

*Full Length Research Paper*

# Some fresh water diatoms of Galta kund, Jaipur, India

Rashmi Pareek<sup>1</sup>, Gajandra Pal Singh<sup>1</sup> and Rajesh Singh<sup>2</sup>

<sup>1</sup>Algal Biotech Laboratory, Department of Botany, University of Rajasthan, Jaipur. India.

<sup>2</sup>Biology Division, Forensic Science Laboratory, Jaipur, India.

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In the present study, fresh water diatoms of Galta kund, Jaipur were investigated between October 2009 and September 2010. Twenty Four species of diatoms were identified from Galta Kund. These species belong to eleven genera namely: *Cyclotella* (2), *Melosira* (2), *Navicula* (4), *Achnanthes* (2), *Amphora* (1), *Synedra* (2), *Nitzschia* (5), *Gomphonema* (3), *Hantzschia* (1), *Pinnularia* (1) and *Fragillaria* (1). Diversity indices Shannon-Wiener diversity index (H'), Evenness index (J') and Berger Parker Dominance (D<sub>BP</sub>) were calculated. This study concludes that the diatoms attains maximum growth during the winter season and gradually declines in summer to reach its minimum during the rainy season.

**Key words:** Algae, diatoms, Galta Kund, Rajasthan.

## INTRODUCTION

Galta ji "Temple of the Sun God" is a pretty little pilgrim spot where one sage Galav is supposed to have lived and meditated. There are some springs and natural reservoirs (Kunds) around the Galta temple. Galta Kund is situated between latitude 72°52'15" and longitude 26°55'15" occupying an area of 530.3 sq kms surrounded by Aravali hills having height above mean sea level from 569 to 597 m. Galta Kund is the place where the devotees take holy dips on many festivals and during these days maximum drowning cases happens. Thus this work is done to generate an extensive reference database of diatoms which can help in diagnosis of drowning cases. The first investigation on diatoms in Rajasthan was made by Gandhi (1955). After a gap, studies on diatoms were done by Trivedi (1982), Jakher et al. (1990), Dadheech et al. (2000), Singh et al. (2006), Kumar et al. (2008, 2009) and Singh et al. (2010). In India major contribution has been made by Desikachary (1954), Gandhi (1955), Zahamensky (1973), Sarode and Kamat (1984) and Tarar and Bodhke (1998), Bhagat (2002), Mishra and Mishra (2002), Mishra (2006) and, Patil and Kumawat (2007).

## MATERIALS AND METHODS

Fortnight sampling was carried out from September 2009 to

September 2010 at selected sites of Galta Kund. Collections were made using a planktonic mesh net (pore size 40 µm) and were preserved in Lugol's solution. Detailed diatom study were done using Hot HCl and KMnO<sub>4</sub> method (recommended technique of acid digestion) (Taylor et al., 2005). Qualitative analyses of diatoms were done by studying 5 to 10 slides under the Nikon Labophot-II microscope with H-III photo micrographic attachment. To estimate the diatom diversity, these monographs were used: Gandhi (1955), Husted (1959), Patrick and Reimer (1966), Prescott (1975), Desikachary (1989), Round (1990), Nautiyal et al. (1996) and Anand (1998). Quantitative estimation was done using "Sedgwick Rafter" Counting chamber.

## Statistical analysis

Diversity indices like Shannon-Weiner index of diversity (H'), evenness index (J') and Berger-Parker index of dominance (D<sub>BP</sub>) were worked out by the software Biodiversity Professional version 2.0.

## RESULTS

Monthly variation of different species of diatoms, diversity indices and diatom count is represented in Tables 1 and 2. Description of various species found in Galta Kund during study period is as follows: (Figures 1 and 2).

### *Cyclotella meneghiniana* Kütz

Valves discoid, margins strong, striae thick and coarse,

\*Corresponding author. E-mail: rashmijpr@yahoo.com.

