BIO-DIVERSITY OF CYANOBACTERIA AT KODIAKKARAI COAST AND MANGROVE IN SOUTH EAST COAST OF TAMIL NADU, INDIA

[1]N. PRIYA*, [2]G. VENKATESAN, AND [3]A. MURUGANANDAM,

P.G & Research Department of Botany, M.R. Government Arts College, Mannargudi, Tamil Nadu, India - 614 001.

***Abstract*:** A study was undertaken to record the Cyanobacteria at Kodiakarai coast and mangrove in Nagapattinam district south east coast Tamil Nadu India, for a period of two years (July 2017 to June 2019). Cyanobacteria contribute to carbon and nitrogen fixation and their cells act as phosphorus storages in ecosystems with extreme or oligotrophic environmental conditions such as those found in mangroves. As the high plant productivity in mangroves is only possible due to interactions with microorganisms, cyanobacteria may contribute to these ecosystems by providing fixed nitrogen, carbon, and herbivory defense molecules, xenobiotic biosorption and bioremediation, and secreting plant growth promoting substances. Some mangrove cyanobacteria were also found in association to algae or seagrasses. Few studies on mangrove cyanobacteria are available, but together they have reported a substantial number of species in these ecosystems. However, the cyanobacterial diversity in this biome has been traditionally underestimated. Though mangrove communities generally host cyanobacterial taxa commonly found in marine environments, unique microhabitats found in mangroves potentially harbor several undescribed cyanobacterial taxa. The relevance of cyanobacteria for mangrove conservation is highlighted in their use for the recovery of degraded coast and mangroves as biostimulants or in bioremediation. In this study, Out of the 38 species of cyanobacteria was recorded from the study areas. Comparatively identified cyanobacteria species are more in mangrove and less in marine environment.

***Index Terms**: Cyanobacteria, Diversity, Water samples, Mangrove, Coast.*

I. INTRODUCTION

Marine cyanobacteria have an ancient marine history which can be traced back almost three billion years ago in the fossil record during the precambrian period[1]. They are important primary producer, and without them no animal populations including fishes could exist in natural waters[2]. They are also called as blue green algae and are widely distributed in the natural ecosystems such as land, soil, fresh water, oceans, estuarine salt lakes, salt marshes and also in hypersaline salt pans[3]. Cyanobacteria are prokaryotic oxygenic phototrophs found in almost every conceivable habitat on earth[4&5]. Cyanobacterial taxonomy has been established based on morphological features, such as the shape and dimensions of the cells, presence of structurally differentiated cells, and whether the cells grow as solitary cells or in colonies[6]. Based on the International Code of Botanical Nomenclature the class Cyanophyceae, contains about 150 genera and 2,000 species[7].

Mangroves are found in the coastal regions of 112 countries and territories on tropical and subtropical zones[8]. In the territories where they are found, this biome provides several ecological benefits to coastal areas. In some regions, mangrove forests are the main source of organic matter to coastal waters due to the exportation of plant leaves and carbon under dissolved and microparticulate forms, and their biomass may excel the biomass of some tropical rainforests[9]. Mangroves plant coverage and location can protect the mainland by reducing the severity of tsunami[10] and reduce the impact of natural disasters such as floods, storms, and hurricanes[11].

The role of mangrove tree and algae communities in food chains is better understood, and mangroves are being increasingly recognized as chemically diverse and important sources of natural resources[12]. Additionally, mangroves contribution to the mitigation of global climate change is currently accepted[13]. The microbial diversity in this biome is also receiving more attention, but relatively few investigations have been published on mangrove cyanobacteria in comparison with research on other microorganisms[14].

II. Meterials and methods

Kodiakkarai (Lat. 10^0 37' N, long 79^0 84' E) is located at the southan end of Tamil Nadu. For the collection of plankton No.10 plankton net (bolting mesh aperture size 158 µm) was used in the present study. The cyanobacterial specimens were observed on the water bodies and pneumatophores of mangrove plants. Light-green, dark-green, dark-brown, olive coloured cyanobacterial samples were collected using forceps, needles, scalpel and knife. Photomicrographs were taken using Leica DM 1000 LED compound microscope. Cyanobacterial identification was done using the taxonomic manuals of Desikachary[15], Prescott[16] and Anand[17].

