



## Preliminary checklist of desmids from Kokrajhar District, Assam, India

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### Abstract

This paper presents a precursor in the investigation of the desmids of Kokrajhar District, Assam, India. The present study deals with the diversity of desmids from different freshwater habitats of the district. For this study samples were collected randomly from 12 different habitat around the district during January 2018 to April 2019. Seventy one species were observed comprising eleven genera: *Actinotaenium* (1), *Arthrodesmus* (3), *Bambusina* (1), *Closterium* (12), *Cosmarium* (16), *Desmidium* (4), *Euastrum* (6), *Gonatozygon* (1), *Hyalotheca* (1), *Micrasterias* (6), *Netrium* (1), *Onychonema* (1), *Penium* (1), *Pleurotaenium* (5), *Spirotaenia* (1), *Staurastrum* (6), *Triplocerus* (1) and *Xanthidium* (4). Among the observed taxa some appeared to be the new records for the state of Assam, India.

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## Introduction

Desmids are unicellular micro-organisms belonging to the division Chlorophyta and order Zygnematales (Kadiri, 2002). These are considered as the closest living relatives of land plants (Timme *et al.*, 2012, Turmel *et al.*, 2013). This beautiful group of algae has diverse symmetry and attractive forms, that have long been attracted the interest of scientist since early time and a great number of observations were made from different part of the world. Thousands of species have been described from a variety of freshwater habitats around the world (Prescott *et al.*, 1972, 1975, 1977, 1981, 1983; Croasdale *et al.*, 1983).

Desmids have been reported from various parts of Asian continent. West and West (1902) reported 279 desmids from Ceylon and 148 desmid taxa from Burma (Myanmar), West Bengal, Bangladesh and Madras presidency (Tamil Nadu) (West and West, 1907). Besides these Kreiger (1932), Hirano (1992), Scott and Prescott (1961) and Kanestsuna (2002), Kanetsuna & Yamagishi, 2018 contributed on the distribution of tropical desmids in the Asian region. Altogether 27 genera with 272 species of have been reported from India (Iyengar and Vimala Bai 1941; Patel and Kumar, 1979; Prasad and Misra, 1992; Bordoloi, 1983; Hegde, 1986; Bongale, 1986; 1987; Issacs and Hegde, 1987; Habib & Pandey (1989); Kumar and Patel, 1988; 1990a; b; Pal and Santra, 1993; Mishra and Srivastava, 2003; Perumal and Anand, 2008; Stanley and Baluswami, 2009).

Although, Kokrajhar District in Assam is blessed with variety of freshwater habitats, but the freshwater algae from the district have been overlooked from documentation. But there is lack of knowledge on this group of algae from the district of Kokrajhar, Assam. The most recent study on freshwater desmids of the state of Assam was done by Deka *et al.* (2011) Yasmin *et al.* (2011, 2015), Das & Adhikary (2012), Phukan and Bora (2012) whom sampled freshwater habitats in different parts of the state of Assam. In all these studies 25 different genera of desmids of the total 160 algal genera reported. Besides these sporadic reports, neighboring regions contain a rich documented

desmid flora. For example, in a study of desmids from Eastern Himalaya, Das D & Keshri JP (2012, 2013, 2016) reported 272 taxa under 27 genera. Thus, this study aims to documents the diversity of Desmids in Kokrajhar Distret of Assam, India. As this group, of organisms are considered as the quality indicator of the freshwater habitat (Ngeampat and Peerapornpisal, 2007) thus, in order to study the freshwater algae from distribution, diversity and taxonomic point of view the desmids is chosen for the present study.

## Materials and methods

### Study Area

The desmids samples were collected during 2017-2019 on monthly basis from 12 different field station at Kokrajhar District. The Kokrajhar District is the western most district of the state of Assam bordering West Bengal in west and International border with Bhutan in North. The district of Kokrajhar settled on the riverbank of Brahmaputra is bounded by Dhubri district on the south and the Chirang district lies on the eastern side.

The area of the district extended from the Manas River in the east to the Sonkosh on the west. Kokrajhar district lies in between 26°18 N to 26°54 N latitudes and 89°46 E to 90°58 E longitudes. This district is located on the northern bank of Brahmaputra River. The total area of the district is 3296.00sq. kms. The climate in Kokrajhar district as in the entire state is hot and humid during summer. It also experiences strong spell of cold winter. Rainfall continues in abundance for more than six months in a year with occasional shower throughout the rest of the year.

