



Taxonomic Diversity and Morphological Characterization of the Diatom Genus *Cymbella* in the Girna River, Jalgaon, Maharashtra, India

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Abstract

A detailed taxonomic investigation of the freshwater diatom genus *Cymbella* was conducted in the Girna River, near Jalgaon, Maharashtra, India, from January 2007 to December 2008. The study aimed to document the diversity and morphological characteristics of *Cymbella* species in this region. A total of 22 taxa were identified, comprising 13 species, 8 varieties, and one form. Samples were collected monthly from various stations, and permanent diatom slides were prepared using acid digestion. Specimens were identified based on meticulous microscopic examination of valve morphology, including dimensions, raphe structure, striae density, and the nature of axial and central areas. This work provides the first comprehensive taxonomic account of *Cymbella* from the Girna River, significantly contributing to the understanding of diatom flora in the Jalgaon region and providing a valuable baseline for future ecological and bioindication studies.

INTRODUCTION

Diatoms are a major and diverse group of unicellular, photosynthetic algae, characterized by their siliceous (frustule) cell walls. They are ubiquitous in nearly all aquatic environments and serve as a fundamental primary producer in freshwater and marine ecosystems. Due to their specific ecological preferences and well-preserved frustules, diatoms are extensively used as powerful bioindicators for monitoring water quality, assessing the impacts of acid precipitation, and reconstructing paleoclimatic conditions (Stoermer & Smol, 1999).

Taxonomy, the science of classifying, naming, and describing organisms, is a critical foundation for all biological research. Accurate identification is essential for ecological studies, biodiversity assessments, and conservation efforts. Without

proper classification and nomenclature, research findings can be ambiguous and of limited use to the scientific community.

The Girna River, which originates in the Western Ghats of Nashik district, flows approximately 174 km through the Jalgaon district. Like many Indian rivers, it is facing increasing pollution pressures. This study focuses on the genus *Cymbella*, a common and often abundant group of pennate diatoms known for its asymmetrical, typically boat-shaped valves. The objective of this paper is to provide a systematic taxonomic account of *Cymbella* species found in the Girna River, featuring detailed morphological descriptions, illustrations, and photomicrographs of all recorded taxa.

Materials and Methods

Algal samples were collected monthly from multiple stations along the Girna River over a two-year period from January 2007 to December 2008. Planktonic forms were collected by scooping surface water between 8:00 and 9:00 AM. Epiphytic forms were obtained by scraping or squeezing submerged aquatic plants (hydrophytes), and filamentous forms were handpicked using forceps. All samples were stored in acid-washed containers and immediately preserved in 4% formalin solution.

Permanent diatom mounts were prepared following the oxidative digestion method of Sarode and Kamat (1984). Briefly, preserved samples were boiled in a 1:1 mixture with concentrated sulfuric acid (H₂SO₄) to remove organic matter. The resulting diatom frustules were repeatedly washed with distilled water via centrifugation until neutral pH was achieved. The cleaned frustules were then preserved in 70% ethanol. For microscopic examination, frustules were mounted on slides using Canada balsam.

Observations and measurements were made under a light microscope. Photomicrographs were taken using a Nikon camera attached to the microscope, and detailed sketches were made with the aid of a camera lucida. Species identification was conducted by comparing morphological characteristics (valve shape, size, raphe structure, striae density, and pore patterns) with standard taxonomic keys and floras provided by Hustedt (1930), Cleve-Euler (1955), Gandhi (1958, 1959, 1960, 1998), Venkataraman (1939), Krishnamurthy (1954), and Sarode and Kamat (1984).

Results and Discussion

A total of 22 taxa belonging to the genus *Cymbella* Agardh were identified, documented, and described. The list includes 13 species, 8 varieties, and 1 form. The systematic account below provides the morphological description for each taxon, including key diagnostic features such as valve dimensions (length and breadth in micrometers, μm), outline, nature of the dorsal and ventral margins, structure of the raphe, characteristics of the axial and central areas, and striae density (number in 10 μm).

Systematic account

Genus: *Cymbella* Agardh, 1830

1. *Cymbella balakrishnanii* Kum.

Valves 31.2–39 μm long, 7.5–11.5 μm broad, asymmetrical with the dorsal margin strongly convex and the ventral margin slightly convex with an inframedian notch; ends rounded; raphe excentric, very slightly curved; axial area narrow; central area slightly formed; striae 9–13 in 10 μm , radial.