III. RESULTS

In the present study, the cyanobacteria species composition in the present study revealed a total number of 38 species were identified from Kodiakkarai coast and mangroves. The Oscillatoria and Plectonema species groups constituted the major component of the cyanobacteria throughout the study period. Comparatively identified cyanobacteria species are more in mangrove and less in marine environment.

Table : 1 Diversity of Cyanobacteria from Kodiyakkarai Coast and Mangrove.

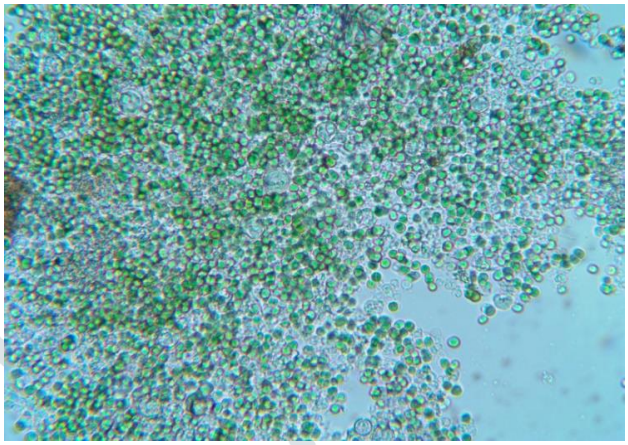
S. No.	Name of the Cyanobacteria	Coast	Mangrove
1	*Anabaena orientalis*Dixit	+	+
2	*Anabaeba spiroids* Klebahn	-	+
3	*Aphanocapsa hiformis* A.Br.	-	+
4	*Aphanocapsa littoralis.* Hansging	-	+
5	*Calorthrix ghosei* Bharadhiraja	-	+
6	*Calothrix contarenii* (zanard) Bornet et flahault	+	-

7	*Chroococcus minor* (Kutz) *Nag.*	+	+
8	*G. compacta* Kutz	+	+
9	*Gloeocapsa calcarea* Tilden	-	+
10	*Lyngbya confervoides* C.Af.ex Gomont	+	+
11	*L.majuscula* Hayveyex Gomot	-	+
12	*L.putealise* Liebm ex Gomot	+	-
13	*Microcystis aeruginosa*Kutzing	+	-
14	*M. pretecystis* Crow	-	+
15	*Microcystis robusta* (Clark) Nyagaard	-	+
16	*Nostoc picsinale* ex Born. Flash	-	+
17	*Oscillatoria acuminata* Gomont	-	+
19	*O. animalis* agex Gomont	+	+
`20	*O. limetica* lemn	-	+
21	*O. okeni* Ag. ex. Gomont	-	+
22	*O. rubescens (Kutz),*Gomont	+	+
23	*O.brevis (Kutz),*Gomont	-	+
24	*O.formosa*Bory ex. Gomont	+	-
25	*O.limosa* Ag. Ex. Gomont	-	+
26	*O.perornata* skuja	+	-
27	*O.subbrevis* Schemidle	+	+
28	*O. salina* Biswas	-	+
29	*Plectonema anomala* Rao, C.B.	-	+
30	*P. terebrans*	+	+
31	*P. uncinatum* (Ag) Gomont	-	+
32	*P.ambiguum* Gomont	-	+
33	*P. radiosum* Bornet ex Gomont	-	+
34	*Phormidiumtenue*	+	+
35	*Spriulina maxima*	-	+
36	*S. subsala* Oerst. Gomont	-	+
37	*Synechococus cedrorum* Sauvagean	+	+
38	*Synecocystis pevalekii* Ercegovic	+	-