**Table 1.** Monthly variation of diatoms in Galta Kund during October 2009 to September 2010.

Diatom genera	Diatom spp	October	November	December	January	February	March	April	May	June	July	August	September
<i>Cyclotella</i>	<i>C. meneghiniana</i>	R	R	-	A	A	-	-				C	C
	<i>C. striata</i>	-	-	C	A	A	-	-	-	P	-	-	-
<i>Melosira</i>	<i>M. varians</i>	R	-	R	A	R	-	P	-	P	-	-	C
	<i>M. granulata</i>	P	-	C	R	C	-	R	C	R		-	R
<i>Achanthes</i>	<i>A. andicola</i>	P	P	C	A	R	-	-	R	C	-	C	P
	<i>A. exigua</i>	-	-	P	P	-	-	-	R	P	-	R	P
<i>Synedra</i>	<i>S. rumpems</i>	R	-	C	A	C	R	R	-	-	-	C	C
	<i>S. ulna</i>	C	C	A	A	C	-	-	-	R	R	C	C
<i>Fragillaria</i>	<i>F. intermedia</i>	-	R	R	A	C	R	R	-	-	-	-	P
<i>Amphora</i>	<i>A. Ovalis</i>	-	-	R	P	-	-	P	-	-	-	P	-
<i>Hantzschia</i>	<i>H. amphioxys</i>	-	P	-	C	-	-	P	-	P	-	-	-
<i>Pinnularia</i>	<i>P. macra</i>	-	-	P	-	-	P	-	-	-	-	P	-
<i>Gomphonema</i>	<i>G. lanceolatum</i>	C	C	C	A	A	A	R	C	-	-	C	C
	<i>G. parvulum</i>	C	A	A	A	A	-	C	C	-	P	P	P
	<i>G. clavatooides</i>	R	C	C	C	A	A	C	P	P	-	-	-
<i>Navicula</i>	<i>N. cuspidata</i>	R	-	C	C	-	R	C	P	P	-	-	-
	<i>N. radiosa</i>	C	C	A	A	C	R	P	P	-	-	C	C
	<i>N. mutica</i>	-	-	C	C	R	-	-	-	P	P	-	-
	<i>N. viridula</i>	-	-	P	P	-	-	-	-	P	-	-	-
<i>Nitzschia</i>	<i>N. amphibia</i>	C	C	A	A	A	C	R	-	-	P	P	-
	<i>N. palea</i>	P	C	C	A	A	C	P	P	-	-	C	C
	<i>N. thermalis</i>	P	P	R	R	A	-	-	-	-	P	R	R
	<i>N. commutata</i>	-	-	P	R	R	-	-	-	R	-	-	-
	<i>N. linearis</i>	P	P	C	C	R	-	-	-	-	R	R	-

Abbreviations used: A = Abundant = above 70%; C = common = 40 to 70%; R = rare = 10 to 40%; P = Present to minimum = below 10% of total diatoms present.

**Table 2.** Monthly Variation of diversity indices of diatoms of Galta Kund during October 2009 to September 2010.

Diversity indices	October	November	December	January	February	March	April	May	June	July	August	September
Shannon - Wiener diversity index (H')	0.26	0.58	0.19	0.40	0.31	0.44	<b>0.18</b>	<b>0.70</b>	0.60	0.49	0.58	0.57
Evenness index (J')	0.25	0.56	0.18	0.38	0.29	0.42	0.18	0.67	0.58	0.47	0.55	1.04
Berger- Parker index of dominance (D <sub>BP</sub> )	0.84	0.60	0.92	0.66	0.81	0.49	0.89	0.49	0.54	0.52	0.42	0.42
Diatom count per liter	543500	122100	208300	1620100	642200	537700	71000	28800	55100	155100	203404	245678

wedge shaped and radially placed. Central portion with extremely fine puncta. Diameter of the cell is 15 to 22  $\mu$ , Striae 5 to 10 in 10  $\mu$ , (Gandhi, 1952: 120), (Figure 1b).

#### ***Cyclotella striata* (Kütz) Grun**

Cell disc shaped. Valves with strong wavy margins in the girdle view and more or less broad, evenly striated border, coarse punctae. Diameter of the cell 19.8 to 31.2  $\mu$ . Striae 7 to 8 in 10  $\mu$ , (Gandhi, 1952: 121), (Figure 1a).

#### ***Melosira granulata* (Ehr) Ralfs**

Frustules cylindrical, united in chains. Mantle line straight. Surface of the Mantle punctate with puncta in spiral rows. Diameter of the cell 6 to 12  $\mu$ . Height of half cell 8 to 15  $\mu$ . (Gandhi, 1952: 119), (Figure 1g).

#### ***Melosira varians* Ag.**

Frustules cylindrical and united in chains. Diameter of the cell is 12 to 15  $\mu$ . Height of half

cell 10 to 12  $\mu$ . (Misra et al., 2009: 96), (Figure 1f).

