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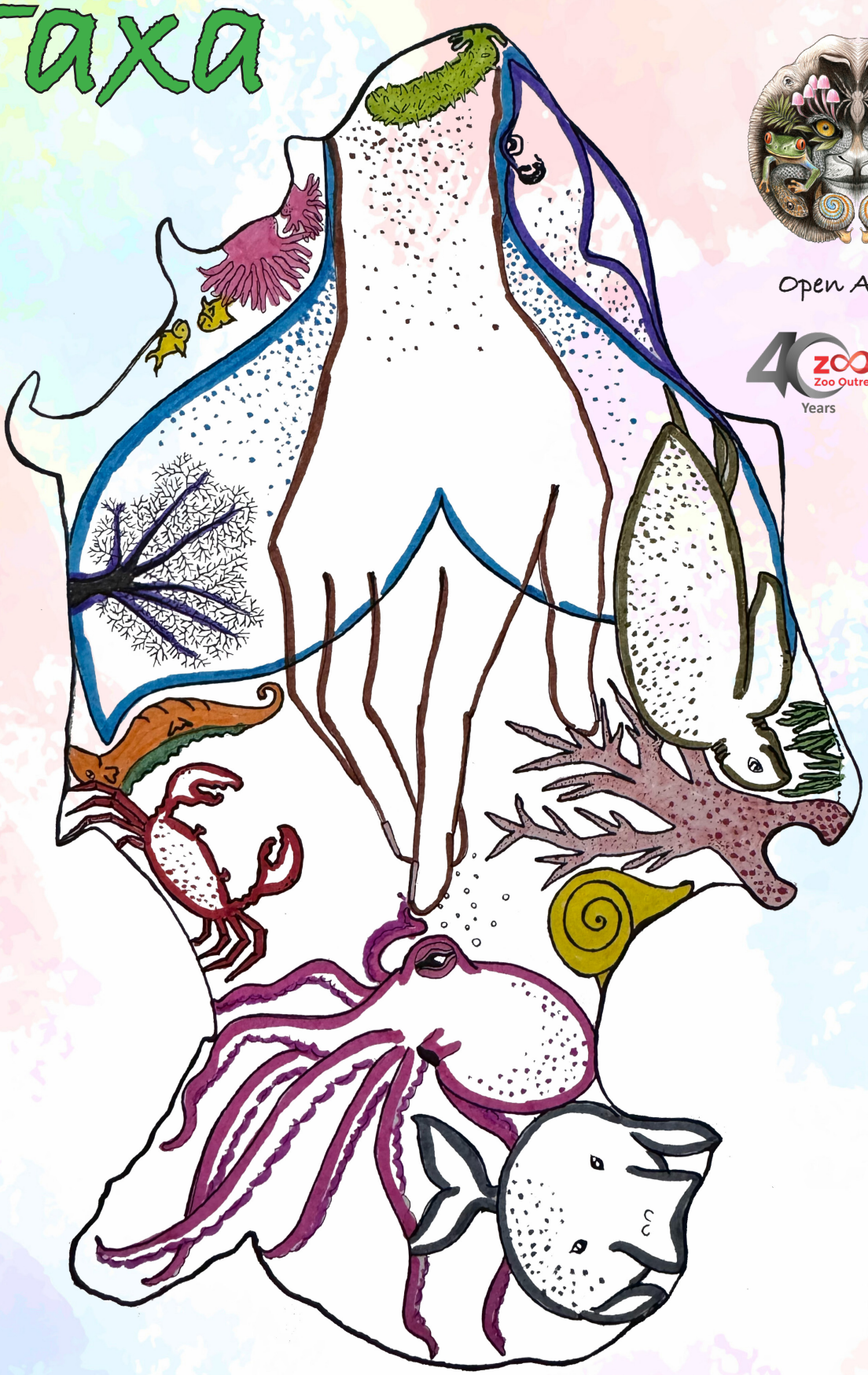

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continued on the back inside cover

Cover: Little Andaman is part of the island chain with incredible biodiversity, but these amazing species are threatened by development projects, and need our support. Pen and ink artwork by Priyanka Iyer.

