

FOUR NEW RECORDS FOR THE VASCULAR FLORA OF BANGLADESH

GAZI MOSHAROF HOSSAIN*, SHAYLA SHARMIN SHETU
AND SALEH AHAMMAD KHAN

*Department of Botany, Jahangirnagar University, Savar,
Dhaka-1342, Bangladesh*

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Abstract

This study records two species of Pteridophytes, viz., *Hemionitis cordata* Roxb. ex Hook. & Grev. and *Ophioglossum nudicaule* L.f. of Pteridaceae and Ophioglossaceae, and two species of Angiosperms, viz., *Bacopa australis* V.C. Souza and *Salvia misella* Kunth of Plantaginaceae and Lamiaceae, respectively, for the first time in Bangladesh, based on the plant specimens collected during the recent botanical explorations conducted in selected areas of Bagerhat, Barguna, and Cumilla districts. A detailed taxonomic description with key characters, notes on ecology, uses, distribution, distinctness from other similar taxa, representative specimens examined, and photographs of each of these four species have been provided.

Introduction

Bangladesh, as an integrated part of the Indian-Subcontinent Centre of Plant Diversity (Vavilov, 1926) and the South Asian Mega Centre of Genetic Diversity (Chowdhury, 1996), harbours almost all groups of plants in its 148,460 sq. km. area. Within the territory of Bangladesh, a total of around 6,612 species of green plants have so far been recorded, in contrast to the flexible estimate of 11,650 plant species for the country (Khan 1977; Ahmed *et al.*, 2007, 2008–2009, 2009a, b; Siddiqui *et al.*, 2007; Sarker and Hossain, 2009; Begum *et al.*, 2014; Rahman and Khatun, 2014; Tabassum, 2018; Alfassane *et al.*, 2019; Tabassum *et al.*, 2020; Dong and Haque, 2021; Sultana and Rahman, 2021; Sultana *et al.*, 2022; Jone *et al.*, 2022; Rahman *et al.*, 2022; <http://bforest.portal.gov.bd>). Nevertheless, the publication of 329 new records of vascular plants following the report of a total of 3,813 species for the vascular flora of Bangladesh (Siddiqui *et al.*, 2007; Ahmed *et al.*, 2008–2009, 2009a) raises the total number of recorded vascular plant species in this country to around 4,142 (Sultana and Rahman, 2021; Hossain *et al.*, 2022; Rahman *et al.*, 2022; Sultana *et al.*, 2022; Uddin and Uddin, 2022).

During our botanical explorations conducted in 2019–2022, in different areas of Bagerhat, Barguna and Cumilla districts, including the Sundarbans and Tengragiri Mangrove Forests, many specimens of vascular plants were collected and housed in the Jahangirnagar University Herbarium (JUH). Recently, we found that some of these specimens do not match any known plant species in Bangladesh. After a detailed taxonomic investigation, we identified a few of these specimens belonging to two Pteridophyte species, namely, *Hemionitis cordata* Roxb. ex Hook. & Grev. of family Pteridaceae and *Ophioglossum nudicaule* L. f. of Ophioglossaceae, and a few other specimens associated with two Angiosperm species, namely, *Bacopa australis* V.C. Souza and *Salvia misella* Kunth of Plantaginaceae and Lamiaceae, respectively. These species have never been reported earlier in any taxonomic literature published so far on the flora of Bangladesh (e.g., Hooker, 1872–1897; Prain, 1903a, b; Siddiqui *et al.*, 2007; Ahmed *et al.*, 2008–2009, 2009a; Rahman *et al.*, 2015; Haque *et al.*, 2018; Shetu *et al.*, 2018, 2022; Uddin and Hassan, 2018;

*Corresponding author, email: gazibotju@gmail.com

Hossain *et al.*, 2019, 2020, 2021, 2022; Khanam *et al.*, 2020; Roy and Khan, 2020a, b; Khan *et al.*, 2021a, b; Islam *et al.*, 2022). Therefore, these four species have been reported here as the new records of vascular plant species for Bangladesh.