The maximum humidity lies from June to October. The south west monsoon season is from June to September and October, November constitute post monsoon season. The major portion of the district is a flat plain and characterized by its configuration, drainage pattern and geological structure. The district is crossed by several rivers. There are also several small streams across the area.

Some perennial wetland marshy places are there like, Diplai Beel and *Naa Bhandar* in Chirang RF. There are several small and large waterfalls. These all are the places of interest for the field collections. The average temperature generally recorded is  $\pm 20^{\circ}\text{C}$  and the average rainfall in the area is about 500 mm.

#### Sampling

The sample was collected randomly from different stations using plankton net of 55 $\mu\text{m}$  mesh size from the shore, scraping of epiphyton, direct collecting of wetland sediment, and squeezing of moss and other plant biomass. The collected samples were transferred into 200ml properly labelled plastic containers and immediately preserved with 4% formalin solution. Analysis and Identification: Samples were examined with a Labomed Research Microscope equipped with tracing and measuring devices and devised with Amscope Microscope Camera to captured micrographs. Relevant texts used for identification includes – Kanetsuna & Yamagishi, 2018; West and West, 1905.

1912; Bruhl and Biswas, 1926; Prescott, 1951, 1976; Turner, 1978; Brook, 1981; Gerrath, 2005; Brook and Johnson, 2002; Coesel and Meesters, 2007.

#### Result and discussion

In this preliminary study a total of 71 taxa of Desmids were identified belonging to 18 genera. Presented below is the checklist of the identified taxa from Kokrajhar District, Assam [Arranged alphabetically]

Division: Chlorophyta  
 Class: Chlorophyceae  
 Order: Zygnematales  
 Family: Desmidiaceae

Genus: *Actinotaenium* (Nägeli) Teiling

*Actinotaenium capax* (Joshua) Teiling var. *capax*

Genus: *Arthrodesmus* Ehrenberg ex Ralfs.

*Arthrodesmus convergens* Ehrenberg ex Ralfs var. *incrassatus*

*Arthrodesmus curvatus* Turner var. *curvatus*

*Arthrodesmus curvatus* Turner var. *kalimantanus*

Genus: *Bambusina* Kuetzing

*Bambusina brebissonii* Kuetz.

Genus: *Closterium* Ralfs

*Closterium acerosum* (Schrank) Ehrenberg var. *tumidum* Borge

*Closterium biclavatum* Boerg. var. *biclavatum* f. *biclavatum*

*Closterium closterioides* Ralfs var. *intermedium* (Roy et Bisset) Ruzicka

*Closterium Cynthia* Notaris var. *cynthia*

*Closterium gracile* Breb. var. *tenuis* (Lemm.) West, W. & G.S.

*Closterium kuetzingii* Breb. var. *kuetzingii*

*Closterium kuetzingii* Breb. var. *vittatum* Nordst.

*Closterium praelongum* Berb. var. *praelongum*

*Closterium rectimarginatum* Scott & Prescott

*Closterium striolatum* Ehrenberg ex Ralfs var. *erectum* Klebs

*Closterium subjuncidiforme* Gronblad

*Closterium turgidum* Ehrenb. var. *borgei* (Borge) Defl.

Genus: *Cosmarium* Ralfs

*Cosmarium angulatum* (Perty) Rabenh. var. *angulatum* f. *major* (Grunow) Turner

*Cosmarium connatum* Breb.

*Cosmarium contractum* Kirch. var. *minutum* (Delp.) West, W. & G.S.

