



TAXANOMIC STUDIES ON CYMBELLA SPECIES IN TWO LAKES OF HYDERABAD

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ABSTRACT - The paper deals with the taxonomy of various *Cymbella* species present in lakes of Osmansagar and Himayatsagar during July 2010 to Dec 2011. The species shows high diversity in its species composition and distributed widely. Most of the species are freshwater, prefers Low temperature high dissolved oxygen high SiO₂ favoured the luxuriant growth in both the lakes. A total of 21 species of *Cymbella* were identified and are described for the first time from these areas. The diversity and distribution of *Cymbella* indicates nature and quality of water.

KEYWORDS: Osmansagar lake, Himayatsagar lake, Taxonomy, Morphology, *Cymbella* and Species.

I. INTRODUCTION

Diatoms were one of the most abundant and diversified groups of phytoplankton found in both oligotrophic and eutrophic waters. The paper deals with the Diatoms of the Oligotrophic lakes, specially on genus *Cymbella* (Bacillariophyceae) which showed a great species diversity. The *Cymbella* genus is well known both from taxonomical and ecological points of view. Extensive limnological studies were made to know different distribution patterns of diatoms in fresh waters by Pulla Reddy (2004), Singh *et al.* (2006), Mishra *et al.* (2007), Anil Kumar (2008), Dhande and Jawale (2009), Anand Kumar Srivastava (2010), Verma (2011), Bhojar and Tamloorkar (2012). The genus *Cymbella* showed wide morphological variations, in view of that the present work were under taken to present the comprehensive data of *cymbella* species. The present study presents information of several *Cymbella* species and varieties recorded in the both lakes. The keys of Krammer & Lange-Bertalot (1997); Krammer (2002), Hofmann *et al.* (2011) and Lange-Bertalot & Metzeltin (1996) were used for determining of the taxa.

II. MATERIAL AND METHODS

Qualitative studies of Bacillariophyceae were carried out in the Department of Botany, Osmania university. The samples were collected in regular intervals. The samples were preserved in Phycology Lab, Dept. Botany(ADL-101). Surface water samples were collected from different stations of both the lakes and were kept in the sedimentation column after adding 2-3 ml of 4% formaldehyde solution. The samples were kept undisturbed for about one month for complete settling of the organisms. The samples were concentrated to 100 ml. Finally, the concentrated material was used for frequency measurements and identification of species, the drop method of Pearsal *et al.*, (1946) was followed. Microphotograph of each specimen was taken using American optical binocular research microscope fitted with Cat com digital image camera. The organisms were identified by following different monographs. (Prescott, 1961; Suxena and Venkateswarlu, 1966). Taxonomical description of taxa were determined on the basis of morphological features Cell dimensions given in description concern the relations: width x length. All observations were made using light microscopy under oil immersion (with focus level 15x X 100).

Osman Sagar popularly known as Gandipet was created to serve as drinking water reservoir for Hyderabad. The lake is around 46 km², and the reservoir is around 29 km², with total level of 1790 feet. Himayatsagar is one among the beautiful lakes located about 20 km from Hyderabad. Both the lakes were constructed for providing drinking water source for Hyderabad, and also saving the city from floods, which Hyderabad suffered in 1908.

III. RESULT AND DISCUSSION

During the period of study, the phytoplankton of lakes was dominated by Diatoms. Among the Bacillariophyceae, *Cymbella* species reached a strong quantitative predominance. A special species richness was observed in the genus *Cymbella* in both the lakes but *Cymbella* species were more in Himayatsagar lake. The genus derived from *Cymbella* C. Agardh (1830) and was described to accommodate a series of small to moderately large freshwater species. The genus *Cymbella* which occur naturally in fresh water environments, Many species of these diatoms have been described as biological indicators of freshwater. Among worldwide distributed taxa, several varieties of *Cymbella* *cymbiformis*, *C.aspera*, *C.turgida*, *C.affinis* and *C.ventricosa* could be dominant in Oligotrophic reservoirs.

