

TAXONOMIC CHARACTERIZATION OF TWO NEW DIATOMS *Podosphenia bangladeshika* sp. nov. AND *Synedra ulna* var. *cladophorae* var. nov. (BACILLARIOPHYCEAE) FROM BANGLADESH WATER

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Abstract

The algal class Bacillariophyceae (diatom) of Bangladesh is represented by nearly 291 species with almost no recent reporting of new species and/or variety. This research paper describes one new species of marine diatom *Podosphenia* and a variety of freshwater diatom *Synedra* species. The former was collected from the Bay of Bengal, Bangladesh and the latter was from Hail Haor, Srimangal, Moulvi Bazar, Bangladesh. The marine species is from genus *Podosphenia* Ehr. The species novo has been proposed as *Podosphenia bangladeshika*. A freshwater periphytic diatom from the Hail Haor wetland, Srimangal, Moulvi Bazar was initially identified as *Synedra ulna* due to the shape of the branched filamentous colony. The shape of the colony was quite different and looked like a twig of a green branched filamentous alga *Cladophora*. The species is hitherto proposed as a new variety *Synedra ulna* var. *cladophorae*.

Key words: Diatom; *Podosphenia bangladeshika* sp. nov.; *Synedra ulna* var. *cladophorae* var. nov.; Phytoplankton; Hail Haor.

INTRODUCTION

The members of the algal class Bacillariophyceae are commonly called diatom. Diatoms are unicellular microalgae which grow in a wide range of fresh and marine habitats (Lalli and Parsons 2010, Speight and Henderson 2010, Tomas 1997, Hustedt 1930). They have a specialized body morphology composed of hard siliceous case called frustule which is variously ornamented (Berber and Haworth 1981, Hustedt 1930). The taxonomy of a diatom is mainly dependent upon different types of frustule surface features and morphology (Berber and Haworth 1981).

A total of 291 taxa of diatom from both the marine and freshwater habitats have been published from Bangladesh (Khondker 2022, Ahmed *et al.* 2009). Although, a significant number of new species (45), variety (38) and forma (16) from different classes of algae were included but none was from Bacillariophyceae (Khondker 2022).

MATERIAL AND METHODS

The first author while working on the phytoplankton samples collected from the St. Martin's Island, Bay of Bengal, Bangladesh found a unique specimen considering the diatom literatures namely, Hustedt (1930), Germain (1981), Prescott (1982), Ahmed *et al.* (2009), Jahn *et al.* (1997). The specimen was later on found closer to *Podosphenia shadboltiana* Grunow, and *Podocystis adriatica* Kg (Grunow 1862, Smith 1853).

RESULTS AND DISCUSSION

The collected specimen was found morphologically similar with *Podocystis adriatica* but not with the structure of the frustule ornamentations. Further comparison of the specimen revealed a

closer look with *Podospheonia shadboltiana*, but differed in a number of characteristic features (Grunow 1862). *P. shadboltiana* though was erected by Grunow (1862) yet detail description of the species could not be found except one figure. The specimen which Grunow described was collected from the North Sea. After a careful consideration given to identify the present specimen comparing with *P. shadboltiana*, it has been decided to report as a new species under the genus *Podospheonia* Ehr.

In Bangladesh, the genus *Synedra* Ehr. has been represented by seven taxa (Ahmed *et al.* 2009). The species *Synedra ulna* (Nitzsch) Ehr. is represented by two varieties, namely *S. ulna* var. *danica* (Kütz.) Van Heureck and *S. ulna* var. *oxyrynchus* (Kütz.) O'Meara. The present author while working on some freshwater periphytic diatom samples collected from a freshwater wetland Hail Haor, Srimangal, Moulvi Bazar has found *Synedra ulna* in a unique colony pattern which looks like just a twig of the green filamentous algae *Cladophora* Kütz. Since this kind of branching has not yet been reported for *S. ulna* and/or for other diatoms elsewhere (Berber and Haworth 1981, Hustedt 1930), the specimen has been considered to be a new variety of the species *S. ulna*. The taxonomic enumeration of the newly described species and a variety of diatom are provided below.

