Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 4, Issue, 10, pp.032-035 October, 2012

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EFFECT OF PHYSICO-CHEMICAL FACTORS ON DISTRIBUTION OF MARINE CYANOBACTERIAL SPECIES IN KURUSADAI ISLAND

G. Silambarasan, T. Ramanathan and K. Kathiresan

Faculty of Marine Sciences, Annamalai University, Parangipettai, Tamil Nadu, India

ARTICLE INFO

Article History:
Received 18th July, 2012
Received in revised form
19th August, 2012
Accepted 21th September, 2012
Published online 30th October, 2012

Key words:
Marine cyanobacteria, mangroves, physic-chemical parameters, Kurusadai Island.

ABSTRACT

Marine cyanobacteria were isolated from water samples of the three mangrove site in Kurusadai island, south east coast of India. Totally 12 species of cyanobacteria were recorded in which one species was heterocystous and 11 were non- heterocystous, belonging to 5 families. The species such as *Oscillatoria tenuis, Oscillatoria cortiana, Oscillatoria salina* and *Lyngbya majuscula* were identified. Among the sites, mangrove isolates of oscillatoriaceae alone contributed maximum number of cyanobacterial species (5) and minimum (1) by Nostocaceae and Synechococcaceae. In order to study the effect of physico chemical parameters on cyanobacterial abundance correlation study was done between these two factors. Salinity, temperature and pH exhibited positive correlation whereas nutrients such as nitrate, nitrite, phosphate and silicate showed negative correlation with cyanobacterial abundance.

INTRODUCTION

Cyanobacteria are also known as blue-green algae or Cyanophyta are a phylum of bacteria that obtain their energy through photosynthesis. They are oxygenic photosynthetic prokaryotes and widely distributed in the natural ecosystems such as land soil, fresh water, oceans, estuarine salt lakes, salt marshes sand also in hyper saline salt pans (Fogg *et al*., 1973). They have a long history of existence and uses are the oldest known oxygenic organisms, which by their photosynthetic activity probably made a fundamental contribution to the development of the present oxygen-rich atmosphere. Cyanobacteria in general and marine Cyanobacteria in particular, are getting prominent importance in the area of biotechnology (Burja *et al.,* 2001).

They also found in symbiosis with photosynthetic hosts, including diatoms, mosses, liverworts, ferns and cycads, where they fix atmospheric nitrogen (Usher, 2008). Symbioses between Cyanobacteria and marine organisms are abundant and widespread among marine plants and animals (Foster *et al.,* 2006). They are one of the important coastal resources of mangrove ecosystem along the tropical coasts (Kathiresan, 2000; Kathiresan Bingham, 2001). They colonize any submerged surface of sediments, roots, aerial roots, branches and trunk of mangroves (Zuberer and silver,1978; Palaniselvam, 1998; Palaniselvam and Kathiresan 2002; Silambarasan, 2008). Marine cyanobacteria constitute integral and major component of the micro biota in every mangrove system (Potts ,1980; Hussain and khoja,1993). The distribution of micro organisms in any environment depends upon various physical and chemical factors such as temperature, salinity, pH, light, nutrients etc.

Cyanobacteria are important primary producers in all aquatic ecosystems. This necessitates the study of eco-biological properties of cyanobacteria with respect to different hydro biological parameters. Most of the earlier work on ecobiology had been at the total planktonic level, primarily at the productivity and other conventional ecological aspects (Srinivasan, 1946; Shim *et al.,* 1985). Hence the present study has been undertaken to study the effect of physicochemical variables on cyanobaterial abundance in a mangrove area of South India.

METHODOLOGY

Sample collection, isolation and identification

Samples were collected from the waters of *Avicennia marina, Rhizophora mucronata* and *Ceriops tagal* in Kurusadai Island, Gulf of Mannar Biosphere Reserve, India. The water samples were collected in sterile conical flask and a small sample was drawn and observed under a light microscope (magnification 100 X). Cyanobacterial species were identified using the standard references (Desikachary, 1959 and Humm and Wicks, 1980).