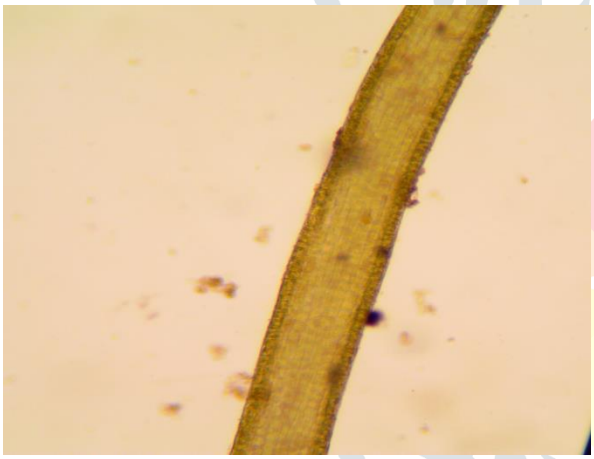
(+) present, **(-)** absent

Plate: 1 - Isolation and identification of cyanobacteria at kodiakkarai coast and mangroves

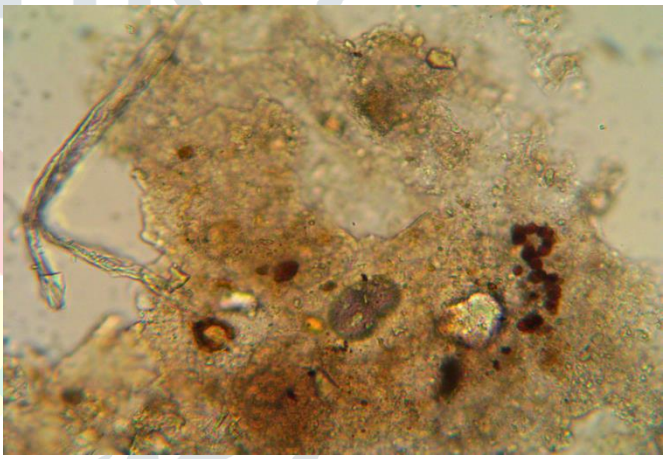
Anabaena sp



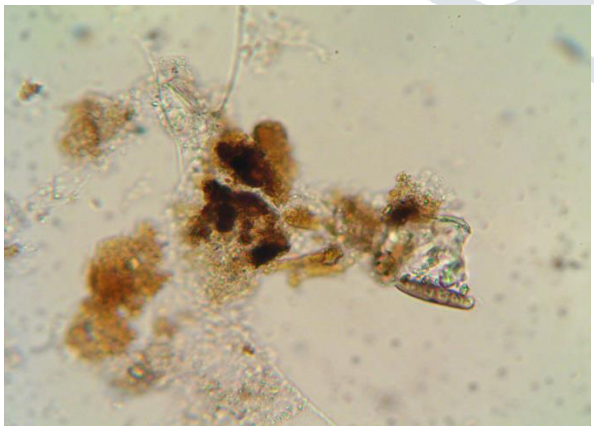
Chrococcoccus sp



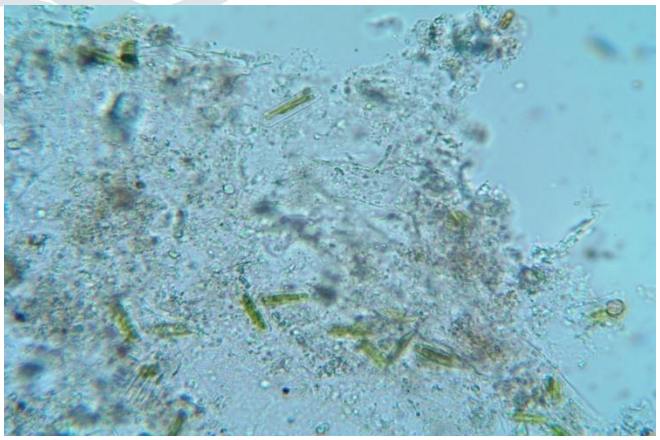
Dermocarpa sp



Gloeocapsa sp



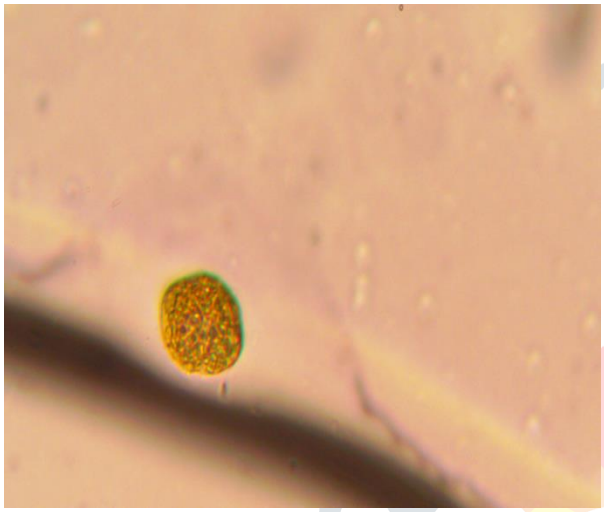
Johannesbaptistia sp



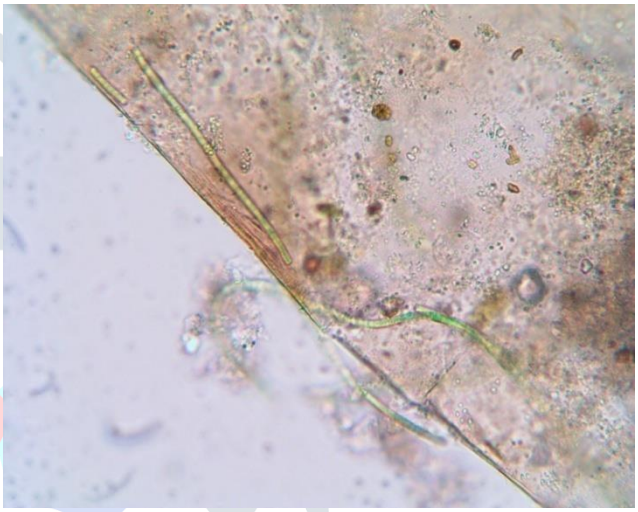
