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ON SOME DIATOMS FROM HIGH ALTITUDE GOKYO LAKE-III, SAGARMATHA NATIONAL PARK, NEPAL

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ABSRACT

The present paper describes total 16 taxa of diatoms under 12 genera, belonging to 1 centric (*Cyclotella antiqua* W. Smith var. *minor* Suxena & Venkateswarlu) and 15 pennate species from Gokyo lake- III, Sagarmatha National Park, Nepal. Of these, 6 were the new records for the country. The morphological descriptions, taxonomic accounts and distribution are described systematically with photographs.

Key Words: Bacillariophyceae, Gokyo lake, mount Everest, central Himalaya, Nepal

INTRODUCTION

Diatoms are the microscopic eukaryotic algae found in marine, freshwater habitats, moist soils, rock surfaces etc. They are mostly unicellular but some form chains or simple colonies and have a characteristic siliceous cell wall called 'frustule'. They have many importances in the field of ecology, environmental science, biogeochemistry, nano-biotechnology, bio-fuel, semiconductor industries etc. So, it is necessary to study the existing diatom flora of the nation and to develop the database and culture collection of this important group of micro-algae for further use in different biotechnological programs.

Diatom flora of Central Himalaya specially from the Himalaya region of Nepal has been studied by Hirano (1955, 1963, 1969, 1984), Suxena and Venkateswarlu (1968), Suxena *et al.* (1972), Subba Raju and Suxena (1979), Jüttner *et al.* (2000, 2003, 2004), Rothfritz *et al.* (1997), Cantonati *et al.* (2001), Simkhada (2006) and Subba *et al.* (2009). Among them, major and preliminary contribution was made by Hirano (1955, 1963, 1984) recording a total 176 taxa of diatoms from Kungbachen, Mewa Valley, Wolangchung Gola of Eastern Nepal and Manang, Mustang, Kathmandu, Gorkha and Kaski of Central Nepal. Later on, Suxena and Venkateswarlu (1968) have also described 69 taxa of diatoms from Eastern Nepal especially from Bhote Koshi, Dudh Koshi, Imja and Lobuche rivers and Muzamba and Dudh Pokhari glacier lakes, all the localities lying between Mt. Everest and Mt. Cho Oyu at an altitude ranging from 3000-5200 m. Further 3 species were also recorded from the same area by Subba Raju and Suxena (1979). Baral (1999) has published a checklist of algae of Nepal in which the total number of diatoms recorded from Nepal are only 195. While studying the stream quality by using diatoms as bio-indicator, Jüttner *et al.* (2000, 2003, 2004) have recognized a total 179 taxa including 7 new *Gomphonema* species *viz*. *G. pararhombicum* from Jumla, *G. nepalense* and *G. saccatum* from Taplejung, *G. nediense* and *G. makaluense* from Bhojpur and *G. incognitum* and *G. sinestigma* from Sankhuwasabha. Cantonati *et al.* (2001) have also reported 182 diatoms from High Mountain streams of Simikot-Rara lake, Jumla-Dunai, Manaslu circuit, Makalu and Kanchanjunga areas (all located above 3500 m). Recently, Subba *et al.* (2009) have reported a total 19 taxa of diatoms from stream and ponds of Upper Mustang Trans-Himalaya region.

All these literature revealed that the exploration of diatoms in high altitude Himalaya region is sporadic and incomplete as diatoms from thousands of glacier lakes, ice fed streams and ponds of Nepal are still have to be explore. Thus, in the present study, an attempt has made to explore high altitude diatoms from Nepal Himalayas. Since there has been no report of diatoms from Gokyo lake hitherto, this is the preliminary attempt to explore these algae.

STUDY AREA

Gokyo wetland series (Latitude 27º57.02′N and Longitude 86º41.58′E, Altitude 4700-5000 msl, Area 42.69 ha, Length 975 m) is situated in Sagarmatha National Park, Solukhumbu District, east Nepal. This wetland series consists 6 main lakes; the largest is Thonak lake at 4834 m followed by Gokyo (DNPWC/WWF 2005). Gokyo-III (Latitude 27º56′59.4″N and Longitude 86º42′06″E, altitude 4780 msl) is a high altitude oligotrophic lake situated at the base of Mt. Everest in Khumjung Village Development Committee (Fig. 1). This area is a unique botanical site for study of various plant groups which lies on the head of Dudh Koshi River and is partially fed by Ngozumpa glacier. Gokyo is one of the popular tourist destinations as it visits by an average of over 7000 tournists per year (DNPWC/WWF 2005). The maximum precipitation (about 80%) on this area falls in the monsoon season between June to September. Similarly, the minimum average temperature fall up to -7.7°C in January and maximum average temperature rise up to 16.2°C in August.

