Study of Cyanobacterial diversity from the major rivers of Chandrapur district, Maharashtra

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Abstract

Present manuscript deals with the record and distribution of Cyanophyceae in Chandrapur district of Maharashtra state, India. During the period from 2013 to 2015 three major rivers Wardha, Painganga and Waineganga of the district were studied to explore their biological wealth and documented 45 taxa belongs to 18 genera and 5 families of blue green algae. Among these 31 taxa are reported first time from the district and a taxa Calothrix stagnalis Gomont is new record for the state.

Key words: Wardha; Painganga; Waineganga; Calothrix stagnalis; New record.

Introduction

Cyanobacteria are widespread prokaryotic photosynthetic microorganisms among which some are able to fix atmospheric nitrogen. They occupied all possible habitats where moisture and light is available. But their distribution among different territory is regulated by physiochemical conditions of that particular habitat. Several habitats of India and Maharashtra state (Anand and Hopper, 1987; Mahajan and Mahajan, 1988; Tripathy et al., 1999; Pattanaik and Adhikary, 2002; Tirkey and Adhikary, 2006; Vijayakumar et al., 2007; Patil and Nandan, 2011; Dash et al., 2011; Ghosh and Keshri, 2011; Hazarika, 2013; Kumar et al., 2013; Kamble and Karande, 2014) have been explored by various workers for blue green algal diversity. But the Chandrapur district was neglected by algal taxonomists, and least literature regarding algae is available from the district. Hence, present work is undertaken during the period from 2013 to 2015 to study the biodiversity of three major rivers of the Chandrapur district.

Materials and Methods

Study area: Chandrapur is the easternmost district of the Maharashtra state, located between 18° 41' to 20° 50' north latitudes and 78° 48' to 80° 55' east longitudes . The district is bounded by Nagpur, Bhandara and Wardha on northern side, Yavatmal on western side, Gadchiroli on eastern side and Adilabad district of the Telangana state on southern side. Physiographically it is situated in the Wainanga and Wardha river basin. The entire area of the district falls in the Godavari basin. The area is drained by major tributaries Wardha, Wainganga and Painganga rivers of the Godavari river.

The climatic condition of the district is hot which ranges between minimum 11.6° C in December and maximum 49° C in May. The average annual rainfall is about 1142.07 mm. The district is highly industrialized and bears the pressure of about 6000 small, medium and large scale industries (Collector office Chandrapur). In the district, there exist few wetlands and that too are bearing the pressure of high industrialization. Day by day pollution in the district is increasing and changing the physico chemical environment and biota of the rivers. And the rivers of
the district are never explored for their biological wealth. Hence, present work is undertaken to explore the algae of major rivers Wardha, Painganga and Waineganga of the Chandrapur district.

Sampling and identification: Samples were collected from 21 selected sites (Table 1) of three major rivers during May, August, November and February months of 2013 – 15 period. From every site approximately 50 liters of running water is filtered through phytoplankton net of 20μ mesh size made of bolting silk. The filtrate was preserved in 4% formaldehyde solution. Microphotographs taken with the help of Costlab CCD camera inbuilt trinocular microscope. Algae were identified with the help of standard flora of Indian Cyanophyta (Desikachary, 1959), Algae of the Western great lakes area (Prescott, 1965) and from several current research papers.

Table 1. Sample collection sites

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<th>Sr.No</th>
<th>Site</th>
<th>Location</th>
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Results

The Cyanophyceae of the major rivers of Chandrapur district is as follows...

1. **Aphanocapsa banaresensis** Bharadwaja, 1935: Pl. I Fig. 1
   [Desikachary 1959, p. 133]
   Colony spherical, colourless. Cells spherical, individual sheath not clear, 5μ-6.5μ in diameter.
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Cyanobacterial diversity from the major rivers of Chandrapur district

Occurrence: S3, S13

2. **Aphanocapsa grevillei** (Berkeley) Rabenhorst, 1865: Pl. I Fig. 2
   (Synonym = *Microcystis grevillei* (Berkeley) Elenkin, 1938
   [Desikachary 1959, p. 134]
   Colony spherical, sheath distinct. Cells spherical, individual sheath not distinct. 4µ-5µ in diameter.
   Occurrence: S1, S2, S5, S7, S11

3. **Aphanocapsa pulchra** (Kützing) Rabenhorst, 1865: Pl. I Fig. 3
   [Desikachary 1959, p. 132]
   Colony near spherical, gelatinous. Cells spherical with minute gas vacuoles, 3µ-4µ in diameter.
   Occurrence: S5, S6, S7, S9, S11

Aphanothece Nageli 1849.

