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Enumeration of Freshwater Algae in Rasa Tal, Sunsari, Nepal

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Abstract

Algae are aquatic plants that can-do photosynthesis and are found in freshwater environments. The primary goal of this study is to count all algae in Rasa Tal and identify the most common types. Twelve algal samples, two from each of the six algal sample collection sites at Rasa Tal, were randomly chosen and put in sample containers. For floating algae, plankton nets were used, while for other types of algae, submerged leaves and roots of aquatic macrophytes were squeezed. This study identified 52 algal species across 6 phyla, 8 classes, 17 orders, 26 families, and 31 genera. In terms of algal species, Rasa Tal's aquatic ecology is rich in freshwater algae, much like other freshwater bodies in eastern Nepal.

Keywords: Algal flora, east Nepal, charophyta, *cosmarium*, ochrophyta, *dinobryon*

Introduction

Around the world, there are many kinds of freshwater algae. Most algae from various families are photosynthetic due to the presence of chlorophyll A and chlorophyll B. They can be found in various forms, such as long filaments, colonies, or individual cells (Chaterjee & Raziuddin, 2006). The diameters of algae vary greatly; unicellular forms are 0.5 μm in diameter, while colonial, palmelloid, filamentous, or bushy species are 30 m or larger. Algae play an important role in aquatic food chains because they can carry out photosynthesis, serving as primary producers and absorbing large amounts of CO2 from the environment. They can be used as food sources for humans and animals, as biofertilizers to increase fertility and productivity in crop fields, as fuel in the form of biodiesel, as bioindicators of water pollution, as medicines and cosmetics, and in research (Prescott, 1969). Men and animals use different species of algae as food. Animals and humans both eat a variety of algae species. Algae are considered very good bioindicators of water quality and freshwater ecosystems due to their position at the base of aquatic food webs (Stoermer, 1977).

When humans came to know the significance of algae in the 1980s, many authors like West and West (1902), Fritsch and Rich (1937), Scott and Prescott (1961), Turner (1892), Bruehl and Biswas (1926), Geitler (1932), Hendy (1964), Foged (1980, 1982), and Gandhi (1999) started to explore algae flora around the world. Historical records indicate that Carter (1926) may have been the first to document Nepal's algal flora in the Nuwakot and Makawanpur districts. The country's algae have since been studied by teams from Nepal, India, Japan, and Germany, primarily in the Himalayan region. Studies on Nepal's algal flora is scarce, and those that are available are mostly limited to the country's higher highlands and central midhills.

A comprehensive analysis has not yet been conducted, even though the hot, humid climate of Nepal's Tarai belt supports luxuriant algal growth and diversity. Algae from some wetlands in eastern Tarai have been explored by several workers, and Shrestha et al. (2013) reported a total of 52 taxa, including 10 new species for Nepal, after studying algae in Itahari and the surrounding area. A total of 23 algal taxa, including 6 diatoms new to Nepal from the Betana wetland (Rai, 2011), and 81 taxa, including 22 new to

Nepal from the Koshi Tappu region (Rai, 2013b), have also been studied. A total of 12 diatoms, including 5 taxa new to Nepal (Rai & Rai, 2005), and 19 Euglenophyceae algae, along with 9 taxa new to Nepal (Rai & Rai, 2007), from Biratnagar, have been reported. Recently, the diatoms of Haseena Wetland were also studied by Adhikari (2016), and the remaining algae of this locality were studied by Rai and Rai (2018). Rajopadhyaya (2016) also studied the algae of the Bagh Jhoda Wetland in Morang, Nepal.

Materials and Methods

Study Area

Rasa Taal (Rastriya Sampada Taal) was established in 2071 BS and is in Ward No. 7 of Ramdhuni Municipality, covering 64 Bighas. It has 75 bigha localities to the west and Charkoshe Forest to the north, east, and south. It lies on the northeast side of Jhumaka Bazar, Itahari Sub-Metropolitan City. Water makes up the entire 2.5-hectare area known as the Tal.

Figure 1

The map of Rasa Taal accessed from Google Earth

Algae Collection and Identification

Six algal sample-collection sites at Rasa Lake were randomly selected, yielding a total of 12 algal samples, two from each site. During March 2023, plankton forms were collected using plankton nets (0.5 mm mesh size), while epiphytic forms were collected by squeezing the submerged leaves and roots of aquatic macrophytes. Quarters of the container were filled with algae, and then the optimal amount of water and a 4% formaldehyde solution were added to preserve the samples in the container, with proper tagging and labeling. The specimen material from each sample was mounted with glycerin jelly on the slides (Sharma, 1992).

While closely inspecting the prepared slides under a compound microscope, the necessary photos were taken using a Canon Digital PowerShot camera and an Olympus CH20i microscope. For a longer exposure time, the macro mode was employed, and the flashlight was switched off. The identification of the algal taxa was done by consulting several books and monographs, including Prescott (1951), Desikachary (1959), Scott and Prescott (1961), Croasdale and Flint (1986, 1988), and Prasad and Mishra (1992).

