In the present study an attempt has been made on cyanobacteria diversity in various habitats such as epiphytic, lithophyte, epizoic, arboreal etc. in and around Ranchi. In a regular survey of various habitats in different localities of Ranchi District, a total of 34 species of 19 genera were identified. The recorded taxa were unicellular, colonial, trichomatous or filamentous, heterocystous and non-heterocystous. The identified genera are Merismopedia, Synechococcus, Arthrospira, Spirulina, Oscillatoria, Phormidium, Microcoleus, Lyngbya, Nostoc, Anabaena, Cylindrospermum, Aulosira, Nodularia, Scytonema, Tolypothrix, Gloeotrichia, Rivularia, Calothrix, Nostochopsis. Among the above the most dominated genus is Oscillatoria followed by Lyngbya. All these forms are being reported for the first time from Ranchi (Jharkhand).

**Key words:** Cyanobacteria, Ubiquitous, Diversity, Habitat.

These oldest known prokaryotic organisms probably made a fundamental contribution to the development of the present oxygen rich atmosphere by their photosynthetic activities. They have been used as a tool to understand several physiological processes and their biological pathways (Fogg et al. 1973). Cyanobacteria occur mostly in terrestrial and aquatic ecosystem (Castenholz and Waterbury 1989, Thajuddin and Subramaniam 2005, Kulasooria 2011) but now-a-days they occur in different habitats also such as damp wall, tree-bark, exposed rocks etc. (Roser and Reynaud 1982, Chadha and Pandey 1982, Tripathi 1984). They are the major primary producers in all habitats producing 80% oxygen. The study of diversified cyanobacteria carried out from the early times by many workers like Geitler (1932), Smith (1950) in abroad while in India by Bruhl and Biswas (1922), Parukuty (1940) etc. The investigations made by above workers were based on morphological characters and growth patterns of taxa. Later on many workers worked on cyanobacterial diversity. Joishi (2014) studied cyanobacterial biodiversity in rivers of Western Ghat region. In mangrove vegetation it was well studied by Sivakamsundari and Rajendran (2015) in the region of South East Cost of India whereas Barman et al.(2015) documented the same from 30 islands of Sundarbans.

So far, limited study has been done in Ranchi District. A detail study is essential in order to identify and catalogue the more species before they disappear under changed habitat conditions and by the idea that inventories of species will help to conserve biodiversity. Hence, the present investigation was aimed to study the distribution of cyanobacteria in various habitats which may help to explore more microalgae through their efficacy for food and food industry, live feed in aquaculture, bio-fertilizer and therapeutic applications.

**MATERIALS AND METHODS**

**Study Area**

Ranchi is the capital of Jharkhand state situated in the Chhotanagpur plateau at the longitude 84°20' to 85°54' East and the latitude 22° to 23°15' North, and about 629 m above the sea level. The tropical deciduous forest of the state is full of natural wealth which support the luxuriant growth of microalgae specially prokaryotes in this area. Repeated and regular collections of samples were made from various unusual habitats in many places such as Ratu, Kanke, Hatia, Bundu, Dhrurwa, Piska etc. in and around Ranchi. The samples were found growing on moist soil, rocky surfaces, tree-bark, sandy bricks, shell of snail, hydrophytic plants, bare and cultivated fields,
damp wall of old buildings etc.

**Collection and analysis of cyanobacterial sample:**

The green scum on moist soil, tree trunk, milestone, rock was scrapped with the help of sterile scalpel. All samples were collected in sterile plastic bottles, polythene bags. The collected specimens were thoroughly washed with tap water taking care of the quality of the specimens and voucher specimens were prepared. The taxa were isolated using agar stab and their unialgal cultures were raised in BG-11 medium. The cultures were maintained at 25°C. Temporary slides were prepared using methylene blue and chloro-zinc iodine and morphotaxonomic characters were studied under the standard research microscope. Camera Lucida diagrams, micrometric measurements were taken. Identifications were made with the help of standard monographs (Desikachari 1959), literatures (Singh 1961), research papers (Komarek, 2013) and various standard journals. Collected specimens have been also preserved in 4% formalin for further references.

**RESULT**

The identified cyanobacterial population was composed of unicellular, colonial, trichomatous or filamentous heterocystous and non-heterocystous taxa. The unicellular species like *Synechococcus aeruginosus* and trichomatous species *Microcoleus chthonopltes* have been recorded from earthen flower pot and bare land respectively with less availability of moisture show their ability to grow in environmental extremities (Friedmann and Galum 1974, Albertano et al. 1994) and are consider as pioneer colonizer. Some genera such as *Phormidium Lyngbya*.

