



Synedra species morphological observation at Bhavani region in Cauvery river, Tamil Nadu, India

Venkatachalapathy R. and Karthikeyan P.

Department of Geology, Periyar University, Salem-636 011, Tamil Nadu, INDIA

Available online at: www.isca.in, www.isca.me

Received 8th September 2013, revised 25th October 2013, accepted 29th November 2013

Abstract

A total number of 60 Diatoms belonging to 21 genera species are identified from Cauvery river at Bhavani region in Erode District, Tamil Nadu State and examined by using Light Microscopy (LM). The fresh water species *Synedra ulna* (Nitzsch) Ehrenberg and *Synedra rumpfen* are recorded for the first time in the study area and abundant of epiphytic diatoms species. The *Synedra ulna* and *Synedra rumpfen* species belonging to the genus *Synedra* are illustrious by tiny taxonomic features. The detailed morphology of the species *Synedra ulna* (Nitzsch) Ehrenberg and *Synedra rumpfen* with the length and breadth of the valve, number of striae, shape of the apices, shape of the pseudoraphe and shape of the central area are examined.

Keyword: Diatom, cauvery river, morphology, light microscopy, *synedra ulna*, *synedra rumpfen*, bacillariophyta.

Introduction

The Geography of River Cauvery starts at its origin at Talakaveri in Karnataka state and reaches up to the fertile plains at its lower course in Tamil Nadu State. The source of the Cauvery lies in the state of Karnataka and the river flows in the direction of southeastward. The waters of the river have been an important source of irrigation for many centuries. The survey shows that about 95% of the Cauvery River water is used for agricultural purposes before flowing into the Bay of Bengal. The Geology of Cauvery River accounts for the floodplain sediments in the river basin. The soil produced by the tide and flow of river Cauvery is rich and best for agricultural purposes. The floodplain sediments of the Cauvery river in the southern India are derived from Archean gneissic and charnockitic source regions, thus revealing the inter-bedding of silty and sandy units. The geochemistry of silty beds is amazingly uniform at a given location and over a tangential distance of almost 250 km. The sandy beds have more inconsistent chemical compositions, yet are comparable to those of silty beds; the only limitation is the diluting effect of quartz. Silty sediments possess the geochemical signature of prominently exposed source rocks for almost all elements and provide proofs of tectonic unsteadiness in the primary source region.

Importance of Diatom Studies in Rivers: A diatom community is a popular tool for monitoring environmental conditions, commonly used in studies of water quality. According to diatoms develop faster when they grow on rocks or hard surfaces, in general cobbles, boulders and pebbles are used in the sampling of these epilithic diatoms¹. The sensitivity of diatom communities has led them to be used as indicators of environmental conditions, such as water quality and habitat conditions in river systems and stream². Researchers³⁻⁸ has

recorded a total of 60 diatoms belonging to 21 genera from Cauvery river in parts of Tamil Nadu. Among these *Achnanthes minutissima* Kutz, *Achnantheidium Plonensis*, *Aulacoseira distans*, *Cymbella turgida* (Greg) Cleve, *Cymbella ventricosa* Kutz, *Fragilaria intermedia* Grun var. *robusta*, *Gomphonema lanceolatum* Ehr, *Nitzschia sigma* (Kutz) W Smith, *Synedra rumpfen*, *Synedra ulna* (Nitzsch) Ehr were the most abundance species.

Material and Methods

Diatom Sampling, Preparation and Analysis The study area lies at 77°40' E to 77°42' E longitude and 11°25' N to 11°27' N latitude with an area of 9.05 sq. km around Bhavani region in Erode District, Tamil Nadu. The Cauvery River is one of the major rivers of South India. Diatom samples are taken by brushing the undersurfaces and petioles of macrophytes (plant leaves and roots). In this study, diatom samples were preserved in formaldehyde (4%). A 10ml subsamples macrophytes were extracted and cleaned using 30% H₂O₂ and concentrated HNO₃. **Light Microscopy (LM):** Diatom samples are fixed in 1% Lugol's solution for the light microscopic studies using inverted microscope (Euromax, Holland). Identification of diatoms was carried out using taxonomic guides⁹⁻¹².

