
Genus *Arthrospira*, *Spirulina*, *Oscillatoria*, *Crinalium* and *Phormidium* of Nostocales from Sakri and Navapur, Maharashtra (India)

Jaiswal A.G.

Arts, Commerce and Science College Navapur;

Dist. Nandurbar 425 418 Maharashtra (India)

ABSTRACT

During the study of systematic account Nostocales of Sakri and Navapur taluka, district Dhule and Nandurbar respectively, Maharashtra the author collected fifty eight taxa belonging to five genera. Oscillatoria Vaucher is a dominant genus followed by Phormidium Kutz. And Spirulina Turpin et. Gardner while Crinalium Crow is represented by three taxa and Arthrospira Kutz. is a monotypic.

Out of fifty eight taxa Oscillatoria cruenta Grun. And Crinalium endophyticum Crow, are first time recorded from India. Three taxa from genus Oscillatoria Vaucher are new record for Maharashtra while six taxa from genus Oscillatoria Vaucher, and one taxa each from genus Spirulina Turpin et. Gardner and Phormidium Kutz. was recorded second time from Maharashtra.

These genus of Nostocales from this region have not been studied earlier. This is the first ever attempt to explore, enumerate and taxonomically evaluate the algal components of the area. Distribution of the taxa in India has been discussed. The quantitative availability of species is also noted.

Key words: Nostocales, Systematic account, Sakri, Navapur.

INTRODUCTION

The good deal of literature is now available on Indian Nostocales – Ashtekar and Kamat (1980), Anand and Subramanian (1994), Anand and Hooper (1995), Anand (1975, 1980), Angadi (1990), Barhate and Tarar (1983), Bruhl and Biswas (1922,1922a, 1926), Bilgrami (1991), Banerji (1938), Bongale and Bharati (1980), Bhoge and Raghoutaman (1986), Bendre and Kumar (1975), Biswas (1925, 1926, 1934, 1942), Chatterjee and Mohanty (1990), Chaturvedi and Habib (1995), Chatterjee and Chaudhary (1980), Chaturvedi and Pandey (1976), Compere (1983), Chaporkar and Gangwane (1984), Desikachary (1959), Dixit (1936), Dominic and Madhusoodanan (1999), Gonzalves and Gangla (1949), Govindan (1990), Gupta and Nair (1962), Goyal et.al. (1984), Gonzalves and Joshi (1943, 1946), Grover and Pandhol (1975), Gupta (1957, 1965), Gupta and Shukla (1994), Jha et.al. (1986), Jayaswal and Ragothaman (1993), Kamat and Patel (1973), Khan (1985), Kamat (1962-63, 1963, 1968, 1971, 1972, 1974), Kant and Gupta (1998), Khan and Rawat (1972), Kohli et.al. (1994), Kolte and Goyal (1985), Kumar (1970), Kumar and Shah (1993), Kaushik (1992), Marathe (1964), Mahajan and Mahajan (1990), Maity and Santra (1985), Mohanty (1984), Marathe and Sontakke, (1977), Nandkar et.al. (1983), Marathe (1962-63, 1966-67), Marathe and Anantani (1972), Mitra (1951), Nandan and Borse (1996), Mukhopadhyay and Chatterjee (1981), Mitra and Purohit (1978), Pandey (1965, 1982), Prasad et.al. (1986, 1998), Pal (1975), Pandey and Pandey (1982), Pal and Santra (1982, 1985), Panchol and Grover (1976), Pal and Yadav (1974), Pandhol and Grover (1976), Parukutty (1940), Prasad and Mehrotra, (1979, 1980), Patil and Satav (1986), Prasad and Srivastav (1986), Pandey and Chaturvedi (1978), Prasad et. al. (1986), Hegde and Bharati (1983), Roy and Sen (1985), Rao (1937, 1938), Rao and Patnik (1975), Reddy et.al. (1986), Somasshekar (1983, 1984), Sinha and Mukherjee (1975), Shrivastava and Singh (1995), Srivastava and Nigam (1980), Somashekar and Ramaswamy (1983), Sabata and Nayar (1995), Sarma and Kant (1978), Sen and Gupta (1998), Shaji and Panikar (1994), Singh et.al. (1970), Sarma and Naik (1996),