Materials and Methods

The plant specimens of *B. australis* and *H. cordata* were collected from Lalmai hill and its adjacent areas in Cumilla district; specimens of *O. nudicaule* from the coastal areas of Bagerhat (Sundarbans East Wildlife Sanctuary) and Barguna (Tengragiri Eco Park) districts; and those of *Salvia misella* from Mongla port area of Bagerhat district, during our recent floristic explorations conducted in 2019–2022. The collected specimens were processed, dried, and managed using standard herbarium techniques (Singh and Subramaniam, 2008). These specimens were critically examined in the Plant Systematics and Biodiversity Laboratory of Jahangirnagar University. Their taxonomic identification was confirmed through consulting the experts and taxonomic descriptions and keys available in the relevant literature (Hooker, 1885; Prain, 1903a, b; Li and Hedge, 1994; Stevens *et al.*, 2001; Hammel *et al.*, 2003–2014; Cui *et al.*, 2004; Mirza, 2007a, b; Khanam, 2009; Rahman, 2009; Gangmin *et al.*, 2013; Xianchun *et al.*, 2013; Sosa *et al.*, 2018), matching with the relevant voucher specimens of the Jahangirnagar University Herbarium (JUH) and Bangladesh National Herbarium (DACB), and digital images of the respective voucher specimens available on the websites of different international herbaria, including Herbarium of Royal Botanic Gardens (K) and Muséum National d'Histoire Naturelle (P).

Nomenclatural details and worldwide distribution were fetched from the most recent and relevant taxonomic publications (Li and Hedge, 1994; Cui *et al.*, 2004; Gangmin *et al.*, 2013; Xianchun *et al.*, 2013) and databases (e.g., GBIF Secretariat, 2022; IPNI, 2023; POWO, 2023; Tropicos, 2023; WFO, 2023). The taxonomic descriptions were produced in the Plant Systematics and Biodiversity Laboratory, Department of Botany, Jahangirnagar University, after consulting the relevant representative specimens, field notes on ecology, and photographs of mature individuals, collected during field surveys.

Results and Discussion

Hemionitis cordata Roxb. ex Hook. & Grev., Icon. Filic. t. 64 (1828). *Parahemionitis cordata* (Hook. & Grev.) Fraser-Jenk (1997), *Mickelopteris cordata* (Hook. & Grev.) Fraser-Jenk. (2016).

(Fig. 1)

A terrestrial, erect herb, 20–35 cm tall when fertile fronds develop. Rhizomes dark brown, erect, short, 1.5–2.5 cm long, with numerous scales, and fibrous roots. Scales brownish to reddish brown, narrowly lanceolate, 1.75–2.25 mm long. Roots many, fibrous, profusely branched, with numerous root hairs. Sterile fronds 6–12 per plant, 7.0–12.5 cm long; stipes 3.0–5.5 cm long, reddish brown, densely with 1.0–1.5 mm long brown hairs; lamina 8.5–9.5 × 3.5–5.5 cm, simple, dorsiventral, adaxially light green and glabrous, abaxially yellowish green, sparsely with 0.5 mm long broad base white hairs, narrowly cordate, base cordate, entire or repand with dense, small whitish hairs, and reduced with maturity. Fertile fronds 4–7 per plant; stipe much longer than that of the sterile frond, 15–20 cm long, reddish brown, sparsely with 1.0–1.5 mm long brown hairs; lamina 7.2–10.8 × 3.2–5.3 cm, abaxially light green, adaxially deep green, sagittate, base sagittate to sub-cordate, abaxially sparse, 1.0–1.5 mm long white, broad base brownish hairs along veins, adaxially glabrous, sparse reddish-brown hairs around the margins, apex obtuse or rounded. Sori black to brown, confluent throughout the abaxial surface along the veins when mature.

Sporophytic stage: October to February.

Ecology: On the shady place of the hill slope.

Uses: This plant is used as an ornamental herb in shade houses.

Distribution: This species is native to Cambodia, China, India, Indonesia, Laos, Malaya, Myanmar, the Philippines, Sri Lanka, Taiwan, and Viet Nam (POWO, 2023). In Bangladesh, this species is recorded in the Lalmai Hill area of the Cumilla district. As Bangladesh belongs to the historical native range of the Indian subcontinent, this species is most probably native to this country.

Representative specimens examined: **Cumilla:** Lalmai, Lalmai Hill, 26.10.2022, G.M. Hossain 7415; S.S. Shetu 4044 (JUH).