Taxonomic enumeration

Division: Chrysophyta; Class: Bacillariophyceae; Order: Pennales

Family: Surirellaceae

Podospheonia bangladeshika Bhuiyan *et al.* sp. nov. (Fig. 1. A, C and D)

Valve outline purely in a linear shape, heteropolar, isobilateral, broadly ovoid to spatulate and/or cuneate. A subcircular posterior end, starting from nearly middle of the frustule towards anterior gradually, regularly, but slowly narrowed and ends in a sudden to a broad notch-like weakly rostrate tip. Frustules anterior heads lightly flat with blunt weakly undulated top. Valve surface ornamented with linear rows of punctae, leneations originated from the margin of the valve proceeds almost straight towards central part of the raphe, but gently arched towards either end (anterior and posterior) from the valve middle. Raphe straight, blank, without central area, little wider longitudinally, towards anterior. Valve 135.50 μm long, 12.5 μm (middle portion) wide, tip 20-23 μm broad. Raphe 1.00 μm wide at the center and 5.00 μm at the anterior end region, gradually narrowed up to posterior end. Centrally located, one straight punctae lineation from its origin from the valve margin up to central raphe region contains 32 punctae, *i.e.* approx. 5.68 punctae in 10 μm .

Table 1. Comparative taxonomic features between *Podospheonia shadboltiana* Grunow and *Podospheonia bangladeshika* Bhuiyan *et al.* sp. nov.

Taxonomic features	<i>P. bangladeshika</i>	<i>P. shadboltiana</i> ¹
Base attachment	Solitary	Sessile
Habitat	Bay of Bengal	North Sea
Valve length (μm)	137.50	107.5
Valve's maximum width (μm)	112.50	57.50
Number of punctae in the longest striae lineate	32	22
Number of punctae per 10 μm	5.68	7.65
Width of anterior tip (μm)	23	7.50
Valves anterior portion	Blunt	Pointed

¹Data were back calculated with the help of the image of Tab. VII (10), Fig. 12 of Grunow (1862).

Holotype: Sample no. 3, 15 March 2020, St Martin's Island, District: Cox's Bazar, Bay of Bengal, Bangladesh, collected by Dr. Mohammad Azmal Hossain Bhuiyan, Abu Kowser, and SAM Shariar Islam, Herbarium of National Professor A. K. M. Nurul Islam Marine and Environmental Sciences, Phycology, Hydrobiology and Limnology Laboratory, Department of Botany, University of Dhaka, Dhaka, Bangladesh.

Type locality: The sample was collected from the Daskhin Para (GPS: 20.598740, 92.332629), Saint Martin's Island, Bay of Bengal, Bangladesh. Surface sea water measuring 100 L was passed through a plankton net (Nitex 55 μm mesh width) and finally the concentrate was fixed in Lugol's Iodine in a glass vial and transported to the laboratory for further study.

Microscopy: The microscopic observation was done in the Department of Botany, University of Dhaka, with the help of a compound microscope (Zeiss, Axio, Lab. A1, with photographic attachment Zeiss Axiocam ERc 5s, Germany). From the collected plankton concentrate 1.57 μL was mounted on a Helber Microplankton Counting Chamber, Thoma ruling, Hawksley Technology, UK and was visualized and photo-micro-graphed at a magnification of 400 \times .