Fig. 1. Gokyo III lake (Photograph by Kamal Maden)

MATERIALS AND METHODS

Diatom samples were collected by one of the author (K. Maden) from Gokyo III lakes during “Botanical Expedition (Higher Group Plants) in the Sagarmatha National Park, east Nepal in 2004”. This expedition was the first of three collaborative botanical collecting expeditions which

form part of the training programme 'Building Capacity for Biodiversity Inventory and Conservation in Nepal', funded by the UK Government, Darwin Initiative Project (Rajbhandari *et al.* 2004).

Collections were made by scrubbing the pebbles with toothbrush and trapping with plankton net (mesh size 10µ) and immediately preserved in 4% formalin. In laboratory, samples were centrifuged, washed with hot saturated solution of chromic acid ($K_2Cr_2O_7$ in conc. H_2SO_4) and mounted by euparol. The slides thus prepared were observed and microphotographs of the frustules were taken using Nikon E-400 microscope with H-III photomicrographic attachment. All their taxonomic treatments and identification were made by following Tiffany and Britton (1952), Hustedt (1961-1966), Prowse (1962), Metzeltin and Lange-Bertalot (1998), Gandhi (1999), You *et al.* (2009) and online available databases *viz*. WoRMS, ITIS, ADIAC and Algaebase. All the samples and slides have been deposited in the algal repository of Department of Botany, P.G. Campus, Biratnagar. Accession numbers of these collections are same as those of the collection numbers.

RESULTS AND DISCUSSION

A total,16 diatom taxa i.e., 1 centric (*Cyclotella antiqua* var. *minor*) and 15 pennate species, are recorded from Gokyo lakes, Sagarmatha National Park, Nepal. Among these, 6 taxa are found to be new to Nepal. They are *Meridion circulare* var. *constricta*, *Achnanthes swazi*, *Didymosphenia geminata*, *Cymbella cornuta*, *C. cuspidata* and *Cymatopleura solea*. Taxonomic account and distribution of all taxa are given below.

Phylum: Bacillariophyta

Class: Coscinodiscophyceae

Order: Thalassiosirales

Family: Stephanodiscaceae

Genus: ***Cyclotella*** (Kützing) Brébisson, 1838.

1. *Cyclotella antiqua* W. Smith **var**. ***minor*** Suxena and Venkateswarlu, 1968. [Suxena and Venkateswarlu 1968, pl. 1, f. 2] (Fig. 2)

Taxonomic description: Frustules small, 11 µm in diameter; Cells drum-shaped with concentric ornamentation; Striae delicate, 14-19 in 10 µm, radially arranged towards the margin; Central area concave with three triangular depressions with apices towards the centre; Depressions are delicately punctate.

Collection number and Date: EN 260 (02-06-2004).

Distribution: Tributaries of Koshi river below Namche Bazar, 2900-4200 m, Solukhumbu (Suxena and Venkateswarlu 1968). Mongolia (Edlund *et al*. 2003) as *Cyclotella antiqua*.

Class: Fragilariophyceae

Sub Class: Fragilariophycidae

Order: Tabellariales

Family: Tabellariaceae

Genus: *Tabellaria* Ehrenberg, 1839.

2. *Tabellaria flocculosa* (Roth) Kützing, 1844. [Tiffany and Britton, 1952, pl. 61, f. 694; Hustedt, 1959, f. 558; Foged, 1982, pl.1, f. 4&10] (Figs. 3-4)

Basionym: *Conferva flocculosa* Roth, 1797.

Synonyms: *Striatella flocculosa* (Roth) Kütz.; *Bacillaria flocculosa* (Roth) Leiblein, 1827; *Tabellaria fenestrata* var. *asterionelloides* Grun. in Van Heurck., 1881; *Tabellaria fenestrata* var. *geniculata* A. Cleve, 1899; *Tabellaria fenestrata* var. *intermedia* Grun. in Van Heurck, 1881.

Taxonomic description: Valves short-elongated, 20-21 µm long, 8-9 µm broad, inflated markedly in the middle and slightly at the poles; Girdles 22-37 µm long, 23.5 µm broad, united into zigzag chains, with numerous intercalary bands and septa; Striae finely punctate; Pseudoraphe narrow.

