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ALGAE OF ITAHARI MUNICIPALITY AND ITS ADJOINING AREA, EASTERN NEPAL

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Abstract

A total fifty-two algal taxa belonging to 3 classes and 21 families were reported from Itahari and its adjoining areas. Among them, Chlorophyceae taxa were rich with 36 taxa followed by 9 taxa of Cyanophyceae and 7 taxa of Bacillariophyceae. Sixteen taxa were identified up to generic level only and rest 36 up to species level. Most of the species were collected from aquatic habitat both lotic and lentic, some were from soil and few as epiphytic. Out of 36, ten algae *viz.*, *Oscillatoria tenuis*, *Lyngbya martensiana*, *Achnanthes brevipes*, *Pithophora varia*, *Stigeoclonium fasciculare*, *Oedogonium gallicum*, *Spirogyra crassa*, *S. gracilis*, *Closterium acerosum* var. *tumidum* and *Cosmarium nitidulum* were new to Nepal. Dominant genera were *Spirogyra*, *Oscillatoria*, *Closterium*, *Cosmarium*, *Navicula* and *Hydrodictyon* collected from ponds, moist soils, ditches, and canals.

Key words: Algal flora, Blue-green algae, Chlorophyceae, Diatoms, Dominancy

Introduction

Algae are the simplest but ancient photosynthetic plants play important role in ecology and molecular phylogeny. They stand at the lowest step in the evolution of life and have enormous economic implications. Recently, algae are using widely as alternative source for human foods, plant fertilizers and biodiesels. Their importance are also increasing as tools for researches in nanotechnology, space biology, genetics and other fields of applied sciences.

Nepal is rich in algal diversity because its climate varies along with its altitudinal and topographical variations. The hot and humid environment of Terai favours luxuriant growth of desmids while ice fed cool streams were dominated by diatoms (Rai *et al.*, 2008).

Algal study in Nepal gets popularized by the activities of Japanese Himalayan Expedition to Mt. Manaslu from which Hirano (1955) reported 271 species of algae. Among these, *Chaetomnion nakoi* Hirano, *Cosmarium bireme* var. *asiaticum* Hirano, *C. acquale* var. *nepalens* Hirano, *Staurastrum crenulatum* var. *nepalens* Hirano were new reports from Nepal. After that, Joshi (1979), Upadhyaya (1979), Nakano and Watanabe (1988), Haga (1988), Bando *et al.* (1989) made contribution to the algal flora of Nepal. After 2010, Rai and Misra (2010) reported 51 cyanobacteria from east Nepal including 19 taxa new to Nepal and gave a complete checklist of total 274 blue green algae