We determined many of freshwater, commonly distributed taxa, i.e *C. cymbiformis* var. *unipunctata*, *C.turgida* var.*maxima*, *C.tumidula* var.*genuina*, *C.ventricosa* var.*genuine*. Abundance of all the *Cymbella* species were recorded in both lakes during winter season. The analysis of these samples showed that the genus *Cymbella* is very well represented in two lakes. The species observed in both the lake belong to unpolluted water organisms. Phycological data analyzed in the Himayat sagar and Osman sagar lakes, indicate that the water bodies are free from pollution and the quality of water is good.

The result of our observations are presented below:

***Cymbella affinis* Kutz. (Plate:1 , Fig: 1)**

Valves are strongly dorsi-ventral, with subrostrate to rostrate apices. The dorsal margin is strongly arched, whereas the ventral margin is slightly convex or flat, often excised. The axial area is narrow, linear. The central area is very small or not distinct. One stigma is present at the end of the middle striae. The proximal raphe ends have central pores that curve to the ventral side. The raphe is lateral, becoming filiform near the distal end. Striae are slightly radiate. The areolae number 25-30 in 10µm. Length 19-36µm, Width 6.9-9.0µm, Striae in 10µm 9-12 in the center valve, 13-14 at the ends. Distribution fresh water.

***Cymbella.aspera* (E.) Cl var. *minor*(Plate: 1, Fig: 2a)**

***Cymbella aspera* (Ehrenb.) Cleve (Plate: 1, Fig: 2)**

Valves are dorsi-ventral, with rounded apices. The dorsal margin is distinctly arched and the ventral margin is slightly concave, with a gibbous middle portion. The central area is only slightly wider than the axial area. The central area is asymmetric, rounded on the dorsal side and nearly flat on the ventral side. The ventral side of the central area is bordered by irregularly spaced areolae. Stigma or stigmata are absent. The raphe is narrow near the proximal ends and is deflected slightly toward the ventral margin. The proximal raphe ends are expanded. Terminal raphe fissures are sickle-shaped and deflected dorsally. Striae are radiate throughout. Areolae are distinct and number 9-11 in 10µm. Length 112.0-221.2µm, Width 25.2-38.5 µm, Striae in 10µm 7-9 at the valve center, 10-11 near the apices. Distribution freshwater.

***C. austriaca* GRUN var *subrhomboidea* (OSTR) (Plate: 1, Fig: 3)**

***C. austriaca. reducta* (GRUN) (Plate: 1, Fig: 3a)**

***Cymbella austriaca* (Grunow) Krammer**

Valves are dorsi-ventral and broadly linear-lanceolate to elliptic-lanceolate with an arcuate dorsal margin and slightly convex ventral margin. Apices are obtusely rounded. The axial area is ventrally displaced and rather straight and broad, expanding towards a somewhat wider central area and together forming a narrow lanceolate shape running the length of the valve. Raphe branches are strongly lateral but become filiform near the distal ends and strongly reverse-lateral near the proximal ends. Proximal raphe ends are slightly expanded. Terminal raphe fissures are comma-shaped and deflected dorsally. Striae are radiate in the middle and become curved and more strongly radiate towards the apices; in the largest specimens, striae are parallel and wavy near the apices. Striae and areolae are more widely spaced on the dorsal side than on the ventral side. Areolae number 20-26 (dorsal) and 24-28 (ventral) in 10 µm. Length 54-107µm, Width 14.2-19.6µm, Striae in 10 µm center: 9-10 (dorsal), 11-12 (ventral); 13-15 ends. Distribution freshwater.

