

BRACKISH WATER OSCILLATORIACEAE FROM NORTH 24-PARGANAS, WEST BENGAL, INDIA

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Abstract

The present communication enumerates 40 taxa of Oscillatoriaceae from the brackish water wetlands of North 24-Parganas district of West Bengal. Out of the reported taxa, 12 are from each of *Lyngbya* and *Oscillatoria*, 6 from each of *Phormidium* and *Spirulina*, 2 belong to *Schizothrix*, and *Hydrocoleum* and *Katagnymene* are represented by one species each. A close relationship was observed between seasonal water temperature and salinity levels of the wetlands in enhancing algal population.

Introduction

Blue-green algae (BGA) are the primitive photosynthetic microorganisms which have tremendous potential in environmental management, as soil conditioners, bio-fertilizer, bio-monitors of soil fertility, water quality, amelioratory agents, feed for animals and protein supplements and rehabilitation of degraded ecosystems through biosorption of metals (Whitton and Potts 2000). The family Oscillatoriaceae includes non-heterocystous filamentous forms of BGA.

Tropical climate of West Bengal, India provides favourable environment for the luxuriant growth of BGA in different types of soil, freshwater bodies, brackish waters and estuarine habitats (Gupta 1965, 1975, Sen and Gupta 1987, 1998, Santra *et al.* 1988, 1991, Sen and Naskar 2002, 2003, Naskar *et al.* 2006, 2007).

Taxonomic work on BGA from brackish water wetlands of West Bengal has long been ignored. The present communication is an outcome of the taxonomic investigation of algal flora from brackish water wetlands of North 24-Parganas district of West Bengal. This study has been made with a view to understand the distribution of different members of Oscillatoriaceae in brackish water environment, which is an initiative study for exploiting their innate potentials.

Materials and Methods

The present study was conducted during 2002 to 2005 in brackish water wetlands of North 24-Parganas district of West Bengal. The district is situated in the southern zone of the state West Bengal, India and lies between 22°11'6'' N and 23°1'2'' N latitude and

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between 88°20' E and 89°5' E longitude. Out of 22 blocks of the district, 12 blocks include brackish water wetlands. The administrative units chosen for the present study were blocks, *viz.* Hingalganj, Sandeshkhali-I and II, Haroa, Hasnabad, Minakhan, Basirhat-I and II, Baduria, Barasat-II, Rajarhat and Deganga. These 12 administrative units have been divided into four zones based on the adjoining blocks. Zone I includes the blocks Hingalganj, Sandeshkhali-I and II; Zone II with Horoa, Hasnabad and Minakhan; Zone III with Basirhat-I and II and Baduria; and Zone IV with Barasat-II, Rajarhat and Deganga.

Algal collections were made during summer (March-May), monsoon (June-August), post-monsoon (September-November) and winter (December-February) seasons. All the collections were preserved in 4% formalin and deposited at the Central Inland Fisheries Research Institute (ICAR), Salt Lake, Kolkata. The materials were then examined microscopically and measurements were taken. Identification was mostly based on the identification keys given by Desikachary (1959) and some other workers (Santra *et al.* 1988, Sen and Naskar 2003, Sen 2005).

Results and Discussion

The study revealed 40 taxa belonging to seven genera of Oscillatoriaceae which are briefly described here alphabetically along with their spatial and temporal occurrence and abundance.