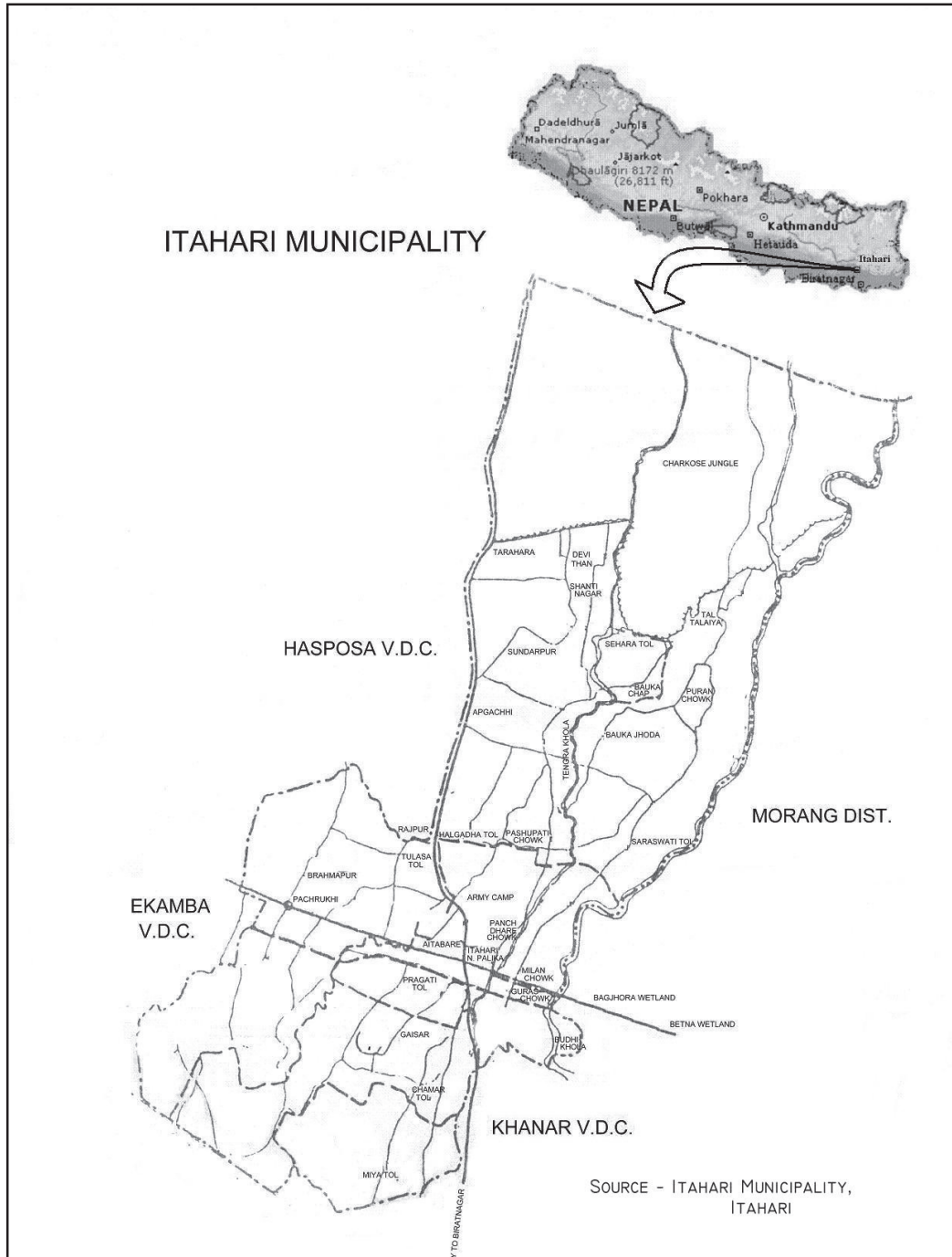
of Nepal till now (Rai *et al.*, 2010). Prasad (2011) also described a checklist of algae of Nepal.

Recently, Rai and Rai (2012) studied freshwater algae of Chimdi lake and reported 6 algae *viz.*, *Oscillatoria splendida* Grev. ex Gom., *Cylindrospermum stagnale* (Kuetz.) Born. et Flah. f. *variabilis* Prasad, *Gloeotrichia raciborskii* Woloszynska var. *kashiense* Rao, *Melosira varians* Ag., *Crucigenia crucifera* (Wolle) Collins and *Euastrum spinulosum* Delp. var. *bellum* Scott et Prescott among which the last one was new to the country. Similarly, Rai (2012) also reported 6 species of *Oedogonium* among which 5 species *viz.*, *Oedogonium leave* Wittrock, *O. peipingense* Jao, *O. pisanum* Wittrock, *O. plagiostomum* Wittrock and *O. undulatum* (Bréb.) A. Braun in De Bary were reported for the first time from Nepal. Ghimire *et al.* (2012 a, b) have also studied the cyanobacteria and diatoms of Khumbu region. Rai *et al.* (2012) have also reported 6 diatoms *viz.*, *Meridion circulare* var. *constricta*, *Achnanthes swazi*, *Didymosphenia geminata*, *Cymbella cornuta*, *C. cuspidata* and *Cymatopleura solea* from Gokyu lake III, Sagarmatha National Park as new to Nepal. Similarly, *Pediastrum* species of Nepal has been studied (Rai and Misra, 2012).

In the present study, a survey of algal flora of Itahari and its adjoining areas is carried out. Itahari Municipality lies between latitudes 26°40'30" to 26°42'30"N and longitudes 87°17'30" to 87°20'00"E

and at an elevation of 116-164 msl. It is bounded by Budhi Khola in the east, Hardiya Khola in the west, Charkose Jungle in the North and Khanar and Ekamba V.D.Cs in the south occupying an area of 28.025 Sq. Km. (Map 1). The climate of this area is tropical or sub-tropical monsoonal type, experiences three distinct

seasons i.e., summer (February to May), rainy (June to September) and winter (October to January). It has maximum temperature of 20°C to 38°C in May and minimum of 10°C to 24°C in January with an average rainfall of 210 cm per year.