**Table 1: List of recorded species of class Cyanophyceae and their habitats.**

<table>
<thead>
<tr>
<th>Order</th>
<th>Species identified</th>
<th>Type of habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHROOCOCALES</td>
<td>Merismopedia marssonii</td>
<td>shell of snail</td>
</tr>
<tr>
<td>NOSTOCALES</td>
<td><em>Synechococcus aeruginosus</em></td>
<td>moist barren soil</td>
</tr>
<tr>
<td></td>
<td>Arthroporea jannieri</td>
<td>concrete surface</td>
</tr>
<tr>
<td></td>
<td><em>A. platensis f. granulata</em> nov.</td>
<td>moist soil</td>
</tr>
<tr>
<td></td>
<td>S. laxissima f. major* nov</td>
<td>moist sewage soil</td>
</tr>
<tr>
<td></td>
<td><em>S. gigantea</em></td>
<td>stone wall</td>
</tr>
<tr>
<td></td>
<td>Oscillatoria limosa</td>
<td>sewage soil</td>
</tr>
<tr>
<td></td>
<td><em>O. amoenae</em></td>
<td>moist sandy soil</td>
</tr>
<tr>
<td></td>
<td><em>O. wiliei</em></td>
<td>moist soil</td>
</tr>
<tr>
<td></td>
<td><em>O. perornata</em></td>
<td>wet exposed rock</td>
</tr>
<tr>
<td></td>
<td><em>O. probroidea</em></td>
<td>wet exposed rock</td>
</tr>
<tr>
<td></td>
<td><em>O. acuta</em></td>
<td>moist soil</td>
</tr>
<tr>
<td></td>
<td><em>O. rubescens</em></td>
<td>paddy field</td>
</tr>
<tr>
<td></td>
<td><em>O. corallinae</em></td>
<td>moist barren soil</td>
</tr>
<tr>
<td></td>
<td><em>Phormidium retzi</em></td>
<td>paddy field</td>
</tr>
<tr>
<td></td>
<td>* Microcoleus*</td>
<td>moist soil</td>
</tr>
<tr>
<td></td>
<td>Lyngbya baculum</td>
<td>sub-harvest soil</td>
</tr>
<tr>
<td></td>
<td><em>L. acutantii</em> - onstricta*</td>
<td>paddy field</td>
</tr>
<tr>
<td></td>
<td><em>L. gracilis</em></td>
<td>moist soil</td>
</tr>
<tr>
<td></td>
<td><em>Nostoc</em></td>
<td>tree-bark</td>
</tr>
<tr>
<td></td>
<td>var. tense</td>
<td>moist soil of barren soil</td>
</tr>
<tr>
<td></td>
<td>Anaabaena dolichium</td>
<td>paddy field</td>
</tr>
<tr>
<td></td>
<td><em>A. aphanizomenoides</em></td>
<td>paddy field</td>
</tr>
<tr>
<td></td>
<td>Cylindropermum</td>
<td>tree-bark</td>
</tr>
<tr>
<td></td>
<td><em>Julonia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Socolaria</em></td>
<td>damp wall of old building</td>
</tr>
<tr>
<td></td>
<td><em>Calothrix</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td>Gloeotrichia</td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Rivularia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Aulosira</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Nodularia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Cylindropermum</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Calothrix</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Gloeotrichia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Rivularia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Aulosira</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Nodularia</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Trichodesmum</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Nostochopsis</em></td>
<td>submerged rock</td>
</tr>
<tr>
<td></td>
<td><em>Notochomis</em></td>
<td>submerged rock</td>
</tr>
</tbody>
</table>
Scytonema etc. have great capacity of desiccation tolerance due to presence of thick mucilaginous covering (Samit Ray 2006). The heterocystous species like Cylindrosporum indicum, Nodularia spumigena, Calothrix parietina etc. have the ability to fix molecular atmospheric nitrogen (Annonymous 1996). The role of the diazotrophic genera like Nostoc, Anabaena, Tolypothrix, Aulosira etc., which have been recorded from paddy fields in Ranchi (Hatia, Kanke, Morabadi), in nitrogen economy of rice fields has been well demonstrated and widely documented (Venkataraman 1981, Santra 1991). The species of Spirulina collected from alkaline soil at Harmu river has both nutritional and pharmacological potential well studied by several workers (Ben Amotze 1987, Weisburger 1991, Srivastava and Gajraj 1996). Moreover, Cyanobacteria such as Oscillatoria, Lyngbya, Nostochopsis etc. recorded from rocks (Cohen 1986).