Analysis of water

The chemical characters of water such as salinity, temperature and pH were analyzed in the present study. Temperature was measured using a mercury centigrade thermometer with 0.5° C accuracy. Salinity was analyzed using a refractometer (Atago hand refractometer, Japan). Hydrogen ion concentration (pH) was measured by using pH meter (pH 315i/SET,

***Corresponding author:** Simbugeeg@gmail.com

wissenschaftlich Technische Werkstatten, Germany) with platinum electoride with an accuracy of ±0.1. The reactive silicate content of water was estimated by following the method of Strickland and parsons (1972).

RESULTS

In this study twelve marine cyanobacterial species belong to five families were identified. Among the mangrove species, *Avicennia marina* harbored the maximum number of cyanobacterial species (12) followed by *Rhizophora mucronata* (10) and *Ceriops tagal* (6).

Environmental parameters

The detailed picture of the environmental parameters prevailing in different mangrove water samples is depicted in the Table -1. The temperature was maximum (28°C) with *Ceriops tagal* and minimum (both 23 °C) in *Rhizophora mucronata* and *Avicennia marina* water samples. The pH was maximum (6.8) in *Rhizophora mucronata* water sample and minimum (6.6) in *Ceriops tagal* water sample. The salinity was maximum (28 °C ‰) in *Ceriops tagal* and minimum (28 °C ‰) in *Avicennia marina* water samples.

Correlation between hydrography

In order to study, the effect of physio chemicals parameters affect on cyanobacterial abundance in correlation between environmental parameters, nutrients and cyanobacterial cell count were determined by statistical analysis correlation was analysed between them. Table-3 shows the correlation between each other. Salinity, temperature and pH exhibited positive correlation whereas nutrients such as nitrate, nitrite, phosphate and silicate showed negative correlation with cyanobacterial abundance.

DISCUSSION

Blue green algae (cyanobacteria) are very small organism and can be seen under the microscope as a single cell or large accumulation of cells or string of cells. Some may be so large that they are easily seen with naked eye. Blue green algae are al so known a cyanophytes, cyanobacteria and most recently cyano-prokaryotes. In the present study, 12 species have been recorded belong to five family and among 12 species one is heterocystous form; *Anabaena iyengarri* and 11 species were non-heterocystous forms; *Oscillatoria salina, Oscillatoria tenuis, Oscillatoria cortiana, Lyngbya majuscula, Phormidium ambiguum, Phormidium tenue, Phormidium fragile, Trichodesmium erythraeum, Spirulina subsalsa, Spirulina major* and *Synechococcus elongatus*. Non- heterocystous forms dominated in the saline environment and this finding is in accordance with many other workers (Iyengar and Desikachary, 1944; Palaniselvam, 1998; Silambarasan, 2008). Among the mangrove species *Avicennia marina* yielded maximum number of species followed by *Rhizophora mucronata* and *Ceriops tagal Table 1.* The species include *Anabaena iyengarri, Oscillatoria salina, Oscillatoria tenuis, Oscillatoria cortiana, Lyngbya majuscula, Phormidium ambiguum, Phormidium tenue, Phormidium fragile, Trichodesmium erythraeum, Spirulina subsalsa, Spirulina major, Synechococcus elongatus.* It was found that out of the different parameters studied, temperature was the prime factor, which showed significant positive correlation with cyanobacteria. It reveals that temperature enhances growth and multiplication of cyanobacteria. Salinity was found to exhibit negative correlation with cyanobacterial numbers, indicates the cyanobacterial are terrestrial origin adapted to marine biotope. Low salinity favours cyanobacteria growth. The pH al so exhibited a similar trend. In the present investigation, concentration of nutrients such as nitrite, phosphate and silicate from various sites showed negative correlation with abundance of cyanaobacteria. However, only phosphate showed statistically significant negative correlation with abundance of cyanaobacteria Table -3. Greater availability of nutrients coincided with low to moderate values of cell counts. The availability of nutrients was largely due to upwelling and river run off and al so drainage from the land.

