



Chlorophyceae flora from Purna River in Parbhani District of Maharashtra

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Abstract:

In the algal diversity study members of Chlorophyceae was recorded from Purna River, is the Sub-basin of Godavari river in Parbhani district from Maharashtra state. The colonial, filamentous, non-filamentous algal genera were recorded from different sites, in this research study total 20 algal taxa were observed from four sites i.e. Amberwadi, Bamni, Wazar and Yeldari along with 14 genus with 20 species i.e. *Oedogonium*, *Cosmarium*, *Scenedesmus*, *Chara*, *Pediastrum*, *Nitella*, *Staurastrum*, *Trachelomonas*, *Rhizoclonium*, *Spirogyra*, *Zygnema*, *Bulbochaete*, *Chlamydomonas* and *Schroederia* members were recorded. This paper is deals with the identification and description of algal species from freshwater samples collected from different regions of Purna river as well as algal diversity was evaluated by light microscopy.

Key words: Diversity, Purna, Yeldari, Amberwadi, Bamni, Wazar, Chlorophyceae.

INTRODUCTION:

Chlorophyceae are highly successful and distinctive groups of algae and found in almost all fresh water habitats. Chlorophyceae flora from different region of India has been described by a various authors like Prescott 1951; Makandar Mohammadd and Bhatnagar 2010; Tippawan and Yuwadee in 2012; Kumar and Sahu 2012; Hosmani in 2013; Satpati et.al. in 2013; Das and Adhikary 2014; Patil, (Behere) and Deore 2017; Arulmurugan et.al. 2011; Farishta Yasmin et.al. 2015; Naskar, et.al. 2009 and Rajeshwari and Krishnamurthy 2015.

Algae are structurally simple photosynthetic plants which play an important role in ecology and molecular phylogeny. Algae are distributed in almost all types of habitat. They are chlorophyll bearing thallophytes include motile unicellular, motile colonial, palmelloid, filamentous, heterotrichous, siphonaceous, uniaxial and multiaxial forms. The cell constituting the thalli is basically of two kinds prokaryotic and eukaryotic. They perform the maximum quantum of photosynthetic activity than any other living organisms in this world. The members of Chlorophyceae were abundantly found in fresh, marine and brackish water environment (Shrestha et. al. 2013; Kumar, et. al. 2014). Chlorophycean algae are rich in cellulose as well as it contains the grassy green chromatophores. Starch and oil are the reserve food material in Chlorophyceae (Ragland et. al. 2014). In recent year it's used as alternative sources for humen as food, fodder, agriculture, medicine and in biodiesel production towards another site it also the important tools for researchers in nanotechnology, space biology, genetics and other fields of applied sciences (Shrestha et. al. 2013).

MATERIALS AND METHODS:

Study area:

The Purna River is a major left-bank tributary of Godavari river originating in the Ajanta Range of hills in Aurangabad, District, Maharashtra state, India. This river is very beneficial to Parbhani district for the irrigation, fish culture and for the drinking purpose point of view. Yeldari dam is located on river Purna. Yeldari dam can be considered as an example of reservoir ecosystem flowing through the districts of Aurangabad, Buldana, Hingoli and Parbhani with a large catchment area . It is situated near the 15 km long from the Jintur city in the Yeldari village. GPS latitude N 190 43' 12.4" Latitude N 190 43' 12.4" Longitude E 760 43' 55" (Mulani and Sonule 2015).

Sampling site of Purna river:

During the present investigation collection of algal samples were done from four sites i.e. Amberwadi, Bamni, Wazar and Yeldari with the help of planktonic net, forceps by handpicking method during the 2014- 2016 from four localities of Purna river. Algal growth was observed from marginal sites, submerged in water, free floating and attached form in water body. Collections of samples were done during the morning period in clean polythene bags and sample bottles. A small amount of sample was used for the taxonomical identification and remaining samples were preserved in 4 % formalin for long time. Taxonomic identification of algal species was done on the basis of morphological types, cell dimensions, trichomes, filaments shape, sheath thickness, size and position of akinetes/heterocyst. Algal taxa were identified and systematized according to standard literature.

