



A Taxonomic and Morphological study of Fresh water Diatom species *Synedra ulna* (Nitzsch) Ehrenberg in Cauvery River at Bhavani region, Tamil Nadu, India

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Abstract

Epilithic and Epiphytic diatoms from stones and macrophytes are collected in Cauvery river at Bhavani region in Erode District, Tamil Nadu State and examined by using Light Microscopy (LM). Sixty diatoms belonging to twenty two genera species are identified. The fresh water species Synedra ulna (Nitzsch) Ehrenberg is recorded for the first time in the study area and a large amount of epiphytic diatoms species. The Synedra ulna species belonging to the genus Synedra are illustrious by tiny taxonomic features. The detailed morphology of the species Synedra ulna (Nitzsch) Ehrenberg 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. The species Synedra ulna (Nitzsch) Ehrenberg was found to be associated with fresh water and slightly water environment.

Keyword: *Synedra ulna*, Cauvery river, Morphology, Light microscopy, Bacillariophyta.

Introduction

Cauvery river is one of the major river systems in southern India and prominent source of water for agriculture, industry and drinking water purposes. Very few studies have been carried out about the Diatoms and their role in monitoring of environment.

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.

Importance of Diatom studies in rivers: Diatoms are so ecologically important that they are used for monitoring environmental conditions of waters. Diatoms have been used in a many countries as indicators of river pollution. The major of important is to measure up to direct measures of urbanization (impermeable surfaces, drainage connection, septic tanks and water quality changes) and assesses their relative contribution to the composition of diatom assemblages in urban river.

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*, *Gomponema lanceolatum* Ehr, *Nitzschia sigma* (Kutz) W Smith, *Synedra ulna* (Nitzsch) Ehr were the most abundance species^{1,2}.

Among the Bacillariophyta Family the presence cosmopolitan genera like *Synedra* and its species *Synedra ulna* in large numbers provides scope for taxonomic and environmental investigations in Cauvery river. The use of *Synedra ulna* taxon in the literature is not common, and its taxonomy needs to be clarified using both Light Microscope (LM) and making a cross comparison with other varieties.

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 (figure 1). 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 guides³⁻⁶.

Systematic Paleontology: Phylum Bacillariophyta, Class Fragilariphyceae, Order Fragilariales, Family Fragilariaceae, Genus *Synedra*, *Synedra ulna* (Nitzsch) Ehrenberg 1932.

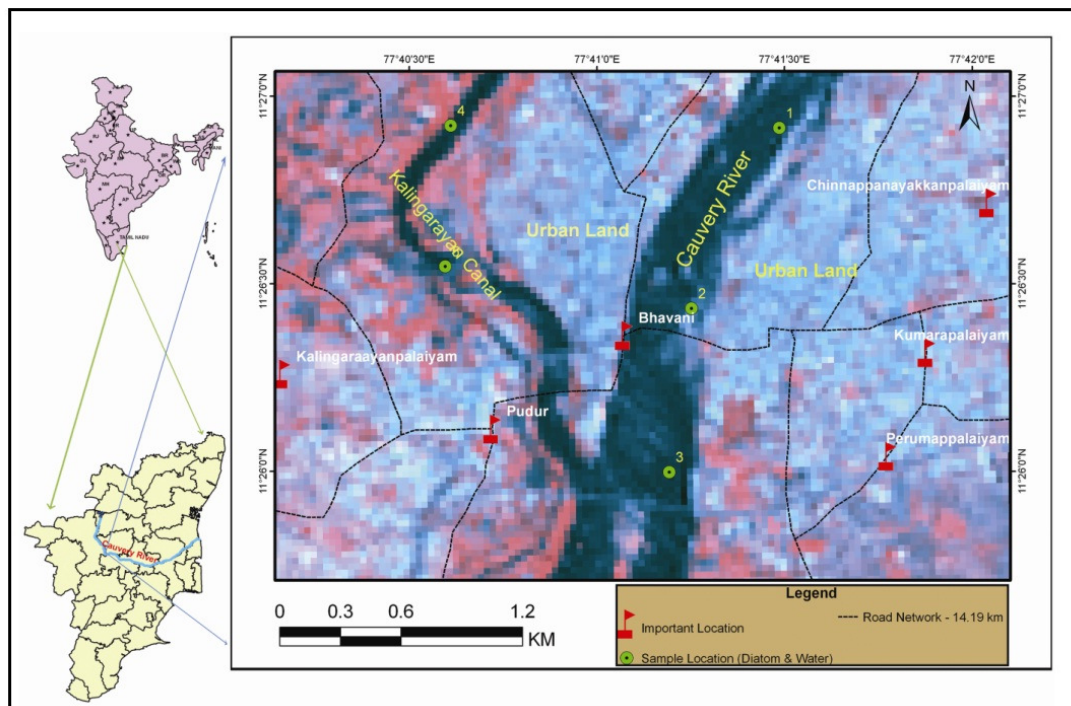


Figure -1
Map of study area of our research work

(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)

Morphology: Valves are narrow and linear, 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. Striae are parallel throughout species. Areolae are coarse and easily resolved in light microscope (LM).