**Systematic Enumeration (Desikachary 1959)**

**Order- CHROOCOCCALES**

**Family- CHROOCOCCACEAE**

**Genus- MERISMOPIEDA** Meyen

1. *Merismopedia marssonii* Lemmermann (Pl. 1, Fig. 1)
   Cells spherical, 1.3-1.9 µ broad; colony rectangular with 16-96 cells, deep blue in colour.

**Genus- SYNECHOCOCCUS** Nag.

2. *Synechococcus aeruginosus* Nag. (Pl. 1, Fig. 2)
   Cells cylindrical, 9.9-11.6µ broad and 16.5-19.8 µ long, pale blue-green in colour.

**Order- NOSTOCALES**

**Family- OSCILLATORIACEAE**

**Genus- ARTHROSPIRA** Stizenberger

3. *Arthrospira jenneri* Stizenb. Ex Gomont (Pl. 1, Fig. 3)
Trichome 3.5-4µ broad, not constricted at the cross-walls; cells 2.5-3.4µ long.

14. *O. rubescens* DC ex. Gomont (Pl. 1, Fig. 14)

Trich. 5-7 µ broad, straight, not constricted at the cross-walls; cells 2.9-4.6 µ long.

15. *O. corallinae* (Kuetz) Gomont (Pl. 1, Fig. 15)

Trichome 3-6µ broad, constricted at the cross-walls; cells 2-3.5µ long.
Genus – **PHORMIDIUM** Kuetz.  
16. *Phormidium retzii* (Ag.) Gomont (Pl. 1 Fig. 16)  
Filament 6.6–9.9 µm broad, unconstructed at the cross-walls; cells 3.3–6.6 µm long.

Genus – **MICROCOLEUS** Desmazieres  
17. *Microcoleus chthonoplastes* Thuret ex. Gomont (Pl. 1, Fig. 17)  
Trichome 3.3–4 µm broad, having many closely grouped trichomes; cells 3.3–6.6 µm long, end cell conical.

Genus – **LYNGBYA** Ag.  
18. *Lyngbya baculum* Gomont (Pl. 1, Fig. 18)  
Filaments curved; sheath thick; trichome 6.6–10 µm broad, constricted at the cross-walls; cells 2.5–5 µm long.  
19. *L. aestuarii* Liebm. Ex. Gomont var. *constricta* Ghose (Pl. 1, Fig. 19)  
Filament 57–75 µm broad, sheath thick and lamelllose; trichome 37–52 µm broad, constricted at the cross-walls; cells 6–12 µm long.  
20. *L. gracilis* (Menegh.) Rabenh. (Pl. 1, Fig. 20)  
Filament 7–8.3 µm broad, sheath smooth, thin; trichome 5–6.3 µm broad, constricted at the cross-walls; cells 2–3.3 µm long, end cell rounded.  
21. *L. palmarum* (Martens) Bruhl et Biswas (Pl. 1, Fig. 21)  
Filament with sheath 10–15 µm broad; trichome 6–9 µm broad, not constricted at the cross-walls, apices rounded; cells 6–9 µm long.  

Family – **NOSTOCACEAE**  
Genus – **NOSTOC** Vaucher  
22. *Nostoc spongiaeforme* Ag. ex Born. Et Flah. var. *tenue* Rao C.B. (Pl. 1, Fig. 22)  
Thallus gelatinous, thin, expanded; trichome 3.6–4.8 µm broad; cell 6.6 µm long; heterocysts 5.3–6.6 µm broad and 6.6–8.7 µm long; spores 4.9–6.3 µm broad and 5.6–9 µm long.

Genus – **ANABAENA** Bory  
23. *Anabaena doliolum* Bhardwaja (Pl. 1, Fig. 23)  
Thallus mucilaginous; trichome 3.3–4.2 µm broad; cells as long as broad; heterocyst 6.2–6.4 µm broad and 6.6–7.3 µm long; spores 5–5.9 µm broad and 6.6–9.9 µm long.  
24. *A. aphanizomenoides* Forti (Pl. 1, Fig. 24)  
Trichome 3.3–5.6 µm broad; cells 1–3 times as long as broad; heterocyst 6.2–6.6 µm broad and 7.2–7.8 µm long; spores 6–7 µm in diameter.

Genus – **CYLINDROSPERMUM** Kuertz.  
25. *Cylindrospermum indicum* Rao, C.B., orth. Mut. De Toni (Pl. 1, Fig. 25)  
Trichome 4.2 µm broad; cells 3.3–6.6 µm long; heterocyst 6.6–7.8 µm in diameter; spores without memb. 6.6–8.3 µm broad and 16.8–18.4 µm long, with membrane 11.5–13 µm broad and 19.8–21.4 µm long.  

