Seaweeds of South Andaman: Chidiyatapu, North Bay and Viper Island

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Introduction

The Andaman and Nicobar group of Islands consists of about 572 islands, islets, fringing reefs and rocks situated in the Bay of Bengal, between 6° N to 14° N latitudinal and 92° E to 94° E longitudinal. Among the Islands of India, Andaman and Nicobar Islands have the maximum area under marine influence. The total area of these Islands is 8249 sq km and the coastline extends upto 1926 km (Anon, 1994). Within their peri-meters they present panoramic views, sheltered fairly nooks, sun-kissed seascapes and unmatched scenic beauty embracing lush-green tropical forest, serpentine creeks and backwater channels, radiant valleys, enthralling hill slopes, co-existing with coastal rides and beaches making this area quite incomparable with any other part of India. The general climate conditions of these islands are warm and humid tropics with tempe-rature ranging between 22 to 32°C. The mean relative humidity is about 82%. Islands are exposed to both the southwest and northeast monsoons with the average rainfall of 3000 mm. The close proximity of these groups of islands to the equator and good amount of rainfall in addition to the irregular and deeply indented coast line, creeks, bays and estuaries facilitate the rich growth of marine algae and seagrass.

Seaweeds or marine algae are well known group of marine plants, belonging to Cryptogams. These are large diversified groups with size ranging from single cell, such as *Chlamydomonas* to several meters in length *i.e.*, *Macrocystis*. The thalli show less morphological and anatomical differentiation. Algae are classified on the basis of pigmentation and their morphological characters. The four classes thus formed are: Chlorophyta (Green algae), Phaeophyta (Brown algae), Rhodophyta (Red algae) and Cyanophyta (Blue-green algae). The algal species belonging to the first three classes are particularly important as many industrial products such as agar, alginate, carrageenan can be extracted from them. They are also traditionally used as food in many Asian countries and are becoming popular in the rest of the world. Seagrasses are the most common of shallow coastal ecosystems, found virtually in all seas except in the polar seas. They are adapted to the marine environments and associated with seaweeds and sea animals. Seagrass are submerged angiospermic monocotyledonous plants belonging to two families (Hydrocharitaceae and Potamogetonaceae). As per our knowledge, there are 12 genera and about 52 species distributed throughout the world.

About 20,000 marine algal species have been

reported to be distributed throughout the world. Totally 844 marine algae species were reported from the Indian coastal region (Oza and Zaidi, 2001). Earlier, nearly 206 species of marine algae are recorded from Andaman and Nicobar islands while the estimate is above 300 species. Marine algal research work has been done covering all aspects in the Indian coastal region but in this archipelago, very little attention has been focused. A few available literature on occurrence of marine algae at different parts of Andaman and Nicobar Islands are those of Krishnamurthy and Joshi (1970), Baluswami *et al.* (1982), Gopinathan and Panigrahy (1983), Iyengar (1984), Jagtap (1985,1992), Srivastava and Mehrotral (1990), Rao and Mudgal (1997), Umamaheswara Rao (2000),Eashwar *et al.*(2001) and Kannan and Thangarajou (2006). The reported seagrass of these Islands was recorded by Das (1996). However, systematic attempts were not made till now to understand the species diversity and abundance of marine algae occurring in Andaman and Nicobar. Also conservation and management strategy has not been made on marine algae. In this point of view, the present study was taken up to explore and document the seaweeds, seagrasses of Chidiyatapu, North Bay and Viper Island, South Andaman.

Methodology

Study Area

The places of collection of marine benthos are depicted in Fig 1, (1.Chidiyatapu, 2. North Bay and 3.Viper Island) and the description of the sampling area is given below.

Chidiyatapu (11° 29' 30" to 11° 30' 34" N and 92° 35' 10" to 92° 42' 30" E) is 25 km away from Port Blair. It is the southern most tip of South Andaman. The coastal area is rocky and muddy but in several areas sand was also observed (Fig.2-3). Mudflats with sandy and coral rubbles promote the growth of seaweeds and seagrass. The lush green mangroves, forest covered with numerous chirping birds and the Sylvan Sands and Mundapahar beaches make it an ideal picnic site. The state forest department recently arranged mini zoo to attract the tourist near to forest guesthouse on top of a hillock provides a fabulous view of isolated islands,

Fig.1. *Map showing the study area in South Andaman*

submerged corals and the breath- taking sunsets. Every day about 50 tourists get into the beautiful blue water for watching the beauty of the corals and enjoying the scenic view of Rutland and birds watch. Local peoples arrange parties on week end day and enjoying the natural beauty. This is the region where large fishes are found and local fishermen spread their catches here. The seaweed adds beauty to the scenery of the beach and associate rocky areas giving shelter to breeding fishes.