*Cosmarium cycladatum* Turner

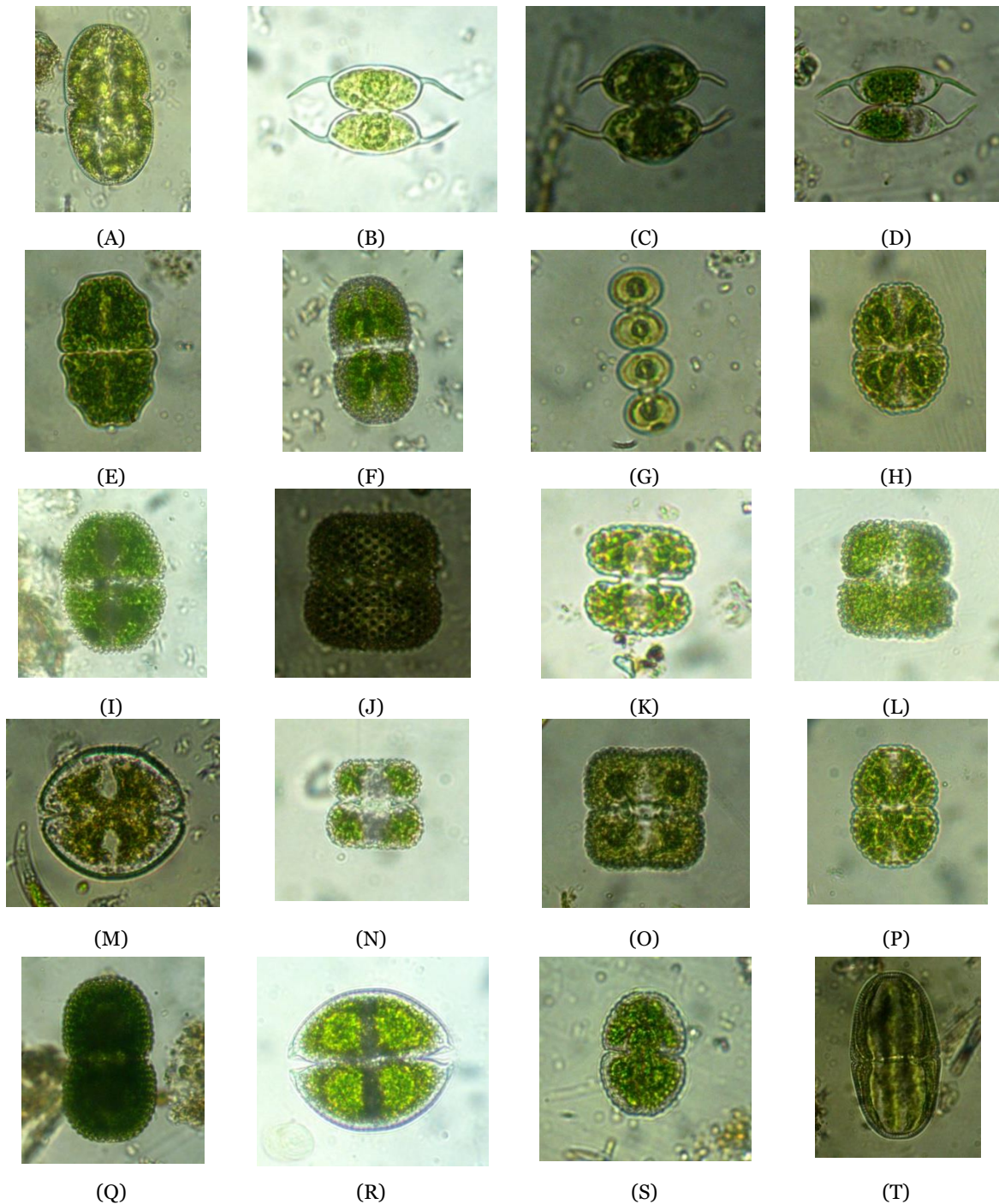
*Cosmarium decoratum* West, W. & G.S.