3. **Aphanothece castagnei** (Kützing) Rabenhorst, 1865: Pl. I Fig. 4
   Basionym: *Palmella castagnei* Kützing 1846. [Desikachary 1959, p. 140]
   Colony near spherical, sheath distinct. Cells ellipsoid cylindrical, arranged compactly, 3µ-4µ X 5µ-7µ in size.
   Occurrence: S4

4. **Aphanothece microscopica** Nägeli, 1849: Pl. I Fig. 5 [Desikachary 1959, p. 142]
   Colony near spherical, gelatinous. Cells blue green, oblong cylindrical with rounded ends, 4µ-5µ X 8µ-9µ in size.
   Occurrence: S2

Chroococcus Nägeli 1849.

5. **Chroococcus dispersus** (Keissler) Lemmermann, 1904: Pl. I Fig. 6 Basionym: *Chroococcus minor* var dispersus Keissler 1902. [Desikachary 1959, p. 106]
   Colony mucilaginous with 4 or 8 cells. Cells spherical, light blue green, 3µ-4µ in diameter (without sheath).
   Occurrence: S15

6. **Chroococcus limneticus** Lemmermann, 1898: Pl. I Fig. 7
   [Desikachary 1959, p. 107] Colony 4 or 8 celled, near tabular. Cells sub spherical to ellipsoid, Sheath thin, unlamellated, colourless. Orientation of cells in the colony is not similar. Cells 6µ-8µ in diameter (without sheath).
   Occurrence: S1-S3, S6-S11, S16-S18, S21.

7. **Chroococcus minor** (Kützing) Nägeli, 1849: Pl. I Fig. 8
   Basionym: *Protococcus minor* Kützing, 1845 Synonym: *Gloeocapsa minor* (Kützing) Hollerbach, 1937
   [Desikachary 1959, p. 105] Colony slimy, 4 or 8 celled. Cells spherical, dirty green, sheath thin, 3µ-4µ in diameter (without sheath).
   Occurrence: S4, S5, S7, S12-S14

8. **Chroococcus urgid** (Kützing) Nägeli, 1849: Pl. I Fig. 9
   [Desikachary 1959, p. 103] Colony 2, 4 or 8 celled. Cells spherical, Sheath thick, unlamellated, 5µ-7µ in diameter (without sheath).
   Occurrence: S1, S2, S4, S10, S12-S15, S17-S20

9. **Chroococcus tenax** (Kirchner) Hieronymus, 1892: Pl. I Fig. 10
   Basionym: *Chroococcus turgidus* var. tenax Kirchner, 1878
   [Desikachary 1959, p. 103] Cells 2 to 4 together, near spherical to triangular, blue green or olive coloured. Sheath thick, distinctly lamellated, colourless. Cells 17µ-20µ in diameter (without sheath).
   Occurrence: S4, S5, S8, S12-S16

10. **Chroococcus turgidus** (Kützing) Nägeli, 1849: Pl. I Fig. 11 Basionym: *Protococcus turgidus* Kützing, 1846

Colony ellipsoid, 1 or 2 celled. Cells near spherical to ellipsoid, sheath thick, colourless, 16µ-20µ in diameter (without sheath). Occurrence: S4, S5, S7, S9, S12, S13

*Coelosphaerium* Nägeli 1849.

11. **Coelosphaerium kuetzingianum** Nägeli, 1849: Pl. I Fig. 12

*Gloeocapsa* Kützing 1843.

12. **Gloeocapsa rupestris** Kützing, 1846: Pl. I Fig. 13
[Desikachary 1959, p. 117, Voucher no. PC13.5.1] Colony spherical, crustaceous, yellowish. Cells spherical to oval, sheath vesicular, yellowish to colourless, and lamellated. Cells 6µ-9µ in diameter. Occurrence: S15

*Gomphosphaeria* Kützing 1836.

13. **Gomphosphaeria aponina** Kützing, 1836: Pl. I Fig. 14
[Desikachary 1959, p. 150, pl. 28, f. 1-3] Colony near spherical or pyriform. Cells cordate at longitudinal cell division, and distinctly placed at dichotomous branches of mucilage stalks. Cells 4µ-6µ X 9µ-11µ. Occurrence: S1-S3, S5-S7, S9-S11, S19-S21

*Merismopedia* F.J.F.Meyen 1839.