#### ***Navicula cuspidata* Kütz.**

Valves rhombic-lanceolate with abruptly narrowed, constricted, much produced capitate ends. Raphe thin and straight. Axial area narrow, linear, slightly widened in the middle. Length 75 to 82  $\mu$ , breadth 20 to 25  $\mu$ . (Gandhi, 1955: 317), (Figure 1h).

#### ***Navicula radiosa* Kütz.**

Valves narrowly lanceolate and gradually tapering to acute rounded ends. Raphe thin and straight. Axial area narrow, linear, central area large, obliquely rectangular. Length is 40 to 52  $\mu$ . Breadth 7 to 7.7  $\mu$ , (Gandhi, 1955: 321), (Figure 1i).

#### ***Navicula mutica* Kütz.**

Valves elliptical-lanceolate with broadly rounded ends. Raphe thin and straight. Axial area narrow. Central area somewhat widened towards the

margins. Length is 11 to 14.5  $\mu$ . Breadth 4.5 to 6.7  $\mu$ . (Gandhi, 1956: 405), (Figures 1j).

#### ***Navicula viridula* Kütz.**

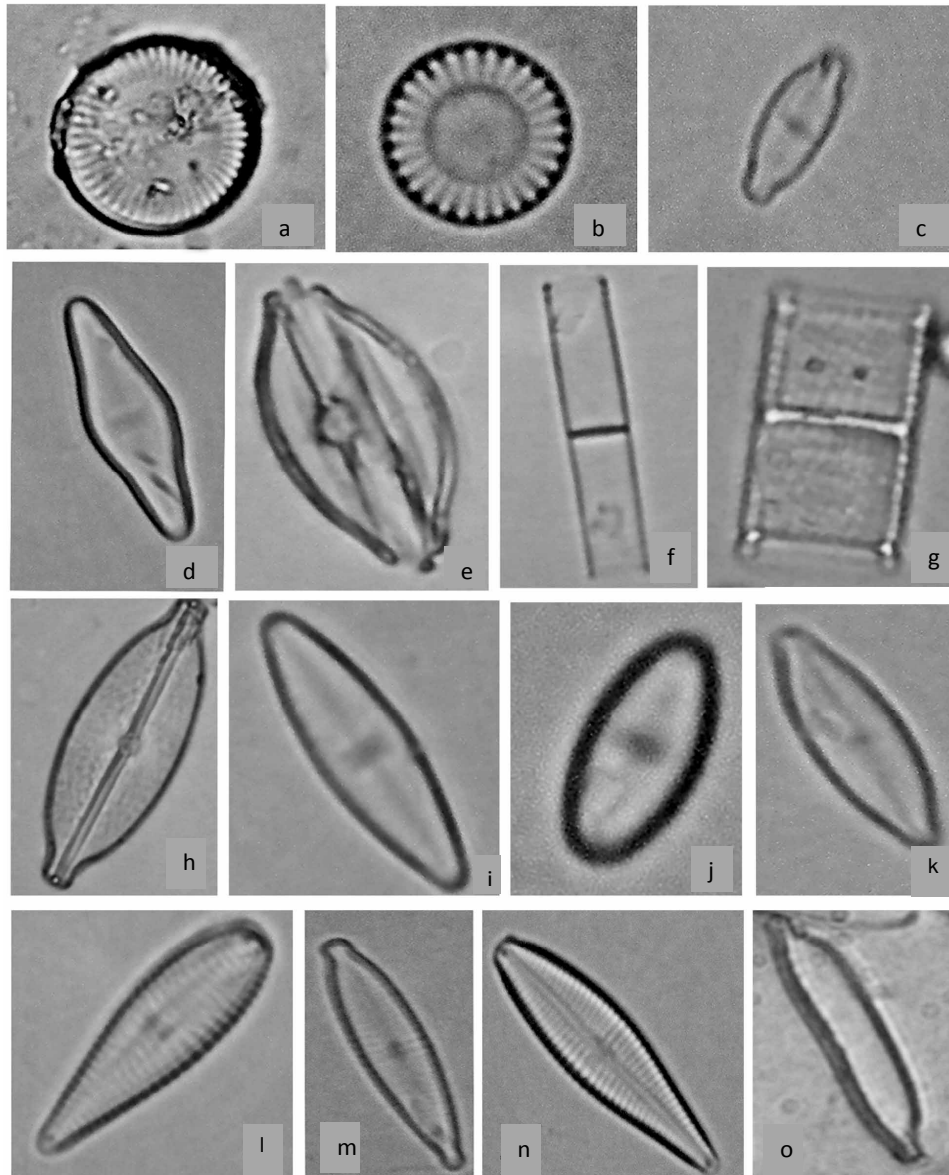
Valves linear-lanceolate with produced and broadly rounded ends. Axial area narrow, central area wide and sub orbicular. Length is 65 to 77  $\mu$ . Breadth 12 to 14.5  $\mu$ . (Gandhi, 1954: 347), (Figure 1k).

