WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 5, 1322-1337. Review Article ISSN 2277–7105

PHOTORAPHIC REVISION OF THE FAMILY EUGLENACEAE GIRNA RIVER NEAR JALGAON REGION MAHARASHTRA, INDIA

R. B. Borse*

Nagnath Art, Commerce and Science College, Aundha (Nag.) Dist. Hingoli (MS.), India.

Article Received on
17 Jan. 2024,

Revised on 06 Feb. 2024,
Accepted on 27 Feb. 2024

DOI: 10.20959/wjpr20245-31582

***Corresponding Author**
Dr. R. B. Borse
Nagnath Art, Commerce and Science College, Aundha (Nag.) Dist. Hingoli (MS.), India.

ABSTRACT

Family Euglenaceae represent an important aquatic phototrophs, it is interesting group resembles like animal as well as algae or plant. In this study, we aimed to revolutionized our knowledge and understanding of conventional taxonomy of different genus of family from Girna river Jalgaon region of Maharashtra, India. Sample were taken from three locations at Girna river. Twenty nine species of family Euglenaceae were observed under Light microscopic (LM), and identified till forms level. All members of Euglenaceae species were taxonomically determined and are described for the first time from these areas. They were listed and presented with morphological descriptions, dimensional information and photographic information. Green flagellates with elongate, ovoid, spindle-like shape cells, varying in length from 15 to 500 µm, and with one or two flagella originating within an anterior of the cell. Euglenaceae have two methods of locomotion involves helical rotation of the cell and most species exhibit, when swimming stops and other is wiggling method. Chloroplasts vary in shape, size, number per cell and pyrenoid type. The chloroplasts are grass-green and contain chlorophylls.

KEYWORDS: *taxonomic, Euglenales, Euglena, flagellates, wiggling, phototrophs,* Euglenophyceae.

INTRODUCTION

Algae provide relatively unique information concerning ecosystem conditions compared with commonly used animal indicators. Algae respond rapidly and predictably to a wide range of pollutants and, thus, provide potentially useful early warning signals of deteriorating conditions and the possible causes. Algal assemblages provide one of the few benchmarks for

establishing historical water quality conditions and for characterizing the minimally impacted biological condition of many disturbed ecosystems. Preliminary comparisons suggest that algal indicators are a cost-effective monitoring tool as well. (Nandan and Patil, 2002). Algae is primary producers in aquatic ecosystem, they consume the number of element dissolved in water for their survival and growth. Hence, study of algae existing in water help to determine what control or changes the water quality. Therefore algae are used as indicators of water pollutions.

Girna river originates in the western hills of Kalwan subdivision of Nasik district. Total length of Girna river in Jalgaon district is approximately around 174 km. It showers on 162 villages and large number of population. Now-a-days this river has also got polluted.

Jalgaon is one of the major towns and Bambhori is small village of the state that appears after beside the river. The pollution of the river water starts right from Jalgaon and Bambhori as the garbage and sewage water of the town ends in the river water at various spots. Because of the contaminated water, the condition of the river is becoming dangerous day by day. The river water has become quite polluted over the past few years and it is a need to study the Girna river. Although considerable work on the limnological study of rivers in different part of India have been carried out by number of researchers. In Maharashtra very few workers have paid attention on limnological aspect of Girna river. Limnological study on algae was carried out of selected area of Girna river. In present investigation, an attempt was made, to find out the relationship of algal communities and physico-chemical parameters of Girna river.

Girna river originates in the western hills of Kalwan subdivision of Nasik district. Total length of Girna river in Jalgaon district is approximately around 174 km. It showers on 162 villages and large number of population. Now-a-days this river has also got polluted.

Jalgaon is one of the major towns and Bambhori is small village of the state that appears after beside the river. The pollution of the river water starts right from Jalgaon and Bambhori as the garbage and sewage water of the town ends in the river water at various spots. Because of the contaminated water, the condition of the river is becoming dangerous day by day. The river water has become quite polluted over the past few years and it is a need to study the Girna river. Although considerable work on the limnological study of rivers in different part of India have been carried out by number of researchers. In Maharashtra very few workers

have paid attention on limnological aspect of Girna river. Limnological study on algae was carried out of selected area of Girna river. In present investigation, an attempt was made, to find out the relationship of algal communities and physico-chemical parameters of Girna river.

In study area of Girna river is about six kms., station area is one km., river flows to south-east direction near Jalgaon city, study area divided in to three different stations (G-I, G-II and G-III). Station G-II is near the bridge of national highway no. 6. Station G-I is two kms. towards upstream direction of river and station G-III is two kms. Towards downstream direction of river.

MATERIALS AND METHODS

Algal materials were collected in specimen bottles at the beginning of the experiment. Attached algal material collected with forceps or by hand, greenish surface water was collected between 8 to 9 am. Algal sample were collected at monthly interval, during July 2013 to December 2013. Greenish water algae were collected in acid washed container bottles, Photographs taken by Nikon camera and sketches were made byusing camera lucida. Identification of diatoms was mostly based on the key given by …., and remainingpreserved in the 4% formalin for further taxonomic investigation.