14. **Merismopedia elegans** A.Braun ex Kützing, 1849: Pl. I Fig. 15
[Desikachary 1959, p. 156] Cells large, light blue green, in many celled large and folded colonies. Cells 7µ-9µ in diameter. Occurrence: S3, S4, S6-S8, S11, S18, S19

15. **Merismopedia glauca** (Ehrenberg) Kützing, 1845: Pl. I Fig. 16
Basionym: *Gonium glaucum* Ehrenberg, 1838 Synonym: *Merismopedia aeruginea* Brébisson, 1849

16. **Merismopedia minima** Beck, 1897: Pl. I Fig. 17 [Desikachary 1959, p. 154] Cells minute, pale blue green, in four to many celled free floating colonies. Cells 0.8µ-1µ in diameter. Occurrence: In all sites

17. **Merismopedia punctata** Meyen, 1839: Pl. I Fig. 18
[Desikachary 1959, p. 155] Cells small, blue green, in four to many celled free floating colonies. Cells 2.5µ-3.5µ. Occurrence: S1, S2, S4-S7, S9-S12, S14-S17, S19

18. **Merismopedia tenuissima** Lemmermann, 1898: Pl. I Fig. 19
[Desikachary 1959, p. 154] Cells minute, pale blue green, in eight to many celled free floating colonies. Cells 1.5µ-2µ in diameter. Occurrence: S4, S5, S9, S10, S12, S13,

*Microcystis* Lemmermann 1907.

19. **Microcystis aeruginosa** (Kützing) Kützing, 1846: Pl. II Fig. 12

20. **Microcystis flosaquae** (Wittrock) Kirchner, 1898: Pl. II Fig. 3 Basionym: *Microcystis aeruginosa* f. flosaquae (Wittrock) Elenkin, 1938 [Desikachary 1959, p. 154] Colonies mostly spherical, sometimes ellipsoid. Cells small, spherical with gas vacuoles, compactly arranged, 5µ-7µ in diameter. Occurrence: S1, S5, S7, S9, S10, S13, S14
21. **Microcystis protocystis** W.B.Crow, 1923: Pl. I Fig. 20
[Desikachary 1959, p. 154]
Colonies spherical to elongate. Cells small, spherical, with gas vacuoles, densely to loosely arranged, but not dispersed, 4µ-5µ in diameter.
Occurrence: S4, S5, S7
22. **Microcystis robusta** (H.W.Clark) Nygaard, 1925: Pl. II Fig. 1
Basionym: *Clathrocystis robusta* H.W.Clark, 1908. [Desikachary 1959, p. 154] [Voucher no. PC13.8.4]
Colony mostly lobate and gelatinous. Cells large, spherical, aggregated, colonial margin distinct but not refractive, 6µ-8µ in diameter. Occurrence: S1, S4, S9-S11
23. **Microcystis wesenbergii** (Komárek) Komárek ex Komárek, 2006: Pl. II Fig. 2

**Synechocystis** Sauvageau 1892.
24. **Synechocystis aquatilis** Sauvageau. 1892: Pl. I Fig. 21
[Desikachary 1959, p. 144] [Voucher no. PC13.9.1]
Cells small, pale blue green, in one to many celled free floating colonies. Cells 5µ-6µ in diameter. Occurrence: S1-S3, S5-S7, S12, S14-S16, S18, S19, S21
25. **Synechocystis sallensis** Skuja, 1930: Pl. I Fig. 22
Cells medium, blue green, two to four together, 8µ-9µ in diameter. Occurrence: S1-S3, S11

Order PLEUROCAPSALES Geitler.

Family PLEUROCAPSACEAE Geitler.

**Myxosarcina** Printz 1921.
26. **Myxosarcina burmensis** Skuja, 1949: Pl. I Fig. 23
Colony small, spherical, sarcinoid, sheath indistinct. Cells minute, angular spherical with rounded corners. Cell divides in both vertical and horizontal directions, 2µ-4µ in diameter. Occurrence: S1, S2, S14, S16
27. **Myxosarcina spectabilis** Geitler, 1933: Pl. I Fig. 24
Basionym: *Cyanosarcina spectabilis* (Geitler) Kováčik, 1988
[Desikachary 1959, p. 178] Colony small, irregular, free floating with distinct sheath. Cells small, angular ovate, blue green, 6µ-8µ in diameter. Occurrence: S15

Order NOSTOCALES Geitler.