#### ***Achnanthes andicola* (Cleve) Hust.**

Valves linear-lanceolate in outline, gibbous in the middle. Ends obtusely rounded. Valve with raphe has straight raphe with distinct central pores. Axial area narrow and linear. Central area broad reaching the side walls. Length-42 to 49.5  $\mu$ . Breadth 9.5 to 10.9  $\mu$ . (Gandhi 1952: 142), (Figure 1d).

#### ***Achnanthes exigua* Grun.**

Valves rectangular-elliptical to almost quadrate in the middle portion, constricted at the ends which



**Figure 1.** a) *Cyclotella striata* (Kütz) Grun. b) *Cyclotella meneghiniana* Kütz. c) *Achnanthes exigua* Grun. d) *Achnanthes andicola* (cleve) Hust. e) *Amphora ovalis* Kütz. f) *Melosira varians* Ag. g) *Melosira granulata* (Ehr) Ralfs. h) *Navicula cuspidata* Kütz. i) *Navicula radiosa* Kütz. j) *Navicula mutica* Kütz. k) *Navicula viridula* Kütz. l) *Gomphonema clavatooides* sp. nov. m) *Gomphonema parvulum* (Kütz) Grun. n) *Gomphonema lanceolatum* Her and o) *Hantzschia amphioxys* (Ehr) Grun.

are rostrate. Axial area narrow and central area linear reaching the margins. Length 12 to 15  $\mu$ , breadth 4.5 to 7  $\mu$ . (Gandhi, 1952: 143), (Figure 1c).