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SHORT COMMUNICATION

A new variety of *Chara corallina* Willd. (Charophyta: Characeae) from Kamrup District, Assam, India

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Abstract: A new variety, *Chara corallina* var. *kamrupensis* P.P.Baruah, S.Bhattacharjee, N.Kalita & B.Boruah var. nov. is described from Kamrup District, Assam (India), based on the observations made under light and scanning electron microscope. This new variety differs from the other two taxonomically accepted varieties of the species viz., *C. corallina* var. *kyusyensis* K.Imahori and *C. corallina* var. *portonovensis* D.Subramanian in having bracts throughout the body, number of spirals in oogonia, and reduced size of antheridia & coronula cells.

Keywords: *Chara corallina* var. *kamrupensis,* Charophyta, freshwater habitats, green algae, light microscopy, scanning electron microscopy, stoneworts.

Charophyta, popularly known as stoneworts or brittleworts constitute one of the major groups of macrophytic green algae occurring in fresh to brackish water ecosystem (Mondal et al. 2021), which shows similarities with some aquatic angiosperms like, *Ceratophyllum*, and *Myriophyllum* (Casanova 2005; Baruah et al. 2024). A few unique morphological features such as, presence of nodes & internodes, branchlets, bracts, stipulodes, and attractive reproductive structures (Mann et al. 2022) like nucule (female reproductive structure), and globule (male reproductive structure) make the taxa different from the other algal groups (Mandal & Ray 2004).

As per algaebase (Guiry & Guiry 2023), a total of 360 taxonomically accepted taxa have been accounted under the genus *Chara*, which includes 221 species, three sub-species, 49 varieties, and 87 formae throughout the globe. The species *Chara corallina* Willdenow, 1805, is one of the most attractive species within the genus *Chara* that have unique characteristics like monoecious plant body, and gametangia at the base of the whorl. According to the recent literature, this species itself has been divided into two accepted varieties, viz., *Chara corallina* var. *kyusyensis* K. Imahori, 1954, and *Chara corallina* var. *portonovensis* Subramanian, 1981 (Guiry & Guiry 2023). The former was first reported from Japan by Imahori (1954) inhabiting freshwater habitat. Subsequently, the species was reported from Korea (Choi & Kim 1996), and India (Karande 1999). On the other hand, *C. corallina* var. *portonovensis* was reported for the first time by Subramanian (1981) from a freshwater habitat of Tamil Nadu (India) which was later on documented in a checklist by Gupta (2012)) from the same region.

The study of a few *Chara corallina* samples in different freshwater aquatic habitats from the Kamrup District of Assam during routine explorations revealed an interesting variety of the species. In this study, we introduce a new variety of *Chara corallina* Willdenow,

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1805 with photomicrographs & descriptions, and compare it with the other two aforementioned varieties. The present communication is aimed to highlight light microscope (LM) and scanning electron microscopic (SEM) observations, and descriptions of *Chara corallina* var. *kamrupensis,* a new additional variety, to science from Kamrup District of Assam (India).

Materials and Method

Collection and observation of samples

Samples were collected from the different freshwater habitats of Kamrup (S1 – 26.087^{O} N, 91.610^{O} E; S2 – 25.975^{O} N, 91.235^{O} E; S3 – 26.449^{O} N, 91.622^{O} E; S4 – 26.348^{O} N, 91.729^{O} E) and Aquaculture & Biodiversity Centre (S5-26.154^{O}N, 91.666^{O}E) of Gauhati University under Kamrup Metro District of Assam (India). Physicochemical properties of the habitats like pH, temperature, and conductivity were also measured to be pH 6.8–7.6, 18–22 ^{O}C, and 139–260 µS/cm, respectively. After collection, samples were washed vigorously with double distilled water, and brought to the Plant Ecology Laboratory, Gauhati University for observations. Leica S9i microscope was used for photography of the samples in fresh conditions. Herbarium was also prepared after drying and fixing the part of the collected samples in Formalin-Glacial Acetic Acid-Alcohol (FAA) solution following the standard protocol as given by Seshagirirao et al. (2016), and the remaining portion of the samples were preserved in 4% formalin solution following Mondal et al. (2021) for future use.