Collection number and Date: EN 260 (02-06-2004).

Distribution: Bhote Koshi river, 5250 m, Solukhumbu (Suxena & Venkateswarlu, 1968); Sabha Pokhari lake, 4100 m, Sankhuwa Sabha (Misra *et al*. 2009). China (Hu and Wei 2006), Iran (Sohrabipour & Rabii, 1999).

Order: Fragilariales

Family: Fragilariaceae

Genus: *Meridion* C. Agardh, 1824.

3. *Meridion circulare* (Greville) C. Agardh **var. *constricta*** (Ralfs) Van Heurck, 1881. [Tiffany and Britton, 1952, pl. 61, f. 691] (Fig. 5)

Basionym: *Meridion constrictum* Ralfs.

Synonyms: *M. circulare* var. *constrictum* (Ralfs) Brun., 1880; *M. constrictum* Ralfs, 1843; *M. circulare* f. *constricta* (Ralfs) Cleve-Euler, 1932.

Taxonomic description: Valves and girdle both wedge-shaped; Valves 15-75 µm long, 3-7 µm broad, constricted at broader end, larger end broadly capitate; Girdles joined together by valve faces forming fan shaped or circular colony; Costae 3-5 in 10 µm; Striae fine, 15 in 10 µm.

Collection number and Date: EN 261 (02-06-2004).

Distribution: New record for Nepal. As *M. circulare*: A pond at Arughat Bazar, 770 m, Gorkha (Hirano, 1955); Pool and ditches at Bhaktapur (Shrestha and Manandhar 1983). China (Hu and Wei 2006).

Genus: *Diatoma* J.B.M. Bory de St-Vincent, 1824.

4. *Diatoma hyemalis* (Roth) Heiberg, 1863. [ADIAC, WoRMS. As *D. hiemale*- Tiffany & Britton, 1952, pl. 61, f. 684; Benson & Rushforth, 1975, pl. 12, f. 5] (Figs. 6-9)

Basionym: *Conferva hyemalis* Roth, 1800.

Synonym: *Odontidium hyemale* (Roth) Kützing, 1844.

Taxonomic description: Valves linear-lanceolate, 30-74.5 µm long, 7-9.5 µm broad, slightly narrowed toward the rounded poles; Girdles 25-80 µm long, 17-21.5 µm broad, united into close chains with numerous intercalary bands; Costae prominent, 3-4 in 10 µm, irregular, coarse, extending the valve width, slightly obliquely placed; Striae parallel, very fine; Pseudoraphe narrow, linear-lanceolate.

Collection number and Date: EN 255 (01-06-2004).

Distribution: Himalaya streams of Nepal (Cantonati *et al*. 2001).

As *D. hiemale* (Lyngb.) Heib.: Sabha Pokhari lake, 4100 m, Sankhuwa Sabha (Misra *et al*. 2009); Yara Khola, 3414 m, Upper Mustang (Subba *et al*. 2009).

As *D. hiemale* (Lyngb.) Heib. var. *mesodon* (Ehr.) Grun.: A stream west from Dudh Koshi river, 5250 m, Solukhumbu (Suxena and Venkateswarlu, 1968); a stream at Wolang Chung Gola (Hirano, 1984); Cherse khola stream at Damku, 1690 m, Khotang (Misra *et al*. 2009).

Genus: *Hannaea* Patrick in Patrick & Reimer 1966.

5. *Hannaea arcus* var. ***arcus*** (Ehr.) Patrick in Patrick & Reimer, 1966. [WoRMS. As *Ceratoneis arcus* var. *arcus*: Hustedt, 1959, p. 179, f. 684 b; Suxena & Venkateswarlu, 1968, p. 7, pl. 1, f. 4; Foged, 1982, p. 354, pl. 5, f. 1] (Fig. 10)

Taxonomic description: Valves lunate, arcuate, 55-60 µm long, 5-6 µm broad with rostrate-capitate apices, a prominent tumescence in the middle at the concave side; Axial area narrow; Central area one sided, extend to the ventral margin; Pseudoraphe towards the concave margin; Striae fine, parallel, 15-17 in 10 µm.

Collection number and Date: EN 260 (02-06-2004).