Class- Euglenophyceae

Order- Euglenales

Family- Euglenaceae

Genus- ***Trachelomonas*** **Ehrenberg, 1835**

Trachelomonas acanthostoma (Stokes) Deflandre Fig. 1

Prescott, 410, Pl. 85, f. 3, 1962

Test subglobose or ovoid; wall densely punctate, sometimes with minute spiny projections about the flagellum aperture which has a low collar; test 21.4 µ in diameter, 32.4 µ long.

Habitat: Station G-II, Dec. 2007

T. armata f. **involuta** Defl. Fig. 2

G. W. Prescott, 411, Pl. 83, f. 33, 1962

Test broad ovate with rounded ends; flagellar opening surrounded by short collar with spines; wall smooth but spine mostly present at anterior and posterior ends. 34.9 × 27.4 µ.

Habitat: Station G-II and G-III, May. 2007

T. armata v. **steinii** Lemm. Fig. 3

G. W. Prescott, 411, Pl. 83, f. 26, 1962

Test broadly oval with rounded ends. Flagellar aperture surrounded by a short collar with sharp spines; anterior end with many short spines, posterior end with many longer, backwardly directed stout spines. Membrane brown in colour. 28.7-37.7 × 24.5-31.1 µ.

Habitat: Station G-II and G-III, Nov., Dec. 2007

T. bacillifera Playf**.** v. **globosa** Playf. Pl. 24, Fig. 11; Pl. 56, Fig. 4

P. Bourrelly and A. Counte, 13(4): 296, f. 7, 1978.

Test globose, flagellum aperture without collar; short spinous, flinger like outgrowths distributed evenly over the surface, spine obtuse and rod like. Membrane yellowish in colour. Chromatophore oval, discs, numerous. Flagellum 1 ½ to 2 times the body length. 13 µ in diameter.

Habitat: Station G-I, G-II and G-III, Oct. 2007

T. bulla (Stein) Defl. Fig. 6

G. W. Prescott, 411, Pl. 84, f. 15, 1962

Lorica ovoid shaped. Collar differing from of the members and in direct continuation of the main part of the envelope, though much thinner. Wall punctate, reddish brown in colour. Chromatophores numerous, ovoid. Nucleus posterior, lateral. 19.8×16.6 µ.

Habitat: Station G-II, Dec. 2008

T. charkowiensis Swirenko ex Deflandre Fig. 7

G. W. Prescott, 411, Pl. 85, f. 14, 1962

Test oval; flagellum aperture with a short collar; wall brown, uniformly beset with stout conical spines; test 20 µ in diameter, 32.5 µ long.

Habitat: Station G-II, Mar. 2008

T. curta Da Cunha Fig. 8

A. Middelhoek, 2(3): 241, Pl. 1, f. 1, 1950

Test spheroidal, compressed in longitudinal direction, appearing wider than long when seen laterally, but circular in cross-section. Membrane red brown in colour. Chromatophore few, pyrenoids sheathed by paramylum cups. Flagellar opening surrounded sometime by a

thickened ring, but no colour. Flagellum twice the body length. 11.1-13.7 × 13.7-14.5 µ.

Habitat: G-II, Mar and Apr. 2008

T. hispida v**. crenulatocollis** f**. recta** Deflandre Fig. 9

G. W. Prescott, 414, Pl. 83, f. 31, 1962

Test ovoid; flagellum aperture in a short collar with a coarsely toothed margin; wall punctuate and unevenly beset with short sharp spines; test 25-26 µ in diameter, 33-34 µ long.

Habitat: Station G-II, Mar and Apr. 2008 and May 2007

T. hispida (Perty) stein em. Defl. v. **crenulatocollis** (Masks)Lemm.

Z. A. Asaul, 77, Pl. 29, Fig. 8-10, 1975 Fig. 10

Test ovoid with rounded ends. Flagellar opening in a short, definite collar, with a coarsely toothed margin. Wall punctate, unevenly beset with short spines. Membrane dark brown in colour. Flagellum upto 1 ½ times the body length. 28.732.3× 18.9-25.1µ.

Habitat: Station G-II, Mar and Apr. 2008

T. intermedia Dang. Fig. 11

G. W. Prescott, 414, Pl. 83, f. 10, 1962

Test subspherical to oval with rounded ends, slightly narrowed anteriorly; the flagellar opening with thickened ring, without collar; surface finely punctate; membrane brown in colour. Chromatophores 3-4 with sheathed pyrenoids. Flagellum about the body length.14.2-18 × 12-16.2 µ.

Habitat: Station G-II, Mar and Apr. 2007

T. lacustris Drezepolski Fig. 12

Test cylindrical, the lateral margins almost parallel, broadly rounded both posteriorly and anteriorly; flagellum aperture usually without a collar but sometimes with a slightly raised rim; wall coarsely and densely punctae, golden yellow-brown; test 12-16.5 µ in diameter, 26-29.6 µ long.