***C. Cymbiformis* KZ. var *longa* NACH (Plate: 1, Fig: 4c)**

***Cymbella cymbiformis* C.Agardh (Plate: 1, Fig: 4)**

Valves are lanceolate and dorsiventral with bluntly rounded apices. The dorsal margin is moderately arched; the ventral margin is weakly concave with a slightly gibbous middle. The axial area is linear. The central area is small and elliptic, somewhat wider on the ventral side. The raphe is distinctly lateral, becoming reverse-lateral near the proximal ends. Proximal raphe ends are deflected ventrally and terminate with inflated pores. Terminal raphe fissures are deflected ventrally at about 45 degrees. Striae are widely spaced and nearly parallel at the valve center, becoming radiate near the apices. Areolae are distinct and widely spaced, numbering 14-17 in 10µm. Stigmata are variable in number. Usually there are 1 or 2 on the ventral side of the central nodule. Length 75.9-120.9µm, Width 17.0-20.1 µm, Striae in 10µm 6-9 at the valve center, up to 15 near the apices. Distribution freshwater.

***Cymbella cymbiformis* (Ag) Kutz var. *unipuncta* A.Cl (Plate: 1, Fig:4a)**

Valves sickle-shaped, asymmetrical, dorsal side convex, ventral side almost straight or concave and inflated in the middle, ends broadly rounded. Raphe arcuate and thick with ventrally bent central pores and dorsally directed terminal fissures. Axial area fairly wide; central area slightly enlarged with an isolated punctum on the ventral side at the end of the central striae. Length 46-65 µm, Width 11-13µm, Striae 8-10 in 10µm, radial, strong and lineate. Distribution freshwater.

***Cymbella cymbiformis* (Ag)Kutz var. *jimboi* (Pant) A.Cl (Plate: 1, Fig: 4b)**

Valves sickle- shaped more inflated in the middle on the ventral side than the type with broadly rounded ends. Central area with 2-3 coarse punctae on the ventral side. Length 55-75µm, Width 12-14µm, Striae 9-10 in 10µm radial and lineate. Distribution freshwater.

***Cymbella gracilis* (RABH) (Plate: 1, Fig: 5)**

Tapered valve, with dorsi-ventral asymmetry, on the convex dorsal side and on the right ventral side to weakly convex. Apex in finely rounded tip or subrostrate and very slightly oriented ventral side. Narrow longitudinal area, moderately displaced on the ventral side. Non-existent central area. Filiform raphe, with proximal ends curving dorsal side and ends curved distals on the ventral side. Streaks parallel to more or less radiant, which may become convergent at the ends in the ventral striations, and at the punctuation generally visible (24 to 28 areoles in 10 µm). Length 16 to 50 µm, Width 4.7 to 6.6µm and 12 to 15 streaks in 10 µm. Distribution freshwater.

***Cymbella helvetica* (Lange-Bertalot & Metzeltin) (Plate: 1, Fig: 6)**

Valve lanceolate with clear dorso-ventral asymmetry, at the dorsal edge more strongly convex than the ventral edge often more or less swollen in the center. Apex little or no differentiation from the valve body, more or less closely rounded. Narrow to moderately narrow longitudinal area. Central area absent on the dorsal side and sparse on the ventral side. Raphe sometimes slightly displaced on the ventral side, usually clearly oblique, becoming filiform near the proximal and distal endings. Finely punctate, slightly radiating, streaks becoming parallel to convergent to ends and punctuation visible in light microscopy (20 to 25 areoles in 10 µm). Length 33 to 67µm, Width 8 to 11µm - 9 to 11 streaks in 10µm. Distribution freshwater.

***Cymbella parva* (W.Sm.) Kirchn. (Plate: 1, Fig: 7)**

Valves are lanceolate and dorso-ventral with narrowly rounded, un-protracted apices. The dorsal margin is moderately arched; the ventral margin is slightly convex to nearly flat in the smallest specimens. The axial area arched and located ventral to the valve mid line. The central area is a slightly wider continuation of the axial area. Proximal raphe ends are reverse-lateral, deflected ventrally, and terminate with inflated pores. Terminal raphe fissures are deflected dorsally at about 45 degrees. Striae are slightly radiate at the valve center, becoming more strongly radiate near the apices. Areolae number 24-28 in 10µm. A single isolated stigma (occasionally 2) is located at the end of the median striae on the ventral side. Length 24.5-41.2µm, Width 6.9-8.9µm, Striae in 10 µm 10-12 at the valve center, up to 14 near the apices. Distribution freshwater.