Distribution: As *Ceratoneis arcus* var. *arcus*: A stream below Namche Bazar, 2900-4200 m, Solukhumbu (Suxena and Venkateswarlu 1968); a stream at Kungbachen, 4150 m (Hirano 1984); Sapta Koshi river, 206 m, Koshi Tappu Wildlife Reserve, Sunsari (Rai 2006, Misra *et al*. 2009); Koshi Barrage, 152 m, Bhantabari, Sunsari (Rai 2006); Rawa khola river at Manglabare, 720 m, Khotang (Misra *et al*. 2009); Chhyo Pema pond, 3839 m, Upper Mustang (Subba *et al*. 2009).

Genus: *Ulnaria* Kützing, 1844.

6. *Ulnaria ulna* (Nitzsch) P. Compère, 2001. [ADIAC. As *Synedra ulna*: Gandhi, 1967, f. 63; Hadi *et al*., 1984, pl. 8, f. 146-149; Sinnu & Squires, 1985, pl. 3, f. 22-23] (Fig. 11)

Basionym: *Bacillaria ulna* Nitzsch, 1827.

Synonyms: *Synedra ulna* (Nitzsch) Ehrenberg, 1832; *Exilaria ulna* (Harvey) Jenner, 1845; *Fragilaria ulna* (Nitzsch) Lange-Bertalot, 1980.

Taxonomic description: Valves solitary, 55-235 µm long, 5-9 µm broad, linear to linear lanceolate, gradually attenuated towards the rostrate or broadly rounded ends; Central area quadrangular having small lineate striae on both margins; Striae coarse, 9-11 in 10 µm, lineate, transverse and parallel.

Collection number and Date: EN 257 (01-06-2004).

Distribution: As *Synedra ulna*: Taudaha, 1350 m, Kathmandu (Hickel 1973); Punyamati river, Panauti, Kavrepalanchowk (Aryal and Lacoul 1996); Gajurmukhi, Ilam (Rai *et al.* 2008); Saptakoshi river at Koshi Tappu Wildlife Reserve, 720 m, Sunsari; Itahari roadside ditches, 120 m, Sunsari; Triyuga river at Gaighat, 152 m, Udayapur (Misra *et al*. 2009); Yamda Khola, 3889 m, Upper Mustang (Subba *et al*. 2009).

As *Fragilaria ulna*: Kathmandu, Likhu Khola and Arun valley (Jüttner *et al*.1996, Cantonati *et al*. 2001).

As *Synedra ulna*: China (Hu and Wei 2006); Iran (Ramzannejad Ghadi 2008).

As *Fragilaria ulna*- Turkey (Soylu and Gönülol 2005).

Class: Bacillariophyceae

Sub Class: Eunotiophycidae

Order: Eunotiales

Family: Eunotiaceae

Genus: *Eunotia* Ehrenberg, 1837.

7. *Eunotia naegelii* Migula, 1907. [ADIAC. As *E. alpine*: Gandhi, 1960, pl. 1, f. 19; Prasad & Srivastava, 1992, pl. 26, f. 7] (Fig. 12)

Synonym: *Eunotia alpina* (Naeg. ex Kütz.)

Taxonomic description: Valves slightly arcuate, 27 µm long, 4.2 µm broad, linear, gradually tapering from the middle towards the rounded ends, dorsal margin convex, slightly recurved at the apices, ventral margin concave; Polar nodules distinct; Raphe not well developed; Striae fine, 19-20 in 10 µm, lineate, parallel.

Collection number and Date: EN 260 (02-06-2004).

Distribution: As *E. alpina*: Sabha Pokhari lake, 4100 m, Sankhuwa Sabha (Misra *et al*., 2009).

8. *Eunotia polydentula* Brun. var. ***perpusilla*** Grun. (Hustedt), 1959. [Hustedt, 1959, f. 759a-e] (Fig. 13)

Taxonomic description: Valves arcuate, 20 µm long, 3-3.5 µm broad, dorsal margin convex with four hemps, middle two slightly small and close, ventral margin concave, slightly swollen near the poles opposite to lateral hemps; Ends broadly rounded; Terminal nodules and raphe small but distinct at the apices near ventral margin; Striae fine,18-25 in 10 µm, lineate.

Collection number and Date: EN 259 (01-06-2004).

Distribution: Sabha Pokhari lake, 4100 m, Sankhuwa Sabha (Misra *et al*. 2009).

Sub Class: Bacillariophycidae

Order: Achnanthales

Family: Achnanthaceae

Genus: *Achnanthes* Bory de Saint-Vincent, 1822.