Habitat: Station G-II, Sep. 2008

T. manginii f**. subpunctata** Safon. Fig. 13

Z. I. Asaul, 115, Pl. 53, F. 4-9, 1975

Test oval to subspherical; broadly rounded at anterior end; rounded or slightly conical at the posterior end. Flagellar opening in a prominent cylindrical short collar. Wall finely punctate,

red brown in colour. 23.8-25.9 × 17-17.5 µ.

Habitat: Station G-II, Apr. 2008

T. oblonga Lemm. Fig. 13

H. Skuja, Ser. 4, 14(5): 165, 1949

Lorica ellipsoidal to oval with rounded ends; flagellar opening surrounded by a ring. Wall smooth, membrane yellow brown in colour. Flagellum 1 $^{1}/_{2}$-2 times the body length. 14.3-21.6 × 12.3-16 µ.

Habitat: Station G-II, May. 2008

T. ornata (Swir.) Skv. Fig. 14

Z. I. Asaul, 50, Pl. 15, F. 1-4, 1975

Test broadly ovate; flatellum aperture in a short collar; small, even spines present all over the test surface, sometimes spines hooked. Membrane brown in colour. Chromatophores 2-4 with sheathed pyrenoids.

Habitat: Station G-II, Jan. 2008

T. planctonica Swir. Fig. 15

G. Huber-Pestalozzi, 328, Pl. 71, f. 668, 1955

Lorica ovate to ovoid, with rounded ends; flagellar opening surrounded by a well developed cylindrical neck with or without serrated edge. Membrane yellow brown in colour. Chromatophore 5-10. Flagellum 2 times the body length. 18.9-24.9 × 14.3-21.3 µ.

Habitat: Station G-II, Oct and Nov. 2008 and G-III, May 2007

T. scabra Playf. Fig. 16

L. Hajdu, 11:21. F. 58, 1976

Test broadly ovoid with slightly narrowed rounded ends; flagellar opening in long slightly curved neck. Surface rough, irregular and scabrous, dark brown in colour; flagellum twice the body length. 28.3 × 18.9 µ.

Habitat: Station G-II, Oct and Nov. 2008 and G-III, Mar. 2007

T. scabra v**. longicollis** Playtair 1916, p. 28 Fig. 17

G. W. Prescott, 417, Pl. 85, f. 7, 1962

Test ovoid; flagellum aperture in a short, twisted collar; wall irregularly and rather coarsely roughened; test 19.5 µ in diameter, 27.3 µ long.

Habitat: Station G-II, Nov. 2008 and G-III, Mar. 2007

T. similis Stokes Fig. 18

G. W. Prescott, 417, Pl. 84, f. 12, 1962

Test oblong ellipsoid, rounded at both ends. Flagellum appears in a curved collar, often swollen at the base; lightly toothed. Wall regularly punctate, uniformly rough ended by irregularly shaped granulation. Membrane yellowish-brown in colour. Chromatophore numerous, small, oval. Nucleus slightly posterior to the middle. Flagellum 1-2 times the body length. 20.4-26 × 15.3-18.2 µ.

Habitat: Station G-II, Aug. 2007

T. superb v. **swirenkiana** Deflandre Fig. 19

G. W. Prescott, 418, Pl. 84, f. 8,9, 1962

Test subglobose; flagellum aperture in a low, ring-like collar; wall spiny in the anterior and posterior portions with a few minute spines in the midregion; the posterior spines longer and stouter than the anterior region; test 31 µ in diameter, 40 µ long.

Habitat: Station G-II, May 2007

T. varians Defl. Fig. 20

G. W. Prescott, 418, Pl. 83, f. 4-5, 1962

Test oval or globose; flagellum aperture surrounded by a cylindrical canal extended inwardly to the test cavity, the special characteristic of the species. Wall dark brown in colour, smooth or may be lightly punctate. 25.5-23.4 µ.

Habitat: Station G-II, Oct. 2007

T. volvocina v. **compressa** Fig. 21

Test depressed-globose of chromatophore compressed; flagellar opening surrounded by a thickening of the wall surface smooth. Yellow in colour; chromatophore few with sheathed pyrenoids 12.3-16 µ in diameter.

Habitat: G-II, Oct. 2007

Genus- *Strombomonas* Deflandre, 1930

Strombomonas acuminata (Schmarda) Defl. Fig. 22

Z. I. Asaul, 133, Pl. 67, f. 1-16, 1975

Test oval; broader towards the posterior end, abruptly ending into a spike; anteriorly

narrowing into a short, cylindrical collar; wall finely punctate. 33.4-46.4 × 19-24.2 µ.

Habitat: Station G-II, Jun. 2007

S. gibberosa (Playf.) Defl. Fig. 23

G. Huber-Pestalozzi, 382, Pl. 79, f. 828, 1955

Lorica distinctly broadly rhombic in outline; tapering to a long, sharp tail posteriorly; anterior end with a wide neck. Wall hyaline to light brown, smooth or rough. 49.6-59 × 26.4-32.5 µ.