IDENTIFICATION OF MICROALGAE

The collected algal samples were observed microscopically using light microscope and identified with standard literature i.e. Prescott, G.M. 1951; Ragland, et.al. 2014 and Tippawan and Yuwadee 2012).

RESULT:



Plate no. 01- Sampling sites a, b- Bamni; c, d-Yeldari; e, f-Wazar and g, h- Amberwadi.

Systematic description:

Order: Conjugales

Family: Desmidiaceae

1. ***Cosmarium margaritatum*** (Lund.) Roy et. Biss. (Fig.c)

Prasad and Misra, 1992, p165.

Cells rather larger, longer than broad, deeply constricted; semicells sub rectangular, apex and sides slightly convex, basal and apical angles broadly rounded, cell wall uniformly granulate and with punctae between them; chloroplast axile with two pyrenoids in each semicell. Long cell 65µm, lat. Cell 52.5µm, lat. isthmus 17.5µm.

2. ***Cosmarium pyramidatum*** Berb. (Fig.a)

Prasad and Misra 1992, P.177.

Cell 37.5µm long 28 µm broad and isthmus 7.5 µm. Cells medium size, about 1.2 times longer than broad, truncate-elliptic in outline, deeply constricted, sinus narrow and dilated towards the apex; semi cells truncate pyramidal, basal angles rounded; sides convex and converging upwards to narrowly truncate and flattened apex showing obtuse angles; cell wall finely sarobiculate, chloroplast axile and dicentric with two pyrenoids in each semi cell.

3. ***Cosmarium granatum*** Breb. (Fig.c)

Cells 30µm long, 20µm broad and isthmus 5µm. Cells small, slightly longer than broad, sub-rhombic to elliptic, deeply constricted, sinus linear with a dilated extremity; semi cells truncate-pyramidate, basal angles rounded, apical angles rounded, apical angles obtuse, sides straight or slightly convex, apex narrowly truncate with faintly retuse margin; cell wall finely punctuate; chloroplast axile with single pyrenoid.

Order: Chlorococcales

Family: Hydrodictaceae

4. ***Pediastrum biwae*** Negoro (Fig.d)

Tippawan and Yuwadee 2012, pp 33-37.

Coenobia are always with perforations. The diameter of perforations is larger than the diameter of the cell. Lobes of marginal cells are narrow and the two neighboring always arcuate one to another. Cell wall ultra structure is smooth or slightly punctuate. Diameter of Coenobia is 60-130 µm, cells 7-20µm wide, 10-35µm long. They are found in oligo-mesotrophic water

5. ***Pediastrum asymmetricum*** Hegewald (Fig.r)

Tippawan and Yuwadee 2012, pp 33-37.

Coenobia are circular in outline with large perforations in young stages and smaller in old stages. Coenobia are usually composed of 8 or 16 celled. Marginal cells are elongated and paired creating opening between cells. Eight-celled have one inner cell and 7 marginal cells, so one marginal cells is not paired but all cells keep their asymmetric form. Cell wall ultrastructure is densely regularly granular. Marginal cells are 5-11µm wide 15-20µm long. Cell 4-8 µm wide, 8-14µm long. They are found in meso-eutrophic water.

6. ***Scenedesmus quadricauda*** var. *Westii* G.M.Smith (Fig.e)

Prescott, G.M. 1951, pp. 281.

Colony composed of 4-8 ovate cells with broadly rounded apices; cells 5-8µ in diameter, 10-18-(22) µ long; spines relatively short, often strongly reflexed.

7. ***Scenedesmus quadricauda*** (Turp.) de Brebisson in de Brebisson and Godey (Fig.f)

Prescott, G.M. 1951, pp.280.

