

Hydrodictyon patenaeformae Pocock: A new report from India

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ABSTRACT

The Meerut region of India is well-known for its rich bio-diversity of flora and fauna including green algae. Since there are no previous records on the diversity of green alga *Htdrodictyon* from Meerut and Hastinapur, this study serves as the first documentation from the region. From the present communication we are reporting three species of *Hydrodictyon*, including *H. reticulatum*, *H. indicum* and *H. patenaeforme* from two natural fresh water biotopes of Meerut region of India, including the Chetawala Ghat, Ganga Khadar, Hastinapur and Cantonment area near the Kendriya Vidyalaya Sikh Lines, Meerut. Of the three species, *H. patenaeforme* is reported from Chetawala Ghat, Ganga Khadar, Hastinapur is the first report and new addition to the *Hydrodictyon* flora of India.

Keywords: Green algae, *Hydrodictyon*, Ganga Khadar, Chetawala Ghat, Meerut, Uttar Pradesh.

Introduction

The genus *Hydrodictyon* (Linn.) Lagerheim, a member of division Chlorophyta, family Hydrodictyaceae, order Sphaeropleales, is composed of thousands of cylindrical cells joined by adjacent edges forming various mesh structures, like tri, tetra, penta, hexa, septa and octagonal, etc (**Table-1**). Resembling a fishing net-like structure, due to which *Hydrodictyon* is famously known as Water Net and is easily visible to naked eyes [1]. This alga is characteristic of warm temperate zone and is widely distributed all over the globe including North Africa, America, Asia, New Zealand and Europe [2].

The genus *Hydrodictyon* has a greater ecological impact on the living biota of agricultural fields or seasonal or temporary water bodies [3]. They are found abundantly in slowly moving water streams, drains, river banks, agricultural lands filled with water and lakes. Till date altogether globally total six species of the genus *Hydrodictyon* are taxonomically accepted and these are *H. africanum*, *H. indicum*, *H. majus*, *H. patenaeformae*, *H. reticulatum*, *H. tertiarum* [4], out of which only one species *H. reticulatum* is ubiquitous in occurrence and has been reported from different countries of the world and well characterized.

The colonies of the genus *Hydrodictyon* are three-dimensional and net-like where cells form an interconnected mesh or tube that is defined by the network of cells. The genus *Hydrodictyon* is coenocytic with vegetative and sexual cycles, also producing a polyeder [5]. Pickett-Heaps [6] demonstrated that the germ net of *Hydrodictyon* forms a flat reticulate coenobium with the outer cells possessing two lobes, thus revealing an alliance with *Pediastrum* [7]. Phylogenetic analyses of the 18S data resolved *Hydrodictyon* as a monophyletic group but with bootstrap support less than 70% [7].

The present communication deals with the diversity of the genus *Hydrodictyon* from two natural fresh-water biotopes including the Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, India and Cantonment area near the Kendriya Vidyalaya Sikh Lines, Meerut Cantonment, Meerut, India.

Materials and Methods

Study sites and sampling:

Total 159 mixotrophic algal growth containing samples were collected from two different biotopes including the bank of Chetawala Ghat, Ganga Khadar, Hastinapur and Cantonment area near the Kendriya Vidyalaya Sikh Lines, Meerut Cantt., Meerut, India from 2018-2026 (Fig. 2A-D). Each sample was assigned with sample number along with the date of collection. Five ml from each sample was preserved in 4% v/v formaldehyde and deposited at the Department of Botany, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India.