Fig. 1. *Hemionitis cordata* Roxb. ex Hook. & Grev. a) Habit (fertile stage) ($\times 0.3$), b) Habit (vegetative stage) ($\times 0.3$), c) Root system ($\times 0.3$), d) Stipe hairs ($\times 15$), e) Stem scale ($\times 30$), f) A sterile lamina (adaxial surface) ($\times 0.3$), g) A sterile lamina (abaxial surface) ($\times 0.3$), h) A fertile lamina ($\times 0.45$) with sori ($\times 15$) (inset).

In Bangladesh, only one species of the genus *Hemionitis* L., namely *H. arifolia* (Burm. f.) T. Moore has been reported before (Mirza, 2007a). *H. cordata* can be distinguished by its sagittate or narrowly cordate lamina with a sagittate to cordate base and reddish-brown stipes and hairs, in contrast to the narrowly ovate lamina with a deeply cordate base and nearly black stripes with brown hairs of *H. arifolia*.

Ophioglossum nudicaule L.f., Suppl. Pl. 433 (1782). Type: South Africa, Cape of Good Hope, Thunberg s.n. (UPS-25286). *O. capense* Sw. (1803), *O. ellipticum* Hook. & Grev. (1831), *O. vulgatum* var. *nudicaule* (L.f.) D.C. Eaton (1860), *O. dendroneuron* E.P.St. John (1938), *O. nudicaule* var. *typicum* R.T. Clausen (1938). (Fig. 2)

A terrestrial, small, erect herb, 3–8 (–10) cm tall. Rhizomes erect, 3.0–4.5 mm height with 2.0–2.5 mm diam., very thick, and with fibrous roots. Roots unbranched, yellowish to pale brown,

1.5–2.5 cm long, with 0.5–1.0 mm diam. Stem cylindrical, pale green, upright, 0.5–1.8 cm, 0.8–1.5 mm diam., most parts being buried underground, usually bearing 1–2 (3) fronds per plant. Sterile lamina 1.2–1.8 × 0.4–0.6 cm; trophophore stalk 2–4 mm, trophophore blade spreading, green, elliptic or elliptic-ovate, 1.0–1.5 × 0.4–0.6 cm, fleshy, cuneate, entire, acute or rounded; Venation indistinct due to thick and fleshy texture of blade. Fertile spikes arise from the base of the sterile lamina, 2.8–8.5 cm long, light green, cylindrical. Sporophore 2.5–7.5 cm long, 0.7–1.0 mm diam.; sporangial clusters 0.8–1.3 cm long, 1.0–1.5 mm diam., apex acute, usually bearing 10–18 pairs of sporangia.

Sporophytic stage: July to November.

Ecology: Moist sand and clay soils in shady-habitats.

Uses: It is used as medicine in the treatment of anti-inflammatories and wounds and as a vegetable or salad.

Distribution: This species is native to Cape Province, South Africa. It is reported from Argentina, Africa, Australia, Brazil, French Guiana, Guyana, Mexico, Peru and the United States of America (POWO, 2023). In Bangladesh, it is recorded in the coastal habitats of Bagerhat (Sundarbans East Wildlife Sanctuary) and Barguna (Tengragiri Eco Park) districts.

Representative specimens examined: **Bagerhat:** Sharankhola, Katka, 19.08.2019, G.M. Hossain 0249 (JUH); **Barguna:** Taltoli, Tengragiri, 05.09.2022, G.M. Hossain 5892 (JUH).



Fig. 2. *Ophioglossum nudicaule* L.f. a) Natural habitat (×0.3), b) Habit (×0.6), c) A fertile spike with sporangia and spores (×5), d) A spike without spore (×4).

In Bangladesh, five species of *Ophioglossum* L., viz., *O. costatum* R. Br., *O. pendulum* L., *O. petiolatum* Hook., *O. polyphyllum* A. Braun ex Schub., and *O. reticulatum* L., have been reported previously (Mirza, 2007b). *O. nudicaule* is clearly distinct from these species of *Ophioglossum* by

its stem height, sterile lamina size, shape, venation, etc. *O. nudicaule* differs from *O. pendulum* by its terrestrial habit and elliptic, erect sterile laminas, in contrast to the epiphytic habit and ribbon-shaped pendulous sterile laminas of *O. pendulum*. *O. nudicaule* can be easily distinguished from *O. costatum*, *O. petiolatum*, *O. polyphyllum*, and *O. reticulatum* by possessing a plant height of up to 10 cm, a sterile lamina length of less than 3 cm, and indistinct venation as compared to the latter's having a 10 cm plant height and a more than 5 cm long sterile lamina with apparent reticulate venation.