Result and Discussion

Since Rasa Lake is a suitable habitat for freshwater algae, 52 algal species were identified using a compound microscope throughout this study period. The largest number of algal taxa is 23 in the phylum Charophyta, followed by Bacillariophyta (10), Chlorophyta (7), Cyanobacteria (6), Euglenozoa (5), and Ochrophyta (1). Similarly, the dominant families were Desmidaceae, Chlosteriaceae, and Euglenaceae, with 13, 6, and 5 algal taxa, respectively.

Taxonomic Description of Algae

Microcystaceae

1. ***Aphanothece stagnina*** (Sprengel) A. Braun (1863) (Pl. 1, fig. 1-2)

Prescott, (1951), P. 469, Pl. 103, Fig. 14-16; Desikachary, (1959), P. 137, Pl.21, Fig. 10

Several centimeters of thallus in diameter and might be spherical, ellipsoidal, dull brown, brownish, or pale blue green; calcareous crystal interior; long cells & 3.5-11 μm in breadth, somewhat ovoid or cylindrical, and blue green in color.

Selenastraceae

2. ***Kirchneriella lunaris*** (Kirchner) Moebius (Pl. 7, fig. 1-2)

Prasad & Misra, (1992), P. 28, Pl. 4, fig.3

Spherical to subelliptical colonies within a thin outer gelatinous coat; cells flattened, crescent-shaped, highly curved & pointed ends; solitary chloroplasts almost fill the cell and contain a single pyrenoid; colonies with diameter 46-51 μm; cell length 8.5- 13 μm.

3.Ankistrodesmus falcatus (Corda) Ralfs (1848) (Pl. 5, fig. 2-4)

Prescott (1951), P. 253, Pl. 56, Fig. 5, 6; Philipose (1967), P. 211, 212, Fig. 121 a, c

Chloroplast 1, a parietal plate devoid of pyrenoids, needle-like to somewhat spindle-shaped cells found alone or in groups of two to three without a colonial sheath; cells 2–6 μ in diameter and 25–100 μ long.

4. ***Monoraphidium griffithii*** (Berkeley) Komárková-Legnerová (1969) (Pl. 7, fig. 3-6)

Peixoto Ramos et al. (2012), p. 429, Fig. 3c

The parietal chloroplast is absent in the solitary, fusiform, elongated cells, 16–22 times longer than broad, straight or slightly curved, gradually narrowing, and ending in an acute or short spine. Cell length 45 58 μm, width 2- 3.5 μm.

Chlorellaceae

5. ***Dictyosphaerium pulchellum Wood*** (1874) (Pl. 4, fig. 7)

Prescott (1951), P. 238, Pl. 51, fig. 5-7

An ovoid to spherical colony with around 32 spherical cells arranged in four series on dichotomously branched colony threads; diameter of cells 3 to 10 μm, and the colony is coated in mucilage.

Sphaerocystidaceae

6. ***Sphaerocystis schroeteri*** Chodat (1897) (Pl. 5, fig. 1)

Prescott (1951), P. 83, Pl. 3, Fig. 6, 7

Within the colonial envelope, a colony with small spherical clusters of both newly divided and undivided cells; diameter of a cell & colony 6–20 μ & 500 μ, respectively; abundant and widely dispersed in both soft and hard water lakes.

Aphanizomenonaceae

7. *Anabaena* sp. Bory ex Bornet & Flahault (1822) (Pl. 2, fig. 4)

Prescott (1951), P. 510, 511; Desikachary (1959)

Filamentous, gregarious algae enclosed in amorphous mucilage; cells are like a barrel or cylindrical; large numbers of heterocysts present, dispersed throughout the trichome, which can be spherical, oval, or cylindrical; round, ovate, or cylindrical gonidia present.

Naviculaceae

8. *Navicula rostellata* Kützing (1844) (Pl. 3, fig. 5)

Karthick et al. (2013), Pl.66

A lanceolate to slightly linear valve is present; a thin axial region; a moderately wide, rounded central area that is symmetrical; and a central nodule that is thicker on one side; valve length 25.0- 40.5 μm, valve breadth 7-9 μm.

Gomphonemataceae

9. *Gomphonema pseudoaugur* Lange-Bertalot (1979) (Pl. 4, fig. 4)

Marquardt et al. (2011). P. 226, Fig. 21

Strongly heteropolar, oval to lanceolate club-shaped valves with rounded foot poles and strongly prolonged head poles have weakly radical, indistinctly punctate striae throughout and a small central area formed by the shortening of central striae.

10. ***Gomphonema acidoclinatum*** Lange-Bertalot & Reichardt (2004) (Pl. 4, fig. 2-3)

Rai & Khadka (2017); Werum and Lang- Bertalot (2004), Pl.92, Fig.1-5, 6-11

Claviform-shaped valves are like lanceolate; heteropolar and usually somewhat bent; the unilateral middle area is roughly rectangular and considerably elongated; the tip is blunt and rounded triangular; striae are 20-25 μm long and 6.5-9 μm wide.

Oscillatoriaceae

11. ***Oscillatoria crassa*** (C.B. Rao) Anagnostidis (2001) [Old name: *Oscillatoria ornate* var. crassa C.B. Rao (1938)] (Pl. 1, fig. 5-6)

Desikachary (2059), P. 206, Pl. 39, Fig. 11; Anagnostidis 2001, P. 372

Thallus is dark blue green; narrow trichomes at the cross wall, granular at the cross wall, straight, and uniformly thick; cells 11–15 µm in width and 2- 5.5 µm in length.