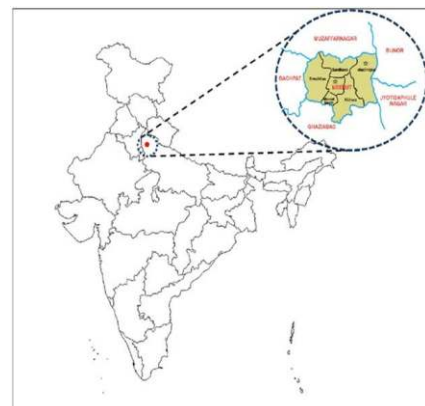


Figure 1: Geographical map of India showing two different sites

Enrichment culturing

Five ml from each sample was inoculated in the solid/liquid nitrogenous Chu-10 medium [8] for enrichment the culturing under controlled conditions (Temperature $28 \pm 2^\circ\text{C}$, light- 4-6 K Lux, 14:10h light: dark cycle) for seven days, and their unialgal cultures were raised by repeated culturing and sub-culturing methods [9].

Morphological observations

Samples from nature, enriched unialgal cultures were subjected to microscopic observations with the help of a Research Microscope (Olympus, CH21i) fitted with digital Camera (Magnus, Magcam-DC10) and their morphometric parameters were recorded with the help of image analysis software (MagVision). All the isolated strains were identified up to species level with the help of available literatures and monographs [2, 10].

Results

Thallus of the genus *Hydrodictyon* is colonial, forming hollow, cylindrical to sac-like structures that resemble a mesh or net. These colonies are typically free-floating often accumulate in vast quantities frequently to blanket the surface and undergo sudden changes in buoyancy and causing them to disappear only to quickly reappear especially during calmer periods. Free-floating mats of *Hydrodictyon* can vary considerably in size, ranging from a few millimeters to several centimeters in length. The net is composed of regularly arranged polygonal meshes, most commonly pentagonal or hexagonal, which impart a highly organized geometric appearance. Each mesh is formed by elongated cells joined end-to-end at distinct angles, creating a continuous reticulate framework. The colony lacks differentiation into specialized tissues, but its structural organization reflects a high degree of coordination among constituent cells. The macroscopic visibility of the colony, cellular dimensions, quantity, morphology of chloroplasts, and the granule count within each filament were documented for morphological characterization and identification of *Hydrodictyon*.

Total three species of *Hydrodictyon* including *H. reticulatum*; *H. indicum* and *H. patenaeforme*, observed from the Meerut region of Uttar Pradesh, India. Of which *H. reticulatum* was observed from both the biotopes while *H. indicum* was observed only from the drains of Cantonment area near the Kendriya Vidyalaya Sikh Lines Meerut. The genus *H. patenaeforme*, new to the flora of India was observed only from Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, Uttar Pradesh, India.

Morphological description

Family: Hydrodictyaceae

Genus: *Hydrodictyon* Roth

Key to the species

1. Coenocytes cylindrical and not generally separating at maturity, cell wall 2 layered and uniform, coenocytes up to $250\mu\text{m}$ broad and up to 1.5cm long.....***H. reticulatum***
2. Coenocytes cylindrical and separating at maturity, cell wall thick and lamellated and with knob like projections into protoplasm, coenocytes up to $1000\mu\text{m}$ broad and 1.6cm long.....***H. indicum***
3. Net flattened, younger colonies may show rhombic or triangular meshes, single layered, of several hundred cells, coenocytes cylindrical $800\mu\text{m}$ -1.2cm.....***H. patenaeformae***

Hydrodictyon reticulatum (Linn.) Lagerheim (Fig. 3A-D)

Thallus macroscopic and colonial, grass green and free floating with closed cylindrical sac-like net. Four to seven cells of colony adjoined to each other at the end walls repeatedly forming a tetragonal to septagonal net like structure. Net may vary in sizes from 400-1900cm. Cells elongated, deeply green, cylindrical and very big, about $100\text{-}130\mu\text{m}$ long and $10\text{-}12\mu\text{m}$ broad, cell wall very thick and lamellated with numerous short knob-like portions of the cell wall projecting into the thin layer of protoplasm inside with smooth, two layered cell-wall. Chloroplast reticulate, young cells have a band-shaped chloroplast; mature cells have a reticulate (net-like) chloroplast with many pyrenoids; each cell of the net can produce a net asexually.