Results and Discussion

Species Composition of Diatom Assemblages: In the present study area at Bhavani region, Erode District, Tamil Nadu, a total number of 60 Diatoms belonging to 21 genera species are identified in Cauvery river. The Diatom species reported in the present study are: *Achnanthes brevipes*, *Achnanthes inflata*, *Achnantheidium binodis*, *Achnantheidium minutissima*, *Amphora holsatica*, *Amphora ovalis*, *Anomooneis sphaerophora*,

Caloneis pulchra, *Caloneis silicula*, *Cocconeis placentula*, *Ctenophora pulchella*, *Cyclotella catenata*, *Cyclotella meneghiniana*, *Cymbella aspera*, *Cymbella cymbiformis*, *Cymbella lanceolata*, *Cymbella tumida*, *Cymbella tumidula*, *Cymbella turgida*, *Cymbella ventricosa*, *Eunotia curvata*, *Eunotia fallax*, *Eunotia pectinalis*, *Fragilaria intermedia*, *Gomphonema affine*, *Gomphonema clavatum*, *Gomphonema gracile*, *Gomphonema lanceolatum*, *Gomphonema parvulum*, *Gomphonema olivaceum*, *Gomphonema truncatum*, *Gomphonema undulatum*, *Mastogloia braunii*, *Melosira granulata*, *Melosira moniliformis*, *Melosira varians*, *Navicula mutica*, *Navicula radiosa*, *Navicula symmetrica*, *Navicula virudila*, *Nitzschia acicularis*, *Nitzschia linearis*, *Nitzschia microcephala*, *Nitzschia palea*, *Nitzschia pseudofonticola*, *Nitzschia recta*, *Nitzschia thermalis*, *Nitzschia sigma*, *Tabellaria flocculosa*, *Pinnularia acrosphaeria*, *Pleurosira indica*, *Pleurosira salinarum*, *Stauroneis anceps*, *Surirella linearis*, *Surirella robusta*, *Surirella splendida*, *Surirella tenera*, *Synedra rumpens*, *Synedra ulna*. Among these the species of *Synedra ulna* are dominant in the Cauvery river.

Systematic Paleontology: Bacillariophyceae: Cells elongate and often symmetrical about at least two planes, one of which is the perivalvar plane; heterovalvar cells also occur. Stria pattern bilateral, orientated about a longitudinal sternum, as in Fragilariophyceae; raphe present (sometimes subtended internally by siliceous bridges), either within the longitudinal rib or to one side of it (*Eunotia*). Costae and septa may be present. Rimoportules absent (except *Eunotia* and related genera). Usually one, two or four plastids per cell, occupying characteristic positions in relation to the raphes; rarely many small, discoid plastids. Chain-like, stellate colonies rarely formed, but epiphytic species often form stalks for attachment.

Genus *Synedra* Ehrenb (1830): Cells approximately rectangular in girdle view, typically long and thin, attached by mucilage pads at the base to form radiate colonies. There are two long plastids lying against the girdles and overlapping slightly onto the valve face. In unhealthy material, these plastids may split up, giving the appearance of many small discoid plastids. Valve outline is usually linear or linear lanceolate (lanceolate in the case of *S. parasitica*) with rounded, rostrate, capitate or swollen ends. The striae are perpendicular to the narrow axial area. The central area, if present, is variable in shape and often contains ghost striae. There are no marginal spines. A rimoportula is found close to each apex, along with a well-developed apical pore field. The copulae are few in number and have a single row of areolae. Williams and Round (1986) moved a number of taxa formerly included in *Synedra* to new genera, leaving this genus as exclusively freshwater in distribution. Most of the new genera are brackish or marine, but representatives of *Ctenophora* and *Tabularia* are found in freshwaters and can be confused with *Synedra* spp.

In the present study the taxonomy of *Synedra ulna* (Nitzsch) Ehrenberg is presented by using the classification by M.D.

