J. Pl. Res. Vol. 18, No. 1, pp 27-38, 2020

Algal Flora of Gajedi Lake, Rupandehi District, Central Nepal

Sajita Dhakal[1]*, Shiva Kumar Rai[2], Pratikshya Chalise[1] and Til Kumari Thapa[1]
[1]National Herbarium and Plant Laboratories, Godawari, Lalitpur, Nepal
[2]Phycology Research Lab, Department of Botany, Post Graduate Campus, Tribhuvan University, Biratnagar, Nepal
*E-mail: *dhakalsajita0@gmail.com*

Abstract

The study was carried out for the documentation of algal flora of Gajedi Lake of Kanchan Rural Municipality of Rupandehi district. Algal samples were collected by using plankton net for planktonic forms and squeezing submerged aquatic macrophytes for epiphytic forms from 10 sampling sites from periphery littoral zone of the lake during May, 2019. Altogether 33 taxa belonging to 10 orders, 14 families, 5 classes and 18 genera were reported in this study. Chlorophyta with 15 taxa was found to be the dominant phylumof algae which was followed by Charophyta (10),Cyanophyta (5), Euglenophyta (2) and Glaucophyta (1). *Scenedesmus* with eight taxa was found to be the dominant genera which was followed by *Coelastrum*, *Cosmarium*, *Euastrum* (3 taxa each), *Staurastrum, Oscillatoria* (2 taxa each)and so on.

Keywords: *Coelastrum, Cosmarium*, Cyanophyceae, *Scenedesmus.*

Introduction

Algae are the photosynthetic organisms and can convert the anaerobic atmosphere of the earth into an aerobic atmosphere by the process of oxygenic photo-phosphorylation. The plant body in algae is always a thallus and is not differentiated into root, stem and leaves. They have a varied size from minute unicellular plants (less than 1μ in diameter in some planktons) to very large highly differentiated multi cellular forms. Phytoplanktons that include algae as their exclusive constituent are directly related to fish populations of the oceans and thereby control the availability of 'sea food'. They are considered very important and their beneficial roles include, an excellent source of single-cell protein, hydrocarbons, biogas, polysaccharides such as agar-agar, antibiotics, colouring pigments as well as some important medicines. They also provide some harmful effects to the human such as, produce water blooms, toxins as well as some diseases.

Several studies have been carried out on algal flora of different Lakes of Nepal (Hirano, 1955; Hirano, 1963; Watanabe, 1995; Rai and Rai, 2012; Rajopadhya et al., 2017; Shrestha & Rai, 2017; Rai & Poudel, 2019) but the work has been done on documentation of algal flora in Nepal is not sufficient. So that documentation of algal flora in unexplored habitats is more important. The algal flora of Gajedi lake has not been studied till date. Hence, a database on number of algal presences is essential in order to document and understand the country's algal wealth. Thus, the database can be used as a baseline to search for more algal species reported to occur as well as act as first comprehensive documentation on the algae in this area.

Materials and Methods

Study area

Gajedi lake (27°39'51" N and 83°16'34" E, Elevation 133 m asl) is located in the Danapur (previously Gajedi) VDC, of Rupandehi district of province-5, southern Nepal located close to the pilgrimage site Lumbini. The village name is a part of Kanchan Rural Municipality (Figure 1). Butwal is notable for being the closest city to the Gajedi Lake and is geographically significant city in Nepal as it is located at the intersection of Nepal's two major highways, the Mahendra Highway and the Siddhartha Highway. This lake is a tourist attraction site as it is located in the jungle and is popular for internal as well as external tourism especially for picnics, boating activities and jungle safaris.

The lake covers an area of about 19 hectares (District Forest Office [DFO], 2073) surrounded by *Shorea robusta* forest and the common constituting tree species of this forest were *Adina cordifolia, Dalbargia sissoo*, *Dalbergia latifolia, Terminalia alata*, *Terminalia bellirica*, *Terminalia chebula*, *Pterocarpus marsupium*, *Schleichera oleosa* etc. to Eastern and North-Western sides, and by private land and settlement area to South-Western facing side (Dhakal et al., 2019). The aquatic macrophytes found in the lake include *Eichhornia crassipes*, *Hydrilla verticillata*, *Nelumbo nucifera*, *Pistia stratiotes*, etc.

The climate of the study site is subtropical and shares monsoon type of climate with dry winter and rainy summer. The average annual precipitation of the nearest meteorological station to the study sites i.e, Butwal showed mean annual precipitation 2600 mm and the mean maximum/minimum temperature recorded were 42.5°C/7.5°C (Thapa & Poudel, 2018).