Location: 29.154966N; 78.078275E

Habitat: Chetawala Ghat, Ganga Khadar, Hastinapur and the Cantonment area near the Kendriya Vidyalaya Sikh Lines Meerut, Uttar Pradesh, India

Hydrodictyon indicum Iyengar (Fig. 4A-D)

Thallus macroscopic, deeply green and non-motile colonial. The cells are cylindrical and free-floating. Six cells of the colony are adjoined to each other at the end walls repeatedly forming small hexagonal net like structure. Nets may vary in sizes from 300-720cm. Coenobium forming a hollow cylindrical network. Cells short, elongated, light green, cylindrical about $10\text{-}13\mu\text{m}$ long and $5.6\text{-}7\mu\text{m}$ broad united at their corners in groups of three. Cell wall very thick and lamellated projecting into the thin layer of protoplasm. Chloroplast reticulate, young cells contain a single, band-shaped parietal chloroplast with one pyrenoid while mature cells become coenocytic (multinucleate) with a reticulate (net-like) chloroplast with many pyrenoids.

Location: 29.154966N; 78.078275E

Habitat: Cantonment area near the Kendriya Vidyalaya Sikh Lines Meerut, Uttar Pradesh, India

H. patenaeforme Pocock (Fig. 5A-F)

Thallus macroscopic, floating, fragile forming net-like tufts or mats within the water column. Nets bright green and composed of regularly arranged meshes, most commonly pentagonal or hexagonal, with highly organized geometric appearance. Nets very large, reaching several centimeters, and sometimes up to 1 meter in length. Cells elongated, light green, cylindrical about $90\text{-}113\mu\text{m}$ long and $20\text{-}24\mu\text{m}$ broad, coenocytic cells are typically linked at their ends to two other cells. Cells mostly pentagonal or hexagonal; some species or younger colonies may show rhombic or triangular meshes. Younger colonies may show rhombic or triangular meshes, single-layered, of several hundred cells, Coenocytes cylindrical linked at their ends to two other cells Cell wall very thick and lamellated. Individual young cells are uninucleate with a single chloroplast, while older cells become coenocytic (multinucleate) with large net-like reticulate chloroplast with numerous pyrenoids.

Location: 29.154966N; 78.078275E

Habitat: Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, Uttar Pradesh, India.

Table 2: Showing occurrence of *Hydrodictyon* species and their habitats

Parameters	<i>H. indicum</i>	<i>H. patenaeforme</i>	<i>H. reticulatum</i>
Sample No and Dates of collection	(MTC-058) 27-01-2020 (MTC-097) 19-04-2022 (MTC-128) 07-04-2025	(MTC-071) 10-04-2022	(MTC-025) 18-01-2019 (MTC-037) 10-03-2019 (MTC-054) 27-01-2020 (MTC-062) 07-04-2021 (MTC-076) 10-04-2022 (MTC-105) 17-03-2025 (MTC-148) 13-03-2026
No. of times species encountered	03	01	07
Habitat/ Biotope	Drain	Shallow pool	Shallow pool/ Lake
Location	Near Kendriya Vidyalaya Sikh Lines, Kaserukhera, Meerut Cantt., Meerut, India	Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, India	Chetawala Ghat, Ganga Khadar, Hastinapur and Near Kendriya Vidyalaya Sikh Lines, Kaserukhera, Meerut Cantt., Meerut, India
Geographical location	29.011347N, 77.733588E	29.154854N, 78.076945E	29.154966N, 78.078275E and 29.011347N, 77.733588E
Colony Shape	Macroscopic, deeply green and non-motile colonial	Macroscopic, free floating, fragile forming net-like tufts or mats	Macroscopic and colonial
Colony size	300-720cm	700-1000cm	400-1900cm
Cell shape	short, elongated, light green, cylindrical	elongated, light green, cylindrical	elongated, deeply green, cylindrical
Cell size	10-13 µm long and 5.6-7 µm broad	90-113 µm long and 20-24 µm broad	100-130 µm long and 10-12 µm broad
Tetragonal %age	13.46%	15.95%	20%
Pentagonal %age	26.92%	34.04%	25%
Hexagonal %age	42.30%	39.36%	42.50%
Septagonal %age	9.61%	9.57%	5%
Octagonal %age	7.61%	1.06%	2.5%

