



NON-HETEROCYST GENUS *OSCILLATORIA* VAUCHER, FROM NASHIK AND ITS ENVIRONS (M.S.) INDIA

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Abstract The present work deals with the biodiversity of *Oscillatoria* in the fresh water reservoirs of different localities of Nashik and its environs. Species are delimited on the basis of the nature of trichome, size and shape of the cells, and apex. Total 33 taxa are being identified from different collected samples, from different water reservoirs of Nashik. Few are rare in occurrence as *Oscillatoria perornata*, *O. ornate*, *O. boryana*, *O. jasorvensis*, *O. limnetica*, *O. brevis*, *O. subbrevis*. This enriches the algal flora of Nashik.

Keywords: Cyanobacteria, Biodiversity, Taxonomy, Nashik.

INTRODUCTION

Presently, a special attention is paid worldwide mainly to the investigation of the biodiversity in aquatic ecosystems, as an important characteristic of the natural resources. Algal diversity is considered at the levels of richness of species and higher taxonomic ranks and as the variety of habitats algae dominate and their functional importance in processes they mediate.

Cyanobacteria are gram negative prokaryotic organisms. Blue green algae are largest oxygen donor amongst plants, Proterozoic oil deposits are due to the activity of Cyanobacteria. Serves as an excellent nitrogen fertilizer and as a food. *Oscillatoria* occurs in water. (Diversity of aquatic environment freshwater, sea or even hot springs). It is not known to be pathogenic but some of its species are secreting anatoxins and microcystins. Anatoxins, interfere with the neuron signaling and microcystins, cause liver bleeding.

The present work is undertaken to reveal the algal flora of fresh water, during the years 2008-2013. Water temperature during study period is ranging from 40-42°C and pH range is 6-9. Nashik is located at a height of 565 meters above sea level in Sahyadri Mountains. Area of Nashik city is 259.13km. Nashik Dist. laying between 19° 35' and 20° 52' north latitude and 73° 16' and 74° 56' east latitude with an area of 15,584 km² (6015 miles).

MATERIALS AND METHODS

The study is based on field, laboratory work and literature survey, valuable data based on identification, distribution pattern and on field observation. All the species collected during the field work were processed for the following work.

Collection of samples

Diverse collections of samples were collected by phytoplankton net, specially designed collection funnel or manually from different areas of the of water reservoirs, at depth near the surface and at 10 meters. The samples were collected at one-month interval.

Preservation of samples

Preserved in F.A.A, 70% ethanol or 4% formaline, Lugol's solution. Few samples, alive for culture studies.

Algal identification

Creation of Semi-permanent and permanent slides were prepared by using glycerin-gel technique for further observation. The identification was done by using standard monographs, books and recent literature, Desikachary (1959), Prescott (1951) etc.

Sketches and Photographs of algal types

Field and microscopic photographs of algal strains are taken by using a Digital camera. Sketches are drawn by using camera Lucida.

RESULTS

Genus- Oscillatoria, Vaucher ex Gomont, 1892.

Desikachary-1981: 198. Trichome single, unbranched or forming a flat or spongy plankton thallus, without sheaths, motile, mostly by oscillating movement, isopolar, straight to slightly curved, uniseriate, constricted or unconstructed at crosswalls, end of trichome distinctly marked, pointed bent like a sickle or coiled more or less like a screw. Cells short cylindrical or discoid with fine granulation or with solitary granules, blue-green, brownish or pinkish, End cells widely rounded, sometimes capitate or with calyptra. False branching, heterocyst and akinetes absent.

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1. *Oscillatoria annae* van Goor, 1918: Pl. 2, Fig. 1

Desikachary - 1959: 203: Pl. - 38, Fig. 13.

Trichome 6.6-8 μ broad, straight, dull blue-green, distinct constriction at the cross-walls slightly attenuated and bent at the ends. Cell 6.6 μ in dia., 3.3-4.95 μ long, not granulated at the cross-walls. Apical cell rounded; calyptra absent.

Habitat: Tapovan (22/06/2012), Ghodegaon (30/08/2012), Ozar (27/02/2012), Dindori (30/03/2012), Ozarkhed Dam (30/03/2012), Jadhavwadi (20/01/2011), Trimbakeshwar (21/01/2012).

Exsic NSK- 266, NSK- 389, NSK- 420, NSK- 458, NSK- 472, NSK- 515, NSK-573.

2. *Oscillatoria formosa* Bory de Saint-Vincent ex Gomont, 1892: Pl. 3, Fig. 9.

Desikachary-1959: 232: Pl.40, Fig. 15.

Thallus blue green, trichome among other algae, blue-green, long, 6.6-7 μ broad, straight, distinctly constricted at the cross-walls, ends slightly attenuated, capitate, calyptra absent. Cells squares or rectangular, 6.6 μ long, 6.6 μ in dia., septa prominent, slightly granular. End cells obtuse.

Habitat: Water logged soils of pond of Anjeneri (02/07/2012).

Exsic NSK- 551.

3. *Oscillatoria limosa* C. Agardh ex Gomont, 1892: Pl.2, Fig.9. Desikachary-1959: 206: Pl. 42, Fig. 11.

= *Conferva limosa* Dillwyn 1802.

= *Oscillatoria limosa* C. Agardh 1812.

= *Oscillatoriella limosa* (Dillwyn) Gaillon 1833.

= *Oscillatoria tenuis* var. *limosa* (Dillwyn) Kirchner ex Forti 1907.

= *Phormidium limosum* (Dillwyn) P.C. Silva 1996.