Map 1: Itahari Municipality and its adjoining areas for algal collection sites.

Materials and Methods

This work was carried out in one year duration from April 2004 to May 2005. Sample collection was done by random sampling technique at an interval of one month. A total 72 algal samples were collected from

ponds, rivers, canals, ditches, rice fields, reeds stems etc in and around Itahari. Planktonic forms were collected with the help of plankton mesh net, epiphytic forms by squeezing macrophytes and distinct large filamentous forms by free hand picking and kept in polythene bags or bottles separately. The materials

were examined as soon as possible after bringing in laboratory in living condition. They were then preserved in 4% formaldehyde solution for further detail studies. The temporary slides of each sample were prepared using glycerin jell (Sharma, 1992) and were examined under different magnification of compound microscope. Identification of green and blue-green algae was done by staining with iodine and 1% aqueous methylene blue solutions, respectively. Microphotography of some algae was taken with Nikon E-400 with H-111 photographic attachment in the Department of Botany, M.M.A.M. Campus, Biratnagar (Plate 1 and 2). Identification of algae was made according to Prescott (1951), Tiffany and Britton (1952), Desikachary (1959), Scott and Prescott (1961), Philipose (1967), Prasad and Srivastava (1992) and Prasad and Misra (1992). All the collected samples have been deposited in the Phycological Research Lab, Department of Botany, P.G. Campus, Biratnagar, Nepal.

Results and Discussion

In the present study, a total 52 algae belonging to 3 classes and 21 families were reported from Itahari and its adjoining areas. Among them 36 algae were identified up to species level, rest 16 were identified only up to generic level (Table 1). They were 9 algae from Cyanophyceae, 7 from Bacillariophyceae and 36 from Chlorophyceae. Among them, 10 algae *viz.*, *Oscillatoria tenuis* C.A. Agardh, *Lyngbya martensiana* Menegh. et Gom., *Achnanthes brevips* (Kütz.) Cl., *Pithophora varia* Wille, *Stigeoclonium fasciculare* Kütz., *Oedogonium gallicum* Hirn., *Spirogyra crassa* Kütz., *S. gracilis* (Hassal) Kütz., *Closterium acerosum* var. *tumidum* Borge and *Cosmarium nitidulum* De Not were recorded as new to Nepal.

Nepal has remarkable altitudinal variations favoring various types of vegetations. This altitudinal variation with a distinct difference in the climate and habitat might have produced a great diversity also in algal flora. It was found from the investigation that algal species were heterogeneous in distribution i.e. different species were dominant at different ecological condition.

In our country Nepal majority of algae are fresh water forms while the rest being terrestrial with only few sub aerial algae (Baral 1995, a, b). In Nepal algae have been recorded from tropical habitation of terai plains to arctic habitation in Himalaya up to 4,880 meters. The favorable growth condition for algae is hot and humid climate, this climate is observed in terai belt of Nepal. But these areas have been least explored phycologically. Slowly the investigation is being

carried out. Recently, the phycoflora of Nepal has been crossed 1000 algal taxa (Rai, 2007).

Hirano (1955) reported altogether 271 species of algae from five different classes of algae including 79 taxa of desmids, among which *Oscillatoria princeps*, Vaucher ex. Gomont, *Closterium* sp, *Cosmarium* sp, *Navicula* sp. *Cymbella* sp were common for the present work. His collection area were Manang base camp, Pisang, Taple Himal, Tukucha, Kali Gandaki, Luitel Bhanjyang, Tadi Khola, Anku Khola, Phewa Tal ect.

Algal flora of Betana pond has been studied previously reporting a total 23 taxa belonging to the classes cyanophyceae (6), chlorophyceae (1) and bacillariophyceae (16) (Rai, 2011). Out of these, 6 diatom taxa *viz.*, *Gomphonema constrictum* Ehr. var. *capitata*, *Gomphonema intricatum* Kütz. var. *vibrio*, *Gomphonema parvulum* (Kütz.) var. *lagenula* Hust., *Rhopalodia gibba* (Ehr.) O. Müll. var. *ventricosa*, *Nitzschia amphibia* Grun. and *Surirella tenera* Greg. var. *ambigua* Gandhi were the new records for the country. *Synedra dorsiventralis* reported in this study was also reported from Sawane, Udayapur (Misra *et al.*, 2009).

