



## Research article

# Occurrence of Genus *Microcystis* Lemmerm. from water bodies of Maldah district, West Bengal, India

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**Abstract:** Present investigation deals with systematic enumeration of Genus *Microcystis* collected from different water bodies of Maldah District, West Bengal and its impacts for which systematic survey and collection of the samples was carried out from different water bodies of all administrative blocks of Maldah District namely Ratua I, Ratua II, Harishchandrapur I, Harishchandrapur II, Chanchal I, Chanchal II, Manikchak, Gazol, Habibpur, Bamangola, Old Maldah, English Bazar and Kaliachak. Altogether ten species of Genus *Microcystis* viz. *Microcystis aeruginosa*, *M. flos-aquae*, *M. ichthyoblabe*, *M. novacekii*, *M. panniformis*, *M. protocystis*, *M. pseudofilamentosa*, *M. robusta*, *M. viridis* and *M. wesenbergii* were recorded from different water bodies of Maldah District, West Bengal. Out of ten, four species of Genus *Microcystis* viz. *Microcystis ichthyoblabe*, *M. panniformis*, *M. wesenbergii* and *M. novacekii* have been reported for the first time from water bodies of block Ratua I, Old Maldah and English Bazar of Maldah District, West Bengal. Some of the species of *Microcystis* are bloom forming. Taxonomically, the Genus *Microcystis* is very important because of its characteristic features among the cyanophyceae forms, global distribution and occurrence.

**Keywords:** Survey - Collection - Identification - *Microcystis* - Systematic enumeration.

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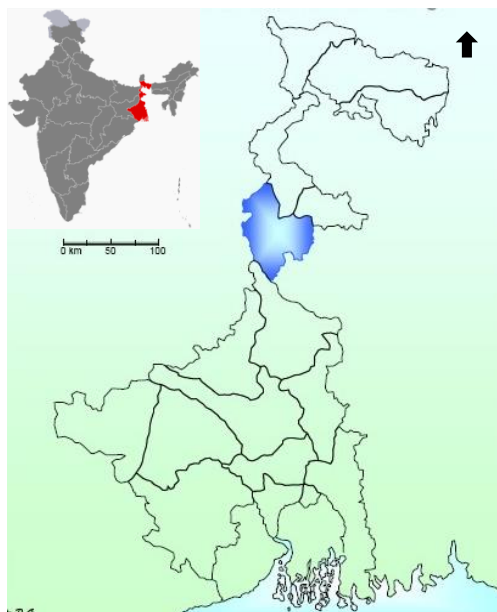
## INTRODUCTION

Maldah district is flood prone area. That is why one of the important district among 19 districts of West Bengal. In terms of duration and frequency of flood and its recurrences is concerned, Maldah district is defined as a chronically flood-affected area. Here the practice of aqua culture, cultivation of rice and Makhana (*Eurayle ferox* Salisb.) are other aspects on which socio-economic condition and livelihood of the district depends. To meet the requirements, huge number of big and small size 'bils' (swamps), 'dighi' and 'ponds' depending upon land area available to individuals are made by them. Such water bodies often get eutrophicated by micro and macrophytes as a result of contaminants from various non-point and point sources like runoff of agriculture fields in which huge quantity of fertilizers and pesticides is used and civic as well as industrial pollutants respectively. Among the aquatic flora, diversity and distribution of microscopic flora is much greater having both beneficial and harmful properties. *Microcystis* Lemmerm. is the main genus found worldwide (Gupta 2012). Some of the species of Genus *Microcystis* Lemmerm. are bloom forming species (Gupta & Kumar 2005) of cyanoprokaryota also known as cyanobacteria/cyanophyceae/blue-green algae which floats on the surface of the water and form scum due to buoyancy produce by intracellular gas vacuolation (Walsby 1972, Paerl & Ustach 1982, Kumar & Gopal 1999, 2003). Due to scum formation, bluish-greenish colour of the water changed on ageing and break down of cells resulting turning it as yellowish-greenish. Present study deals with systematic enumeration of Genus *Microcystis* Lemmerm. collected from different water bodies of Maldah District, West Bengal and its impacts on aquatic environment which is unexplored area.