9. *Achnanthes swazi* Cholnoky [Carter, 1970, pl. 1, f. 33-34] (Fig. 14)

Taxonomic description: Valves small, 33-37 µm long, 12-15.3 µm broad, broadly elliptic or somewhat quadrate with broadly produced rostrate ends; Raphe thin, straight; Axial area narrow, linear; Central area broad; Striae lineate, radial.

Collection number and Date: EN 261 (02-06-2004).

Distribution: New record for Nepal.

Order: Naviculales

Sub Order: Sellaphorineae

Family: Pinnulariaceae

Genus: *Pinnularia* Ehrenberg, 1843.

10. *Pinnularia conica* Gandhi, 1956. [Gandhi, 1956-1957, f. 9-10; Gandhi, 1960, pl. 2, f. 57-58] (Fig. 15)

Taxonomic description: Valves linear-lanceolate, 65 µm long, 10.5 µm broad with slightly convex to rarely subparallel sides; Apices slightly constricted, produced, slightly capitate-cuneate; Raphe thin, more or less straight with distinct central nodules and curved terminal fissures: Axial area narrow, linear; Central area large, reaching the sides; Striae coarce, 10 in 10 µm, strongly radial at the middle, convergent towards apices.

Collection number and Date: EN 260 (02-06-2004).

Distribution: Mai Pokhari, 2150 m, Ilam (Rai, 2005).

11. *Pinnularia viridis* (Nitzsch) Ehrenberg, 1843. [Tiffany & Britton, 1952, pl. 70, f. 809; Prasad & Srivastava, 1992, pl. 30, f. 6] (Fig. 16)

Basionym: *Bacillaria viridis* Nitzsch, 1817.

Synonym: *Frustulia viridis* (Nitzsch) Kütz., 1833; *Navicula viridis* (Nitzsch) Ehr., 1835; *Schizonema viride* (Nitzsch) Kuntze, 1898; *Pinnularia semicruciata* (Ehr.) Cleve

Taxonomic description: Valves solitary, linear to elliptic-linear, 44-125 µm long, 8-25 µm broad, almost parallel or slightly convex sides and broadly rounded ends; Axial area less than ¼ of cell diameter, narrow near the poles, widened centrally; Central area round or elliptical; Raphe thick, undulate with a one-sided central pore; Transverse striae coarse, lineate, 6-9 in 10 µm, slightly radial medianly and convergent polarly, crossed by a wide longitudinal band.

Collection number and Date: EN 261 (02-06-2004).

Distribution: Manang bhot base camp, 3500 m, Manang and Pond at Tukucha moor, 2600 m, Mustang (Hirano 1955); Bhaktapur (Shrestha and Manandhar, 1983); Garphu Khola, 3891 m, Upper Mustang (Subba *et al*. 2009). China (Hu and Wei 2006)

Order: Cymbellales

Family: Gomphonemataceae

Genus: *Didymosphenia* M. Schmidt, 1899.

12. *Didymosphenia geminata* (Lyngbye) M. Schmidt, 1899. [Tiffany & Britton, 1952, pl. 73, f. 850] (Fig. 17)

Basionym: *Echinella geminata* Lyngbye, 1819.

Synonyms: *Gomphonema geminatum* (Lyngbye) C.A. Agardh, 1824; G. vulgare Brébisson, 1838.

Taxonomic description: Valves bi-constricted, 60-125 µm long, 23-37 µm broad, broadly rounded sub-truncate apices, the apex is larger than the base; Axial area linear; Central area rounded, 2-4 stigmata in a longitudinal row; Raphe terminally with dorsal hooks; Transverse striae radial, 8-10 in 10 µm, medianly long and short striae alternately.

Collection number and Date: EN 260 (02-06-2004).

Distribution: New record for Nepal. China (Kilroy, 2004; Hu & Wei, 2006), Iran (Jamaloo *et al*., 2006; Ramzannejad Ghadi, 2008)

Family: Cymbellaceae

Genus: *Cymbella* C.A. Agardh, 1830.

13. *Cymbella cistula* (Hempr and Ehr.) Kirchn, 1878. [Tiffany & Britton, 1952, pl. 74, f. 861; Foged, 1982, pl. 8, f. 13; Sinnu & Squires, 1985, pl. 13, f. 115-117] (Fig. 18)

Synonym: *Cocconema cistula* (Ehr.) Ehr., 1831.