*Cosmarium favum* West, W. & G.S. var. *indicum*

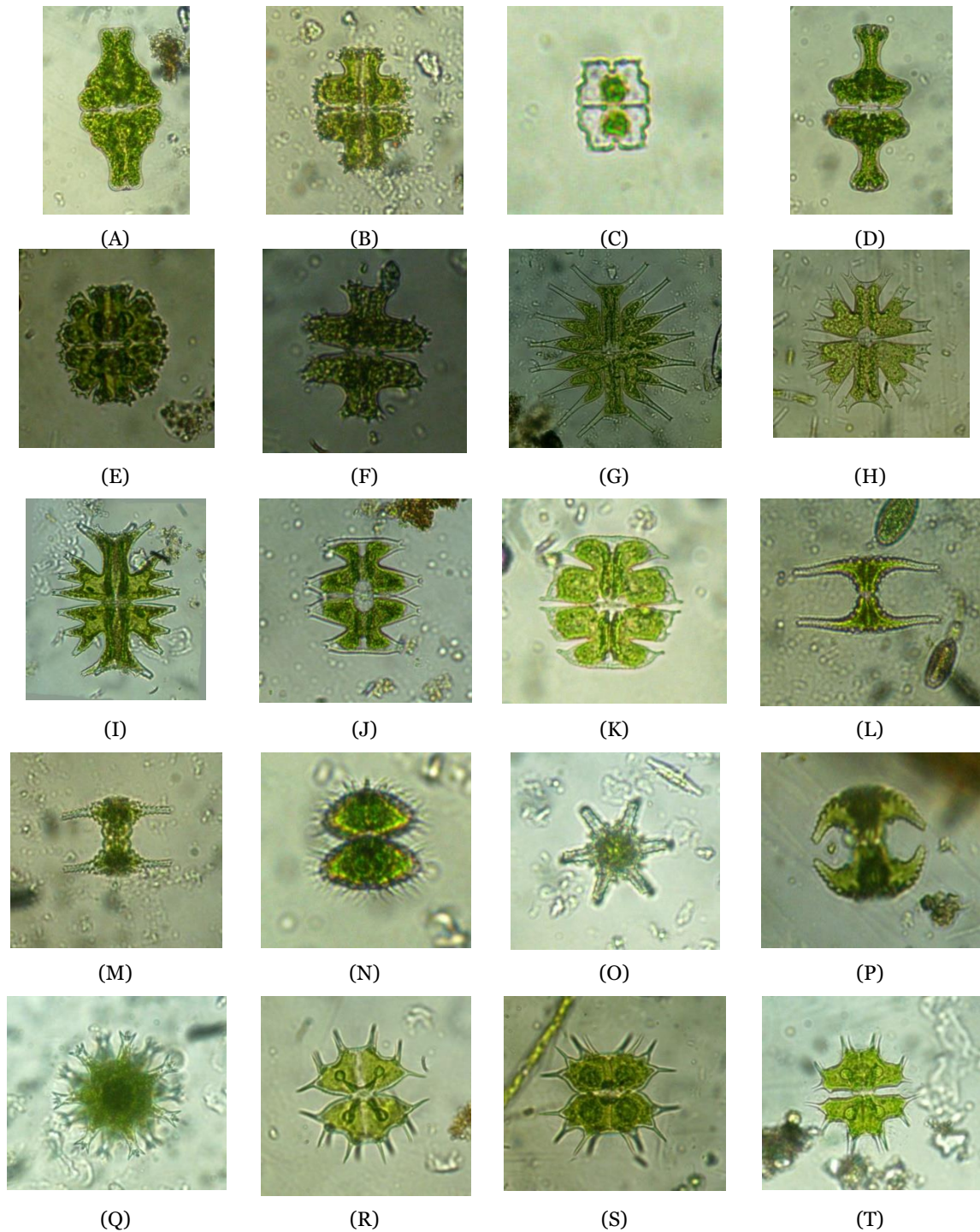
*Cosmarium geminatum* Lund. var. *geminatum* f. *ornatum* Behre