Genus – **AULOSIRA** Kirchner  
26. *Aulosira bombayensis* Gonzalves (Pl. 1, Fig. 26)  
Filament 4.9–6.2 µm broad; trichome 3.3–3.9 µm broad; cell 9.9–10.5 µm long; heterocysts 3.6–4.9 µm broad and 9.9–11.5 µm long.

Genus – **NODULARIA** Mertens  
27. *Nodularia spumigena* Mertens ex Born et Flah. (Pl. 1, Fig. 27)  
Filament 12–13 µm broad; trichome 9.9–10.5 µm broad; cells 2.9–3.3 µm long; heterocysts broader than the vegetative cells; spores 10.5–11.8 µm long and 8.2–8.8 µm long.  

Family – **RIVULARIACEAE**  
Genus – **CALOTHRIX** Ag.  
28. *Calothrix parietina* Thuret ex Born. Et Flah. (Pl. 1, Fig. 28)  
Filament 7.2–11.3 µm broad; trichome 4.2–9.9 µm broad; cells 2–3.3 µm long; heterocysts 9.9 µm broad and 7.2 µm long.  

Genus – **GLOEOTRICHIA** Ag.
29. *Gloeotrichia rasiborskii* Woloszynska (Pl. 1, Fig. 29)

Trichome 6.6- 8.2 µ broad, is tapering towards end; heterocyst 6.6 µ broad; spores 13.8 µ broad and 49.5 µ long.

**Genus-RIVULARIA** (Roth) Ag.

30. *Rivularia baccariana* (De Not.) Born. Et Flah. (Pl. 1, Fig. 30)

Filament 6.6- 10.2 µ broad; trichome 3- 7.2 µ broad, produced into a bent hair; cells shorter than broader; heterocyst 9.9 µ long.

**Family-SCYTONEMATACEAE**

**Genus- TOLYPOTHRIX** Kuetzing

31. *Tolypothrix distorta* Kuetzing ex Born. et Flah. (Pl. 1, Fig. 31)

Filament 11.5- 13.2 µ broad, thin sheath with a single trichome; trich. 9.9- 11 µ broad; cells 3.3- 4.9 µ long; heterocysts 10.2- 13 µ broad and 8.3- 9.9 µ long.

**Genus-SCYTONEMA** Ag.

32. *Scytonema tolyporthrichoides* Kuetzing ex Born. et Flah. (Pl. 1, Fig. 32)

Filament 10- 14.8 µ broad, false branches geminate; trich. 8.2- 11.5 µ broad; cells 6.6 µ long; heterocysts 6.6- 8.3 µ long.

**Order-STIGONEMATALES**

**Family- NOSTOCHOPSIDACEAE**

**Genus- NOSTOCHOPSIS** Woodem. Geitler

33. *Nostochopsis lobatus* Woodem. Geitler (Pl. 1, Fig. 33)

Thallus with true branching having short and long laterals; cells 3.6- 9.9 µ broad and 8.2- 19.5 µ long; heterocysts 6.9- 9.5 µ broad.

34. *Nostochopsis radians* Bhardwaja (Pl. 1, Fig. 34)

Thallus mucilaginous and profusely branched; cells 1.6- 3.3 µ broad and 7.6- 10.8 µ long; heterocysts 6.6- 13.2 µ in diameter.

We are thankful to Prof. Anjani Kumar Srivastawa, Head and Dean (Science faculty) P. G. Department of Botany, Ranchi University, Ranchi for providing Lab. facilities. We are also grateful to Dr. H.P. Sharma, University Professor, Department of Botany, Ranchi University, Ranchi for consistent support and help for research activities and helping for preparation of this paper.

**REFERENCES**


Amotz Ben 1987 *Polysaccharides from microalgae.* Presented to Workshop at Duke University, N. Caroliina, U.S.A.

Anonymous 1996 *Studies on blue-green algae from Rice field soils of North Eastern India for Biofertilizer Technology*, Final Technical Report, DBT, Govt. of India, New Delhi, pp. 144.


Santra S C 1991 Rice field blue green algae (Cyanobacteria) and its utilization prospect as biofertilizer in West Bengal, India *Proc Nat Symp* on cyanobacterial nitrogen fixation, New Delhi.

Singh R N 1961 *Role of blue-green algae in nitrogen economy of Indian agriculture*, ICAR, New Delhi.

Sivakamasundari K and Rajendran R 2015 Cyanobacterial Biodiversity in Natural Mangrove vegetation of Paravanar Estuary at Poondiyankuppam, Cuddalore Coast, South East Coast of India. *Int. J. Curr. Res. in Life Sciences*, 4(2) 130-132.


Thajuddin N and Subramanium, G 2005 Cyanobacterial biodiversity and potential applications in biotechnology. *Curr. Sci.* 89 1-10