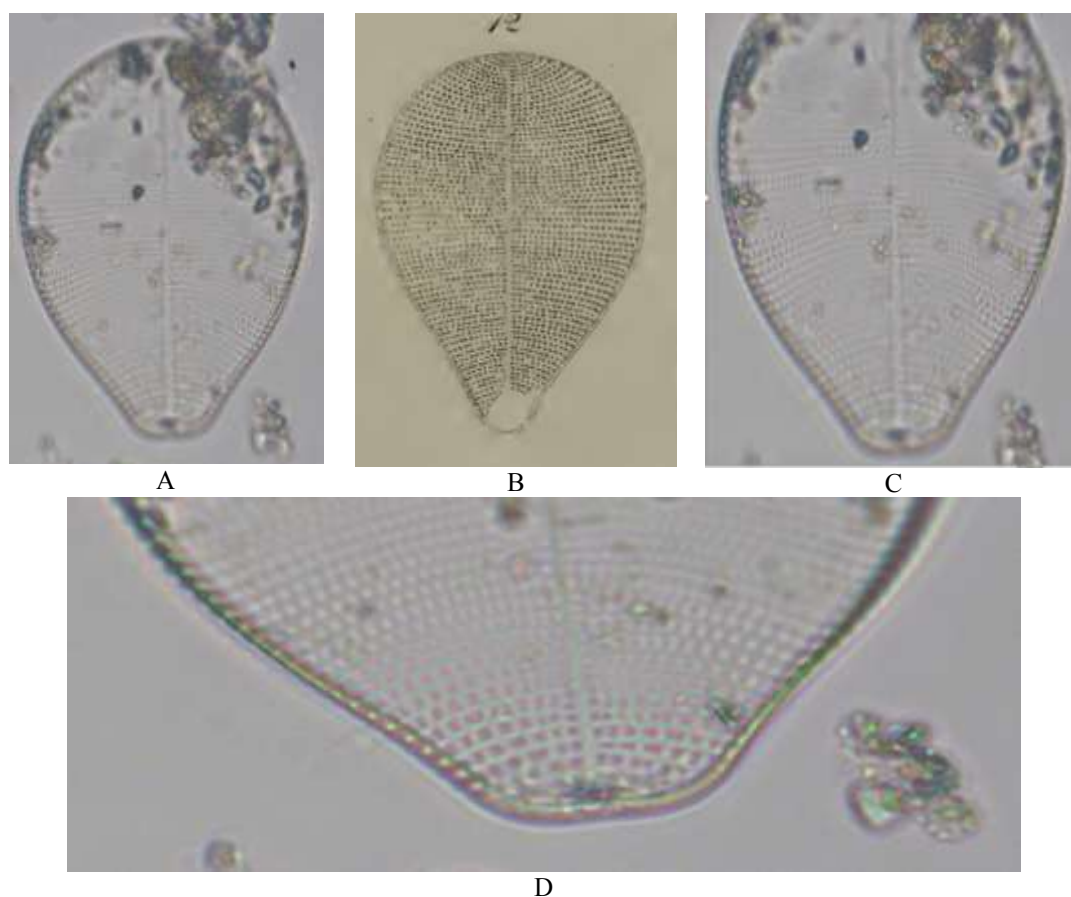


Fig. 1. Frustule morphology comparison: **A.** *Podosphenia bangladeshika* sp. nov.; **B.** *P. shadboltiana* Grunow (reproduced after Grunow (1862); Tab. VII (10), Fig. 12). **C.** *Podosphenia bangladeshika* sp. nov. under high magnification (1000 \times). **D.** *Podosphenia bangladeshika* sp. nov. (enlarged tip) (850 \times).

Ecology: Pelagic plankton. Some water quality data from the study locality can be referenced as: salinity 32.09 - 33.76 ppt, pH 8.16 - 8.22.

Distribution: So far, several species of the genus *Podosphenia* have been known from the North Sea (Grunow 1862, Smith 1853), but this newly described species *Podosphenia bangladeshika* sp. nov. is distributed only in the Saint Martin's Island, Cox's Bazar, Bangladesh.

Note: To identify the present species, literatures on diatom by Hustedt (1930), Germain (1981), Prescott (1982), Ahmed *et al.* (2009), Jahn *et al.* (1997), and Tomas (1997) were searched and consulted but without having any fruitful result. Finally, two nearly closer species, namely *Podosphenia shadboltiana* Grunow, and *Podocystis adriatica* Kg. (Grunow 1862, Smith 1853) were found to be compared. But our sample was found closer to *P. shadboltiana* (Fig. 1. B). Therefore, the present taxon was identified comparing the taxonomic features of *P. shadboltiana* Grunow and described as a new species. A comparative taxonomic feature between the two species has been presented in Table 1. We consider this specimen as new species under the genus *Podosphenia* Ehr. (Smith 1853). The reasons are: (i) A subcircular posterior end from nearly middle of the frustule gradually, regularly, but slowly narrowed towards anterior and ends in a sudden to a broad notch-like, weakly rostrate tip; (ii) head of the tip is slightly flat with blunt and weakly undulated top; (iii) the newly described species is larger by 1.28, 1.95, 1.45, and 3.06 times more for length, breadth, number of striae and anterior tip width (Table 1); and (iv) our plant is solitary. So, the specimen has been identified as *Podosphenia bangladeshika* Bhuiyan *et al.* sp. nov. and hitherto added as new to science. The species epithet has been designated after the name of our motherland Bangladesh.

