Forssk.)Vierh.

➢ *Plant Characteristic:*

Plant contains pencil like pneumatophores pop up above ground with forming shallow underground roots network. Leaves simple, 3-6 cm long and 2- 3cm wide, opposite, elliptic, acute apex, glabrous and glaucus. Flower yellow, sessile in condensed terminal cyme.

Fig:3 flower(left) and fruit(right) strucutre of *Avicennia marina* (Forsk.) Vierh

➢ *Phytosociological Analysis of Mangrove:-*

Table:1 phytosociological analysis of mangrove.

Species Name	***Avicennia marina* (Forsk.) Vierh**
Frequency	**94%**
Relative Frequency	**100%**
Abundance	**4.02**
Relative Abundance	**100%**
Density	**3.78**
Relative Density	**100%**
IVI	**300**

Field study and qualitative study shows single mangrove species *Avicennia marina* (Forsk.) Vierh. in all sampling unit with 94% frequency, 4.02 (plants/450m^2) abundance, 3.78 (plants/450m^2) density, 300 important value index and with 100% relative abundance and relative density.

➢ *Diversity of Marine Macroalgae:-*

Total 4 verities of macroalgae *Ulva prolifera, Ulva ovata, Ulva intestinalis* and *Ulva compress* recorded in this investigation. Investigated macroalgae belongs to same genus Ulva, family Ulvaceae and same division Chlorophyta. There is absence of red algae and brown algae.

1. Ulva intestinalis Linnaeus:

Thalli are simple and branching near base sometimes proliferous structure present, appear green to yellowish-green, 15-40 cm high, 0.5–1.0cm wide, solitary, comprised of several cylindrical, hollow, narrow tubular to flattened blades, with smooth or wrinkled surface, Margins entire or twisted to curly. Attachment by small disc-like holdfast on pneumatophores as well as on sand particles.

ISSN No:-2456-2165

2. *Ulva ovate Thivey et Visalakshmi ex Joshi et Krishnamurthy:*

Thalli yellowish green, 0.3-2 cm wide and 0.5-4.0 cm long. Frond hollow, single, simple, flat, ovate. Attached with substrate by minute holdfast. It is endemic to Indian coast.

3. *Ulva prolifera (Miiller) J. Agardh:*

Thallus tubulose, branched and filamentous. Thallus appear dark green,10 to 13 cm long, profusely branched and attached by disk like hold fast with substratum.

4. *Ulva Compressa (Linnaeus) Nees:*

Thallus tubulose and compressed, plant yellowish green up to 11cm long, narrow, obtuse or round apices and stalk like base.