FeSEM study

A portion of the fresh samples was first washed in double distilled water followed by detachment of reproductive parts using scalpels and needles, air dried at room temperature by keeping them on a glass cover slip. Once dried, the samples were dipped in 3% glutaraldehyde solution for 24 h in 4^{O}C and then 0.1 M phosphate buffer was used to rewash the sample. The samples were dehydrated with 30%, 50%, 70%, 90%, 100% ethanol solution (Sadiq et al. 2017), and then coated with gold as per protocol prior to taking SEM photographs (John & Moore 1987; Urbaniak 2011) with SEM-Zeiss Sigma 300 at CIF, Gauhati University.

Identification of the sample

The samples were identified morphologically by comparing the characters with the standard monographs and literature, i.e., Sundaralingam (1959), Pal et al. (1962), Wood & Imahori (1964), Choi & Kim (1996), Subramanian (2002), and John et al. (2005).

Results

Taxonomic treatment

***Chara corallina* var. *kamrupensis* P.P.Baruah, S.Bhattacharjee, N.Kalita & B.Boruah, var. nov. (Figure 1–4)**

Plant monoecious, more than 40 cm in height (Image 1A); axis stout to fragile, 350–450 µm in diameter; ecorticated; Branchlet 2–3 times longer than internodes, six in a whorl (Image 1D), each with 3–4 segments, ultimate segment smaller and conical to oval in shape having only one dactyl (Image 1C); branchlets swollen at node/nodal region; both upper and lower nodes possess bracts, bracteoles absent throughout the body; stipulodes rudimentary; Gametangia produced at the base of the whorls as well as at the nodes, aggregated at the base (Images 1D,E), and solitary at node (Image 1I); antheridia mature earlier than oogonia; Antheridia smaller than the typical varieties, 367–407 µm in diameter (Image 4C) , greenish in colour (Images 1E,F,H,I) ; Oogonium small, 940–1,000 µm in length with coronula cell, 700–750 µm broad (Image 4A), greenish in colour but gradually turns into brick-red at maturity; Coronula five in number, 40–47 µm long, 25–30 µm broad (Image 1G; Image 4B); spiral cells five in number with eight convolutions.

Present specimen tallies with *C. corallina* var. *portonovensis* (Subramanian 2002) but differs in:

1. Presence of bract throughout the body.
2. Much smaller antheridia and oogonia.
3. Number of spirals in oogonia.
4. Much smaller coronula cells.

Present specimen tallies with *C. corallina* var. *kyusyensis* (Choi & Kim 1996) but differs in

1. Presence of bract throughout the body.
2. Lower node sterile.
3. Smaller antheridia and larger oogonia.
4. Much smaller coronula cells.

Type: India, Assam: Kamrup District, Aquaculture and Biodiversity Centre, 26.154O N & 91.666O E, 72 m, 5.xi.2023, S. Bhattacharjee GUBH20650 (holotype: GUBH) (Image 5)

Etymology: The variety 'kamrupensis' is named after its collection site Kamrup District.

Discussion

Chara corallina, a notable morphologically attractive as well as ecologically well-known freshwater species within the genus *Chara* that mainly has two taxonomically accepted varieties, viz., *C. corallina* var. *portonovensis* and *C. corallina* var. *kyusyensis*. The present endeavour provides the unique diagnostic