Trichomes very dark blue-green, brown or olive green mass attached to the submerged object. Trichome straight, not constricted or slightly constricted at the cross-walls, 5.65-8.25 μ , broad. Cells 5.65-8.25 μ broad, 1.65-3.3 μ long, cross-walls distinct and frequently granulated, present at either side of cross wall. Apical cell dome shape, not bend, covered by thickened membrane, without calyptra.

Habitat: Kumbharwadi (28/07/2012).

Exsic NSK- 557.

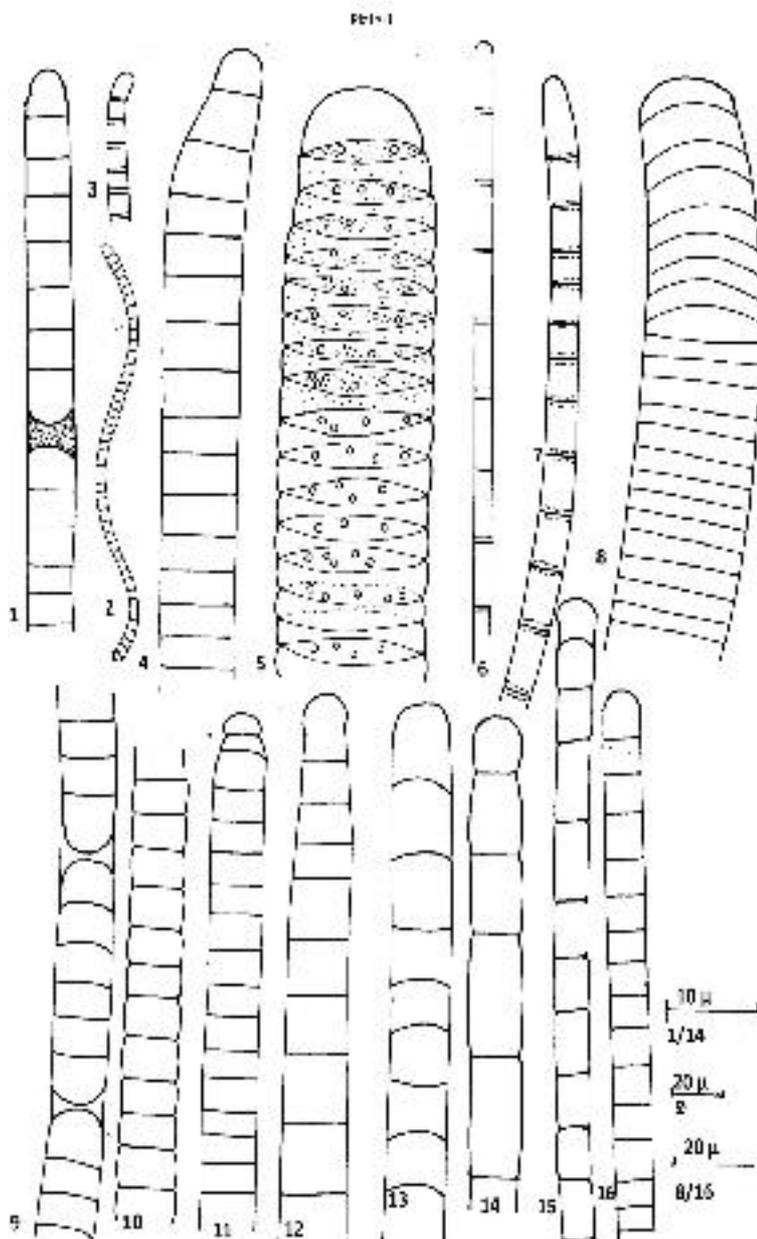


PLATE 1:

Fig. 1 & 16, *Oscillatoria subbrevis*, Fig.2 & 7, *O. obscura*, Fig.3 & 6, *O. jasorvensis*, Fig.4, *O. vizagaptensis*, Fig.5 & 8, *O. princeps*, Fig.9 & 10, *O. agardhii*, Fig.11 *O. simplicissima*, Fig.12 to 15. *O. irrigua*