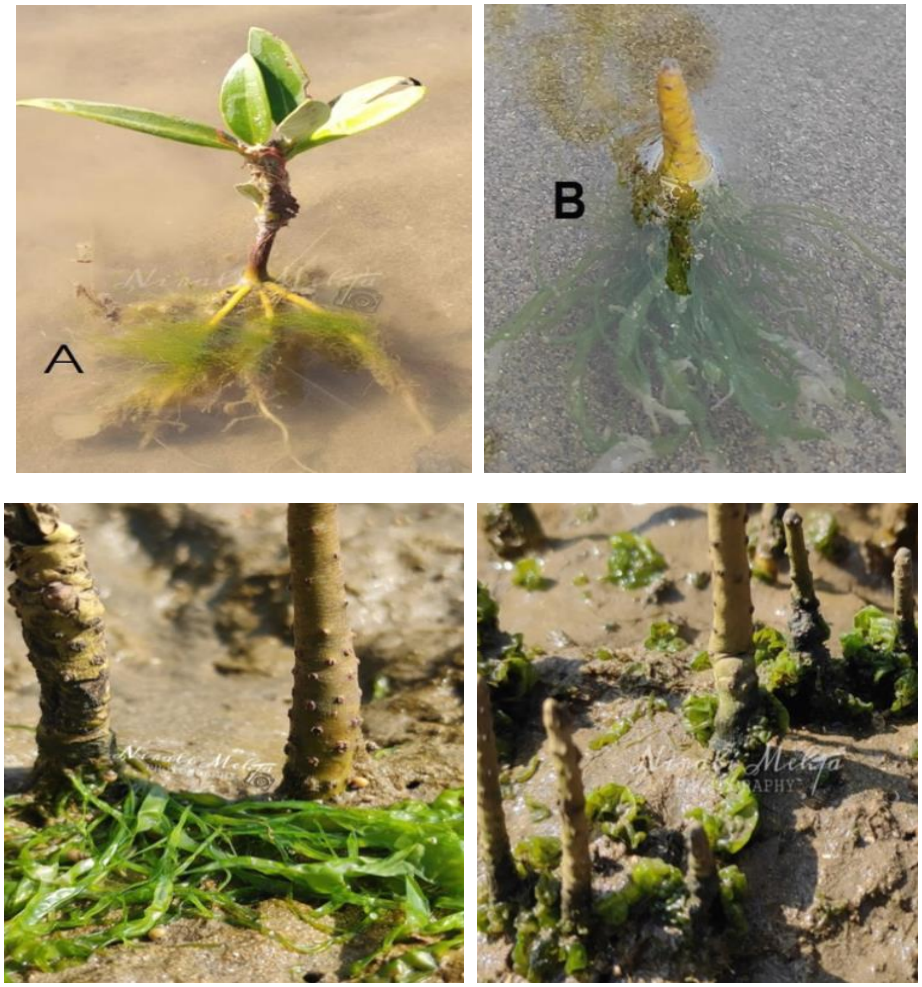
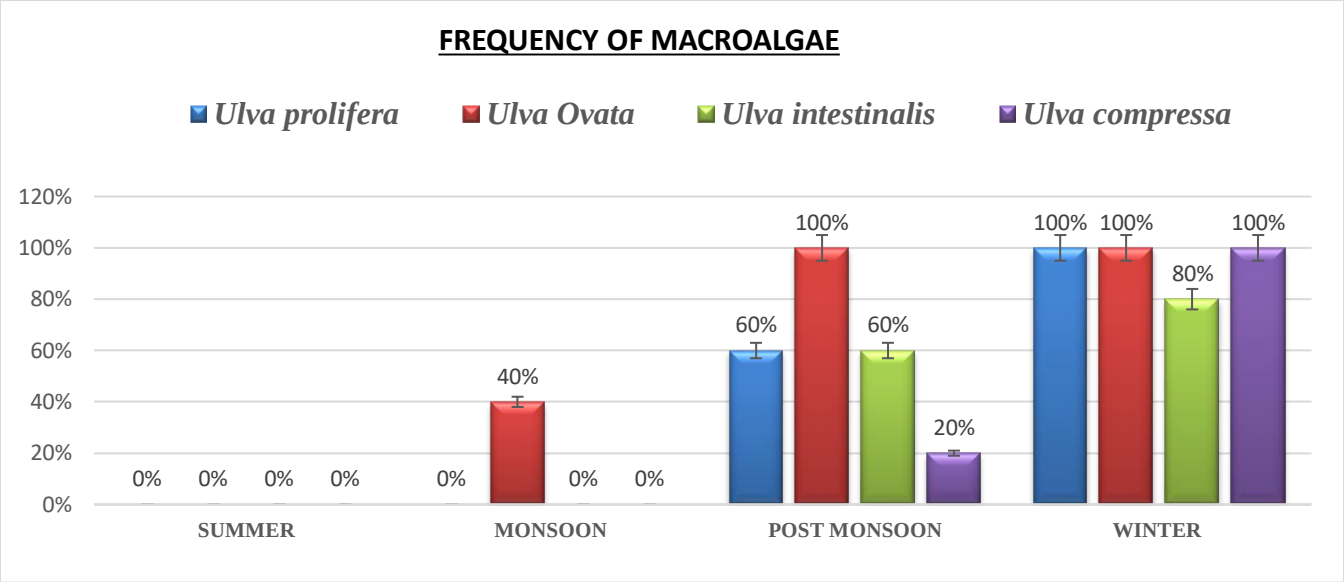


Fig:4 epibionts essemblage of macroalgae on pneumaophores of *Avicennia marina* (Forsk.) Vierh; A. *Ulva prolifera, B. Ulva compres,C.Ulva intestinalis, D.Ulva ovata*