Gloeothece sp

Katagnymene sp

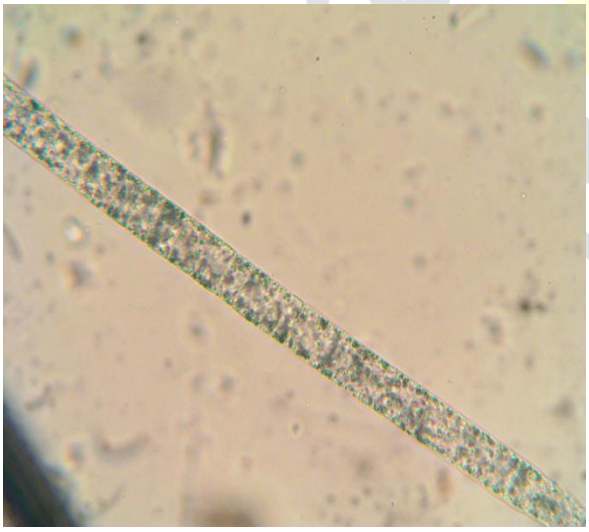
Microcoleus sp



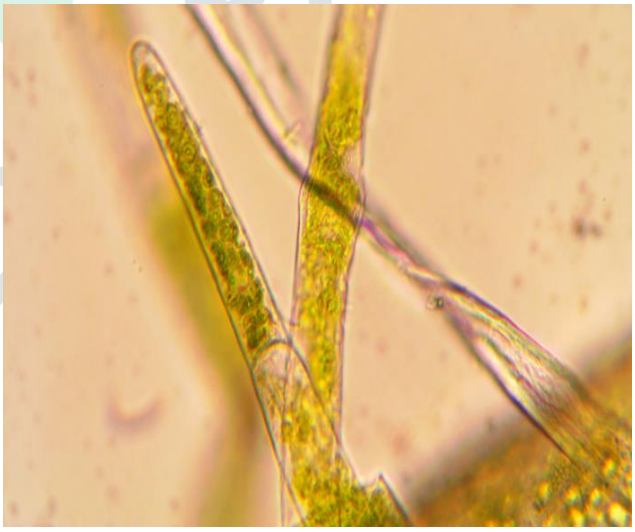
Myxosarcina sp



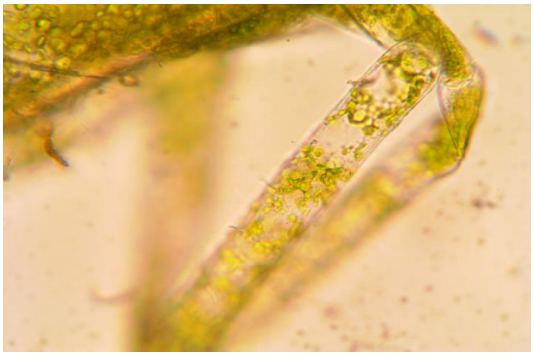
Nostoc sp



Oscillatoria sp

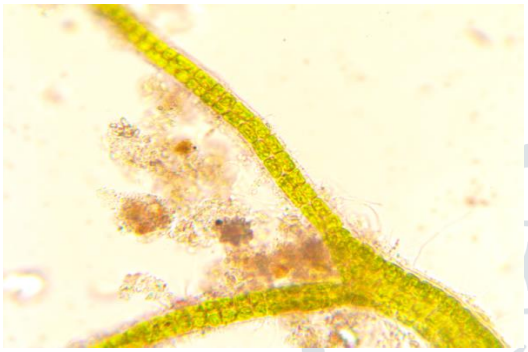


Plectonema sp

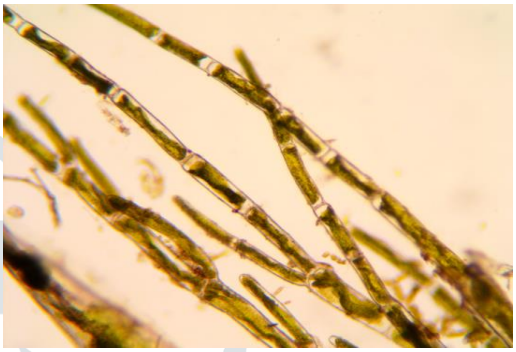


Pseudanabaena sp

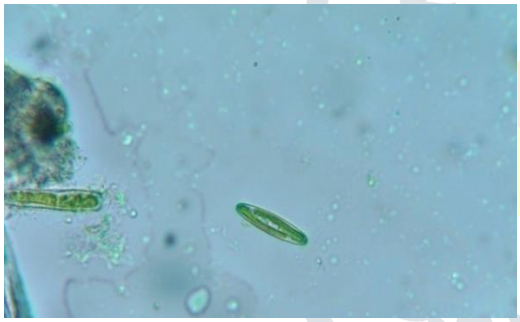
Spirulina sp



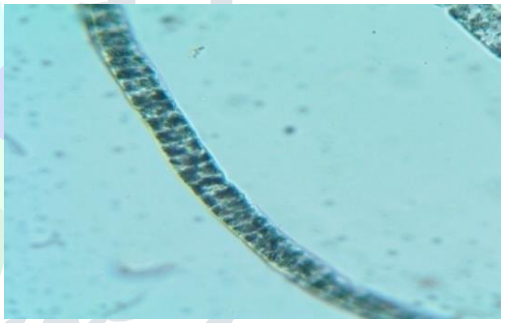
Stigonema sp



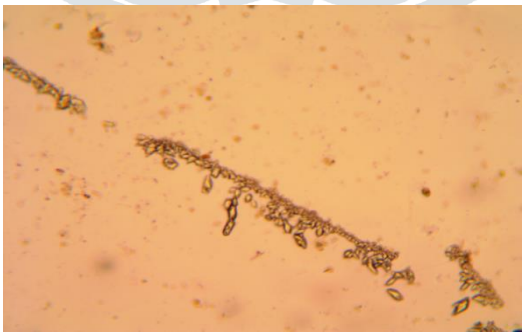
Symploca sp



Synechococcus sp



Trichodesmium sp



Xenococcus sp

IV. DISCUSSION

In the present study, the cyanobacteria species composition in the present study revealed a total number of 38 species were identified from Kodiakkarai coast and mangroves. The Oscillatoria and Plectonema species groups constituted the major component of the cyanobacteria throughout the study period. Similar workers