1. **Hydrocoleum lyngbyaceum** Kütz. ex Gomont, Trichomes 7.5-8.3 µm broad. On wet soil in brackish water wetland at Hasnabad, Voucher no. 8, 28.05.2002; few.
2. **Katagnymene pelagica** Lemm., Trichomes 13.5 µm broad, cells 1.7-2.5 µm long. Free-floating with green algae in brackish water at Hingalganj, Voucher no. 83, 14.09.2002; rare.
3. **Lyngbya aestuarii** Liebm. ex Gomont, Filaments 18-20 µm broad, trichome 10-12 µm broad. Planktonic in brackish water wetland at Baduria, Voucher no. 206, 23.01.2004; rare.
4. **Lyngbya birgei** Smith G.M., Filaments 20-22 µm broad, cells 2.0-2.5 µm long. Free-floating in brackish water wetlands at Sandeshkhali-II, Baduria, Basirhat-II and Deganga, Voucher nos 86 (04.01.2004), 104 (17.04.2004), 84 (15.06.2005) and 72 (01.05.2002); common.
5. **Lyngbya confervoides** C. Ag. ex Gomont, Trichomes 8.0-9.3 µm broad. Free-floating in brackish water at Basirhat-II, Voucher no. 40, 28.04.2002; few.
6. **Lyngbya connectans** Bruhl et Biswas, Trichomes 12-16 µm broad, cells 2.0-2.6 µm long. Free-floating with other BGA in brackish water wetland at Deganga, Voucher no. 39, 01.05.2002; rare.

7. **Lyngbya gracilis** (Menegh.) Rabenh. [Syn.: *Leibleinia gracilis* Meneghini], Trichomes 5.0-6.3 μm broad, cells 1-1/2 times as long as broad, 2.5-4.0 μm long. Free-floating form in brackish water wetland at Haroa, Voucher no. 98, 09.07.2004; very rare.
8. **Lyngbya heironymusii** Lemm., Filaments 12-15 μm broad, cells 11-13 μm broad, 2.4-3.0 μm long. Free-floating in brackish water wetland at Baduria, Voucher no. 6, 04.04.2002; rare.
9. **Lyngbya major** Menegh ex Gomont, Filaments 22-24 μm broad, cells 13-15 μm broad, 1/8 to 1/4 as long as broad, 2.0-2.8 μm long. Free-floating in brackish water at Baduria, Voucher no. 96, 09.07.2004; rare.
10. **Lyngbya majuscula** Harvy ex Gomont, Filaments 18-20 μm broad, cells short, 2-3 μm long. Associated with green alga *Lola* sp. in brackish water at Hingalganj, Voucher no. 66, 28.05.2002; rare.
11. **Lyngbya martensiana** Menegh ex Gomont, Trichomes 8-12 μm broad, cells 1/4 to 1/2 times as long as broad, 1-3 μm in length. Free-floating and grown in stagnant brackish water at Sandeshkhali-II, Baduria and Basirhat-II, Voucher nos 86 (03.07.2004), 63 (09.07.2004) and 28 (13.07.2004); common.
12. **Lyngbya semiplena** (C. Ag.) J. Ag. ex Gomont, Filaments up to 26 μm broad, cells 9-11 μm broad, 2-3 μm long. Free-floating with green algae in brackish water at Hingalganj, Voucher no. 55, 28.05.2002; rare.
13. **Lyngbya sordida** Gomont, Trichomes 16-24 μm broad, cells 4-6 μm long. Free-floating at the edge of a brackish water fishery at Deganga and Sandeshkhali-II, Voucher nos 38 (01.05.2002) and 34 (21.05.2002); few.
14. **Lyngbya truncicola** Ghose, Filaments 13-15 μm broad, cells 3-4 μm long. On wet soil in brackish water wetlands at Baduria and Deganga, Voucher nos 48 (04.04.2002) and 47 (01.05.2002); few.
15. **Oscillatoria chalybea** Mertens [Syn.: *Oscillatoria subsalsa* C. Agardh], Trichomes 25-33 μm broad, 10-12 μm long. Free-floating with other BGA in brackish water at Basirhat-II, Voucher no. 85, 29.03.2002; few.
16. **Oscillatoria corallinae** (Kütz.) Gomont [Syn.: *Leibleinia corallinae* Kütz.], Trichomes 5.6-6.3 μm broad, cells 2.3-3.0 μm long. Found with green algae *Lola* sp. and *Chaetomorpha* sp. in brackish water at Hingalganj, Voucher no. 9, 28.05.2002; rare.
17. **Oscillatoria curviceps** Ag. ex Gomont, Trichomes 13-20 μm broad, cells 1/6 to 1/3 as long as broad, 3-6 μm long. Planktonic form in brackish water at Deganga and Basirhat-II, Voucher nos 17 (01.05.2002) and 29 (29.03.2002); common.