12. ***Oscillatoria*** **sp.** Gomont (1892) (Pl. 1, fig. 7-8)

Prasad & Srivastava (1992), P. 55.

Trichomes occur alone or in the shape of a flat, spongy, free-swimming thallus without a sheath.

Trichomes have pointy ends, bent like a sickle, coiled, or less like a screw.

Cyanothrichaceae

13. ***Johannesbaptistia*** **sp.** Toni (1934) (Pl. 1, fig. 2-3)

Desikachary (1959), p. 163, Pl. 14. Fig. 19

Algae have a tiny, linear, elongated, cylindrical, straight, or curved thallus; discoid-shaped cells in a single series within the narrow, cylindrical hyaline mucilage.

Aphanizomenonaceae

14. ***Anabaena inaqualis*** (Kutz.) Bornet and Flahault (Pl. 2, fig. 1-3)

Desikachary (1959), P. 413

Thallus looks like floccos, free-floating or attached to other algae, blue-green color; Trichome 4–5 µ wide, always parallel, straight, and occasionally free of a mucilaginous sheath; cells 5–6 µ long, spherical or barrel-shaped with rounded ends and barely attenuated apices.

Aulacoseiraceae

15. *Aulacoseira granulata* (Ehrenberg) Simonsen (1979) (Pl. 2, fig. 5)

Karthick et al. (2013), Pl. 3

Valve diameter is 13–30 µm; the valve mantle depth is 3- 6 µm; long filaments are formed by the end-to-end elongated linking spines that adjoin the frustules; smaller spines may also be present around the valve margin.

Ulnariaceae

16. *Ulnaria ulna* (Nitzsch) Compère (2001**)** (Pl. 2, fig. 6; Pl. 3, fig. 1-3)

Karthick, Hamilton & Kociolek (2013), Pl.18

Valves linear, with margins parallel, tapering to protracted to rostrate apices; central sternum narrow, straight; central area transversely expanded rectangular area, nearly square in shape; valve length 74-103.5µm, valve breadth 6.5-8.0µm.

Eunotiaceae

17. ***Eunotia bilunaris*** (Ehrenberg) Schaarschmidt (1880) (Pl. 3, fig. 4)

Karthick et al. (2013), Pl. 33

Only a little section of the raphe is visible on the valve face, and the valves are lunate or curved; apices slightly swollen, rounded; striae indistinctly punctate; valve length 66-86µm, valve breadth 2-3µm, stria density 19- 20/10µm.

Pinnulariaceae

18. *Pinnularia* cf. *cardinaliculus* Cleve (1895) (Pl. 3, fig. 6)

Friedman & Potapova (2021).

The sides of a valve are almost parallel and linear. The cuneate apices are marginally wider than the valve's overall width. The linear axial region makes up around one-third of the valve width. Valve 76-123µm long, 15-19µm wide, and striae 8-8.5µm

19. *Pinnularia grunowii* Krammer (2000) (Pl. 4, fig. 1)

Jüttner & Carter

Cell shape is linear with undulating margins, capitates, and subcapitate ends, 27–55 µm long, 6.5–9 µm wide; isopolar, bilaterally symmetrical; radiate striae, becoming strongly convergent at capitate valve ends.

Bacillariaceae

20. ***Nitzschia palea*** (Kützing) W. Smith (1856) (Pl. 4, fig. 6)

Karthick (2013), Pl. 118

From linear-lanceolate to linear or lanceolate, the valve appears; the poles are thin with apices subcapitate or weakly capitate; the marginal raphe is supported by a short block; the valve is 27.5–47.5 µm long and 3.5–5 µm wide.

Cymbellaceae

21. Encyonema silesiacum (Bleisch) D.G. Mann (1990) (Pl. 4, fig. 5)

Karthick et al. (2013), Pl. 100.

Widespread dorsiventral valves with a little center expansion; blunt tip, rounded, and not extended; linear axial region and tapering, lanceolate central portion. Valve length 37.5-68.0 µm, Vave breadth 10.0-13.5 µm, and stria density 7-11/10 µm.

Scenedesmaceae

22. Scenedesmus obtusus var. apiculatus (West &G.S.West) P.M.Tsarenko (2000) (Pl. 8, fig.5)

West & West (1984), P. 16, Pl. 2, Fig. 38

Colonies enclose 4-8 cells; fusiform, ellipsoid, oblong-ellipsoid to ovoid-shaped cells with obtuse poles; Colonies aggregated in syncoenobia; Cells measure 4.5-7.9 µm in width and 10-16.7 µm in length.

Hydrodictyaceae

23. Pediastrum tetras (Ehr.) Ralfs. (Pl. 8, fig. 6)

Prasad & Misra, (1992), P. 11, Pl.1, Fig. 9

Circular colonies with 8 cells lacking intercellular spaces and perforation on wall; outer side of marginal cell with a deep, cuneate incision up to the middle of cell; size of colonies 24- 26.5 µm, cell length 7.0- 9.0 µm & lat.cell. 8- 9.5 µm

Spirogyraceae

24. *Spirogyra sp.* Link (1820) (Pl. 8, fig. 4)

Prasad & Misra (1992), P. 77.