*Cosmarium margaritatum* (Lund.) Roy & Bisset var. *quadrum* Krieger

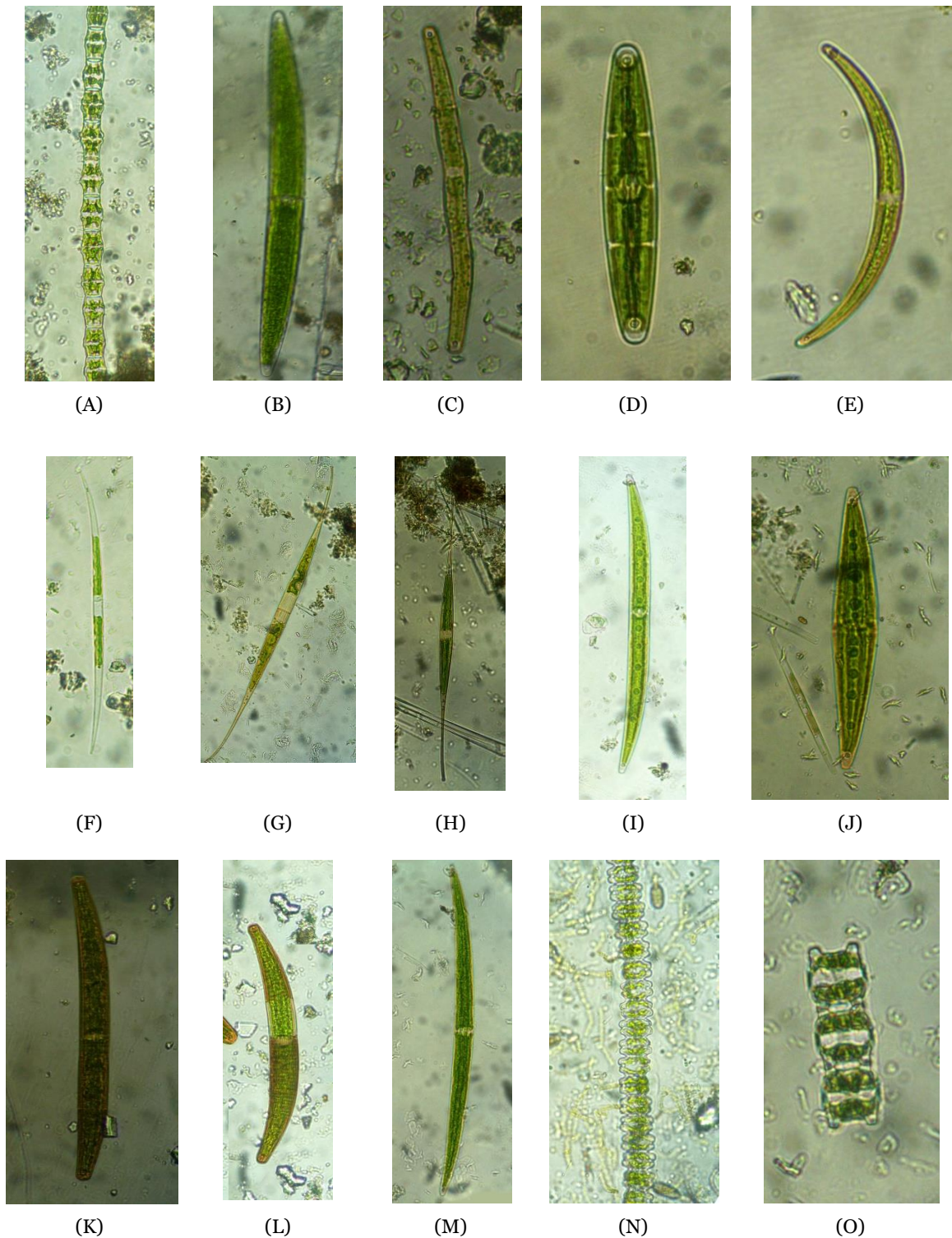
- Cosmarium obsoletum* (Hantz.) Reinsch  
var. *sitense* Gutw.
- Cosmarium pakistanicum* Islum
- Cosmarium pseudobroomei* Wolle
- Cosmarium quadrum* Lund. var. *quadrum*
- Cosmarium scabrolatum* Turner
- Cosmarium striolatum* Naeg. var.  
*striolatum* f. *intermedium* Krieger
- Cosmarium tagmasterion* Scott & Prescott
- Cosmarium undulatum* Corda ex Ralfs var.  
*alaskanum* f. *reductum*
- Genus: *Desmidium* Ralfs.
- Desmidium aptogonum* Breb. var.  
*aptogonum*
- Desmidium baileyi* (Ralfs) Nordst. var.  
*baileyi*
- Desmidium coarctatum* Nordst.
- Desmidium swartzii* Agardh var. *swartzii*
- Genus: *Euastrum* Ralfs
- Euastrum ansatum* Ehrenberg ex Ralfs var.  
*pixidatum* Delponte
- Euastrum ceylanicum* (West, W. & G.S.)  
Krieger
- Euastrum denticulatum* (Kirchner) Gay var.  
*quadrifarium* Krieger
- Euastrum longicolle* Nordst. var. *capitatum*  
West, W. & G.S.
- Euastrum spinulosum* Delponte var. *lindae*  
Grönblad et Scott
- Euastrum substellatum* Nordst
- Genus: *Gonatozygon* Bary
- Gonatozygon kinahani* (Arch.) Rabenh.
- Genus: *Hyalotheca* Ralfs
- Hyalotheca dissiliensis* (Smith, J.E.) Breb.  
var. *dissiliensis*
- Genus: *Micrasterias* Ralfs
- Micrasterias alata* Wallich var. *alata*
- Micrasterias crux-melitensis* (Ehrenb.) Ralfs
- Micrasterias foliacea* Bail. var. *foliacea*
- Micrasterias mahabuleswarensis* Hobson  
var. *bengalica* (Lagerh.) Krieger
- Micrasterias pinnatifida* (Kuetz.) Ralfs var.  
*pinnatifida*
- Micrasterias zeylanica* Fritsch
- Genus: *Netrium* Itzigson & Rothe
- Netrium digitus* (Ehrenb.) Itzigs. &  
Rothe var. *digitus*
- Genus: *Onychonema* Wallich
- Onychonema leave* Nordst. var. *latum* West,  
W. & G.S.
- Genus: *Penium* Brebisson (Family: *Peniaceae*)
- Penium spirostriolatum* Barker
- Genus: *Pleurotaenium* Nageli
- Pleurotaenium kayei* (Arch.) Rabenh.
- Pleurotaenium nodosum* (Bail.) Lund. var.  
*borgei* Grönl.
- Pleurotaenium nodulosum* (Breb.) Bary
- Pleurotaenium ovatum* Nordst. var. *ovatum*
- Pleurotaenium verrucosum* (Bail.) Lund.  
var. *verrucosum*
- Genus: *Spirotaenia* Ralfs
- Spirotaenia condensata* Bréb.
- Genus: *Staurastrum* Ralfs
- Staurastrum anatinoides* Scott & Prescott  
var. *javanicum*
- Staurastrum crenulatum* (Naeg.) Delp.
- Staurastrum gladiusum* Turner.
- Staurastrum pinnatum* Turner var.  
*subpinnatum*
- Staurastrum rhynchoceps* Krieger
- Staurastrum sexangulare* Lund. var.  
*asperum* Playfair
- Genus: *Triploceras* Bailey
- Triploceras gracile* Bailey var. *gracile*
- Genus: *Xanthidium* Ehrenberg ex Ralfs
- Xanthidium antilopaeum* (Brébisson)  
Kütz. var. *antilopaeum* f. *javonicum* Nordst.
- Xanthidium burkillii* West, W. & G. G.S. var.  
*burkillii*
- Xanthidium subtrilobum* West, W. & G. G.S.  
var. *inornatum*
- Xanthidium urniforme* (W. & W.) Scott &  
Croasdale