18. **Oscillatoria decolorata** West, G.S., Trichomes 12.0-12.5 μm broad. Associated with other algae in brackish water at Baduria, Voucher No. 149, 05.06.2003; rare.
19. **Oscillatoria irrigua** (Kütz.) Gomont [Syn.: *Oscillaria irrigua* Kütz.], Trichomes 9.0-10.3 μm broad, cells 4.0-7.5 μm long. Planktonic form with *Enteromorpha* sp. In brackish water at Minakhan, Voucher no. 298, 15.05.2005; rare.
20. **Oscillatoria laete-virens** var. **minimus** Biswas, Trichomes 2.8-3.0 μm broad, cells 1.5-2.0 μm long. Planktonic in brackish water at Deganga, Voucher no. 277, 04.06.2005; few.
21. **Oscillatoria limosa** Ag. ex Gomont, Trichomes 12-17 μm broad, cells 2.5-4.0 μm long. Found in association with *Chaetomorpha* sp. in brackish water at Haroa, Voucher no. 101, 10.04.2002; few.
22. **Oscillatoria nigroviridis** Thwaites ex Gomont, Trichome 6.0-7.5 μm broad, cells 1.5-2.3 μm long. Free-floating and on muddy substratum in brackish water wetlands at Basirhat-I and Deganga, Voucher nos 277 (07.06.2005) and 49 (04.06.2005); rare.
23. **Oscillatoria princeps** Vaucher ex Gomont, Trichomes 43-48 μm broad, cells 4-8 μm long. Free-floating with other green algae in brackish water at Basirhat-II, Voucher no. 85, 29.03.2002; few.
24. **Oscillatoria proboscidea** Gomont, Trichomes 26-39 μm broad, cells 1/6 to 1/3 as long as broad, 7-8 μm long. On muddy substratum in brackish water wetland at Basirhat-II, Voucher no. 106, 29.03.2002; rare.
25. **Oscillatoria subbrevis** Schmidle, Trichomes 6-7 μm broad, cells 1.0-1.5 μm long. Planktonic and benthic form in brackish water wetlands at Baduria, Basirhat-II and Minakhan, Voucher nos 206 (29.03.2002), 72 (20.03.2002) and 78 (25.03.2002); few.
26. **Oscillatoria tenuis** Ag. ex Gomont, Trichomes 4.6-7.0 μm broad, cells 1.5-2.3 μm long. On wet soil in brackish water wetland at Basirhat-I, Voucher no. 12, 13.04.2002; rare.
27. **Phormidium ambiguum** Gomont, Trichomes 4.0-5.3 μm broad, cells 1.5-2.3 μm long. On the wet soil and floating in brackish water wetland at Hasnabad, Voucher no. 61, 28.05.2002; common.
28. **Phormidium anomala** Rao, C.B., Trichomes 8-10 μm broad, cells much broader than long, 1.3-2.0 μm long. Free-floating form in brackish water at Minakhan and Baduria, Voucher nos 32 (09.07.2004) and 96 (15.05.2005); few.
29. **Phormidium corium** var. **capitatum** Gardner, Filaments 7 μm broad, trichomes 4.2-5.8 μm broad, cells 1.4-2.0 μm long. Attached to a bamboo stick in brackish water at Haroa, Voucher no. 99, 25.05.2004; rare.