Taxonomic description: Valves naviculoid, asymmetric, 35-100 µm long, 13-31 µm broad, dorsal side convex, ventral side concave with a median expansion and bluntly rounded ends; Raphe broad, excentric; Axial area narrow, widened slightly at middle; Transverse striae 6-9 in 10 µm, radial with isolated 2-4 stigmata at the ends of the middle ventral striae; Punctae 18-22 in 10 µm.

Collection number and Date: EN 257 (01-06-2004).

Distribution: Dudh Koshi river on the way from Dudh Pokhari to Dole village, 4790 m, Solukhumbu (Suxena and Venkateswarlu 1968); A stream at Kungbachen, 4150 m (Hirano, 1984); Mai Pokhari, 2150 m, Ilam (Rai 2005); Gajurmukhi, Ilam (Rai *et al.* 2008); Bhalle Khola, 4688 m, Upper Mustang (Subba *et al*. 2009). China (Hu and Wei 2006), Iran (Afsharzadeh *et al.* 2003; Ramzannejad Ghadi 2008), Pakistan (Mehwish and Aliya 2005), Turkey (Soylu and Gönülol 2005)

14. *Cymbella cornuta* (Ehr.) R. Ross, 1950. [Hartley, 1986] (Fig. 19)

Synonyms: *Cocconema cornutum* Ehr., 1839; *Cymbella boeckii* (Grun. in A. Shmidt)

Taxonomic description: Valves naviculoid, asymmetric, 109 µm long, 23 µm broad, dorsal side convex, ventral side concave with a median expansion; Raphe narrow, excentric, medianly curved; Axial area narrow, slightly expanded at middle, no isolated dots; Transverse striae radial, 8-15 in 10 µm; Puncta 14-18 in 10 µm.

Collection number and Date: EN 256 (01-06-2004).

Distribution: New record for Nepal.

15. *Cymbella cuspidata* Kützing, 1844. [Tiffany & Britton, 1952, pl. 74, f. 863] (Fig. 20)

Taxonomic description: Valves broad, linear-lanceolate, asymmetric, 32-90 µm long, 12-29 µm broad, constricted below the capitate ends; Raphe excentric, slightly straight; Axial area narrow; Central area large, circular; Transverse striae radial, 8-14 in 10 µm.

Collection number and Date: EN 258 (01-06-2004).

Distribution: New record for Nepal. China (Hu and Wei 2006),

Order: Surirellales

Family: Surirellaceae

Genus: *Cymatopleura* W. Smith, 1851.

16. *Cymatopleura solea* (Bréb.) W. Smith, 1851. [Foged, 1980, pl.15, f. 2; Sinnu & Squires, 1985, pl. 20, f. 186] (Fig. 21)

Basionym: *Cymbella solea* Bréb., 1835.

Synonyms: *Surirella solea* (Bréb.) Bréb., 1838; *Cymatopleura solea* var. *regula* (Ehr.) Grun., 1862.

Taxonomic description: Valves large, broadly linear, 70-140 µm long, 10-28 µm broad, wide constriction at the middle with attenuated, cuneate ends; Costae broad, 6-9 in 10 µm, short at the periphery of the valve; Transverse striae fine, perpendicular to the margin.

Collection number and Date: EN 260 (02-06-2004).

Distribution: New record for Nepal. China (Hu and Wei 2006), Iran (Afsharzadeh *et al.* 2003, Jamaloo *et al.* 2006)

The diatom flora of Himalaya region is rich and diverse (Misra *et al*. 2009). Suxena and Venkateswarlu (1968), Hirano (1984) and Misra *et al*. (2009) have also studied the diatom flora of eastern Nepal Himalaya and recorded many species which are also found in the present study. Most of the diatoms were found to be attached on the pebbles near the edge of the pond. Pennate forms were common than the centric as usual. Among the 16 diatom taxa, *Meridion circulare* var. *constricta*, *Tabellaria flocculosa*, *Diatoma hyemalis*, *Hannaea arcus* var. *arcus* and *Cymbella cistula* were common whereas *Ulnaria ulna*, *Eunotia polydentula* var. *perpusilla*, *Achnanthes swazi*, *Didymosphenia geminata*, *Cymbella cornuta*, *Cymbella cuspidata* and *Cymatopleura solea* were rare. The dominant species was *Tabellaria flocculosa* which occurred in almost all the collected samples.