Colony consisting of 2-4-8 oblong cylindrical cells usually in 1 series; outer cells with a long curved spine at each pole; inner cells without spines or with mere papillae at the apices; cells variable in size, 3-8µ diameter, 9-35 µ long.

8. ***Staurastrum subsaltans*** W & G.S. West var. *indonesianum* Scott & Prescott. (Fig.l)

Prescott, G.M. 1951, pp.

Cell strongly compressed, bilaterally or radially symmetrical; deeply constricted with acute-angled sinus; cell wall smooth or ornamented; apex of semi cells extended into 4 divergent arms; chloroplast axial; pyrenoids one to many.

Order: Zygnemales

Family: Zygnemaceae

9. ***Spirogyra communis*** (Hassal) Kuetzing (Fig.i)

Prescott, G.M. 1951, pp.312.

Vegetative cells slender, cylindrical, (18)-20-26µ in diameter, (35)- 65-100µ long, with plane end walls; chloroplast solitary, making 1½ to 4 turns. Conjugation by tubes from both gametangia; fertile cells cylindrical. Zygospores ellipsoid, with narrowly rounded poles; median spore wall smooth, colorless, or yellowish in age; 19-23µ, in diameter, 36-69µ long.

10. ***Spirogyra fluvialilis*** Hilse in Rabenhorst (Fig.h)

Prescott, G.M. 1951, pp 314.

Filaments of rather stout cells, 36-40µ in diameter and 5-6 times the diameter in length, with plane end walls; chloroplasts 3-5, making one half and two half turns. Conjugation scalariform by tubes from both gametangia, fertile cells becoming inflated. Zygospores ovate; median spore wall wrinkled and irregularly pitted; 42-44µ in diameter, 59-77µ long.

11. ***Spirogyra mirabilis*** (Hass.) Kuetzing (Fig.g)

Prescott, G.M. 1951,pp.317.

Filaments of slender cells, 24-26 μ in diameter and up to 10 times the diameter in length, with plane end walls; chloroplast solitary, making 4 to 7 turns. Conjugation by tubes from both gametangia; fertile cells inflated. Zygospores ovate to ellipsoid; median spore wall smooth and brown; 24-29 μ , in diameter, 50-83 μ long.

12. ***Zygnema chlalybeospermum*** Hansgirg (Fig.j)

Prescott, G.M. 1951, pp.324.

Vegetative cells 24-27 μ in diameter and up to 3 times the diameter in length; fertile cells cylindrical (shortened). Zygospores formed in one of the gametangia; globose or broadly ovate; median wall blue and smooth; 30-35 μ in diameter, 30-38 μ , long.

Order: Charales

Family: Characeae

13. ***Chara excelsa*** Allen (Fig.m)

Prescott, G.M. 1951, pp.338

Plants coarse and brittle, encrusted with lime, 6-14 cm. high; stems bearing 7-8 leaves and a double whorl of stipulodes of which the upper row is longer than the lower; cortication of the internode diplostichous, the primary cortical cells larger and more prominent than the secondary laterals; 2-3 cells at the tip of the leaves uncorticated; sex organs monoecious, produced on the same node; oogonia 0.8-1.5 mm. long, investing cells showing 7-10 turns; bracts subtending the oogonium longer than the fruit: antheridia 0.32- 0.35 mm. in diameter.

14. ***Nitella flexilis*** (L.) C. A. Agardh (Fig.k)

Prescott, G.M. 1951, pp.332

Plants large (up to 30 cm. tall) and stout, with long internodes (about 2 times longer than the branchlets), repeatedly branched, especially long and sprawling stems in deep water; nodes bearing whorls of 6-8 branchlets, with the sex-organ-bearing branchlets usually shorter, forming dense clusters, the branchlets but little divided, usually only one, the ultimate rays 1-celled and ordinarily acuminate; sex organs monoecious, the oogonia 2-3, subglobose or broadly ovoid, 0.55-0.75 mm. in diameter, 0.625-0.9 mm. long, the investing cells showing 8-9 turns; antheridium 0.5-0.75 mm. in diameter. Mainly found in shallow water.

