



## Bacillariophycean Diversity of Churu Region of Rajasthan, India.

**G. K. Barupal\* and G. S. Meghwal**

Research Lab., Department of Botany, Govt. Dungar College, Bikaner (Rajasthan). \*Email: [gkbarupal@yahoo.com](mailto:gkbarupal@yahoo.com)

### Abstract:

In the present study Bacillariophycean diversity was observed from Churu region. A total 38 species of 14 genera were reported from the various fresh water bodies of Churu region during January 2013 to December 2014. The number of species were observed to be maximum (13) in Cymbellales order. Bacillariophycean algae were reported from all possible habitats of aquatic bodies like Planktonic (P); Epiphytic on algae (E<sub>A</sub>); Epiphytic on plants (E<sub>P</sub>); On moist rocks or stones (R); Moist soil (S); Small stagnant water bodies (S<sub>w</sub>) and Attach on dead or decaying contents (A).

**Keywords:** *Bacillariophyceae, Diatom, Churu, Habitat, Systematic enumeration.*

### Introduction

The richness of biodiversity depends on the climatic conditions and area of the region. A number of factors have been attributed to influence the algal diversity in any aquatic ecosystem. So, the algal diversity of Rajasthan Desert area is very interesting due to its extreme climatic conditions.

Bacillariophyceae are highly successful and distinctive groups of algae and found in almost all fresh water habitats. Bacillariophycean flora from different region of India has been described by a various authors. (Pascher, 1930; Venkataraman, 1939; Gonzalves and Gandhi, 1952, 1953; Krishnamurthy, 1954; Gandhi, 1956, 1958, 1960, 1961; Sarode and Kamat, 1983; Prasad and Srivastava, 1984; Bongale, 1985; Jose and Patel, 1989; Nautiyal *et al.*, 2004; Nandan *et al.*, 2007; Tripathi *et al.* 2012; Jadhawar and Papdiwal, 2012; Murulidhar and Murthy, 2014; Dwivedi and Misra, 2015; Misra *et al.*, 2015; Verma and Nautiyal, 2016; Nautiyal *et al.*, 2016 and Singh, 2016. Diatoms of Rajasthan were studied by many workers (Gandhi, 1955, Singh *et al.*, 2010, Pareek *et al.*, 2011, Prakash Narayan and Barupal, 2015, Sharma and Bhardwaj, 2017, Grover *et al.*, 2017).

The district Churu stretches between 27°24' to 29°0' at North Latitude and 73°40' to 75°41' at East Longitude. It experiences arid to semi arid type of climate. The general topography reveals a succession of dry undulating plain which are covered by loose sand. In the present study, 10 ponds of Churu region viz. Fatehpuria pond, Sethani Johada, Pithana Johada, Droun pond, Manaksar pond, Natho pond, Talchhappar pond, Chadwas Pond, Parmana pond, Girdhar pond of Churu region were selected.

### Material and Methods

Algal samples were collected by random sampling technique from different geographical localities of Churu region of Rajasthan during January 2013 to December 2014. Generally, epiphytic forms of diatom were collected by squeezing submerged or floating plants and planktonic forms with the help of planktonic mesh net. All the collected samples were fixed in 3-4% formalin and studied after cleaning the frustule by acid treatment. Clean frustules were examined for their morphological investigations.

### Results

#### Systematic Enumeration and Description

**Order:** Thalassiophysales D. G. Mann

**Family :** Catenulaceae Mereschkowsky

**Genus:** *Amphora* Ehrenberg ex Kutzing

***Amphora ovalis* Kutz.**

Frustule has more excentric axial field, raphe gibbous, central nodules close to concave margin of the valve, cells elliptical in girdle view with truncate ends, intercalary bands ornamented with punctae or striae, frustule 12-20 μ broad, 33-52 μ long.

***Amphora turgida* Gregory**

Frustule small, broadly elliptical with rostrate apices, valve almost hemicyclic with straight ventral margin and broad arcuate dorsal margin, apices slightly produced, raphe closed to the ventral margin, valve surface striate, striae 15-16 in 10 μ, frustule 8-9 μ broad, 25-37 μ long.

