



BIODIVERSITY OF CYANOBACTERIA AND ITS DISTRIBUTION PATTERN IN RIVER GANGA AT PARMAT GHAT, KANPUR

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The study on the occurrence and periodicity of algal samples reveal that distribution of algae found in Ganga water at Parmat Ghat mainly belongs to class cyanophyceae. The results showed an interesting relationship among the species of algae growing in the Ganga river water. Out of total 57 algae recorded, 25 species belongs to cyanobacteria viz:- *Microcystis aeruginosa*, *Microcystis flos-aquae*, *Aphanocapsa montana*, *Aphanothece microscopica*, *Synechocystis pevalekii*, *Coelosphaerium kuetzingianum*, *Arthrospira platensis*, *Spirulina gigantea*, *Spirulina lebyrinthiformis*, *Oscillatoria subuliformis*, *Oscillatoria tenuis*, *Oscillatoria irrigua*, *Oscillatoria acuta*, *Phormidium jenkelianum*, *Phormidium tenue*, *Phormidium ambiguum*, *Lyngbya contorta*, *Nostoc calcicola*, *Nostoc commune*, *Nostoc punctiforme*, *Anabaena planctonica*, *Anabaena sphaerica*, *Anabaena affinis*, *Nodularia spumigena*, and *Gloeotrichia pisum*, were recorded.

Kanpur is situated at 26.58N latitude and 80.34E longitude at an elevation of 110 meters from level on the bank of river Ganga. The river receives domestic and industrial waste and the water shows high degree of pollution. Desikachary¹, Singh², Zafar³, Phawa and Mehrotra⁴, Munawar⁵, Prasad and saxena⁶, Senger and Sharma⁷, Pandey and Habib⁸, Singh and Das⁹ and Dubey and Mohan¹⁰ were among the earliest to associate algal communities with varying degree of pollution.

Parmat Ghat: Parmat Ghat is situated 3 km away from Companybagh chauraha (C.S.A. University) and 1.5 km downstream from Ganga barrage. The main sources of water pollution are sewage, burnt and unburnt bodies of human being, ashes, human/animal excreta and religious material discharge. Water pollution due to sewage is in large extent due to existence of Sisamau Nala just before Parmat. Water pollution due to cremation of human body also present in large extent due to existence of Bhairo ghat Shavdahgrah 500 meter upstream from Parmat. Water pollution due to religious material discharge is also present in Parmat Ghat due to famous Anandeshwar Shiv temple. (Fig. 1)

MATERIALS AND METHODS

Regular monthly samplings of algae were conducted during January 2010 to December 2010. Spots were selected for collecting samples. Sampling was done from four sites in river. Samples of algae from each spots were made once a month. The samples were collected in standard manner in bottle of about 125cc capacity which was filled with water

obtained by towing a silk net for equal distance along four sides of the spots on surface and at a depth of 6-8 inch. From the preserved sample algal materials were mounted on slides and examined in detail for their systematic position and periodicity. Microphotograph of each specimen was taken using Sony digital camera, and edited in Adobe Photoshop. Identification of cyanophyceae members were carried out with the help of Prescott¹¹, Desikachary¹ and Geitler¹².

RESULTS AND DISCUSSION

The occurrence and periodicity of algal samples studied are given in Table 1 and Photographs are given in Plates 1 and 2.

SYSTEMATIC ENUMERATION

MYXOPHYCEAE:

Chroococcales

Chroococcaceae

Microcystis aeruginosa (Kutz.)

Planktonic, young colonies round, old colonies clathrate; cells spherical.

Dimensions: Cells 2.8-4.5 micron in diameter.

Distribution: Free-floating in Ganga water. Plate 1-1.

Microcystis flos-aquae (Wittr.) Kirchner.

Colonies roughly spherical or somewhat elongate not clathrate; cells spherical, with gas-vacuoles.

Dimensions: Cells 3.08-3.2 micron in diameter.