Bacopa australis V.C. Souza., Acta Bot. Bras. 15(1): 58 (2001). Type: Brazil. Paraná. Capanema, río Iguazú, J. Lindeman & H. Haas 3358 (HT: MBM!, IT: K!). (Fig. 3)

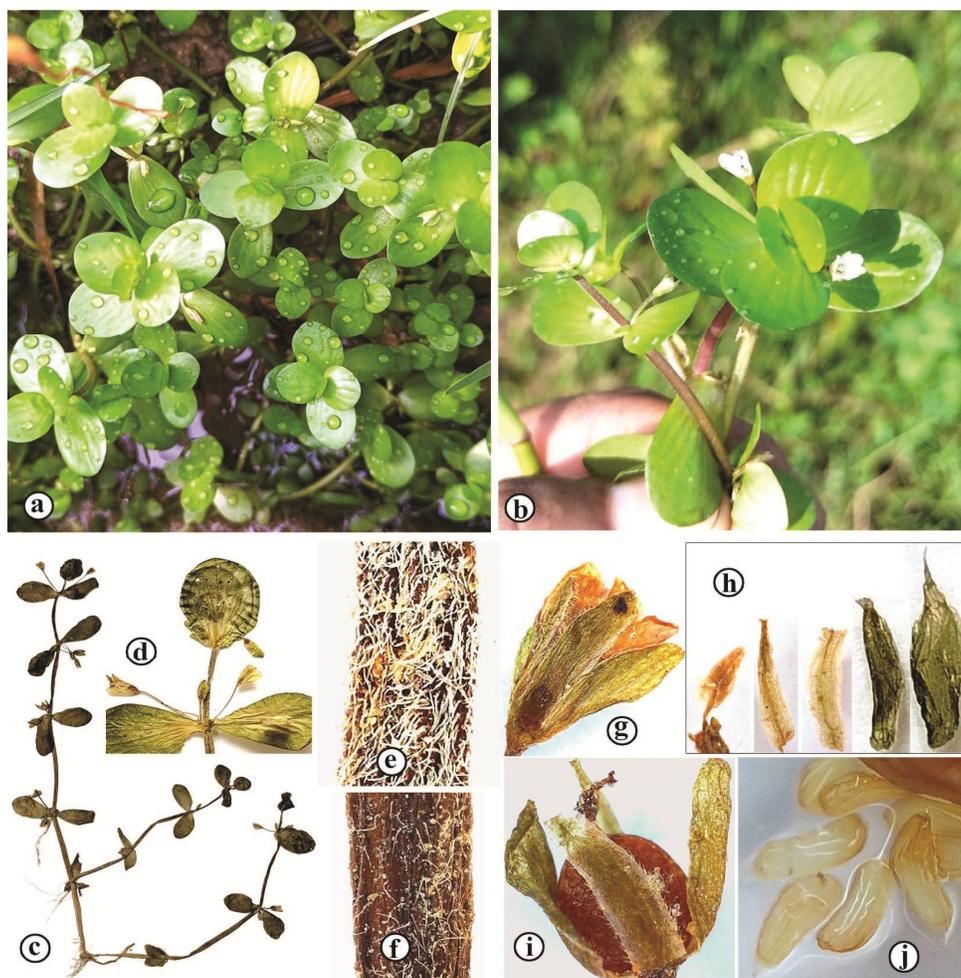


Fig. 3. *Bacopa australis* V.C. Souza. a) Natural habitat ($\times 0.45$), b) Habit with flowering branches (fresh) ($\times 0.75$), c) Whole plant (dry sample) ($\times 0.25$), d) Flowering branch (dry) ($\times 0.75$), e) Dense hairs on apical internode ($\times 15$), f) Sparse hairs on median internode ($\times 15$), g) A flower (dry) ($\times 4$), h) Calyx ($\times 5$), i) A fruit with persistent calyx ($\times 4$), j) Seeds ($\times 30$).