Order: Euglenales

Family: Euglenaceae

15. ***Trachelomonas volvocina*** Ehrenberg (Fig.n)

Prescott, G.M. 1951, pp.419.

Test globose; flagellum aperture without a collar; wall yellowish, sometimes colorless, smooth; test 16-20 μ in diameter. Generally distributed; common in ponds and ditches.

Order: Chlamydomonadales

Family: Chlorococcaceae

16. ***Schroederia judayi*** G.M. Smith (Fig.o)

Prescott, G.M. 1951, pp.256.

Cells fusiform, straight or arcuate, the poles narrowed and extended in to long setae, one of which terminates in short bifurcation; 1 chloroplast, with a single pyrenoid; cells 2.5-6 μ in diameter, 45-63 μ long, including the setae, which are 10-16 μ long.

Order: Oedogoniales

Family: Oedogoniaceae

17. ***Oedogonium giganteum*** Kuetzing (Fig.p)

Prescott, G.M. 1951, pp.170.

Macrandrous; dioecious (male plants not observed in our collections). Vegetative cells cylindrical, 46-48 μ in diameter, 65-200 μ , long. Oogonia solitary; cylindrical-obovoid or ellipsoid; opening by a superior pore; 55-60 μ in diameter, 65-95 μ , long. Oospores ellipsoid; nearly filling the oogonium; wall of three layers, the middle layer with longitudinal rows of deep pits; 55-65 μ in diameter, 90-93 μ long.

18. ***Bulbochaete hiloensis*** (Nordst.) Tiffany (Fig.t)

Prescott, G.M. 1951, pp.150.

Nannandrous; gynandrosporous. Vegetative cells 14-20 μ in diameter, 24-48 μ long. Oogonia ellipsoid, patent, 28-33 μ in diameter, 43-51 μ long. Oospores ellipsoid; outer spore wall with longitudinal crenulate costae; 26-30 μ in diameter, 38-45 μ long. Male filament 13-17 μ in diameter, 30-34 μ long. Division of suffultory cell superior.

Order: Volvocales

Family: Chlamydomonaceae

19. *Chlamydomonas polypyrenoideum* Prescott (Fig.q)

Prescott, G.M. 1951, pp.71

Cells ovoid to ellipsoid, without an apical papilla; gelatinous sheath lacking. Chloroplast a dense parietal cup with a deep median invagination; pyrenoids many (12-16), scattered; pigment spot not observed. Cells 8-10µ in diameter, 9-12µ long.

Order: Cladophorales

Family: Cladophoraceae

20. *Rhizoclonium pachydermum* Kjellmann (Fig.s)

Satpati et.al. 2013,pp.32.

Thallus branched, the principal axes becoming indistinct, 95 µ broad, filaments with frequent rhizoidal branches, short filaments with 3 or more cells, cells are 30-40 µ in diameter, frequently longer than broad, with thin cell wall, branches crowded in lower part of the thallus, cells of branches 40-60 µ in diameter, cylindrical, twice as long as broad.

Table 01 list of the algal taxa recorded.