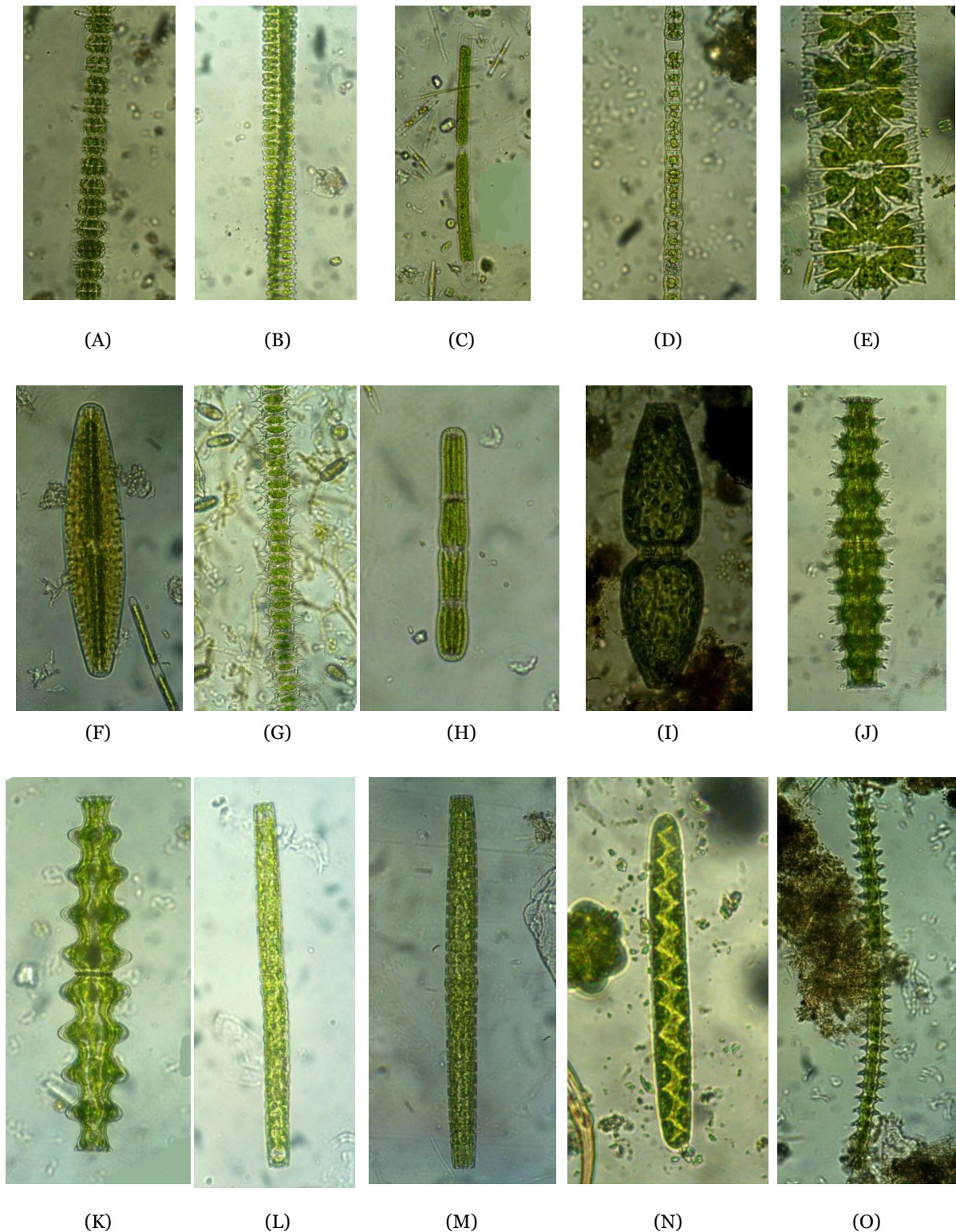
**Fig. 1.** (A) *Actinotaenium capax* (Joshua) Teiling var. *capax* (B) *Arthrodesmus convergens* Ehrenberg ex Ralfs var. *incrassatus* (C) *Arthrodesmus curvatus* Turner var. *curvatus* (D) *Arthrodesmus curvatus* Turner var. *kalimantanus* (E) *Cosmarium angulatum* (Perty) Rabenh. var. *angulatum* f. *major* (F) *Cosmarium connatum* Breb. (G) *Cosmarium contractum* Kirch. var. *minutum* (H) *Cosmarium cycladatum* Turner (I) *Cosmarium decoratum* West, W. & G.S. (J) *Cosmarium favum* West. var. *indicum* (K) *Cosmarium geminatum* Lund. var. *geminatum* f. *ornatum* (L) *Cosmarium margaritatum* (Lund.) Roy & Bisset var. *quadrum* (M) *Cosmarium obsoletum* (Hantz.) Reinsch var. *sitense* (N) *Cosmarium pseudobroomei* Wolle (O) *Cosmarium quadrum* Lund. var. *quadrum* (P) *Cosmarium scabrolatum* Turner (Q) *Cosmarium striolatum* Naeg. var. *striolatum* f. *intermedium* (R) *Cosmarium tagmasterion* Scott & Prescott (S) *Cosmarium undulatum* Corda ex Ralfs var. *alaskanum* f. *reductum* (T) *Cosmarium pakistanicum* Islum.