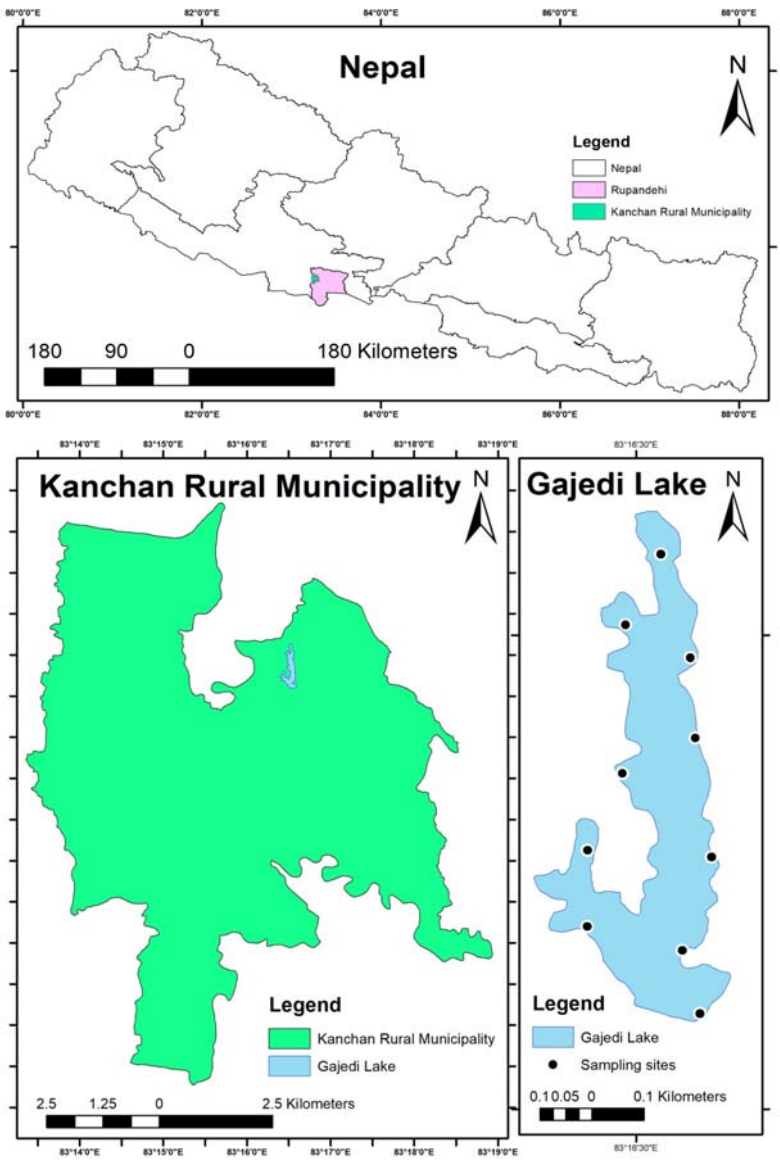

Figure 1: Location map of Gajedi Lake, showing algal sampling sites

Collection and identification of algal samples

A total of 30 algal samples were collected from peripheral littoral zone of the lake during May2019 but the data of only 10 samples were described in this paper. Geographical position (Latitude, Longitude, Elevation) and physico-chemical parameters like temperature, pH, conductivity (by Hanna Multi-range EC meter, HI8733) were measured on the spot (Table 1). Algal samples were collected by using plankton net for planktonic forms and squeezing submerged aquatic macrophytes for epiphytic forms. Each sample was assigned with collection number starting from G1, G2, G3,.....G10 and preserved in 4% formaldehyde solution in airtight glass bottles and brought to the laboratory of National Herbarium and Plant Laboratories, Godawari. All the collected materials have been deposited in the Cryptogams Section (Algae, Fungi and Lichen), National Herbarium and Plant Laboratories, Godawari, Lalitpur for further examination. Samples were screened then; microphotography was done for each specimen under 40X objective using Huma Scope Premium LED microscope fitted with the digital camera. Taxa (excluding of diatoms), were identified consulting various articles, literatures and monographs (West & West, 1904; Prescott, 1951; Prescott & Scott 1952; Deshikachary, 1959; Philipose, 1967; Hirano, 1969; Croasdale &Flint, 1988; Rai & Misra, 2008 and 2010; Rai, 2013; Halder, 2016; Shrestha & Rai, 2017; Godar & Rai, 2018; Mhaske & Talwankar, 2018). Nomenclature, as well as classification follows Guiry & Guiry (2019).

Table 1: Physico-chemical parameters of water at different collection sites of Gajedi Lake

S.N.	Collection No.	pH	Temperature (°C)	Conductivity (µs/cm)
1.	G1	6.5	32	306
2.	G2	6.5	29	337
3.	G3	6.5	29	334
4.	G4	6.5	28	316
5.	G5	6.5	28	316
6.	G6	7	34	303
7.	G7	6.5	28	316
8.	G8	6.5	28	316
9.	G9	7	34	303
10.	G10	7	34	303
Mean		**6.65**	**30.4**	**315**

Results and Discussion

In the present study, a total of 33 algal taxa belonging to 18 genera, 14 families, 10 orders and 5 classes have been reported from Gajedi Lake, Rupandehi, Nepal (Table 3). It included six taxa identified up to generic level only, (viz., *Oedogonium* sp., *Oscillatoria* sp., *Phacus* sp., *Phormidium* sp., *Scenedesmus* sp. and *Staurastrum* sp.) and three taxa closely related to corresponding species (viz., *Ankistrodesmus* cf. *falcatus*, *Cosmarium* cf. *seelyanum* and *Trachelomonas* cf. *oblonga* Lemmermann Wolle (Corda) Ralfs. Among the classes, Chlorophyceae have the maximum number of algal species followed by Conjugatophyceae and Cyanophyceae. However, Euglenophyceae and Glaucophyceae were represented by single taxa each. Similarly, among the genera, *Scenedesmus* had the highest species number (i.e, eight taxa) followed by *Coelastrum*, *Cosmarium*, *Euastrum* (three taxa each), *Staurastrum*, *Oscillatoria* (two taxa each) and so on. The detailed list of the algal flora of Gajedi lake is presented in Table 2.

This preliminary investigation of 10 samples showed that the lake is rich in algae. The mean temperature at the collection sites are very congenial being within the range of 28°C to 34 °C, the pH was in near to neutral (6.5) or neutral (7) with mean conductivity value 315 (ìs/cm) which possibly are the regulating factors for the high number of algal species. Further, the water body of the lake is nutritionally rich due to loading of anthropogenic wastes and it may be the reason behind the excessive growth of algal taxa.

Taxonomic description

Each taxon is appended with author/s name, figure number (in parenthesis), reference used for identification followed by brief morphological characters.