Very often, these nutrients available in the water column are not fully utilized by the phytoplankton and high concentration was detected in water column are not fully utilized by the phytoplankton and high concentration was detected in water samples and this substantiates the negative correlation between nutrient distribution observed at the study site. Cell counts however, showed a positive correlation with nitrate. All these studies find support of (Subramanian and Thajuddin (1995). In the present study 12 species of marine cyanobacteria from mangroves were recorded. The biodiversity of cyanobacteria also varies with the area of sampling. Thajuddin and Subramanian (1992) observed that the shore in the Bay of Bengal was essentially sandy and therefore there are only 11 species cyanobacteria. Little (1973) and Renaunt *et al.,* (1975) reported that the cyanobacterial community is most abundant on soft, porous rocks such as sand stones. Hard substratum is not essential for growth of cyanobacterial mats. Cyanobacteria are apparently always present as epilithis, chasmolith and endolithis including some times as discrete well developed cryptoendolith layer.

The remarkable adaptability of cyanobacteria to salinity reaching 100 ppt. Thajuddin and Subramanian (2002) reported that as many as 75 of the species which were originally reported from fresh water sources by earlier workers, were also marine. It is therefore difficult to strictly segregate cyanobacteria in to marine and fresh water species which is possible with other algal forms. A bundle forming marine cyanobacterium *Trichodesmium erythraeum,* forms massive blooms in many parts of tropical and sub tropical waters (Karal *et al.,* 2002). Subramanian and Thajuddin (1995) reported that the maximum diversity of the cyanobacterial flora in the Gulf of Mannar region correlated well with the higher salinity, pH and nutrient content of the water. Marine cyanobacteria constitute integral and major component of the microbiota in every mangrove system (Potts, 1980; Hussain and Khoja, 1993, Kathiresan and Bingham, 2001; Palaniselvam and Kathiresan, 2002; Sakthivel, 2004; Silambarasan, 2008). Despite this seeming metabolic uniformity, their ecological diversity is remarkable; they occupy a very wide range of illuminated ecological niches in terrestrial, marine, and freshwater environments. Most marine forms grow along the

Table-1 Diversity of marine cyanobacteria from Kurusadai island, Gulf of Mannar Biosphere Reserve

S. No	Species Name	Kurusadai island		
		Avicennia marina	*Rhizophora mucronata*	*Ceriops tagal*
	Nostocaceae			
1	*Anabaena iyengarri* Bharadwaja	+	+	-
	Oscillatoriaceae			
2	*Oscillatoria salina* Biswas	+	-	+
3	*Oscillatoria tenuis* Ag. Ex Gomont	+	-	-
4	*Oscillatoria cortiana* Meneghini ex Gomont	+	+	-
5	*Lyngbya majuscula* Harvey ex Gomont	+	+	+
	Phormidiaceae			
6	*Phormidium ambiguum* Gomont	+	+	-
7	*Phormidium tenue* (Menegh.) Gomont	+	+	+
8	*Phormidium fragile* (Menegh.) Gomont.	+	+	+
9	*Trichodesmium erythraeum* Ehrenberg ex Gomont	+	-	-
	Pseudanabaenaceae			
10	*Spirulina subsalsa* Oerst.ex Gomont	+	+	+
11	*Spirulina major* Kutz.ex Gomant			
	Synechococcaceae			
12	*Synechococcus elongatus* Nag	+	-	-

Table-1 Environmental parameters of different mangrove species

Mangrove species	Temperature (°C)	pH	Salinity
Avicennia marina	23	6.6	23
Rhizophora mucronata	23	6.8	24
Ceriops tagel	28	6.5	24