Distribution: Planktonic in Ganga water. Plates 1-2.



Fig. Parmat Ghat

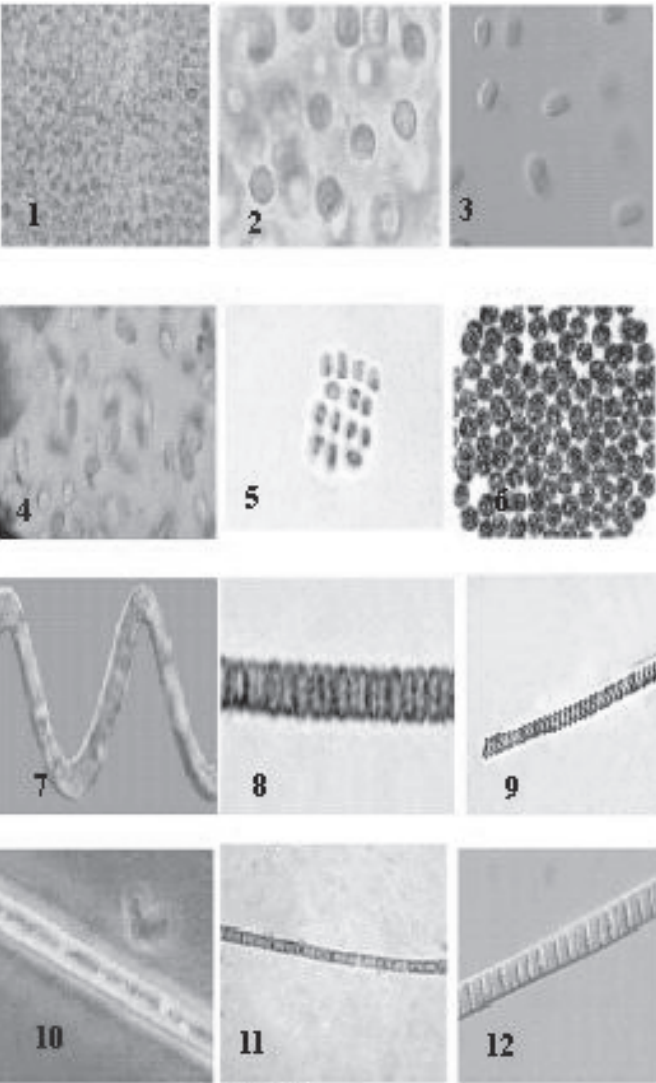


PLATE 1.