30. **Phormidium fragile** (Meneghini) Gomont, Trichomes 1.2 -2.4 μm broad. On muddy region in brackish water wetland at Basirhat-I, Voucher no. 10, 14.04.2002; few.
31. **Phormidium microtomum** Skuja, Filaments 8.5-10.3 μm broad, trichomes 7-8 μm broad, cells 0.7-1.5 μm long. On muddy substratum in brackish water wetland at Basirhat-II, Voucher no. 81, 05.04.2002; rare.
32. **Phormidium stagnina** Rao, C.B., Filaments interwoven, 12-16 μm broad, cells 1.6-2.0 μm long. In stagnant water of brackish water wetlands at Baduria and Basirhat-II, Voucher nos 105 (09.07.2004) and 103 (11.07.2004); rare.
33. **Schizothrix fuscescens** Kütz. ex Gomont, Trichomes 2.5-3.3 μm broad, cells 7.5-11.3 μm long. At the bottom of stagnant water of a brackish water fishery at Haroa and Deganga, Voucher nos 10 (10.04.2002) and 18 (17.04.2002); few.
34. **Schizothrix telephoroides** (Mont.) Gomont, Cells 3-4 μm board, 7-8 μm long. On wet soil and planktonic in brackish water wetland at Basirhat-II and Haroa, Voucher nos 68 (10.04.2002) and 11 (13.04.2002); few.
35. **Spirulina gigantea** Schmidle, Trichomes 3.2-3.8 μm broad, spirals 11.3-17.0 μm broad. Free-floating in brackish water at Rajarhat, Voucher no. 19, 26.04.2002; common.
36. **Spirulina labyrinthiformis** (L.) Gomont [Syn.: *Oscillatoria labyrinthiformis* (L.) C. Agardh], Trichome 1.2-1.6 μm broad, spirals 2.0-2.5 μm broad. Planktonic in brackish water at Deganga, Voucher no. 221, 01.05.2002; rare.
37. **Spirulina major** Kütz. ex Gomont, Trichomes 1.2-1.5 μm broad, spirals 3-4 μm broad, 3.8-4.0 μm distant. Free-floating in brackish water at Rajarhat and Deganga, Voucher nos 38 (26.04.2002) and 52 (01.05.2002); common.
38. **Spirulina meneghiniana** Zanard ex Gomont, Trichomes 1.2-1.5 μm , spirals 3.0-3.5 μm broad and 4-6 μm distant from each other. Planktonic in brackish water at Haroa and Basirhat-II, Voucher nos 151 (10.04.2002) and 74 (06.04.2002); few.
39. **Spirulina princeps** W. et G.S. West, Trichomes 4.5-5.3 μm broad, spirals 10.0-11.5 μm broad and 9.1-11.0 μm distant. Among with *Enteromorpha* sp. in brackish water at Barasat-II, Voucher no. 27, 15.04.2002; common.
40. **Spirulina subtilissima** Kütz. ex Gomont, Trichomes 0.7-0.8 μm broad, spirals 1.2-1.8 μm broad, distance between spirals 1.8-2.0 μm . Associated with BGA and green algae in brackish water at Barasat-II and Haroa, Voucher nos 20 (05.04.2002) and 22 (12.04.2002); few.

The study site has got a unique algal assemblage in terms of algal diversity. Most of the algal taxa showed planktonic habitat (25 taxa) followed by epiphytes (7 taxa) and benthos (8 taxa). The studied brackish water wetlands showed highest number of BGA

species in summer (35 taxa) and the lowest in monsoon (9 taxa) and winter (3 taxa). The post-monsoon period showed absence of these algae. The taxa which appeared during winter were (*viz.* *Lyngbya birgei*, *L. aestuarii* and *Spirulina major*) also found in summer, but not in monsoon.

Table 1. Range of temperature and salinity of different zones of North 24-Parganas district, West Bengal. (Naskar *et al.* 2007)

Zone	Water temperature (°C)	Salinity (g l ⁻¹)
I	20.0-33.9	7.9-22.3
II	19.3-32.5	7.8-17.3
III	16.3-30.5	7.2-12.0
IV	18.2-33.9	3.4-8.4

The brackish water wetlands are fed with tidal waters of Hooghly-Matla estuarine system and its tributaries. The salinity distribution of the studied wetlands does not indicate specific salinity zones. The temperature range and salinity spectrum of all four studied zones (Zone I to Zone IV) are shown in Table 1. The salinity values of brackish water wetlands were maximum during summer and went down during monsoon showing minimum values. But salinity values were higher during post-monsoon and winter periods than monsoon. The Table 2 summarizes the zone-wise distribution of recorded Oscillatoriaceae species.