An annual, prostrate, aquatic, or amphibious herb, up to 15 cm tall. Roots fibrous, arising from lower nodes with dense and fine short hair. Stems stout, green or reddish, succulent, prostrate with ascending tips, strigose or villous, denser towards the apex; internodes slender, 2.5–3.5 cm long. Leaves simple, opposite, entire, sessile, 1.0–1.8 cm × 0.7–1.4 cm, fleshy and thick but very thin and fragile when dry, broadly spatulate to orbicular, shallowly cordate to rounded or broadly angled at the base, slightly clasping the stem, rounded at the tip, the venation palmate with 6–8 main veins, glabrous at maturity, adaxial surface glassy. Inflorescences axillary, solitary, or 2–3 per leaf axil. Flowers bisexual, zygomorphic, pedicellate, 0.5–2.5 cm long, sub-glabrous or sparsely pubescent, bracteoles absent; calyx 5-lobed, the outer 3 lobes leaf-like, green and the inner 2 inconspicuous, the external dorsal lobe ovate to broadly ovate, 3.5–4.5 × 2.2–3.0 mm, apex rounded, base cordate, hispid towards the apex; the two lateral lobes ovate, 3.5–4.2 × 1.7–2.0 mm, apex obtuse, base cordate, hispid; the two internal lobes linear, 2–3 × 0.4–0.5 mm, apex acute, hispid on the margins; corolla 5-lobed, glabrous, tubular, 2.5–4.5 mm long, white; stamens 4, not exerted, the anthers attached near the midpoint, the anther sacs parallel, staminodes absent; ovary bilocular, glabrous, style not exerted, bifid, apex smooth. Fruits a capsule, globose to broadly ellipsoid, 3.5–3.8 × 1.7–2.0 mm long, glabrous, usually enclosed within a persistent calyx, dehiscent longitudinally by 4 valves. Seeds numerous, 0.4–0.6 mm long, ellipsoid to cylindrical, with a minute tail-like appendage at each end and a yellowish-brown surface with a network of fine ridges.

Flowering and fruiting: June to December.

Ecology: On mud in ditches and paddy fields.

Uses: The stems and leaves of this species are eaten by wildlife.

Distribution: This species is native to Argentina, Brazil, and Paraguay (POWO, 2023). In Bangladesh, this species seems to be introduced.

Representative specimens examined: **Cumilla:** Lalmai, 26.10.2022, S.S. Shetu 4171; G.M. Hossain 7413 and 7414 (JUH).

In Bangladesh, two species of *Bacopa* Aubl., viz., *B. hamiltoniana* Wettst. and *B. monnieri* (L.) Pennell., have been reported previously (Rahman, 2009). *B. australis* differs from *B. hamiltoniana* and *B. monnieri* by its pubescent stems, broadly spatulate to orbicular leaves, and ebracteate flowers, in contrast to the glabrous stems, linear-lanceolate to oblong-ob lanceolate leaves and bracteate flowers of the latter two species.

Salvia misella Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 2: 290 1818. *S. riparia* Kunth (1818), *S. obscura* Benth. (1833), *S. privoides* Benth. (1846), Type: Mexico: Guerrero, Humboldt & Bonpland s.n. (HT: P-Bonpl., P00670423, image!). **(Fig. 4)**

An annual to perennial, erect or decumbent terrestrial herb, up to 1 m tall, with a strong and unpleasant odour. Stems quadrangular, pubescent, with simple, unbranched white hairs, reddish-tinged, swollen above nodes. Leaves simple, sessile; leaf blades membranous, deltoid ovate, lanceolate-ovate or rhombic-ovate, 4.5–8.0 × 2–4 cm, acute, crenate-serrate along the distal margins, the bases narrowed, obtuse to truncate or rarely attenuate, sparsely pubescent with short hairs on both surfaces but more on abaxial surface. Inflorescence terminal racemes, up to 20 cm long with 6 to 15 interrupted verticils of 1–2 flowers in each, pubescent with glandular-capitate hairs. Bracts broadly ovate and long-acuminate, or rhomboid, ca 4.5–5.0 × 2.0–2.5 mm long, persistent, glabrous inside, glandular-pilose outside. Flowers pedicellate, ca 1.0–1.5 mm long, zygomorphic; calyx green, zygomorphic, tubular or campanulate, 3.5–5.0 mm long, clothed, bilabiate, prominently veined (the upper lip mostly 5–9-veined), densely covered with capitate glandular hairs persisting in fruit; corolla tubular, ca 2.5 mm long, blue with white streaks, naked

within, the upper lip ca 1.2–1.8 mm long, the lower lip weakly 3-lobed, ca 3.0–3.5 mm long; stamens 2, included, filaments 1.2–1.3 mm long, pubescent, connective produced, adnate towards the lower half of anther; anthers slender, ca 0.6–0.8 mm long; styles 5–6 mm long, included, slender, glabrous; stigmas 2-lobed, lobes flattened. Fruits a mericarp, oblong, ca 1.5 mm long, grey with dark streaks, mucilaginous when wet. Seeds greyish to brown, obovate with highly reticulate venation.

