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## Cyanobacterial diversity from seven mangrove environments of Kerala, India

**Arun T. Ram\*** and **M. Shamina**

Department of Botany, Plant Diversity Division, University of Calicut,  
Malappuram (Dist), PIN - 673635, Kerala, India

\*E-mail address: [aruntram@gmail.com](mailto:aruntram@gmail.com)

### ABSTRACT

A survey on the cyanobacterial biodiversity of 7 mangrove environments viz. Vallikunnu, Kadalundi, Kallayi, Mangalavanam, Kumbalam, Kumarakom and Mekkara mangroves of Kerala was undertaken during 2014-2016. In total, 31 species of cyanobacteria coming under 10 genera and 4 families were recorded in all mangrove environments. Maximum species (13 species) of cyanobacteria were recorded from Kadalundi, whereas the minimum was recorded from Mangalavanam (2 species). The genus *Oscillatoria* was observed with maximum distribution (13 species), followed by *Nostoc* (5 species) and *Lyngbya* (3 species). The genus *Aphanocapsa*, *Microcoleus* and *Scytonema* (2 species each) and *Chroococcus*, *Aphanothece*, *Merismopedia*, and *Phormidium* (1 species each) shows equal distribution. As many as three species, namely *Oscillatoria salina*, *Oscillatoria ornata* and *Oscillatoria vizagapatensis* were common in all mangrove environments except Mangalavanam and Mekkara.

**Keywords:** Mangroves, marine cyanobacteria, biodiversity

### 1. INTRODUCTION

Mangroves are considered as one of the highly productive natural ecosystems of the world. The diversity and distribution of the flora and fauna in an estuary is mainly controlled by the fluctuations in the physico-chemical characteristics of water. Cyanobacteria are one of the important coastal resources, constitute integral and major component of the microbiota in mangrove ecosystem along the tropical coasts (Kathiresan and Bingham, 2001; Sakthivel, 2004).

Cyanobacteria are an important group in phytoplankton in most marine systems. They provide oxygenic atmosphere of our planet. Cyanobacteria contribute to carbon and nitrogen fixation and their cells act as phosphorus storages in ecosystems with extreme environmental conditions such as those found in mangroves. Cyanobacterial species are capable of growing on both soil and water conditions and play an imperative role in that ecosystem (Ray, 2006). The present study covers a total of 94.6 ha of mangrove area (Table 1). *Avicennia officinalis*, *Avicennia marina*, *Bruguiera sexangula*, *Bruguiera gymnorrhiza*, *Excoecaria agallocha* and *Rhizophora mucronata* are the true mangrove species found among the seven mangrove environments. Even if the grand possession of mangrove diversity exists in Kerala, the literature on mangrove cyanobacterial association is comparatively less. Hence the present study has been carried out to understand the association between mangrove vegetation and cyanobacterial species.

## 2. MATERIALS AND METHODS

A survey on the cyanobacterial biodiversity of 7 mangrove environments viz. Vallikunnu, Kadalundi, Kallayi, Mangalavanam, Kumbalam, Kumarakom and Mekkara of Kerala had been studied during 2014-2016 (Table 1).

**Table 1.** Study areas.

No.	Place	District	GPS	Area
1	Vallikunnu	Malappuram	11°8'0"N 75°50'0"E	12 ha
2	Kadalundi	Kozhikode	10°7'36"N, 75°50'02"E	5 ha
3	Kallayi		11°42'0"N, 75°32'0"E	6 ha
4	Mangalavanam	Ernakulam	9°54'N, 76°18'E	3 ha
5	Kumbalam		9°54'14"N, 76°18'40"E	7 ha
6	Kumarakom	Kottayam	9° 36' 15" N, 76° 25' 53" E	60 ha
7	Mekkara		9° 48' 54" N, 76° 21' 57"E	1.6 ha

The cyanobacterial specimens were observed on the water bodies, soil, bark 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 (1959), Prescott (1982), Anand (1989) and Kesarwani *et al.* (2015 a, b).

### 3. RESULTS AND DISCUSSION

Total 31 species of cyanobacteria coming under 10 genera and 4 families (5 Chroococcaceae; 19 Oscillatoriaceae; 5 Nostocaceae and 2 Scytonemataceae) were recorded in all mangrove environments. The taxa represent 2 orders, 4 families, 10 genera and 31 species (Table 2). From the present study, the order Nostocales showed maximum dominance than Chroococcales.