**Fig. 2.** (A) *Euastrum ansatum* Ehren. var. *pixidatum* Delp. (B) *Euastrum ceylanicum* (C) *Euastrum denticulatum* (Kirchner) Gay var. *quadrifarium* (D) *Euastrum longicolle* Nordst. var. *capitatum* West. (E) *Euastrum spinulosum* Delp. var. *lindae* Grönblad et Scott (F) *Euastrum substellatum* Nordst (G) *Micrasterias alata* Wallich var. *alata* (H) *Micrasterias crux-melitensis* (Ehrenb.) Ralfs (I) *Micrasterias mahabuleswarensis* Hobson var. *bengalica* (Lagerh.) Krieger (J) *Micrasterias pinnatifida* (Kuetz.)Ralfs var. *pinnatifida* (K) *Micrasterias zeylanica* Fritsch (L) *Staurastrum anatinoides* Scott & Prescott var. *javanicum* (M) *Staurastrum crenulatum* (Naeg.) Delp. (N) *Staurastrum gladiusum* Turner. (O) *Staurastrum pinnatum* Turner var. *subpinnatum* (P) *Staurastrum rhynchoceps* Krieger (Q) *Staurastrum sexangulare* Lund. var. *asperum* Playfair (R) *Xanthidium antilopaeum* (Brébisson) Kütetz. var. *antilopaeum* f. *javanicum* Nordst. (S) *Xanthidium burkillii* West, W. & G G.S. var. *burkillii* (T) *Xanthidium subtrilobum* West, W. & G G.S. var. *inornatum*.