Family OSCILLATORIACEAE Kirchner.

**Arthrospira** Sitzenberger ex Gomont 1892.
28. **Arthrospira khannae** Drouet & Strickland, 1942: Pl. II Fig. 5 [Desikachary 1959, p. 189, pl. 35, f. 12]
Trichome blue green, regularly spirally coiled and not constricted at cross walls. Cells broader than long, end cells subcapitate, cross walls granulated. Cells 3µ-5µ X 1µ-2µ, Trichome 3µ-5µ broad, Spiral 18µ-20µ broad & 25µ-30µ apart. Occurrence: S7, S8, S11

29. **Arthrospira maxima** Setchell & N.L.Gardner, 1917: Pl. II Fig. 6
   Synonym: *Spirulina maxima* (Setchell & N.L.Gardner) Geitler, 1932
   Trichome blue green, regularly spirally loosely coiled and constrictions not clear. Cells broader than long, end cells slightly attenuated.
   Cells 7μ-8μ X 4μ-6μ, Trichome 7μ-8μ broad, Spiral 40μ-50μ broad & 70μ-80μ apart.
   Occurrence: S12-S14, S16, S17

30. **Arthrospira platensis** (Nordstedt) Gomont, 1892: Pl. II Fig. 7
   Synonym: *Spirulina jenneri* var. *platensis* Nordstedt, 1884
   [Desikachary 1959, p. 190, pl. 35, f. 2] Trichome blue green, regularly spirally coiled and slightly constricted at cross walls. Cells quadrangular as broad as long or broader, end cells broadly rounded.
   Cells 5μ-8μ X 4μ-6μ, Trichome 5μ-8μ broad, Spiral 30μ-45μ broad & 50μ-60μ apart.
Occurrence: S16, S17

**Lyngbya** Agardh 1892.
31. **Lyngbya hieronymusii** Lemmermann, 1905: Pl. II Fig. 4
   [Desikachary 1959, p. 297] Filaments free floating, single, and straight. Sheath firm, homogenous, colourless. Cells broader than long, not or slightly constricted at cross walls, granulated. End cells broadly rounded. Filament 14µ-16µ broad, Cells 12µ-14µ X 3µ-4µ.
   Occurrence: S2, S3

**Oscillatoria** Vaucher 1892.
32. **Oscillatoria limosa** Agardh ex Gomont, 1892: Pl. I Fig. 25
   Occurrence: S4, S5, S7-S9, S11
33. **Oscillatoria princeps** Vaucher ex Gomont, 1892: Pl. II Fig. 9
   [Desikachary 1959, p. 210, pl. 37, f. 1, 10, 13, 14] Trichomes straight, not constricted at cross walls, slightly attenuated at apex and slightly bent. End cells flatly rounded, slightly capitates. Cells 3µ-6µ X 40µ-60µ.
   Occurrence: S4, S5, S7-S9, S11
34. **Oscillatoria princeps var. pseudo-limosa** Ghose, 1924: Pl. II Fig. 8
   Occurrence: S15-S17, S19-S21

**Spirulina** Turpin ex Gomont 1892.
35. **Spirulina major** Kützing ex Gomont, 1843: Pl. I Fig. 26
   Synonym: *Arthrospira major* (Kützing ex Gomont) W.B.Crow, 1927 [Desikachary 1959, p. 196, pl. 36, f. 13] Trichomes blue green, regularly spirally loosely coiled. Trichome 1.5µ-2µ broad, Spiral 3µ-4µ broad & 4µ-5µ apart. Occurrence: In all the sites
36. **Spirulina meneghiniana** Zanardini ex Gomont, 1892: Pl. I Fig. 27 Synonym: *Arthrospira meneghiniana*
   (Zanardini ex Gomont) W.B.Crow, 1927 [Desikachary 1959, p. 195, pl. 36, f. 8] Trichomes blue green, irregularly spirally loosely coiled. Trichome 1.5µ-2µ broad, Spiral 3µ-5µ broad & 4µ-6µ apart. Occurrence: S6, S7, S12, S14
37. **Spirulina subsalsa** Oersted ex Gomont, 1842: Pl. I Fig. 28
   Synonym: *Arthrospira subsalsa* (Oersted ex Gomont) W.B.Crow, 1927 [Desikachary 1959, p. 193, pl. 36, f. 3, 9] Trichomes blue green, regularly spirally compactly coiled. Trichome 2µ-3µ broad, Spiral 5µ-7µ broad. Larger than the dimensions given by Desikachary. Occurrence: S7