It is clear from the above discussion that the algae diversity of Nepal is very diverse. The Topography, altitudinal ranges and climate zone of Nepal provided a conducive environment for greater algal diversity. The species among the same genera also varies from places to places. This is due to the ultimate factors soil and water composition.

Most of the species were dominant in lentic environments specially in the ponds and wetlands rather than lotic environment. Common species like *Spirogyra* sp., *Oscillatoria* sp., *Closterium* sp., *Cosmarium* sp., *Navicula* sp., *Hydrodictyon* sp. were dominant taxa which were found in ponds, moist soils, ditches, and canals. The most abundance species of Bacillariophyceae were found in Bagjhora wetland, Biratchowk and Betana pond, Belbari, Morang district. The species found were *Cyclotella meneghiniana*, *Fragillaria* sp., *Synedra dorsiventralis*, *Achnanthes brevips*, *Navicula cuspidata*, *Rhopalodia* sp., *Closterium* sp., and *Cosmarium* sp. In comparison, diatoms were present in rare condition.

The species *Cladophora* sp. was found attached to the shell of the snail in stagnant water. *Chara* sp. was found submerged in the stagnant water near Budhi Khola. *Hydrodictyon* sp. was found in stagnant water at roadside of Bagaichatol. *Pithophora varia* was found in Gaisar in the fish pond forming dense mat over water.