**Order :** Naviculales Bessey sensu emend.

**Family : Naviculaceae Kutzing**

**Genus: *Navicula* Bory**

***Navicula elegans* Wm. Smith**

Cells solitary, valve elliptical-lanceolate with sub rostrate apices, axial area narrow, straight, central area large orbicular or quadrate, valve striate radiate at middle and curved middle, raphe clear, number of striae 15-16 in 10  $\mu\text{m}$ , frustule 28-32  $\mu\text{m}$  broad, 75-95  $\mu\text{m}$  long.

***Navicula cuspidata* Kutz.**

Valve rhombic-lanceolate with slightly produced rounded ends, longitudinal striae 18-20 in 10  $\mu\text{m}$  and transverse striae 16 in 10  $\mu\text{m}$ , somewhat coarse and perpendicular to the middle line, frustule 27-30  $\mu\text{m}$  broad, 110-130  $\mu\text{m}$  long.

***Navicula exigua* (Greg.) Grun.**

Valve lanceolate with rostrate apices, central area clear orbicular, axial area narrow, straight, central area clear orbicular, axial area clear, raphe straight somewhat bifurcate at apex, number of striae 11-12, frustule 28-32  $\mu\text{m}$  broad, 75-95  $\mu\text{m}$  long.

***Navicula radiosa* Kütz.**

Frustule linear, narrowly lanceolate, elongated, attenuated from middle to both the ends, end rounded, slightly capitate, longer than broad; distinct striation, Raphe thin and straight. Axial area narrow, linear, central area large, obliquely rectangular, frustule 7-7.7  $\mu\text{m}$  broad, 40-52  $\mu\text{m}$  long.

***Navicula protracta* (Grunow) Cleve**

Valve linear to linear-elliptical with broadly rostrate, bluntly rounded apices, striae finely punctuate, transverse and slightly more widely spaced at the centre, becoming slightly radiate over most of the valve, central area very slightly expanded compared to the axial area, frustule 5-10  $\mu\text{m}$  broad, 17-60  $\mu\text{m}$  long.

***Navicula amphirhynchus* Ehrenberg**

Frustules broadly elliptic- lanceolate with quite narrowly rostrate apices, apices constructed to form truncate, longer than broad, striation barely visible in fresh material, frustule 10-20  $\mu\text{m}$  broad, 50-100  $\mu\text{m}$  long.

***Navicula semilunum* Grun.**

Frustule symmetric, rounded apices, small, laminate single plastid apposed to one of the valves, spreading on to the two girdles, frustule 7.35  $\mu\text{m}$  broad, 42.5  $\mu\text{m}$  long.

**Genus : *Gyrosigma* Hassal**

***Gyrosigma acuminatum* (Kutz.) Rabh.**

Valve linear, solitary, sigmoid toward end with obtuse ends, axial area narrow, raphe sigmoid, central area elliptical, striae equidistant, number of striae 17-18 in 10  $\mu\text{m}$ , frustule 14-18  $\mu\text{m}$  broad, 120-135  $\mu\text{m}$  long.

***Gyrosigma scalproides* (Rabh.) Cleve**

Valve linear, sigmoid toward end with obtuse ends, axial area narrow, central area not clear, frustule 6-7  $\mu\text{m}$  broad, 50-65  $\mu\text{m}$  long.

**Family: Diadesmidaceae D. G. Mann**

**Genus : *Diadesmis* Kutzing**

***Diadesmis confervacea* Kutzing**

Frustules attached side by side to form ribbon shaped colony, filamentous, gelatinous, rectangular in girdle view, truncate flat, slightly gap between the valves at the middle, striation not distinct, frustule 6-14  $\mu\text{m}$  broad, 10-30  $\mu\text{m}$  long.