***Cymbella tumida* (Brebisson ex Kutzing) (Plate: 2, Fig: 8)**

Dorso-ventral asymmetry valve, strongly convex dorsal side and ventral side slightly concave which may have a central bulge in large forms, completely straight in small children. Apex generally rostrate, sometimes just truncated and barely distinct from the valve body. Maximum length and width ratio around 4. Narrow and curved axial area, opening onto a very distinct central area, round to rhombic and the width equal to a third to half that of the valve. Raphe almost median, curved, slightly oblique, becoming threadlike near the endings distal and proximal. Proximal endings with a very clear central pore distal endings showing a short crack more or less at right angles, dorsal side. Central nodule carrying a strong stigma, ventral side. Strong streaks, markedly linear, well radiant in the center becoming slightly radiant at almost parallel, even convergent, at the ends and with the line clearly visible in light microscopy (14 to 19 lineoles in 10µm). Length 35 to 95µm, Width 16 to 22µm - 8 to 11 streaks in 10 µm in the center and 12 to 13 in 10µm at the ends. Distribution freshwater.

***Cymbella tumidula* Hustedt. (Plate: 2, Fig: 9)**

Valve with clear dorso-ventricular asymmetry, dorsal side moderately convex in the large individuals and strongly convex in the small ones, on the ventral side slightly convex or in half-rhombus. Apex slightly or not stretched and finely rounded. Maximum length and width ratio equal to 5.7. Narrow axial area in the smallest individuals, linear-lanceolate and tapering at the extremities in the medium and the great. Central area almost absent, resulting from shortening of some dorsal stripes around the central nodule and or their irregular arrangement. Striped sometimes slightly displaced ventral side, weakly oblique, becoming very slightly reverse oblique to proximal endings. Proximal terminations with very small pores centers and distal ends curved on the dorsal side. Presence of 2 to 4 stigmas (usually 2) just at the end of the central stripes on the ventral side. Radiant streaks in the middle part, becoming more prominent at the extremities and at the thin line (28 to 32 lines in 10µm). Features Length: 19 to 43µm, Width 6 to 8µm - 11 to 14 dorsal stripes in 10µm - up to 15 Ventral Striae 10µm at the center and up to 17 in 10µm at the ends. Distribution freshwater.

***Cymbella tumidula* var *genuina* A.Cl (Plate: 2, Fig: 9a)**

Valves, asymmetrical, lanceolate with strongly convex dorsal side and slightly convex ventral side; ends constricted and produced, rounded. Raphe thick, ex-centric. Axial area very narrow, central area slightly widened towards the dorsal side, ventral side with two distinct puncta. Length 35-40 µm, Width 8.8-9µm, Striae 12-14 in 10µm, radial indistinctly punctate and closer at the ends. Distribution cosmopolitan.

***Cymbella turgidula* (Grunow) A. Schmidt. (Plate: 2, Fig: 10)**

Dorso-ventral asymmetry valve, dorsally arched and ventral moderately convex. Apex rather short, sub-rostrate to rostrate, sometimes blunt, barely prolonged at most great individuals. Maximum length and width ratio: 3.3. Narrow longitudinal area, slightly curved. Central area round to elliptic, usually more developed on the dorsal side than on the side ventral and sometimes absent in younger individuals. Raphe a very slightly displaced from ventral side, distinctly oblique, becoming filiform close distal and oblique terminations approaching proximal endings. You fear clearly visible centers, and distal endings directed to the dorsal side. Presence of two, sometimes one or three stigmas, located just opposite the terminations of the Central striae of ventral face, sometimes scarcely separated. Strong streaks, more radiant at the ends than at the center and with the lines visible (22 to 25 in 10µm). Length 30 to 50 µm, Width 11 to 15µm - 8 to 11 dorsal stripes in 10µm (center) and 12 at 14 in 10µm at the ends. Distribution freshwater.