Table 1. Algae of Itahari and its vicinity

S.N.	Algae	Family	Locality	Dominancy
1	<i>Achnanthes brevips</i>	Achnanthaceae	Epiphytic on <i>Hydrilla</i> at Betana pond, Belbari	+
2	<i>Anabeana</i> sp.	Nostacaceae	Rice field at Halgadol, Itahari	++
3	<i>Chaetophora</i> sp.	Chaetophoraceae	Running water, attached on cement floor, Hatkhola, Itahari	+
4	<i>Chara</i> sp.	Characeae	Submerged rooted on stagnant water beside Budhikhola, Itahari	+++
5	<i>Cladophora</i> sp.	Cladophoraceae	On the snail shell, stagnant water, Bagjhora wetland, Biratchowk	++
6	<i>Closterium acerosum</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	++++
7	<i>Closterium acerosum</i> var. <i>tumidum</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	+
8	<i>Closterium cynthia</i>	Desmidiaceae	Epiphytic on <i>Eichhornia</i> , Betana pond, Belbari	+
9	<i>Closterium kuetzing</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	++
10	<i>Closterium lunula</i>	Desmidiaceae	Planktonic in ditch at Panchdhare chowk, Itahari	+
11	<i>Closterium pritchardianum</i>	Desmidiaceae	Planktonic in ditch at Panchdhare chowk, Itahari	+
12	<i>Cosmarium circulare</i>	Desmidiaceae	Epiphytic on <i>Eichhornia</i> , Betana pond, Belbari	++++
13	<i>Cosmarium lundellii</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	++++
14	<i>Cosmarium nitidulum</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	+
15	<i>Cosmarium obsoletum</i>	Desmidiaceae	Epiphytic on <i>Eichhornia</i> , Betana pond, Belbari	++
16	<i>Cosmarium quadrum</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	++
17	<i>Cyclotella meneghiniana</i>	Coscinodiscaceae	Planktonic in Betana pond, Belbari	++
18	<i>Flagillaria</i> sp.	Flagillariaceae	Planktonic in Budhikhola, Itahari	++
19	<i>Gonium pectorale</i>	Volvocaceae	Planktonic in Bagjhora wetland, Biratchowk	++
20	<i>Hydrodictyon</i> sp.	Hydrodictyaceae	Floating on stagnant water of ditches at Bagaicha tol, Itahari	++++
21	<i>Lyngbya birgei</i>	Oscillatoriaceae	Free floating in small pond at Puran chowk, Itahari	++
22	<i>Lyngbya martensiana</i>	Oscillatoriaceae	Free floating in ditch at Tulasa tol, Itahari	+
23	<i>Merismopedia glauca</i>	Chroococcaceae	Planktonic in Betana pond, Belbari	++
24	<i>Micrasterias mahabuleshwariensis</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	+
25	<i>Micrasterias radians</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	+
26	<i>Microcystis aeruginosa</i>	Chroococcaceae	Planktonic in a tank at Guras chowk, Itahari	+++
27	<i>Navicula cuspidata</i> var. <i>ambigua</i>	Naviculaceae	Epiphytic on <i>Eichhornia</i> at Bagjhora wetland, Biratchowk	+++
28	<i>Navicula</i> sp.	Naviculaceae	On moist soil near Bagjhora wetland, Birat chowk	+
29	<i>Nostoc</i> sp.	Nostocaceae	On moist soil of building terrace, Itahari Nagar Palika, Itahari	+
30	<i>Oedogonium gallicum</i>	Oedogoniaceae	Epiphytic in angiosperm twigs at Panchdhare Chowk, Itahari	++
31	<i>Oscillatoria princeps</i>	Oscillatoriaceae	Planktonic on shallow water in a small ditch at Gaisar, Itahari	+++
32	<i>Oscillatoria sancta</i>	Oscillatoriaceae	On damp soil near a ditch at Apgachi, Itahari	++++
33	<i>Oscillatoria tenuis</i>	Oscillatoriaceae	Attached on stones of running water at Tengra Khola, Itahari	+
34	<i>Pithophora oedogonia</i>	Cladophoraceae	Floating on stagnant water at Shantinagar, Itahari	++
35	<i>Pithophora varia</i>	Cladophoraceae	Floating on fish pond at Gaisar, Itahari	+
36	<i>Pleurotaenium ehrenbergii</i>	Desmidiaceae	Planktonic in Bagjhora wetland, Biratchowk	+
37	<i>Pleurotaenium ehrenbergii</i> var. <i>undulatum</i>	Desmidiaceae	Planktonic in Betana pond, Belbari	+
38	<i>Rhopalodia</i> sp.	Epithemiaceae	Epiphytic on <i>Eichhornia</i> , Bagjhora wetland, Biratchowk	++
39	<i>Scendesmus acutiformis</i>	Scendesmaceae	Planktonic in Bagjhora wetland, Biratchowk	++
40	<i>Scendesmus quadricauda</i>	Scendesmaceae	Planktonic in Bagjhora wetland, Biratchowk	+++
41	<i>Schizomeris</i> sp.	Schizomeridaceae	Free-floating in a drain at Puranchowk, Itahari	+
42	<i>Selenastrum</i> sp.	Oocystaceae	Planktonic in Betana pond, Belbari	++
43	<i>Sphaerocystis schroederi</i>	Palmellaceae	Running water, attached on stones at Betana pond, Belbari	+
45	<i>Spirogyra crassa</i>	Zygnemataceae	Running water, attached to the twig of grasses at Bauka, Itahari	++
46	<i>Spirogyra gracilis</i>	Zygnemataceae	Floating in ponds at Taltaliya, Itahari	+
47	<i>Spirogyra</i> sp.	Zygnemataceae	Free-floating in fish pond at Tarahara, Itahari	++++
48	<i>Stigeoclonium fasciculare</i>	Chaetophoraceae	Running water, attached on mango seed at Hatkhola, Itahari	+
49	<i>Synedra dorsiventralis</i>	Fragillariaceae	Planktonic in Betana pond, Belbari	+++
50	<i>Ulothrix</i> sp.(a)	Ulotrichaceae	On cemented wall near a tap water at Pakali, Itahari	+
51	<i>Ulothrix</i> sp.(b)	Ulotrichaceae	Attached on stones at Khetikhola, Itahari	+
52	<i>Zygnema</i> sp.	Zygnemataceae	Free-floating in a fish pond at Tarahara, Itahari	++

Rare (+), Common (++), Frequent (+++), Dominant (++++)

