

# Species

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# *Hyella taptapanica* (Hyellaceae, Pleurocapsales): a new rare cyanobacteria from Taptapani thermal spring, Odisha, India

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## ABSTRACT

A new species of *Hyella* Born. et Flah., a rare freshwater cyanobacteria was reported for the first time from Taptapani hot spring of Odisha at 45°C. This new species is described and comparative morphological study of the above mentioned species along with its closely related species depicts its dissimilarities in thallus structure, branching and cell arrangement and thus proposed as a new species that is *Hyella taptapanica*. The detailed description, microphotographs and illustrations are delineated to support the present investigation.

**Key words:** *Hyella taptapanica*, new species, hot spring, taxonomy

## 1. INTRODUCTION

*Hyella* is pseudo filamentous, most common euendoliths composed of irregular rows of more or less ramified pseudo filaments or pseudoparenchymatous colonies creeping on calcareous substrates. It is comprised of 33 species throughout the world. This genus is classified under Pleurocapsales, Hyellaceae and mostly reported from marine environments (Pantazidou et al., 2006; Radtke and Golubic, 2011). Only few species were reported from freshwater biotope and the species studied here is reported from freshwater thermal spring for the first time.

Taptapani hot spring is a place for tourist attraction not only for the thermal spring complex but also for its scenic beauty. This hot spring is surrounded by Eastern Ghats along with its dense forest. Very few research works have been done regarding algal diversity in thermal springs among them Bhakta et al. (2016) studied algal diversity in hot water springs of Odisha. *Hyella caespitosa* Bornet and Flahault (1888) was the first reported species of this genus from France. Lukas and Golubic (1983) have reported *H. gigas* as a new species from the Florida continental margin. Two euendolithic species, *H. kalligramos* and *H. maxima* in association with some other morphotypes, were reported from the freshwater habitat of Greece

(Anagnostidis and Pantazidou, 1988). Al-Thukair and Golubic (1995) reported and described 5 new species of *Hyella* from the Arabian Gulf. From the Indian Ocean, a total of 12 species of *Hyella* were listed and reported in the Indian ocean catalog of University of California herbarium. The catalog includes *H. balani*, *H. caespitosa*, *H. caespitosa* var. *arbuscula*, *H. conferta*, *H. gigas*, *H. immanis*, *H. inconstans*, *H. littorinae*, *H. racemus*, *H. reptans*, *H. salutans* and *H. stella* (Silva et al., 1996). Three marine species, *H. inconstans*, *H. reptans* and *H. caespitosa* var. *arbuscula* were studied from Greek marine biotopes and were recorded as new for Europe in that time (Pantazidou et al., 2006).

In the Indian subcontinent, *H. caespitosa* was found to be the most dominant species throughout Karnataka, Bihar, Haryana, Gujarat, Maharashtra, Tamilnadu, Jammu and Kashmir (Gupta and Das, 2018). In a recent study, Chatterjee (2020) has reported two species viz., *H. maxima* and

*H. fontana* from different sampling stations of Purba and Paschim Bardhaman districts of West Bengal, India. In this current study, a new species of *Hyella* collected from this thermal spring has been described. The proposed new species of *Hyella* differs from other species by its irregular cell arrangement, branching and thallus structure. The thallus of the present species is pseudoparenchymatous, pseudo filaments densely packed, branching rare or irregular.

## 2. MATERIAL AND METHOD

The algae was collected from the wall of main kund of Taptapani hot spring (45°C) (19°29'4.99"N, 84°23'37.248"E) as mat (Fig. 1) along with other algae mainly with members of Nostocales. The algae was collected in collection vials and preserved in a 4% formalin solution (v/v) with voucher number and deposited at the algal collection in the Cryptogamic unit, Central National Herbarium (CNH), Howrah. Microscopic observations, morphological descriptions and microphotographs were done in a Nikon eclipse Ni-11 microscope fitted with Nikon Digital Camera DS-R11-U3 and operated by Nikon Imaging Software NIS-D+EDF. The holotype of alga is deposited in CNH with the acronym CAL!. The identification was done with the help of standard monographs (Desikachary, 1959; Komárek and Anagnostidis, 1998) and digital platforms like AlgaeBase (Guiry in Guiry and Guiry, 2021).