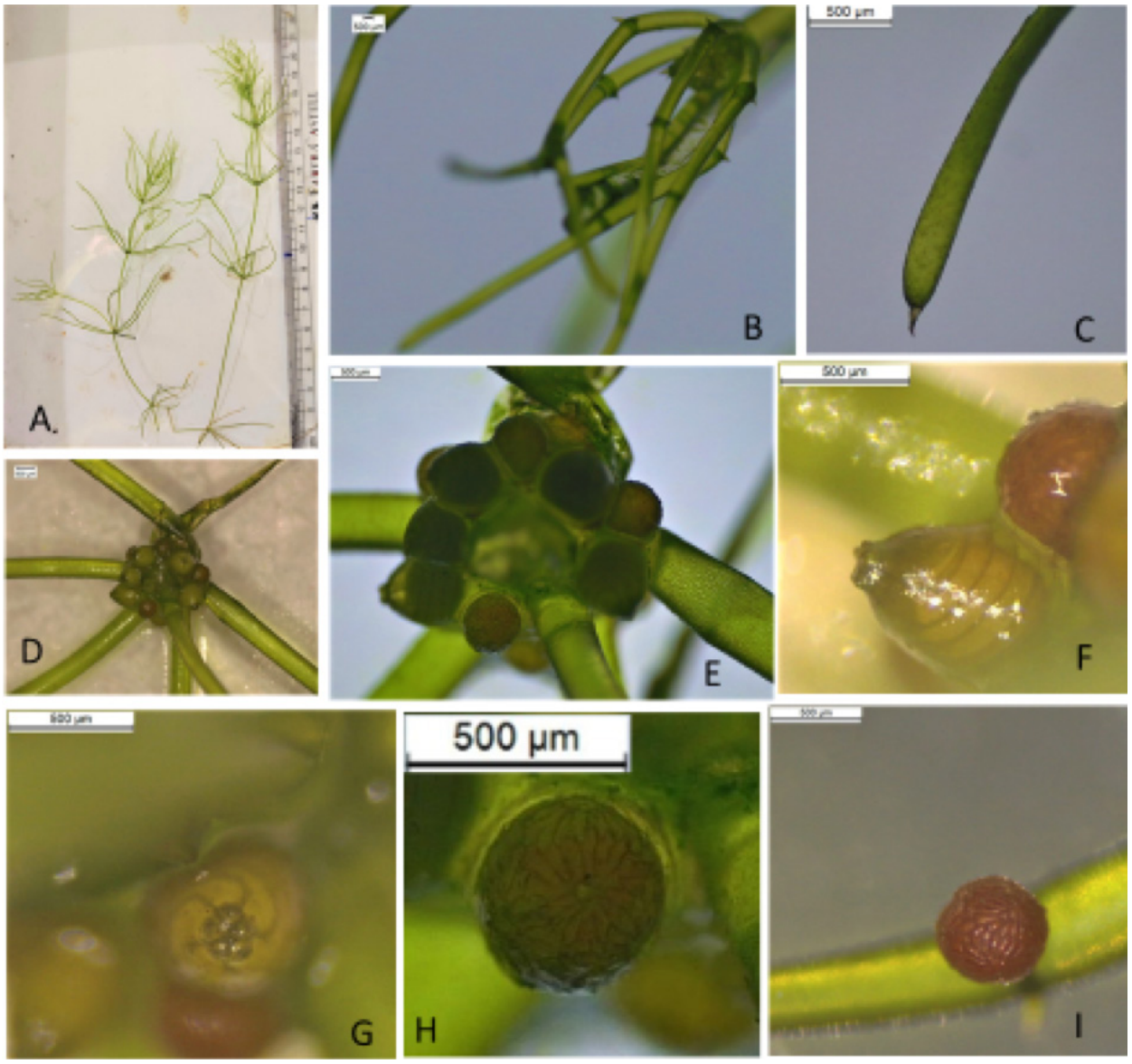

Image 1. Light microscopic photographs of *Chara corallina* var. *kamrupensis*: A–D—Morphology | A—Whole plant body | B—Apical end showing bracts and branchlet with segments | C—Single branchlet with dactyl | D—A whorl of branchlet | E–I—Reproductive structures | E—Aggregated gametangia | F—A pair of antheridium and oogonium | G—Oogonium showing coronula cells and spirals | H—A octascutate antheridium with triangular shield cells | I—A matured antheridium. © Bhattacharjee and Kalita.