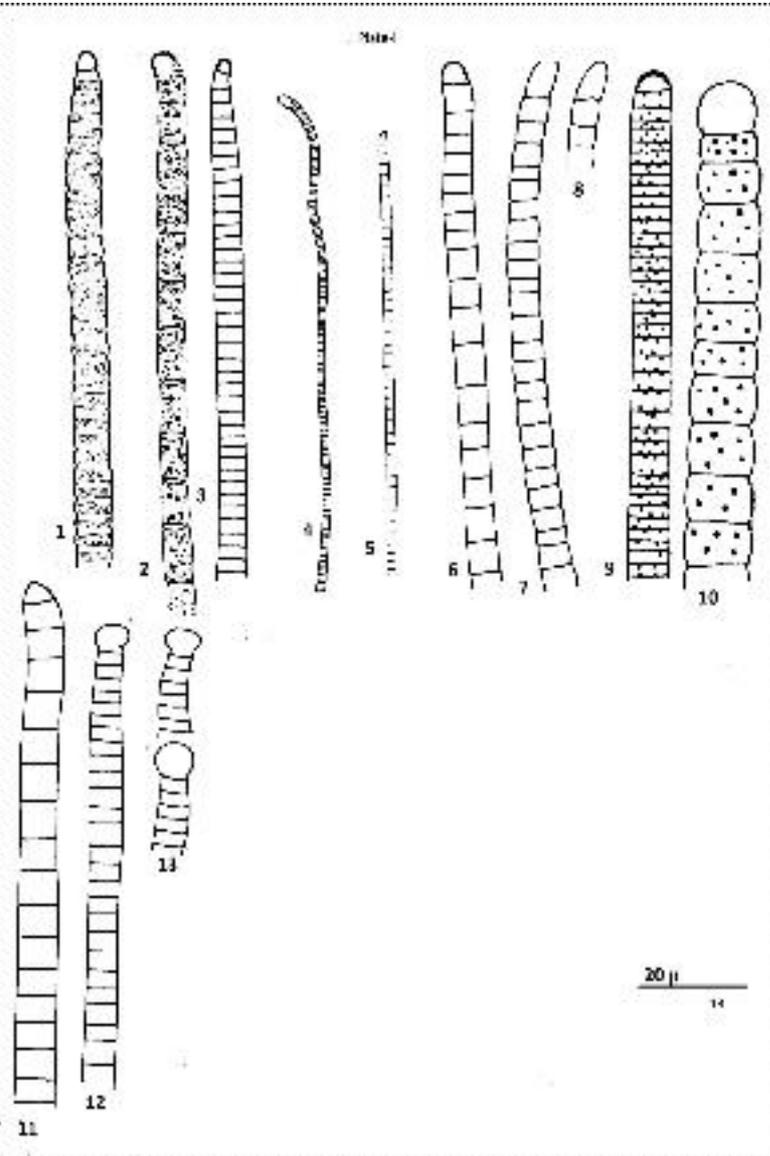


PLATE II:

Fig. 1: *O. annae*, Fig. 2: *O. proteus*, Fig. 3: *O. acuta*, Fig. 4: *O. acutissima*, Fig. 5: *O. amphigranulata*, Fig. 6: *O. brevis*, Fig. 7 & 8: *O. curviceps*, Fig. 9: *O. limosa*, Fig. 10: *O. sancta*, Fig. 11: *O. Subuliformis*, Fig. 12 & 13: *O. tenuis*

4. *Oscillatoria amphibia* C. Agardh, 1827: Pl. 3, Fig. 11-12.

Desikachary- 1959: 229: Pl. - 37, Fig.6.

Trichome straight or curved and interwoven to form thin blue green mass on submerged object. Trichome not attenuated, not capitate, not constricted at the cross-walls, 1.65 -3.3 µ broad. Cells 1.6-3.3µ broad, 5-9.9 µ long, with two large granules either side of septa. Terminal cell rounded, without capitate and calyptra.

Habitat: Planktonic in freshwater ponds at Kumbharwadi (28/07/2012)

Exsic NSK- 555.

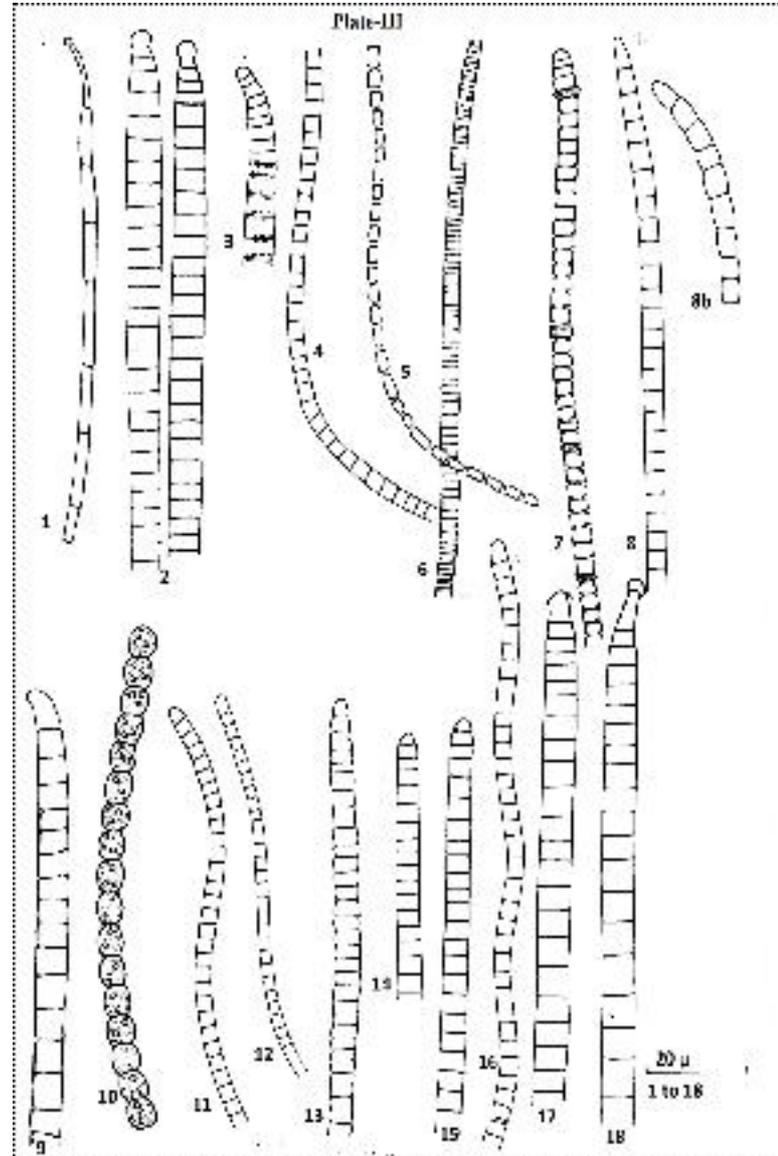


PLATE III:

Fig.1: *Oscillatoria. splendida*, Fig.2 & 3/17 & 18 : *O. amoena*, Fig. 4 & 5: *O. foreaui*, Fig.6: *O. okeni* Fig.7: *O. ornata*, Fig.8a & 8b: *O. schultzei* Fig.9: *O. Formosa*, Fig.10: *O. boryana*, Fig.11 & 12: *O. amphibia*, Fig.13-15: *O.*, Fig.16: *O. terebriformis*

5. *Oscillatoria chalybea* Mertens, 1822: Pl.3, Fig.13-15.