Habitat: Station G-II, Jan. 2007

S. schauinslandii (Lemm.) Defl. Fig. 24

G. Huber-Pestalozzi, 381-382, Pl. 79, f. 827, 1955

Envelope, broadly rounded and slightly rhombic in the median part; tapering into a pointed tail posteriorly; with a relatively long, smooth, cylindrical neck, widening slightly at the opening anteriorly. Wall hyaline to yellow-brown, rough. Flagellum about body length. 22-36 ×14-21 µ.

Habitat: Station G-I, Jan. 2007

S. costata Defl. Fig. 25

G. Huber-Pestalozzi, 386, Pl. 80, f. 840, 1955

Test obovate; broadly rounded posteriorly, abruptly ending in a long spine; anteriorly tapering into a cylindrical neck with serrated margins; chloroplasts many without pyrenoids. Wall rough, granular, yellow-brown in colour. Stigma oval, large, reddish. 62.3-64.7 × 23-26.3 µ.

Habitat: Station G-I, Feb. 2007

S. urceolata v**. hyaline** (Swir.) Skv. Fig. 26

Z. A. Asaul, 135, Pl. 68, f. 6-8, 1975

The present form differs from the type in being larger in size, gradually tapering at both ends and comparatively long tail.

Habitat: G-I, Feb. 2007

S. deflandrei (Roll) Defl. Fig. 27

Z. A. Asaul, 133, Pl. 68, f. 1, 1975

Lorica broadly oval with sides sometime nearly parallel; rounded at the poles, bearing short, conical, blunt or pointed tail posteriorly; a short, wide neck, often obliquely cut, at the

anterior end. Envelop brown, rough. Flagellum about 2-2 ½ times the body length. 37.1-37.7 × 24-26.4 µ.

Habitat: Station G-I, Feb and Mar 2008

Genus- *Astasia* Ehr., 1830 em. Duj., 1841

Astasia dangeardii v. **parva** pringsh. Fig. 28

G. Huber-Pestalozzi, 435, Pl. 88, f. 898, 1955

Cell fusiform, narrowing at both ends; posterior half drawn into a short, blunt process. Pellicle faintly spirally striated. Paramylum many, oval granules. Flagellum about length or slightly more. Nucleus in posterior half of the cell. 31.1-37 × 10.4-14.2 µ.