**Order: Cymbellales D. G. Mann**

**Family : Gomphonemataceae Kutzing**

**Genus : *Gomphonema* Ehrenberg**

***Gomphonema parvulum* (Kutz.) Grun.**

Valve clavate with sub-cuneate apices, valve surface striate, striae clearly separated, parallel, axial area narrow, central area clear orbicular, number of striae 10-11 in 10  $\mu\text{m}$ , raphe straight, frustule 12-16  $\mu\text{m}$  broad, 38-42  $\mu\text{m}$  long.

***Gomphonema lanceolatum* Ehr.**

Valves are found in mucous on higher algae or on hydrophytes, valve weakly clavate with rounded apices, valve surface punctuate, Striae well separated, distinct, radiate at centre and convergent at apex, number of striae 11-13 in 10  $\mu\text{m}$ , axial area wide, clear, linear, raphe straight, frustule 38-45  $\mu\text{m}$  broad, 8-12.5  $\mu\text{m}$  long.

***Gomphonema gracile* var. *lanceolatum* (Kutz.) Cleve**

Valve linear, clavate with capitate rostrate end on upper part while cuneate at lower part, axial area narrow clear, linear, central area not distinct, valve surface striate, parallel throughout valve, raphe straight with central nodules somewhat curved at poles, frustule 8-11  $\mu\text{m}$  broad, 31-49  $\mu\text{m}$  long.

***Gomphonema montanum* var. *genuinum* Mayer**

Frustule slightly clavata with rounded poles, central area wide, one side normal and other attenuated, striation clear but not continuous, convergent towards the base, striae 5-8 in 10  $\mu\text{m}$ , frustule 8-12  $\mu$  broad, 35-80  $\mu$  long.

***Gomphonema subclavatum* Grunn.**

Valve linear-clavate with rounded apices, axial area narrow, indistinct at apex, central area clear, linear, lanceolate, valve surface striate, striae radiate at middle and parallel at poles, frustule 7-10  $\mu$  broad, 24-32  $\mu$  long.

***Gomphonema olivaceum* (Lyngbye) Kuetzing**

Valves ovoid-clavate, with broadly rounded apex and acutely rounded base; axial area narrow, linear; central area widened transversely without dots; raphe straight; transverse striations radial and indistinctly punctuate, Striae 11 in 10  $\mu\text{m}$ , frustule 6  $\mu$  broad, 25  $\mu$  long.

***Gomphonema clavatoides* sp. nov.**

Valves clavate with more or less broadly rounded apex and gradually attenuated to rarely subcapitate base. Raphe thin and straight. Axial area narrow, central area more or less large unilaterally dilated with an isolated stigma on the opposite side. Striae radial and coarse. striae 7 to 9 in 10  $\mu\text{m}$ , frustule 6.8-8.9  $\mu$  broad, 27-35  $\mu$  long.

***Gomphonema gracile* Ehrenberg**

Lanceolate-clavate, valves, strongly narrowed from the middle toward the ends and sharply rounded at the ends, often almost symmetrical to the transapical plane, axial area slender, linear, central area small, somewhat transversely widened, with an isolated stigma on one side. Transapical striae radial, indistinctly punctuate, frustule 4-11  $\mu$  broad, 25-70  $\mu$  long.

***Gomphonema telographicum* Kuetzing**

Frustule cuneate, apices slightly wide, truncate, base acute, stipe long with 2-3 valves at the end, stipe 20-32  $\mu$  long and 6-8  $\mu$  broad, striation clearly distinct, marginal; striae 8-10 in 10  $\mu\text{m}$ , frustule 7-14  $\mu$  broad, 30-60  $\mu$  long.

**Family : Cymbellaceae Greville**

**Genus : *Cymbella* Agardh**

***Cymbella tumida* (Breb.) Van Heurck.**

Valve semi-lanceolate with rostrate apices, axial area narrow, central area rounded, clear, valve surface finely punctate, striae sharply radiated, number of striae 12-13 in 10  $\mu$ , ventral margins slightly concave, frustule 21  $\mu$  broad, 65-85  $\mu$  long.