1. ***Chroococcus minutus*** **(**Kützing) Nägeli (Fig. 2: 1-2)
   Desikachary 1959, P. 103, Pl. 24, Figures 4, 15; Rai and Mishra 2010, P. 123, Pl. 1, Fig. 5.
   Cells spherical or oblong, solitary or in groups of 2-4, light blue-green; sheaths not lamellated, colourless; colonies 15-20 µm long, 10-13 µm broad; cells diameter 6-15 µm with sheath, 4-10 µm without sheath
2. ***Oscillatoria princeps*** Vaucher ex Gomont (Fig. 2: 3)
   Desikachary 1959, P. 210, Pl. 37, Figures 1, 10, 11, 13, 14; Rai and Mishra 2010, P. 2, Pl. 1, Fig. 10-11.
   Trichomes usually straight, not constricted at the cross walls, mostly forming a thallus, blue-green, or more or less brownish; end-cells flatly rounded, slightly capitate; Trichomes (15-) 20-50 (-80) µm broad; cells (2-) 2.5-6.5 (-8.7) µm long.
3. ***Oscillatoria*** **sp. (**Fig. 2: 4)
   Wehr and Sheath 2003, P.155, Fig. 16.
   Trichomes straight or slightly irregularly undulate, motile by gliding or oscillating; sheaths absent in vegetative state; endsscrew-like coiled.
4. ***Phormidium*** **sp.** (Fig. 2: 5)
   Wehr and Sheath 2003, P.141, Fig. 12A.
   Filaments arranged in tufts, not in fascicles, forming flat, slimy mats; filaments vary in curvature, without pseudo-branches, usually entangled, slightly too strongly waved or loosely and irregularly screw-like coiled; sheaths facultative.
5. ***Spirulina princeps*** West and G.S. West (Fig. 2: 6)

Desikachary 1959, P. 107, Pl. 36, Figure 7; Rai and Mishra 2010, P.130, Pl. 2, Fig. 4.

Trichomesshort, regularly spirally coiled, blue-green; spirals 11-12 µm broad, 9.5-11 µm distant; trichomes 4.5-5 µm broad.

6. ***Sphaerocystis schroeteri*** Chodat (Fig. 2: 7)
Prescott 1951, P. 83, Pl. 3, Figures 6, 7; Godar and Rai 2018, P.4, Fig. 3.

Colonies more or less spherical, consists of both undivided and recently divided cells; cells arranged in small spherical clusters within the colonial envelope; colonies up to 500 µm in diameter; cells 6-20 µm in diameter.

7. ***Oedogonium* sp.** (Fig. 2: 8-9)
Shrestha and Rai 2017, P. 47, Pl. 1, Fig. 15.

Filaments solitary, unbranched; vegetative cells cylindrical, capitate, with numerous pyrenoids; basal cell with holdfast; terminal cell obtuse.

8. ***Pediastrum tetras*** (Ehrenberg) Ralfs (Fig. 2: 10-11)
Philipose 1967, P. 128, Fig. 45.

Colonies oval, composed of 4-8-16 (-32) cells, without intercellular spaces; marginal cells blobbed divide by a linear incision up to the middle of the cell, each lobe truncates or further divided into two lobes; colonies 20-33 µm in diameter; cells 8.5 µm long, 9.5 µm broad.

9. ***Coelastrum astroideum*** De Notaris (Fig. 2: 12)
Halder 2016, P. 50, Pl. 1, Fig. 2.

Coenobium spherical, composed of 8-16 cells; sheaths gelatinous, delicate; cells oval, smooth walled, closely interconnected by gelatinous process; coenobium 38-46 µm in diameter; cells 10-15 µm in diameter.

10. ***Coelastrum cambricum*** W. Archer (Fig. 3: 13-14)
Philipose 1967, P. 230, Fig. 138a.

Colonies spherical, composed of 32 cells; cells spherical, thickened at the poles, with circular or triangular intercellular spaces; colonies up to 70 µm in diameter; cells 6-12 µm in diameter.

11. ***Coelastrum proboscideum*** Bohlin (Fig. 3: 15)
Philipose 1967, P. 229, Fig. 137.

Colonies pyramidal, composed of 4-8-16 cells; cells conical, truncate and six-sided, thickened at the poles, with large and polygonal intercellular spaces; colonies 17-30 µm in diameter; cells 8-11 µm in diameter.

12. ***Scenedesmus abundans*** (O.Kirchner) Chodat (Fig. 3: 16)
Rai 2013, P. 28, Fig. 23-25.

Colonies composed of 2-4 cells; cells ovoid; cells arranged in a linear series, external cells with one or more median lateral spines in addition to spines from four corners of the colony, internal cells with 1-2 spines from their poles, or rarely without spines; cells 6-15 µm long, 2-7 µm broad; spines 3.5-8 µm long.

13. ***Scenedesmus acuminatus*** (Lagerheim) Chodat (Fig. 3: 17)
Philipose 1967, P. 251, Fig. 161.

Colonies composed of 4-8 cells, forming a flat plate; external cellscurved, internal cells lunate, cell wall smooth and without teeth or spines; cells 12-48 µm long, 2-7 µm broad.

14. ***Scenedesmus bijugatus*** Kützing (Fig. 3: 18)
Philipose 1967, P. 252, Fig. 164 c, e, f.

Colonies composed of 2-4 cells, arranged in a single linear series; cells oblong or ellipsoidal to ovoid, end broadly rounded; cells 7-23 µm long, 3.5-7 µm broad.

15. ***Scenedesmus bijugatus*** var. ***alternanans*** (Fig. 3: 19)
Philipose 1967, P. 256, Fig. 164 g.

Colonies flat, composed of 4-8 cells, arranged in an alternating series; adjacent cells adnate to each other along a short portion of their length only; cells 13-16 µm long, about twice as long as broad.

16. ***Scenedesmus bijugatus*** var. ***gravenitzii*** (C.Bernard) Philipose (Fig. 3: 20)
Rai 2013, P.30, Fig. 5, 19.

Colonies flat, composed of 4-8 cells, arranged in alternate series with adjacent cells in contact only along a short portion of their length; cells fusiform, ellipsoid, oblong-ellipsoid to ovoid

with obtuse apices, without teeth and spines; cells 11-16 µm long, 4.5-6.5 µm broad.

17. ***Scenedesmus quadricauda*** var. ***longispina*** (Chodat) (Fig. 3:21)
Rai 2013, P.35, Fig. 13.