**Fig. 3.** (A) *Bambusina brebissonii* Kuetz. (B) *Closterium acerosum* (Schrank) Ehrenberg var. *tumidum* Borge (C) *Closterium biclavatum* Boerg. var. *biclavatum* f. *biclavatum* (D) *Closterium closterioides* Ralfs var. *intermedium* (Roy et Bisset) Ruzicka (E) *Closterium Cynthia* Notaris var. *cynthia* (F) *Closterium gracile* Breb. var. *tenue* (Lemm.) West, W. & G.S. (G) *Closterium kuetzingii* Breb. var. *kuetzingii* (H) *Closterium kuetzingii* Breb. var. *vittatum* Nordst. (I) *Closterium praelongum* Berb. var. *praelongum* (J) *Closterium rectimarginatum* Scott & Prescott (K) *Closterium striolatum* Ehrenberg ex Ralfs var. *erectum* Klebs (L) *Closterium subjuncidiforme* Gronblad (M) *Closterium turgidum* Ehrenb. var. *borgei* (Borge) Defl. (N) *Desmidium aptogonum* Breb. var. *aptogonum* (O) *Desmidium baileyi* (Ralfs) Nordst. var. *baileyi*.



**Fig. 4.** (A) *Desmidium coarctatum* Nordst. (B) *Desmidium swartzii* Agardh var. *swartzii* (C) *Gonatozygon kinahani* (Arch.) Rabenh. (D) *Hyalotheca dissiliensis* (Smith, J.E.) Breb. var. *dissiliensis* (E) *Micrasterias foliacea* Bail. var. *foliacea* (F) *Netrium digitus* (Ehrenb.) Itzigs. & Rothevar. *Digitus* (G) *Onychonema leave* Nordst. var. *latum* West, W. & G.S. (H) *Penium spirostriolatum* Barker (I) *Pleurotaenium ovatum* Nordst. var. *ovatum* (J) *Pleurotaenium kayei* (Arch.) Rabenh. (K) *Pleurotaenium nodosum* (Bail.) Lund. var. *borgei* Gronbl. (L) *Pleurotaenium nodulosum* (Breb.) Bary (M) *Pleurotaenium verrucosum* (Bail.) Lund. var. *verrucosum* (N) *Spirotaenia condensate* Bréb. (O) *Triploceras gracile* Bailey var. *gracile*.



## Discussion

Present investigation shows that the desmids flora of Kokrajhar District of Assam is rich and diverse. Among the observed genera, *Cosmarium* has the maximum taxa represented by 16 out of 71 species. Among the observed taxa the representation of the genera are like - *Actinotaenium* (1%), *Arthrodesmus* (4%), *Bambusina* (1%), *Closterium* (16%), *Cosmarium* (22%), *Desmidiium* (5%), *Euastrum* (8%), *Gonatozygon* (1%), *Hyalotheca* (1%), *Micrasterias* (8%), *Netrium* (1%), *Onychonema* (1%), *Penium* (1%), *Pleurotaenium* (7%), *Spirotaenia* (1%), *Staurastrum* (8%), *Triploceras* (1%) and *Xanthidium* (5%). For a complete documentation of the specimens, regular seasonal explorations of the study sites are essential. Due to rapid urbanization and degradation, freshwater habitats are shrinking rapidly in the area. So, conservation of all such habitat is necessary to preserve the algal communities. In this study it is found that habitats like *Naa Bhandar* and *Diplai beel* are important just because of the species diversity they possess. There need to be mass awareness for saving all such habitat, which is essential for maintaining ecological integrity. Because of high species diversity, these habitats can be used for monitoring the ecological quality of the area. Moreover, a full limnological investigation in these habitats will strengthen the justification of these habitats for becoming monitoring gear.

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