***Cymbella affinis* Kuetzing**

Valves asymmetrical, semi-elliptical having dorsal margin convex, ventral margin slightly convex with constricted, very slightly produced rostrate ends; raphe thick, excentric curved with distinct central nodules, terminal fissures dorsally bent; axial area narrow, linear gradually widening towards centre; central area elliptical with a distinct puncta on the ventral side; striae coarse, radiate throughout the valve. Striae 10 in 10  $\mu\text{m}$ , frustule 13  $\mu$  broad, 38  $\mu$  long.

***Cymbella cistula* (Ehr) Kirchn.**

Epiphytic, Valve 11.0  $\mu$ , broad, 24  $\mu$  long, puncta indistinct, somewhat coarser striae, frustule 11-13  $\mu$  broad, 24  $\mu$  long.

***Cymbella kappi* Chohnoky**

Valve symmetrical at trans-apical axis and asymmetrical, semi-lanceolate with obtuse ends, valve with two stigmata, on ventral side, valve surface finely punctate, striae strong, parallel, striae 11 in 10  $\mu\text{m}$ , frustule 11.0  $\mu$  broad, 30-47  $\mu$  long.

**Order : Achnanthales P. C. Silva**

**Family : Achnanthaceae Kuetzing**

**Genus : *Achnanthes* Bory**

***Achnanthes microcephala* (Kutz) Grun.**

Cells generally in twos with yellowish stipe, valve narrowly lanceolate with slightly inflated at middle, striae 30-32 in 10  $\mu$ , frustule 5  $\mu$  broad, 20  $\mu$  long, epiphytic on algae.

**Family : Cocconidaceae Kuetzing**

**Genus : *Cocconies* Ehrenberg**

***Cocconies pediculus* Ehrenberg**

Frustules ovoid to elliptical, with marginal bend, lanceolate outline, rounded end, striation not visible in fresh material, frustule 10-17  $\mu$  broad, 20-25  $\mu$  long.

**Order : Fragilariales Silva sensu emend.**

**Family : Fragilariaceae Greville**

**Genus : *Fragilaria* Lyngbye**

***Fragilaria construens* var. *venter* (Ehr.) Grun.**

Cell rectangular in girdle view and usually united in free floating, frustules linear, attached together to form chain, valve linear lanceolate, pseudoraphe narrow, striae 14-16 in 10 µm, strong, frustule 2.9-3.0 µ broad, 12.0-14.5 µ long.

**Genus : *Synendra* Ehrenberg**

***Synendra dorsiventralis* O. Muell.**

Valve linear with slightly concave margin and attenuated rostrate apices; pseudiraphe linear, distinct, central area excentric, reaching the margins only on one side, striae parallel throughout, 8-10 in 10 µm, frustule 5-19 µ broad, 70-90 µ long.

**Order: Licmophorales Round**

**Family: Ulnariaceae Kutzing**

**Genus : *Ctenophora* Kutzing**

***Ctenophora pulchella* (Ralfs ex Kutzing) D.M. Williams & Round**

Elongated frustules, with truncate apices, valve surface striate, striae transverse, punctuate, striae 12-13 in 10 µm, frustule 10-14 µ broad, 150-170 µ long.

**Order : Bacillariales Hendey**

**Family : Bacillariaceae Ehrenberg**

**Genus : *Nitzschia* Hassal**

***Nitzschia acicularis* W. Smith.**

Frustule small, needle like extremities, presence of rapidity in movement. Valve long, linear with parallel margins and broadly cuneate, slightly constricted rounded apices, striae very fine, lineate, delicate parallel throughout the valve, frustule 4.5 µ broad, 65-70 µ long.

***Nitzschia obtusa* Wm. Smith**

Valve 65 µ long, 9 µ broad; carinal dots 7 in 10 µ in diameter, frustule 9 µ broad, 65 µ long.