Desikachary- 1959: 218: Pl. -38, Fig. 3.

= *Oscillatoria subsalsa* 1925.

Thallus blue-green, trichome straight, terminal portion is distinctly attenuated, slightly constricted at the cross-walls, cross wall not distinct, apex bent, trichome 6.6 -11.2 µ broad, blue - green. Cells 6.6-9.9 µ broad, 3.6-8µ long, septa not granulated, terminal cell not capitate and calyptra absent.

Habitat: Kumbharwadi (28/07/2012).

Exsic NSK- 557.

6. *Oscillatoria terebriformis* C. Agardh, 1827: Pl. 3, Fig.16.

Desikachary - 1959: 217: Pl. 38, Fig. 16.

Thallus dull blue green. Trichome apically bent a screw-like manner or wavy, not attenuated or slightly attenuated, unconstructed at the cross-walls, septa distinct, granules distributed throughout, cells 3.3-6.5 μ broad, 2.5-6 μ long. End cell rounded.

Habitat: Free floating in fresh water pond, forming a green scum in stagnant waters Kumbharwadi (28-7-2012).

Exsic NSK- 557.

Rare in occurrence. Reported first time from North Maharashtra by Patil N .H. (Thesis, 2000)

7. *Oscillatoria simplicissima* Gomont, 1892: Pl. 1, Fig. 11

Desikachary-1959: 215.

Trichome straight, loosely arrange, dark blue-green to yellowish blue-green, not constricted at the crosswalls, 8-9 μ broad, not attenuated at the apices. Cells 3-4 μ long, septa not granulated, end cell hemispherical, with or without a slightly thickened membrane.

The present specimen is similar to the type described by Desikachary (1959).

Habitat: Darana Dam (04/06/2011), Darana dam Back Water (23/11/2011).

Exsic NSK- 308, NSK- 382.

8. *Oscillatoria agardhii* Gomont, 1892: Pl.1, Fig.9, 10.

Desikachary- 1959: 235.

Trichome straight, not constricted at the ends, gradually tapering, 4.5-6.6 μ broad, free-swimming. Cell 6.6 μ broad, 2.5-3 μ long, granulated at the septa, end cells convex or pointed with calyptra.

The present taxon agrees well with *O. agardhi* Gomont. It also resembles in dimensions to the plant reported by Mahajan (1986) from Maharashtra.

Habitat: Darana Dam Backwater (23/11/2011)

Exsic NSK- 390.

9. *Oscillatoria brevis* Kützing ex Gomont, 1892:

Pl.2, Fig.6

Desikachary- 1959: 241:

Trichome long, straight, slightly attenuated, not constricted at the cross wall, terminal cell dome shape not capitate, covered by thick wall. Apical portion slightly bent. Trichome blue green colour, granulation present either sides of septa. Cells 1/3 times long as broad, 3.3-4.95 μ long, 6.6 μ broad.

Rare in occurrence. Reported first time in Maharashtra by Patil N.H. (Thesis, 2000)

Habitat: Makhmalabad (05/09/2012).

Exsic NSK- 577.

10. *Oscillatoria tenuis* C. Agardh, 1813: Pl.2, Fig.12, 13.

Desikachary-1959: 222: Pl. 42, Fig. 15.

Thallus thin olive-green, trichome straight, fragile slightly constricted at the cross walls, 5.8 μ broad, blue-green, bent or straight at the ends, apices not attenuated, 3.2 μ long, septa granulated. Apical cell hemispherical with thick outer wall.

Habitat: Botanical Garden (HPT College Campus, Nashik) (10/02/2011).

Exsic NSK- 267.

The present species is of common occurrence in different parts of India as revealed by earlier reports. However, it shows variation in dimensions of trichome and cell. The present taxon resembles in all respects with the type described by Desikachary (1959).

11. *Oscillatoria acuta* Brühl & Biswas, 1922: Pl. 2, Fig.3.

Desikachary- 1959:240: Pl. 39, Fig.5, 8.

Trichome arranges parallel and aggregated to bundles. Brittle, not constricted at the cross-walls, 6.6 μ thick, straight, narrow and acuminate at apex, without capitate and calyptra. Trichome apex sharply bent aside, both sides bend in a one direction. Cells 6.6 μ broad 2.4 μ long, bluish green and finely granular.

Habitat: Tributary of Godavari River at Anandwadi (09/02/2011), Darana Dam (04/6/2011).

Exsic NSK- 269, NSK- 330.

The plant resemble the type describe by the Desikachary (1959) but cells are slightly smaller in length.

12. *Oscillatoria obscura* Brühl & Biswas, 1922: Pl.1, Fig.2, 7.

Desikachary- 1959: 207:

Trichome long, straight, 3.3-3.63 μ broad, not attenuated at the apex, rounded, blue-green, un constricted or slightly constricted at the cross-walls. Apical cell straight, folded, without capitate. Cells 2.64-4.95 μ long, 3.3-9.9 μ broad, cross-walls granulated, large granules are present across the cross wall, not distinct.

Habitat: Jadhavwadi (20/01/2011), Darana Dam Back Water (23/11/2011), KTHM boat Club (25/02/2012), Someshwar (08/02/2012), Gangapur Dam (25/03/2011), Gangapur Dam (01/02/2011), Dindori (30/03/2012).

Exsic NSK- 207, NSK- 278, NSK- 262, NSK- 291, NSK- 373, NSK- 377, NSK- 413, NSK- 417.

The specimen is resemble with the trichome, described by Bruhl and Biswas, Rao, C. B., (1938b): and Rao, C. B., (1937b). The type describe by the Desikachary (1959) cells are slightly longer in length and Large granules are present across the cell.