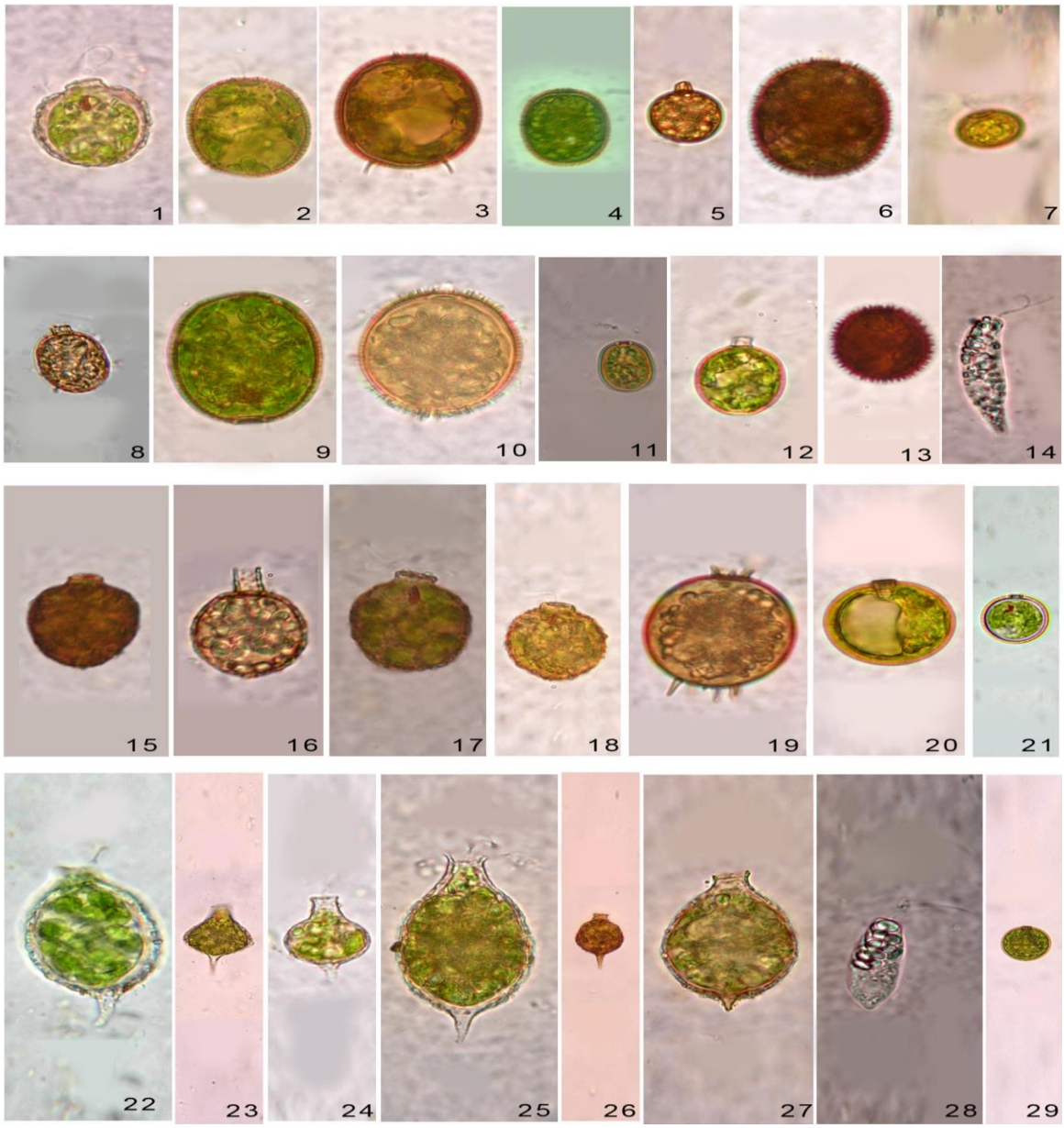
Habitat: Station G-II, Mar 2008

A clava E. G. Pringsh Fig. 29

Asaul, p. 293, Pl. 189, f. 3

Cell fusiform; anterior end truncated, bilabilate with reservoir; posterior end flatended. Pellicle finely spirally striated. Paramylum small rod or discs, irregularly distributed. Flagellum about ¼ of body length or slightly more. Nucleus large. Spherical.

Habitat: Station G-II, Mar 2008.



1) Trachelomonas acanthostoma (Stokes) Deflandre 2) T. armata f. involuta Defl. 3) T. armata v. steinii Lemm.4) T. bacillifera v. globosa Playf. 5) T. bulla Stein 6) T. charkowiensis Swirenko 7) T. curta Da. Cunha 8) T. hispida v. crenulatocollis f. recta Deflandre 9) T. hispida v. crenulatocollis (Masks) Lemm. 10) T. intermedia Dangeard 11) T. lacustris Drezepolski 12) T. manginii f. subpunctata Safon. 13) T. oblonga Lemm. 14) T. ornate (Swir.) Skv. 15) T. planctonica Swir. 16) T. scabra Playf. 17) T. scabra v. longicollis Playfair 18) T. similis Stokes 19)T.superbav.wirenkiana Deflandre 20) T. varians Defl. 21) T. volvocina v. compressa Defl. 22) Strombomonas acuminate (Schmarda) Defl. 23) S. gibberosa (Playf.) Defl. 24) S. schauinslandii (Lemm) Defl. 25) S. costata Define 26) S. urceolata v. hyaline (Swir.) Skv. 27) S. deflandrei (Roll) Defl. 28) Astasia dangeardii v. parva Pringsh. 29) A. clava E. G. Pringsh.

REFERENCES

1. A.P.H.A. Standard methods for the examination of water and waste water. 16th Edition. American Publ. Hlth. Asso. New York. Abraham, B.T., Bissibore, K.S., Heno, T. N. 2002. Study of some physicochemical parameters and treatment of industrial effluent. J. of Environ. Poll, 1985; 1(2): 213-216.
2. Bandela, N. N., Vaidya, D. P., Shivnikaar, S.V. and Lomte, V. S. Determination of Biochemical oxygen demand to estimate biodegrability and self purification Capacity of Burul dam water, district Nanded. Mharashtra. J.of Aqua. Biol., 2002; 17(1): 21-22.
3. Barhate, V. P. and J. L. Tarar. The algal flora of Tapti river, Bhusawal, Maharashtra. Phykos, 1981; 75-78.
4. Baykal, T., Udoh, A. U. and Kazim, Y. The algal flora and seasonal variation of species abundance in Kilicozu stream (Kireshir) Turkey. J. Phytol Res., 2001; 14(1): 43-54.
5. Beeton, A. M. Eutrophication of St. Lawrence great lakes. Limnol. Oceanography, 1965; 10: 240-254.
6. Carter, N. Fresh water algae from India. Records Bot. Surv. India, 1926; 9: 263-302.
7. Chacko, P. I. and Ganapati, S. V. Some observations on the Adyar river with special reference to its hydrobiological conditions. Indian Geo. J., 1949; 24: 25-49.
8. Chacko, P. I. and Ganapati, S. V. Hydrobiological survey of the Suruli river in the Highways, Madurai district, India to determining its suitability for the introduction of the Rainbow trout Sonderdruck aus dem Arch. Fur Hydrobiol, 1952; 47: 128-141.
9. Das, S. M. and Srivastava, V. K. Qualitative studies of fresh water plankton of fish tank in Lucknow, India. Proc. Nat. Acad. Sci. (India), 1956; 26: 8-82.
10. David, A., Rao, N. G. and Rahman, F. A. Limnology and fisheries of Tungabhadra reservoir. Bull Cifri Barrrackpore, 1999; 13: 188.
11. Fritsch, F. E. Observations on phytoplankton of the river Tames Ann. Bot., 1913; 17: 631-647.
12. Ganapati, S. V. Ecology of tropical waters. Proc. Symp. Algol. ICAR, New Delhi, 1960; 1: 214-218.
13. Ganapati, S. V. and Chacko. P. J. An investigation of the river Godavari and effluent of paper mill pollution at Rajahmundry. Proc. Indo- Pacific Fish. Con. Sec., 1940; 2: 1-5.
14. Govindan V. S. and Sudersan. 1979. Seasonal Succession of algal flora in polluted region of
15. Griffiths, B. M. Studies in the phytoplankton of the lowland waters of Great Britain. IV: 1912; (1): 73-76. eutrophication. Biovigyanam, 5: 171–172.