Results and Discussion

Toma 2012 described the valves *Synedra ulna* as length 145-230 μm ; Width 4.65-7.2 μm ; 9-10 striae in 10 μm from Iraq⁷.

Pareek 2011 from India fresh water diatom described the valves *Synedra ulna* as linear to linear lanceolate and tapering at the poles. Ends rounded pseudoraphe linear. Central area absent. Striae coarse. Length 95 to 156 μm , Breadth 6.5 to 7 to 9 μm . Striae 9 to 11 in 10 μm . (f.2v)⁸.

Palanisamy 2007 described the valves *Synedra ulna* as Valve length varied from 170 to 175 μm , breadth 6-7 μm and striae are

located in 10 μm . It is reported from Schirmacher Oasis, East Antarctica⁹.

Gopinathan 1984 coasts of India Estuaries as reported presented in *synedra ulna* and described the valves narrowly linear, somewhat broadened at the ends, rounded, pseudoraphe narrow, linear, central area rectangular, striae coarse, 12 in 10 μm . Length of valve 145 μm and breadth 10 μm . 28 μm broad and rather suddenly diminish in breadth lower down and becoming linear, lower part 12 μm broad, Length of valve 820 μm (fig. 1 ac), p. 9.¹⁰
Distribution: Coasts of Atlantic, North Sea, Florida Coast, coasts of India.

Bharat 2012 described the valves *Synedra ulna* as length 100-250 μm , breadth 10-12 μm , striation distinct, Parallel, absent at the middle, striae 9- 12 in 10 μm . Pl. 1, p. 4814. f. 4.¹¹

Hassan 2012 described the valves *Synedra ulna* as valve Length 145-230 μm ; Width 4.65-7.2 μm ; 9-10 striae in 10 μm . Epiphytic on all host studied plants¹². (pl. 4, Fig. 53)

Phukan 2012 described frustule in girdle view linear with broad ends; valves linear, lanceolate with tapering ends; pseudoraphe narrow, axial, central area varying, valve surface with coarse striae. Length of valve 70-300 μm , breadth 10- 10.5 μm girdle width 12 μm , transverse striae 6-9 in 10 μm (Fig-16) p. 55.¹³

Diatom Assemblages, Species Composition and Comparison: In the present study area at Bhavani region, Erode

District, Tamil Nadu, sixty diatoms belonging to twenty two 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*, *Anomoeoneis 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*, *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 flocculos*, *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.

The comparison of *Synedra ulna* species from Bhavani region, Erode District, Tamil Nadu with other regions are presented and discussed below (table 1). The concept of starting with Ehrenberg 1838, who has identified and described *Synedra ulna* in including the morphotypes with differing valve ends and growing as epiphytes. It is possible that Ehrenberg 1838 could have included some organisms currently belonging to the genus *Nitzschia* together with other *Synedra*-like taxa¹⁴.

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 and 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
Sangita Phukan 2012	70-300	12	6-9	Narrow	varying	Sivasagar district of Assam	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

Gandhi 1956 described the *Synedra ulna* species with the measurements of frustules elongated with widened truncate ends in the girdle view, valve narrow, linear- lanceolate, bent in the middle with capital ends, 172-225 μ long and 5-6 μ broad. Pseudoraphe very narrow striae slender but distinct 9-10 in 10 μ .⁵

Patrick and Reimer 1966 stated that the apices of *Synedra ulna* can be rostrate and either broadly or sharply rounded. The axial area is narrow and it expands at the center of the valve leaving a commonly square central area (rectangular in some cases) devoid of striae. The striae are parallel throughout the valve¹⁵. The results of present study from Cauvery river at Bhavani region, Erode District, Tamil Nadu shows that the species *Synedra ulna* has similar measurements reported by Patrick and Reimer 1966 from United States, but length usually fluctuates between 75-100 μ m and that the striae density is usually 9-11 in 10 μ m (figure 2).¹⁵

Jena 2006 described the valves *Synedra ulna* as long 100-250 μ m, broad 10-12 μ m. Striae 9-12 in 10 μ m. Absent at the middle¹⁶.

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 Reimer¹⁵. 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.

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). Sixty diatoms belonging to twenty one 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, 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 75-100 μ m, breadth 9-15 μ m, striae 9-10 μ m 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. The shape and the width of *Synedra ulna* (Nitzsch) Ehrenberg valves are very consistent among individuals except the length which shows some variable.

Synedra ulna (Nitzsch) Ehrenberg was found to be associated with fresh water and slightly water environment.