North Bay (11° 42' 16" to 11° 42'25" N and 92° 45' 00" to 92° 45' 23" E) is paradise to tourists and ideal ground for marine biologist to study the corals and the animals associated here. It is situated in the north east of Port Blair about 4.5 km away from Phoenix bay jetty. The tourist inflow into North Bay is more than 400 per day. The tourists are more enthusiasm to watch the beauty of the corals reefs in the shallow waters, get into the sea water, of two- three meter deep water and most of them enjoying the coconut plantation and the light house. The light house in this area helps to monitor the movement of ships in the Andaman sea water and it provides the gateway entry point to Andamans. The coastal area is rocky and muddy but in several cases sandy with rubbles. Mudflats with sandy, rocks and coral rubbles promote the growth of seaweeds. The coral

Fig. 2. *A view of Chidiatapu*

Fig. 3. *Algal vegitation at Chidiyatapu*

Fig. 4. *Panoramic view of North Bay*

Fig. 5. *Luxuriant growth of green algae*

Fig. 6. *View of viper Island*

Fig. 7. *Ulva sp. mixed with red algae*

reefs and seaweeds are breeding ground to the fishes and other animals. The rocky area gets exposed during low tide and gets covered by algae (Fig. 4-5).

Viper Island (11° 39'35" to 11° 39'49" N and 92° 41' 30" to 92° 42' 20" E) is tiny island with serene beauty, situated to the north east, 2.5 km away from Haddo Jetty, Port Blair (Fig.6-7). It has a rocky shore on the western side and the remaining area is covered with sand and rock. The rocky areas are exposed to low tide and these rocks are covered by green algae mixed with red alga. This Island has witnessed the untold sufferings the freedom fighters had to undergo. The jail at Viper, where prisoners were deported from the mainland were confined, was built by the British under the supervision of Major Fort. Work on the prison was started in 1867. Owing to the working conditions, the jail earned the

notorious name Viper Chain Gang Jail. The island derives its name from the vessel 'Viper' in which Lt. Archibald Blair came to the islands in 1768 with the purpose of establishing a Penal Settlement. Gallows built on top of a hillock, visible to all prisoners in the island, signified death. Sher Ali, the Pathan, guilty of murdering Lord Mayo, was condemned to death and hanged at Viper Island.

During the period 2007-2008, two field trips were conducted in the different seasons to cover the selected coastal area in Andaman Sea. In this survey totally 12 localities along the south Andaman sea coast were intensively explored for study of marine algae and seagrass, of which 5 localities are from Chidiyatapu, 4 are from North Bay and 3 are from Viper Island. A total of 86 field numbers of seaweed and seagrass samples were collected in the inter tidal and shallow regions during medium or low tides. Samples were washed with seawater and removed sand, sediments and animals without any damage to seaweeds. They were preserved with 4% sea-water formalin and brought to Botanical Survey of India, Andaman and Nicobar Circle, Port Blair. Simultaneously, important field observations like habitat, nature of substratum, distribution, associations of several seaweeds, depth, abundance, colour and epiphytic organism were noted in the field book. Algal specimens were pressed and dried, they were neatly pasted on herbarium sheets and deposited at Botanical Survey of India, Andaman and Nicobar circle, Port Blair for further use and references.

The collected samples were identified authentically with the help of previous collections with references,recent books and publications i.e Boergesen series publications of Indian Algae and adjacent to Indian waters (1930-1938); Desikachery *et al.* 1990 & 1998; Srinivasan, 1969&1973 etc. The seagrass were identified based on Ramamurthy *et al.* 1992.

Physico-chemical Parameters of Sea water

Temperature (°C)

During the exploration surface water temperature and atmospheric temperature were measured using a standard centigrade thermometer from all the stations.

Salinity (‰)

Salinity was estimated with the help of Refractometer (Model E-2).

pH

pH was measured using Henna Hand held pH meter.

Dissolved Oxygen (ml/l)

Seawater DO was measured with the help of Strickland & Parsons 1972.