***Cymbella tumescens* A.Cleve (Plate: 2, Fig: 11)**

Cells solitary, gelatinous mass, intercalary band absent in valve view asymmetrical longitudinally lunate rhombic or naviculoid, dorsal surface convex. Axile areas narrow gradually widening towards center, raphe thin, ex-centric usually placed towards ventral side with well-defined nodules. Length 40µm, Width 10µm. Distribution freshwater.

C. ventricosa* var *paucistriata* A.Cl. (Plate: 2, Fig: 12b)**Cymbella ventricosa* C. Agardh (Plate: 2, Fig: 12)**

Half-moon valve, strongly dorsal and rectilinear ventral or slightly convex, with a slight central bulge in large individuals. Apex more or less broadly rounded, usually straight, rarely very weak curved ventral side. Maximum length and width ratio equal to 4.3. Narrow longitudinal area, strongly offset ventral. Central area often not marked, or even absent. Filiform raphe, with proximal terminations curving at dorsal side and terminations distal curved strongly ventral. Strips at the points generally visible in photonics, almost parallel to the center, becoming slightly convergent, and sometimes even radiating at the ends of the face ventral. Length: 16 to 42µm, Width 5.9 to 9.6µm and 11 to 14 strips in 10µm. Distribution freshwater.

***Cymbella ventricosa* Kutz var *genuine* Meyer (Plate: 2, Fig: 12a)**

Valves strongly convex on the dorsal and straight or slightly convex on the ventral side with acutely rounded end. Raphe thin and straight. Axial area narrow. Length 29-35µm, Width 9-9.5µm, Striae 10-12 in the middle and 12-16 in 10µm at the ends, radial coarse lineate and slightly convergent at the ends. Distribution freshwater.