Discussion

In India, the diversity of the genus *Hydrodictyon* appears limited when assessed solely on species richness, yet its ecological significance and spatial distribution across freshwater habitats are notably substantial. According to available taxonomic databases, the genus is represented globally by six confirmed species and three varieties [4], indicating a modest level of taxonomic diversification. However, within the Indian subcontinent, only two species have been formally documented to date [11-13]. This apparent disparity between global diversity and regional records may reflect under-exploration, taxonomic ambiguities, or limitations in molecular characterization studies in India.

Despite the limited number of species, *Hydrodictyon* demonstrates extensive geographical distribution across diverse aquatic ecosystems in India, including ponds, lakes, reservoirs, wetlands, and slow-flowing rivers. The genus typically thrives in stagnant or slow-moving, nutrient-rich freshwater bodies, particularly during warmer months and monsoon seasons, where it may form dense floating mats [14]. Reports from regions such as Chennai, Uttar Pradesh, West Bengal, Himachal Pradesh, Uttarakhand, and other parts of the Gangetic plains confirm its widespread occurrence [15-19]. Despite the low number of reported species, *Hydrodictyon* plays a crucial ecological role in freshwater ecosystems by contributing to primary productivity, nutrient cycling, and habitat structuring, thereby underscoring the need for more comprehensive taxonomic and ecological investigations in the region [20-22].

From a taxonomic perspective, the apparent low diversity of *Hydrodictyon* in India may be attributed to under-exploration, morphological plasticity, and the lack of integrative taxonomic approaches combining molecular and ultrastructural data [23]. Many floristic surveys report *Hydrodictyon* only at the genus level, suggesting possible cryptic diversity that remains unrecognized [24].

Furthermore, regional studies have often focused on broader algal diversity, leading to insufficient detailed documentation of this genus [25].

The Meerut region of India has been explored by many biologists [26-36] but no such reports on the diversity of *Hydrodictyon* from the Meerut region are available till date. From the present communication we are reporting three species of *Hydrodictyon* including *H. reticulatum*; *H. indicum* and *H. patenaeforme* from the Meerut region of Uttar Pradesh, India. Of the three species, *H. patenaeforme* reported from Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, Uttar Pradesh is the first report and new addition to the macroalgal flora of India.

Conclusion

From the present communication, it could be concluded that, the Meerut region including Hastinapur of Uttar Pradesh, is rich in bio-diversity of micro and macroalgae including *Hydrodictyon*. The colonies of *Hydrodictyon* are free-floating often accumulate to blanket the surface undergoing sudden changes in buoyancy and causing them to disappear during calmer periods. Of the three species of *Hydrodictyon*, *H. patenaeforme* reported for the first time from Chetawala Ghat, Ganga Khadar, Hastinapur, Meerut, Uttar Pradesh, India and is a new addition to the *Hydrodictyon* flora of India.