Colonies flat, composed of 2-4 cells; cells ovoid to cylindrical, external cells with spines, internal cells without spines; spines slightly longer than the length of the cells; cell wall smooth; cells 15 µm long, 5 µm broad; spines 13-15 µm long.

18. ***Scenedesmus longus***Meyen (Fig. 3: 22)
Philipose 1967, P. 273, Fig. 180 a.

Colonies flat, composed of 2-4-8 cells,arranged in a single linear series;cells ovoid to oblong cylindrical with rounded or sometimes subacute poles; cells 8-19 µm long, 2.3-8 µm broad; spines1.5-15 µm long.

19. ***Scenedesmus*** **sp.** (Fig. 3: 23)
Wehr and Sheath 2003, P.298, Fig. 24B.

Colonies flat, composed of 2-4-8-16(-32) cells, arranged in linear or alternating series; cells ellipsoidal, ovoid, or crescent-shaped or tapering toward each end; cells not ending in spines.

20. ***Ankistrodesmus*** **cf.** ***falcatus*** (Corda) Ralfs (Fig. 3: 24)
Philipose 1967, P. 211, Fig. 221.

Colonies composed of fasciculate bundles of 2-4-8 cells; cells acicular to narrowly fusiform, with tapering to acute apices; cells 20-165 µm long, 1.5-7 µm broad.

21. ***Glaucocystis nostochinearum*** Itzigsohn (Fig. 3: 25)
Philipose 1967, P. 188, Fig. 101-102.

Colonies composed of 4-8 cells, enclosed within the old mother cell wall; cells oblong-ellipsoid, with a number (less than 20) of radiating chromatophore-like bodies inside; colonies 45-50 µm long, 15-20 µm broad; cells 15-30 µm long,10-18 µm broad.

22. ***Closterium ralfsii*** **Brébisson** ex Ralfs (Fig. 3: 26)
West and West 1904, P. 182, Pl. 24, Fig. 6, 7.

Cells large, moderately curved, yellow-brown or reddish-brown in colour; outer margin about 35° of arc, inner margin much inflated for over half the length of the cell; apices obtuse; cell wall finely striated, 28-33 striae visible across the cell; cells 6-8 times longer than their diameter.

23. ***Cosmarium impressulum*** Elfving (Fig. 3: 27)
Hirano 1969, P. 31 Pl. 2, figure 4; Croasdale and Flint 1988, P. 71, Pl. 40, Fig. 16-19.

Cells constricted; sinus deep and closed; semicells subcircular, with 8 even marginal crenae, the two basal crenae being in a straight line with those of the opposite semicell; apex retuse; cell wall fairly thick, often thicker at apex, closely punctate; cell 27-37 µm long, 13-18 µm broad; isthmus 3-10 µm thick.

24. ***Cosmarium*** **cf.** ***seelyanum*** Wolle (Fig. 3: 28)
Wolle 1883, P. 16, Pl. XXVII, Fig. 14.

Cell small, quadrangular, deeply constricted; sinus narrow, liner, with rounded notch in the middle of the sides; cell 25-30 µm in diameter; semicells twice as wide as long.

25. ***Cosmarium subprotumidum*** var. *gregoryi* West and G.S.West (Fig. 4: 29)
Mhaske and Talwankar 2018, P. 21, Fig. 2d.

Cell small, upper half narrowed to broadly truncate apex; cell wall with somewhat radially arranged granules within the margin in pair above but single further away, center with tumour above the isthmus, consisting of relatively larger granules disposed in irregular vertical series; cell 28 µm long, 21 µm broad.

26. ***Euastrum bidentatum*** Nägeli (Fig. 4: 30)
Rai and Mishra 2008, P. 49, Pl. 2, Fig. 4.

Cells deeply constricted; sinus slightly dilated at the extremity; apical angles with a short spine; lateral lobes bilated, marginal spines not distinct; semicells 3-lobed, polar lobe 19 µm broad with deep median incision, with 5 protuberances, one large just above the isthmus, one on each lateral lobe and one on each side of apical notch in the polar lobe; isthmus narrow; cells 44 µm long, 30 µm broad; isthmus 6-7 µm wide.

27. ***Euastrum lacustre*** (Messikommer) Coesel (Fig. 4: 31-33)

Reddy and Chaturvedi 2017, P. 32, Fig. 10.

Cells medium sized; sinus narrow linear with dilated apex; semicells nearly quadrangular, with deeply incised three lobed, polar lobe rectangular with rounded angles and truncate retuse apex, lateral lobes short with rounded angles and retuse margin, retuse margin some time more incised and giving appearance of two more lobes; cell wall smooth; cell 28-48µm long, 26-46 µm broad; Isthmus 9-10µm wide.

28. ***Euastrum platycerum*** Reinsch (Fig. 4: 34)

Rai and Mishra 2008, P.50, Pl. 2, Fig. 7.

Cells deeply constricted; semicells 3 lobed, polar lobes 12.5-13 µm broad, truncate without