## MATERIALS AND METHODS

Maldah district is situated in West Bengal of north-east India and lies between 24° 41'20" and 25° 32'08"

North Latitude and  $87^{\circ} 45'50''$  and  $88^{\circ} 28'10''$  East Longitude, extends over  $3733.17 \text{ km}^2$  with total population 32,90,468 as per Census, 2001 (BAES 2004) and English Bazar is the District Administrative Headquarter. The district is bounded to its south by the district of Murshidabad across the river Ganga, by Rajshahi district of Bangladesh and Dakshin Dinajpur district to its east and north-east, by Uttar Dinajpur district to its direct north and by the Purnea of Bihar to its direct west and by Sahibganj of State of Jharkhand across the Ganga to the south-west (Fig. 1).



**Figure 1.** Location of the study site: Maldah district, West Bengal, India.

During the survey all administrative blocks of Maldah district namely Ratua I, Ratua II, Harishchandrapur I, Harishchandrapur II, Chanchal I, Chanchal II, Manikchak, Gazol, Habibpur, Bamangola, Old Maldah, English Bazar and Kaliachak were visited and samples sampled from different water bodies of Maldah District, W.B. Samples were sampled randomly towing Phytoplankton net to a distance of 1.0–5.0 m depending up on depth of water bodies. The samples were preserved in 15.0 ml screw cap Borosil glass specimen vials to avoid any chemical reaction. To take samples from other water bodies, Phytoplankton net was thoroughly washed with clean water after collection of each sample. Samples were preserved by adding 2–3 drops of 4% Formalin solution. Specimens were observed under Leica DM 2500 Microscope and photomicrograph of each specimen was taken by DFC 500 digital camera with annotation using Leica QWin V 3.2 Image Processing and Analysis Software and Leica Application Suit V4. Specimens were identified by consulting standard books, monograph (Geitler 1932, Tiffany & Britton 1952, Desikachary 1959, Prescott 1982, Anand 1989, 1998, Komárek & Anagnostidis 1998). The authority name of each species is cited in the text as described in ‘Authors of Plant Names’ (Brummitt & Powell 1992), title of the books in citation is cited in accordance with Stafleu & Cowan (1976, 1979, 1981, 1983, 1985, 1986, 1988) and supplements as described by Stafleu & Mennege (1992, 1993, 1995, 1997, 1998, 2000), whereas Journals, Periodicals with Botanical content as described in “Botanico-Periodicum-Huntianum”, BPH-2 (Bridson 2004a, b).

## RESULTS

### *Systematic Enumeration*

Systematic studies carried out on Genus *Microcystis* Lemmerm. from different water bodies of Maldah district, West Bengal. Taxonomic enumeration of altogether ten identified species of Genus *Microcystis* Lemmerm. of Maldah District of West Bengal are described here along with their details.

*Microcystis* Lemmerm. Kryptogamenfl. Mark Brandenb. 3(1): 45, 1907

Colonies spherical, oval, lobate to irregular or elongate in several species irregularly clathrate, sometimes composed of subcolonies or clustered together, with irregularly, sparsely or densely arranged cells in common fine mucilage, colourless, usually homogeneous or indistinctly lamellate, diffluent or distinct and delimited, in many species with refractive outline (surface); around individual cells gelatinous envelope absent; cells spherical or hemispherical, many in spherical, ellipsoidal or irregularly overlapping or net like colony, gas vesicles often present. Ten species have been reported from this region.

## Key to the Species

- 1a. Colonies clathrate.....2  
 1b. Colonies not clathrate.....3  
 2a. Colony enveloped by diffluent somewhat indistinct slime.....*M. aeruginosa*  
 2b. Colony rounded, sheath distinct.....*M. robusta*  
 3a. Mucilage of the colony not clearly restricted.....*M. potocystis*  
 3b. Mucilage with definite margins.....*M. viridis*  
 3c. Mucilage with indistinct margins.....4  
 3d. Mucilage very irregular or wide or rarely diffused.....5  
 4a. Colonies almost spherical, ellipsoidal or somewhat elongate.....*M. flos-aquae*  
 4b. Colonies long, narrow, with series of partial colonies.....*M. pseudofilamentosa*  
 5a. Colonies without hole.....6  
 5b. Colonies with hole.....7  
 6a. Cells densely agglomerated in centre.....*M. novacekii*  
 6b. Cells homogeneously and evenly agglomerated.....*M. ichthyoblabe*  
 7a. Colony lobate composed with connected spheroidal subcolonies.....*M. wesenbergii*  
 7b. Colony not lobate composed with connected spheroidal sub-colonies and flattend.....*M. panniformis*

*Microcystis aeruginosa* (Kütz.) Kütz., Tab. Phycol. 1: 6, 8, t.8, f. 1. 1846; Desikachary, Cyanophyta 93, t.17, f. 1-2, 6 & t.18, f. 10. 1959. (Fig. 2A)

*Micraloa aeruginosa* Kütz., Linnaea 8: 371, t.8, f. 23. 1833.

An ovate, spherical, or irregularly lobed, clathrate and mucilaginous colony of numerous spherical cells much crowded within a gelatinous matrix; mucilage colourless, structureless, diffluent, sometimes forming distinct cell contents blue-green, highly granular with conspicuous pseudo vacuoles.

Dimension: Cells 3.0–7.0 µm in diameter.

Distribution: Bil (Ghogha and Manna), Dighi (Sukan) and Pond (Bhadobartola, Meenatula, Rohini, Shivrampalli, Salami Darwaja, Samda, Kuppa, Jorkuppa and Damua).

*Microcystis flos-aquae* (Wittr.) Kirchn., in Engl. & Prantl, Nat. Pflanzenfam., I. (1a): 56, f. 49 N. 1898; Desikachary, Cyanophyta 94, t.17, f. 11 & t.18, f. 11. 1959. (Fig. 2B)

*Microcystis aeruginosa* f. *flos-aquae* (Wittr.) Elenkin, Monogr. Alg. cyanophyc., Pars Gen. 1: 103, 1938.

Colony ellipsoidal or more or less elongate or roughly spherical, not clathrate; colonial mucilage indistinct; cells spherical with gas-vacuoles.

Dimension: Cells 3.0–7.0 µm in diameter.

Distribution: Dighi (Kalua and Sukan).

*Microcystis ichthyoblabe* (G.Kunze) Kütz., Phycol. general. 170, 1843; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 226, f. 297. 1998. (Fig. 2C)

*Granularia ichthyoblabe* G.Kunze in E.Schmalz, Flora 6: 566, 1823.

Colony large, irregular, compact, without holes, mostly flattened, often form cell clusters or sub colonies in common mucilage, later on disintegrated in to small groups of aggregated cells; margins of colonies irregular, indistinct, diffuse, irregularly overlapping cells; cells spherical, densely homogeneously and evenly accumulated.

Dimension: Cells 2.0–3.7 µm in diameter.

Distribution: Pond (Bhadobartola).

*Microcystis novacekii* (Komárek) Compère, Bull. Jard. Bot. Natl. Belg. 44: 19, 1974; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 220, f. 302. 1998. (Fig. 2D)

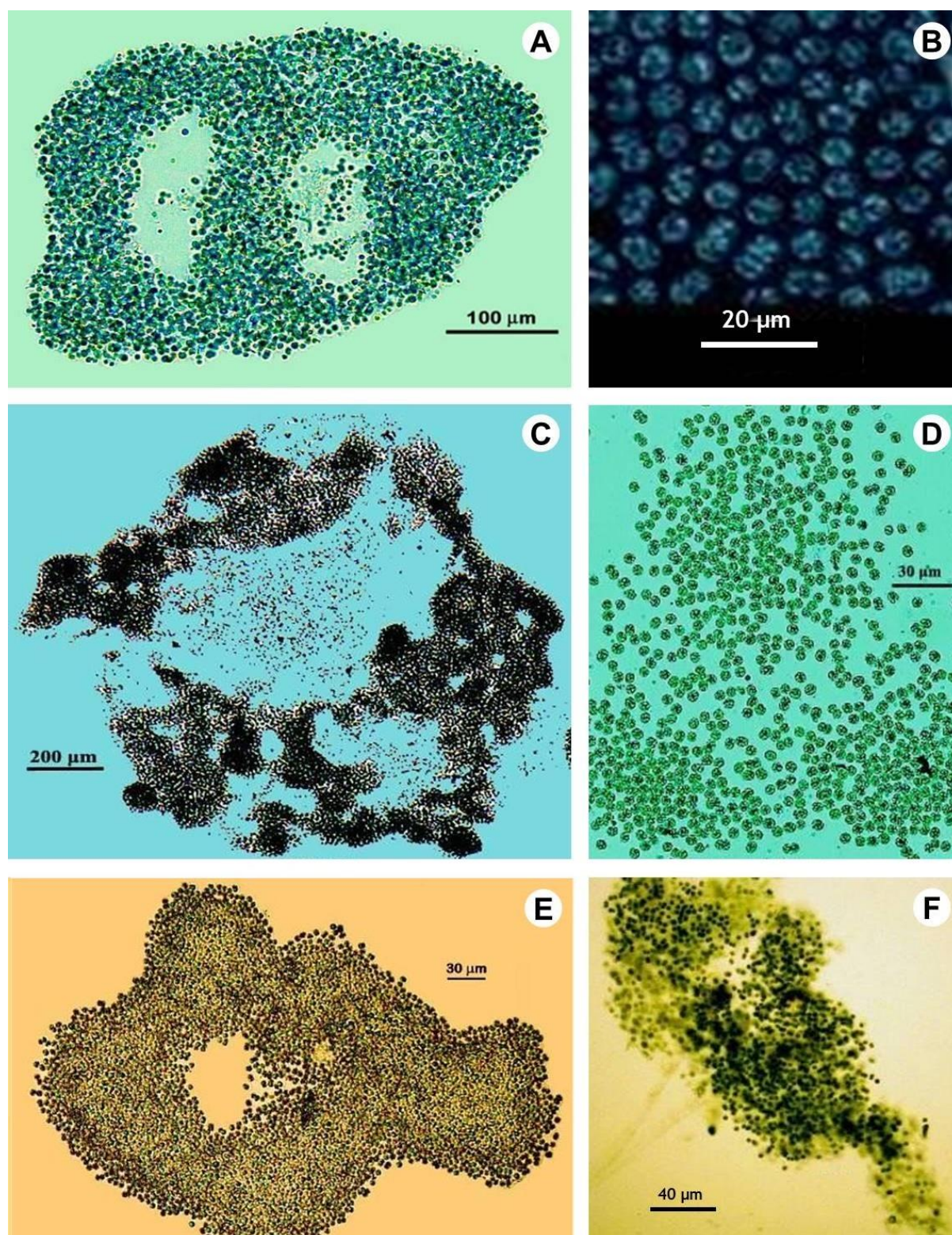
*Diplocystis novacekii* Komárek, in Komárek & Ettl., Alg. Stud.: 63, t.6, f. 1-4. 1958.

Colony almost spheroidal and slightly flattened, sometimes cells aggregated together; cells densely agglomerated in the centre of the colony, few solitary cells in enveloping mucilage.

Dimension: Cells 2.3–6.0 µm in diameter.

Distribution: Dighi (Bara Sagar).





**Figure 2.** A, *Microcystis aeruginosa* (Kütz.) Kütz.; B, *M. flos-aquae* (Wittr.) Kirchn.; C, *M. ichthyoblabe* Kütz.; D, *Microcystis novacekii* (Komárek) Compère; E, *M. panniformis* Komárek; F, *M. protocystis* Crow.

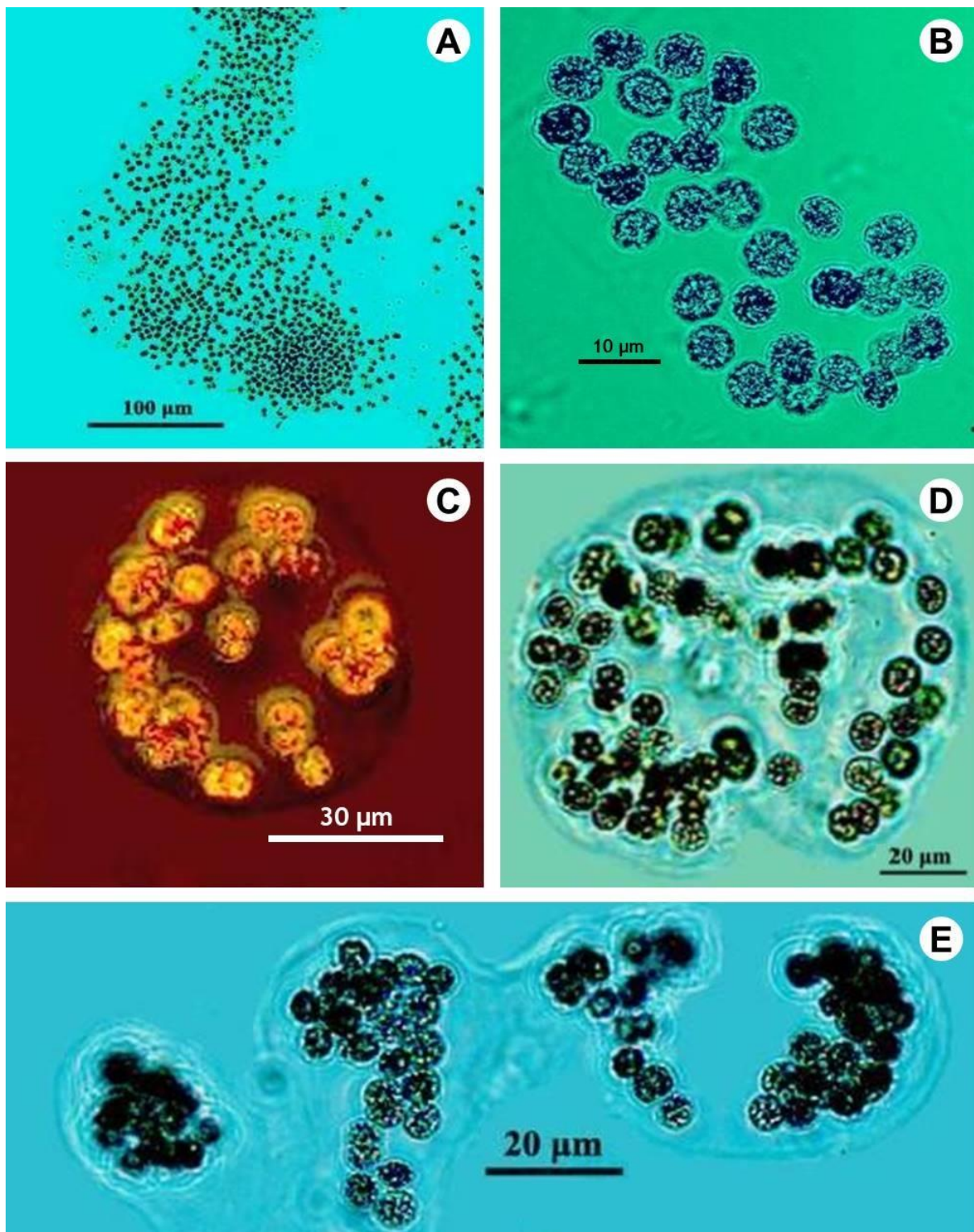
*Microcystis panniformis* Komárek, Komárk.-Legn., C.L. Sant'Anna, M.T.P. Azevedo & Senna, *Crypto. Algol.* 23: 165, f. 14-28. 2002; Komárek & Anagn., *Cyanoprokaryota Part 1: Chroococcales* 19(1): 226, f. 297. 1998. (Fig. 2E)

Colony flat, irregular with small holes; margins of the colonies smooth or irregular; cells regularly densely and smoothly accumulated.

Dimension: Cells 2.5–4.9 µm in diameter.

Distribution: Pond (Bhadobartola).





**Figure 3.** A, *Microcystis pseudofilamentosa* Crow; B, *M. robusta* (H.W.Clark) Nygaard; C, *M. viridis* (A.Braun) Lemmerm.; D–E, *M. wesenbergii* (Komárek) Komárek.

*Microcystis protocystis* Crow, New Phytol. 22: 62, t.1, f. d. 1923; Desikachary, Cyanophyta 91, t.20, f. 4. 1959. (Fig. 2F)

Colony irregular, mostly diffuse with the limits of colonial mucilage, not clearly restricted; cells spherical, many varying in the mode of aggregation from closely packed to generally dissociated.

Dimension: Cells 3.3–6.0 µm in diameter.

Distribution: Dighi (Bara Sagar).

*Microcystis pseudofilamentosa* Crow, New Phytol. 22: 64, t.1, f. e-f. 1923; Desikachary, Cyanophyta 95, t.18, f. 9 & t.20, f. 1. 1959. (Fig. 3A)

Colony varying in size, usually 220 - 290 µm long; margins of the colonial mucilage indistinct; mostly partial colonies; cells spherical with gas-vacuoles.

Dimension: Cells 3.2–6.5 µm in diameter.

Distribution: Dighi (Bara Sagar).

***Microcystis robusta*** (H.W.Clark) Nygaard, Dansk Bot. Ark. 4(10): 8, f. 1-4. 1925; Desikachary, Cyanophyta 85, t.17, f. 7-10. 1959. *Clathrocystis robusta* H.W.Clark, Proc. Biol. Soc. Washington 2: 94, 1909. (**Fig. 3B**)

Colony rounded first, later on irregularly elongated and clathrate; sheath distinct; cells spherical.

Dimension: Cells 5.6–7.0 µm in diameter.

Distribution: Dighi (Bara Sagar and Sukan).

***Microcystis viridis*** (A.Braun) Lemmerm., Abh. Naturwiss. Vereins Bremen 17: 342, 1903; Desikachary, Cyanophyta 87, t.18, f. 1-6. 1959. (**Fig. 3C**)

*Polycystis viridis* A.Braun, Fl. eur. alg. 2: 53, 1865.

Colony rounded, sometimes numbers of daughter colonies surrounded by common mucilaginous sheath, margins of colonial mucilage definite; cells spherical, even single cell frequently develop a thick mucilage envelop all round and split from the thallus by further division, these cells later give rise to new colonies.

Dimension: Cells 3.5–7.0 µm in diameter.

Distribution: Pond (Shivrampalli).

***Microcystis wesenbergii*** (Komárek) Komárek ex Komárek, in Kondrateva Cvetenie vody, Naukova Dumka Kiev 32, 1968; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 232, f. 305. 1998.

*Diplocystis wesenbergii* Komárek, Komárek & Ettl., Alg. Stud.: 68, t.7, f. 1-4. 1958. (**Fig. 3D, E**)

Colony irregular, spheroidal to lobate or elongate with holes when old; mostly composed with connected spheroidal subcolonies; cells sparsely to densely accumulated often near the surface of subcolonies.

Dimension: Cells 4.0–8.6 µm in diameter.

Distribution: Dighi (Sukan).