## 3. RESULTS

### Taxonomic Treatment

*Hyella taptapanica* P. Basu, G. G. Satpati & R. K. Gupta *sp. nov.* Fig. 2, 3

**Type:** INDIA. Ganjam, Odisha, 19°29'4.99"N, 84°23'37.248"E, pH- 8.8, water temperature - 45°C, 26 November 2019, B.S.I. (C.N.H) 82091 (Holotype CAL!)

**Etymology:** The specific epithet is based on the name of the thermal spring "TAPTAPANI".

**Description:** Thallus epilithic, blue-green to olive green attached to the rocks of Taptapani thermal springs, Odisha, composed of short densely packed pseudo filaments forming a parenchymatous appearance (Fig. 1-2). Pseudo filaments are densely packed, small in groups of 2-3 cells (Fig. 3). Gelatinous sheath is firm, variedly coloured, homogeneous. Branching irregular; cells of branches and main body is similar and irregularly arranged, isodiametric to angular, 3.84-5.76 µm long and 4.23-7.69 µm wide (Fig. 2-3). Branching is mainly one type arising from distal part of intercalary cells (Fig. 3). Cell content blue-green to olive green in color with fine granules (Fig. 2D; Fig. 3).

**Table 1.** Comparative morphological study of *Hyella taptapanica* with its closely related species.

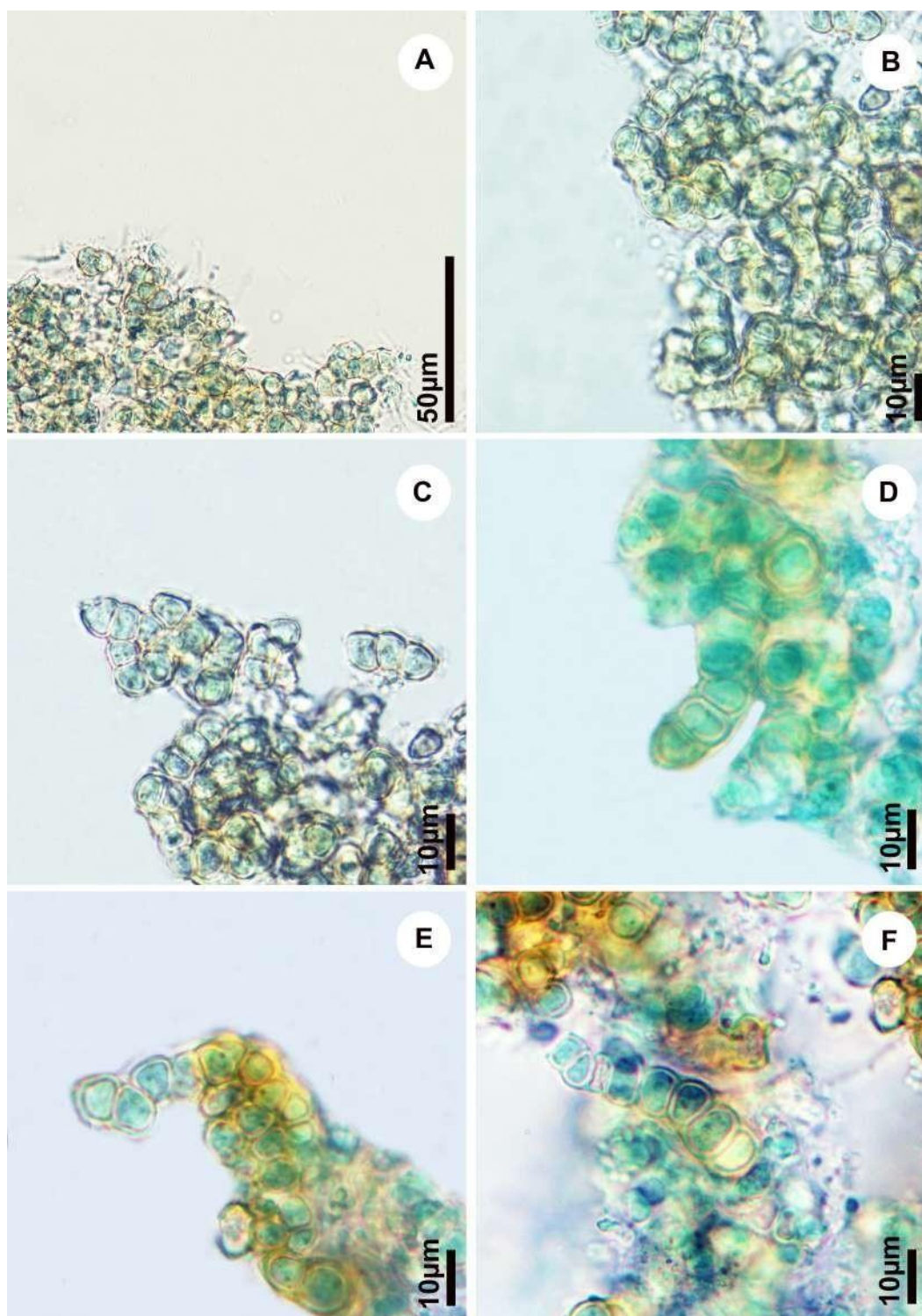
Morphological features	<i>Hyella taptapanica</i>	<i>Hyella fontana</i>	<i>Hyella maxima</i>	<i>Hyella kalligramos</i>
Thallus structure	Epilithic, pseudoparenchymatous, present in form of mats, blue-green.	Euendolithic, apparently pseudoparenchymatous, gray green or brown.	Euendolithic, dark blue green to olive green.	Eu-endolithic gray to dark gray.