Guiry in Guiry, M.D. and Guiry, G.M.. Algae Base. World-wide electronic publication presented at <http://www.algaebase.org> and referred with the Integrated Taxonomic Information System (ITIS).

Phylum Bacillariophyta, Class Fragilariophyceae, Order Fragilariales, Family Fragilariaceae, Genus *Synedra*

***Synedra ulna* (Nitzsch) Ehrenberg 1932:** (Hustedt, 1930, 154, fig. 166; Patrick & Reimer, 1966, 148, pl. 7, figs. 1-2; Germain, 1981, 76, pl. 24, figs. 1-6; pl. 168, fig.8, Hadi *et al.*, 1984, 324, pl. 1, figs. 1-6; pl. 8, De Toni, 1891, p. 653; Van Heurck, 1899, p. 310, pi. 10, fig. 409; Boyer, 1926, p. 198; Hustedt, 1930, p. 151, figs. 158-59; Venkataraman, 1939, p. 105, figs. 37, 39, 43. Reimer 1966, 148, pl. 7, Figs. 1-2; Germain 1981, 76, pl.24, Figs. 1-6; pl. 168, Fig.8, Hadi *et al.* 1984, 324, pl. 1, Figs. 1-6; pl. 8, Kyung Lee *et al.* 2001, pp 376-377, pl 1, fig 2a-c)

Description: Valves are narrow and linear, not swollen in the middle, with gradually tapered and rounded apices. Axial area is straight and very narrow. Central area is ovoid, often offset to one side of the valve and with ghost striae. Short striae are typically found at one or both sides of the central area. Striae are parallel throughout the species. Areolae are coarse and easily resolved in light microscope (LM).

Morphology: Valve linear with gradually attenuated to rostrate or sometimes somewhat restrate-wedge-shaped end; axial area narrow; central area not much longer than broad, often almost square, very short striae on the margins; striae parallel; length of valve 75-100 μm , breadth 9-15 μm , striae 9-10 in 10 μm . The comparison of *Synedra ulna* species from Bhavani region, Erode District, Tamil Nadu with other regions are presented and discussed below.

Comparative study of morphological characters of *Synedra ulna* from the present study area coincides with the length, breadth and striae of the valve of *Synedra ulna* species reported from the United States by Patrick and Reimer 1966. However, the *Synedra ulna* taxon from other regions of India and abroad shows increased in size of length, breadth and striae of the valve and variation in Pseudo-raphe and central area.

Systematic Paleontology: Phylum Heterokontophyta, Class Fragilariophyceae, Order Fragilariales, Family Fragilariaceae Genus *Synedra*.

***Synedra rumpens* Kutz. (1844):** (Synop. Diat. Belg. pl. 40, f. 14, 1881; Hustedt, Sussw. pl. 10, p. 156, f. 175, 1930; Krypt. Fl. 7:2, p. 207, f. 697a, b, 1932; A. Cleve, K. V. A. Handl. 4:1, p. 41, f. 352a, 1953 (as var. genuina). Hustedt Fr., Paschers Susswasser- Flora, Heft 10, 1930, p. 156, fig. 175; Hustedt Fr., Rabenhorst's *Kryptogamen-Flora*, Bd. VII, Teil 2, Lief 1-4, 1931-32, p.207, fig 697a, b; Abdul- Majeed, M., 1935, pl. I, fig 16; Skvortzow, B. W., vol. 62, 1937, p. 293, pl. 5, figs 6, 61.)

Synedra rumpens Kutz (1844): Morphology: Single cells that is elongated and needle-like in shape. In valve view the the cells are linear and each end can be slightly swollen. Striations are sometimes visible radiating outward from the center. The center of the cell can also appear slightly swollen. Several cells can be found clumped together at one pole with a pad of mucilage. Rarely is the cells joined valve face to face. The plastids appear as two long plates in girdle view and in valve view they slightly overlap and appear as one.