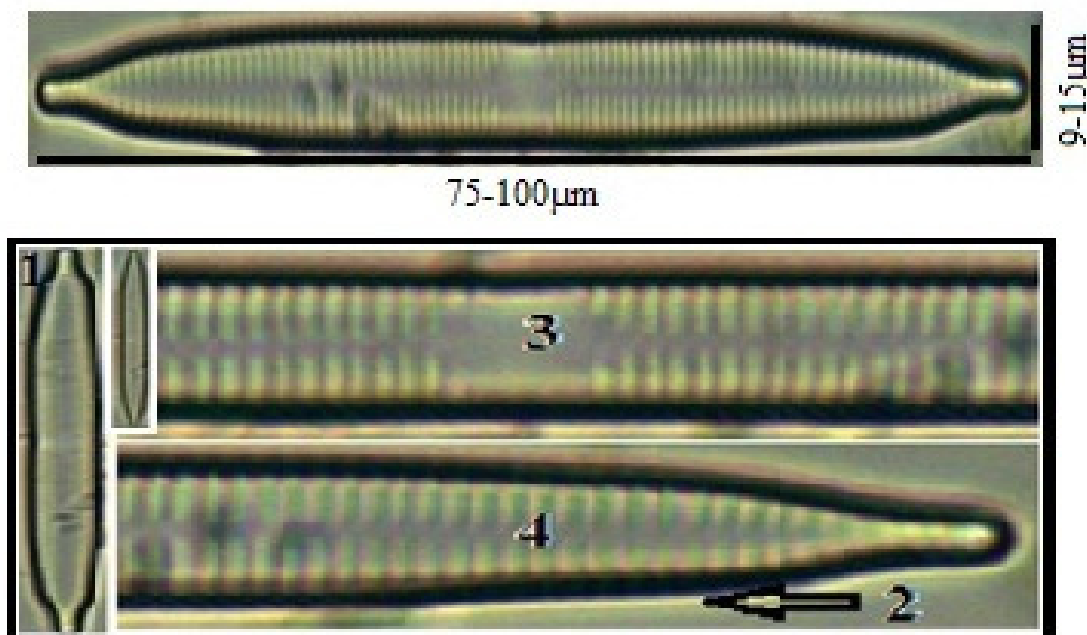


Figure-2

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

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References

1. Venkatachalapathy R. and Karthikeyan P., Benthic Diatoms in River Influenced By Urban Pollution, Bhavani Region, Cauvery River, South India, *Int.J. Inn.Tech.Exp.Eng.*, **2-3**, (2013)
2. Venkatachalapathy R. and Karthikeyan P., Environmental impact assessment of Cauvery River with diatoms at Bhavani, Tamil Nadu, India, *Int.J.Geo.Ear.Env.Sci.*, **2-3** 36-42 (2012)
3. 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 (1991)
4. 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)
5. Gandhi H.P., A contribution to the freshwater Diatomaceae of S. Western India - I. Freshwater diatoms of Dharwar, *J.Ind.Bot.Soc.* **35**, 194-202, (1956)
6. Hustedt F. Bacillariophyta (Diatomae). In Pascher, A. (Ed.). Verlag von Gustav Fischer. Jena, Germany. *Die Süßwasser-Flora Mitteleuropas*, **10**, 1-466 (1930)
7. Toma Hassan, Ismail Alhassany R.A.M. Hadi and Maulood, A Contribution to algal Flora in Baghdad area, Iraq, *J.adv.lab.res.bio*, **3(2)**, (2012)
8. Rashmi Pareek, Gajandra Pal Singh and Rajesh Singh., Some fresh water diatoms of Galta kund, Jaipur, *Ind.J.Soi.sci.Env.Man*, **2(4)**, 110-116 (2011)
9. Palanisamy M., *Synedra ulna* (Nitzsch) Ehrenberg: A new generic record in Schirmacher Oasis, Antarctica, *Cur.sci*, **92, 2-25**, (2007)
10. Gopinathan., A Systematic account of the littoral Diatoms of the Southwest Coast of India, *J.Mar.Bio.Ass.Ind*, **26**, (1984)
11. Bharat B Buragohain, Farishta Yasmin and Nilotpal K Brahma., Epipelagic Algal Flora of Samaguri Lake of India: A Systematic Approach on Algae - II, *Sch.Res.Lib, Ann.Bio.Res*, **3(10)**, (2012)
12. Fikrat M. Hassan1, Rafia A. Hadi, Thaer. Kassim mand Jinan S. Al-Hassany., Systematic study of epiphytic algal after restoration of Al-Hawizah marshes, southern of Iraq, *Int.J.Aqu.Sci*, **3**, (2012)
13. Sangita phukan, Sailendra and Prasad bora., Preliminary report of Diatoms from Sivasagar district of Assam, *Ind.J.Fun.App.Lif.Sci*, **2 (2) 55 – 61**, (2012)
14. Ehrenberg, C. G. *Die infusionsthierchen als vollkommene Organismen. Ein Blick in das tiefere organische Leben der Natur. Atlas von vier und sechzig Kupfertafeln zu Christian Gottfried Ehrenberg über infusionsthierchen*, Leipzig, Germany **547**, (1838)
15. Mrutyunjay Jena, Sachitra Kumar Ratha and Siba Prasad Adhikary., Diatoms (Bacillariophyceae) from Orissa State and Neighbouring Regions, India, *Alg*, **21(4)**, 377-392, (2011)