It is not oppugn that the taxonomic exploration of organism is most essential for their proper documentation and conservation strategy. Furthermore, diatoms are important to measure the water quality of stream and ponds in hilly region and may act as a major bio-indicator for the climate change in the whole Himalaya region. Thus, further extensive exploration of diatoms throughout the Himalayan range of Nepal, periodically as well as seasonally and their relationship with water chemistry are essential and to be carried out in the future.

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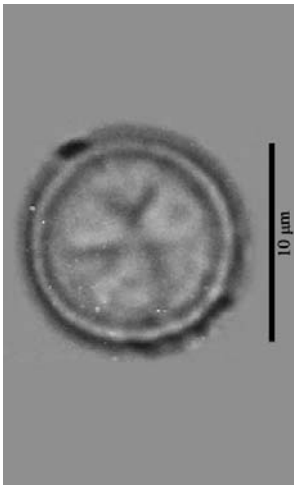


Fig. 2. Cyclotella antiqua var. minor

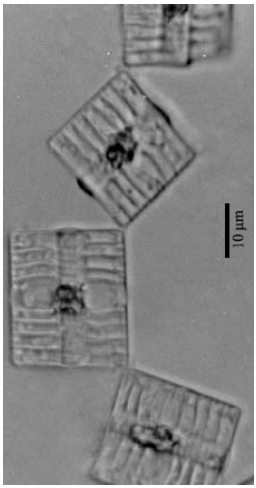
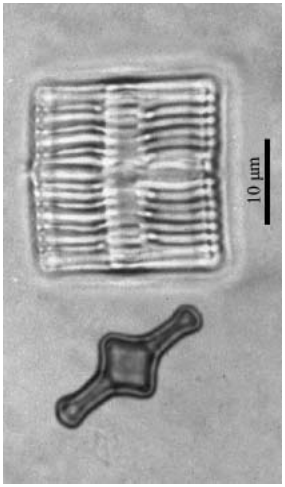


Fig. 3. *Tabellaria flocculosa*



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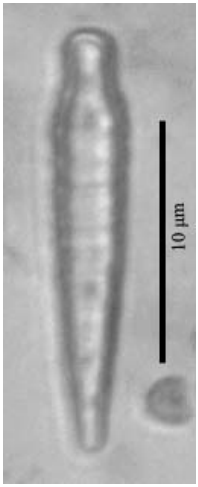


Fig. 5. *Meridion circulare* var. *constricta*

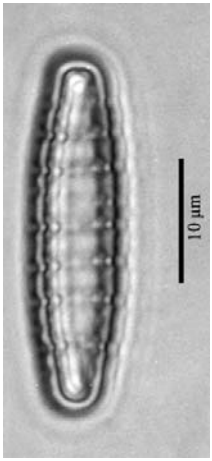


Fig. 6. *Diatoma hyemalis* (Girdle view)

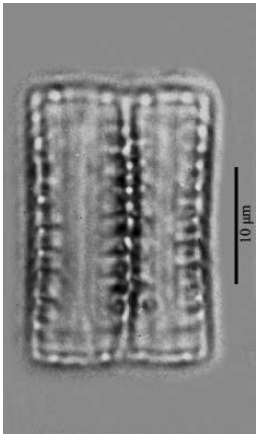
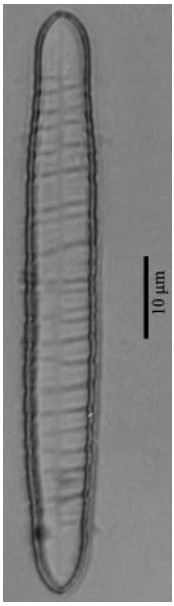


Fig. 7. *Diatoma hyemalis* (Valve view)



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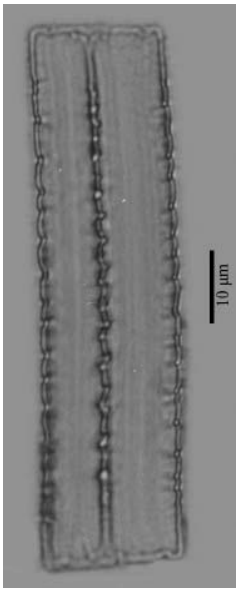
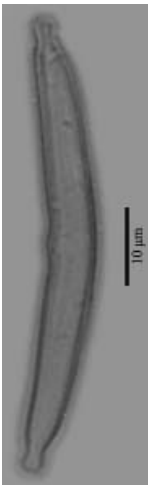