Simple, unbranched filaments, with short to very long cylindrical cells; chloroplasts 1–16 parietal ribbon-like, spiral, or sporadically nearly straight, with multiple prominent pyrenoids; the nucleus positioned in the middle of the protoplasmic strand.

Gonatozygaceae

25. *Gonatozygon monotaenium* De Bary (1858) (Pl. 8, fig. 1-3)

Kalina; Walne & Houk, (2001), P. 121; Das & Keshari, P. 142, Pl.XXVII, Fig.455, 456.

cylindrical apices, occasionally curved cells truncated and somewhat dilated; 10 times longer than broad; chains of 4–8 cells; two axial in each cell; undulate chloroplasts with three to four pyrenoids; cell 105–112µm long, 9–10µm broad, & apex 6–8µm.

Closteriaceae

26. ***Closterium dianae Ehrenberg ex*** Ralfs (1848) (Pl. 8, fig. 7)

Prasad and Misra (1992), P. 105, Pl. 16, Fig. 7.

Medium-sized cells with a smooth cell wall and 9–10 times longer length than breadth; chloroplasts with 6–8 pyrenoids arranged in a row; cells 105–303 µm long and 16–35 µm broad.

27. *Closterium dianae* var. *arcuatum* (Brebisson ex Ralfs) Rabenhorst (1868) (Pl. 9, fig. 5-6)

Croasdale & Flint (1986), P. 58, Pl.

This variety is characterized by its greater curvature (130-176°) and, in general, dimensions greater than 250x20µm.

28. *Closterium ehrenbergii* Meneghini ex Ralfs (1848) (Pl. 9, fig. 4)

Scott & Prescott (1961), P. 11, Pl. 2, Fig. 2; Prasad & Misra (1992), P. 106, Pl. 17, Fig. 1, 2

Large cells, 6-8 times longer than broad, moderately curved, inner margin concave; however, inflated in the center; chloroplast with 6-8 bands and numerous scattered pyrenoids; cells 450-530 µm long, 65-80 µm broad.

29. ***Closterium gracile*** Brébisson ex Ralfs (1848) (Pl. 10, fig. 1-4)

Oliveira, Bicudo & Moura, P.122, Fig.23

The semi-straight cells have an apex width of 2.5–4 µm, are 112.5–200 µm long, 3.5–6 µm wide, and are 30- 33 times longer than wide; cells with a convex dorsal margin, a straight ventral margin in the middle region, and a slight apical region curve.

30. ***Closterium setaceum*** Ehrenberg ex Ralfs (1848) (Pl. 10, fig. 5-6)

Oliveira, Bicudo & Moura, P.122, Fig.23

Fusiform-lanceolate-shaped cells with 255-350 µm length, 10-20 µm in width, and 2.5-3 µm at the apex; nearly straight dorsal and ventral margins, with equal convexity; and a fusiform middle region.

31. ***Closterium* cf. *striolatum*** Ehrenberg ex Ralfs (1848) (Pl. 11, fig. 1-3)

Croasdale and Flint (1986), P., Pl.10, Figs. 1, 2

Apices of cells are broadly truncate with rounded angles, sometimes slightly capitulate with thickened walls; cell wall brownish with girdle bands, striae, 5-10 striae in 10 µm, mostly punctate between striae.

Desmidiaceae

32. ***Pleurotaenium ehrenbergii*** (Ralfs) Delponte (Pl. 11, fig. 4-5)

Croasdale & Flint (1986), P. 71, Pl.14, Fig. 8; Das & Keshari (2016), P. 155, Pl. XXIV, Fig. 397, 398.

Slightly constricted large cells and 13–15 times longer than broad; semicells with one or two smaller swellings; the wall is punctate, and the semicell margins are tapered slightly to a rounded shape. The cells are 621–626 µm long and 23–30 µm broad, and the chloroplast is organized into longitudinal bands, with four parietal bands in the face view and several pyrenoids.

33. ***Euastrum binale*** (Turp.) Her. ex Ralfs, Plate 22, fig. 8

Suseela & Toppo, (2007), P. 109, Pl. 1, Fig. 7

Semicells have concave sides above a big, truncate apex, complete, broadly rounded basal angles, and usually acute outer angles, giving them a subpyramidal appearance. There is a slight center protuberance and no decoration on the face. The zygospore appears globose and contains several blunt spines. It has spines that measure 5.7 to 11.6 µm and a diameter of 20 to 26 µm.

34. ***Cosmarium auriculatum*** Reinsch (1875)

Prasad & Misra (1992), P. 153, Pl.22, Fig. 14

Semi-elliptical, with five undulating sides with sharp, pointed ridges and a thin, straight apex; cell wall arranged in transverse series; cell length: 41.5-45 µm; cells are tiny, with a shallow constriction at the middle, an open sinus outward, and a rounded apex.

35. *Cosmarium blytii* Wile forma Croasdale (Pl. 12, fig. 4-5)

Prasad& Misra (1992), P. 155, Pl. 24, fig. 2, 3.

Each semicell of Forma has six somewhat elongated granules around the center granule, with marginal crenations not being as noticeable. The chloroplast axial filament has a single central pyrenoid, and the cell is 16.5 µm long, 13 µm wide, with an isthmus of 3 µm.