Habitat: Gangapur farm (12/12/2011), Darana dam Back Water (23/11/2011).

Exsic NSK- 373, NSK- 377.

13. *Oscillatoria subbrevis* Schmidle, 1901: Pl.1, Fig. 1, 16. Desikachary- 1959: 207: Pl. - 37, Fig. - 2: Pl. - 40, Fig. 1. Trichome, solitary, not occurring in a mass, free floating, long, straight, terminally slightly bend, apical cell dome shape, rectangular, not covered by calyptra or thick wall. Trichome slightly attenuated, dark blue green colour, non constricted, 4.95-9.9 μ in dia., Cells rectangular, septa clear, 1.15-3.3- μ long, 4.5 -9.9 μ in dia., granules gathered either side of cross wall.
Habitat: Nandur Madhameshwar (29/02/2012), Dindori (30/03/2012), rainwater pools Makhmalabad (05/09/2011), Aashawadi (01/10/2012), on the moist banks of Gangapur Dam (01/02/2011, 22/03/2011, 11/10/2012,), Kashyapi Dam (18/08/2011), Darana Dam (04/06/2011). Makhmalabad (02/07/2012), Aashawadi (01/10/2012), Darana dam Back Water (23/11/2011).
Exsic NSK- 275, NSK- 295, NSK- 305, NSK- 343, NSK- 423, NSK- 434, NSK-458, NSK- 579, NSK- 605, NSK- 617, NSK- 341, NSK- 382,
 Specimen is resemble with the type describe by the Desikachary but it is more close to Singh's specimen the trichome to be 4.9-6.8 μ broad and its cells 1.5-2.5 μ long. (River Ravi 1941).
 The present specimen is smaller in respect of dia. of trichome and larger the length of the cell than the specimen describe by the Dixit (1936). Specimen from Nandur Madhameshwar, Dindori toll naka and Aashawadi shows the granules on the either side of cross wall.
 Rare in occurrence. Reported first time in Maharashtra by Patil N.H. (Thesis, 2000)

14. *Oscillatoria curviceps* C. Agardh, 1824: Pl.2, Fig.7, 8. Desikachary- 1959: 209: Pl. 38, Fig. 2. Thallus expanded green mass, light or dark blue-green, trichome straight, slightly bent at the end at one side, slightly attenuated, not constricted at the cross-walls, 6.6 μ broad. Cells quadrangular, 6.6 μ broad, 3.3- 4.95 μ long, cross-walls granulated. Cyanophycean granules distributed throughout cell. Apical cell flat or rounded, not capitate.
Habitat: Planktonic in Gangapur Dam (01/02/2011, 04/06/2011), Pegalwadi (06/01/2011), Karajan River (15/02/2011), Darana Dam (04/06/2011).
Exsic NSK-4, NSK- 274, NSK-308, NSK- 331.
 Specimen resemble with the type describe by the Desikachary except smaller in dia. It is differ from Parukutty's taxon in respect to cell length. The type has larger length than Parukutty's taxon., (Myxo. Travancore state, Indian Acad. Sci., 11: 120,1940 Trichome 6.6-11. μ broad, cells 1.5-2 μ long. & the type has smaller length than Rao's, C. B taxon, Trichome 14-17.8 μ long.

15. *Oscillatoria princeps* Vaucher, 1803: Pl.1, Fig.5, 8. Desikachary-1959: 210: Pl. -37, Fig. 1,10,13,14. Trichome solitary or loosely entangled to form blue-green, brownish, violet or reddish mass, free floating, forming a thallus, straight not constricted at the cross walls, 30 μ broad, blue-green to dirty green, slightly attenuated at the apex and bent. Cells 30 μ broad, 6.6 μ long. Apical cells flatly capitate with slightly thickened membrane.
 Common, frequent and occurs throughout the year. Reported first time from North Maharashtra, Patil N .H. (Thesis, 2000)
Habitat: Darana dam Back Water (23/11/2011), Kumbharwadi (28/07/2012), Nandur Madhameshwar (29/02/2012), Dindori (30/03/2012), Gangapur Dam (15/10/2010), Ozarkhed Dam (30/03/2012), Rajurgaon Stone Mine (08/02/2012).
Exsic NSK- 6, NSK- 382, NSK- 408, NSK- 479, NSK- 423, NSK- 458, NSK-555.

16. *Oscillatoria subtilissima* Kützing ex De Toni, 1907: Desikachary- 1959: 215: Thallus dull green, trichome yellow-green, very long flexuous, bent, not constricted at the cross walls, 3.3 μ broad, ends gradually attenuated and bent. Cells quadrate, 1.62 μ dia, 1.62 μ length long, obtuse, not capitate and calyptra absent.
 The present species is agrees with the type described by the Desikachary except the dia. (dia. of present species- 3.3 μ , the type specimen- 1-1.5 μ in dia.)
Habitat: Rajurgaon Fata (20/01/2011).
Exsic NSK- 265.

17. *Oscillatoria foreau* Frémy, 1942: Pl.3, Fig. 4-5. Desikachary, 1959: 219: Pl. 40, Fig.18. Trichome straight, elongate, light blue green, distinctly constricted at the cross-walls, 2.64-2.97 μ broad, Apical cell with thick wall, conical, without calyptra. Cells 2.64 μ broad, 3.3-6.6 μ long, cells with thick wall, septa inconspicuous. Each cell with one large refractive granule.
 The present taxon is similar as the type describe by the Desikachary (1959) except it consist one large refractive granule in each cell
Habitat: Gangapur Dam (15/02/2011), Rajurgaon Mine Stone (09/03/2012), Dindori (30/03/2012), Jadhavwadi (20/01/2011). In stagnant water of pond of Aashawadi. In association with the filaments of Ulothrix zonata. Aashawadi (01/10/2012), Sinner (02/10/2012).
Exsic NSK- 608, NSK- 355, NSK- 270, NSK- 444, NSK- 458, NSK- 266.
 Rare in occurrence. Reported first time in Maharashtra by Patil N.H. (Thesis, 2000)

18. *Oscillatoria jasorvensis* Vouk, 1919: Pl.1, Fig.3, 6.