Table 2. Presence (+) and absence (-) of species of Oscillatoriaceae in different zones of North 24 Parganas district, West Bengal.

Species	Zone-I	Zone-II	Zone-III	Zone-IV
1. <i>Hydrocoleum lyngbyaceum</i>	-	+	-	-
2. <i>Katagnymene pelagica</i>	+	-	-	-
3. <i>Lyngbya aestuarii</i>	-	-	+	-
4. <i>Lyngbya birgei</i>	+	-	+	+
5. <i>Lyngbya confervoides</i>	-	-	+	-
6. <i>Lyngbya connectans</i>	-	-	-	+
7. <i>Lyngbya gracilis</i>	-	+	-	-
8. <i>Lyngbya heironymusii</i>	-	-	+	-
9. <i>Lyngbya major</i>	-	-	+	-
10. <i>Lyngbya majuscula</i>	+	-	+	-
11. <i>Lyngbya martensiana</i>	+	-	+	-
12. <i>Lyngbya semiplena</i>	+	-	-	-
13. <i>Lyngbya sordida</i>	+	-	-	+
14. <i>Lyngbya truncicola</i>	-	-	+	+
15. <i>Oscillatoria chalybea</i>	-	-	+	-

(Contd.)

Table 2 contd.

Species	Zone-I	Zone-II	Zone-III	Zone-IV
16. <i>Oscillatoria corallinae</i>	+	-	-	-
17. <i>Oscillatoria curviceps</i>	-	-	+	+
18. <i>Oscillatoria decolorata</i>	-	-	+	-
19. <i>Oscillatoria irrigua</i>	-	+	-	-
20. <i>Oscillatoria laete-virens</i> var. <i>minimus</i>	-	-	-	+
21. <i>Oscillatoria limosa</i>	-	-	+	-
22. <i>Oscillatoria nigroviridis</i>	-	-	+	+
23. <i>Oscillatoria princeps</i>	-	-	+	-
24. <i>Oscillatoria proboscidea</i>	-	-	+	-
25. <i>Oscillatoria subbrevis</i>	-	+	+	-
26. <i>Oscillatoria tenuis</i>	-	-	+	-
27. <i>Phormidium ambiguum</i>	-	+	-	-
28. <i>Phormidium anomala</i>	-	-	+	+
29. <i>Phormidium corium</i> var. <i>capitatum</i>	-	+	-	-
30. <i>Phormidium fragile</i>	-	-	+	-
31. <i>Phormidium microtomum</i>	-	-	+	-
32. <i>Phormidium stagnina</i>	-	-	+	-
33. <i>Schizothrix fuscecens</i>	-	+	-	+
34. <i>Schizothrix telephoroides</i>	-	+	+	-
35. <i>Spirulina gigantea</i>	-	-	-	+
36. <i>Spirulina labyrinthiformis</i>	-	-	-	+
37. <i>Spirulina major</i>	-	-	-	+
38. <i>Spirulina meneghiniana</i>	-	+	+	-
39. <i>Spirulina princeps</i>	-	-	-	+
40. <i>Spirulina subtilissima</i>	-	+	-	+

Algae is one of the most important primary producer groups in aquatic ecosystems, and the productivity of these ecosystems depends very much on them (Kamath *et al.* 2006). Species diversity does influence the rates or nature of ecosystem processes (Giller and O'Donovan 2002). In brackish water wetlands, the high algal diversity is favorable for aquaculture and ecosystems with high diversity are more stable because fluctuation in abundance of individual species has less influence on the function of the entire ecosystem (Boyd 1973). The role of temperature and light in regulating algal growth is well known. Water temperature in the present study area does not appear to be a significant factor in determining the algal population as a whole, as it was always within the bio-kinetic range and never fall below 12°C (Knopp 1960). But it definitely played a significant role in regulating the seasonal spectrum of algae. So, the present study showed BGA under Oscillatoriaceae can thrive well in low to high salinity conditions and also survive in low to high temperature conditions.

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