36. *Cosmarium* cf. *lundellii* Delp. (Pl. 12, fig. 6-8)

Prasad and Misra, 1992, P. 163, Pl. 22, fig. 1, 5.

Medium-sized cells are somewhat shorter than they are wide, highly constricted, and almost linear. Semicells feature a sub-semicircular to sub-pyramidal shape, a rough punctuation pattern on the cell wall, and a spherical basal angle. The dimensions of the cell are 20.5-23 µm in height, 51-56 µm in breadth, and 62.5-71 µm in length.

37. *Cosmarium circulare* *Reinsch*, nom. illeg. 1867 (Pl. 13, fig. 1-2)

Prasad and Misra, 1992, P. 156, Pl. 22, fig .8

Semicircular, sinusoidally linear, and closely spaced are the typical characteristics of semicells. Each semicell has two pyrenoids, a rigid chloroplast axis, and visible cell wall punctures. Cell length: 70.5 µm, lat. cell: 59 µm, isthmus length: 21 µm.

38. ***Cosmarium connatum*** Brébisson ex Ralfs (1848) (Pl. 13, fig. 3-4)

Prasad and Misra, 1992, p.157, pl.23, fig.10, 15; Croasdale, H. &Flint, E.A., 1988, p.60, pl.37, fig. 30

Semicells that are transversely subelliptic with a rounded or slightly flattened apex; subcircular in end view; walls that are relatively thick, delicately scrobiculate, and punctate; chloroplasts with two pyrenoids and with more than one; cells 60-105 X 42-90 µm (c. 1.3×), with a very shallow and wide-open sinus at the isthmus 31-71 µm.

39. ***Cosmarium obsoletum*** (Hantzsch) var.***sitvense*** (Gutw.) Krieger (Pl. 13, fig. 5-7)

Prasad & Misra, 1992, P. 171, Pl.22, fig. 13; Scott, A.M. & Prescott, G.W., 1961, pp. 63- 64, Pl.25, fig. 11, Pl. 26, fig. 2

With the broadest part in the center, the cell has a larger, almost round shape, thick, mucrate basal angles, and somewhat broader apices. At 55 µm for cell length, 69 µm for lat. cell, and 31 µm for lat. isthmus, the cell wall is strongly punctuated.

40. ***Cosmarium obtusatum*** (Schmidle) Schmidle 1898, (Pl. 13, fig. 8)

Croasdale & Flint, 1988, P. 81, Pl. 36, fig. 14-16

The cells are sinus-deep, closed but dilated within, 48-60 (87) × 41-50 (54) µm in size, and 15-18 µm thick at the isthmus. Semicells can be semicircular or truncate-pyramidal with rounded angles, and they have two pyrenoids. The globose zygospore is 42–45 µm in diameter (ssp) and 57–62 µm in csp, with numerous sharp, conical spines.

41. ***Micrasterias zeylanicavar.rectangularis*** A.M.Scott & Prescott 1961 (Pl. 14, fig. 3)

Das & Keshari, 2016, P.150, Pl. XXX, fig. 517, 518; Croasdale & Flint, 1986, p. 102-110,Pl. 24, fig. 3,4 ; Scott & Prescott 1961: 53, pl. 21: figs 5-7

The sinus has a pointed inner terminal and is open, deep, acuminate, and triangular. It is made up of tiny, somewhat longer-than-wide cells. Cells are between 60 and 62 µm wide and between 62 and 65 µm long. The sinus has a pointed inner terminal and is open, deep, acuminate, and triangular. It is made up of tiny, somewhat longer-than-wide cells. Cells are between 60 and 62 µm wide and between 62 and 65 µm long.

42. ***Staurastrum forficulatum*** var**. *verrucosum*** Grönblad (1920) (Pl. 14, fig. 4-5)

Grönblad 1920, P.64, Pl. 3, Figs. 47, 50-51.

Semicells are small, about 1.5 times longer than wide, constricted, deep, and have a sinus that is sharply open but pointed at the apex. They are elliptical or subtrapeziform, with slightly convex tips, and four short emarginate spines arranged in protrusions on the upper and lower margins with two to three warts at the margin. The dimensions of cells are 14 µm in breadth, 39 µm in width, and 47.6 µm in length.

43. *Staurastrum lunatum* Ralfs (1848) [Recent name: *Staurastrum avicula* var. *lunatum* (Ralfs) Coesel & Meesters (2013)] (Pl. 14, fig. 6)

Croasdale, Flint & Racine, P. 111, Pl.83, Fig. 4- 6

With an isthmus of 10–15 µm and a width equal to their length, cells are quite densely packed. From the inside, the sinus opens wide. Semicells are semicircular or shallowly cup-shaped, with a strong spine that extends obliquely upward, an obtuse angle, a strongly convex ventral edge, and a slightly convex apex.

44. *Staurastrum muticum* Brébisson ex Ralfs 1848 (Pl. 14, fig. 7-8)

Das & Keshari, 2016, P.168, Pl. VII, Fig. 223-225

Medium-sized cells are slightly longer than broad. From a vertical perspective, the cells are triangular, narrowly rounded at the angles, and have heavily perforated cell walls. The cell width is 19–21 µm, the cell length is 21–22 µm, and the isthmus is 7- 8 µm.