2. *C. bharatensis* Sarode et Kamat

Valves 56.4–71 μm long, 10–13 μm broad, asymmetrical; dorsal margin smoothly convex and ventral margin almost straight with a slight inflation in the middle; ends rounded, not acute; raphe thin and almost straight with central pores dorsally directed and terminal fissures curved; axial area narrow; central area slightly formed; striae 8–9 in 10 μm , slightly closely set towards the ends, radial but convergent at the ends on the ventral side, finely punctate.

3. *C. cistula* (Hemp.) Grun. v. *woosungensis* Voigt

Voigt 1943, p. 16, pl. 1, f. 17.

Valves 80–101 μm long, 20.5–23 μm broad, asymmetrical, with the dorsal margin strongly convex and the ventral margin almost straight or slightly concave and slightly inflated in the middle; ends broadly rounded; raphe thick and straight with central pores curved toward the dorsal side; striae 8–9 in 10 μm , distinctly punctate and radial.

4. *C. aspera* (Ehr.) Cleve

Hustedt 1930, p. 365, f. 680.

Valves 98–161 μm long, 22–34 μm broad, asymmetrical with a strongly convex dorsal margin and a straight or slightly convex ventral margin; ends obtusely rounded; raphe thick, arcuate, slightly excentric with large, ventrally bent central pores and dorsally directed terminal fissures; axial area moderate, linear; central area slightly formed, rounded with an arcuate marking on the dorsal side; striae 8–10 in 10 μm , radial, clear and coarsely punctate.

5. *C. austriaca* Grun. v. *subrhomboidea* (Ostr.) A. Cl.

Valves 40–53 μm long, 11.5–12.9 μm broad, rhomboid-lanceolate with the dorsal margin strongly convex and the ventral margin slightly convex with a slight median inflation; ends obtusely rounded; raphe thick, arcuate with central pores shortly flexuous and terminal fissures reflexed towards the dorsal side; axial area fairly broad, linear-lanceolate; central area narrow; striae 9–10 in 10 μm , coarsely punctate, strongly radial at the ends.

6. *C. bengalensis* Grun.

Voigt 1943, p. 11, pl. 2, f. 1.

Valves 75–110 μm long, 20.5–25.5 μm broad, asymmetrical; dorsal side strongly convex and ventral side slightly convex with slightly constricted, broadly rounded ends; raphe thick with prominent central pores and dorsally directed terminal fissures; axial area moderate; central area slightly formed with an isolated stigma on the ventral side; striae 8–10 in 10 μm , radial and coarsely punctate.

7. *C. cymbiformis* (Ag.?) Kuetz. v. *jimboi* (Pant.) A. Cl.

Cleve-Euler 1955, p. 160, f. 1246 g.

Valves 56.3–63 μm long, 11.7–12.5 μm broad, sickle-shaped and more inflated in the middle on the ventral side with broadly rounded ends; raphe thick with ventrally curved central pores and dorsally directed terminal fissures; axial area narrow; central area small with 2–3 coarse puncta on the ventral side; striae 8–9 in 10 μm , radial and linearly punctate.

8. *C. cymbiformis* (Ag.?) Kz. v. *nonpunctata* Font.

Cleve-Euler 1955, p. 160, f. 1246 g.

Valves 56.3–62 μm long, 11.7–12.5 μm broad, sickle-shaped and more inflated in the middle on the ventral side with broadly rounded ends; raphe thin with ventrally curved central pores and dorsally directed terminal fissures; axial area narrow; central area small; striae 8–9 in 10 μm , radial and linearly punctate.

9. *C. gracilis* (Rabh.) v. *aurangabadensis* Sarode et Kamat

Sarode and Kamat, 1984, Pl. 20, Fig. 452.

Valves 34.4–52 μm long, 6.7–8 μm broad, asymmetrical with a convex dorsal margin and a straight or slightly concave ventral margin with a

strong inflation in the middle; ends produced and rounded; raphe thin and straight, close to the ventral margin, with central pore dorsally curved; axial area narrow; central area small; striae 12–14 in 10 μm , fine, slightly radial, at the ends slightly convergent to the ventral side.