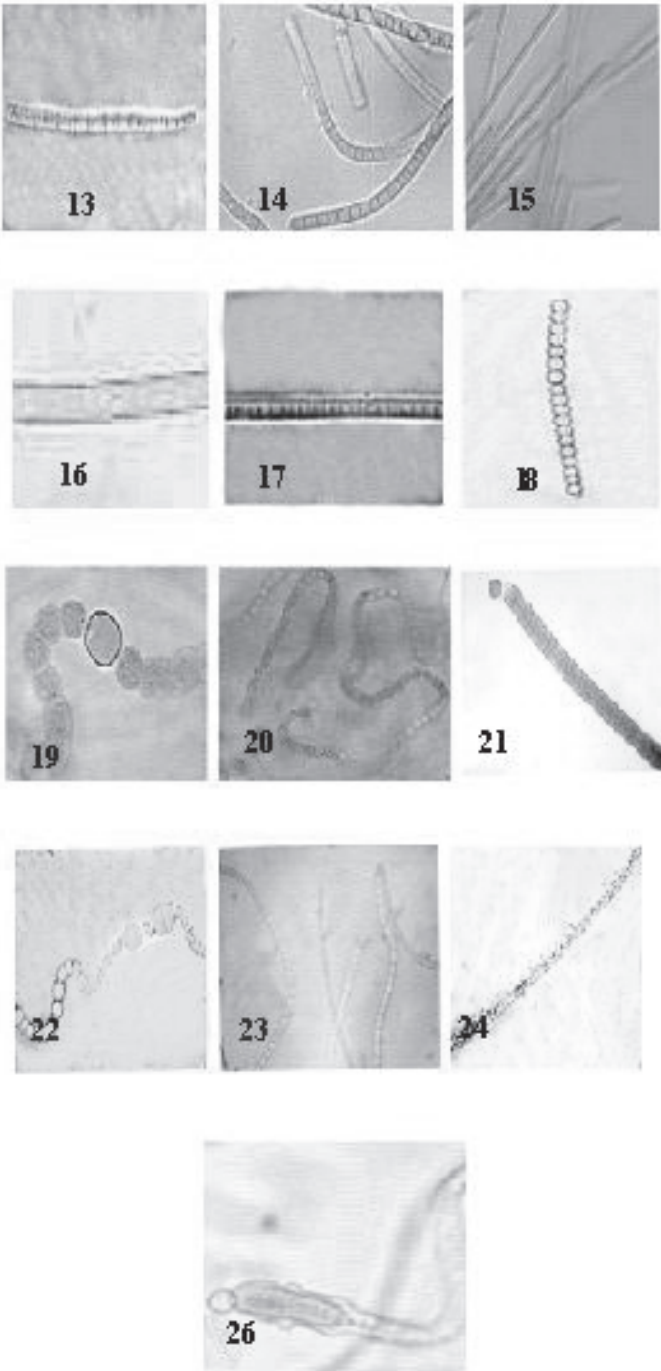


PLATE 2.

Aphanocapsa montana Cramer.

Thallus of no definite shape, gelatinous, yellow-green, or blue-green, cells spherical; mucilage colourless diffluent.

Dimensions: Cells 2.8-3.2 micron in diameter.

Distribution: On submerged objects in Ganga water. Plate 1-3.

Genus *Aphanothece* (Nag.)

Aphanothece microscopica (Nag.)

Thallus small, gelatinous; cells oblong cylindrical.

Dimensions: Cells 4.2-4.48 micron broad; 7.8-8.4 micron long.

Distribution: On submerged soil on the banks of river Ganga. Plates 1-4.

Genus *Synechocystis sauvageau*

Synechocystis pevalekii (Ercegovic.)

Cells spherical after division hemispherical single or two together, contents blue-green homogeneous.

Dimensions: Cells 2.6-2.9 micron in diameter.

Distribution: Mix with other algae in muddy places on the bank of river Ganga. Plates 1-5.

Genus *Coelosphaerium* (Nag.)

Coelosphaerium kuetzingianum (Nag.)

Colony more or less spherical with a thin colonial mucilage envelope; cells spherical or sub-spherical, cells loosely arranged.

Dimensions: Colony 45-50.1 micron in diameter; Cells 2.3-2.8 micron in diameter.

Distribution: Mix with other algae in muddy places on the bank of river Ganga. Plates 1-6.

Nostocales
Oscillatoriaceae

Arthrospira platensis (Nordst.)

Trichome slightly constricted.

Dimensions: Cells 4-5 micron broad, 2-3 micron long; spirals 20-22 micron broad, 46-59 micron distant.

Distribution: In ditches of stagnant Ganga water.

Plates 1-7.

Spirulina gigantea (Schmidle.)

Trichome deep blue-green, regularly spirally coiled, at the end conical attenuated.

Dimensions: Trichome 3.8-4.0 micron broad; spirals 11-12.2 micron broad.

Distribution: Free-floating in Ganga water.

Plates 1-8.

Spirulina labyrinthiformis (Menegh)

Trichome dirty, dark-green, very regularly coiled; spirals close to each other.

Dimensions: Trichome 1 micron broad; spirals 2.2-2.8 micron broad.

Distribution: In ditches of stagnant Ganga water.

Plates 1-9.

Genus *Oscillatoria* Vaucher

Oscillatoria subuliformis (Kutz. ex Gomont.)