Family: Fragilariaceae

Synedra ulna var. *cladophorae* Bhuiyan *et al.* var. nov.

Alga epiphytic, a colonial diatom, colony regularly branched, basal frustule of colonial branchlet shows clear differentiation, serves the purpose of attachment with the substratum. The branching pattern of the filamentous colony shows weakly dichotomous type which looks like a twig of the filamentous alga *Cladophora*. Three cells joint diagonally end to end to form the furcation of the branch. The jointing is done by the presence of mucilage secreted by the individual cell. Colonial branchlet 800 μm long, consists of 7 cells, the basal cell measures 120 μm long and 20 μm broad; cells of the middle of the branchlet 170 μm long and 30 μm broad, frustules linear in girdle view, poles more or less broad, number of striae 10 in 10 μm .



Fig. 2. *Synedra ulna* var. *cladophorae* var. nov. showing branching pattern.



Fig. 3. *Synedra ulna* var. *cladophorae* var. nov. showing the jointing pattern of three frustules.

Holotype: Sample no. 8, 2 Nov 2021, Hail Haor, Srimangal, Moulvi Bazar, Bangladesh, collected by Dr. Mohammad Azmal Hossain Bhuiyan, and Sumiya Najnin Choytee, Herbarium of National Professor A. K. M. Nurul Islam Marine and Environmental Sciences, Phycology, Hydrobiology and Limnology Laboratory, Department of Botany, University of Dhaka, Dhaka, Bangladesh.

Type locality: The sample was collected from Hail Haor, Srimangal, Moulvi Bazar, Bangladesh. Samples of periphyton was collected by washing submerged foliar parts of an aquatic angiosperm *Ceratophyllum demersum* in a plastic bucket. After shaking gently, a dense concentrate was obtained which was fixed in 4% commercial formaldehyde for further study.

Microscopy: One drop of concentrate from the periphytic sample was mounted on to Helber Microplankton Counting Chamber, Thoma ruling, Hawksley Technology, UK and was visualized and photo-micro-graphed with the help of a compound microscope (Zeiss, Axio, Lab. A1, with photographic attachment Zeiss AxioCam ERc 5s, Germany) using magnifications 100 - 400 \times .

Ecology: Hail Haor is a perennial waterbody and covers an area of 400 km² in monsoon but in dry season, the water area reduces to ~30 km². The new variety of diatom *Synedra ulna* var. *cladophorae* Bhuiyan *et al.* var. nov. grew as epiphytic on aquatic macrophyte *Ceratophyllum demersum*. During sampling, few recorded physicochemical factors were habitat water temperature: 30.46°C, pH: 7.0 - 7.8, PO₄-P: 31.15 μ g/L, and NO₃-N: 182.00 μ g/L.

Distribution: This newly described *Synedra ulna* var. *cladophorae* Bhuiyan *et al.* var. nov., is distributed only in Hail Haor, Srimangal, Moulvi Bazar, Bangladesh.

Note: Some diatoms are free living but still there are many which form various types of colonies and grow as free-floating and/or attached (Berber and Haworth 1981) with submerged objects. Berber and Haworth (1981) described nearly 19 different colonial forms of diatoms. The branching pattern as described in the present variety of *Synedra* has not been reported in literatures (Berber and Haworth 1981, Hustedt 1930). While the present authors were carrying out a limnological investigation in Hail Haor, one sample containing *Synedra ulna* was found to grow in a *Cladophora* - like branching pattern. After detailed taxonomic investigation the taxon was identified as *Synedra ulna* var. *cladophorae* Bhuiyan *et al.* var. nov. and hitherto described as a new contribution to science.

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