Srivastava and Odhwani (1993), Salam and Khan (1978), Sabata and Nayar (1995), Thomas and Gonzalves (1956, 1965, 1965a, b, c), Tiwari (1972), Tarrar and Shewale (1984), Tarar et.al. (1993), Trivedy (1982), Singh (1941), Singh et.al. (1997), Subba Raju (1972), Sankaran (1984), Srinivasan (1963), Santra (1990), Schmidle (1900), Sarma et. al. (1985), Verma et.al. (1990), Vasishta (1960). No information exists on these genus of Nostocales from Sakri and Navapur taluka. Fifty eight taxa belonging to five genera collected from different places. Out of 58 taxa two are reported for the first time from India, three taxa are new to Maharashtra and eight taxa has been reported second time from Maharashtra.

MATERIALS AND METHOD

During study of algal flora of this region the survey of Nostocales was carried out from December 1990 to January 1992 and March 1998 to March 1999. The collections were made at every fortnight from all possible places. The materials were preserved in 4 % formaldehyde.

The Nostocales were identified with the help of available publications and monograph i.e. Anand (1990), Anand and Hooper (1995), Biswas (1926, 1980), Bruhl and Biswas (1924, 1926, 1992), Compere (1983, 1984), Crow (1927), Desikachary (1959), Das and Peters (1990), Ghose (1923, 1925), Holsinger (1954), Kamat (1963), Kant and Gupta (1998), Parukutty (1940), Prasad et. al. (1986), Rao (1936, 1937, 1938a, 1938b), Smith (1950), Shaji and Panikar (1994), Singh et. al. (1970), West (1907) etc.

Distribution of the taxa in India has been studied with the available literature. The quantitative availability of species is also noted. For quantitative abundance abbreviations are used as: C- common; RC- rather common; VC- very common; R- rare; RR- rather rare; VVR- very very rare; VVVR- very very very rare.

SYATEMATIC ACCOUNT

NOSTOCALES Geitler

OSCILLATORIACEAE Kirchner

ARTHROSPIRA

***Arthrospira blkrishnanii* Kamat**

Observed trichomes 4 μ broad; cells 1.2 μ long; spirals 6 μ broad; distance between the two consecutive spirals 13 μ

Habitat: On a moist soil in forest and soil algae forming a mat in botanical garden (A)

CBN: 174 and 185 (Kondaibari and Navapur: 01/08/2013 and 28/08/2013)

SPIRULINA Turpin et. Gardner

***Spirulina meneghiniana* Zanard ex. Gomont.**

Observed breadth of trichomes 1.2 μ ; spirals 2 μ broad; distance between the spirals 2 μ

Habitat: In a pond (A)

CBN: 50 (Dusane: 29/09/2013)

***Spirulina laxissima* West G.S.**

Observed breadth of trichome 0.8 μ ; spirals 5.2 μ broad, 22 μ distant from each other

Habitat: Plank tonic in a small pond (A)

CBN: 143 (Pimpalner: 05/07/2013)

***Spirulina laxissima* West G.S. form *major* Desikachary**

Observed breadth 1.3 μ

Habitat: In road side rain water pool (A)

CBN: 232 (Vadphali: 04/10/2013)

Distribution: Second record for Maharashtra

***Spirulina subtilissima* Kutz. Ex. Gomont.**

Observed breadth of trichome 0.8 μ ; distance between the spirals 2 μ

Habitat: Road side ditch (A)

CBN: 130 (Dusane: 02/07/2013)

Distribution: Second record for Maharashtra

***Spirulina major* Kutz. Ex. Gomont.**

Trichome 1.2-1.7 μ broad, regularly spirally coiled, blue-green, spirals 2.5-4 μ broad and 2.7-5 μ distant

Habitat: Floating on water surface in road side ditch (A)

CBN: 320 (Navapur: 08/11/2013)

***Spirulina princeps* W et. G.S.West**

Observed breadth 0.5 μ ; spirals 7-10 μ . The species is highly variable

Habitat: Road side ditch (A)

CBN: 130 (Dusane: 02/07/2013)

OSCILLATORIA Vaucher

***Oscillatoria annae* Van Goor**

Observed breadth of cells 7.5 μ ; length 3.5 μ

Habitat: Road side ditch (C)