**Table 2.** Cyanobacterial diversity from different mangrove environments of Kerala.

No	Name of the species	Mangrove areas						
		VA	KA	KI	MA	KU	KM	ME
<b>Chroococcaceae</b>								
1	<i>Aphanocapsa grevillei</i> (Berkeley) Rabenhorst	-	-	-	-	-	-	+
2	<i>Aphanocapsa roseana</i> De Bary in Rabenhorst	-	-	-	-	-	-	+
3	<i>Aphanothece pallida</i> (Kutz.) Rabenh.	-	-	-	-	-	-	+
4	<i>Chroococcus turgidus</i> (Kutz) Nag.	-	+	-	-	-	-	-
5	<i>Merismopedia elegans</i> A.Br.	-	+	-	-	-	-	-
<b>Oscillatoriaceae</b>								
6	<i>Lyngbya limnetica</i> Lemmermann	-	-	-	-	+	-	-
7	<i>Lyngbya martensiana</i> Menegh.ex Goma	-	+	-	-	-	-	-
8	<i>Lyngbya aerugino-coerulea</i> (Kutz.) Gomont	-	-	-	-	-	-	+
9	<i>Microcoleus acutissimus</i> Gardner	-	+	-	-	-	-	-
10	<i>Microcoleus chthnoplastes</i> Thuret ex Gomont	+	+	-	-	-	-	-
11	<i>Oscillatoria salina</i> Biswas	+	+	+	-	+	+	-
12	<i>Oscillatoria curviceps</i> Ag.ex Gomont.	-	+	+	-	-	-	-
13	<i>Oscillatoria perornata</i> Skuja f. <i>attenuata</i> Skuja	-	+	-	-	-	-	-
14	<i>Oscillatoria ornata</i> Kutz.ex Gamont var. <i>Crassa</i> Rao,C.B.	-	+	-	-	-	-	-
15	<i>Oscillatoria minnesotensis</i> Tilden	-	+	-	+	-	-	-

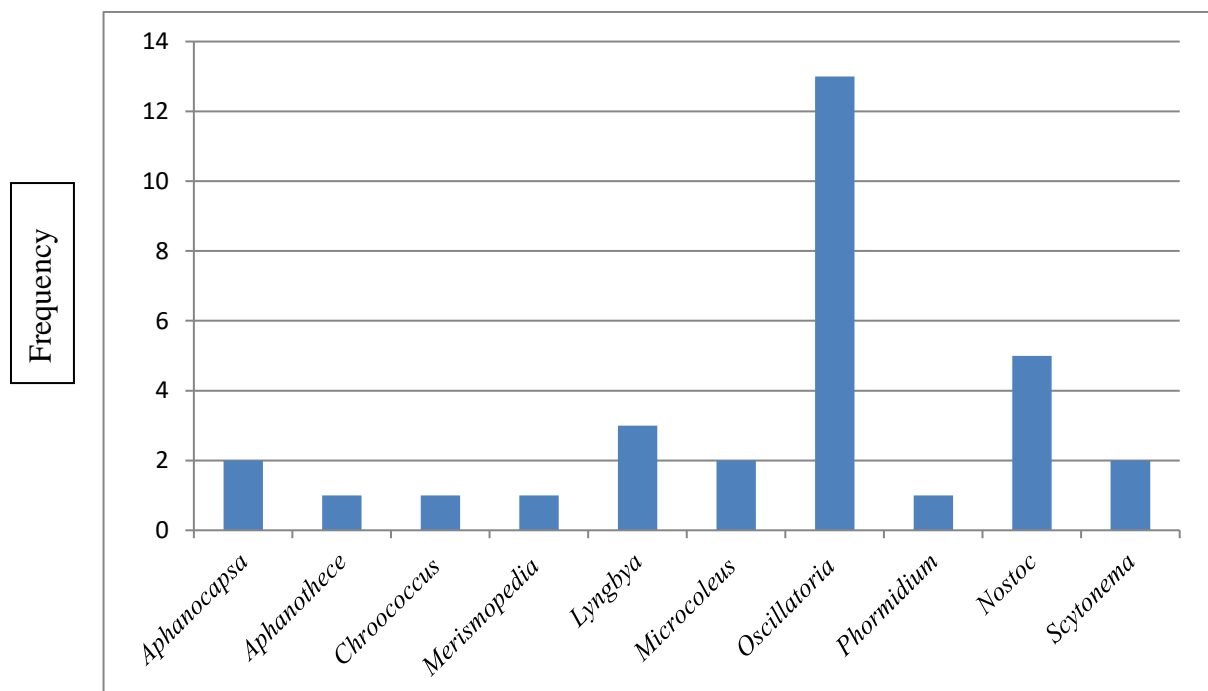
16	<i>Oscillatoria annae</i> van Goor	+	-	+	-	-	-	+
17	<i>Oscillatoria ornata</i> Kutz. ex Gomont	+	+	+	-	+	+	+
18	<i>Oscillatoria boryana</i> Bory ex Gomont	-	-	-	-	-	+	-
19	<i>Oscillatoria vizagapatensis</i> C.B.Rao	+	+	+	-	+	+	-
20	<i>Oscillatoria okenii</i> C.Agardh ex Gomont	-	-	+	-	+	-	-
21	<i>Oscillatoria obscura</i> Brühl & Biswas	-	-	-	-	+	-	-
22	<i>Oscillatoria chilensis</i> Biswas	-	-	-	-	+	-	-
23	<i>Oscillatoria schultzei</i> Lemmermann	-	-	-	-	+	-	-
24	<i>Phormidium molle</i> (Kutz.) Gomont	-	-	-	-	-	+	+
<b>Nostocaceae</b>								
25	<i>Nostoc ellipsoforum</i> Rabenhorst ex Bornet & Flahault	-	-	-	+	-	-	-
26	<i>Nostoc microscopicum</i> Carn.ex Born.et. Flah	-	+	-	-	-	-	-
27	<i>Nostoc muscorum</i> Ag.ex Born. et Flah.	-	-	-	-	-	+	+
28	<i>Nostoc passerinianum</i> (De Not.) Bornet ex Born. Et Flah.	-	-	-	-	-	-	+
29	<i>Nostoc paludosum</i> Kützing ex Bornet & Flahault	-	-	-	-	+	-	-
<b>Scytonemataceae</b>								
30	<i>Scytonema leptobasis</i> Ghose	-	-	-	-	-	+	-
31	<i>Scytonema bohneri</i> Schmidle	-	-	-	-	-	+	+