***Nitzschia palea* (Kutz.) W. Smith**

Frustule small, valve linear, lanceolate with obtuse apices, striae 8-9 in 10 µ, frustule 7-10 µ broad, 22-38 µ long.

***Nitzschia hantzschiana* Rabenh.**

Valve linear narrow, lanceolate with rostrate apices, striae 23-24 in 10 µm, raphe marginal, valve surface finely striate, frustule 4-6 µ broad, 45-55 µ long.

**Genus: *Hantzschia* Grun.**

***Hantzschia amphioxys* (Ehr.) Grun.**

Valves somewhat arcuate, linear, strongly narrowed, constricted and produced towards the ends, keel excentric with small keel punctae. striae 16 to 18 in 10 µm, frustule 6.7-8.5 µ broad, 35-47 µ long.

**Order : Thalassiosirales Glezer & Makarova**

**Family : Stephanodiscaceae Glezer & Makarova**

**Genus : *Cyclotella* Kutzing**

***Cyclotella bodanica* Eulenstein ex Grunow**

Marginal zone with 11 striae in 10 µ, finely lineate, 2-3 isolated puncta in 10 µ, intermediate zone covered by irregular rows of puncta, central zone covered with sparse puncta, frustule 23 µ Diameter.

***Cyclotella kutzingiana* Thwaites**

Central area with punctae or short lines, Width of frustules 7.2-8.6 µ.

***Cyclotella meneghiniana* Kütz.**

Valves 15 to 23 µ in diameter, 14 striae in 10 µm. Outer zone broad; central zone smooth or finely radially punctuate, frustule 15-23 µ diameter.

## Discussion

In Bacillariophyceae, algae of Thalassiosiphysales, Naviculales, Cymbellales, Achnanthes, Fragilariales, Licmophorales, Bacillariales and Thalassiosirales orders were observed. Order Thalassiosiphysales was observed to be represented by two species of a single genera (*Amphora*), Naviculales by 10 species of 3 genera, Cymbellales by 13 species of 2 genera, Achnanthes by 2 species of 2 genera, Fragilariales by 2 species of 2 genera, Licmophorales by 1 species of 1 genera, Bacillariales by 5 species of 2 genera and Thalassiosirales by 3 species of a single genera. On the basis of data recorded in table 1, it is apparent that Bacillariophyceae exhibited fluctuation in the number of species in different water bodies. It was also observed that Natho Pond showed a single peak of maximum Bacillariophycean diversity.

Maximum diatom species were reported as planktonic form. *Amphora ovalis*, *Navicula elegans*, *Navicula exigua*, *Cymbella cistula*, *Cymbella kappi*, *Fragilaria construens*, var. *venter*, *Nitzschia hantzschiana*, *Cyclotella bodanica* and *Cyclotella kutzingiana* were observed as epiphytic on plants. Some species of diatom were found

on the habitat of moist soil. Some are observed on moist rocks, dead decaying contents or in small stagnant water bodies. *Gomphonema montanum* var. *genuinum*, *Gomphonema clavatooides* and *Achnanthes microcephala* diatoms were reported as epiphytic on some algal species.

**Table – 1 Bacillariophycan Algae Observed from Various Habitats of the Different Ponds of Churu Region, During 2013-2014.**