Sr. no.	Name of the taxa	Order	Family
1	<i>Cosmarium margaritatum</i> (Lund.) Roy et. Biss. (Fig.c	Conjugales	Desmidiaceae
2	<i>Cosmarium pyramidatum</i> Berb.	Conjugales	Desmidiaceae
3	<i>Cosmarium granatum</i> Breb.	Conjugales	Desmidiaceae
4	<i>Oedogonium giganteum</i>	Oedogoniales	Oedogoniaceae
5	<i>Pediastrum biwae</i> Negro	Chlorococcales	Hydrodictaceae
6	<i>Pediastrum asymmetricum</i> Hegewald	Chlorococcales	Hydrodictaceae
7	<i>Scenedesmus quadricauda</i> var. <i>Westii</i> G.M.Smith	Chlorococcales	Scenedsmaceae/C oelastraceae
8	<i>Scenedesmus quadricauda</i> (Turp.) de Brebisson in de Brebisson and Godey	Chlorococcales	Scenedsmaceae
9	<i>Chlamydomonas polypyrenoideum</i> Prescott	Volvocales	Chlamydomonaceae
10	<i>Spirogyra mirabilis</i> (Hass.) Kuetzing	Zygnemales	Zygnemaceae
11	<i>Spirogyra fluviatilis</i> Hilse in Rabenhorst	Zygnemales	Zygnemaceae
12	<i>Spirogyra communis</i> (Hassal) Kutzing	Zygnemales	Zygnemaceae
13	<i>Zygnema chlalybeospermum</i> Hansgirg	Zygnemales	Zygnemaceae
14	<i>Nitella flexilis</i> (L.) C. A. Agardh	Charales	Characeae
15	<i>Chara excelsa</i> Allen	Charales	Characeae
16	<i>Trachelomonas volvocina</i> Ehrenberg	Euglenales	Euglenaceae

17	<i>Schroederia judayi</i> G.M. Smith	Chlamydomonadales	Chlorococcaceae
18	<i>Staurastrum subsaltans</i> W & G.S. West var. <i>indonesianum</i> Scott & Prescott	Chlorococcales	Hydrodictaceae
19	<i>Rhizoclonium pachydermum</i> Kjellmann	Cladophorales	Cladophoraceae
20	<i>Bulbochaete hiloensis</i> (Nordst.) Tiffany	Oedogoniales	Oedogoniaceae

Table 02 identified algal specimens from four sites

Sr. no.	Name of the taxa	Collection sites			
		Site01	Site02	Site03	Site04
1	<i>Cosmarium pyramidatum</i>	-	+	+	-
2	<i>Cosmarium margaritatum</i>	+	-	-	-
3	<i>Cosmarium granatum</i>	-	+	+	-
4	<i>Oedogonium giganteum</i>	+	+	-	-
5	<i>Pediastrum biwae</i>	-	+	-	-
6	<i>Pediastrum asymmetricum</i>	+	-	-	-
7	<i>Scenedesmus quadricauda</i>	-	+	-	-
8	<i>Scenedesmus quadricauda</i>	+	-	-	-
9	<i>Chlamydomonas polypyrenoideum</i>	+	-	-	-
10	<i>Spirogyra mirabilis</i>	+	-	+	+
11	<i>Spirogyra fluviatilis</i>	+	-	+	+
12	<i>Spirogyra communis</i>	+	-	-	+
13	<i>Zygnema chlalybeospermum</i>	-	-	-	+
14	<i>Nitella flexilis</i>	-	+	-	-
15	<i>Chara excelsa</i>	-	-	-	-
16	<i>Trachelomonas volvocina</i>	-	-	-	-
17	<i>Schroederia judayi</i>	+	-	+	-
18	<i>Staurastrum subsaltans</i>	+	-	-	-
19	<i>Rhizoclonium pachydermum</i>	+	-	+	-
20	<i>Bulbochaete hiloensis</i>	-	-	+	-
Total		11	06	07	04

Site01-Yeldari, Site02-Bamni, Site03-Wazer, Site04-Amberwadi.

DISCUSSION:

In the all study 14 genus were observed along with nine (09) orders, ten (10) family with 20 species i.e. *Cosmarium pyramidatum*; *Cosmarium margaritatum*; *Cosmarium granatum*; *Oedogonium giganteum*, *Pediastrum biwae*, *Pediastrum asymmetricum*, *Scenedesmus quadricauda*, *Chlamydomonas polypyrenoideum*, *Spirogyra fluviatilis*, *Spirogyra communis*, *spirogyra mirabilis*, *Zygnema chlalybeospermum*, *Nitella flexilis*, *Chara excels*, *Trachelomonas volvocina*, *Schroederia judayi*, *Rhizoclonium pachydermum*, *Bulbochaete hiloensis* and *Staurastrum subsaltans* species were recorded.