VA-Vallikkunnu; KA-Kadalundi; KI-Kallayi; MA-Mangalavanam; KU-Kumbalam; KM-Kumarakom and ME-Mekkkara

The present study recorded 5 unicellular, 19 non heterocystous and 7 heterocystous types of cyanobacteria. Non heterocystous forms show maximum diversity than other heterocystous or unicellular forms. Silambarasan *et al.* (2012) identified 39 cyanobacteria from three mangrove environment (Parangipettai, Ariyankuppam and Mudasal Odai) in Tamil Nadu coast. Nedumaran *et al.* (2008) identified 23 cyanobacterial species from Pichavaram. Selvakumar and Sundararaman (2001) recorded 17 cyanobacterial strains from Muthupet estuary. Sakthivel and Kathiresan (2013) recorded 68 cyanobacterial species from three different mangrove environments of Pichavaram, Porto Novo and Mudasal Odai.

**Table 3.** Showing the frequency of cyanobacterial genera

No.	Genus	Frequency
1	<i>Aphanocapsa</i>	2
2	<i>Aphanothece</i>	1
3	<i>Chroococcus</i>	1
4	<i>Merismopedia</i>	1
5	<i>Lyngbya</i>	3
6	<i>Microcoleus</i>	2
7	<i>Oscillatoria</i>	13
8	<i>Phormidium</i>	1
9	<i>Nostoc</i>	5
10	<i>Scytonema</i>	2



**Graph 1.** Showing the frequency of cyanobacterial genera recorded.

#### 4. CONCLUSIONS

Maximum species (13 species) of cyanobacteria were recorded from Kadalundi whereas the minimum was recorded from Mangalavanam (2 species) (Table 3; Graph 1). The genus *Oscillatoria* was observed with maximum distribution (13 species), followed by *Nostoc* (5 species) and *Lyngbya* (3 species). The genus *Aphanocapsa*, *Microcoleus* and *Scytonema* (2 species each) and *Chroococcus*, *Aphanothece*, *Merismopedia*, and *Phormidium* (1 species each) shows equal distribution. As many as three species namely *Oscillatoria salina*, *Oscillatoria ornata* and *Oscillatoria vizagapatensis* were common in all mangrove environments except Mangalavanam and Mekkarra.

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