Results

In the present survey (2007-2008), totally 81 species of seaweeds and 5 species of seagrass (Table - 1) were recorded from Chidiyatapu, North Bay and Viper Island, South Andaman. Of these 26 taxa are Chlorophyceae belonging to 14 genera, 19 taxa are Phaeophyceae belonging to 10 genera, 32 taxa are Rhodophyceae belonging to 19 genera, 4 taxa are Cyanophyceae belonging to 4 genera and 5 taxa are seagrasses belonging to 4 genera. This survey revealed that the red algal diversity is more than the other algal groups, but luxuriance is observed in brown algae, whereas the Cyanophyceae members were observed in very less number. In seagrass totally five species were recorded from this exploration and more numbers were recorded in Chidiyatapu. Seaweeds were growing luxuriantly in Chidiyatapu and North Bay, in which 74 and 67 species were recorded but in Viper Island only nine algal species were recorded.

Chlorophyceae

Among the different genera recorded from the study area , the genus Caulerpa is the most represented (6 species) followed by Halimeda (4 species) and Enteromorpha, Chetomorpha, Ulva and Acetabularia (each 2 species) while remaining 8 genera are represented by each one species thus making a total of 26 species. Although the genus Caulerpa is dominate in species vise the Halimeda, Enteromorpha, Ulva and Acetabularia are found to be predominant in terms of biomass and luxuriance on the Chidiyatapu and North Bay. The species of *Averainvillea, Boergesenia,*

Fig. 8 Chlorophyceae

Fig. 9 *Acetabularia cranulata*

Fig. 10 *Caulerpa peltata*

Fig. 11 *Caulerpa peltata*

Fig -12 15 : Phaeophyceae

Fig. 12 *Dictyota dichotoma*

Fig. 13 *Padina testrastromatica*

Fig. 14 *Padina pavonica*

Fig. 15 *Sargassum duplicatum*

Fig -16-19 : Rhodophyceae

Fig. 16 *Atinotrichia*

Fig. 17 *Galaxaura rugosa*

Fig. 18 *Gelidiella acerosa*

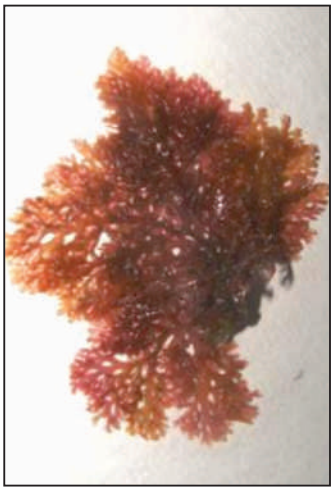

Fig. 19 *Portieria homemanni*

Table 1. **Marine Algal Flora of S. Andaman: Chidiyatapu, North Bay and Viper Island**

Marine Algal	Chidiya-tapu	North Bay	Viper Island
CHLOROPHYCEAE			
ULVALES			
ULVACEAE			
1. *Enteromorpha compressa*(L) Nees	+	+	+
2. *Enteromorpha intestinalis* (L) Nees	+	+	–
3. *Ulva lactuca* L.	+	+	+
4. *Ulva reticulata Forsskal*	+	+	–
CLADOPHORALES			
CLADOPHORACEAE			
5. *Chaetomorpha aerea* (Dillwyn) Kutzing	+	+	–
6. *Chetomorpha linum* (O.F.Muller) Kutzing	+	+	–
7. *Cladophora saracenica* Boergs.	+	+	–
SIPHONOCLADALES			
SIPHONOCLADACEA			
8. *Boergesenia forbesii* (Harv.) Feldm.	+	–	–
9. *Dictyosphaeria cavernosa* (Forsk.)Boergs.	+	+	–
BRYOPSIDALES			
BRYOPSIDACEAE			
10. *Bryopsis plumose* (Huds.) C. Agardh	+	+	–
CAULERPACEAE	+	+	–
11. *Caulerpa peltata* (Tura.) Lamouroux	+	–	–
12. Caulerpa racemosa (Forsk.) J.Agardh	+	–	–
13. *Caulerpa scalpelliformis* (R.Br.)C.Agardh	+	–	–
14. *Caulerpa serrulata* (Forsk.) J. Agardh	+	–	–
15. *Caulerpa taxifolia* (Vahl) C. Agardh	+	–	–
16. *Caulerpa verticillata* J. Agardh	+	+	–
CODIACEAE			
17. *Codium tomentosum* (Hudson)Stack	+	–	–
HALIMEDACEAE			
18. *Halimeda discoidea* Decaisne	+	+	–
19. *Halimeda distorta* (Yamada) Hillis	–	+	–
20. *Halimeda macroloba* Decs.	+	+	–
21. *Halimeda opuntia* (L.) Lamouroux			
UDOTEACEAE			
22. *Avrainvillea erecta* (Berkel.) Gepp&Gepp	+	+	–
DASYCLADALES			
DASYCLADACEAE			
23. *Bornetella nitida* Sonder	+	–	–
24. *Neomeris annulata* Dickie	+	+	–
POLYPHYSACEAE			
25. *Acetabularia calyculus* Lamouroux	+	–	–
26. *Acetabularia crenulata* Lamouroux	+	+	–
PHAEOPHYCEAE ECTOCARPALES			
ECTOCARPACEAE			
1 . *Ectocarpus siliculosus* (Dillwyn) yngbye	+	+	–
DICTYOTALES			
DICTYOTACEAE			
2. *Dictyota dichotoma* (Hudson) Lamouroux	+	+	–
3. *Padina boergesenii* Allender & Kraft	+	–	–
4. *Padina gymnospora* (Kuetz) Sonder	+	+	–
5. *Padina pavonica* (Linnaeus) Thivy	+	+	–
6. *Padina tetrastromatica* Hauck.	+	–	–
7. *Spathoglossum asperum* J. Agardh	+	+	–
8. *Stoechospermum marginatum* (C.Agardh)Kutzing.	+	+	–
SCYTOSIPHONALES			
SCYTOSIPHONACEAE			
9. *Hydroclathrus clathratus* (C. Agardh)Howe	+	–	–