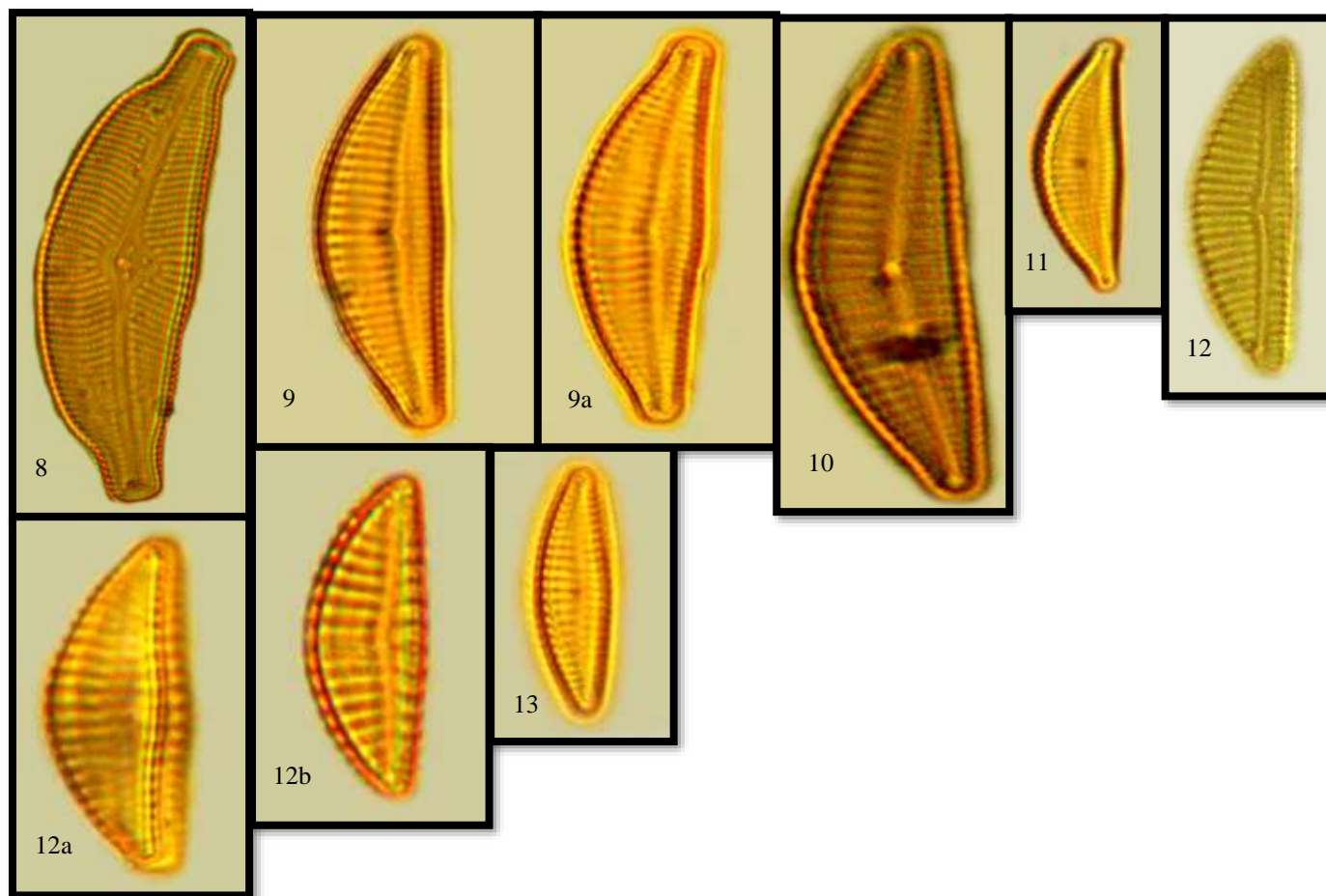
***Cymbella reinhardtii* Grun. (Plate: 2, Fig: 13)**

Valve with slight dorso-ventral asymmetry, broadly lanceolate, and on the dorsal side slightly more convex than the ventral side. Apex simply diminished or stretched into a fairly short, more or less fine point, and rounded. Maximum length and width ratio: 3.9. Longitudinal area of moderate width, gradually widening to the central area. Fairly large central area, rounded to lozenge-shaped, often extending more over one side asymmetrically. Slightly oblique raphe, becoming threadlike at the proximal endings and distal: proximal endings sometimes bending on the ventral side and distal on the dorsal side. Radiant, finely punctuated streaks, punctuation (32 to 36 areoles in 10 µm). Length 43 to 62µm, Width 13 to 16µm and 9 to 10 ridges (dorsal) in 10µm in the center and up to 14 at the ends. Distribution freshwater.

PLATE - 1

1. *Cymbella affinis* (KZ) 2. *Cymbella aspera* (Ehr.) 2a. *Cymbella aspera* (E.) Cl. minor 3. *C. austriaca* GRUN var *subrhomboidea* (OSTR) 3a. *austriaca. reducta* (GRUN) 4. *C. cymbiformis* KZ 4a. *C. cymbiformis unipunctata* 4b *Cymbella Cymbiformis* KZ .var *Jimbio*(PANT 4c. *C. Cymbiformis* KZ. var *longa* NACH 5. *C. gracilis* (RABH) 6. *C. helvetica* 7. *C. parva* (W.SM)Cl.

PLATE - 2



8. *C. tumida* (BREB) 9. *C. tumidula* (GRUN) .HUST 9a. *C. tumidula* (GRUN.) var *genuina* A.CL 10. *C. trigidula* GRUN 11. *C. tumescens* A.Cl 12. *C. ventricosa* A.Cl 12a. *C. ventricosa* var *genuine* Meyer 12b. *C. ventricosa* var *paucistriata* A.Cl. 13. *C. rein hardtii* GRUN.

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