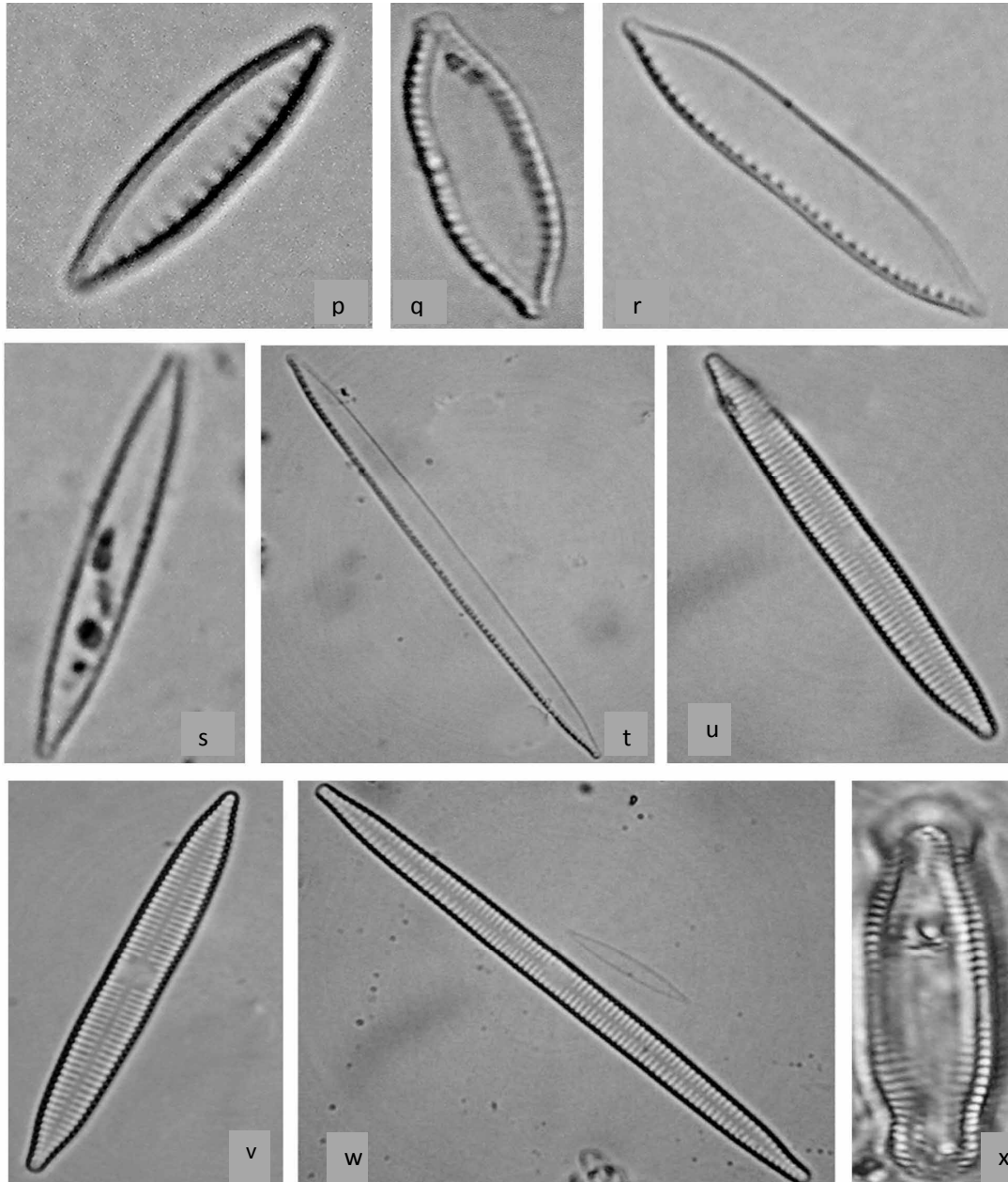
#### ***Amphora ovalis* Kütz**

Frustules broadly elliptical with truncate. Rounded ends in the girdle view. Valves lunate with highly convex dorsal and straight or slightly concave ventral side, ends broad,

rounded, raphe thin and slightly arcuate. Axial area narrow, central area very large, reaching the ventral side. Length 9 to 18  $\mu$ . Breadth 7.5 to 11.2  $\mu$  (Gandhi, 1955: 325) (Figure 1e).

#### ***Synedra rumpens* Kütz**

Valves linear with narrow and capitate ends. The central area reaches the margins. Pseudo raphe linear and



**Figure 2.** p) *Nitzschia amphibia* Grun. q) *Nitzschia thermalis* Kütz. r) *Nitzschia commutata* Grun. s) *Nitzschia palea* Kütz. t) *Nitzschia linearis* W Sm. u) *Fragilaria intermedia* Grun. v) *Synedra rumpens* Kütz. w) *Synedra rumpens* Kütz. x) *Pinnularia macra* Gandhi.

broad. Striae strong and distantly placed. Length 45 to 44  $\mu$ , breadth 3 to 3.7  $\mu$ . Striae 12 in 10  $\mu$ . (Gandhi, 1952: 129), (Figure 2u).

***Synedra ulna* (Nitz) Ehr.**

Valves linear to linear lanceolate and tapering at the poles. Ends rounded pseudoraphe linear. Central area absent. Striae coarse. Length 95 to 156  $\mu$ , Breadth 6.5 to

7 to 9  $\mu$ . Striae 9 to 11 in 10  $\mu$ . (Gandhi, 1952: 309), (Figure 2v).

***Nitzschia amphibia* Grun.**

Frustules small, rectangular in the girdle view, valves linear to linear lanceolate, with slightly constricted, shortly wedge shaped, acute rounded ends. Keel excentric with large, squarish keel punctae. Striae strong with coarse

punctae. Length 23 to 37.5  $\mu$ , breadth 3.8 to 5.7  $\mu$ , Striae 12 to 19 in 10  $\mu$  and punctae-19-24 in 10  $\mu$ . (Gandhi, 1955: 331), (Figure 2o).

#### ***Nitzschia palea* Kütz**

Frustule narrowly linear with slightly narrowed truncate ends in the girdle view. Valves linear – sublanceolate with narrowed, constricted feebly capitate ends. Keel excentric, keel punctae small. Striae fine and almost indistinct. Length 17 to 28  $\mu$ , breadth 2.5 to 4, striae 30 to 35 in 10  $\mu$  and punctae 12 to 15 in 10  $\mu$  (Gandhi, 1956: 407), (Figures 2s).

#### ***Nitzschia thermalis* Kütz**

Valves linear with concave sides and wedge shaped, constricted produced ends, keel excentric, keel punctae very small, striae very fine, almost indistinct. Length 28 to 31  $\mu$ , breadth 5 to 6.9  $\mu$ , striae 32 to 36 in 10  $\mu$ . (Gandhi, 1956: 407), (Figure 2p).