10. *C. hungarica* (Grun.) Pant. v. *signata* (Pant.) A. Cl.

Cleve-Euler 1955, p. 159, f. 1245 h–n.

Valves 32–61 μm long, 8.2–11 μm broad, asymmetrical with the dorsal margin strongly convex and the ventral margin more or less straight with an inflation in the middle; ends narrowed, slightly reflexed on the dorsal side and rounded; raphe thick, slightly arcuate with central pores and terminal fissures dorsally directed; axial area narrow; central area slightly formed with a stigma on the ventral side; striae 8–10 in 10 μm , thick, radial.

11. *C. kerkevaensis* A. Cl.

Cleve-Euler 1955, p. 146, f. 1215.

Valves 19–23 μm long, 6–7.5 μm broad, asymmetrical with the dorsal margin highly convex and the ventral margin slightly convex; ends slightly constricted and rostrate; raphe thin, slightly arcuate or apparently straight, excentric and strongly marked; axial area very small; striae 10–12 in 10 μm , radial throughout and punctate.

12. *C. osmanabadensis* Gandhi

Valves 20.4–23 μm long, 6.2–6.4 μm broad, asymmetrical with a strongly convex dorsal margin; ends slightly constricted and rounded; raphe thick and straight with central pores slightly ventrally bent and terminal fissures dorsally directed; axial area narrow; central area small; striae 12–14 in 10 μm , coarse, slightly radial.

13. *C. powaiana* Gandhi

Gandhi 1960b, p. 104, f. 67.

Valves 60–63 μm long, 17.5–20 μm broad, asymmetrical, boat-shaped; dorsal margin strongly convex, ventral margin straight with a slight inflation in the middle; ends constricted on the dorsal side, distinctly produced and subtruncate; raphe thick, arcuate, nearly central with distinct central pores and terminal fissures reflexed towards the dorsal side; axial area fairly wide, linear; central area large, somewhat roundish, without any

stigmata; striae 7–8 in 10 μm , coarsely lineate, radial throughout.

14. *C. radiosa* Reichelt

Gandhi 1966, p. 110, f. 174, 175.

Valves 40–53 μm long, 11.5–12.9 μm broad, rhomboid-lanceolate with the dorsal margin strongly convex and the ventral margin slightly convex with a slight median inflation; ends obtusely rounded; raphe thick, arcuate with central pores shortly flexuous and terminal fissures reflexed towards the dorsal side; axial area fairly broad, linear-lanceolate; central area slightly dilated; striae 9–10 in 10 μm , coarsely punctate, strongly radial at the ends.

15. *C. sagarensis* Gandhi

Gandhi 1959b, p. 322, f. 24, 25.

Valves 20–36.6 μm long, 8.2–9.5 μm broad, asymmetrical; dorsal margin slightly more convex than the ventral, somewhat straight in the middle with abruptly narrowed, shortly rostrate, acutely rounded ends; raphe thin or coarse, slightly arcuate, almost central; axial area fairly wide, linear; central area slightly dilated on the ventral side with a distinct stigma; striae 8–10 in 10 μm , slightly radial and lineate.

16. *C. tumida* (Breb.) V.H. f. *ventricosa* Gandhi

Gandhi 1964, p. 371, f. 68.

Valves 80–120 μm long, 18–25 μm broad, asymmetrical, boat-shaped; ventral margin concave with a single median inflation, dorsal margin strongly convex; ends constricted on the dorsal side, produced with obliquely truncate ends; raphe excentric; axial area narrow; central area large, rounded with a ventrally placed isolated dot; striae 7–9 in 10 μm , clearly punctate and radial.

17. *C. turgida* (Greg.) Cleve

Hustedt 1930, p. 358, Fig. 660.

Valves 22–71 μm long, 7–11.8 μm broad, lunate with a strongly convex dorsal margin and an almost straight or often ventrally gibbous ventral margin; ends more or less acute, rounded; raphe strongly excentric, straight, with the central pores dorsally bent and terminal fissure ventrally directed; axial area moderate, linear; central area small, elliptical; striae 8–9 in 10 μm in the middle and 12–13 in 10 μm linear; central area small; striae 9–10 in 10 μm , strong and coarse, radial throughout.

μm at the ends, strong, lineate and radial, convergent at the end on the ventral side.