Desikachary- 1959: 221:

Thallus pale to dark blue-green, free floating. Trichome long, straight, without constriction 2.64- 3.3- 4.95 μ broad, bent at the ends, not attenuated, not capitate. Terminal cell rounded or dome shape, apex slightly tapering without calyptra. Cells 1.65-4.95 μ broad, 3.3-4.95 (6.6-8.25-9.9) μ long, cyanophycean granules distributed throughout cell.

Reported first time from North Maharashtra by Patil N.H. (Thesis, 2000)

Habitat: Dindori (30/03/2012), Ozarkhed (30/03/2012), Gangapur Dam (01/02/2011), Tapovan (22/06/2012), Anjeneri (02/07/2012), Kumbharwadi (28/07/2012), Gangapur Farm (12/12/2011), Gangapur Dam (25/3/2011).

Exsic NSK- 274, NSK- 303, NSK- 314, NSK- 373, NSK- 458, NSK- 472, NSK-507, NSK- 551, NSK- 555.

19. *Oscillatoria amphigranulata* van Goor, 1918: Pl.2, Fig.5

Desikachary- 1959: 226: Pl. 37, Fig. 4.

Trichome straight, pale blue-green, distinctly constricted at the cross-walls, 1.32 μ broad, ends not attenuated, not capitate. Cells 1.32 μ in dia., 2.4 μ long, up to twice as long, with two gas-vacuoles at the septa. Apical cell rounded, without calyptra.

Habitat: Plankton form of Gangapur Dam (22/03/2011).

Exsic NSK- 295.

20. *Oscillatoria okeni* Agarth ex. Gomont, 1827: Pl. 3, Fig.6

Desikachary- 1959: 231: Pl. 38, Fig. 17.

Trichome dark blue green, long, straight, with distinct constriction at the cross-walls, slightly attenuated towards the apex, slightly bent at terminal portion, 6.2-6.6 μ broad. Terminal cell conical with rounded end, distinctly attenuated, not capitate, without calyptra, 4.95 μ long. Cells 6.2-6.6 μ broad, 1.65-2.64-3.63 μ long. The specimen agrees the type describe by the Desikachary except the undulating terminal portion and Anjeneri's specimen shows distinct attenuated apex.

Habitat: Nandur Madhameshwar (29/02/2012), Gangapur Dam (22/03/2011), Tapovan (22/06/2012), Aashawadi (01/10/2012), Anjeneri (02/07/2012).

Exsic - NSK- 295, NSK- 437, NSK- 507, NSK- 551, NSK- 553, NSK- 554, NSK-608.

21. *Oscillatoria acutissima* Kufferath, 1914: Pl. 2, Fig.4.

Desikachary- 1959: 237:

Thallus dark blue green, gelatinous leathery mass and free floating. Trichome solitary and scattered or loosely entangled in the other algae. Trichome short, not constricted at cross wall, distinctly attenuated at both ends, both ends curved in opposite directions, 1.65 μ broad. Cells horizontal, 1.65 μ in dia., 0.8 μ long.

Habitat: In a stagnant water of ditch of Gangapur Dam (22/03/2011).

Exsic NSK- 300.

22. *Oscillatoria irrigua* Kützing ex Gomont, 1892: Pl.1, Fig.12-15.

Desikachary- 1959: 224: Pl. 42, Fig.7, 9.

Thallus blackish blue-green, trichome light blue green, straight, not torulose, 6.6 μ dia., slightly attenuated, subcapitate and straight. Cell quadrate, 6.6 μ long 6.6 μ dia. Apical cell with thick wall.

Habitat: Darana dam Back Water (23/11/2011), Nandur Madhameshwar (29/02/2012).

Exsic NSK-382, NSK-437.

23. *Oscillatoria splendida* Greville, 1824: Pl.3, Fig.1

Desikachary- 1959: 234: Pl. 37, Fig.70: Pl. 38, Fig.10: Pl.40, Fig.11.

Thallus light blue-green mass, free floating. Trichome solitary or scattered, straight, not constricted or slightly constricted at the cross-walls. Terminal cell distinctly attenuated for long distance, apex slightly bends, conical and capitate with thick wall, without calyptra, 2.97-3.3 μ broad. Cells 6.6-9.9 μ long, 2.64-3.3 μ broad, septa granulated.

Habitat: In stagnant water Darana Dam Back water (08/02/2012), Planktonic in a temporary ditches under Nasardi Bridge (30/04/2010), Gangapur Dam (11/10/2012).

Exsic NSK-1, NSK- 403, NSK- 611.

The present specimen alike to the type describe by the Desikachary, 1959. Rare in occurrence.

24. *Oscillatoria ornata* Kützing ex Gomont, 1892: Pl.3, Fig.7.

Desikachary-1959: 206: Pl. 37, Fig.12, Pl.40, Fig.3

Thallus dark blue-green, free floating. Trichome straight or wavy distinctly constricted at the cross-walls, 7.5 μ broad, dark blue-green. Cells 1.65 long, 3.3 μ broad, cross-walls granulated. Apical cell dome shape not capitate, without calyptra, with thick wall. Apices slightly attenuated.

Habitat: Plankton in Godavari River at Tapovan (22/06/2012).

Exsic NSK- 516.