CBN: 320 (Navapur: 08/11/2013)

***Oscillatoria vizagapatensis* Rao C.B.**

Cells 1.6-2 μ long

Habitat: Submerged in stagnant water (VC)

CBN: 213 (Nagziri Dam: 03/10/2013)

Distribution: Second record for Maharashtra

***Oscillatoria ornata* Kutetz. E. Gomont var. *crassa* Rao.C.B.**

Observed breadth of trichome 11.75 μ ; length of cells 3.75 μ

Habitat: Attached to submerged vegetation in pond (R)

CBN: 133 (Samode: 05/07/2013)

***Oscillatoria limosa* Ag. ex. Gomont**

Observed breadth of trichome 13 μ ; cells 4-8 μ long

Habitat: On a moist soil near river and inside stream (A)

CBN: 19 and 146 (Navagaon and Gangapur: 10/03/2013 and 07/04/2013)

***Oscillatoria obscura* Bruhl et. Biswas**

Observed length 4.5 μ ; breadth 2.5 μ

Habitat: Attached to rock in stream (VC)

CBN: 19 (Navagaon: 10/03/2013)

***Oscillatoria subbrevis* Schmidle**

Observed breadth of trichome 8.4 μ ; cells 1.4 μ long. The present form shows more resembles with Dixit (1936) than Desekachary's (1959) form.

Habitat: On moist soil on bank of river (RC)

CBN: 18 (Navagaon: 10/03/2013)

***Oscillatoria bharadwajae* Kamat**

Observed diameter of trichome 36 μ ; cells 5-6 μ long

Habitat: Soil algae, forming a mat in botanical garden (VC)

CBN: 185 (Navapur: 28/08/2013)

Distribution: Second record for Maharashtra

***Oscillatoria princeps* Vaucher ex. Gomont**

Habitat: On a moist soil near river and in a stream (VC)

CBN: 19 and 146 (Navagaon and Gangapur: 10/03/2013 and 07/04/2013)

***Oscillatoria princeps* Vaucher ex. Gomont. var. *pseudolimosa* Ghose**

Habitat: Free floating on a water surface of road side ditch (VC)

CBN: 291 (Navapur: 08/11/2013)

Distribution: Second record for Maharashtra

***Oscillatoria gamdiensis* Mahajan et. Patel**

Trichomes 26 μ broad; cells 3 μ long

Habitat: Submerged in stream (RC)

CBN: 146 (Gangapur: 07/04/2013)

Distribution: First record for Maharashtra

***Oscillatoria laete-virens* (Crouan) Gomont**

Observed length 2 μ ; breadth 4 μ

Habitat: on mud (A)

CBN: 56 (Nacktya Bandhara: 29/09/2013)

***Oscillatoria chlorina* Kutz. Ex. Gomont**

Observed length 3.8 μ ; breadth 4 μ

Habitat: In muddy water pool (C)

CBN: 153 (Sakri: 01/10/2013)

***Oscillatoria terebriformis* Ag. ex. Gomont**

Observed length 5.1 μ ; breadth 4.9 μ

CBN: 19 and 146 (Navagaon and Gangapur: 10/03/2013 and 07/04/2013)

***Oscillatoria chalybea* (Mertens) Gomont**

Cells 3.6-8 μ long

Habitat: Submerged in road side rain water ditch (C)

CBN: 102 (Chinchpada: 01/10/2013)

***Oscillatoria chalybea* (Mertens) Gomont var. *insularis* Gardner**

Observed length 6.4 μ ; breadth 12.2 μ

Habitat: In waste water passage (C)

CBN: 191 (Vadphali: 04/10/2013)

Distribution: Second record for Maharashtra

***Oscillatoria foreaui* Fremy**

Observed length 2 μ ; breadth 2 μ

Habitat: In stagnant water (A)

CBN: 19 (Navagaon: 10/03/2013)

***Oscillatoria mougeottii* Kutz.**

Observed breadth 6 μ

Habitat: Attached on submerged rocks (VC)

CBN: 45 (Visarwadi: 27/09/2013)

***Oscillatoria tenuis* Ag. ex. Gomont**

Observed length 6 μ ; breadth 5 μ

Habitat: In muddy water pool (RC)