Marine Algal	Chidiya-tapu	North Bay	Viper Island
10. *Rosenvigea intricate* (J.Ag.)Boergs.	+	+	–
FUCALES			
CYSTOSEIRACEAE			
11. *Hormophysa cuneformis* (J.Gmelin)P.Silva.	+	+	–
SARGASSACEAE			
12. *Sargassum cinereum* J.Agarth	+	+	–
13. *Sargassum duplicatum* J.Agardh	+	+	–
14. *Sargassum lanceolatum* J. Agardh	–	+	–
15. *Sargassum swartzii* (Turn.) C. Agardh	+	–	–
16. *Turbinaria conoides* (J.Agarth)Kuetz	+	+	–
17. *Turbinaria decurrens* Bory de saint-Vincent	–	+	–
18. *Turbinaria ornata* J. Agardh	+	+	–
19. *Turbinaria turbinata* (J. Agardh) Kutzing	+	+	–
RHODOPHYCEAE			
NEMALIALES			
GALAXAURACEAE			
1. *Actinotrichia fargilis* (Forsskal) Boergesen	+	+	–
2. *Galaxaura obtusata* Eills&Solander)Lamouroux	+	+	–
3. *Galaxaura rugosa* (Eills & Solander) Lamouroux.	+	+	–
HELMINTHOCLADIACEAE			
4. *Liagora ceranoides* Lamouroux	+	–	–
5. *Liagora indica* V. Krishna. & Sundrajan	+	+	–
GELIDIALES			
GELIDIACEAE			
6. *Gelidium pusillum* (Stackouse)Le Jolis	+	+	–
7. *Pterocladia caerulescens* (Kuetz) Sante.	–	+	–
GELIDIELLACEAE			
8. *Gelidiella acerosa*(Forssk.) J.Feldm.&G.Hame	+	+	–

Marine Algal	Chidiya-tapu	North Bay	Viper Island
GRACILARIALES			
GRACILARIACEAE			
9. *Gracilaria corticata* (J. Agardh) J. Agardh	+	+	–
10. *Gracilaria edulis* (S.Gmalin) P. Silva	+	+	–
11. *Gracilaria pygmaea* Boergs.	+	–	–
12. *Gracilaria verrucosa* (Huds.) Papenfuss	+	+	–
BONNEMAISONIALES			
BONNEMAISONIACEAE			
13. *Asperagosis taxiformis* (Delile))Col. & Harv.	+	+	–
CRYPTONEMIALES			
HALYMENIACEAE			
14. *Grateloupia furcata* Kuetz	+	+	–
15. *Halymenia durvillei Bory* de Saint-Voncent	+	+	–
16. *Halymenia floresia* (Clemente y Rubio) C. Agardh	–	+	–
RHZOPHYLLIDACEAE			
17. *Portieria hornemannii* (Lyngbye) P. Silva	+	+	–
CORALLINALES			
CORALLINACEAE			
18. *Amphiroa anastomosans* Weber-van Bosse	+	+	–
19. *Amphiroa anceps* (Lamarck)Decaisne	+	+	–
20. *Amphiroa foliacea* Lamouroux	–	+	–
GICARTINALES			
HYPNEACEAE			
21. *Hypnea hamulosa*(Esper) Lamouroux	+	+	–
22. *H.musciformis* (Wulfen) Lamouroux	+	+	–
23. *H. spinella* (C.Agardh.) Kutzing.	+	+	–
RHODYMENIALES			
RHODYMENIACEAE			
24. *Gelidiopsis intricate* (C.Ag.)Vickers	–	+	–
25. *Rhodymenia dissecta* Boergesen	+	+	–