Trichomes pale-green, very long flexuous and bent not constricted at the joints; ends gradually attenuated and bent; end cell obtuse, not capitate.

Dimensions: Trichome 5.0-6.0 micron broad, cell 4.8-5.0 micron long.

Distribution: Planktonic in river Ganga. Plates 1-10.

Oscillatoria tenuis (Ag. ex Gomont.)

Thallus thin, slimy, blue-green, trichome straight, slightly constricted at the joints, sometimes bent at the ends, not attenuated at the apices, not capitate; end cell more or less hemispherical with thickened outer membrane.

Dimensions: Trichome 4-5.8 micron broad; cells 2.2-3.0 micron long.

Distribution: On muddy banks of river Ganga. Plate 1-11.

Oscillatoria irrigua (Kutz) Gomont.

Thallus blackish blue-green, trichome light bluish purple, when dried hyaline or pale blue, straight, flexuous, not torulose.

Dimensions: 6-11 micron broad; 4-11 micron long.

Distribution: On moist soil at bank of Ganga. Plate 1-12.

Oscillatoria acuta Bruhl et Biswas, orth. mut. Geitler, op. cit., 978, 1932; Desikachary, op. cit., 240, Pl. 39, Figs. 5, 8, 1959.

Trichome usually quite straight, narrow or acuminate towards the subobtuse, non-capitate, non-calyprate apex, which may be straight but is more often rather bent aside.

Dimensions: Trichome 4.0-5.2 micron broad; cells 2.6-2.8 micron long.

Distribution : On muddy banks of river Ganga. Plate 2-13.

Genus *Phormidium* (Kutz.)

Phormidium jenkelianum schmid G.

Thallus brownish black, slimy; trichome brownish blue-green, flexuous 2-2.6 micron broad, not attenuated at the ends.

Dimensions: Cells 2-2.5 micron broad, 1.2 micron long.

Distribution: On the bank of river Ganga. Plate 2-14.

Phormidium tenue (Menegh.) Gomont.

Thallus pale blue-green, thin, membranous expanded; trichome straight or slightly bent, densely entangled, slightly constricted

at the cross-walls, attenuated at the ends; cross-walls not commonly visible; end cell acute conical, calyptra absent.

Dimensions: Trichomes 1.8-2.0 micron broad, 2.5-3.5 micron long.

Distribution: On moist surfaces on banks of river Ganga. Plates 2-15.

Phormidium ambiguum (Gomont.)

Algae bright blue-green; trichomes slightly constricted at the cross-walls, at the ends not attenuated, not capitate; end cell rounded, calyptra absent.

Dimensions: Trichomes 4.2-5.8 micron broad, 1.5-2.8 micron long.

Distribution: On submerged objects of River Ganga. Plates 2-16.

Lyngbya contorta (Lemm.)

Filaments single, regularly spirally coiled, with a delicate, nearly circular coils; end cell rounded, not attenuated.

Dimensions: Trichomes 1-1.44 micron broad; cells 2.86-3.00 micron long.

Distribution: In stagnant Ganga water. Plates 2-17.

Nostocales

Nostocaceae

Genus *Nostoc* Vaucher

Nostoc calcicola, *Brebisson ex.* (Born.)

Thallus mucilaginous, slightly diffuent, blue-green; filaments loosely entangled; sheath mostly indistinct, colourless; trichome pale blue-green; cells barrel-shaped, subspherical; heterocysts subspherical; akinete subspherical.

Dimensions: Trichome 2.48-2.52 micron broad; heterocysts 4-4.8 micron broad; akinete also 4-4.8 micron in diameter.

Distribution: Free- floating in river Ganga. Plates 2-18.

Nostoc commune (Vaucher.)

Trichome closely entangled and intertwined; cells subglobose or barrel-shaped, constricted at the cross walls; heterocysts spherical; akinete have the same shape and about same size as the vegetative cells.