16. Griffiths, B. M. Studies in the phytoplankton of the lowland waters of Great Britain. IV: The phytoplankton of the Isle of Anglessey and of Llyn Ogwen. North Wales. Linn. J. Bot., 1929; 47: 355-366.
17. Gurudeva, M. R., Govindappa, D. A. and Somashekar, R. K. Desmid flora of Savandurga, Karnataka. Phykos, 1983; 22(1&2): 48-56.
18. Hegewald, E. *Scenedesmus* communis Hegewald, a new species and its relation to S. quadricauda (Trup.) Breb. Arch. Hydrobiol, 1977; 51(19): 142-155.
19. Hegewald, E. New combinations in the genus Desmodesmus (Chlorophyceane, Scenedesmaceae). Archiv. fuer. Hydrobiol. Supplement, 2000; 131: 1-18.
20. Hill, M. K., Understanding environmental pollution. Cambridge University Press, Cambridge, 2004; 233.
21. Hirano, M. and Minoru, H. Some new or noteworthy desmids from Japan, II. Acta Phytotax. Geobot, 1950; 14(2): 34-38.
22. Holmes, N. T. and B. A., Whitton. Phytoplankton of 4 rivers, The Tyne, Wear, Teesand and Swale, Hydrobiologia, 1981; 10: 111-127.
23. Hutchinson, G. E. A treatise on limnology Vol. I John wiley and Sons, Inc. New York. The phytoplankton of the Isle of Anglessey and of Llyn Ogwen. North Wales. Linn. J. Bot., 1929; 47: 355-366.
24. Hutchinson, G.E. A treatise on limnology. II John Wiley Sons., New York, 1967; 1015.
25. Hutchinson, G. E. 1957. A treatise on limnology Vol. I John wiley and Sons, Inc. New York.
26. Hedge, G. R. and Bharti, Freshwater algae of Bijapur district, Karanataka state, India. Phykos, 1983; 22: 167-170.
27. Hayes K. P. and Burch M. D. Odorous compounds associated with algal blooms in South Australian waters. Wat. Res., 1989; 23(1): 115–121.
28. Hugo, C., Steffen, W. Auguero, G. Parra, O. and Zuniga, L. Limnological study of lake Llanquidue (Chile): Morphometry, physics, chemistry, plankton and primary productivity. Arch Hydrobiol, 1988; 81(1): 37–68.
29. Indirabai, W. P. S. and George, S. Assessment of drinking water quality in selected area of Tiruchirappalli town after floods. Poll. Res., 2002; 21(3): 243-248.
30. Iyenger, M. O. P. Algal problems peculiar to the trophics with special reference to India Proc. 25th Indian Sci. Cong, 1920-1963; 25: 141-149. ccalean blooms -A comparative account. J. Indian Botanical. Soc., 69: 115-119.