Fig. 9. *Diatoma hyemalis* (Valve view)



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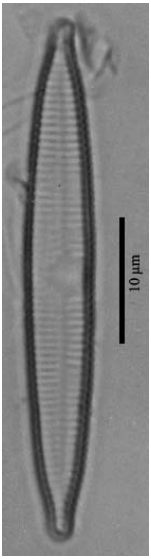

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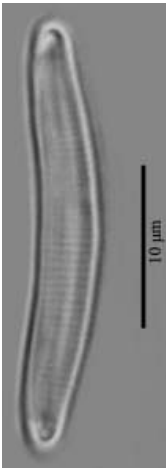

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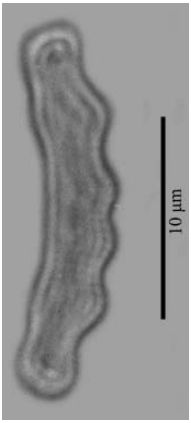
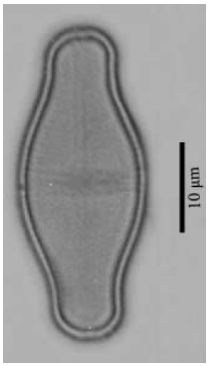


Fig. 13. *Eunotia polydentula* var. *perpusilla*



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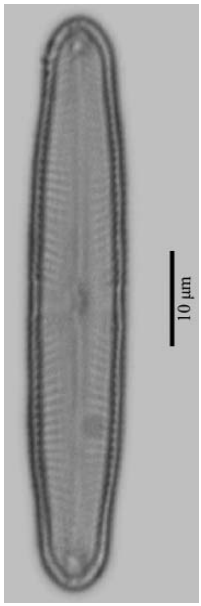

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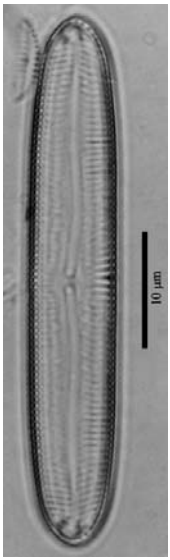

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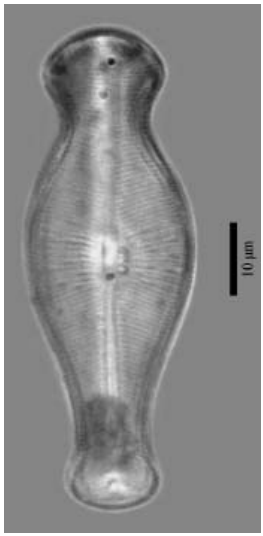
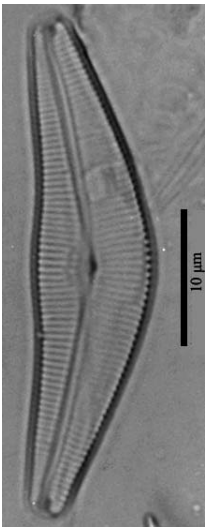


Fig. 17. *Didymosphenia geminata*



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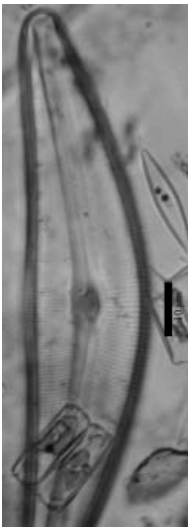

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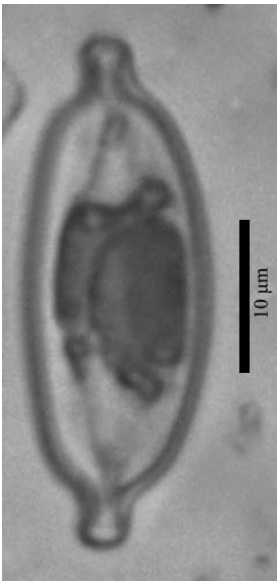

Fig. 20. *Cymbella cuspidata*

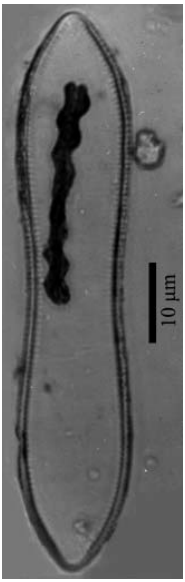

Fig. 21. *Cymatopleura solea*