#### ***Nitzschia commutata* Grun**

Valves linear, concave in the middle with wedge shaped, constricted, shortly capitate ends. Keel excentric, keel puncta distinct. Striae fine. Length 44 to 48  $\mu$ . Breadth 7 to 7.8  $\mu$ . (Gandhi, 1958: 504), (Figure 2r).

#### ***Nitzschia linearis* W Sm.**

Frustules linear to linear-lanceolate in the girdle view with gradually narrowed truncate ends. Valves linear, keel excentric, keel punctae small, two middle ones set apart, striae fine, indistinct, length 35 to 78.5  $\mu$ , breadth 4.5 to 6.4  $\mu$ , Striae 32 to 35 in 10  $\mu$ . Keel punctae 11 to 14 in 10  $\mu$  (Gandhi, 1961: 482).

#### ***Gomphonema lanceolatum* Ehr**

Valves broadly lanceolate-clavate with acute ends, raphe thick with unilaterally bent central pores. Axial area moderate, linear; central area unilateral with an isolated stigma on the opposite side, striae radial, in the centre shortened. Length is 35 to 47  $\mu$ , breadth 9.5 to 10.4  $\mu$ . Striae 8 to 10 in 10  $\mu$  (Gandhi, 1955: 328), (Figure 1n).

#### ***Gomphonema parvulum* (Kütz) Grun**

Valves lanceolate-clavate with short, constricted, produced, rounded ends. Raphe thin and straight. Axial area very narrow, central area unilateral. Striae radial. Length 22 to 25  $\mu$ , breadth 6 to 6.9  $\mu$ , striae 12 to 14 in 10  $\mu$  (Gandhi, 1955: 327), (Figure 1m).

#### ***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. Length 27 to 35  $\mu$ , breadth 6.8 to 8.9  $\mu$ , striae 7 to 9 in 10  $\mu$  (Gandhi, 1960: 112), (Figures 1l).

#### ***Hantzschia amphioxys* (Ehr) Grun**

Valves somewhat arcuate, linear, strongly narrowed, constricted and produced towards the ends, keel excentric with small keel punctae. Length 35 to 47  $\mu$ , breadth 6.7 to 8.5  $\mu$ , striae 16 to 18 in 10  $\mu$  (Gandhi, 1961: 472), (Figure 1o).

#### ***Pinnularia macra* Gandhi.**

Valves linear with capitate ends. Striae radial in the middle and convergent towards ends. Length 20 to 24.5  $\mu$ , breadth 2.8 to 3.4  $\mu$ , striae 14 to 15 in 10  $\mu$  (Gandhi, 1999: 226), (Figures 2w).

#### ***Fragilaria intermedia* Grun**

Valves linear with constricted produced or slightly capitate ends. Central area unilateral. Length 54 to 78  $\mu$ , breadth 6.5 to 7  $\mu$ , striae 10 to 12 in 10  $\mu$ . (Gandhi, 1957b: 46), (Figure 2t).

## **DISCUSSION**

In the present study, 24 diatom taxa under 11 genera were enumerated from Galta Kund of Jaipur, Rajasthan. Among them *Nitzschia*, *Gomphonema*, *Achnanthes*, *Amphora* and *Hantzschia* were reported from the first time from the study area. Monthly distribution of diatoms shown in Table 1 reveals that most of the species were abundant in the month of December and January while in the month of June and July most of the species were rare or present in minimum number. Table 2 depict Shannon-Wiener Diversity Index was highest in the month of May and lowest in April. Evenness ranges from 0.18 to 1.04 and Berger- Parker index of dominance was highest in the month of December and lowest in the month of August and September. It is reported that species diversity implies both richness and evenness in the number of species and equitability for the distribution of individual among the species (Vadrucci et al., 2007; Rajagopal et al., 2009). Data of diatom count reveals that diatom growth is maximum in the month of January (winter season), declines gradually and shows its lowest value in the month of May (rainy season).

Philipose (1960) also reported diatom peaks in winter. Karikal (1995) reported maximum population of bacillariophyceae during winter season. Low count of diatom in monsoon is attributed to rainfall which dilutes the water and disturbs the structure and composition of aquatic ecosystem. The disturbance influenced by high flow of water on aquatic life is also been studied by several workers (Stevenson et al., 1996; Biggs et al., 1998).

## Conclusion

The present basic information of the diatom database, distribution and diversity would form a useful tool for further ecological assessment and monitoring of the Kund.

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