CBN: 153 (Sakri: 01/10/2013)

***Oscillatoria raoi* De Toni J.**

Observed breadth of cells 5.5 μ ; length 5 μ

Habitat: Attached on rock in streamlet (VC)

CBN: 135 (Samode: 26/03/2013)

***Oscillatoria simplicissima* Gomont**

Observed length 11 μ ; breadth 4.5 μ

Habitat: Attached on rock in running water (VC)

CBN: 70 (Rangawali Dam: 28/11/2013)

***Oscillatoria irrigua* (Kutz.) Gomont**

Observed length 3.9 μ ; breadth 6.5 μ

Habitat: In a pond in agricultural plot (RC)

CBN: 04 (Sakri: 09/12/2013)

***Oscillatoria limnetica* Lemm.**

Observed cells 1.5 μ broad; 3 μ long

Habitat: In road side ditch (A)

CBN: 213 (Nagziri Dam: 03/10/2013)

***Oscillatoria amphigranulata* Van. Goor.**

Observed breadth 2 μ ; length 2 μ

Habitat: Attached to submerged vegetation in pond (RR)

CBN: 133 (Samode: 05/07/2013)

Distribution: First record for Maharashtra

***Oscillatoria angustissima* West & West**

Observed breadth of trichome 3 μ ; cells 3.2 μ long

Habitat: Attached to rock in running water (VC)

CBN: 133 (Samode: 05/07/2013)

Distribution: First record for Maharashtra

***Oscillatoria quadripunctulata* Bruhl et. Biswas var. *unigranulata* Singh R.N.**

Observed length 3 μ ; breadth 1 μ

Habitat: Attached on *Chara* sp. in a stagnant water (C)

CBN: 56 (Nackatya Bandhara: 29/09/2013)

***Oscillatoria quadripunctulata* Bruhl et. Biswas var. *unigranulata* Singh R.N. form *ahmedabadensis* Kamat**

Observed length 5.2 μ ; breadth 2 μ

Habitat: Submerged in stagnant water (C)

CBN: 135 Samode: 26/03/2013)

Oscillatoria amphibia Ag. ex. Gomont

Observed length of cells 5 μ ; breadth 2.6 μ

Habitat: On submerged twig (RC)

CBN: 189 (Kondaibari: 01/08/2013)

Oscillatoria okeni Ag. ex. Gomont

Observed breadth 5.5 μ ; length 4 μ

Habitat: Attached to Chara sp. In pond (VC)

CBN: 230 (Vadphali: 04/10/2013)

Oscillatoria schultzei Lemm.

Observed length 4 μ ; breadth 2.9-4.4 μ

Habitat: In road side ditch (C)

CBN: 213 (Nagziri Dam: 03/10/2013)

Oscillatoria formosa Bory ex. Gomont.

Observed length of cells 5 μ ; breadth 4.5 μ

Habitat: Soil algae- forming mat in botanical garden (C)

CBN: 185 (Navapur: 28/08/2013)

Oscillatoria formosa Bory ex. Gomont. form *loktakensis* Bruhl & Biswas

Observed form 3.4-3.7 μ broad; cells 2.5-3 μ

Habitat: Soil algae- forming mat in botanical garden (VC)

CBN: 185 (Navapur: 28/08/2013)

Distribution: Second record for Maharashtra

Oscillatoria rubescens Dc. Ex. Gomont

Observed breadth 5 μ ; length of cells 2 μ

CBN: 215 (Nagziri Dam: 03/10/2013)

Oscillatoria lemmermanni Wolosz.

Observed length 5 μ ; breadth 3 μ

Habitat: Road side ditch (RC)

CBN: 217 (Visarwadi: 04/10/2013)

Distribution: Second record for Maharashtra

Oscillatoria acutissima Kufferath

Observed breadth of trichome 2 μ ; cells 3.3 μ long

Habitat: On moist soil near river and stream near Gangapur (RC)

CBN: 19 and 146 (Navagaon and Gangapur: 10/03/2013 and 07/04/2013)

Distribution: Second record for Maharashtra

Oscillatoria salina Biswas

Habitat: Road side ditch (C)

CBN: 311 (Navapur: 08/11/2013)