Dimensions: Vegetative cell 4.8-5.1 micron broad; heterocyst 7.0 micron broad.

Distribution: On submerged aquatic plants in river Ganga. Plates 2-19.

Nostoc punctiforme (Kutz) Hariot.

Thallus sub-globose, scattered; filaments flexuous, densely entangled; sheath delicate hyaline, mucous; cells short barrel-shaped or ellipsoidal, blue-green; akinete subspherical or oblong.

Dimensions: Trichome 2.8-3.4 micron broad; heterocysts 4-5.2 micron broad; akinete 5.4-5.8 micron broad.

Distribution: In Ganga water. Plates 2-20.

Anabaena planctonica (Brunnthal.)

Filaments free-floating, solitary, straight or slightly bent; cells rounded or broadly ellipsoid; heterocysts spherical; akinetes solitary adjacent to heterocysts, spherical to elongate.

Dimensions: Cells 11-12.8 micron broad, and 9.3-10.8 micron long; heterocysts 14-15.5 micron in diameter; akinete 20-22.8 micron in diameter.

Distribution: Intermingled with other algae in shallow water of river Ganga. Plates 2-21.

Anabaena sphaerica var. attenuata (Bharadwaja.)

Thallus floccose, gelatinous, thin, pale blue-green; trichomes curved or straight, more or less entangled with each other, slightly attenuated at the ends with rounded and cells, without a mucilage sheath; cells spherical or slightly barrel-shaped; heterocysts intercalary, spherical or oval, with smooth yellow outer wall.

Dimensions: Trichomes 3.3-3.5 micron broad; heterocysts 5.04-5.80 micron diameter; akinets 11.2-11.9 micron in diameter.

Distribution: In moist soil on banks of river Ganga. Plates 2-22.

Anabaena affinis (Lemmermann.)

Trichomes straight, solitary and free-floating; cells spherical to spherical; heterocysts spherical slightly larger than vegetative cells.

Dimensions: Trichomes 5.2-5.8 micron broad; heterocysts 7.8-8.6 micron in diameter, 16.8-18.2 micron long.

Distribution: In ditches of river Ganga. Plates 2-23.

Genus *Nodularia* (Mertens)

Nodularia spumigena (Mertens.) Illinois, op. cit., Pl. 99, Figs. 1139, 1952.

Filaments brown, curved or straight, solitary; cells disciform; heterocysts slightly larger than vegetative cells; akinetes spherical, solitary, few or many in series; brown.

Dimensions: Cells 8-8.5 micron broad, 3.8-4.2 micron long; reproductive cell 9-10 micron broad, and 5-6 micron long.

Distribution: In muddy material mixed with filament in river Ganga. Plates 2-24.

Genus *Gloeotrichia* Ag.

Gloeotrichia pisum (Thuret) ex. Born.

Thallus spherical, blue-green; filaments densely arranged; sheath thin, colourless; trichome ending in a long hair; cells