**Trichodesmium** Ehrenberg ex Gomont 1892.
38. **Trichodesmium lacustre** Klebahn, 1895: Pl. I Fig. 29
   Synonym: *Oscillatoria lacustris* (Klebahn) Geitler, 1925 [Desikachary 1959, p. 246, pl. 42, f. 22] Trichomes straight, constricted, arranged parallel in bundles. Cells short barrel shaped, end cells rounded and somewhat capitates, 6µ-8µ X 5µ-7µ Occurrence: S15, S16, S18, S20, S21

Family **NOSTOCACEAE** Kützing.

**Anabaena** Bory 1822.
39. **Anabaena laxa** (Rabehn.) A. Braun, 1886: Pl. I Fig. 30

Cells 4µ-5µ X 5µ-6µ. Heterocyst 5µ-6µ X 7µ-8µ, Akinete 7µ-8µ X 14µ-16µ
Occurrence: S7, S13

40. **Anabaena sphaerica** Bornet & Flahault, 1888: Pl. I Fig. 31

Occurrence: S8, S13, S14

41. **Anabaena volzii** Lemmermann, 1906: Pl. II Fig. 10

Synonym: **Macrospermum volzii** (Lemmermann) Komarek, 2008

[Desikachary 1959, p.403, pl. 77, f. 1] Trichome straight or bent, free. Cells barrel shaped to cylindrical, end cells with rounded ends, heterocyst nearly cylindrical, spore ellipsoidal and present on only one side of the heterocyst. Epispore smooth and colourless. Cells 5µ-7µ X 7µ-10µ, Heterocyst 8µ-10µ X 10µ-12µ, Akinete 20µ-25µ X 50µ-60µ
Occurrence: S16-S20

**Family MICROCHAETACEAE** Lemmermann.

**Microchaete** Thuret 1875.

42. **Microchaete violacea** Fremy, 1929: Pl. II Fig. 11

Occurrence: S20, S21

Family **RIVULARIACEAE** Rabenhorst.

**Calothrix** Agardh 1824.

43. **Calothrix fusca** Bornet & Flahault, 1886: Pl. I Fig. 32. [Desikachary 1959, p. 527, pl. 107, f. 10; Prescott 1962, p. 551, pl. 132, f. 4, 5] Filament single or few together, embedded in the mucilage of other algae. Strongly curved from horizontal basal portion, distinctly broad at base and tapered into a long hair. Cells discoid, broader than long at base, heterocyst single, hemispherical or pyramidal, and basal in position. Cell 7µ-10µ X 3µ-4µ, Heterocyst 5µ-6µ broad, Filament 10µ-14µ broad. Occurrence: S18, S19

44. **Calothrix stagnalis** Gomont, 1895: Pl. I Fig. 33

[Prescott 1962, p. 553, pl. 132, f. 7] Plants few together, attached with the substratum with basal portion, but suddenly bent to form erect apical portion. Trichome gradually tapers into a long narrow tail. Cells short near rectangular with constriction at septa. Heterocyst sinque, spherical, basal. Spore single, adjacent to the heterocyst. Cell 5µ-7µ X 5µ-9µ, Heterocyst 5µ-6µ broad, Filament 8µ-10µ broad. Occurrence: S15, S16

This is probably first report of the taxon from Maharashtra.
Discussion & Conclusion

In India the Cyanophyceae is represented by 1232 taxa of 90 genera (Gupta, 2012) and distributed widely in all possible types of habitats. From the Maharashtra state several workers have enlisted a number of taxa of Cyanophyceae from different habitats.

But, from the district there are only few studies are available concerning Cyanophyceae. Kamat (1975) reported 13 taxa of Cyanophyceae from few sites of Chandrapur proper and Warora city. And Wadhave (2014) reported 74 taxa from rice fields of the Bhadrawati taluka of the district.

In present work, 444 km length of rivers was studied by selecting 21 sites and identified 45 taxa of 18 genera of blue green algae from the district. Among these 31 are reported first time from the district and a taxa Calothrix stagnalis Gomont is reported first time from the state. From this study it is observed that the district is rich in biodiversity and need further extensive taxonomic studies in different ecological habitats.

Bibliography:


