

THE GENUS *OSCILLATORIA* VAUCHER (OSCILLATORIALES: CYANOPROKARYOTA) IN WEST BENGAL, INDIA

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ABSTRACT

In spite of its ubiquitous occurrence our knowledge about Cyanoprokaryotes of tropical countries is not proper (Komárek & Anagnostidis 2005). *Oscillatoria* Vaucher is the most ubiquitous genus of Oscillatoriales of Cyanoprokaryota growing in almost all accessible habitats starting from hot springs to snow-fed rocky areas. Its adaptability to different climatic conditions is marvelous. In India *Oscillatoria* Vaucher is represented by over 76 species (Desikachary 1959, Anand, 1989, 1998). During systematic investigations on the algal flora of West Bengal the authors recorded following species of *Oscillatoria* viz *O. obscura* Brühl et Biswas, *O. sancta* (Kützing) Gomont, *O. simplicissima* Gomont, *O. anguina* (Bory) Gomont, *O. subbrevis* Schmidle, *O. nitida* Škorbatov, *O. proboscidea* Gomont, *O. tenuis* Agardh ex Gomont, *O. salina* Biswas, *O. princeps* Vaucher ex Gomont, *O. raoi* De Toni, J., *O. limosa* Agardh ex Gomont, *O. amoena* (Kützing) Gomont, *O. vizagapatnensis* Rao, C.B., *O. okeni* Agardh ex Gomont and *O. laete-virens* (Crouan) Gomont. The distributions of different species have been discussed. *O. simplicissima*, *O. princeps*, *O. subbrevis*, *O. sancta* and *O. tenuis* are most common species in unpolluted habitats whereas *O. limosa* is common in polluted habitats. *O. nitida* appears to be the first Cyanoprokaryote recorded in India.

Key Words: Oscillatoriales, Cyanoprokaryotes, West Bengal, India

INTRODUCTION

In spite of good quantum of work done on Indian Cyanoprokaryotes our knowledge about this group is not proper. According to the world authorities (Komárek & Anagnostidis 1999, 2005) this knowledge is to be updated at least in the tropical countries. Investigations in India have been done in scattered manner. This venture has been taken to fill the lacuna concentrating genus & area wise. In this investigation the genus *Oscillatoria* Vaucher has been taken into consideration. It is represented by over 76 species (Desikachary 1959, Anand, 1989, 1998) in India. The distributional records however need to be checked all over the country because of its various roles in wide climatic conditions and due to its wide ecological adaptability. Keeping this fact in mind the present investigation has been done. In this account following 16 species of the genus *Oscillatoria* have been recorded from Singur block, Hooghly district of West Bengal.

Cyanoprokaryotes of West Bengal has been studied by several workers. Biswas (1925) worked on road slimes of Calcutta. Banerji (1938) reported some cyanoprokary-

otes of adjoining area from Calcutta. Jana and Sarkar (1971) reported few cyanoprokaryotes from the thermal springs in Bakreshwar. Mukhopadhyay and Chatterjee (1981) prepared a checklist of cyanoprokaryota in the rice field of 24-Pargana district. Pal and Santra (1982) worked on Murshidabad district. Sen *et al.* (1987, 1998) worked on Gangetic planes of West Bengal. Santra *et al* (1988) provided information on cyanoprokaryotes of saline habitats. Sen and Naskar (2003) worked on the flora unusual habitats of Sundarban. Sinha and Mukerjee (1975a, 1975b and 1984) investigated the cyanoprokaryota of Bankura district. Some other works have been done by Gupta (1965, 1975), Gupta and Sen (1987a, 1987b), Brühl and Biswas (1922a, 1922b), Prain (1905), Naskar *et al.*, 2008, Chakraborty *et al.* 2010 and Keshri & Chatterjee (2010).

MATERIAL AND METHODS

The Singur block is part of the Hooghly district of West Bengal from which the samples have been collected throughout the year. Freshly collected materials were

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stored in 5% formalin in polythene bags (size 4" X 3"), tagged and ecological notes recorded in field data book. Lugol's Iodine in the ratio of 1:100 of water samples were sometimes used for phytoplanktonic samples. pH and temperature of the water bodies were measured using pH paper (Merck indicator range 1-10). 10% glycerin or G.E.W. solution (Bando 1988) was used as mountant for microscopical observation. Algal specimens were worked out with Olympus GB compound microscope. Camera Lucida drawings were made for identification up to species level and digital photographs were also taken from the Carl Zeiss Axiostar microscope with Axio vision 4.8 software. Algal materials were identified with the help of standard literature (Desikachary 1959, Prescott 1962, Komárek & Anagnostidis 2005).

RESULTS

Following sixteen taxa of *Oscillatoria* have been recorded in this investigation

1. *Oscillatoria limosa* Agardh ex Gomont 1892

Geitler 1932, page 944, figure 598d; Desikachary 1959, page 206, plate 42, figure 11; Prescott 1962, page 489, plate 109, figure 17; Komárek & Anagnostidis 2005, page 593, figure 886.

Thallus dark blue green, trichome straight, not constricted at the cross-walls, 10 μm broad and 4 μm long, granules uniformly distributed, end cell rounded and thickened, apex not attenuated, cross walls frequently granulated.

Collection No. JS-49; Date: - 18/11/2011

pH:- 6.5; Temperature- 30°C; Place:- Near Singur Health Center, West Bengal.

Habitat: - Aquatic, lodged on the surface of a stagnant polluted water body.

Distribution in India:- Andhra Pradesh (Ghousuddin, 1937; Munawar, 1974; Rao, 1977); Assam (Deka & Sarma, 2011); Bihar (Vasishta, 1968); Gujarat (Kamat, 1962-63; Gupta, 1964); Himachal Pradesh (Vasishta, 1968; Kumar et al., 2013); Uttarakhand (Gupta, 2005); Jammu and Kashmir (Anand, 1979); Karnataka (Bharati & Bongale, 1975a, 1975b; Bongale & Bharati, 1980a); Kerala (Shaji & Panikkar, 1994); Maharashtra (Vasishta, 1968; Kamat, 1968b; Tiwari, 1972, 1975; Ashtekar & Kamat, 1980; Kumawat & Jawale, 2006); Odisha (Rao, 1939; Mohanty, 1982; Dash et al., 2011), Punjab (Vasishta, 1961, Prasad & Srivastava, 1965a; Sarma & Kantha, 1978); Tamil Nadu (Ganapati, 1940, Ramkrishnan & Kannan, 1992; Subramaniyan et al., 2012; Ramanathan et al., 2013); Uttar Pradesh (Ahmad, 1967, 1972; Kumar, 1970; Singh et al., 1970; Khan & Kumari, 1972; Khan &

Rawat, 1972; Pal & Yadav, 1974; Bendre & Kumar, 1975; Darbal et al., 1978; Rai & Kumar, 1979; Prasad & Mehrotra, 1980; Pandey, 1982; Pandey & Pandey, 1982; Misra & Srivastava, 2005; Tiwari & Chauhan, 2006; Misra et al., 2008), West Bengal (Martens, 1870, 1871, Prain, 1905; Biswas, 1927, 1942; Kachroo, 1959; Chatterjee et al., 1980; Sen & Gupta, 1998; Naskar et al., 2008; Chakraborty et al. 2010, Sen Sarkar et al., 2013)

2. *Oscillatoria simplicissima* Gomont 1892

Synonym: *Phormidium simplicissimum* (Gomont) Anagnostidis & Komárek 1988

Geitler 1932, page 961; Desikachary 1959, page 224; Komárek & Anagnostidis 2005, page 586, figure 876.

Thallus light green, not constricted at the cross-walls, trichome more or less straight, 6-8 μm broad and 4 μm long, granule uniformly distributed, end cell rounded, not capitate.

Collection No. JS-26, 142, 145, 157; Date: - 25/10/2011, 28/01/2012

pH:- 6, Temperature- 28°C; Place:- Near Singur Abani Maidan, West Bengal.

Habitat: - Attached on the aquatic weeds in a small water body.

Distribution in India:- Punjab (Sarma & Kanta, 1978); Karnataka (Kamat, 1972); Maharashtra (Bhosale et al. 2012); Madhya Pradesh (Sharma & Naik, 1996); Odisha (Dash et al., 2011); Uttar Pradesh (Kumar, 1970; Pal & Yadav, 1974; Bendre & Kumar, 1975; Pal, 1975); West Bengal (Sen & Gupta, 1998; Chakraborty et al. 2010).

3. *Oscillatoria sancta* (Kützing) Gomont 1892

Desikachary 1959, page 203, plate 42, figure 10; Geitler 1932, page 943, figure 598c; Prescott 1962, page 490, plate 110, figure 4; Komárek & Anagnostidis 2005, page 594, figure 890.

Thallus dark blue green, mucilaginous sheath present, trichome more or less straight, constricted at the cross-walls, 12 μm broad and 6 μm long, end cell hemispherical and attenuated, slightly capitate with a thickened membrane.

Collection No. JS-228; Date: - 17/03/2012

pH: -7; Temperature- 30°C; Place:- Beside Singur Mahamaya High School, West Bengal.

Habitat: - Lodged on the surface of aquatic weeds. Distribution in India:- Assam (Deka & Sarma, 2011); Bihar (Rao, 1939; Vasishta, 1968; Sinha & Srivastava, 1980); Delhi (Rao, 1940); Himachal Pradesh (Vasishta, 1968); Jammu & Kashmir (Kant & Kachroo, 1975); Kar-

nataka (Gonzalves & Joshi, 1946; Vasishta, 1968); Odisha (Rao, 1939; Rao & Pattnaik, 1975; Mohanty, 1982); Punjab (Vasishta, 1961; Grover & Pandhol, 1975; Pandhol & Grover, 1976; Sarma & Kanta, 1978); Maharashtra (Karande et al., 2012; Patil & Neelima, 2013); Uttar Pradesh (Rao, 1937; Gupta, 1956; Singh, 1959a; Bendre & Kumar, 1975; Pal, 1975; Prasad & Mehrotra, 1980; Prasad & Saxena, 1980; Pandey & Pandey, 1982); West Bengal (Banerji, 1938; Kachroo, 1959; Sen & Gupta, 1998)

4. *Oscillatoria obscura* Brühl et Biswas 1922

Brühl et Biswas 1922, page 6, plate 2, figure 9; Geitler 1932, page 945; Desikachary 1959, page 207; Komárek & Anagnostidis 2005, page 599.

Trichome 4 μm broad and 2 μm long, end cell rounded, nearly straight, thallus blue green colour, constriction not present at the cross-walls, cross wall granulated, trichome attenuated at the apex.

Collection No. JS-141; Date: - 28/01/2012

pH:- 6.5; Temperature- 32°C; Place:- Near Singur Abani Maidan, West Bengal.

Habitat: - Aquatic, attached on an aquatic weed in a rice field.

Distribution in India:- Uttar Pradesh (Rao, 1937; Pandey, 1965a; Kumar 1970; Bendre & Kumar, 1975; Prasad & Mehrotra, 1980; Pal, 1975; Chadha & Pandey, 1983; Tiwari & Chauhan, 2006); Bihar (Laloraya & Mitra, 1973; Jha et al., 1986); Odisha (Rao, 1938a; Laloraya & Mitra, 1973; Mohanty, 1982); Andhra Pradesh (Laloraya & Mitra, 1973); Karnataka (Bongale & Bharati, 1980; Somashekar & Ramaswamy, 1984); Punjab (Grover & Pandhol, 1975; Pandhol & Grover, 1976); Jammu & Kashmir (Goyal et al., 1984); Madhya Pradesh (Sharma & Naik, 1996); West Bengal (Laloraya & Mitra, 1973; Sinha & Mukherjee, 1975b; Pal & Santra, 1982; Sen & Gupta, 1998; Chakraborty et al. 2010).

5. *Oscillatoria subbrevis* Schmidle 1901

Geitler 1932, page 946, figure 601b; Desikachary 1959, page 207, plate 37, figure 2 and plate 40, figure 1; Prescott 1962, page 491, plate 107, figure 23; Komárek & Anagnostidis 2005, page 587, figure 878;

Thallus yellow green, trichome almost straight, constriction absent at the cross-walls, 8 μm broad and 4 μm long, end cell capitate.

Collection No. JS-32, 49; Date:- 05/11/2011

pH: - 6.5; Temperature- 32°C; Place:- Near Singur Co-operative Bank, West Bengal.

Habitat:- Floating on the water body and attached with weeds.

Distribution in India:- Assam (Baruah et al. 2009; Deka & Sarma, 2011); Maharashtra (Dixit 1936; Gonzalves & Joshi, 1943; Vasishta, 1968; Marathe & Sontakke, 1977; Tarar & Kelkar, 1979; Bharate & Tarar, 1982; Thomas & Gonzalves 1965; Ansari et al. 2012; Nandan & Ahuja 2010; Thakur & Behere 2008; Patil & Nandan 2011; Tarar & Mazumdar 1981; Charian 2010a; Charian 2010b; Kumawat & Jawale 2006; Patil & Neelima. 2013; Karande et al., 2012); Jammu & Kashmir (Prasad & Srivastava 1965); Uttar Pradesh (Bendre & Kumar, 1975; Misra et al. 2008; Tiwari & Chauhan 2006; Misra et al., 2008; Singh 1959a; Singh 1959b; Dubey et al. 2010; Goyal et al. 2008; Gupta & Agrawal 2008; Dwivedi 2010; Singh & Saxena 1969; Rao, 1936; Prasad & Srivastava, 1965, 1968; Pandey, 1969; Khan, 1970; Kumar, 1970; Singh & Chaturvedi, 1970; Pal & Yadav, 1974; Pal, 1975; Rai & Kumar, 1976, 1979; Prasad & Saxena, 1980; Pandey, 1982a); Arunachal Pradesh (Sudhakar & Venkateswarlu 1989; Mikter et al. 2006); Tamil Nadu (Anand & Subramanian, 1994; Muthukumar et al. 2007; Kasthuri et al. 2011; Sugumar et al. 2011; Balasingh 2010; Nagasathya & Thajuddin 2008; Senthilkumar & Sivakumar 2008; Kannan & Vasantha 1992; Sankaran 1998; Vetriselvi et al. 2011; Singh & Balasingh 2011; Vijayakumar et al. 2007; Anand & Subramanian 1994; Subramaniyan et al., 2012; Madhumathi & Vijayakumar, 2013); Punjab (Singh 1941; Vasishta, 1960b; Prasad & Srivastava, 1965; Grover & Pandhol, 1975; Pandhol & Grover, 1976; Sarma & Kant, 1978); Karnataka (Bharati & Bongle, 1975a; Bongale & Bharati, 1980a; Basavarajappa et al. 2010; Kumar & Hosmani 2010; Somashekar & Ramaswami 1984); Madhya Pradesh (Garg & Garg 2002; Singh & Samdariya 2006), Jharkhand (Kumar & Sahu 2012); Bihar (Saha & Wujek 1989; Kumar & Choudhary 2009; Bharadwaja 1963); Kerala (Shaji & Panikkar 1994; Senthil et al. 2012); Odisha (Dash et al., 2011); Rajasthan (Vishnoi & Srivastava 2006); Andhra Pradesh (Reddy & Venkateswarlu 1992; Reddy & Venkateswarlu 1985); Arunachal Pradesh (Singh et al. 1997); Sikkim (Suseela & Toppo, 2004); Odisha (Dey et al. 2010; Dash et al. 2011); West Bengal (Sen & Gupta, 1998; Sen & Gupta 1998; Naskar et al. 2008; Chakraborty et al. 2010); Gujarat (Gupta, 1964); Himachal Pradesh (Vasishta, 1968); Kerala (Shaji & Panikkar, 1994); Uttarakhand (Gupta, 2005).

6. *Oscillatoria anguina* (Bory) Gomont 1892

Desikachary 1959, page 210, plate 38, figure 11; Geitler 1932, page 948, figure 599b; Komárek & Anagnostidis 2005, page 592, figure 885; Prescott 1962, page 485, plate 108, figure 24.

Thallus yellowish green, trichome almost straight, constriction absent at the cross-walls, 8 μm broad and 4 μm

long, end cell capitate and slightly thickened membrane present, cross walls more or less granulated.

Collection No. JS-8; Date: 09/08/2011

pH:- 7; Temperature- 31°C; Place:- Beside Singur station, West Bengal.

Habitat:- Aquatic, lodged on weeds in a small stagnant water body.

Distribution in India: - Assam (Deka & Sarma, 2011); Uttar Pradesh (Pandey, 1965); Odisha (Mohanty, 1982); Bihar (Rao, 1939); Delhi (Rao, 1940); West Bengal (Mukhopadhyay & Chatterjee, 1981)

7. *Oscillatoria salina Biswas 1926*

Synonym: *Oscillatoria indica* PC.Silva 1996

Geitler 1932, page 979, figure 624; Desikachary 1959, page 239; Komárek & Anagnostidis 2005, page 601, figure 906.

Thallus blue green, trichome more or less straight, end of the trichome arcuated and pointed constriction not present at the cross-walls, cells 4 μm broad and 2 μm long, end cell not capitate, calyptra absent.

Collection No. JS-51; Date: - 05/11/2011

pH:- 7; Temperature- 30°C; Place:- Near Singur Co-operative Bank, West Bengal..

Habitat: - Aquatic, lodged on the surface of the submerged aquatic plants.

Distribution in India:- Goa (Modassir & Ansari, 2011); Kerala (Shaji & Panikkar, 1994); Maharashtra (Ashtekar & Kamat, 1980); Tamil Nadu (Anand & Subramanian, 1994; Nedumaran & Manokaran, 2009; Sugumar et al., 2011; Subramaniyan et al., 2012; Silambarasan et al., 2012, Madhumathi & Vijayakumar, 2013; Ramanaathan et al., 2013); Uttar Pradesh (Prasad & Mehrota, 1980); West Bengal (Banerji, 1938; Sen & Gupta, 1998; Chakraborty et al., 2010)

8. *Oscillatoria tenuis Agardh ex Gomont 1892*

Geitler 1932, page 959, figure 611f, g; Desikachary 1959, page 222, plate 42, figure 15; Prescott 1962, page 491, plate 110, figure 8, 9, 14; Komárek & Anagnostidis 2005, page 587, figure 878.

Thallus blue green, trichome straight, constriction not present at the cross-walls, cell 6 μm broad and 4 μm long, granule present uniformly.

Collection No. JS-58, 158, Date: - 18/11/2011, 28/01/2012

pH:- 6.5; Temperature- 28°C; Place:- Beside Mahamaya High School, West Bengal.

Habitat: - Aquatic, lodged on the aquatic weeds in a rice field.

Distribution in India:- Andhra Pradesh (Ghusuddin, 1937; Zafar, 1968); Assam (Deka & Sarma, 2011); Bihar (Rao, 1939, Vasishta, 1968); Delhi (Rao, 1940); Gujarat (Kamat, 1962-63; Vasishta, 1968; Marathe & Choudhari, 1976); Kerala (Shaji & Panikkar, 1994); Himachal Pradesh (Kamat, 1968a; Vasishta, 1968); Karnataka (Kamat, 1972); Maharashtra (Gonzalves & Joshi, 1946; Kamat, 1963b; Vasishta, 1968; Ashtekar & Kamat, 1980; Kumawat & Jawale, 2006); Manipur (Brühl & Biswas, 1926); Madhya Pradesh (Sharma & Naik, 1996); Odisha (Rao, 1939; Mohanty, 1982; Dash et al., 2011); Tamil Nadu (Fremy, 1942; Ramkrishnan & Kannan, 1992; Anand & Subramanian, 1994; Silambarasan et al., 2012, Subramaniyan et al., 2012; Madhumathi & Vijayakumar, 2013; Ramanathan et al., 2013); Uttar Pradesh (Rao, 1937; Saxena, 1960; Prasad, 1964-65; Kumar, 1970; Singh et al., 1970, Ahmad, 1972; Bendre & Kumar, 1975; Pal, 1975; Darbel et al., 1978; Prasad & Saxena, 1980; Misra & Srivastava, 2005; Tiwari & Chauhan, 2006; Misra et al., 2008); West Bengal (Martens, 1870; Prain, 1905; Brühl & Biswas, 1922; Biswas, 1925, 1927, 1942; Banerji, 1938; Vasishta, 1968; Chakraborty et al. 2010).

9. *Oscillatoria proboscidea Gomont 1892*

Geitler 1932, page 948, figure 598b; Desikachary 1959, page 211, plate 38, figure 9; Komárek & Anagnostidis 2005, page 596, figure 891;

Thallus pale green colour, trichome straight, constriction absent at the cross-walls, cell 8 μm broad and 4 μm long, tip portion capitate.

Collection No. JS-71; Date: - 30/11/2011

pH:- 7.5; Temperature- 32°C; Place:- Near Singur Health center, West Bengal.

Habitat: Aquatic, lodged on the submerged bamboo leaves.

Distribution in India:- Assam (Deka & Sarma, 2011); Andhra Pradesh (Sarojini, 1996); Bihar (Vasishta, 1968; Sinha & Srivastava, 1980); Delhi (Rao, 1940); Gujarat (Vasishta, 1968); Himachal Pradesh (Vasishta, 1968; Kumar et al., 2013); Karnataka (Bongale & Bharati, 1980a); Madhya Pradesh (Tiwari, 1972, 1975); Maharashtra (Gonzalves, 1947; Vasishta, 1968; Tiwari, 1972, 1975; Kamat, 1975; Kumawat & Jawale, 2006); Tamil Nadu (Tiwari, 1972; 1975; Anand & Subramanian, 1994; Subramaniyan et al., 2012); Uttar Pradesh (Singh, 1939a, 1939b, Venkataraman, 1958; Pandey, 1965a, 1965b; Ahmad, 1967; Khan, 1970; Kumar, 1970; Bendre & Kumar, 1975; Pal, 1975; Chaturvedi & Pandey, 1976; Darbal et al., 1978; Tiwari & Chauhan, 2006); West Bengal

(Vasishta, 1968; Sinha & Mukherjee, 1975; Naskar et al., 2008)

10. *Oscillatoria nitida* Škorbatov 1923

Komárek & Anagnostidis 2005, page 586, figure 875

Thallus green colour, constriction absent at the cross-walls, cells 8 μm broad and 4 μm long, trichome straight, tip portion rounded, granule uniformly present.

Collection No. JS-68; Date: - 30/11/2011

pH:- 7; Temperature- 31°; Place:- Near Singur Abani Maidan, West Bengal.

Habitat: - Growing on the surface of a stagnant water body.

Distribution in India:- This is probably the first record of the species from India.

11. *Oscillatoria raoi* DeToni, J. 1939

Desikachary 1959, page 223, plate 42, figure 16-19

Thallus light green colour, trichome more or less straight, constriction not present at the joints, cells 5 μm broad and 4 μm long, end cell more or less rounded not capitate, without any calyptra.

Collection No. JS-34, 155; Date: - 05/11/2011, 28/01/2012

pH:- 7; Temperature- 29°C; Place:- Near Singur Co-operative Bank, West Bengal.

Habitat: - Aquatic, found in the stagnant water in a rice field.

Distribution in India:- Karnataka (Somashekhar, 1984); Uttar Pradesh (Kumar, 1970; Pal, 1975; Bendre & Kumar, 1975); Punjab (Pandhol & Grover, 1976; Sarma & Kant, 1978); Maharashtra (Bhoge & Ragothaman, 1986; Kumawat & Jawale 2006); West Bengal (Sinha & Mukherjee, 1984; Chakraborty et al. 2010).

12. *Oscillatoria princeps* Vaucher ex Gomont 1982

Desikachary 1959, page 210, plate 37, figure 1, 10, 11, 13, 14; Geitler 1932, page 947, figure 598a, 601c-g;

Komárek & Anagnostidis 2005, page 590, figure 883; Prescott 1962, page 489, plate 110, figure 1.

Thallus blue green, slightly curved, constriction absent at the cross-walls, 6 μm long and 24 μm broad, end cell slightly capitates.

Collection No. JS-15; Date: - 09/08/2011

pH:- 6.5; Temperature- 30°C; Place:- Beside Singur station, West Bengal.

Habitat: - Whitish green algal mass, attached on the surface of the aquatic plants.

Distribution in India:- Andhra Pradesh (Ghousuddin, 1937; Venkateswarlu, 1976; Sarojini, 1996); Assam (Biswas, 1934; Deka & Sarma, 2011); Delhi (Rao, 1940); Gujarat (Gupta, 1964; Patel et al., 1974); Himachal Pradesh (Kumar et al., 2013); Jammu & Kashmir (Subba-Raju, 1963; Mir & Suri, 1975; Anand, 1976, 1979); Karnataka (Srinivasan, 1963; Kamat, 1972; Tiwari, 1972, 1975; Bongale & Bharati, 1980a, 1980b); Kerala (Suxena et al., 1973; Shaji & Panikkar, 1994); Madhya Pradesh (Bendre & Agarkar, 1965; Agarkar, 1967; Tiwari, 1972, 1975; Dikshit & Agarkar, 1974); Maharashtra (Dixit, 1936; Kamat, 1963b; 1974; Palli, 1975; Kumawat & Jawale, 2006); Odisha (Rao, 1939; Mohanty, 1982; Dash et al., 2011; Das & Adhikary, 2012; Patil & Neelima. 2013); Punjab (Vasishta, 1963; Grover & Pandhol, 1975; Pandhol & Grover, 1976); Rajasthan (Goyal, 1964); Tamil Nadu (Rao, 1938b; Tiwari, 1972, 1975; Ramkrishnan & Kannan, 1992; Anand & Subramanian, 1994; Subramaniyan et al., 2012; Madhumathi & Vijayakumar, 2013); Uttar Pradesh (Rao, 1936; Mitra, 1961; Gupta, 1957; Singh, 1959b; Saxena, 1960; Gupta & Nair, 1962; Prasad, 1964-65; Das et al., 1965; Gupta & Srivastava, 1965; Gupta, 1966; Shukla, 1966; Kumar, 1970; Singh et al., 1970; Pal & Yadav, 1974; Bendre & Kumar, 1975; Chaturvedi & Pandey, 1976; Rai & Kumar, 1976, 1979; Darbal et al., 1978; Prasad & Saxena, 1980; Pandey, 1982a; Misra & Srivastava, 2005; Tiwari & Chauhan, 2006; Misra et al., 2008); Uttarakhand (Gupta, 2005); West Bengal (Biswas, 1925, 1927, 1949; Banerji, 1938; Kachroo, 1959; Sinha & Mukherjee, 1975; Sen & Gupta, 1998; Chakraborty et al. 2010)

This appears to be the one of the most common species of *Oscillatoria* in India.

13. *Oscillatoria okeni* Agardh ex Gomont 1892

Synonym: *Phormidium okenii* (C. Agardh) Anagnostidis & Komárek 1988

Desikachary 1959, page 231, plate 38, figure 17

Thallus yellowish green, trichome more or less straight, constriction at the cross-walls, 4-5 μm broad and 4 μm long, end cell attenuated, slightly bent, undulating, end cell not capitate, without calyptra.

Collection No. JS-69,117; Date: - 12/01/2012

pH:- 7; Temperature- 32°C; Place:- Near Singur Co-operative Bank, West Bengal.

Habitat: - Aquatic, lodged on the aquatic plants in a rice field.

Distribution in India:- Assam (Deka & Sarma, 2011); Uttar Pradesh (Rao 1937, Kumar, 1970; Bendre & Kumar, 1975; Chaturvedi & Pandey 1976, Pandey & Chaturvedi 1979, Chadha & Pandey 1983; Singh & Suxena 1969; Tiwari & Chauhan 2006; Mishra et al. 2008); Andhra Pradesh (Sarojini 1996); Arunachal Pradesh (Singh et al. 1997); Delhi (Suryaprakasa 1940); Odisha (Rao 1938a; Ghadai et al. 2010; Mohanty 1982); Southern east coast of India (Thajuddin & Subramanian 1992); Tamil Nadu (Tiwari 1972; Deepa et al. 2011; Subramaniyan et al., 2012); Madhya Pradesh (Singh & Samdariya 2006); Bihar (Ranjana et al. 1998); Uttarakhand (Shukla et al. 2009); Maharashtra (Kamat 1963a; Kamat 1975); Punjab (Pandhol & Grover 1976, Sarma & Kanta 1978); Kerala (Parukutty 1940); West Bengal (Sinha & Mukherjee 1975a, Sen Sarkar et al. 2013); Karnataka (Kamat, 1972).

14. *Oscillatoria vizagapatnensis* Rao, C.B. 1938

Rao, C.B. 1938, page 89, figure 1-3; Desikachary 1959, page 205, plate 39, figure 16, 18; Komárek & Anagnostidis 2005, page 602, figure 909

Thallus yellowish green colour, trichome straight, 12 μm broad and 4 μm long, without constriction at the cross-walls, tip portion elliptical forming cap like structure.

Collection No. JS-126; Date:- 12/01/2012

pH: - 7; Temperature- 29°C; Place:- Near Singur Abani Maidan, West Bengal.

Habitat: - Light green, growing on the moist soil.

Distribution in India:- Andhra Pradesh (Rao, 1938b); Assam (Deka & Sarma, 2011); Gujarat (Vaidya & Upadhyaya, 1968); Jammu & Kashmir (Anand, 1976, 1979); Karnataka (Kamat, 1972); Kerala (Shaji & Panikkar, 1994); Madhya Pradesh (Tiwari, 1972, 1975); Maharashtra (Patil & Neelima. 2013); Rajasthan (Anantani & Marathe, 1972); Odisha (Sethi et al., 2012); Tamil Nadu (Tiwari, 1972; 1975); Uttar Pradesh (Khan, 1970; Bendre & Kumar, 1975; Pal, 1975); West Bengal (Chakraborty et al. 2010; Sen Sarkar et al., 2013).

15. *Oscillatoria amoena* (Kützing) Gomont 1892

Desikachary 1959, page 230, plate 40, figure 12; Prescott 1962, page 484, plate 109, figure 2-4.

Thallus light green colour, trichome straight, end cell slightly attenuated, 8 μm broad and 4 μm long, end cells capitate, slightly constricted at the cell walls, granule uniformly distributed, end cell with calyptra.

Collection No. JS-32, 49; Date: - 05/11/2011

pH: - 6.5; Temperature- 30°C; Place:- Beside Singur Mahama-ya High School, West Bengal.

Habitat: - Attached on the surface of the bamboo in a shaded area in a small water body.

Distribution in India:- Uttar Pradesh (Chaturvedi & Pandey, 1976; Prasad & Mehrotra, 1980); Karnataka (Bongale & Bharati, 1980; Somashekhar & Ramaswamy, 1984); Jammu & Kashmir (Goyal et al., 1984); Madhya Pradesh (Mishra & Purohit, 1979); Punjab (Sarma et al., 1979); West Bengal (Sinha & Mukherjee, 1975b; Mkhopadhyay & Chatterjee, 1981).

16. *Oscillatoria laete-virens* P.L.Crouan & H.M.Crouan ex Gomont 1892

Synonym: *Phormidium laetevirens* (P.L.Crouan & H.M.Crouan ex Gomont) Anagnostidis & Komárek 1988

Geitler 1932, page 949, figure 603c; Desikachary 1959, page 213.

Thallus blue green in colour, trichome slightly bent at tip portion, cross wall slightly constricted, 4 μm broad and 6 μm long, apical part slightly attenuated and bent, cells more or less as long as broad, end cell not capitates, without calyptas.

Collection No. JS-131; Date: - 28/01/2012

pH:- 7; Temperature- 30°C; Place:- Beside Singur station, West Bengal.

Habitat: - Aquatic, attached on aquatic weeds.

Distribution in India:- Gujarat (Vasishta, 1968); Himachal Pradesh (Vasishta, 1968; Kumar et al., 2013); Karnataka (Bongale & Bharati, 1980a); Maharashtra (Kumawat & Jawale, 2006); Uttar Pradesh (Gupta, 1975; Singh, 1961; Gupta & Nair, 1962; Gupta, 1966; Pandey, 1965a, 1965b; Pandey, 1969, 1970; Khan & Kumari, 1972; Pal & Yadav, 1974; Bendre & Kumar, 1975; Chaturvedi & Pandey, 1976; Pandey & Chaturvedi, 1979; Prasad & Mehrota, 1980; Prasad & Saxena, 1942; Kumar, 1970), Madhya Pradesh (Sharma & Naik, 1996); Andhra Pradesh (Sarjojini, 1996); Tamil Nadu (Subramaniyan et al., 2012; Madhumathi & Vijayakumar, 2013).

DISCUSSION

During the course of investigation it has been observed that *O. simplicissima*, *O. princeps*, *O. subbrevis*, *O. sancta* and *O. tenuis* are most dominant species in unpolluted habitats and *O. limosa* is common in polluted habitats. From this studies we can easily explain the ecological preferences of various species of *Oscillatoria* and role of some of them (*O. limosa*) as pollution indicator.

CONCLUSION

Under this study we recorded 16 species of *Oscillatoria* Vaucher from various localities of Singur block of Hooghly district of West Bengal. Actually these types of studies pinpoint the habitat specified knowledge of this group of algae in the concerned area. As we all know that cyanoprokaryotic members can withstand a wide ecological regime this study will also help to fill the existing lacunae in our knowledge of the biodiversity of the group in this country. In this study we found *O. simplicissima*, *O. princeps*, *O. subbrevis*, *O. sancta* and *O. tenuis* as most common species in unpolluted habitats where as *O. limosa* is common in polluted habitats. *O. nitida* appears to be the first Cyanoprokaryote recorded in India.

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Plate I

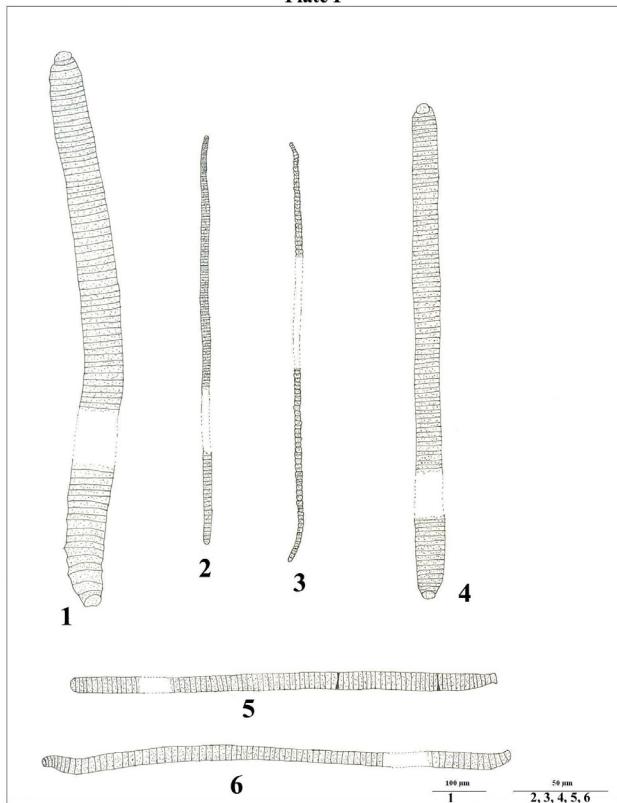


Plate II

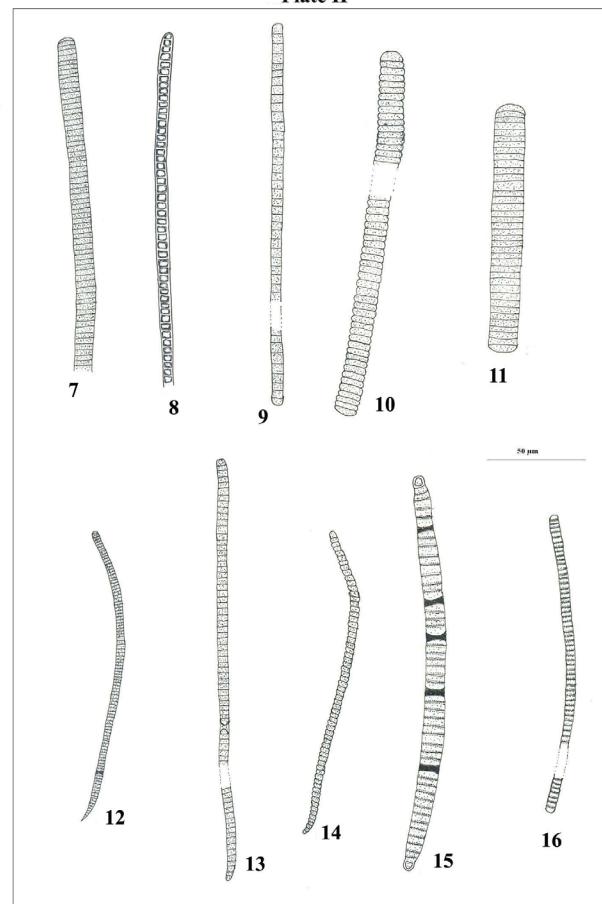
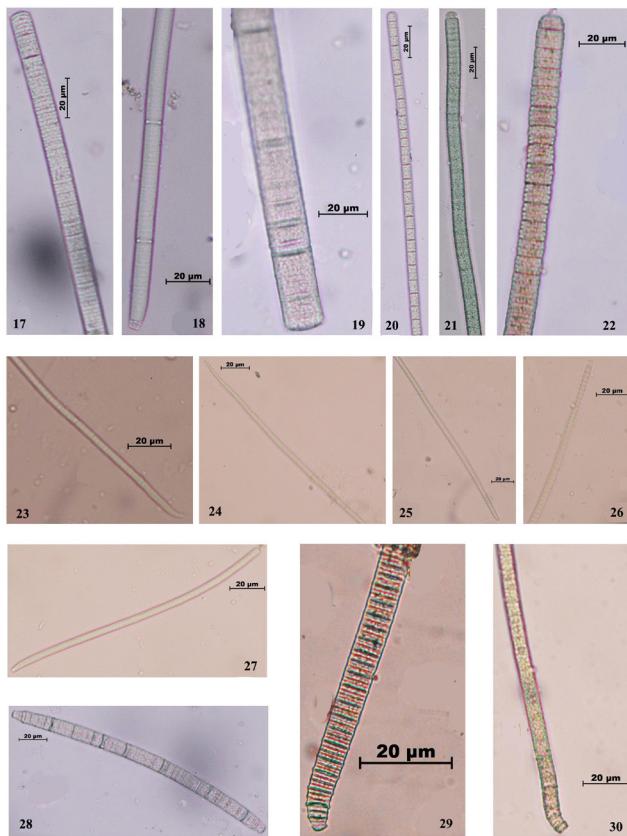


Plate III



LEGEND TO FIGURES

Oscillatoria princeps Vaucher ex Gomont; Plate I, Figure 1 and Plate III, Figure 29

Oscillatoria simplicissima Gomont; Plate I, Figure 2 and Plate III, Figure 24

Oscillatoria laete-virens PAGEL.Crouan & H.M.Crouan ex Gomont; Plate I, Figure 3

Oscillatoria vizagapatnensis Rao, C.B.; Plate I, Figure 4

Oscillatoria proboscidea Gomont; Plate I, Figure 5 and Plate III, Figure 18

Oscillatoria anguina (Bory) Gomont; Plate I, Figure 6 and Plate III, Figure 30

Oscillatoria limosa Agardh ex Gomont; Plate II, Figure 7 and Plate III, Figure 17

Oscillatoria nitida Škorbatov; Plate II, Figure 8 and Plate III, Figure 25

Oscillatoria raoi DeToni, J.; Plate II, Figure 9 and Plate III, Figure 20

Oscillatoria sancta (Kützing) Gomont; Plate II, Figure 10 and Plate III, Figure 22

Oscillatoria subbrevis Schmidle; Plate II, Figure 11 and Plate III, Figure 19

Oscillatoria salina Biswas; Plate II, Figure 12 and Plate III, Figure 23

Oscillatoria tenuis Agardh ex Gomont; Plate II, Figure 13 and Plate III, Figure 21

Oscillatoria okeni Agardh ex Gomont; Plate II, Figure 14 and Plate III, Figure 27

Oscillatoria amoena (Kützing) Gomont; Plate II, Figure 15 and Plate III, Figure 28

Oscillatoria obscura Brühl et Biswas; Plate II, Figure 16 and Plate III, Figure 26

Study Area: - Plate IV

Plate IV