Zygnemataceae

45. *Cylindrocystis brebissonii*(Ralfs) De Bary 1858(Pl. 15, fig. 1)

Croasdale & Flint, 1986, P. 34, Pl. 1, fig. 15, 16.

The cylindrical cells measure 26- 87 × 14- 22 (35) µm (2-4X) and contain widely rounded apices. Although they can occasionally be extended, chloroplasts are axially orientated and usually feature a few large rays and huge central pyrenoids. Zygospores have a diameter of 26–62 µm and are subspherical to quadrate.

Mesotaeniaceae

46. ***Netrium digitus*** (Ehr.) Itzigs.et Rothé (Pl. 15, fig. 2)

Prasad & Misra, 1992, P. 89, 90, Pl.15, fig. 2

The medium-sized cells are oblong-elliptic, non-constricted, four to five times as long as broad, and have convex edges that gradually attenuate towards rotundo-truncate apices. Chloroplasts feature longitudinal plates and deeply serrated borders, while cell walls are smooth. Latitude: 41-44.5 μm; Apex: 15-16.5 μm; Length: 171-204 μm.

Dinobryaceae

47. ***Dinobryon sertularia*** Ehrenberg 1835 (Pl. 15, fig. 3-4)

Prescott, 1951, P. 378, Pl. 98, Fig. 10

With a smooth, convex lateral boundary that narrows above the mid region before flaring slightly to a large mouth and a blunt-pointed posterior, colonies eventually diverge; they resemble loricas fusiform-campanulate. colonies with dimensions of 10–14 μ in diameter and 30–40 μ in length.

Euglenaceae

48. ***Trachelomonas armata*** Ehrenberg (1834) (Pl. 15, fig. 6)

Prescott, 1951, P. 410, Pl.83, fig 32

The flagellum opening is surrounded by a circle of straight spines, while the cells themselves are roughly elliptical in shape. The cell, which is 22 μ in diameter and 38–40 μ long, has spines. The wall seems spiny at the front, with long spines pointing backward at the back and a poorly distributed spine in the middle.

49. ***Trachelomonas intermedia*** P.A.Dangeard 1902 (Pl. 15, fig. 7)

Prescott, 1951, P. 415, Pl.83, fig. 10

The cells are oval to subspherical in shape, with a small anterior narrowing; the flagellum aperture is thickened but lacks a clear collar; and the wall is black and heavily perforated. The cell is 16–18 μ in diameter and 20–25 μ in length.

50. ***Euglena proxima*** Dangeard 1902 (Pl. 16, fig. 1)

Prescott, 1951, P. 394, Pl.85, fig. 25

Cells with a large chloroplast, a disc that is irregularly shaped, spiral-striped periplasts, fusiform cells that are constricted posteriorly to a blunt tip, and tiny rods scattered all over the cell. Cells with dimensions of 14.5–19–(21) μm in diameter and 50–70–85–95 μ in length.

Phacaceae

51. ***Phacus longicauda*** (Ehrenb.) Dujardin 1841 (Pl. 16, fig. 2)

Prescott, 1951, P. 400, Pl.87, Fig. 1

The cells appear to be broadly ovoid to pyriform, tapering gradually posteriorly to create a long, straight, sharply pointed caudus, and the periplast is longitudinally striated. The flagellum is shorter than the cell length. Cells vary from 4 to 70 μ in width and 85 to 170 μ in length.

52. ***Phacus orbicularis*** Huebner 1886 (Pl. 16, fig. 3-4)