18. *C. turgidula* Grun.

Hustedt 1930, p. 362, f. 670.

Valves 30–43 μm long, 9–11 μm broad, asymmetrical with a strongly convex dorsal margin and an almost straight ventral margin; ends rostrate and obtuse; raphe excentric, arcuate; axial area narrow; central area slightly widened with two punctae on the ventral side; striae 9–10 in 10 μm , distinctly punctate.

19. *C. ventricosa* Kuetz.

Hustedt 1930, p. 359, f. 661.

Valves 17.7–35 μm long, 3.7–3.8 μm broad, strongly convex on the dorsal side and straight or slightly convex on the ventral side with acutely rounded ends; raphe thin and straight; axial area narrow; central area small; striae 10–14 in 10 μm , radial, coarse, lineate and slightly convergent towards the ends.

20. *C. ventricosa* Kuetz. v. *arcuata* Skv.

Skvortzow 1938a, p. 257, pl. 1, f. 20.

Valves 25–31 μm long, 9.2–10 μm broad, semielliptic with a strongly convex dorsal margin and a straight ventral margin; raphe arcuate; axial area narrow and central area not defined; striae 10 in 10 μm on the dorsal side and 12 in 10 μm on the ventral side, coarse.

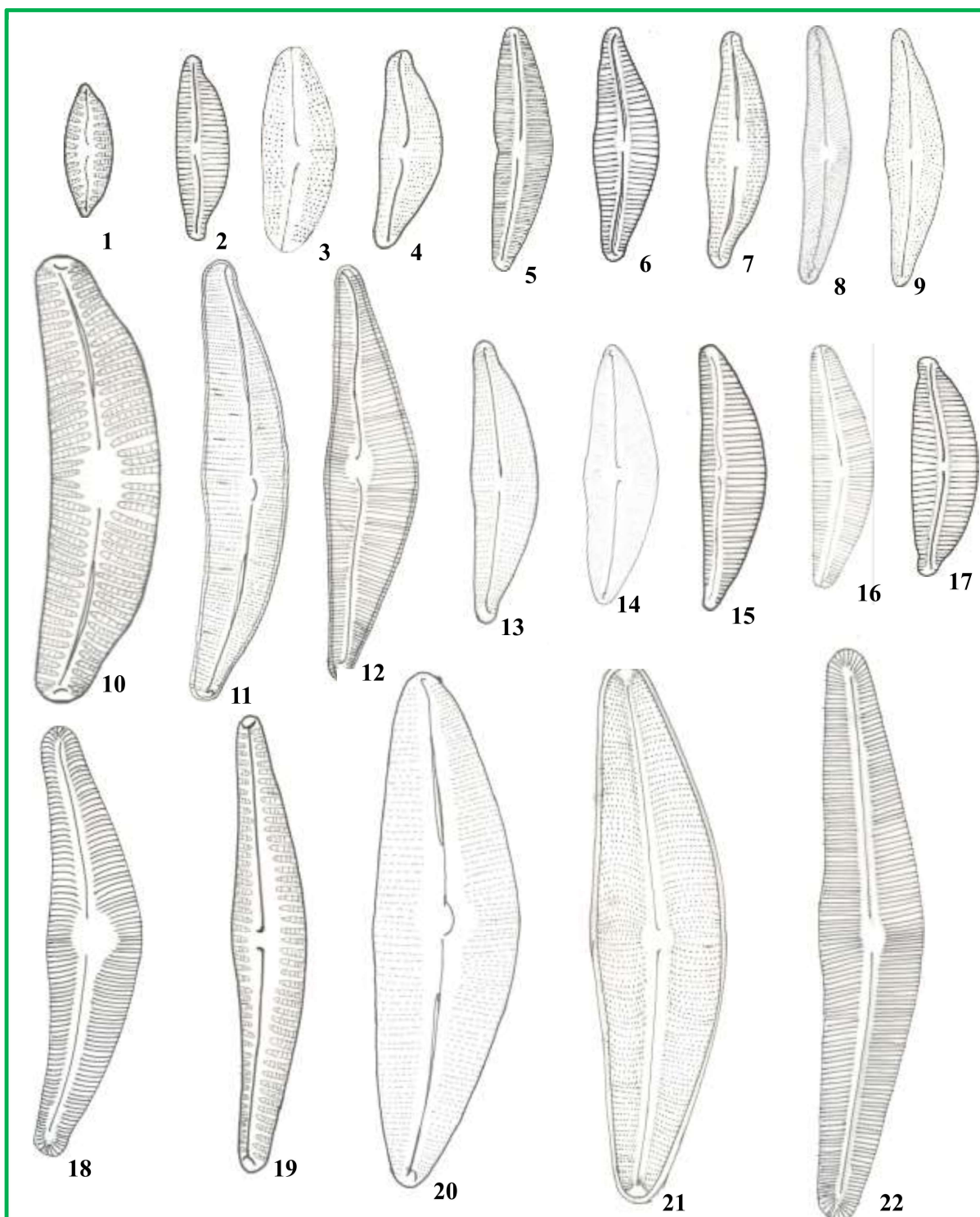
21. *C. ventricosa* Kuetz. v. *depressa* Krishn.