Marine Algal	Chidiya-tapu	North Bay	Viper Island
26. *Rhodymenia sonderi* P. silva	–	+	–
CERAMIALES			
RHODOMELACEAE			
27. *Acanthophora spicifera* (Vahl) Boerges.	+	+	–
28. *Enantiocladia prolifera* (Grev.) Falkenb.	–	+	–
29. *Laurencia papillosa* (C.Ag.) Greville	+	+	–
30. *Polysiphonia ferulaceae* Suhr ex J. Agardh	+	+	+
31. *Polysiphonia ungiforms* Borgesen	+	+	+
32. *Polysiphonia partha-sarathyi* Sreenivasa Rao	+	–	–
CYANOPHYCEAE			
1. *Pormedium fragile* (Menegh.) Gomont.	+	+	+
2. *Oscillatoria corallinae* (Kuetz)Gom.	+	+	+
3. *Lyngbya majuscule* Harv.ex Gomont	+	+	+
4. *Anabaena variabilis* kuetz ex Born et Flah	+	+	–
SEAGRASS			
HYDROCHARITACEAE			
1. *Enhalus acoroides* (L.f.)Royle	+	–	–
2. *Halophila ovata* Grud.	+	+	–
POTAMOGETONACEAE			
3. *Cymodoceae serrulata* (R.Brown)Ascherson & Magnus	+	–	–
4. *Halodule uninervis* (Forskall) Ascherson	+	+	–
5. *Halodule pinifolia* (Miki)den Hartog	+	+	–

(+) indicates species present , (-) indicates species absent

Table. 2 **Data collected on physicochemical parameters from the study areas**

Months	Temperature (°C)		Salinity	pH	DO (ml/l)
	Atmospheric	Seawater	(‰)		
Sept.2007	29.5	28.8	29.00	7.3	5.7
Dec.2007	31.5	29.7	30.5	7.8	5.2

Dictyosphaeria, Bornetella, Bryopsis, Codium and Neomeris are rare occurrence.

Rhodophycae

The economically important red algae is well represented by 19 genera and 32 species in the study area among which the genus Gracillaria has maximum no of species, *i. e.*, 5. Many of this red algae are known to yield agar agar that are used in many of the industries and laboratories. The genus Hypnea and Amphiroa represented by 3 species each, Galaxaura, Halymenia, Liagora, Rhodymenia and Polysiphonia with 2 species each and the remaining 11 genera are represented only one species each. Although floristically rich and distributed in many areas, the biomass availability of the red algae is less as compared to brown and green algae in the study area. In station wise distribution 23 species of red algae were recorded in Chidiyatapu and 26 were in North Bay and only 2 species were recorded in Viper Island.

Phaeophycae

The wide economically important brown seaweed was widely prevalent with representation from 10 genera and 19 species in the present study. Among which the genera Padina, Sargassum and Turbinaria