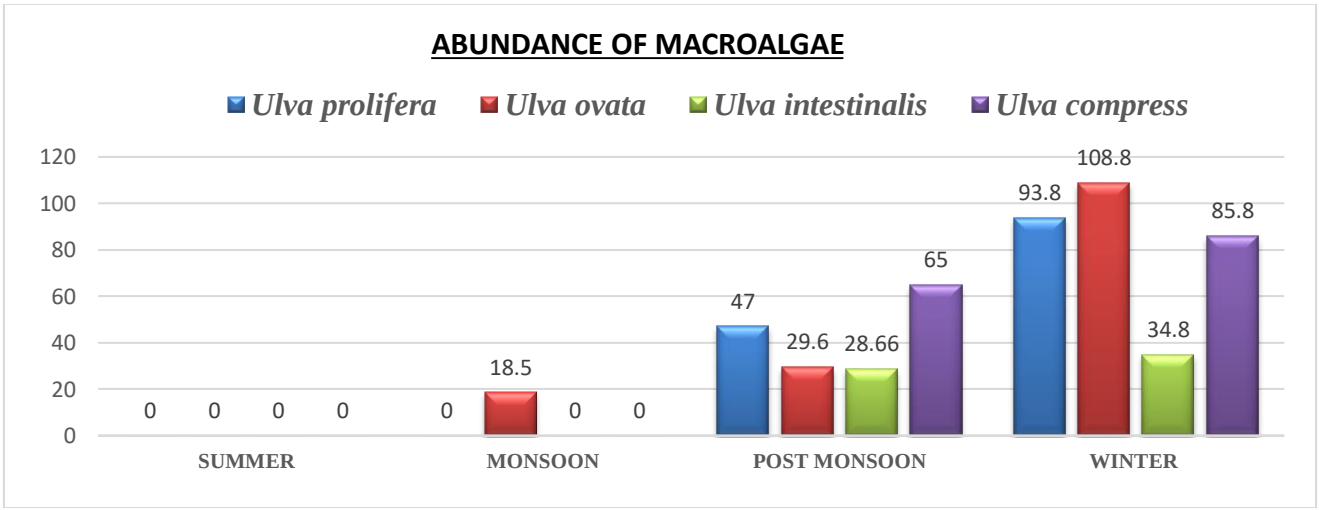
Ulva ovata present in 3 seasons (Monsoon, Post monsoon and winter) with maximum frequency while *Ulva prolifera*, *Ulva intestinalis* and *Ulva compressa* present in post monsoon and winter season, while in summer season diversity were not observed.

The maximum abundance reported in winter season for *Ulva prolifera* and *Ulva ovata*. Table 2 shows The occurrence of macroalgae on pneumatophores is up to the 15 cm from the basal area. *Ulva prolifera,, Ulva intestinalis, Ulva compress* present on soil sediments only when it contain sand type particles.

ISSN No:-2456-2165



Graph:1 Frequency of marine macroalgae assemblage with pneumatophores



Graph:2 Abundance of marine macroalgae assemblage with pneumatophores

The maximum abundance reported in winter season for *Ulva prolifera* and *Ulva ovata*. Table 2 shows The occurrence of macroalgae on pneumatophores is up to the 15 cm from the basal area. *Ulva prolifera,, Ulva intestinalis, Ulva compress* present on soil sediments only when it contain sand type particles.

- *Physico-chemical parameter of seawater:-*

Table:2 Substratum preference of marine macroalgae

Macroalgae	Pneumatophores		Soil Sediments	
	Basel area	Apex area	Sandy soil	Muddy soil
Ulva prolifera	+	-	+	-
Ulva ovata	+	-	+	-
Ulva intestinalis	+	-	+	-
Ulva compress	+	-	+	-

In summer season maximum reading recorded in temperature, Electrical conductivity and total dissolved solids. While minimum value recorded in winter season for temperature, electrical conductivity. Minimum value of pH, Dissolved oxygen and Total dissolved solids, salt concentration recorded in monsoon and post monsoon.

Table:3 average data of physic-chemical parameter of seawater

Season	Tempera-ture °C	pH	EC (mS)	TDS (ppt)	SALT (ppt)	D.O.(mg/l)
Summer	**33.2**	**8.1**	**49.7**	**31.7**	**21.3**	**6.70**
Monsoon	**31.9**	**7.90**	**45.9**	**30.2**	**22.9**	**3.64**
Post monsoon	**31.1**	**8.34**	**38.1**	**24**	**18.2**	**7.0**
Winter	**27.8**	**8.18**	**36.4**	**24.2**	**18.4**	**6.98**

V. CONCLUSIONS

Investigation shows there is single species of mangrove *Avicennia marina* (Forsk.) Vierh. Was dominant and Presence-absences of macroalgal species is depend on morphological structure of pneumatophores as well as the seasonal changes that would affect the growth of macroalgal growth. Conservation and development of mangrove give chance to flourish more macroalgal diversity that increase the diversity of marine flora and fauna.

Pneumatophore of mangrove varies in height from 10 cm to 35 cm, macroalgae present on the basal area of pneumatophores near to soil sediments. *Ulva ovate*, *Ulva prolifera and Ulva compressa* present with 100% frequency in winter season. *Ulva ovate* (108.8), *Ulva prolifera* (93.8), *Ulva compressa*(85.8)and *Ulva intestinalis* (34.8)abundant in winter season.

Apart from contributing immensely in the primary trophic level in the marine ecosystem marine algae assist in harvesting excess carbon dioxide in the atmosphere and provide refugee for a diversity of organisms. Besides, the study also discussed some important hydrological factors that can influence the occurrence and abundance of mangrove macroalgae. References and literature on mangrove associated marine macroalgae in Bhavnagar district was not sufficient so, this investigation of epibionts assemblage of macro algae in mangroves area is very important in the area of Bhavnagar district, Gujarat, India. Presented data may prove useful in experimental design for future research aimed at investigating suitable macroalgal bio-indicator species from mangrove systems, detailed relationship between mangrove and marine algae.