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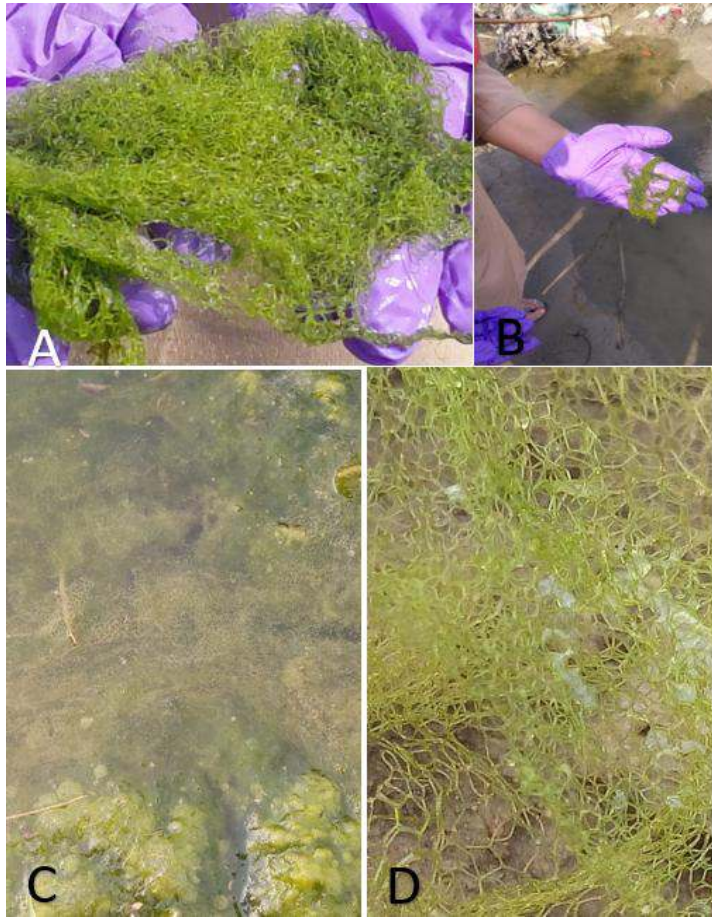


Figure 2(A-D): Figures (A-D) showing collection of *Hydrodictyon* and their mats in natural habitats