Flowering and fruiting: November to February.

Ecology: Found to grow along the roadside in moist and semi-shady habitats.

Uses: This species is considered a weed in Tropical America (Richardson and Keng, 2010).

Distribution: This species is native to Belize, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panamá, Peru, Puerto Rico, United States of America (Florida), and Venezuela. It is introduced to Australia, Central Africa, India, and Indonesia (POWO, 2023). In Bangladesh, it has been recorded from wild habitats along the roadside near the Mongla Port area of the Bagerhat district. This species is most probably introduced to Bangladesh.

Representative specimens examined: **Bagerhat**: Mongla (near Mongla port area), 22.12.2021, G.M. Hossain 2951 and 5805; S.S. Shetu 3891 (JUH).

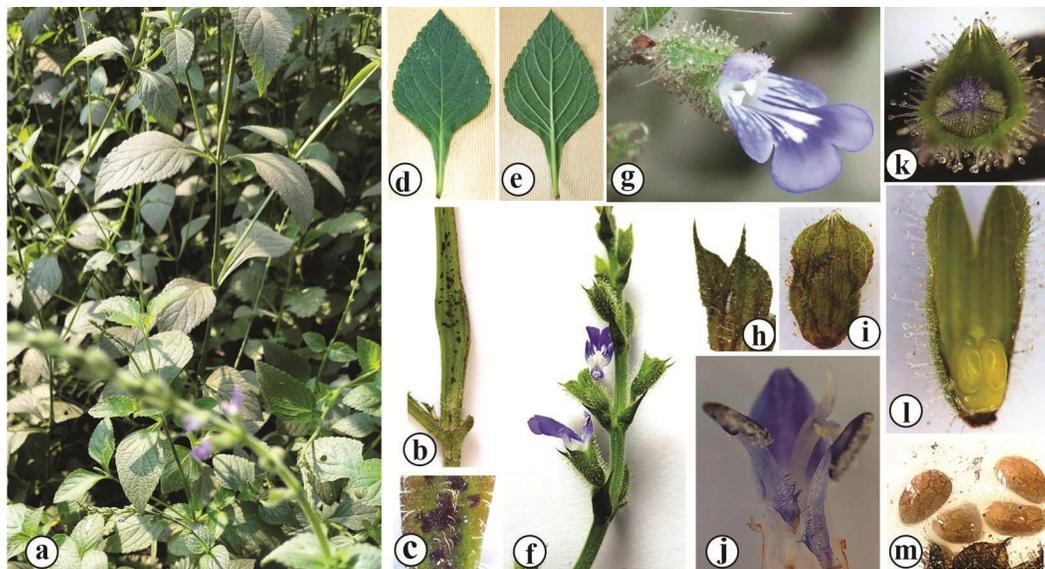


Fig. 4. *Salvia misella* Kunth. a) Habit ($\times 0.25$), b) Stem with swollen part and reddish tinged dots ($\times 0.8$), c) Stem hairs ($\times 3.5$), d) A leaf (adaxial surface) ($\times 0.30$), e) A leaf (abaxial surface) ($\times 0.3$), f) An inflorescence ($\times 1$), g) A flower ($\times 3.75$), h) Calyx (lower lips) ($\times 3$), i) Calyx (upper lip) ($\times 3$), j) Anthers and stigma ($\times 10$), k) Ovary (top view) with glandular hairs on calyx tube ($\times 6$), l) Ovary (lateral view) with glandular hairs on calyx ($\times 7$), m) Seeds ($\times 6.5$).