| ALGAL- SPECIE S | YEAR | | | | | | | | | | | |
|-------------------------------------|------|------|------|------|-----|------|------|------|------|------|------|------|
| 2010 | JAN. | FEB. | MAR. | APR. | MAY | JUN. | JUL. | AUG. | SEP. | OCT. | NOV. | DEC. |
| <i>Microcystis aeruginosa</i> | - | + | + | + | + | + | + | - | - | - | - | + |
| <i>Microcystis flos-aquae</i> | - | - | + | + | + | + | + | + | + | - | - | - |
| <i>Aphanocapsa montana</i> | - | - | + | + | + | - | - | - | - | + | + | - |
| <i>Aphanathece microscopica</i> | - | - | + | + | + | + | - | - | - | - | - | - |
| <i>Synechocystis pevalekii</i> | + | - | + | - | - | - | - | - | - | - | - | + |
| <i>Coelosphaerium kuetzingianum</i> | + | - | + | + | + | - | - | - | + | - | + | - |
| <i>Arthrospira platensis</i> | - | + | + | - | - | - | - | - | - | - | - | - |
| <i>Spirulina gigantea</i> | - | - | - | - | + | + | - | - | - | - | - | - |
| <i>Spirulina lehywinzhiformis</i> | - | - | - | - | - | - | - | + | + | + | - | + |
| <i>Oscillatoria subuliformis</i> | - | - | - | + | + | + | - | - | - | - | - | - |
| <i>Oscillatoria tenuis</i> | + | - | + | + | + | - | - | - | + | + | + | + |
| <i>Oscillatoria irrigua</i> | + | - | - | - | - | - | - | + | + | + | + | + |
| <i>Oscillatoria acuta</i> | - | - | - | - | - | - | - | + | + | + | + | - |
| <i>Phormidium jenkelianum</i> | + | + | + | + | - | - | - | - | - | + | + | + |
| <i>Phormidium tenue</i> | - | + | - | + | + | - | - | - | + | + | + | - |
| <i>Phormidium ambiguum</i> | - | - | - | - | - | - | + | + | + | - | + | + |
| <i>Lyngbya contorta</i> | + | + | + | - | - | - | - | - | + | + | - | - |
| <i>Nostoc calcicola</i> | + | + | + | + | - | - | + | - | + | + | + | - |
| <i>Nostoc commune</i> | + | + | + | + | - | + | - | - | + | - | - | - |
| <i>Nostoc punctiforme</i> | + | + | + | + | - | - | - | + | + | + | + | - |
| <i>Anabaena planctonica</i> | + | - | + | - | - | + | + | - | - | - | + | + |
| <i>Anabaena sphaerica</i> | + | - | + | + | + | - | - | - | - | - | + | + |
| <i>Anabaena affinis</i> | + | - | - | - | + | - | - | - | - | - | + | + |
| <i>Nodularia spumigena</i> | + | + | + | + | - | - | - | - | - | - | + | + |
| <i>Gloeotrichia pismus</i> | - | - | + | + | + | - | - | - | - | - | + | + |

+ : Present; - : Absent;

nearly as long as broad, or twice as long, blue-green; heterocysts more or less spherical; spores cylindrical, smooth.
Dimensions: Trichome 6-7.2 micron broad, cells 8-9.2 micron long; heterocysts 10-12.5 micron broad; spores with sheath 24-25.0 micron broad, without sheath 12-14.5 micron broad, 75-80.5 micron long.
Distribution: In ditches of stagnant and floating Ganga water. Plate 2-25.

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REFERENCES

1. Desikachary, T.V. (1959). In: Cyanophyta. I.C.A.R. New Delhi, India.

2. Singh, V.P. (1960). Proc. Sym. Algal. ICAR New Delhi; 243-271.

3. Zafer, A.R. (1964). *Hydrobiologia* 24(4) 556.

4. Phawa, D.V. and Mehrotra, S.N. (1966). Proc. Nat. Acad. Sc. 56: 157.

5. Munawar, M., (1970). *Hydrobiologia*, 31: 105.

6. Prasad, B.N. and Saxena, M. (1980). *Indian J. Environ. Health.* 22(2). 151.

7. Sengar, R.M.S. and Sharma, K. D. (1985). *Phykos.* 24: 117.

8. Pandey, U.C. and Iqbal, H. (1989). *Vegetos*. 2: 108.
9. Singh, D.N. and Das, A.K. (2001). Periodicity and abundance of plankton in a peninsular river of India. *N.A.S.I.* 21: PP. 31.
10. Dubey, V. and Mohan, N. (2004). Proc. National Seminar on Recent Emerging Trends in Plant Science, Kanpur. I: p. 3.
11. Prescott, G. W. (1951). In: *Algae of the Western Great Lakes area*, Institute of Science, Bulletin No. 31. pp. 946.
12. Geitler, (1932): In: *Rabenhorst's Kryptogamenflora*, Leipzig 14. 1996.