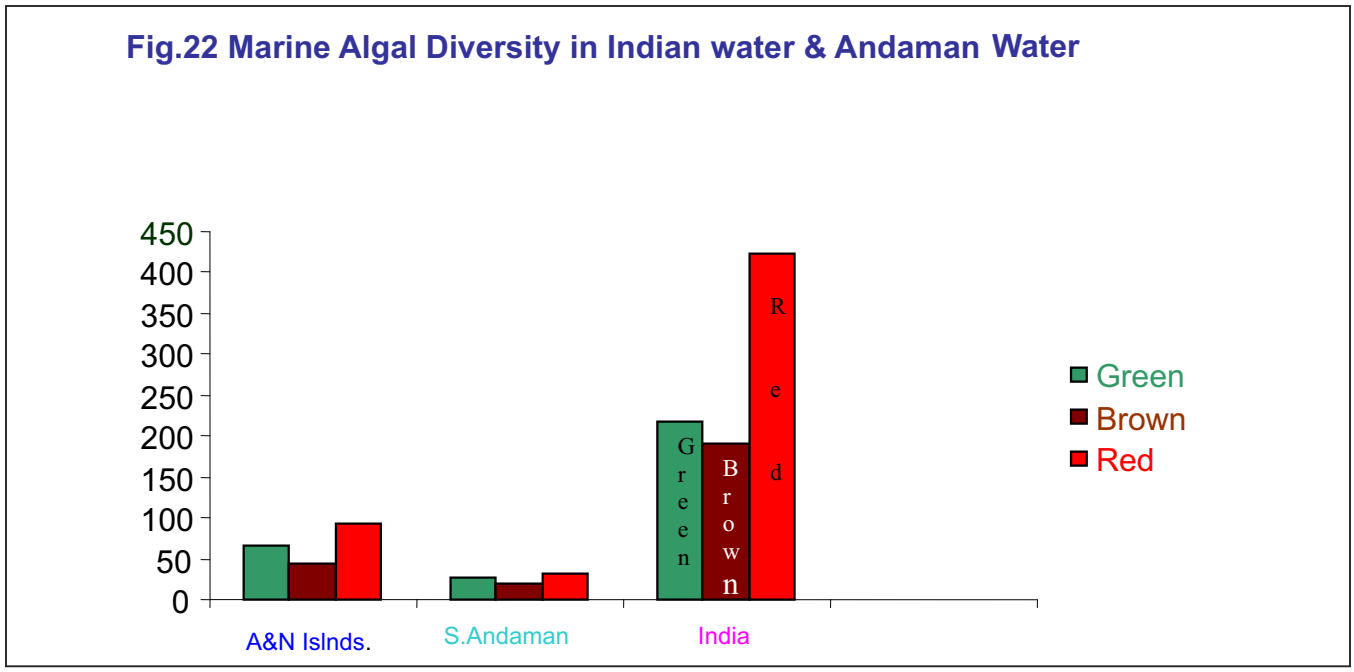

Fig.20 *Marine Algal Diversity in Indian water & Andaman water*

have maximum no of species, *i.e.*, 4 each, many of which are known to yield the alginic acid, alginates and mannitol. Remaining 7 genera are represented only one species each. The brown algae were floristically less but biomass availability is more compared to red and green algae. In study area the harvestable quantity of brown algae was recorded. Station-wise 17 in Chidiyatapu and 16 were recorded in North Bay and only one was recorded in Viper Island.

Cyanophyceae

In the present survey, totally four species of cyanophyceae belonging to four genera were recorded from the study area. All the four species were recorded in Chidiyatapu and North Bay but in Viper Island three species occurred while many are yet to be collected and identified.

Seagrasses

Totally five species of seagrass belonging to four genera were recorded in the present study. The dominant species recorded here are *Halodule, Cymodoceae* and *Halophila*. All the five species were recorded in Chidiyatapu and three specie in North Bay but no seagrass species were recorded in Viper Island.

In the present study the lowest temperature (28.8°C) recorded in September 2007 and the highest temperature (29.7°C) recorded in December 2007. Salinity 29.00‰. In September 2007 and 30.5‰ in December was recorded. pH 7.3 and 7.8 were recorded in September 2007 and December 2007 respectively . The lowest (5.2 ml/l) Dissolved Oxygen (DO) was measured in the month of December 2007 and the highest DO was observed in September 2007. There exist a correlation between the occurrence of marine algae and environmental parameters like temperature, salinity, pH and Dissolved Oxygen (D.O). An increase in dissolved oxygen and decrease in temperature, pH and salinity were associated with heavy rainfall that favored the growth of algae.

The present study area is rich in species diversity than the Rani Jhansi Marine National park, Andaman (Marcel Tigga and Rao, 2004) but less than that of Nicobar Biosphere reserve (Kannan and Thangaradjou, 2006), while compared this algal diversity richness to the other country algal diversity, it revels that the coastal area of Andaman sea is more suitable for algal collection

and cultivation. The temperature, salinity, substrate and tidal range are the major abiotic components which influence the algal species composition (Agadi, 1983).

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