In Bangladesh, four species of *Salvia* L., viz., *S. coccinea* Juss. ex Murr, *S. leucantha* Cav., *S. plebeia* R.Br., and *S. splendens* Sellow ex Rome & Schult., have been reported so far (Khanam, 2009). *S. misella* is clearly distinct from *S. splendens* by its deltoid, sparsely pubescent leaves, deep green calyx, and 5–6 mm long corolla, in contrast to *S. splendens*'s ovate, glabrous leaves, red calyx, and 4.5 cm long corolla. *S. misella* is a herb with a green calyx, while *S. leucantha* is a

subshrub with a purple calyx. *S. misella* differs from *S. coccinea*'s campanulate and deep red or scarlet, 2 cm long corolla by its tubular, purple, 5–6 mm long corolla. *S. misella* is different from *S. plebeia* by its deltoid ovate leaves and bluish-purple corolla, in contrast to *S. plebeia*'s elliptic-lanceolate leaves and white corolla.

References

- Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2007. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 3. Asiatic Society of Bangladesh, Dhaka, 812 pp.
- Ahmed, Z.U., Hassan, M.A., Begum, Z.N.T., Khondker, M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2008-2009. Encyclopedia of Flora and Fauna of Bangladesh. Vols. 6–8, 12. Asiatic Society of Bangladesh, Dhaka.
- Ahmed, Z.U., Hassan, M.A., Begum, Z.N.T., Khondker, M., Kabir, S.M.H., Ahmad, M. and Ahmed, A.T.A. (Eds). 2009a. Encyclopedia of Flora and Fauna of Bangladesh. Vols. 9–10. Asiatic Society of Bangladesh, Dhaka.
- Ahmed, Z.U., Khondker, M., Begum, Z.N.T., Hassan, M.A., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2009b. Encyclopedia of Flora and Fauna of Bangladesh. Vol. 4. Asiatic Society of Bangladesh, Dhaka, 543 pp.
- Alfasane, M.A., Bhuiyan, R.A., Jolly, J.A. and Islam, S. 2019. *Azolla microphylla* Kaulf. (Salviniaceae): A new pteridophytic record for Bangladesh. Bangladesh J. Plant Taxon. **26**(2): 325–327.
- Begum, S., Islam, R. and Ara, T. 2014. Gymnosperms of Bangladesh: Diversity of Gymnospermic Plants in Bangladesh. Lap Lambert Academic Publishing, pp. 1–64.
- Chowdhury, M.S.U. 1996. Bangladesh: country report to the FAO international technical conference on plant genetic resources, Leipzig, pp. 1–112.
- Cui, H., Li, Z., Wei, L. and Hoggard, R.K. 2004. Plantaginaceae. In: Wu, Z.Y., Raven P.H. and Hong D.Y. (Eds), Flora of China. Vol. 19 (Acanthaceae, Plantaginaceae, Viburnaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, pp. 495–503.
- Dong, S. and Haque, A.K.M.K. 2021. A taxonomic study on *Pteris* L. (Pteridaceae) of Bangladesh. Bangladesh J. Plant Taxon. **28**(1): 131–140.
- Gangmin, Z., Liao, W., Mingyan, D., Lin, Y., Wu, Z., Xianchun, Z., Dong, S., Prado, J., Gilbert, M.G., Yatskievych, G., Ranker, T.A., Hooper, E.A., Alverson, E.R., Metzgar, J.S., Funston, M., Masuyama, S. and Kato, M. 2013. Pteridaceae. In: Wu, Z.Y., Raven P.H. and Hong D.Y. (Eds), Flora of China. Vol. 2 (Aspleniaceae, Pteridaceae, Woodsiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, pp. 169–256.
- GBIF Secretariat, 2022. GBIF Backbone Taxonomy. <https://doi.org/10.15468/39omei> Accessed via <https://www.gbif.org/species> accessed via GBIF.org on 2023-06-11.
- Hammel, B.E., Grayum, M.H., Herrera, C. and Zamora, N. 2003-2014. Manual de Plantas de Costa Rica. Missouri Botanical Garden Press.
- Haque, A.K.M.K., Khan, S.A., Uddin, S.N. and Shetu, S.S. 2018. An annotated checklist of the angiospermic flora of Rajkandi Reserve Forest of Moulvibazar, Bangladesh. Bangladesh J. Plant Taxon. **25**(2): 187–207.
- Hooker, J.D. 1872–1897. The Flora of British India. Vols. I–VII. L. Reeve & Co., Ashford, Kent, UK.
- Hooker, J.D. 1885. The Flora of British India. Vol. IV. Indian Reprint 1992. L. Reeve & Co. Ltd., Kent, England and Bishen Singh Mahendra Pal Singh, Dehra Dun, India, pp. 1–780.
- Hossain, G.M., Khan, S.A., Rahim, M.A., Rahman, M.S., and Islam, K.M.N. 2021. Floristic composition of the coastal district Satkhira, Bangladesh. Bangladesh J. Plant Taxon. **28**(1): 97–124.
- Hossain, G.M., Khan, S.A., Rahman, M.S., and Rahim, M.A. 2020. New records of three species and a variety of angiosperms for Bangladesh. Bangladesh J. Plant Taxon. **27**(2): 251–260.