Pseudo film- ents	Densely packed, short in groups of 2-3 cells.	Densely packed, penetrate into carbonate substrates, proximal part composed of coccoid cells and distal part with cylindrical cells.	Pseudo filaments loosely aggregated consists of proximal coccoid cells and distal cylindrical cells.	Pseudo filaments penetrate into carbonate substrates are straight and grows perpendicular to the substrate.
Shealth	Gelatinous sheath, firm, thin, variedly coloured, not layered.	Gelatinous sheath, firm, thin, colorless and homogeneous.	Gelatinous sheath firm, colorless, occasionally bluish, homogeneous.	Gelatinous, shealth firm, colorless, not layered.
Branching	One type arising from distal part of intercalary cells and irregularly distributed.	Two types: a) Initiated at distal end of intercalary cell b) Initiated by lateral protrusion of intercalary cell.	Three types: a) initiated from large superficial cell, b) initiated from an intercalary cell at distal end, c) initiated from an intercalary cell near its middle	One type initiated from lateral protrusion of vegetative cells.
Cells	Irregular, isodiametric to angular, 3.84-5.76 $\mu\text{m}$ x 4.23-7.69 $\mu\text{m}$ . Cell content blue- green to olive green, finely granular.	Proximal cells spherical, 7-11.2-17 $\mu\text{m}$ x 4.6-9.2 $\mu\text{m}$ , distal cells cylindrical, 3-6.8-12 $\mu\text{m}$ x 4-6 $\mu\text{m}$ . Cell content blue green or gray, finely granular.	Proximal cells spherical, oval 10- 22.8 $\mu\text{m}$ x 17.8-23 $\mu\text{m}$ , distal cells irregular, 13.6-18 $\mu\text{m}$ x 4.5-6.2 $\mu\text{m}$ . Cell content dark blue- green to olive green, finely granular.	Proximal cells cylindrical, isodiametric, 1.5-4 $\mu\text{m}$ x 2-4 $\mu\text{m}$ , intercalary cells cylindrical, 4-17 $\mu\text{m}$ – 2.5-4 $\mu\text{m}$ . Cell content blue-green to dark gray, granules are fine.