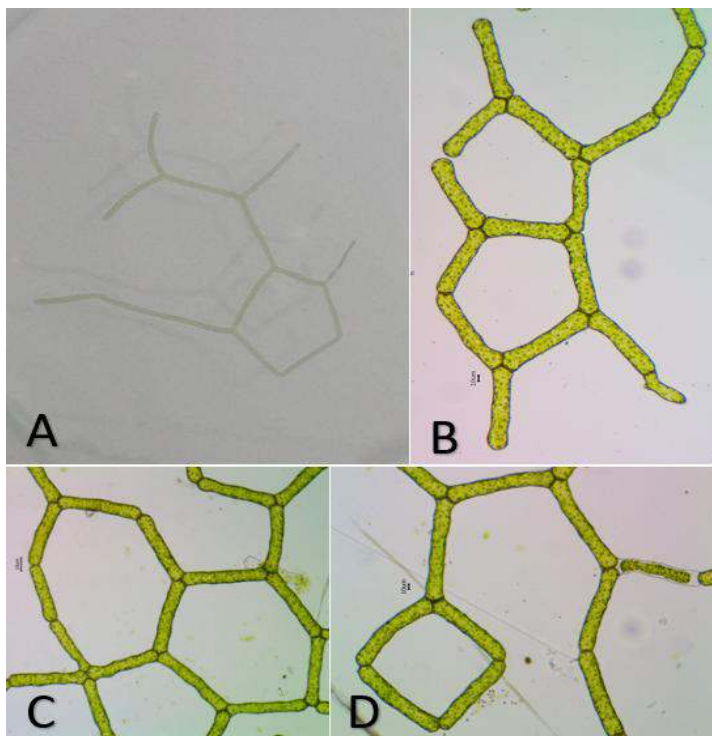


Figure 3(A-D): Figures (A-D) showing microphotographs of *H. reticulatum*

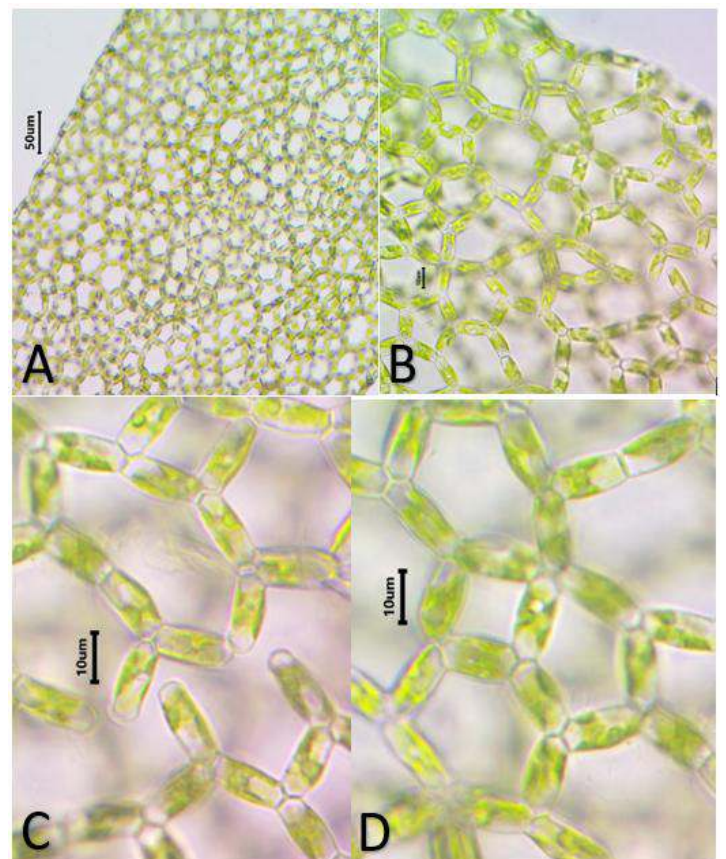


Figure-4(A-D): Figures (A-D) showing microphotographs of *H. indicum*

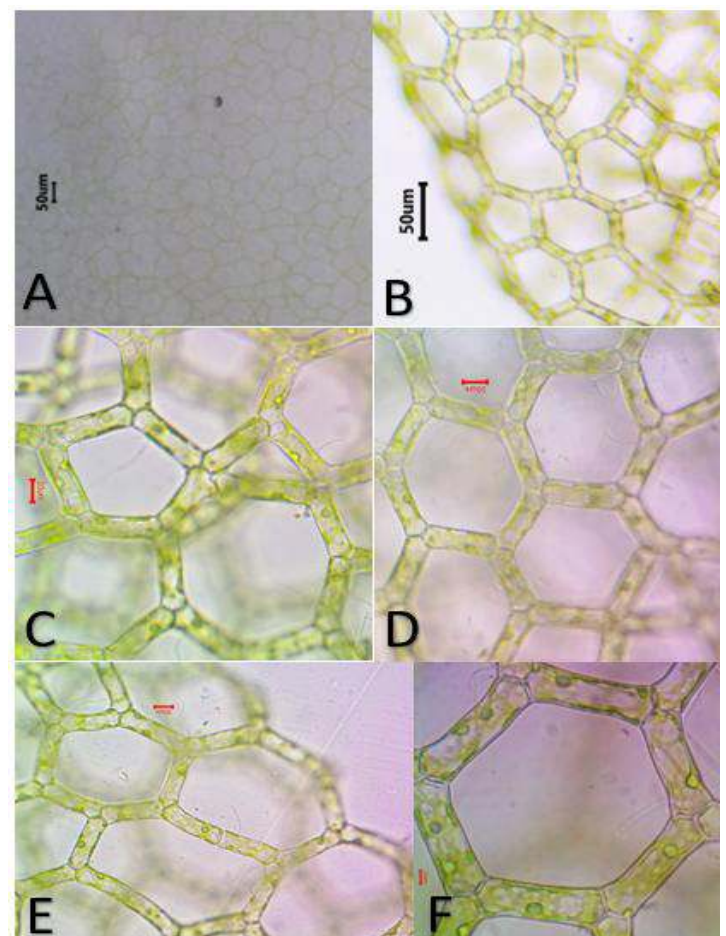


Figure 5(A-F): Figures (A-F) showing microphotographs of *H. patenaeforme*



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