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New record of marine tube dwelling diatoms *Navicula mollis* and *Navicula rusticensis* from South Andaman, India

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The occurrence of two species of marine tube dwelling diatoms was reported from the water samples collected from Phoenix Bay, South Andaman. The recorded species were *Navicula mollis* and *Navicula rusticensis.* The morphometric dimensions of these two species were also given. Along with the tube dwelling diatoms, co-habitant diatoms were also observed in the present study. This was the first report of tube dwelling diatoms from Indian waters particularly from Andaman Islands.

[Keywords: Tube dwelling diatom, New record, *Navicula*, *Nitzchia*, South Andaman]

Introduction

Benthic diatoms are the key components of marine ecosystems. Some of the marine benthic diatoms living in the inter-tidal zone secrete very long mucopolysaccharide tubes that surround the cells[1]. Diatoms release this mucilage through various structures in the cell wall to facilitate locomotion or attachment of the cells to various substrata. Some of the diatoms are able to produce their own tubes, but some others use tubes made by other diatoms. These diatoms living within the mucilaginous tubes are termed as tube dwelling diatoms. The movement of individual diatom within the tube suggests that they function independently[1]. The major tube dwelling diatoms come under the genera: *Navicula, Berkeleya, Nitzschia, Parlibellus, Haslea, Gyrosigma,* and *Frustulia*[2-5].

Marine tube dwelling diatoms were first reported from the Mediterranean Sea. The tube formation is initiated by a single diatom cell. After attaching to a suitable substratum, the cells start to secrete a thread of mucus through its girdle pores. When the tube is several times longer than the cell, vegetative reproduction takes place and the tube is gradually filled with diatoms. In the course of time, the mucilaginous threads form a very thin cocoon like structure, in which the diatom cells move slowly back and forth. Due to this movement, the more mucilaginous materials is added to the inside of the tube and the wall of the tube becomes more solid. The back and forth movement of the cells forces the neighboring cells in the same direction, so the whole cells then move together[6]. The tube dwelling diatoms and a number of co-habitant diatoms were reported from the Indian Ocean, particularly in the Arabian Gulf coastal waters of Bahrain[7].

The objective of the present work was to study marine diatoms from the coastal waters of Andaman Islands. This was the first report of tube dwelling diatoms from Indian waters especially from Andaman Islands.

Materials and Methods

Inshore water samples were collected from Phoenix Bay, South Andaman, during February 2013. Twenty litres of water collected and filtered using 30 µm sieve and the filtered samples were siphoned and concentrated to 15 ml. The same were immediately transferred to the laboratory for further procedure. From the concentrated sample, an aliquot was taken to observe diatoms in live condition. Rest of the samples were immediately fixed with Lugol's iodine solution. The lowest taxonomic level was identified based on the gross morphology investigated, using light microscope (Zeiss 100x oil immersion) and standard keys[5,8-11] and the photographs of the diatoms were taken using a digital camera.

Results

During the identification of phytoplankton samples, tube dwelling diatoms were observed to move through their own tubes or tubes made by other diatoms. The observed tube dwelling diatoms species, viz., *Navicula mollis* and *Navicula rusticensis* comes under the family *Naviculaceae.* The taxonomic description of the species is as follows:

***Navicula mollis* (W. Smith)** [5, 12]

Cells lanceolate with cuneate or subrostrate apices, 30-32 µm long, 6 µm wide (Fig. 1 a&b). The chloroplast lie along the girdle faces. Central area is small and oval and central striae weakly radiate.

***Navicula rusticensis* (Lobban)**[5]

Cells variable in length, 20-30 µm long, 6 µm wide (Fig. 2 a&b). The shape is lanceolate, with apices cuneate or very weakly rostrate. The chloroplast lie along each girdle and clearly visible. The tube material is thick.

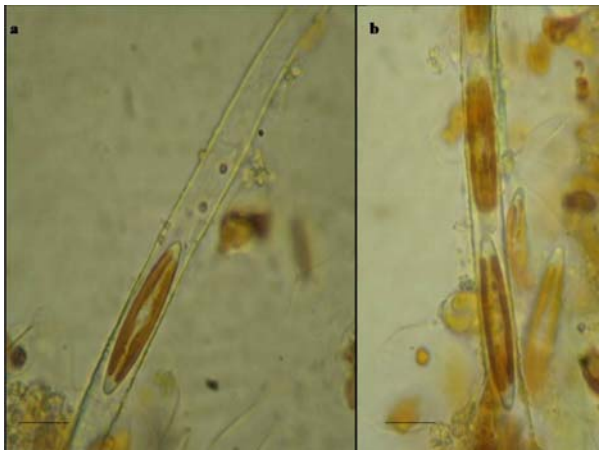

Fig. 1 — *Navicula mollis.* (a & b) living cells in tube (scale bar: 10 µm)

Fig. 2 — *Navicula rusticensis.* (a) Cells moving outside the tubes and (b) Single cell (scale bar: a = 50 µm, b = 10 µm).