Table-1
The comparison of some morphological characteristics of *Synedra ulna* species

Authors	Characteristics/ Type					Habit/ Location	Countries
	Length (µm)	Width (µm)	Striae (µm)	Pseudo-raphe	Central area		
Venkatachalapathy & Karthikeyan (Present study)	75-100	9-15	9-10	Narrow	Square	Freshwater, Cauvery river, Bhavani region, Erode District, Tamil Nadu.	India
Toma 2012	145-230	4.6-7.2	9-10	-	-	Streams, stagnant water, Baghdad.	Iraq
Fikrat M. Hassan 2012	145-230	4.6-7.2	9-10	-	-	Fresh water Mesopotamian marshes, Karkheh River.	Iraq
Bharat 2012	100-250	10-12	9- 12	linear	Narrow	Fresh water lake, Samaguri Lake, Nagaon town of Assam state.	India
Rashmi Pareek 2011	95-156	6.5-7	9-11	linear	Absent	Fresh water, Galta kund, Jaipur.	India
Jena 2006	100-250	10-12	9-12	linear	-	Streams, stagnant water, Orissa State, fresh water.	India
Palanisamy 2007	170 - 175	6-7	10	distinct	Square	Schirmacher Oasis,	East Antarctica
Asha Khandelwal, Gupta 1989	90-200	5-7	9-10	Frag-mental	Slender	Fresh water diatoms from Kua Tal, district Nainital, Kumaon Himalaya.	India
Gopinathan 1984	145	10	12	Narrow	Rect- angular	Marine Diatoms, Southwest Coast of India, Cochin.	India
Patrick and Reimer 1966	75-100	9-11	10	-	Square	Fresh water, United States exclusive of Alaska and Hawaii.	U. S
Gandhi 1956	172-225	5-6	9-10	Very narrow	-	Freshwater, Diatomaceae of S. Western India. Dharwar	India

Table-2
The comparison of some morphological characteristics of *Synedra rumpen* species

Authors	Characteristics/ Type					Habit/ Location	Countries
	Length (µm)	Width (µm)	Striae (µm)	Pseudo-raphe	Central area		
Venkatachalapathy and Karthikeyan (Present study)	45-50	3	14	Linear	Central	Freshwater, Cauvery river, Bhavani region, Erode District, Tamil Nadu.	India
Rashmi Pareek 2011	45-44	3-3.7	12	-	-	Fresh water, Galta kund, Jaipur.	India
Biggs 2000	25-50	2-4			Central	Stream, Periphyton	New Zealand
Gandhi 1952	70-74	3	19-20	-	-	Fresh water. Powai lake Bombay Salsette.	Indian

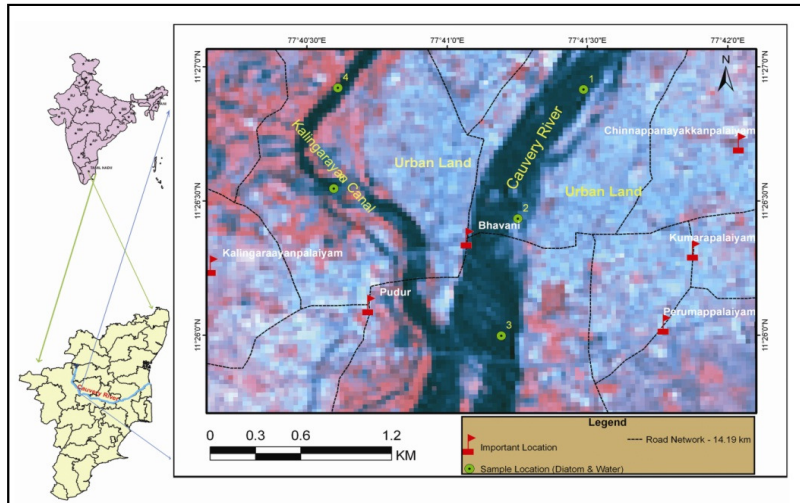


Figure-1
 Study Area (Bhavani)