Name of the species	Habitat
<b>BACILLARIOPHYCEAE</b>	
<b>Order: Thalassiophyceales D. G. Mann</b>	
<b>Family : Catenulaceae Mereschkowsky</b>	
<i>Amphora ovalis</i> Kutz.	P, E <sub>P</sub> , R
<i>Amphora turgida</i> Gregory	P, R
<b>Order : Naviculales Bessey sensu emend.</b>	
<b>Family : Naviculaceae Kuetzing</b>	
<i>Navicula elegans</i> Wm. Smith	E <sub>P</sub> , R
<i>Navicula cuspidata</i> Kutz.	P
<i>Navicula exigua</i> (Greg.) Grun.	E <sub>P</sub> , R
<i>Navicula radiosa</i> Kütz.	P, R
<i>Navicula protracta</i> (Grunow) Cleve	R, A
<i>Navicula amphirhynchus</i> Ehrenberg	A
<i>Navicula semilunum</i> Grun.	P
<i>Gyrosigma acuminatum</i> (Kutz.) Rabh.	S
<i>Gyrosigma scalproides</i> (Rabh.) Cleve	P, S
<b>Family: Diadesmidaceae D. G. Mann</b>	
<i>Diadesmis confervacea</i> Kuetzing	P, R
<b>Order: Cymbellales D. G. Mann</b>	
<b>Family : Gomphonemataceae Kuetzing</b>	
<i>Gomphonema parvulum</i> (Kutz.) Grun.	R, A
<i>Gomphonema lanceolatum</i> Ehr.	P, S
<i>Gomphonema gracile</i> var. <i>lanceolatum</i> (Kutz.) Cleve	P, R, S
<i>Gomphonema montanum</i> var. <i>genuinum</i> Mayer	P, E <sub>A</sub>
<i>Gomphonema subclavatum</i> Grunn.	P, R, S,
<i>Gomphonema olivaceum</i> (Lyngbye) Kuetzing	P, S
<i>Gomphonema clavatooides</i> sp. nov.	P, E <sub>A</sub>
<i>Gomphonema gracile</i> Ehrenberg	P, S <sub>W</sub>
<i>Gomphonema telographicum</i> Kuetzing	P, S
<b>Family : Cymbellaceae Greville</b>	
<i>Cymbella tumida</i> (Breb.) Van Heurck.	P
<i>Cymbella affinis</i> Kuetzing	P, R
<i>Cymbella cistula</i> (Ehr) Kirchn.	P, R, E <sub>P</sub>
<i>Cymbella kappi</i> Cholnoky	P, S, E <sub>P</sub>
<b>Order : Achnanthes P. C. Silva</b>	
<b>Family : Achnantheaceae Kuetzing</b>	
<i>Achnanthes microcephala</i> (Kutz) Grun.	P, E <sub>A</sub> , R
<b>Family : Cocconiedaceae Kuetzing</b>	
<i>Cocconies pediculus</i> Ehrenberg	P, S
<b>Order : Fragilariiales Silva sensu emend.</b>	
<b>Family : Fragilariaceae Greville</b>	
<i>Fragilaria construens</i> var. <i>venter</i> (Ehr.) Grun.	P, R, E <sub>P</sub>
<i>Synendra dorsiventralis</i> O. Muell.	P, R
<b>Order: Licmophorales Round</b>	
<b>Family: Ulnariaceae Kuetzing</b>	
<i>Ctenophora pulchella</i> (Ralfs ex Kuetzing) D.M. Williams & Round P, A	
<b>Order : Bacillariales Hendey</b>	
<b>Family : Bacillariaceae Ehrenberg</b>	
<i>Nitzschia acicularis</i> W. Smith.	P, S <sub>W</sub>
<i>Nitzschia obtusa</i> Wm. Smith	P, R
<i>Nitzschia palea</i> (Kutz.) W. Smith	P
<i>Nitzschia hantzschiana</i> Rabenh.	R, E <sub>P</sub>
<i>Hantzschia amphioxys</i> (Ehr.) Grun.	R
<b>Order : Thalassiosirales Glezer &amp; Makarova</b>	
<b>Family : Stephanodiscaceae Glezer &amp; Makarova</b>	
<i>Cyclotella bodanica</i> Eulenstein ex Grunow	P, E <sub>P</sub> , R, S
<i>Cyclotella kutziangiana</i> Thwaites	P, E <sub>P</sub> , R
<i>Cyclotella meneghiniana</i> Kütz.	P, R, S

**Habitat Abbreviations:** P- Planktonic; E<sub>A</sub>-Epiphytic on algae; E<sub>P</sub>-Epiphytic on plants; R- On moist rocks or stones; S- Moist soil; S<sub>W</sub>- Small stagnant water bodies; A- Attach on dead or decaying contents

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