differences (Table 1) of the studied species from these accepted varieties due to the presence of sterile lower nodes and bracts, a critical morphological distinguishing feature (Pal et al. 1962). The absence of bracts in *C. corallina* var. *portonovensis* (Subramanian, 2002) and rudimentary or sometimes absent (Choi & Kim 1996) in *C. corallina* var. *kyusyensis* could make us convinced to differentiate this variety form the other two. The studied species closely resembles *C. corallina* var. *portonovensis* in branchlet morphology but differs from *C. corallina* var. *kyusyensis* due to its lower sterile branchlets (Choi & Kim 1996; Subramanian 2002). The studied variety possesses a bunch of extremely smaller antheridia of having a size of less than 500 µm also established this study taxon as a new variety (Table 2). Though there have been insufficient SEM investigations to distinguish between the varieties of *C. corallina*, an effort was made to observe the gametangia sizes that underscore with facts and figures as an authenticated novel variety.

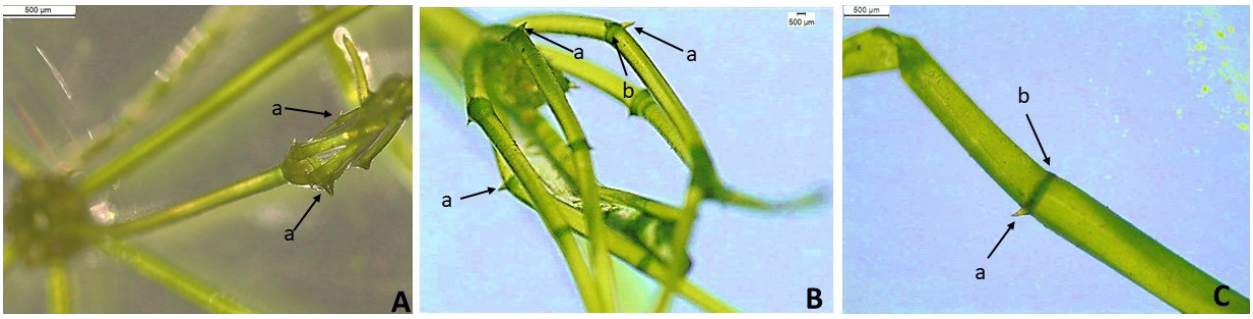

Image 2. Light microscopic photographic images of *Chara corallina* var. *kamrupensis*: A–C—Bracts on the nodes of the branchlets (a—Bracts | b—Nodes on branchlets). © Bhattacharjee and Kalita.

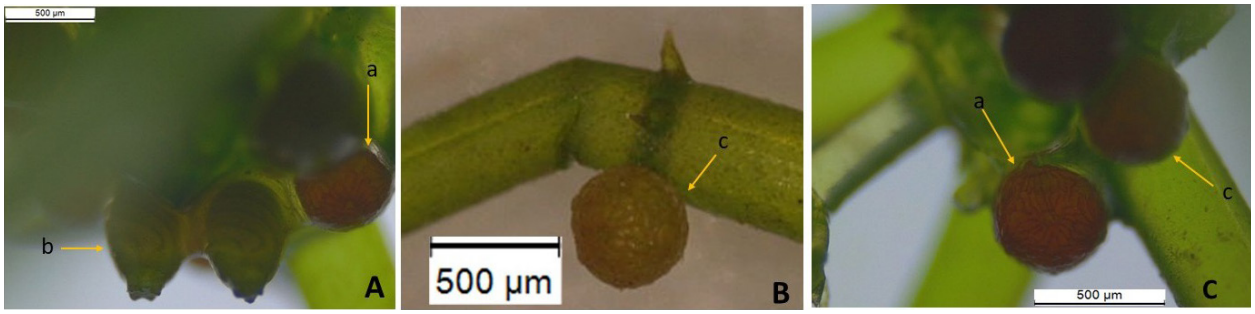

Image 3. Light microscopic photographic images of *C. corallina* var. *kamrupensis*: A–C—Antheridia and oogonia at different maturity stages (a—Mature, ripened, brick reddish antheridia | b—Young and premature oogonia | c—Yellowish-green premature antheridia). © Bhattacharjee and Kalita.