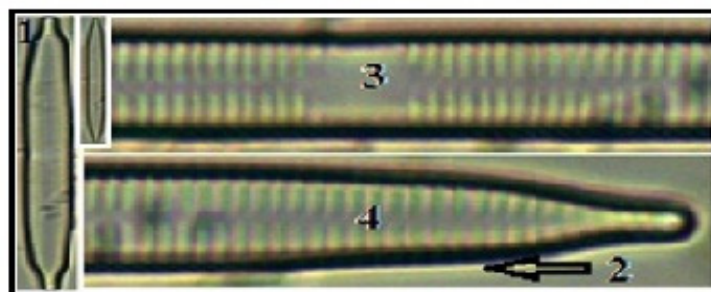
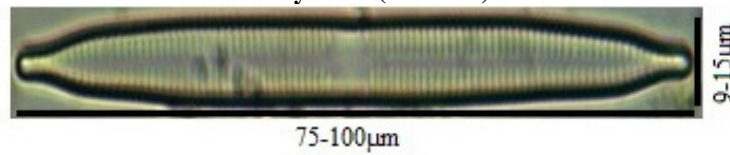
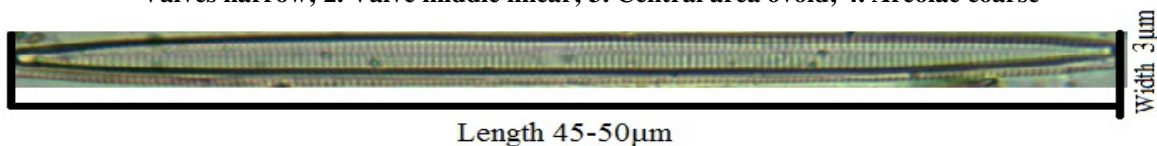
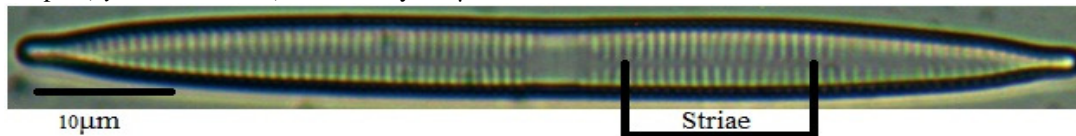


Figure-2

Images of *Synedra ulna* (Nitzsch), light microscopy (LM), Magnification (X40), Morphology of *Synedra ulna* (Nitzsch): 1. Valves narrow; 2. Valve middle linear; 3. Central area ovoid; 4. Areolae coarse



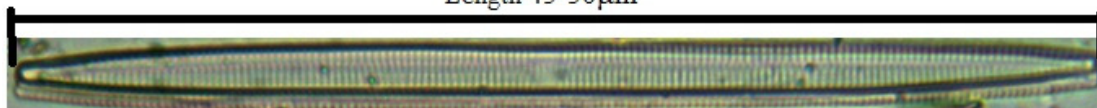
Descriptions: Striae: Description: The number of striae measured in 10 µm approximately midway between the centre and the poles. In this example (*Synedra ulna* Ehr), the density is 1µm. This is a numeric character.



Synedra ulna Ehr

Length: Description : Maximum distance measured between the two poles. This is a numeric character.

Length 45-50µm



Synedra rumpfen Ehr

Conclusion

Epilithic and Epiphytic diatoms from stones and plants are collected in Cauvery river at Bhavani region, Erode District, Tamil Nadu State during 2011- 2012 have been examined by using Light Microscopy (LM). A total number of 60 Diatoms belonging to 21 genera species are identified. Among these, the dominant fresh water species *Synedra ulna* (Nitzsch) Ehrenberg is recorded for the first time in the study area and most abundant of epiphytic diatoms species. The detailed morphology of the species *Synedra ulna* (Nitzsch) Ehrenberg with the length and breadth of the valve, number of striae and shape of the apices, shape of the pseudoraphe and shape of the central area are examined. The present study records the presence of *Synedra ulna* (Nitzsch) Ehrenberg species with the length of valve 75-100µm, breadth 9-15µm, striae 9-10µm and very narrow linear valves. The central area is ovoid and often to one side. The species *Synedra ulna* (Nitzsch) Ehrenberg differs from other species of *Synedra* by having characteristic undulate-linear valves and straight pseudoraphe. ***Synedra rumpens* Kutz. (1844)** The Valves very linear with narrow and capitate ends. The central area reaches the margins. Pseudo raphe linear and broad. Striae strong and distantly placed. Length 45-50 µm, breadth 3 µm. Striae 14 in 10 µm. The shape and the width of *Synedra ulna* (Nitzsch) Ehrenberg valves are very consistent among individuals except the length which shows some variable. Linear to linear-lanceolate valves, narrowing towards sub-capitate poles. Distinct rectangular central area usually reaching the margin on both sides of the valve and which can appear to be slightly swollen. *Synedra ulna* (Nitzsch) Ehrenberg and *synedra rumpen* was found to be associated with fresh water and slightly water environment.