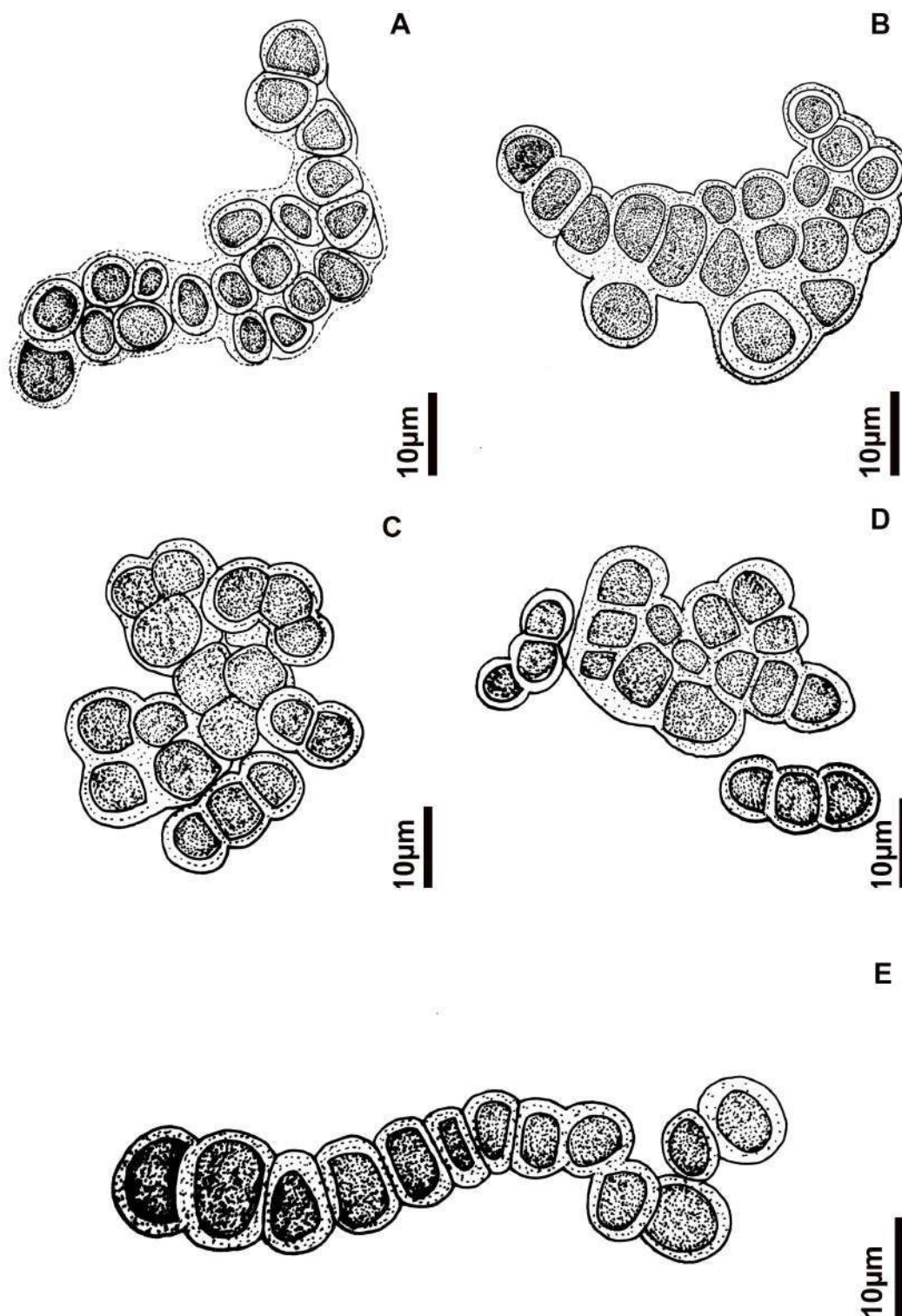


**Fig. 1.** Habit and natural habitat of *Hyella taptapanica*. **A:** Collected biomass. **B-C:** Epilithic *H. taptapanica* attached on the rock of the kund of thermal spring.