## DISCUSSION AND CONCLUSION

Altogether 10 species have been reported from 14 water bodies of Maldah District, West Bengal. Out of 15 blocks of Maldah District, species of *Microcystis* Lemmerm. Were recorded from 09 Ponds, 02 Bils, and 03 Dighi of 06 blocks namely Ratua I, Harishchandrapur I, Harishchandrapur II, Chanchal II, Old Maldah and English Bazar. It was observed that some of the species have been recorded in more than one water bodies like *Microcystis flos-aquae* (Wittr.) Kirchn. from Kalua and Sukan Dighi of Old Maldah block, *M. robusta* (H.W.Clark) Nygaard from Bara Sagar and Sukan Dighi of English Bazar and Old Maldah block respectively. *M. aeruginosa* (Kütz.) Kütz. was observed from maximum 12 water bodies of 06 blocks viz. Chanchal - II (Ghogha bil), Old Maldah (Sukan Dighi, Meenatula, Rohini, Shivrampalli, Salami Darwaja ponds) English Bazar (Samda, Kuppa and Jorkuppa) Ratua I block (Bhadobartola Pond), Harishchandrapur I (Damua Pond) and Harishchandrapur - II (Manna bil) and showed massive presence of *Microcystis* colonies while in Meenatula and Bhadobartola ponds it was recorded almost axenic. However, single species of *Microcystis* Lemmerm. i.e. *M. ichthyoblabe* (G.Kunze) Kütz. and *M. panniformis* Komárek, Komárk.-Legn., C.L. Sant'Anna, M.T.P. Azevedo & Senna observed from Bhadobartola Pond of block Ratua I; *M. novacekii* (Komárek) Compère, *M. protocystis* Crow, *M. pseudofilamentosa* Crow from Bara Sagar Dighi of English Bazar; *M. viridis* (A.Braun) Lemmerm. and *M. wesenbergii* (Komárek) Komárek ex Komárek from Shivrampalli Pond and Sukan Dighi of Old Maldah block respectively. It was observed that maximum species of *Microcystis* Lemmerm. have been recorded from Sukan Dighi of Old Maldah and Bara Sagar Dighi of English Bazar block of Maldah District of West Bengal. Four species of *Microcystis* Lemmerm. viz. *M. ichthyoblabe* (G.Kunze) Kütz., *M. novacekii* (Komárek) Compère, *M. panniformis* Komárek and *M. wesenbergii* (Komárek) Komárek ex Komárek new records from West Bengal (Gupta 2017). Toxic and bloom forming species viz. *M. aeruginosa* (Kütz.) Kütz., *M. flos-aquae* (Wittr.) Kirchn., *M. novacekii* (Komárek) Compère, *M. panniformis* Komárek, *M. viridis* (A.Braun) Lemmerm. and *M. wesenbergii* (Komárek) Komárek ex Komárek found in Maldah District, W. B. *Microcystis protocystis* Crow produced the highest level of lipids so it is the most promising species for utilization at an industrial scale and may be used for the production of Biofuel (Cordeiro 2017). Toxicity of the specific taxa becomes both taxonomically and ecologically very important. *M. aeruginosa* produced neurotoxins and hepatotoxins and other species of

*Microcystis* Lemmerm. viz. *M. flos-aquae* (Wittr.) Kirchn., *M. ichthyoblabe* (G.Kunze) Kütz., *M. novacekii* (Komárek) Compère, *M. viridis* (A.Braun) Lemmerm., *M. wesenbergii* (Komárek) Komárek ex Komárek also produced toxins (Komárek & Anagnostidis 1998, Fastner *et al.* 2001, Komárek & Komárkova 2002, Kurmayer *et al.* 2002, Via-Ordorika *et al.* 2004, Gupta & Husain 2007, Šejnohová 2008). Further detail analysis of toxins producing species found abundantly in water bodies is required because in water bodies of Maldah District practice of aqua culture is common and used for cultivation of rice and Makhana (*Eurayle ferox* Salisb.) on which socio-economic condition and livelihood of the district depends. Beside this, *Microcystis aeruginosa* (Kütz.) Kütz. also having antiviral activity against influenza A virus (Nowotny *et al.* 1997). These studies may be utilized by experimental, evolutionary and ecological researchers worldwide and fill the gap in our existing knowledge.

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