Silambarasan *et al.*[18] identified 39 cyanobacteria from three mangrove environment (Parangipettai, Ariyankuppam and Mudasal Odai) in Tamil Nadu coast. Nedumaran *et al.*[19] observed 23 cyanobacterial species from Pichavaram. Selvakumar and Sundararaman[20] recorded 17 cyanobacterial strains from Muthupet estuary. Sakthivel and Kathiresan[21] reported 68 cyanobacterial species from three different mangrove environments of Pichavaram, Porto Novo and Mudasal Odai.

Cyanobacteria are unique group of photosynthetic prokaryotic microorganisms. They are better known till recent times as blue green algae. Cyanobacteria constitute one of the commercially important marine resources having unique characters of fixing atmospheric carbon and nitrogen; In general, cyanobacteria seem to be more abundant in natural or slightly alkaline habitats. Among the planktonic species several forms blooms. The most common bloom-forming marine cyanobacterium in the tropical water is Trichodesmium[22].

Cyanobacteria also have a great potential to accumulate certain hazardous materials like heavy metals and industrial dyes[23&24]. Further research is required to understand the survival mechanisms, and the bioaccumulation and bioremediation potential of these microorganisms. Further molecular research is required to explore microbial mat which may facilitate detailed observation of species interaction and their biochemical aspects. However the diversity cyanobacteria of Kodiakkarai coast and mangrove is not explored properly. In the present investigation suggests that the 38 cyanobacteria species can be identified. An attempt has also been made to delineate the cyanobacteria conditions within the marine ecosystem and mangrove of Kodiakkarai coast and mangrove, South east coast of India.

V. CONCLUSION

The present study was undertaken to record the cyanobacteria diversity of Kodiakkarai marine and mangrove in Nagapattianm District, Tamil Nadu. Biotic and abiotic factors influence the distribution of cyanobacteria in marine and mangrove environments. Basic knowledge of ecological factors is important for understanding the ecology and biodiversity of cyanobacteria. From this investigation it is observed, plankton density and diversity is higher in the summer season compared to winter and monsoon seasons.

VI. ACKNOWLEDGEMENT

The authors are grateful to the Principal of M.R. Govt. Arts College, Mannargudi for providing necessary facilities to carry out the work.

REFERENCES

[1] Brock, T.D. 1973. Evalutionary and Ecological Aspects of the Cyanophytes, In: Carr, N.G. and B.A. Whitton, (Eds.), The Biology of Blue-Green Algae. *Blackwell Scientific Publications, Oxford*, 9: 487-500.

[2] Post, A.F. 1999. The Prochlorophytes-An Algal Enigma: Biology of Chlorophylla, Containing Photosynthetic Prokaryotes. In: Seckback, J. (Ed.), Enigmatic Microorganisms and Life in Extreme Environment. *Kluwer Acad. Publ. Dordrecht, Netherlands*, pp: 115-125.

[3] Fogg, G.E., Stewart, W.D.P., Fay, P., and Walsby, E. 1973. The Blue Green Algae. *Academic Press, London, New York*, pp: 469.

[4] Ferris, M.J., Muyzer, G., and Ward, D.M. 1996. Denaturing gradient gel electrophoresis profiles of 16S rRNA- defined populations inhabiting a hot spring microbial mat community. *Appl Environ. Microbiol*. 62: 40-346.

[5] Ward, D.M., Santegoeds, C.M., Nold, S.C., Ramsing, N.B., Ferris, M.J., and Bateson, M.M. 1997. Biodiversity within hot spring microbial mat communities: molecular monitoring of enrichment cultures. *Anton. Van Leeuwen*. 71: 143 150.