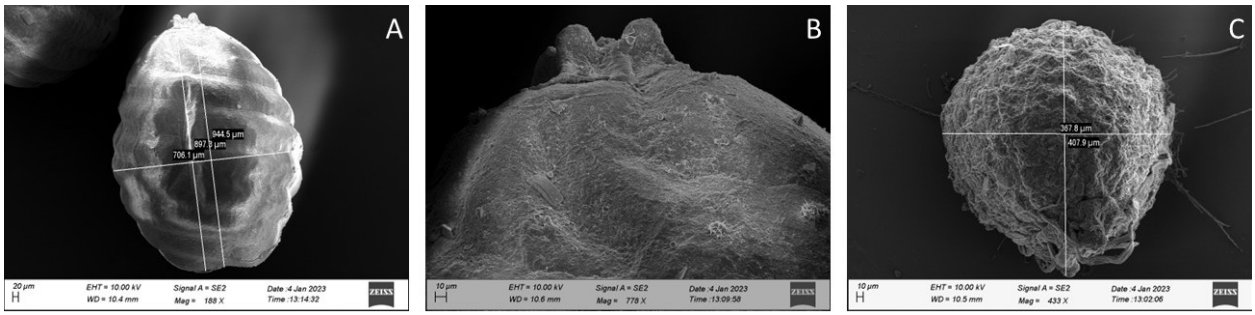

Image 4. Scanning electron microscopic photograph well developed reproductive structures of *Chara corallina* var. *kamrupensis*: A—Mature oval oogonium with eight convulations | B—Coronula cells of oogonium | C—Mature spherical to slightly oblong antheridium. © Rakesh Talukdar, CIF, Gauhati University.

Table 1. Comparison between the vegetative features of accepted varieties of Chara corallina with the new variety.

Features	***C. corallina*** var. ***portonovensis*** D. Subramanian (Subramanian 2002)	***C. corallina*** var. ***kyusyensis*** K.Imahori (Choi & Kim 1996)	***C. corallina*** var. ***kamrupensis*** var. nov.
Plant body	Monoecious, lower node sterile	Monoecious, lower node fertile	Monoecious, lower node sterile
Height	Up to 23 cm	Up to 30 cm	Up to 40 cm
Thickness	4,000 µ	1,000 µ	450–650 µ
Stipulodes	ND	Degenerated	Rudimentary
Bracts	Absent at the upper node	Rudimentary or absent or degenerated	Present (3 in a whorl), throughout the body (Images 1B, 2A,B,C)
Branchlets	Six branchlets in a whorl with 5–6 segments	Six branchlets in a whorl with five segments	Six branchlets in a whorl with 3–4 segments (Images 1A, 2A,B)

Table 2. Comparison of reproductive structure of accepted varieties of *Chara corallina* with the new variety.

Characteristics	***C. corallina*** var. ***portonovensis*** D.Subramanian (Subramanian 2002)	***C. corallina*** var. ***kyusyensis*** K. Imahori (Choi & Kim 1996)	***C. corallina*** var. ***kamrupensis*** (Studied Species)
Oogonia	Large, orange, 2,500–2,600 µm in length; 1,200–1,300 µm in breadth.	700 µm in length; 450 µm in breadth.	Moderate, Greenish, 940–1,000 µm in length; 700–750 µm in breadth. (Images 1E,F,G, 4A,B)
Antheridia	Very large, orange, 1,335 µm in diameter	480–640 µm in diameter	Very small, Brick reddish, 367–407 µm in diameter (Images 1E,F,H,I, 3A,B,C, 4C)
Coronula	235 µm long, 200 µm broad	120 µm long, 270 µm broad	40–47 µm long, 25–30 µm broad (Images 1G, 4B)