31. Jagdale, M. H., Salunke M. M., Yabhute Y. B., Kodaskar, S. N. and Ghuge, K. N. Pollution of Godavari river water at Nanded Poll. Res., 1984; 2: 83-84.
32. Jayasree, J. Quality of water in Paarvathy Pithanar in Thiruwananthapuram. Eco. Env. And Cons, 2002; 8(2): 167-170.
33. Jeejibai, N. and S. Rajendra. Phytoplankton Constituents as indicators of water quality. A study of Adyar river Proc. National Workshop Algal Systems, 1980; 267-270.
34. Jose, L. and Patel, R. J. A systematic account of Chlorococcales new to Kerala, 1992.
35. Joshi, B. D., J. K. Pathak, Y. N. Singh, Rcs Bisht, P. C. Hoshi. On the physico-chemical characteristics of river Bhagirathi in the uplands of Garhwal Himalaya. Himalayan J. Env. Zoo., 1992; 7(1): 64-75.
36. Khanna, D. R. and Bhutiani, R. Ecological status of Sitapur pond at Hardwar (Uttaranchal), India. Indian J. Environ and Ecoplan, 2003; 7(1): 175-178.
37. Khare, P.K. Phytoplankton as indicator of water quality and pollution status of Lodhe water reservoir from Tasgaon thasil (Maharashtra) Indian J. Enviro. and Ecoplan. of Turkwel gorge reservoir, and new man made lake in northern Kenya. Limnologica, 1999; 29(4): 377–392.
38. Kumawat, D. A. and Jawale, A. K. Genus Crucigenia Morren (Chlorococcales) from fish ponds, Maharashtra. J. Aqua. Biol., 2004d; 19(1): 5-6.
39. Kumawat, D. A. and Jawale, A. K. Genus *Scenedesmus* Meyen from Maharashtra. J. Phytol. Res., 2004c; 17(1): 117-118.
40. Kumawat, D. A. and Jawale, A. K. Observations on the periodicity of desmids in a fish pond. Oikoassay, 2004e; 17(1&2): 45-48.
41. Kumawat, D. A. and Jawale, A. K. On some *Oedogonium* sp. from fish ponds in Anjale, district Jalgaon, Maharashtra. J. Aqua. Biol., 2004f; 19(2): 14-16.
42. Kumawat, D. A. and Jawale, A. K. The genus *Oscillatoria Vaucher* (Cyanobacteria) from fish ponds of Jalgaon district, Maharashtra (India). J. Indian bot. Soc., 2006; 85(1-4): 97-102.
43. Kumawat, D. A. and Jawale. A. K. Phytoplankton ecology of a fish pond at Anjale, dist. Jalgaon. (Maharashtra). J. Aquqa. Biol., 2003c; 18(1): 9-13.
44. Kumawat, D. A., Y. P. Malche, H.E. Rane, S.B. Patil, R.B. Borse and S.D. Vanjari. Diatoms from southern Satpura hill ranges of Maharashtra. genus – *Gomphonema agardh*. J. Indian bot soc., 2008; 87(1 & 2): 61–66.

45. Kumawat, M. R., Nandan, S. N. and Chaudhari, G. S. Algae indicators used for assessing the pollution status of Aner dam of Dhule. (M.S.). Plant Diversity and Biotechnology, 2005; 53-56.
46. Mini, L., Radhika, C.G. and Devi, G.T. Hydrological studies on a lotic ecosystem Vamanpuram river, Thiruvananthapuram, Kerala, South India. Poll. Res., 2003; 22(4): 617-626.
47. Nandan, S.N. and Patel, R. J. Algal flora of Vishwamitri river, Baroda-II. Chlorophyceae. Ibid, 1986; 5(1): 97.
48. Nandan, S. N. and Aher, N. H. Evaluation of eutrophication in Haranbaree dam of Baglan using algae as indicators. J. Aqua. Biol., 2002; 18(2): 75-78.
49. Nandan, S. N. and Aher, N. H. Evaluation of eutrophication in Haranbaree dam of Baglan using algae as indicators. J. Aqua. Biol., 2003; 18(2): 75-78.
50. Nandan, S. N. and Aher, N. H., Limnological study of algae of the river Mausam in Maharashtra. Indian J. Environ. & Ecoplan, 2002; 6(3): 605-608.
51. Pandey, U. C. and Pandey, D. C. Diatom-flora of Allahabad (India)-1. Proc. Indian. Natn. Sci. Acad, 1980e; 46(3): 350-355.
52. Pandey, U.C. and Pandey, D.C. Additions to the Algal flora of Allahabad – V. Desmids. Phykos, 2006; 19(2): 161-170.
53. Pandey, Usha. Soil cyanobacteria from arable lands of southern Rajasthan. Phykos, 2002; 41(1&2): 7-12.
54. Pankow, H. and Martens, B. Uber *Nostoc, sphaericum, Vauch*. Arch. fur. Mikrobiol, 1964; 48: 203-212.
55. Philipose, M.T. Contribution to our knowledge of Indian algae III. Euglenineae - Part-I. The genus Euglena Ehrenberg. Proc. Indian Acad. Sci. (Plant Sci.), 1983; 91(6): 551-599.
56. Plisneir, P. Recent climate and limnology changes in lake Tanganyika. Verh. Internat. Verein Limnol, 2000; 27: 2670-2673.
57. Plisnier, P. Probable impact of global warming and ENSO on lake Tanganyika. Bull. Seanc. Acad. R. Sci. Outre- Mer., 2004; 50(2): 185–196.
58. Pochman, A. Symposis der Gattung. Phacus. Arch. Protistenk, 1942; 95(2): 81–252.
59. Prakash, M.M. Seasonal variation in the physico- chemicak characteristics of a perennial pond of Jhabua. M.P. J. Aqua. Biol. Fish., 1980; 1(1): 43-47.
60. Prasad, R. N. and Chaudhary, B. R. Studies on north Indian euglenoid flagellates I. Euglena Ehrenherg. Vegetos, 1989; 2(2): 216-222.