[6] Paerl, H.W. 1988. Growth and reproductive strategies of freshwater blue-green algae. In: C.D. Sandgren [Ed.]. Growth and Reproductive Strategies of Freshwater Phytoplankton. *Cambridge University Press, Cambridge*. 261-315.

[7] Hoek, C., Van den., Mann, D.G., and Jahns, H.M. 1995. Algae. *An Introduction to Phycology. Cambridge University Press, Cambridge*. 623.

[8] Kathiresan, K., and Bingham, B.L. 2001. Biology of mangroves and mangrove ecosystems. *Adv. Mar. Biol*., 40: 81-251

[9] Dittmar, T., Lara, R.J., and Kattner, G. 2001. River or mangrove? Tracing major organic matter sources in tropical Brazilian coastal waters. *Mar. Chem*., 73: 253-271.

[10] Danielsen, F., Sorensen, M.K., Olwig, M.F., Selvam, V., Parish, F., Burgess, N.D., Hiraishi, T., Karunagaram, V.M., Rasmussen, M.S., Hansen, L.B., Quarto, A., and Suryadiputra, N. 2005. *The Asian tsunami: a protective role for coastal vegetation. Sci.,* 310: 643

[11] Adger, W.N., Hughes, T.P., Folke, C., Carpenter, S,R,, and Rockstrom, J. 2005. Social- ecological resilience to coastal disasters. *Sci*., 309: 1036-1039.

[12] Alongi, D.M. 2002. Present state and future of the world's mangrove forests. *Environ Conserv*, 29: 331-349.

[13] Duarte, C.M., Losada, I.J., Hendriks, I.E., Mazarrasa, I., and Marba, N. 2013. The role of coastal plant communities for climate change mitigation and adaptation. *Nat. Clim. Change*, 3: 961-968

[14] Thatoi, H., Behera, B.C., Mishra, R.R., and Dutta, S.K., 2013. Biodiversity and biotechnology potential of microorganisms from mangrove ecosystems: a review. *Ann. Microbiol*., 63: 1-19.

[15] Desikachary, T.V. 1959. Cyanophyta Monographs on Algae, *Publ. Ind. Council Agricult. Res. New Delhi.*

[16] Prescott, G.W. 1951. Algae of the Western great lakes area. *Brown Dubuguedowa*. pp.977.

[17] Anand, N., E. Mohan, R. S. S. Hopper and D. Subramanian. 1986. Taxonomic studies on blue-green algae from certain marine environments. *Seaweed Res. Util.*, 9:49-56.

[18] Silambarasan, G., Ramanathan, T., and Kathiresan, K. 2012. Diversity of marine cyanobacteria from three mangrove environment in Tamil Nadu coast, South East coast of India. *Curr. Res. J. Biol. Sci*., 4(3): 235-238.

[19] Nedumaran T., Rajasekar K. T. and Perumal P. 2008. Mangrove associated cyanobacteria at Pichavaram, Tamil Nadu. *Seaweed Res. Utilizat*., 30, 77- 85.

[20] Selvakumar, G., and Sundararaman, M. 2001. Mangrove associated cyanobacterial species in Muthupet estuary. *Seaweed Res. Utilizat*., 23(1&2): 19-22.

[21] Sakthivel, K., and Kathiresan, K. 2013. Cyanobacterial diversity from mangrove sediment of South East Coast of India. *Asian J. Biodiver*., 4: 190-203.

[22] Nedumaran, T., and Perumal, P. 2012. Biodiversity of cyanobacteria from Uppanar estuary, south-east coast of India. *Emir. J. Food Agric*., 24 (3): 248-254.

[23] Rawat, I., Kumar, R.R., Mutanda, T., and Bux, F., 2011. Dual role of microalgae: phycoremediation of domestic wastewater and biomass production for sustainable biofuels production. *Appl. Energ*., 88(10): 3411-3424.

[24] Vijayakumar, S., and Manoharan, C., 2012. Treatment of Dye Industry Effluent Using Free and Immobilized Cyanobacteria. *J. Bioremed. Biodeg*., 3(10): 1-6.