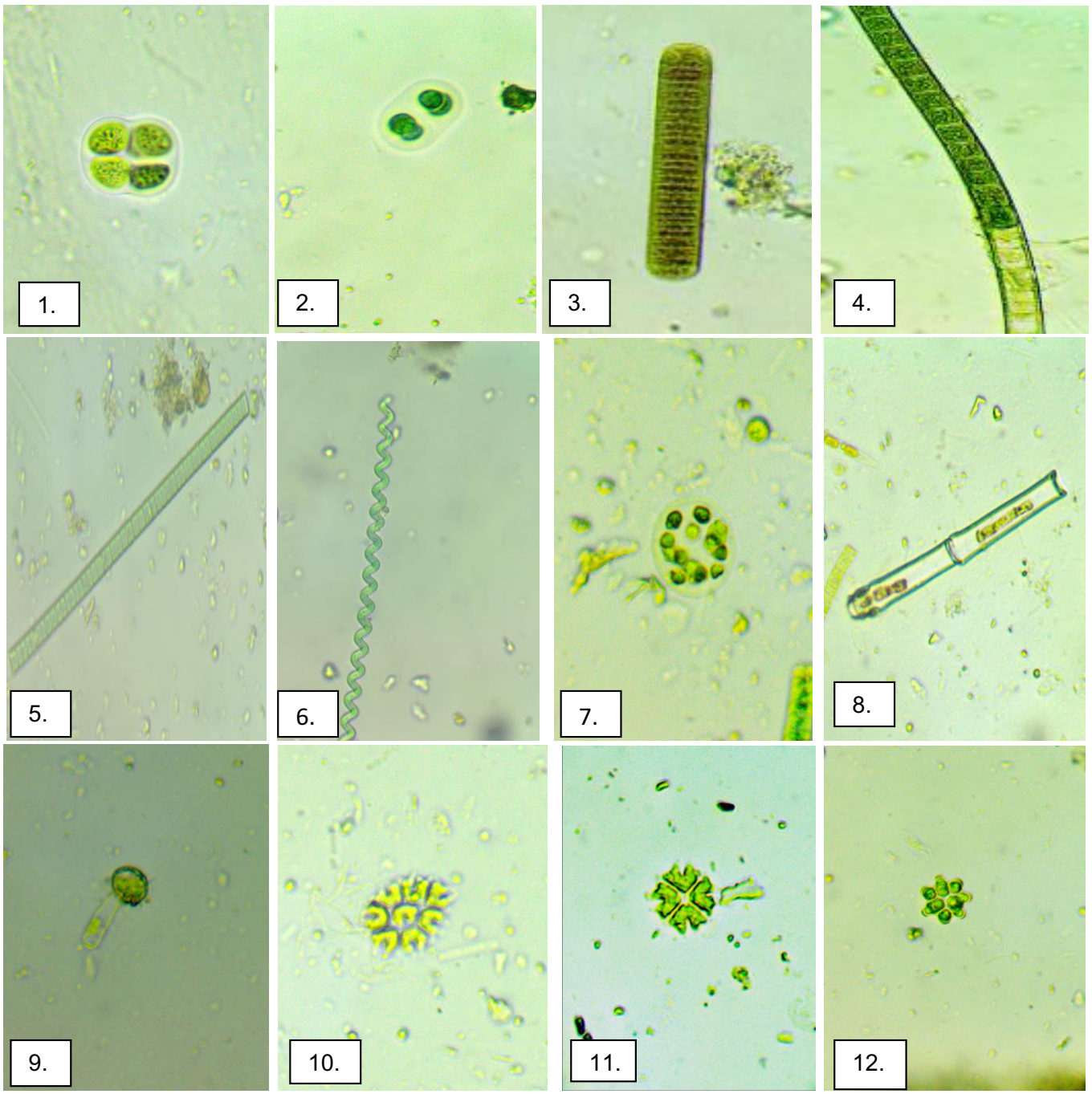

Figure 2: 1-2. *Chrococcus minutus*,3. *Oscillatoria princeps*,4. *Oscillatoria* sp., 5. *Phormidium* sp., 6. *Spirulina princeps*,7. *Sphaerocystis schroeteri*,8-9. *Oedogonium* sp., 10-11. *Pediastrum tetras*, and12. *Coelastrum astroideum*.