Out of recorded species *Cosmarium margaritatum*, *Oedogonium giganteum*, *Pediastrum asymmetricum*, *Scenedesmus quadricauda*, *Chlamydomonas polypyrenoideum*, *Spirogyra mirabilis*, *S.fluviatilis*, *S.communis*, *Schroederia judayi*, *Staurastrum subsaltans* and *Rhizoclonium pachydermum* were recorded from Yeldari site, *Cosmarium pyramidatum*, *Cosmarium granatum*, *Oedogonium giganteum*, *Pediastrum biwae*, *Scenedesmus quadricauda*, *Nitella flexilis* were recorded from Bamni site, *Spirogyra mirabilis*, *S.fluviatilis*, *S.communis* and *Zygnema chlalybeospermum* were recorded from Amberwadi site and *Cosmarium pyramidatum*, *Cosmarium granatum*; *Spirogyra fluviatilis*, *Spirogyra communis*, *spirogyra mirabilis*, *S.fluviatilis*, *Rhizoclonium pachydermum* and *Bulbochaete hiloensis* were recorded from Wazar site. In this over all study maximum 11 genus were recorded from Yeldari site, 06 from Bamni site, 07 from Wazar site and 04 from Amberwadi site. In this research survey maximum number of species of *Spirogyra* and *Rhizoclonium* were observed. This algal genera were also recorded by many researcher like Prescott, G.M. in (1951) from Western Great Lakes Area; Tippawan and Yuwadee in (2012) from Thailand; Kumar and Sahu in (2012) from in Paddy Fields of Lalgutwa Area, Ranchi, Jharkhand; Hosmani in (2013) from Mysore district; Satpati et.al. in (2013) from Sundarbans mangrove forest, India and Gupte in (2017) from Shelar Lake.

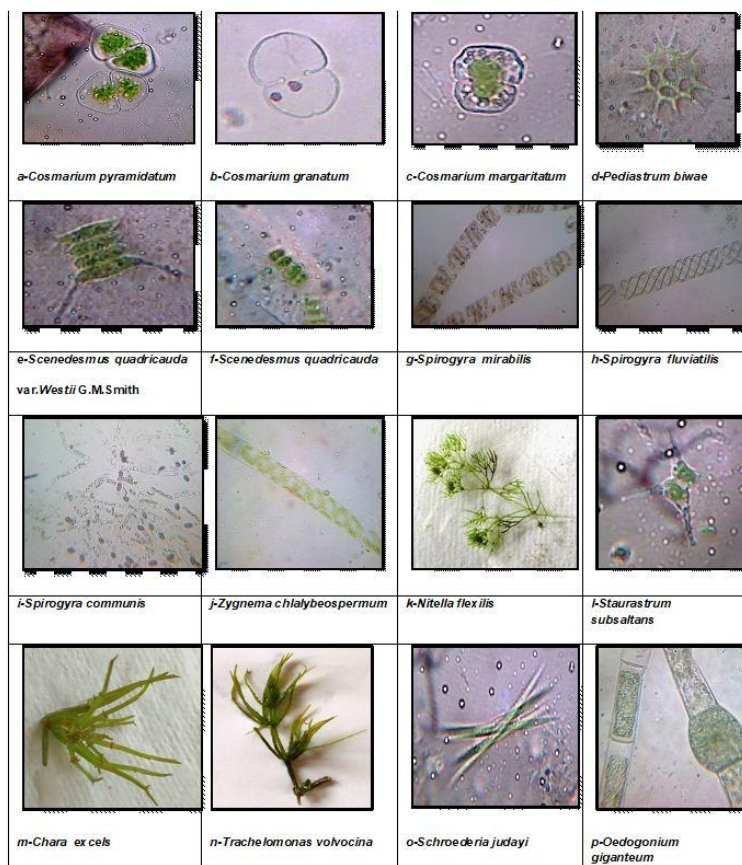


Plate .02- Identified algal genera from Amberwadi, Bamni, Wazar and Yeldari sites.