**Fig. 2.** Light microphotographs of *Hyella taptapanica* sp. nov., A-C: Pseudoparenchymatous thallus. D-F. Blue-green to olive green densely packed pseudo filaments with irregular branching.



**Fig. 3.** Line drawings of *Hyella taptapanica* sp. nov., **A-B:** Densely packed thallus surrounded by a gelatinous sheath. **C-D:** Irregular branching of the pseudo filaments. **E:** One type of branching arises from the distal part of the intercalary cells.

**Diagnosis:** *H. taptapanica* closely resembles *H. fontana* Huber & Jadin morphologically, but differs in its cell arrangement and branching (Table 1); branching one type irregular arising from distal portion of intercalary cells (*vs.* branching two types one arising from distal part of intercalary cells and other arising from lateral protrusion of intercalary cells); sheath intact firm and color ranges from dark green to yellow green (*vs.* sheath gelatinous, firm and colorless). Cells  $3.84\text{--}5.76\text{ }\mu\text{m} \times 4.23\text{--}7.69\text{ }\mu\text{m}$  (*vs.* proximal cells  $7\text{--}11.2\text{--}17\text{ }\mu\text{m} \times 4.6\text{--}9.2\text{ }\mu\text{m}$  and distal cells  $3\text{--}6.8\text{--}12\text{ }\mu\text{m} \times 4\text{--}6\text{ }\mu\text{m}$ ) (Table 1).

*H. taptapanica* also resembles *H. maxima* (Geitler) Anagnostidis & Pantazidou but differs morphologically in arrangement of pseudo filaments; pseudo filaments densely packed giving parenchymatous appearance (*vs.* pseudo filaments arranged loosely); branching pattern is irregular arising from distal part of intercalary cells (*vs.* branching three types one arising from large superficial cell, other arising from distal part of intercalary cell and another arising from middle of intercalary cells (Table 1); sheaths firm and coloured (*vs.* sheath firm, colorless occasionally bluish); cells irregular isodiametric to angular,  $3.84\text{--}5.76\text{ }\mu\text{m} \times 4.23\text{--}7.69\text{ }\mu\text{m}$ , (*vs.* cells spherical, subspherical or angular rounded, proximal cells  $10\text{--}22.8\text{ }\mu\text{m} \times 17.8\text{--}23\text{ }\mu\text{m}$ , distal cells  $13.6\text{--}18\text{ }\mu\text{m} \times 4.5\text{--}6.2\text{ }\mu\text{m}$ ). *H. taptapanica* closely resembles *H. kalligrammos* Anagnostidis & Pantazidou. The thallus of *H. taptapanica* is dark blue green (*vs.* thallus grayish to dark gray); pseudo filaments arranged tightly giving a pseudoparenchymatous appearance (*vs.* pseudo filaments straight growing perpendicular to the substrate with multiseriate cells in proximal part and uniseriate cells in distal part) (Table 1); branching irregular (*vs.* branching divaricate initiated from lateral protrusion of a vegetative cell); sheaths firm and coloured (*vs.* sheath gelatinous, firm, colorless); cells isodiametric to angular,  $3.84\text{--}5.76\text{ }\mu\text{m} \times 4.23\text{--}7.69\text{ }\mu\text{m}$ , apical cells angular (*vs.* proximal cells cylindrical or isodiametric  $1.5\text{--}4\text{ }\mu\text{m} \times 2\text{--}4\text{ }\mu\text{m}$ , intercalary cells cylindrical  $4\text{--}17\text{ }\mu\text{m} \times 2.5\text{--}4\text{ }\mu\text{m}$ , apical cells cylindrical).

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### Authors' contribution:

PB and GGS contributed equally. PB has collected the specimen, identified and done microscopic study. GGS has written, structured and edited. RKG provided the lab support and edited the manuscript.

### Ethical approval

*Hyella taptapanica* was observed from Odisha in the study. The ethical guidelines were followed in the study for sample collection & identification.

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This study has not received any external funding.

### Conflicts of interests

The authors declare that there are no conflicts of interests.

### Data and materials availability

All data associated with this study are present in the paper.

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