Krishnamurthy 1954, p. 371, f. 50.

Valves 20–29 μm long, 7–8 μm broad, strongly asymmetrical with a strongly convex dorsal margin and an arcuate ventral margin with a slight median depression; ends obtuse, slightly constricted on the dorsal side; raphe thin and arcuate; axial area somewhat broad; central area slightly dilated; striae 9–10 in 10 μm , distinctly punctate and radial.

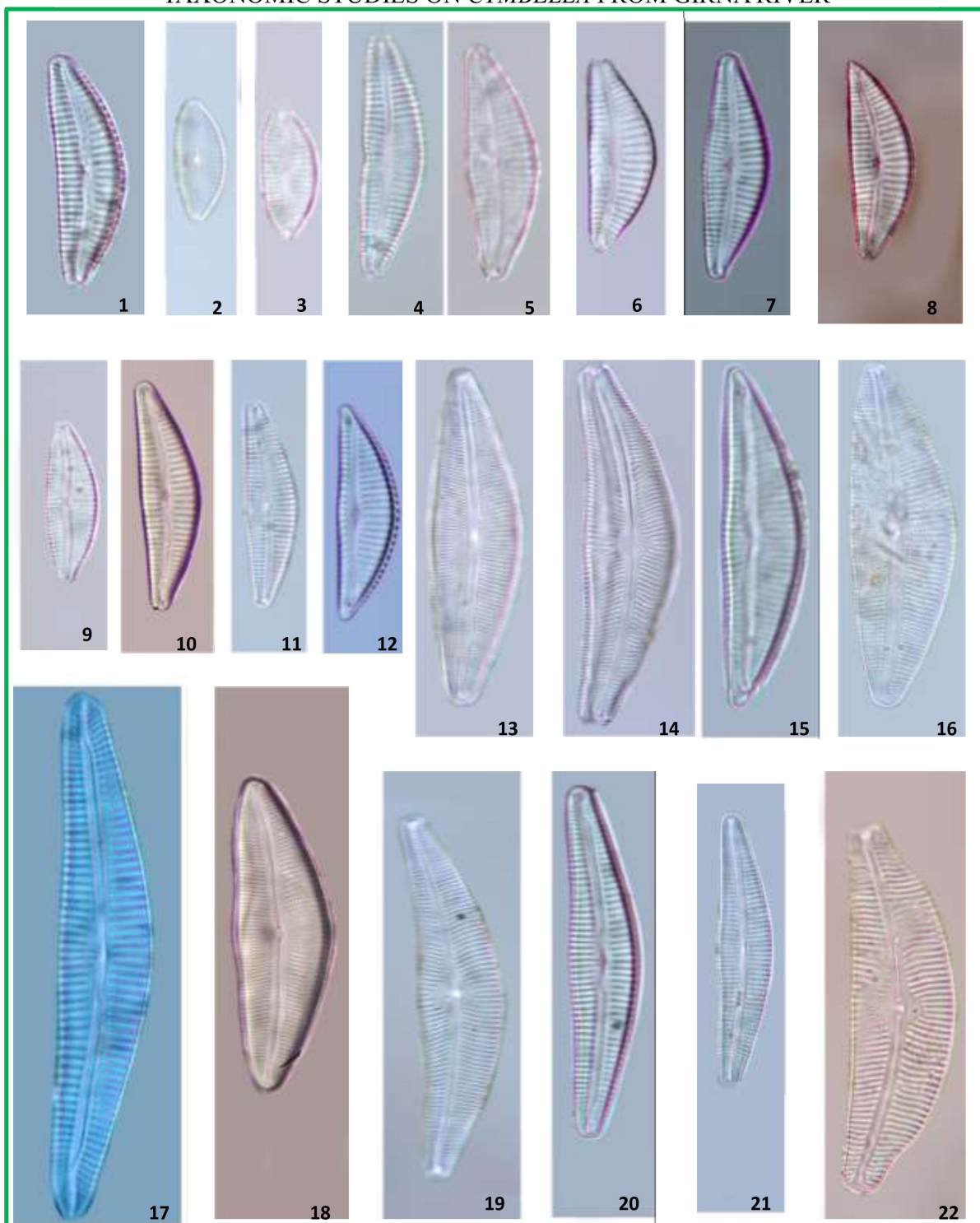
22. *C. vidarbhensis* Sarode et Kamat.