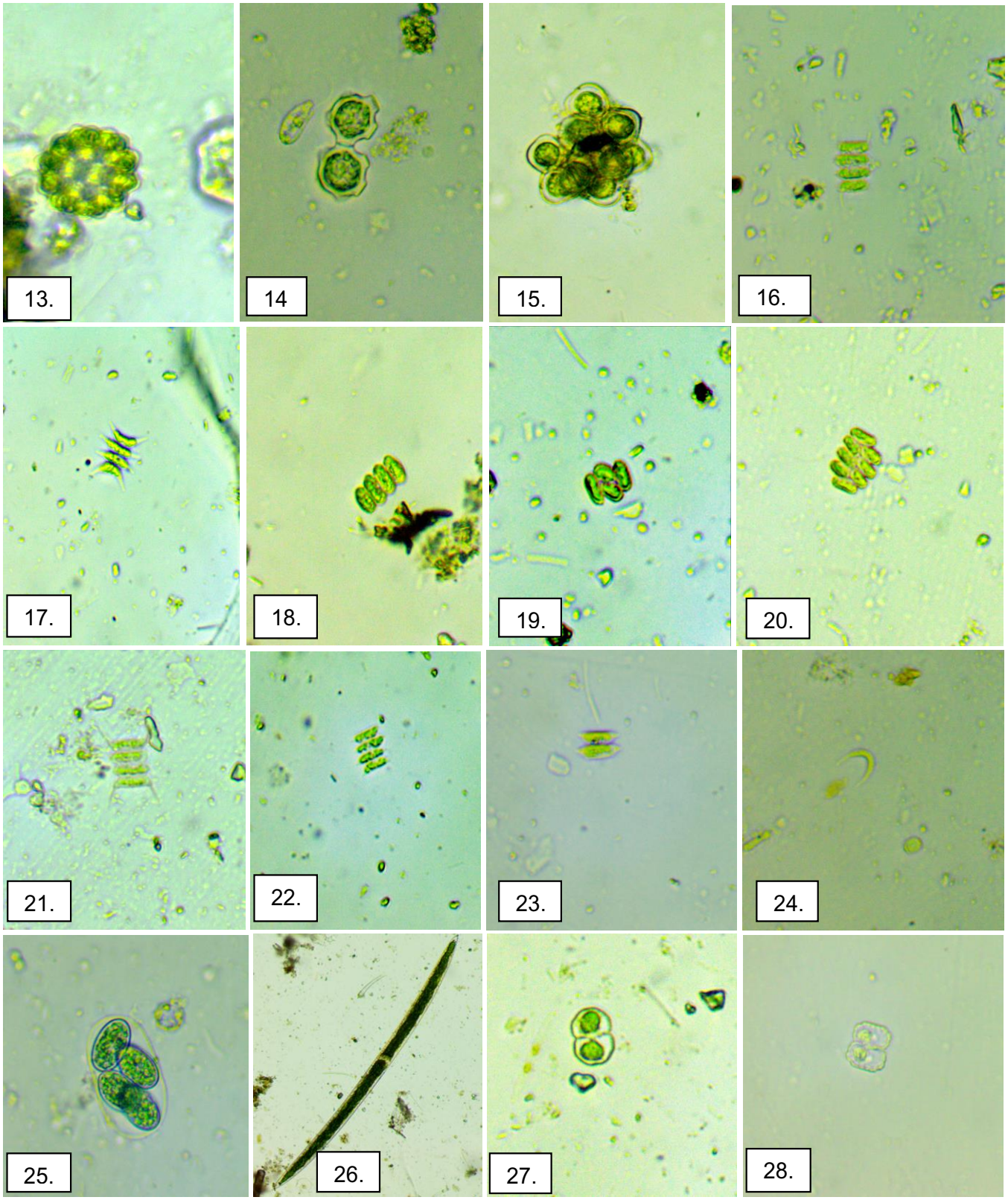

Figure 3: 13-14. *Coelastrum cambricum*, 15. *Coelastrum proboscideum*,16. *Scenedesmus abundans*,17. *Scenedesmus acuminatus*,18. *Scenedesmus bijugatus*,19. *Scenedesmus bijugatus* var. *alternanans*,20. *Scenedesmus bijugatus* var. *gravenitzii*, 21. *Scenedesmus quadricauda* var. *longispina*, 22. *Scenedesmus longus*,23. *Scenedesmus* sp., 24. *Ankistrodesmus* cf. *falcatus*, 25. *Glaucocystis nostochinearum*,26. *Closterium ralfsii*, 27. *Cosmarium impressulum*, and 28. *Cosmarium* cf. *seelyanum.*

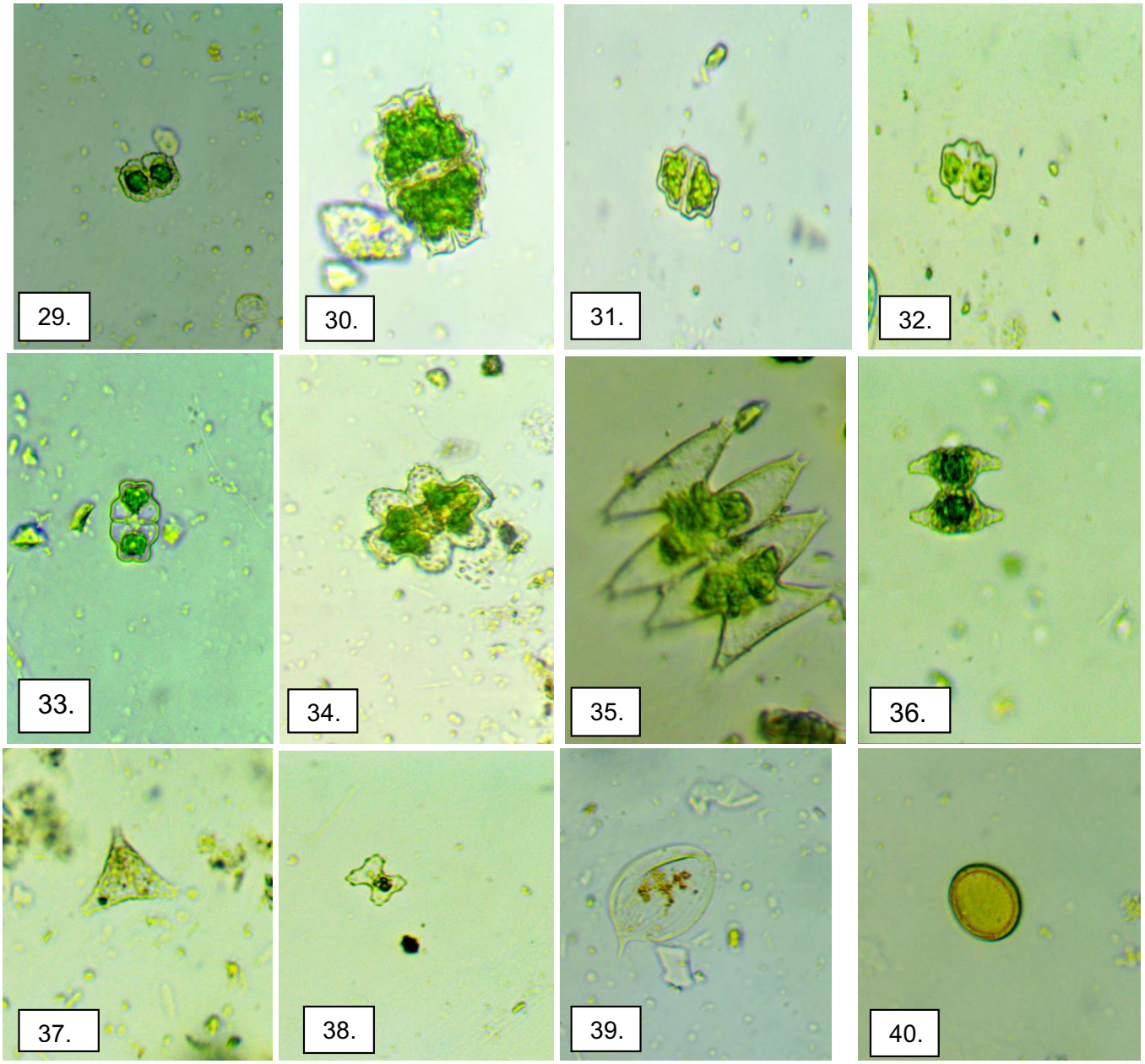

Figure 4: 29. *Cosmarium subprotumidum* var. *gregoryi*, 30. *Euastrum bidentatum*, 31-33. *Euastrum lacustre*, 34. *Euastrum platycerum*, 35. *Micrasterias pinnatifida*, 36. *Staurastrum manfeldtii*, 37-38. *Staurastrum* sp., 39. *Phacus* sp., and 40. *Trachelomonas* cf. *oblonga*.

median constriction, broadly rounded angles with 2 small marginal spines, lateral lobes broadly rounded with 5 small marginal spines; semicells with a rounded central protuberance just above the isthmus; cells 40-42 µm long, 37-37.5 µm broad; isthmus 8-10 µm wide.