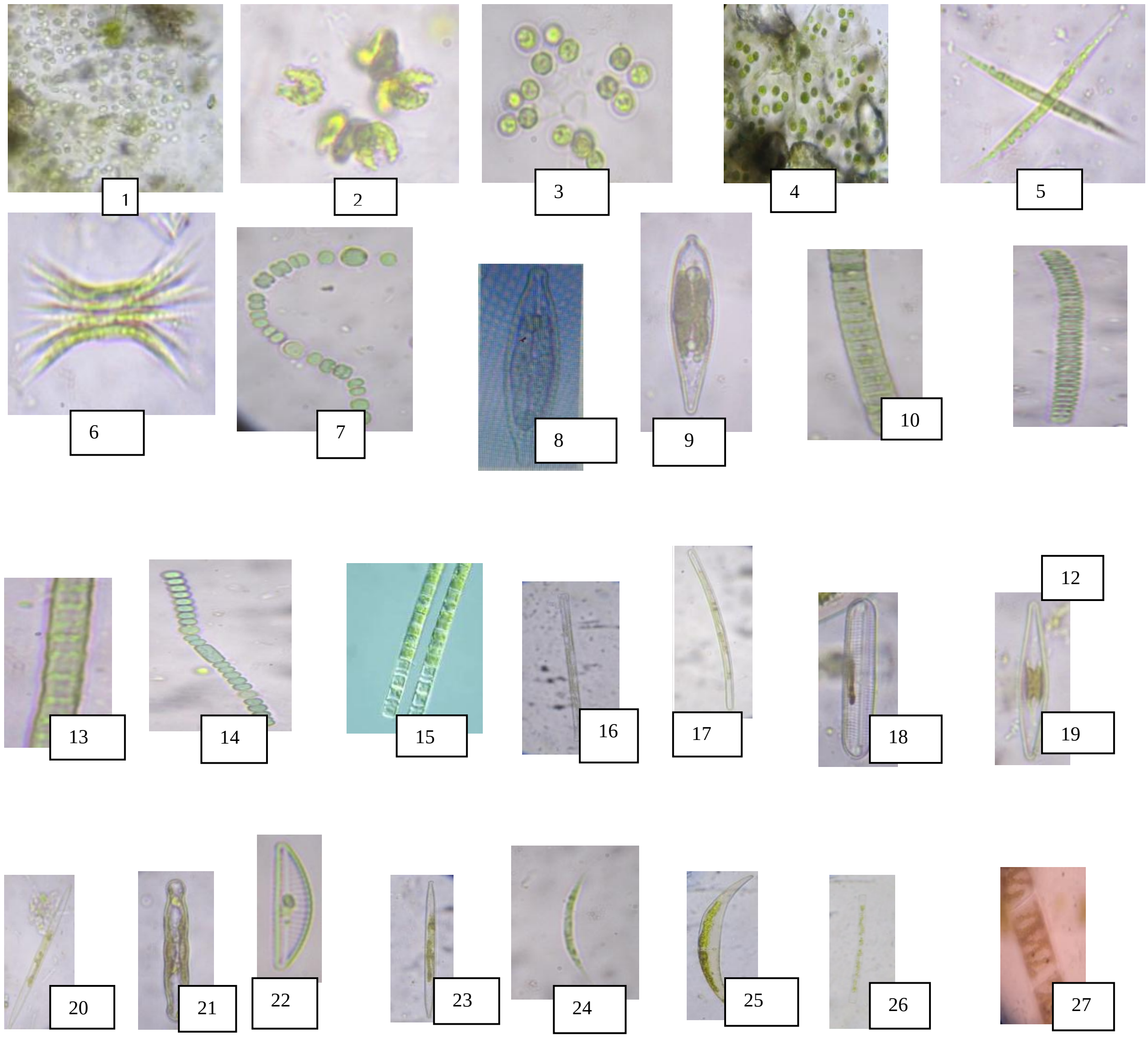
Presscott, 1951, P. 401, Pl. 87, fig. 10

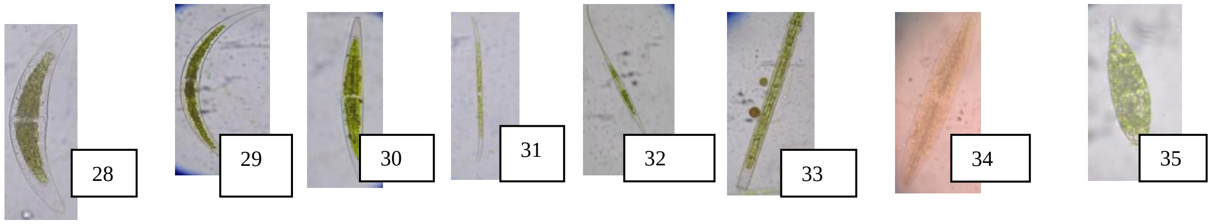
The cells are orbicular in shape and spherical on the front. The flagellum is twice as long as the body, the periplast has fine longitudinal striation, and the paramylon bodies are two disc-shaped plates with a short caudus that curves to the right when viewed ventrally. The cells are 39–45 μ in diameter and 60–70–100 μ in length.

Figure 1

1. *Aphanothece stagnina*; 2. *Kirchneriella lunaris;* 3. *Dictyosphaerium pulchellum;* 4. *Sphaerocytis schroeteri;* (5-6) *Ankistrodesmus falcatus;* 7. *Anabaena* sps.; 8. *Navicula rostellata;* 9. *Gomphonema pseudoaugur;* 10. *Oscillatoria crassa;* 12. *Johannesbaptistia;* 13. *Oscillatoria* sp.; 14. *Anabaena inaequalis;* 15. *Aulacoseira granulate;* 16. Ulnaria *ulna;* 17. *Eunotia bilunaris;* 18. *Pinnularia cardinaliculus;* 19. *Gomphonema acidoclinatum;* 20. *Nitzschia palea;* 21. *Pinnularia grunowii;* 22. *Encyonema silesiacum;* 23. *Ulnaria ulna;* 24. *Monoraphidium griffithii;* 25. *Closterium dianae;* 26. *Gonatozygon monotaenium;* 27. *Spirogyra* Sp.; 28.Closterium *ehrenbergii;*

29. *Closterium dianae var. arcuatum;* 30.*Closterium striolatum*; 31. Closterium *gracile;* 32. *Closterium setaceum;* 33. *Pleurotaenium erenburgii; 34. Netrium digitus;* 35. *Euglena proxima*