Valves 59–78 μm long, 16–17 μm broad, lunate; dorsal margin strongly convex and slightly depressed towards both ends; ventral margin almost straight and ventrally gibbous; ends rounded; raphe strongly excentric, straight with terminal fissures ventrally directed; axial area moderate

TAXONOMIC STUDIES ON *CYMBELLA* FROM GIRNA RIVER

1) *Cymbella Sagarensis* Gandhi 2) *C. kerkevarensis* A. Cl. 3) *C. ventricosa* Kuetz. v. *depressa* Krishn. 4) *C. turgidula* Grun. 5) *C. balakrishnanii* Kum. 6) *C. hungarica* (Grun.) Plant. v. *signata* (Plant.) A. Cl. 7) *C. austriaca* Grun. v. *subrhomboidea* (Ostr.) A. Cl. 8) *C. bharatensis* Kuetz 9) *C. cymbiformis* (Ag.?) Kz. v. *nonpunctata* Font 10) *C. powaiana* Gandhi 11) *C. tumida* (Breb.) V. H. f. *ventricosa* Gandhi 12) *C. vidarbhensis* Kuetz 13) *C. radiosa* Reichelt 14) *C. Cistula* Grun. v. *woosungensis* Voigt. 15) *C. ventricosa* Kuetz. v. *arcuata* Skv. 17) *C. osmanabadensis* Sarode et Kamat 18) *C. turgida* (Greg.) Cleve 19) *C. cymbiformis* (Ag.?) Kuetz. v. *jimboi* (Plant) A. Cl. 20) *C. bengalensis* Grun. 21) *C. aspera* (Her.) Cleve 22) *C. gracilis* (Rabh.) Cleve v. *aurangabadensis* Sarode et Kamat

TAXONOMIC STUDIES ON *CYMBELLA* FROM GIRNA RIVER



1. *C. ventricosa* Kuetz. v. *arcuata* Skv. 2. *C. ventricosa* Kuetz. v. *depressa* Krishn. 3. *Cymbella Sagarensis* Gandhi 4. *C. balakrishnanii* Kum. 5. *C. hungarica* (Grun.) Plant. v. *signata* (Plant.) A. Cl. 5. *C. radiosa* Reichelt 6. *C. turgidula* Grun. 8. *C. aspera* (Her.) Cleve 9. *C. kerkevensis* A. Cl. 10. *C. austriaca* Grun. v. *subrhomboidea* (Ostr.) A. Cl. 11. *C. cymbiformis* (Ag.?) Kz. v. *nonpunctata* Font 12. *C. ventricosa* Kuetz. 13. *C. osmanabadensis* Sarode et Kamat 14. *C. tumida* (Breb.) V. H. f. *ventricosa* Gandhi 15. *C. vidarbhisensis* Kuetz 16. *C. Cistula* Grun. v. *woosungensis* Voigt. 17. *C. gracilis* (Rabh.) Cleve v. *aurangabadensis* Sarode et Kamat 18. *C. bengalensis* Grun. 19. *C. turgida* (Greg.) Cleve 20. *C. bharatensis* Kuetz 21. *C. cymbiformis* (Ag.?) Kuetz. v. *jimboi* (Plant) A. Cl. 22. *C. powaiana* Gandhi

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