Table-2 Nutrient characteristics of waters adjoining different mangrove species

Mangrove species	Reactive silicate	Nitrate (µg/l)	Nitrite (µg/l)	Total Phosphate (µg/l)
Avicennia marina	28.5±1.9	14.9±1.2	0.7±0.05	1.65±0.09
Rhizophora mucronata	22.1±1.2	13.9±1.1	0.6±0.05	1.58±0.08
Ceriops tagel	21.7±1.2	15.7±1.4	0.5±0.05	1.55±0.08

Table-3 Correlation matrix between environmental parameters, nutrients

	Temperature	Salinity	pH	Nitrate	Nitrite	Silicate	Phosphat	Cell count
Temperature	1							
Salinity	0.986*	1						
pH	0.7969	0.9946*	1					
Nitrate	0.4954	0.4899	-0.9987*	1				
Nitrite	0.3993	0.4823	-0.9960*	0.9963*	1			
Silicate	0.3958	0.4958	0.9968*	0.39918	0.9921*	1		
Phosphate	0.3733	-0.4956	-0.5880	0.39859	0.9708	0.9835*	1	
Cell count	0.881*	-9463*	0.9126*	0.9048	-0.8728	-9130	-9634	1

shore as benthic vegetation in the zone between the high and low tide marks (Humm and Wicks, 1980, Ramachandran, 1982; Thajuddin, 1991; Iyenger, 1927; Palaniselvam, 1995; 1998; Ramachandra Rao, 1994; Thajuddin and Subramanian, 2002; Kathiresan and Bingham, 2001). However, the cyanobacteria of Kurusadai Island in Gulf of Mannar are not explored properly. The present chapter evaluates the effects of the environment parameters on the growth and proliferation of cyanobacteria in a mangrove area of Kurusadai Island in Gulf of Mannar, south India.

Acknowledgement

The authors are thankful to The Dean, Faculty of marine sciences, Annamalai University for providing facility.

REFERENCES

Burja, A. M., Banaigs, E. B., Abou-Mansour, Burgess, J. G., and Wright, P. C. (2001).Marine cyanobacteria- a prolific source of natural products. Tetrahedron, 57: 9347-9377.

Desikachary, T. V. (1959). Cyanophyta, Indian Council of Agricultural Research, New Delhi, pp. 686.

Fogg, G.E., Stewart W.D.P., Fay, P. and Walsby, A.E. (1973). The blue green algae. London, New York: Academic Press, 469 pp.

Foster, R. A., Carpenter, E.J. and Bergman, B. (2006). Unicellular cyanobionts in open oceandinoflagellates, radiolarians, and tintinnids: ultrastructural characterization and immunelocalization of phycoerythrin and nitrogenase. J. Phycol., 42: 453–463.

Humm, J. and Wicks R. (1980). Introduction and guide to the marine blue - green algae. A. Wiley interscience publication, New York, pp.1-273.

Hussain, M.I. and Khoja, T.M. (1993). Intertidal and subtidal blue-green algal mats of open and mangrove areas in the Farasab archipelago (Saudi Arabia) Red Sea. Botanica Marina, 36: 377-388.

Iyengar, M.O.P. and Desikachary T.V. (1944). A systematic account of some marine myxophyceae of the south Indian coast .J. Madras Univ., 16: 37-68.

Iyengar, M.O.P.(1927). Krusadai Island flora. Bull. Madras Govt.Mus.New.Ser.,1:185- 188.

Karal, D., Michaels, A., Bergman, Capine, D., Carpenter,E., Latelier R., Lipschultz, F., Paerl, H., Sigman, D. and Stal, L.(2002). Dinitrogen fixation in the world's oceans. Biogeochemistry, 57-58:47-98.

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

Kathiresan, K. (2000). Mangrove Atlas and Status of Species in India. A report submitted to Ministry of Environment & Forests, Govt. of India, New Delhi, pp235.

Little, M. G. (1973).The zonatiosn of supralittoral blue–green algae. Br.Phycol. J. 8: 47–50.