Oscillatoria acuminata Gomont

Observed length 6 μ ; breadth 4.9 μ

Habitat: Gently adhered on moist rock near stream bank (VC)

CBN: 163 (Kondai bari: 01/08/2013)

Oscillatoria acuta Bruhl et. Biswas (Orth-mut. Geitler)

Observed breadth of trichome 7.1 μ ; cells 3.7 μ long

Habitat: On moist soil on river bank and in rain water pool (A)

CBN: 19 and 146 (Navagaon and Gangapur: 10/03/2013 and 07/04/2013)

Oscillatoria cruenta Grun. (Fig.1)

Observed breadth of trichome 6.5 μ ; length of cells 3.5 μ

Habitat: Road side ditch, floating on water surface (C)

CBN: 311 (Navapur: 08/11/2013)

Distribution: New to India

CRINALIUM Crow.

Crinalium endophyticum Crow. (Fig.2)

Observed width of trichomes 3 μ ; the end of trichome are slightly pointed when mature. Calyptra absent. Each filament consists in the adult state of trichome and sheath, the latter being thin but clearly defined, membranous slightly brownish.

Habitat: Compactly attached to soil on margin of drying pond (VVR)

CBN: 145 (Navapur: 04/04/2013)

Distribution: New to India

Crinalium magnum Fritch et. John.

Observed length 2 μ ; breadth 15 μ

Habitat: In stagnant water with Spirogyra sp. (C)

CBN: 16B (Pimpalner: 10/02/2013)

PHORMIDIUM Kutz.

Phormidium fragile (Meneghini) Gomont

Observed length and breadth of cells 2 μ

Habitat: On a muddy bank of river (R)

CBN: 135 9Samode: 26/03/2013)

Phormidium laminosum Gomont

Observed breadth of trichome 2 μ ; cells 2 μ long

Habitat: On river bank (C)

CBN: 331 (Kolde and Mohanpada: 23/10/2013)

Phormidium tenue (Menegh) Gomont

Observed length of cells 4 μ ; breadth 2.5 μ

Habitat: Floating on water surface in road side ditch (VC)

CBN: 311 (Navapur: 08/11/2013)

Phormidium bohnrei Schmidle

Observed breadth of trichome 2 μ ; cells 1.8 μ long

Habitat: On moist rock (VC)

CBN: 134 (Gangapur: 07/04/2013)

Phormidium purpurasens (Kutz.) Gomont

Observed breadth of trichome 2.7 μ ; cells 4 μ long. The present form is slightly thicker than described by Desikacharya (1959) but matches with that of Rao's algae from Cuttack and Berhampur (Rao, 1938b)

Habitat: Attached to rock in running water (C)

CBN: 332 (Kolde and Mohanpada: 23/10/2013)

Phormidium stagnina Rao C.B.

Observed breadth of filament 13.6 μ ; cells 1.3-1.8 μ

Habitat: In a stagnant water (C)

CBN: 291 (Navapur: 08/11/2013)

Phormidium anomala Rao C.B.

Observed length of trichome 1.2-2 μ ; width with sheath 13.2 μ ; without sheath 10.3 μ

Habitat: Gently adhered on moist rock near stream bank (VC)

CBN: 163 (Kondaibari: 01/08/2013)

Phormidium calacicola Gardner

Observed breadth of filament 10 μ ; trichome 8 μ broad; cells 3.4-4 μ long

Habitat: On a bark of *Ficus* sp. (C)

CBN: 175 (Kondaibari: 01/08/2013)

Phormidium retzii (AG) Gomont

Observed length 7 μ ; breadth 7 μ

Habitat: On submerged twig in road side pond ((C)

CBN: 116 (Navapur: 28/08/2013)

Phormidium corium (Ag.) Gomont

Observed breadth of trichome 6 μ ; cells 3.5 μ broad; 4 μ long

Habitat: Soli algae (VC)

CBN: 185 (Navapur: 28/08/2013)

Phormidium uncinatum (Ag.) Gomont

Observed breadth 4 μ ; length 6 μ

Habitat: From paddy field (VC)

CBN: 241 (Bedki: 03/10/2013)

Phormidium autumnale (Ag.) Gomont

Habitat: On river bank (VR)

CBN: 133 (Samode: 05/07/2013)

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