ACKNOWLEDGMENT

Author is grateful to government of Gujarat for providing “SODH-ScHeme of Developing High Quality Research” scholarship. Author would like to thank Dr. Shailesh Mehta, Head & associate professor Botany Department Sir P.P. Institute of science, M.K.Bhavnagar

University for his encouragement and guidance, I/C Principal Dr. G.M. Sutariya, Sir P.P. Institute of science, M.K.Bhavnagar University and Department of Life Science, M.K.Bhavnagar University for providing laboratory facilities.

REFERENCES

[1]. Abbott, I. A. 1999. Marine red algae of the Hawaiian Islands. Bishop Museum Press, Honolulu, HI, 477 pp.
[2]. Børgesen, F. 1915. The marine algae of the Danish West In-dies. Part 3. Rhodophyceae (1). Dansk. Bot. Arkiv. 3:1-80.
[3]. Chapin, F. S. 2003. Effects of plant traits on ecosystem and regional processes: A conceptual framework for predicting the consequences of global change. Annals of Botany 91: 455-463.
[4]. Davey A, Woelkerling WJ (1980) Studies on Australian mangrove algae: I. Victorian Communities: composition and geographic distribution. Proceedings of the Royal Society of Victoria 91: 53–66
[5]. Dor I (1975) The blue-green algae of the mangrove forests of Sinai. Rapport Commission Internationale pour la Mer Mediterranee 23: 109–110
[6]. Feller, I. C., Lovelock, C. E., Berger, U., mckee, K. L., Joye. S. B., Ball, M. C. 2010. Biocomplexity in mangrove ecosystems. Annual Review of Marine Science 2: 395-417.
[7]. Hicks BJ, Sylvester WB (1985). Nitrogen fixation associated with the New Zealand mangrove Avicennia marina (Forssk.) Vierh. var. resinifera (Forst.f) Bakh. Appl. Environ. Microbiol. 49: 955-959.
[8]. Jaasund E (1976) Intertidal Seaweeds in Tanzania. University of Tromsø Press, pp 159
[9]. King RJ, Puttock CF (1989) Morphology and taxonomy of Bostrychia and Stictosiphonia (Rhodomelaceae / Rhodophyta). Australian Systematic Botany 2: 1–73
[10]. King RJ, Wheeler MD (1985) Composition and geographic distribution of mangrove macroalgal communities in New South Wales. Proceedings of the Linnaean Society of New South Wales 108: 97–117
[11]. Kyaruzi JJ, Kyewalyangal MS, Muruke MHS (2003). Cyanobacteria Composition and Impact of Seasonality on their In Situ Nitrogen Fixation Rate in a Mangrove Ecosystem Adjacent to Zanzibar Town. Western Indian Ocean J. Mar. Sci. 2(1): 35–44.
[12]. Mann FD, Steinke TD (1988). Photosynthetic and respiratory responses of the mangrove- associated red algae, Bostrychia radicans and Caloglossa leprieurii. S. Afr. J. Bot. 54: 203- 207
[13]. Caloglossa leprieurii. S. Afr. J. Bot. 54: 203- 207
[14]. Phillips A, Lambert G, Granger JE, Steinke TD (1996) Vertical zonation of epiphytic algae associated with Avicennia marina (Forssk.) Vierh. pneumatophores at Beachwood Mangroves Nature Reserve, Durban, South Africa. Botanica Marina 39: 167–175

[15]. Reynolds ES (1963). The use of lead citrate at high pH as an electron opaque stain in electron microscopy. J. Cell Biol. 17: 208-212.
[16]. Sage WW, Sullivan MJ (1978) Distribution of blue-green algae in a Mississipi Gulf coast salt marsh. Journal of Phycology 14: 333–337
[17]. Tinley KL (1958) A preliminary report on the ecology of the Kosi Lake System. Unpublished report to Natal Parks, Fish and Game Preservation Board, Pietermaritzburg
[18]. Ward CJ, Steinke TD (1982) A note on the distribution and approximate areas of mangroves in South Africa. South African Journal of Botany 1: 51–53
[19]. Yoshida, T. 1998. Marine algae of Japan. Uchida Rokakuho Publishing Co., Ltd., Tokyo, 1222 pp.
[20]. Zuccarello, G. C., Buchanan, J., West, J. A. & Pedroche, F. F. 2011. Genetic diversity of the mangrove-associated alga Bostrychia radicans/Bostrychia moritziana (Ceramiales, Rhodophyta) from southern Central America. Phycol. Res. 58:98-104.