29. ***Micrasterias pinnatifida*** Ralfs (Fig. 4: 35) Prescott and Scott 1952, P.244, Pl. 7, Fig. 6.

Polar lobe relatively broader at the apex, margin broadly convex and the lobules slightly converging, relatively less distance between apices and upper basal lobules; cells 60 µm long, 69 µm broad.

30. ***Staurastrum manfeldtii*** Delponte (Fig. 4: 36) Godar and Rai 2018, P. 9, Fig. 69-71.

Cellswith processes; semicells with swollen base; apex convex with row of emarginated verrucae; processes tapered, slightly

convergent, spinulose end with 3-4 spines; cells 37-58 µm long, 33-100 µm broad; isthmus 13-15 µm wide.

31. ***Staurastrum*** **sp.** (Fig. 4: 37-38)
Wehr and Sheath 2003, P.377, Fig. 33, 34, 87–89, 92, and 93.

Cells are small to large, 2 to 12 radiate in end view, with a shallow or deep median constriction; semicells have long hollow processes.

32. ***Phacus*** **sp.** (Fig. 4: 39)
Wehr and Sheath 2003, P.413, Fig. 13.

Cells laterally flattened, leaf-shaped, and perhaps twisted as well.

33. ***Trachelomonas*** **cf.** ***oblonga*** Lemmermann (Fig. 4: 40)
Wo³owski and Grabowska 2007, P. 210, Fig. 23, 43, 44.

Lorica oblong, slightly narrowed at the posterior end, smooth; cells 12.5-13.0 µm long 10.5-12.6 µm wide; apical pore 1.5 µm diameter without collar.

Conclusion

This study is a pioneer work on the algal flora of Gajedi Lake which showed that the lake is rich in algal flora. But the data collected from this study alone was not sufficient to determine the richness of algal species in the area as well as their variation with different seasons. Therefore, further studies are necessary to documents common as well as interesting algae in the lake and to find out the seasonal variation of algae.

Acknowledgements

We are grateful to Mr. Dhananjaya Paudyal, Director General, Department of Plant Resources and Mr. Mohan Dev Joshi, Deputy Director General, Department of Plant Resources. We also express our sincere thanks to Mr. Subhash Khatri, Chief, National Herbarium and Plant Laboratories for his kind support and encouragement during this study. We would like to give special thanks to Mr. Lila Ram Tharu, Research Officer for helpingus during the field visit. We are also immensely grateful to Mr. Sandesh Dhakal, for helping with the map of study area.

References

Croasdale, H. & Flint, E.A. (1988). *Flora of New Zealand*, *Fresh water algae, chlorophyta, desmids with ecological comment on their habitats* (pp. 147). Vol. II. Botany Division, D.S.I.R., Christchurch, New Zealand.

Deshikachary, T.V. (1959). *Cyanophyta.* I.C.A.R. monograph in algae, New Delhi.

District Forest Office. (2073 B.S.). Annual Progress Review Report, Detailed introduction and Progress account fiscal Year 2072/073, Rupandehi, Nepal: Author.

Dhakal, K.S., Saud, D.S. & Joshi, N (2019). Wetland flora of Rupandehi District, Nepal. *Journal of Plant Resources*, *17(*1), 58-68.

Godar, K., & Rai, S.K. (2018). Freshwater green algae from Raja-Rani wetland, Bhogateni-Letang, Morang, Nepal. *Journal of Plant Resources*, *16*(1), 1-17.

Guiry, M.D., & Guiry, G.M. (2019). *Algae Base*. World-wide electronic publication, National University of Ireland, Galway. http:// www.algaebase.org; searched on December 2019.

Halder, N. (2016). Taxonomy and Periodicity of *Chlorococcum* Fries, *Coelastrum* Näg. and *Scenedesmus* Meyen in Hooghly, West Bengal, India. *Mesop. Environ. J*., *2*(2), 47-56.

Hirano, M. (1955). Fresh water algae. *In*: H. Kihara (Eds.), *Fauna and flora of Nepal Himalaya* (pp. 5- 42), Kyoto University, Kyoto, Japan: Fauna and Flora Research Society.

Hirano, M. (1963). Fresh water algae from the Nepal Himalaya, collected by a member of the Japanese Climbing Expedition. *Contr Biol Lab, Kyoto Univ*, Japan, *16*, 1-23.

Hirano, M. (1969). Fresh water algae from Langtang Himal, Nepal Himalaya. *Contr. Biol. Lab., Kyoto Univ., Japan*, *22,* 1-42.

Mhaske, T.K. & Talwankar D.S. (2018). Occurrence of *Cosmarium* species in Khadakpurna reservoir, Buldana district – Maharashtra, India. *GSC Biological and Pharmaceutical Sciences*, *5*(3), 20-24.

Phiipose, M.T. (1967). *Chlorococcales: Monograph on algae*. New Delhi, India: Indian Council of Agricultural Research.

Prescott, G.W. (1951). *Algae of the Western Great Lakes area* (pp. 977). Dubuque, Iowa: WM.C. Brown Publishers.

Prescott, G.W. & Scott, A.M. (1952). The algal flora of southeastern United States. V. Additions to our knowledge of the desmid genus *Micrasterias*. *Transactions of the American Microscopical Society*, *71*, 229-252.