Acknowledgement

The authors express their sincere thanks to the Department of Science & Technology, New Delhi and Periyar University for their support to initiate the detailed study on Diatoms in Cauvery river. This research work was carried out at the Advanced Micropaleontology Laboratory, Department of Geology, Periyar University, Salem.

Reference

1. Kelly M.G. and Whitton B.A., Biological monitoring of eutrophication in rivers. *Hydrobiol*, **384**, 55-67 (1998)
2. Soininen J., Paavola R., Muotka T., Benthic diatom communities in boreal streams: community structure in relation to environmental and spatial gradients, *Ecography*, **27**, 330-342 (2004)
3. Venkatachalapathy R. and Karthikeyan P., Physical, Chemical and Environmental Studies on Cauvery River in Parts of Tamil Nadu (Mettur and Bhavani) *Universal Journal of Environmental Research and Technology All Rights Reserved Euresian Publication* © 2013 eISSN 2249 0256, **3(3)** 415-422 (2013)
4. Venkatachalapathy R. and Karthikeyan P., Diatoms Assemblages Distribution in Cauvery Rivers, Bhavani, Tamil Nadu in Relation to Chemical and Physiographical Factors, *Research Journal of Chemical Sciences*, **3(11)**, 55-59 (2013)
5. Venkatachalapathy R. and Karthikeyan P., A taxonomic and morphological study of fresh water Diatom species *Synedra ulna* (Nitzsch) Ehrenberg in Cauvery River at Bhavani region, Tamil Nadu, India, *International Research Journal of Environmental Sciences*, **2(11)**, 18-22 (2013)
6. Venkatachalapathy R., Nandhakumar G. and Karthikeyan P., Diatoms Community Structure in Relation to Physico-Chemical Factors in Yercaud Lake, Salem District, Tamil Nadu, India, *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, **2(4)**, 220-222 (2013)
7. Venkatachalapathy R. and Karthikeyan P., Benthic Diatoms in River Influenced By Urban Pollution, Bhavani Region, Cauvery River, South India, *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, **2(3)**, 206-210 (2013)
8. Venkatachalapathy R. and Karthikeyan P., Environmental Impact Assessment of Cauvery River with Diatoms at Bhavani, Tamil Nadu, India, (2012), *International Journal of Geology, Earth and Environmental Sciences*, **2(3)**, 36-42 (2012)
9. Krammer K. and Lange-Bertalot H., Bacillariophyceae. 3. Teil: Centrales, Fragilariaceae, Eunotiaceae. In *Ettl, H., Gerloff, J., Heynig, H. & Mollenhauer, D. (Eds.), Süßwasserflora von Mitteleuropa.*, **2(3)**, 1-576 *Gustav Fisher Verlag, Stuttgart, Germany* (1991)
10. Patrick R.M. and Reimer C.W., The Diatoms of the United States exclusive of Alaska and Hawaii, V. 1. *Monographs of the Academy of Natural Sciences of Philadelphia* **13**, (1966)
11. Gandhi H.P., A contribution to the freshwater Diatomaceae of S. Western India - I. Freshwater diatoms of Dharwar, *Journal of the Indian Botanical Society*, **35**, 194-202 (1956)
12. Hustedt F., Bacillariophyta (Diatomeae). Dr. A. Pascher: Die süßwasser-Flora Mitteleuropas Heft, **10**, 1-466 (1930)