Palaniselvam, V. (1995). Studies on the Cyanobacterium *Phormidium tenue* (Menegh.) Gomont for its utility in aquaculture shrimp feed and as bio fertilizer for mangroves. M.Phil.Thesis, Annamalai University,India,45pp.

Palaniselvam,V.(1998). Epiphytic cyanobacterial of mangrove ecological, physiological and biochemical studies and their utility as biofertilizer and shrimp-feed. Ph.D. Thesis, Annamalai University, India, 141pp.

Palaniselvam, V. and Kathiresan, K.(2002). Epiphytic cyanobacterial from mangroves In:N.Anand ,(ed.)Algological research in India ,pp.45-54.

Potts, M. (1980). Blue-green algae (Cyanophyta) in marine coastal environments of Sinai peninsula, distribution, zonation, stratification and taxonomic diversity. Phycologia. 19: 60-73.

Ramachandra Rao, C.S.V. (1994). Antimicrobial activity of cyanobacterial. Indian J. Mar. Sci. 23: 55-56.

Ramachandran, S. (1982). Studies on blue-green algae from Porto Novo marine environments.Ph.D. Thesis, Annamalai University, Tamil Nadu, India.

Renaunt, J., Sasson, A., Pearson, H. W. and Stewart, W. D. P. (1975). In Nitrogen Fixation by Free-living Microorganisms (ed. Stewart, W. D. P.), Cambridge Univ. Press, Cambridge, pp. 229–246.

Sakthivel, K. (2004). Studies on marine cyanobacteria from mangrove environments. Ph.D. Thesis, Annamalai University, India.

Shim, J.H., Lee,W.H. and Bak.S.Y.(1985). Studies on the plankton in the south western waters of the East sea (Sea of Japan) (II) phytoplankton standing crop, nano fraction and primary production. J. Oceanol. Soc. Kor.20:37-54.

Silambarasan, G. (2008). Studies on ecology and anti inflammatory activity of cyanobacteria in mangroves of Kurusadai island (south east coast of India), M.Phil., Thesis, Annamalai University, Tamil Nadu, India.

Srinivasan,K.S.(1946). Ecology and seasonal succession of the marine algae at Mahabalipuram (Seven pagodas) near Madras. Indian Botanical Society M.O.P. Iyenger Commomoration. pp.257-78.

Strickland, J.D.H. and Parson T.R. (1972). A practical handbook of seawater analysis. Fishery Research Board, Canada, 310p.

Subramanian, G. and Thajuddin, N. (1995). Ecobiology of marine cyanobacteria. Advances in Ecology and Environmental Sciences (eds).Mishra,P.C.,Bashera,N., Senapathi, B.K. and Guru, B.C. Ashish Publishing House. 8/81.Punjabi Bagh. New Delhi.

Subramanian, G. and Thajuddin, N. (1995). Ecobiology of marine cyanobacteria. Advances in Ecology and Environmental Sciences (eds).Mishra,P.C.,Bashera,N., Senapathi, B.K. and Guru, B.C. Ashish Publishing House. 8/81.Punjabi Bagh. New Delhi.

Thajuddin, N. and Subramanian, G. (1992). Survey of Cyanobacterial flora of the southern east coast of India, Botanica Marina, 35: 305-311.

Thajuddin, N. and Subramanian, G. (2002).The enigmatic bloom forming marine cyanobacterium Trichodesmium. In Advances in Marine and Antarctic Sciences (eds Sahoo, D. and Pandey, P. C.), APH Publishing Co, New Delhi, pp. 57–89.

Thajuddin, N. (1991). Marine cyanobacteria of the southern east coast of India - Survey and eco-biological studies, Ph.D. Thesis, Bharathidasan University, Tiruchirappalli, India.

Usher, K.M. (2008). The ecology and phylogeny of cyanobacterial symbionts in sponges. Marine Ecology, 29:178–192.

Zuberer, D.A. and Silver, W.S. (1978). Biological dinitrogen fixation (acetylene reduction) associated with Florida mangroves. Appl. Environ. Micobiol., 35: 567-575.

****