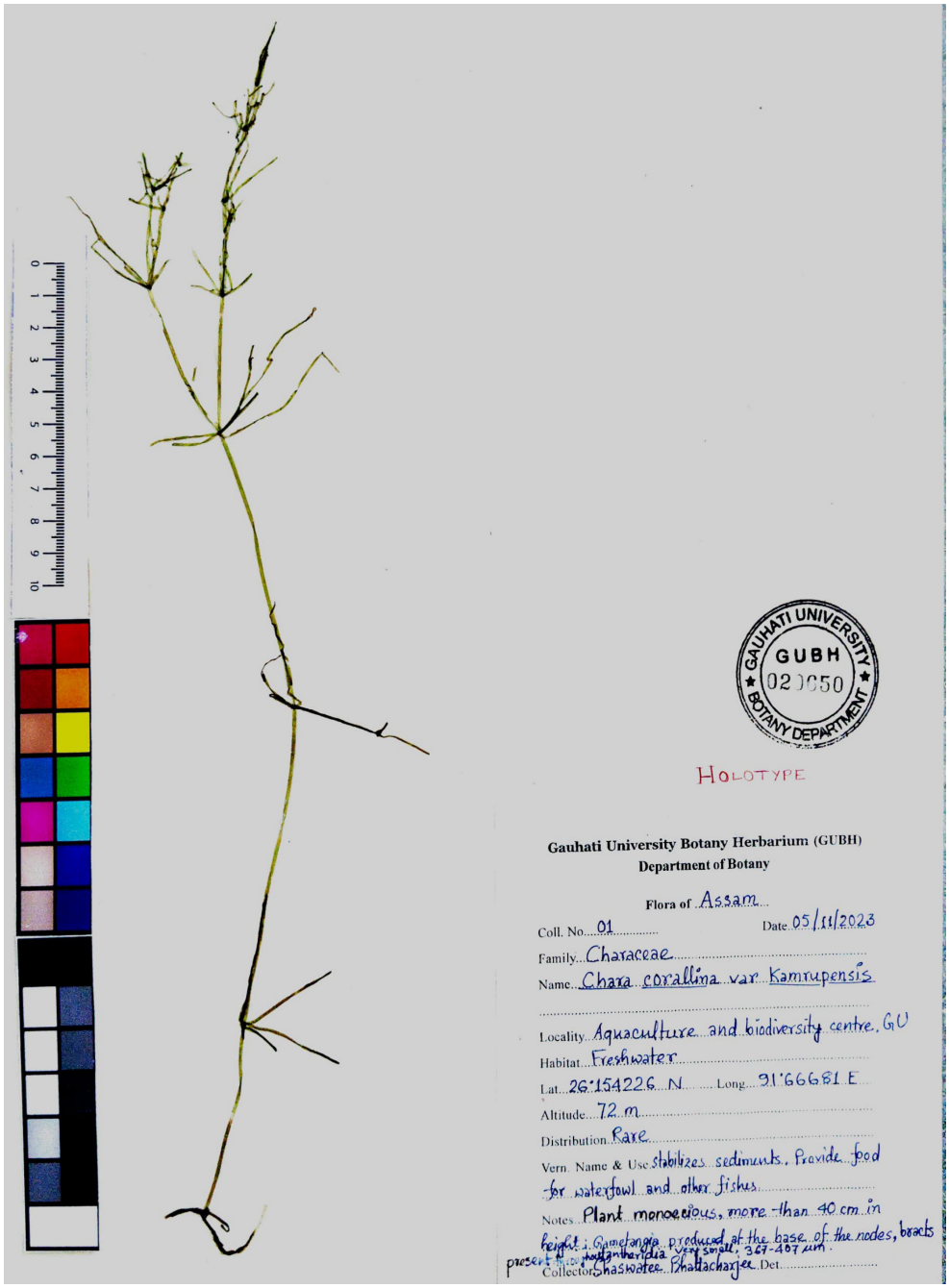

Image 5. Holotype of *C. corallina* var. *kamrupensis* (GUBH 20650) from Aquaculture and Biodiversity centre. © Bhattacharjee and Kalita.

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