25. *Oscillatoria perornata* Skuja, 1949:

Desikachary-1959: 205: Pl. 41, Fig. 8,9,14.

Phytoplankton, trichome straight, single or aggregated in floccose masses dark blue green and flexuous, apices dome shape, briefly attenuated and curved, slightly constricted at the cross-walls, 7.15 μ broad. Cells 3.25 μ long, 6.5 μ broad, contents finely granular, septa granulated. Terminal cell hemispherical without calyptra.

Habitat: Jadhavwadi (20-01-2011), Tapovan (22-06-2012).

Exsic NSK-266, NSK-522

The present taxon is similar to the type, describe by the Desikachary (1959). Rare in occurrence.

26. *Oscillatoria amoena* (Kützing) Gomont, 1892: Pl. 3, Fig. 2, 3, 17, 18.

Desikachary- 1959: 230: Pl- 40, Fig. - 12.

= *Phormidium lucidum* var. *amoenum* (Kützing) Playfair.= *Phormidium amoenum* Kützing 1843.= *Lyngbya amoena* (Kützing) Hansgirg 1892.= *Hypheothrix amoena* (Kützing) Hansgirg ex Dalla Torre & Sarnthein 1901.

Thallus thin layer, submerged, weft like dark blue green mass or scattered among other algae. Trichome long, straight, distinctly attenuated and slightly bend, single, 6.6 μ dia. Terminal cell conical, elongated with thick wall and distinct calyptra, septa clear, granulated. Cells 6.6 μ in dia., 3.3-4.95 μ in length.

Type occur in Nandur Madhameshwar is alike the Desikachary's type except larger in dia.

Habitat: Gangapur Dam (01/10/2012), Darana Dam (15/08/2012).

Exsic NSK- 618, NSK- 563.

27. *Oscillatoria brevis* Kützing ex Gomont, 1892: Pl.2, Fig.6.

Desikachary- 1959: 241:

Trichome long, straight, blue green, slightly attenuated, not constricted at the cross wall. Terminal cell dome shape with thick wall, not capitata. Apically bent. Septa granulated. Cells 3.3-4.95 μ long, 6.6 μ broad.

Habitat: Makhmalabad (05/9/2012).

Exsic NSK- 577.

28. *Oscillatoria schultzei* Lemmermann, 1905: Pl.3, Fig.8.

Desikachary- 1959: 232: Pl. 41, Fig.11.

Thallus dull blue green .Trichome long, distinctly attenuated, straight, arrange parallel to each other, cross wall granulated, dark blue green, unconstructed at septa, 3.3 μ in dia. Terminal cell conical or square with thick wall, slightly bend, without calyptra and granules distributed throughout the cell. Cells barrel shape, 3.3 μ in dia., 3.3-4.95 μ in length.

Habitats: Paddy -field soils of Anjeneri (02/7/2012).

Exsic NSK -553.

29. *Oscillatoria boryana* Bory ex. Gomont, 1892: Pl.3, Fig.10.

Desikachary- 1959: 218: Pl. 38, Fig. 12.

Trichome short, straight, greenish or olive green distinctly constricted at the cross-walls, 6.6 μ broad, lightly granulated at the cross walls. Cells 3.3-6.6 μ long 5.77-6.6 μ dia., Terminal cell rounded, not capitata, calyptra absent.

The trichome of the present species is differ in respect to, not coiled screw like, not bent at the apices, and pointed to the type.

Rare in occurrence.

Habitat: Fresh water Darana Dam (15/08/2012).

Exsic NSK- 565.

30. *Oscillatoria limnetica* Lemmermann, 1900: Pl., Fig.

Desikachary- 1959: 226: Pl. 37, Fig. 3.

=*Oscillatoria splendida* var. *limnetica* (Lemmermann) Playfair, 1914.

Trichome solitary, planktonic or intermingled with other algae, straight, slightly bent, distinctly constricted at the cross walls, pale blue green, 1.5 μ broad, not capitata. Cells 1.65-2 μ broad, 4-12 μ long. Apical cell bluntly rounded, without calyptra.

Rare in occurrence. Reported first time in Maharashtra by Patil N.H. (Thesis, 2000).

Habitat: Near Dental College (22.6.2012).

Exsic NSK-513.

31. *Oscillatoria subuliformis* Twaites ex Gomont 1982:

Pl.2, Fig.11.

Desikachary- 1959: 213: Pl. 49, Fig. 10.

Thallus dull green, free floating. Trichome yellow-green, very long flexuous, both ends bend in one direction or opposite, granulation in the center of cell, dark blue green colour, not constricted at the cross-walls, 5.7 μ broad, at the ends gradually attenuated and bent. Cells horizontal, 2.45 – 3.3 μ long, 5.5-6 μ in dia., obtuse without calyptra and capitata.

Habitats: Kashyapi Dam (18-08-2011).

Exsic NSK -343.

32. *Oscillatoria proteus* Skuja, 1949: Pl.2, Fig.2

Desikachary-1959: 221: Pl. 41, Fig. 15,16,18.

Trichome blue-green, among the other algae, free floating, straight, not attenuated, slightly bent, 8. 25 μ broad, distinctly constricted at the cross walls. Cross wall distinct and granulated. Cells 5.7 μ broad, 8.25 - 9.9 μ long, Apical cell conical or hemispherical.

Habitat: Ghodegaon (18/08/2011).

Exsic NSK- 361, NSK- 341.

33. *Oscillatoria vizagapatensis* Bhashyakarka Rao, 1938:

Pl.1, Fig. 4.

Desikachary- 1959: 205: Pl. 39, Fig. 16, 18.