Rai, S.K. & Misra P.K. (2008). On some desmids from Koshi Tappu wildlife reserve, Nepal. *Ecoprint*,*15,* 47-58.

Rai, S.K. (2013). Occurrence of genus *Scenedesmus* Mayen (Chlorophyceae) from East Nepal. *Nepalese Journal of Biosciences*, *3*, 26-37.

Rai, S.K. & Misra, P.K. (2010). Freshwater cyanophyceae from east Nepal. *Bangladesh J. of Plant Taxonomy,17*(2), 121-139.

Rai, S.K. & Paudel, S. (2019). Algal flora of Jagadishpur Tal, Kapilvastu, Nepal. *Journal of Plant Resources, 17*(1), 6-20.

Rai, S.K. & Rai, R.K. (2012). Some interesting freshwater algae from Chimdi Lake including a new record for Nepal. *Nepalese Journal of Biosciences, 2*, 118-125.

Rajopadhyaya, R., Joshi, S., Shrestha, S. & Rai, S.K. (2017). Some new and interesting cyanobacteria from Baghjhoda pond, eastern Nepal. *Himalayan J. of Science and Technology, 1*, 1-8.

Reddy, M. & Chaturvedi, A. (2017). Desmids from the rivers of Chandrapur district, Maharashtra. *An international journal of environment and biodiversity,8*(1), 25-34.

Shrestha, G. & Rai, S.K. (2017). Algal flora of Rajarani Lake, Dhankuta and their seasonal distribution. *Our Nature*, *15* (1-2), 44-54.

Thapa, M.S. & Poudel, G. (2018): Assessing the coverage of Urban Green Space in Butwal Sub-Metropolitan City, Nepal: A GIS based approach. *Journal of Institute of Forestry*, 15, 77-86.

Watanabe, M. (1995). Algae from lake Rara and its vicinities, Nepal Himalayas. *In*: H. Watanabe and H. Hagiwara (Eds.), *Crytogams of the Himalaya: Nepal and Pakistan* pp. 1-17, Vol. 3. Tsukub Japan: Department of Botany, National Science Museum.

Wehr, J. & Sheath, R.G. (2003). *Freshwater Algae of North America: Ecology and Classification* (pp. 917): Academic Press.

West, W. & West, G.W. (1904). *A monograph of the British desmidiaceae*. Vol. 1, London: Ray Society

Wolle, F. (1883). Fresh-water algae. VII. *Bulletin of the Torrey Botanical Club, 10*(2), 13-21.

Wo³owski, K. & Grabowska, M. (2007). *Trachelomonas* species as the main component of the euglenophyte community in the Siemianówka Reservoir (Narew River, Poland). *Ann. Limnol. - Int. J. Lim,43* (3), 207-218.

Table 2: Algal taxa reported from Gajedi Lake, Rupandehi district (Classification is based on Guiry & Guiry, 2019)

Phylum	Class	Order	Family	Genus	Algal taxa
Cyanobacteria	Cyanophyceae	Chroococcales	Chroococaceae	*Chroococcus*	1. *Chroococcus minutes* (Kützing) Nägeli
		Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	2. *Oscillatoria princeps* Vaucher ex Gomont
					3. *Oscillatoria* sp.
			Oscillatoriaceae	*Phormidium*	4. *Phormidium* sp.
		Spirulinales	Spirulinaceae	*Spirulina*	5. *Spirulina princeps* West and G.S.West
Chlorophyta	Chlorophyceae	Chlamydomonadales	Sphaerocystidaceae	*Sphaerocystis*	6. *Sphaerocystis schroeteri* Chodat
		Oedogoniales	Oedogoniaceae	*Oedogonium*	7. *Oedogonium* sp.
		Sphaeropleales	Hydrodictyaceae	*Pediastrum*	8. *Pediastrum tetras* (Ehrenberg) Ralfs.
		Sphaeropleales	Scenedesmaceae	*Coelastrum*	9. *Coelastrum astroideum*De Notaris.
					10. *Coelastrum cambricum* W.Archer.
					11. *Coelastrum proboscideum* Bohlin
				Scenedesmus	12. *Scenedesmus abundans*(O.Kirchner) Chodat
					13. *Scenedesmus acuminatus* (Lagerheim) Chodat
					14. *Scenedesmus bijugatus* Kützing
					15. *Scenedesmus bijugatus* var. *alternanans*
					16. *Scenedesmus bijugatus* var. *gravenitzii* (C.Bernard) Philipose
					17. *Scenedesmusquadricauda* var. *longispina* (Chodat) G.M.Smith
					18. *Scenedesmus longus* Meyen
					19. *Scenedesmus* sp.
			Selenastraceae	*Ankistrodesmus*	20. *Ankistrodesmus* cf. *falcatus* (Corda) Ralfs
Glaucophyta	Glaucophyceae	Glaucocystales	Glaucocystaceae	*Glaucocystis*	21. *Glaucocystis nostochinearum* Itzigsohn
Charophyta	Conjugatophyceae	Desmidiales	Closteriaceae	*Closterium*	22. *Closterium ralfsii* Brébisson ex Ralfs
			Desmidiaceae	*Cosmarium*	23. *Cosmarium impressulum* Elfving

Phylum	Class	Order	Family	Genus	Algal taxa
					24. *Cosmarium* cf. *seelyanum* Wolle
					25. *Cosmarium subprotumidum* var. *gregoryi* West and G.S.West
				Euastrum	26. *Euastrum bidentatum* Nägeli
					27. *Euastrum lacustre* (Messikommer) Coesel
					28. *Euastrum platycerum* Reinsch
				Micrasterias	29. *Micrasterias pinnatifida* Ralfs
				Staurastrum	30. *Staurastrum manfeldtii* Delponte
					31. *Staurastrum* sp.
Euglenophyta	Euglenophyceae	Euglenida	Phacidae	*Phacus*	32. *Phacus* sp.
			Euglenidae	*Trachelomonas*	33. *Trachelomonas* cf. *oblonga* Lemmermann