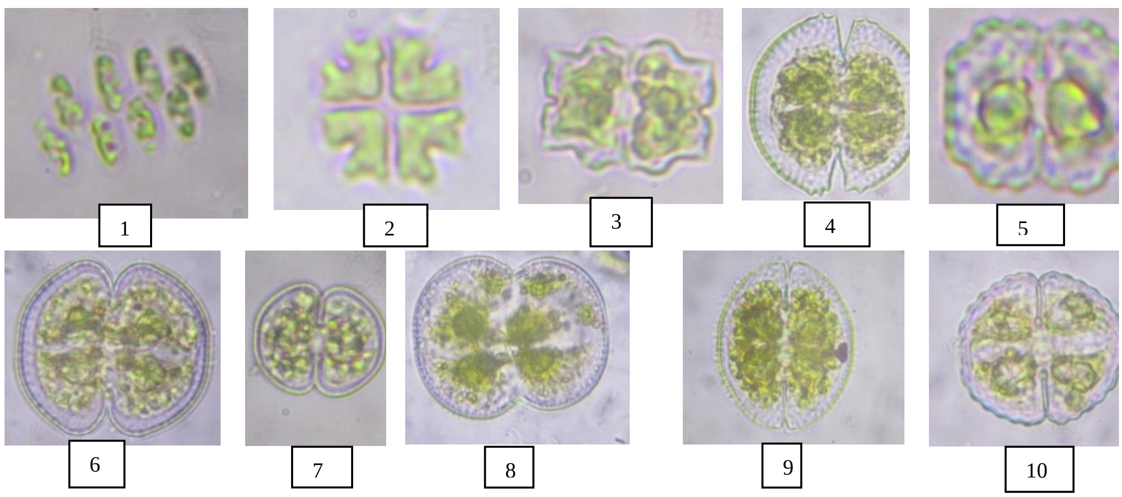


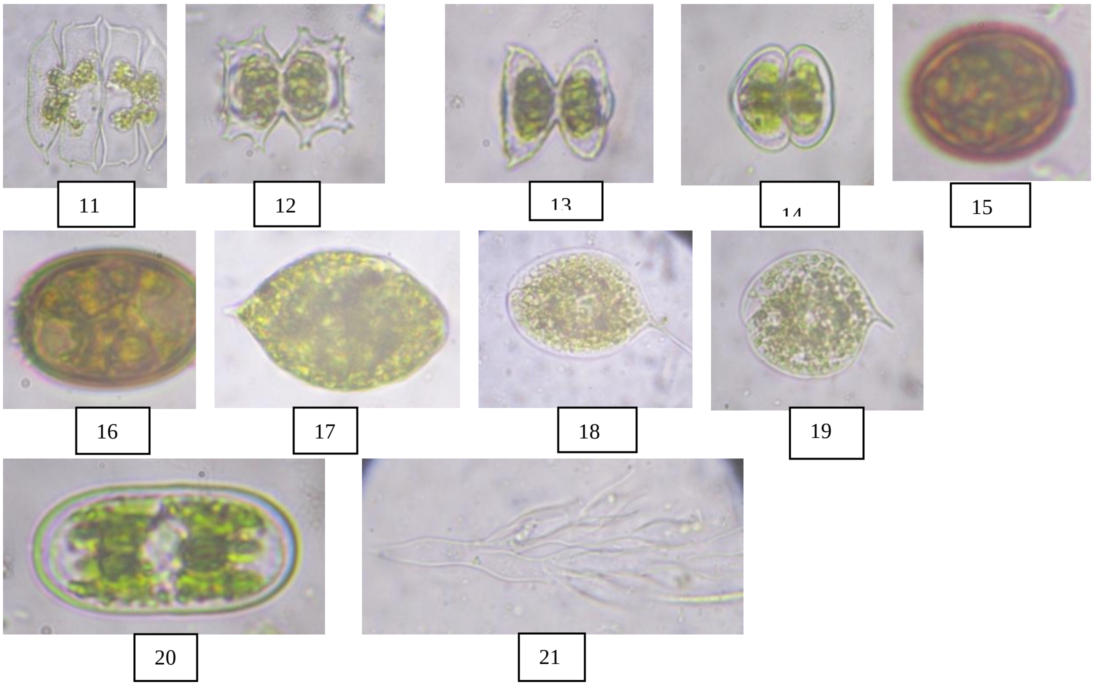


Photoplates continued

Figure 2

1. *Scenedesmus obtusus;* 2. *Pediastrum tetras;* 3. *Euastrum binale;* 4. *Cosmarium auriculatum;* 5. *Cosmarium blyttii;* 6. *Cosmarium cf. lundellii;* 7. *Cosmarium circulare*; 8. *Cosmarium connatum;* 9. *Cosmarium obsoletum;* 10. *Cosmarium obtusatum;* 11. *Micrasterias zeylanica var. rectangularis;* 12.*Staurastrum forficulatum var.* verrucosum; 13. *Staurastrum lunatum;* 14. *Staurastrum muticum* ;15. *Trachelomonas intermedia; 16. Trachelomonas armata;* 17. *Euglena proxima;* 18. *Phacus longicauda;* 19. *Phacus orbicularis;* 20. *Cylindrocystis brebissonii;* 21. *Dinobryon sertularia*





Conclusion

While fewer algal taxa were found in the lake's lentic habitat, the aquatic environment of Rasa Tal has more freshwater algae in the lotic water flowing through the lake's northern stream channel. It might suggest that, to grow and develop properly, freshwater algae need bodies of water that are both fresh and moving.

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Conflict of interest

The author declares no conflict of interest.

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