Thallus blue-green. Trichome straight, slightly bent, attenuated, pale blue-green, uniformly broad, 9.9 μ broad, slightly constrictions at the crosswalls. Cells 8.25 μ broad, 2.4-3.3 μ long, granulated cross wall. End cell rounded, cap with slightly thickened outer wall.

Habitat: Tapovan (22/02/2012).

Exsic NSK- 522.

CONCLUSION

This investigation is mostly focused on lentic and lotic water reservoirs. To explore the algal flora number of samples were collected from the different stations as per aforesaid methods. In present study the *Oscillatoria* occur frequently and abundant in, alkaline water, members of the cyanophyceae are known to occur fairly abundant at high pH valve (John, 1942; Panday, 1965). Seasonal variation during the year play

an important role in the distribution of algal vegetation in natural condition (Panday, 1965).

Few species are rare in occurrence as *Oscillatoria perornata*, *O. ornate*, *O. boryana*, *O. jasorvensis*, *O. limnetica*, *O. brevis*, *O. subbrevis*. This enriches the algal flora of Nashik.

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REFERENCES

- Agarkar DS, Myxophyceae of Gwalior MP, Phykos 1967, 6 (1&2): 1-6
- Anand N, Hand book of Blue green algae, Published by Bishen Singh, Mahendra pal Singh, Dehradun: 1990 :79
- Barhate UP and Tarar JL, Algae on Coal Tar. Phykos: 1982: 21 (1-2): 141.
- Barhate UP and Tarar JL, Thermal algae from Khandesh (Maharashtra) Trop. Plant Sci. Res: 1983a: 1 (2): 195.
- Bendre AM and Deal PK, Algae of Rishikesh and its adjacent foot hills. Ann. Meet. Soc. Adv. Bot.:1974:30. Carter N. Freshwater algae from India. Res. Bot. Surv. India : 1926 :9:263-302
- Desikachary TV, Recent trends in plant taxonomy: Taxonomy of algae. Mem. Indian Bot. Soc.:1958b: 1: 52-62
- Desikachary TV, Cyanophyta. Indian Council of Agricultural Research, New Delhi: 1959:686.
- Deore LT, Studies on fresh water algae of Maharashtra, Univ. of Poona, Ph.D. Thesis: 1979.
- Dixit SC, The Myxophyceae of the Bombay presidency, India – I. The Proceedings of the Indian Academy of Sciences”: 1936: Vol. III No. 3(1): Sec. B: 93-106.
- Smith GM, Manual of Phycology, Scientific publishers, Jodhpur: 1994: 375.
- Kumar S, Cyanophyceae of Meerut. Phykos: 1971:14 (1-2): 1-7.
- Kamat ND, Oscillatoriaceae of Mysore State. Reprinted from Phykos: 1972: Vol. 11 (1 & 2), Pages 59 – 63.
- Kamat ND, The Oscillatoriaceae of Ahmedabad, Gujarat, India. Reprinted from the Journal of the University of Bombay: 1963: vol. XXXI, Parts 3 & 5.
- Kumawat DA and Jawale AK, The Genus *Oscillatoria* Vaucher (Cyanobacteria) from fish Ponds of Jalgaon District, Maharashtra (India). Indian bot. Soc.: 2006:Vd.85 (2006) 97-102.
- Kaul S and Mir AM: An addition to the algal flora of Kashmir. Cyanophyta: 1984: (1-2).
- Prescott GW, Algae of the Western Great lakes Area: Wm. C. Brown Company Publisher: Michigan State, America: 1951: 1000
- Pandhol RK and Grover IS, Algal flora of Ludhiana and its adjacent area. Phykos: 1976: 15 (1-2): 81-87.
- Pandey SN, Studies on Planktonic algae of Kanpur. Lab. Dev. J. Sci. Tech.: 1969: B.7 (2): 163-167
- Srinivasan MV, Some Myxophyceae from the Mysore state. Phykos: 1963: 3:45
- Mahajan AD and Mahajan Neelima, Freshwater Blue-Green algae from Kalimpong, West Bengal. Ad. Plant. Sci.: 1990:3(2): 278 – 280.
- Mahajan AD, Some *Oscillatoria* Vaucher and *Phormidium* Kuetz. From banana fields of Jalgaon, Dist. Maharashtra. India. Bot. Repr.: 1968:5(1):24-26.
- Mahajan AD and Mahajan Neelima, Habitats effects on the Occurrence and Distribution of Blue Green Algae in Jalgaon district. M.S. Recent Researches in ecology, Environment and Pollution: 1990. Vol.5: 151 – 159.
- Mahajan AD and Patel RJ, *Oscillatoria* voucher (Cyanophyceae) from Paddy fields of Kaira district, Gujarat, India. Indian bot. Repr.: 1989: 8(1): 5 to 11.
- Rao CB, The Myxophyceae of United Provinces, India-III. The Proc. Indian Acad. Sci: 1937b: 6(6): Sec.B:339-375.
- Rao CB, The Myxophyceae of the Orissa Province, India – I. Reprinted from “The Proceeding of the Indian Academy of Sciences.” 1938b: Vol. VIII, No. 3, Sec. B: 157 – 170.
- Sinha JP and Mukherjee D, On Blue green algae from the paddy fields of Bankura district of West Bengal-I. Phykos: 1975: 14 (1&2): 117 – 120.
- Vaidya BS, A Preliminary survey of Cyanophyceae of Mount Abu in Ahmadabad, Gujarat. Phykos: 1968: Vd.7 (1& 2), Pages: 195-197.
- Pandey DC, A study of algae from Paddy fields soils of Ballia and Gazipur district of Uttar Pradesh, India. Nov. Hedw: 1965:9:299-334
- John RP, An ecological and taxonomical study of British soil I. The distribution of surface growing algae. Ann. Bot. N.S: 1965, 2:232-349.

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