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References:

1. Arulmurugan, P., Nagaraj, S. and Anand, N. 2011. Biodiversity of Fresh water algae from Guindy campus of Chennai, India. *Journal of Ecobiotechnology*. **3 (1)**: 19-29.
2. Das, S. K. and Adhikary, S. P. 2014. Freshwater algae of Cherrapunjee and Mawsynram, the wettest places on earth. *Phykos* .**44 (2)**: 29-43.
3. Farishta Yasmin, Buragohain, B. B. and Sarma, R. 2015. Aquatic Algae from Kaziranga National Park, Assam, India. *Int. J. Curr. Microbiol. App. Sci*. **4(12)**: 297-302.
4. Hosmani, S. P. 2013. Fresh water algae as indicators of water quality. *Universal Journal of Environmental Research and Technology*. **3(4)**: 473-482.
5. Kumar, A. and Sahu, R. 2012. Diversity of algae (Cholorophyceae) in paddy fields of Lalgotwa area, Ranchi, Jharkhand. *Journal of Applied Pharmaceutical Science*. **2(11)**: 092-095.
6. Kumar, G. E., Rekha, C., Kumar, P.G., Sasikala, K. and Sivadasan, K. K. 2014. Diversity of planktonic algae of selected Temple ponds of Mahe (U.T. of Puducherry). *International Sciences Journal*. **1(3)**: 48-53.
7. Makandar Basha Mohammad and Bhatnagar, A. 2010. Biodiversity of Microalgae and Cyanobacteria from freshwater bodies of Jodhpur, Rajasthan (India). *Journal Algal Biomass Utilization*. **1(3)**: 54-69.
8. Mulani, R. M. and Sonule, M. D. 2015. Fresh Water Cyanophycean Algae from Yelderi Dam Parbhani District (M. S.), India. *International Journal of Science and Research*. **4 (1)**:740-742.
9. Naskar, N. M, Naskar, K. R and Talai, S. 2009. Addition to the List of Brackish Water Zygnemaceae of Sundarbans and its Adjoining Areas, India Genus *Spirogyra* Link. *Our Nature*. **7**:187-192.
10. Patil, (Behere) K. P. and Deore, L. T. 2017. Biodiversity of genus *Cosmarium* from district Nashik (MS) India. *Phykos*. **47 (1)**: 133-152.
11. Prescott, G. M. 1951. Algae of the Western Great Lakes Area WM. C. Brown Company Publishers. Dubuqua, Iowa. 1- 977.
12. Ragland, A., Kumaresan, V. and Arumugam, N. 2014. *Algae*. Saras Publication. pp. 1-712.
13. Rajeshwari, M. S. and Krishnamurthy, S. R. 2015 Algal flora of the river Bhadra at the outlet of Bhadra Dam, Shivamogga. *Phykos*. **45 (1)**: 40-53
14. Satpati, G. G., Barman, N. and Pal, R. 2013. A study on green algal flora of Indian Sundarbans mangrove forest with special reference to morph taxonomy. *Journal of Algal Biomass Utilization*. **4 (1)**: 26-41.
15. Shrestha, S., Rai S. K. and Dhakal, M. N. 2013. Algae of Itahari Municipality and its Adjoining area, Eastern Nepal. *International Journal Applied Sciences and Biotechnology*. **1(1)**: 5-10.
16. Sonule, M. D. 2015. *Planktonic Biodiversity of Yeldari dam* (M.Phil Thesis) Swami Ramanand Teerth Marathwada University, Nanded (M.S.). 1-95.
17. Tippawan, P. and Yuwadee, P. 2012. Diversity of *Pediastrum* sp. in some water resources of Thailand. *Journal of the Microscopy Society of Thailand*.**5 (1-12)**: 33-37.