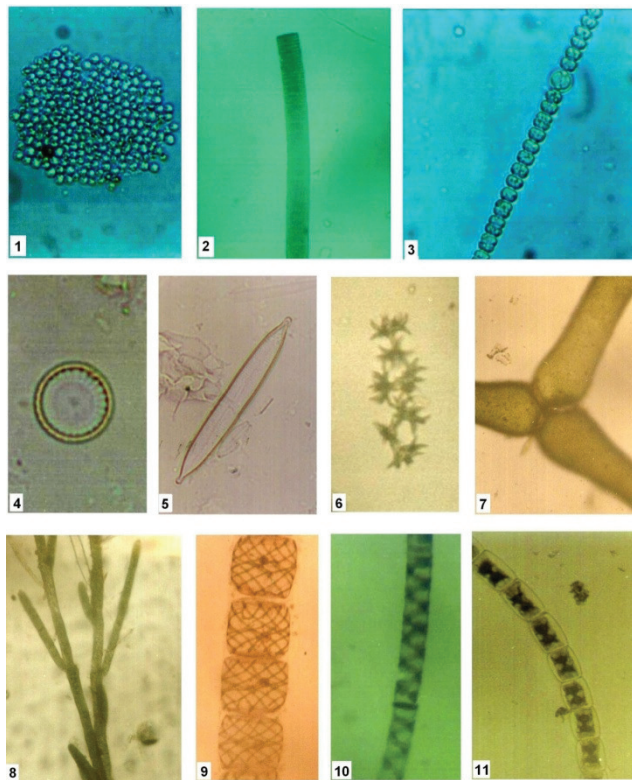


Plate 1. Fig 1. *Microcystis aeruginosa* (×500), Fig 2. *Oscillatoria princeps* (×100), Fig 3. *Anabaena* sp. (×500), Fig 4. *Cyclotella meneghiniana* (×500), Fig 5. *Synedra dorsiventralis* (×500), Fig 6. *Selenastrum* sp. (×50), Fig 7. *Hydrodictyon reticulatum* (×100), Fig 8. *Cladophora glomerata* (×100), Fig 9. *Spirogyra crassa* (×100), Fig 10. *S. gracilis* (×300), Fig 11. *Zygnema* sp. (×100).

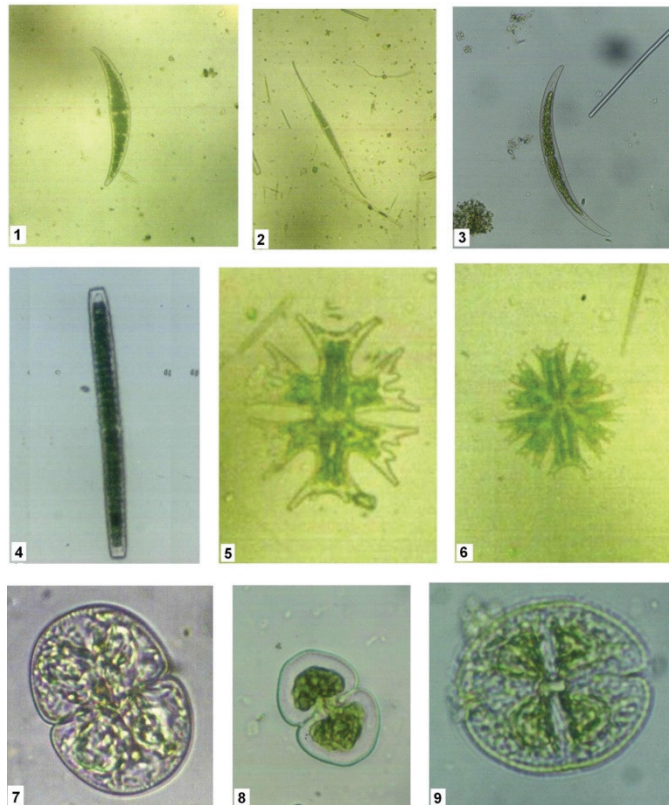


Plate 2. Fig 1. *Closterium acerosum* var. *tumidum* (×100), Fig 2. *Cl. kuetzingii* (×100), Fig 3. *Closterium* sp. (×100), Fig 4. *Pleurotaenium ehrenbergii* var. *undulatum* (×100), Fig 5. *Micrasterias mahabuleshwariensis* (×200), Fig 6. *M. radians* (×100), Fig 7. *Cosmarium lundellii* (×500), Fig 8. *C. nitidulum* (×100), Fig 9. *C. obsoletum* (×500).

Itahari is a rapidly growing town of eastern Tarai. During the present study it was noticed that owing to gradual urbanization and covering up of small ponds or ditches etc. for building purpose, occurrence of algae in their natural state is not common within the city limits. As we move away from the town we find good collection of algae. The decrease in number of algae in the town area may be due to pollution, growing population and unlimited water resources leading to significant disturbances in aquatic life and detergents, cattle entering to ponds, domestic sewage and other effluents from industry, contaminating the lentic water spoils the algae of ponds lakes and rivers etc.

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