The associated diatoms with the tube dwelling diatoms were: *Diploneis smithi, Paralia sulcata, Cymbella* sp., *Entomoneis* sp., *Melosira nummuloides, Biddulphia pulchella, Coconeis sp., Synedra sp., Biddulphia aurita, Nitzchia constricta, Navicula hennedeyi,* and *Diploneis gemmata* (Fig. 3).

Discussion

Two tube dwelling diatoms along with the co-habitant diatoms were observed in the present study. The morphological features and dimensions of the two tube dwelling species were checked with descriptions, checklist and illustrated keys[5]. No distinct variation in the length and width of tube dwelling diatoms were observed in the present study while comparing the dimensions of Canadian tube dwelling diatom[5]. In all previous studies, the tube dwelling diatoms were collected from solid substrata, like rocks, mangrove roots, bivalve shells etc.[4,13,14]. However, in the present study, the tube dwelling diatoms were obtained from the water samples at 1 m depth. This is the first report of the occurrence of marine tube dwelling diatoms from water samples. The presence of the tube dwelling diatoms in the sub-tidal water sample indicated that the colonies might have been broken off and suspended in the water column and that they were able to withstand the current or wave action. This might be a method of dispersal of the species to new areas. *N. mollis* may form separate tubes or may cohabit with other species, such as *N. ramossima* or *N. smithii.* The species. *N. rusticensis* has been found to frequently cohabit with *Nav. delognei forma elliptica,* but they also form their own colonies[5].

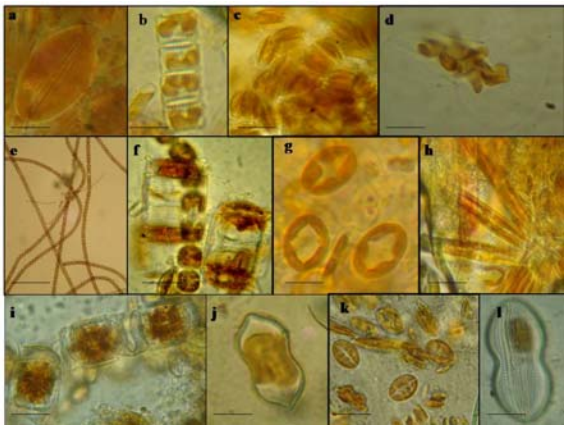

Fig. 3 — Associated diatoms (a) *Diploneis smithi,* (b) *Paralia sulcata,* (c) *Cymbella* sp. (d) *Entomoneis* sp., (e) *Melosira nummuloides, (*f) *Biddulphia pulchella,* (g) C*oconeis sp.,* (h) *Synedra sp.,* (i) *Biddulphia aurita,* (j) *Nitschia constricta,* (k) *Navicula hennedeyi, and* (l) *Diploneis gemmata* (Scale bar: a = 5 µm, (b-e) = 20 µm; (f- l) = 10 µm).

Seasonal variation and species distribution of tube dwelling diatoms were studied in Severn Estuary [15].

In addition to the tube dwelling diatoms, other diatoms were also observed as associated forms of tube dwellers. The occurrence of such associated forms was also reported in other regions. It has been reported that the associated diatoms of a tube dwelling diatom, *Nitzchia martiana* were: *Grammatophora oceanica, Acanhthes brevipes, Diploneis weissflogii, Diploneis aestuari, Navicula platyventris, Parlibellus delognei, lyrella spectabilis, Anaulus sp.*, and *Biddulphia pulchella*[16]. These associated forms might be contributing to the formation of tubes. In most of the studies, the co-habitants of the tube dwelling diatoms were almost the same, indicating that the presence of tube dwelling diatoms promote or provide the conditions for cohabitants to proliferate or the cohabitants provide good conditions for the growth of tube dwelling species and to make their tubes.

Conclusion

The present study reported two species of the tube dwelling diatom along with associated diatoms and formed the first report from Indian waters. The study pointed towards further research in the ecology of tube dwelling diatoms.

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