61. Premila, N., Nirmala, R. and Bharathan, S. A preliminary report on the epiphytic and epiphyllous green algae from Niligiris. Phykos, 1990; 29(1&2): 159-165.
62. Prescott, G. W. New Zygnemataceae from Ecuador The Ohio jour. Sci., 1939; 47(3): 130-132.
63. Prescott, G.W. How to know the fresh water algae. W.M.C. Brown Company Dubuque, lowa, 1951; 1-211.
64. Prescott, G. W. Algae of the Panama Canal and its Tributaries-II. Conjugales. Phykos, 1966; 5(1&2): 1-49.
65. Puttalah, E. T. and Somashekar, R. K. Distribution of Euglenoids in lakes of Mysore city. Ibid., 1987; 26(1&2): 39-46.
66. Raghothaman, G. and Jaiswal, R.N., Hydrobiology of Tapti river from Jalgaon region (Maharashtra) with reference to phytoplankton. Poll. Res., 1995; 14(2): 181-194.
67. Rai, H. A limnological studies on the river Yamuna at Delhi, India Part-I. Relation between the chemistry and the state of pollution in the river Yamuna Arch. Hydrobiol, 1974; 73(3): 369-393.
68. Rai, H. Limnological studies on the river Yamuna at Delhi. India Part- Ii. The dynamics of potamoplankton population in river Yamuna. Arch. Hydrobiol, 1974b; 73: 492-517.
69. Rai, Hukumat, Limnological observation on the different Rivers and Lakes in the Ivory Coast. Hydrobiologia, 1974b; 44(2-3): 301-317.
70. Rai, Hukumat. Hydrobiology of river Yamuna at Okhala (Delhi, India). Sci. papers Inst. Chem. Tech., Prague. Tech. Of water, 1962; 6(1): 77-98.
71. Rai, L. C., Ecological studies on algal communities of River Ganga at Varanasi. Ind. J. Ecol, 1978; 5: 1-6.
72. Raina, V. A., Shah, R. and Ahmed, S. R., Pollution studies on river Jhelum: An assessment of water quality. Indian J. Environ. Hlth, 1990; 26: 187-201.
73. Rajurkar N. S., Nongbri B., Patwardhan, A. M. Physico-chemical and Biological Investigation of River Umshyrpi at Shillong. Meghalaya. Indian J. Environ. Hlth, 2003; 45(1): 83-92.
74. Rama Rao, S. V., Singh, V. P. and Mall, L. P. Pollution studies of river Khan (Indore). India I. Biological assessment of pollution. Water Res., 1978; 12: 555-559.
75. Ramanathan, K. R. 1964. Ulotrichales. ICAR, New Delhi, 1-188.
76. Ramesh, M., Saravanan, M. and Pradeepa, G. Studies on the physico-chemical characters of the Singanallur lake, Coimbatore, South India. Proc. DAE- BRNS Nat. Sym. On Limnol, 2007; (NSL 2007): 215-217.

77. Rana, B. C. and Palria, S. Physiological and Physico-chemical evaluation of the river Ayad, Udaipur. Ibid., 1988; 27(1&2): 211-217.
78. Randhawa, M. S. Observations on some Zygnemales from Northern India- Part I. Proc. Ind. Acad. Sci., 1964; 8(B): 109-150.
79. Sankaran, V. Cyanobacterial biodivesity of the tributaries of reiver Kaveri II. Ibid., 2006b; 9(1): 65-70.
80. Sarkar, H. L. and Rai, H. The limnology of Suraj Kund, India- I: Physico- chemical conditions and plankton. Trans. Amer. Micro. Soc, 1964; 83(2): 260-266.
81. Smith, David G. A better water quality indexing system for Rivers and Streams Water Research, 1990; 24(10): 1237-1244.
82. Smith, G. M. Phytoplankton of the inland lake of Wiscosin Part- I. Mysophyceae, Phaeophyceae, Heterokontae and Chlorophyceae exclusive of the Desmidiaceae. Wis. Goel. Nat. Hist. Surv, 1920; 57: 1-243.
83. Turner, W. B. Algae aquae dulcis Indiae Orientalis (The fresh water algae Principally Desmidieae of East India). Kgl. Svensk. Vet-Akad. Handl, 1892; 25(5): 1-187,Pl.25.
84. Vanlandingham, S. Comparative evaluation of water quality on the St. Joseph River (Michigan and Indiana, U.S.A.) By three methods of algal analysis. Hydrobiologia, 1976; 48(2): 145-173.
85. Varma, U. P. and Gupta, A. B. On some algae of Dalipnagar user soil. Kan. Univ. Res. J. Sci., 1980; 1: 89-96.
86. Venkataraman, G. Contribution to our knowledge of fresh water Diatoms of South India. Suptd. Govt. Press, Madras, 1957; 1-12.
87. Venkataraman, V. An ecological study of the algae of the river Moosi Hyderabad (India) with special reference to water pollution II. Hydrobiologia, 1968; 33(3&4): 352-363.