- Hossain, G.M., Khan, S.A., Rahman, M.S., Sharma, S., Rahim, M.A. and Khan, M.R.I. 2019. New records of three species and a genus of angiosperms for Bangladesh. *Bangladesh J. Plant Taxon.* **26**(2): 149–156.
- Hossain, G.M., Khan, S.A., Shetu, S.S., Rahman, M.S., Ahmed, F.A. and Ali, M.H. 2022. Floristic Survey of Vascular Plants in Coastal District Bagerhat of Bangladesh. *Bangladesh J. Plant Taxon.* **29**(1): 43–78.
- IPNI, 2023. International Plant Names Index. Published on the Internet <http://www.ipni.org>, The Royal Botanic Gardens, Kew, Harvard University Herbaria & Libraries and Australian National Herbarium.
- Islam, M.R., Hossain, G.M. and Rahman, M.M. 2022. An annotated checklist of the vascular flora of coastal mangrove ecosystems of Barguna district, Bangladesh. *Bangladesh J. Plant Taxon.* **29**(2): 403–429.
- Jone, M.J.H., Ashrafuzzaman, M. and Pramanik, M.H.R. 2022. Pteridophytes (Ferns and Fern Allies) diversity in Bangladesh Agricultural University Botanical Garden. *Journal of Bangladesh Agricultural University* **20**(2): 122–132.
- Khan, M.S. 1977. Onagraceae. *In*: Khan, M.S. (Ed). *Flora of Bangladesh*. Fasc. **6**: 1–10. Bangladesh National Herbarium, BARC, Dhaka.
- Khan, S.A., Hossain, G.M., Shetu, S.S., Rahim, M.A., Islam, M.S., Ahmed, F.A. and Fairy, R.H. 2021b. A preliminary taxonomic study on the flora of Rangpur district, Bangladesh. *Bangladesh J. Plant Taxon.* **28**(2): 329–365.
- Khan, S.A., Sultana, S., Hossain, G.M., Shetu, S.S., and Rahim, M.A. 2021a. Floristic composition of Jahangirnagar University Campus - A semi-natural area of Bangladesh. *Bangladesh J. Plant Taxon.* **28**(1): 27–60.
- Khanam, M. 2009. *Salvia* (Lamiaceae). *In*: Ahmed, Z.U., Hassan, M.A., Begum, Z.N.T., Khondker, M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). *Encyclopedia of Flora and Fauna of Bangladesh*, Bangladesh. Vol. **8**. Asiatic Society of Bangladesh, Dhaka, pp. 324–327.
- Khanam, R., Khan, S.A. and Rahim, M.A. 2020. Angiosperms in Narsingdi district of Bangladesh: Class Magnoliopsida. *Bangladesh J. Plant Taxon.* **27**(1): 153–271.
- Li, X. and Hedge, I.C. 1994. Lamiaceae. *In*: Wu, Z.Y., Raven P.H. and Hong D.Y. (Eds), *Flora of China*. Vol. **17** (Verbenaceae, Lamiaceae, Solanaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, pp. 50–299.
- Mirza, M.M. 2007a. *Hemionitis* (Pteridaceae). *In*: Siddiqui, K.U., Islam, M.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Rahman, M.M., Kabir, S.M.H., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2007. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. **5**. Asiatic Society of Bangladesh, Dhaka, Bangladesh, pp. 255–256.
- Mirza, M.M. 2007b. *Ophioglossum* (Ophioglossaceae). *In*: Siddiqui, K.U., Islam, M.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Rahman, M.M., Kabir, S.M.H., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2007. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. **5**. Asiatic Society of Bangladesh, Dhaka, Bangladesh, pp. 208–212.
- POWO, 2023. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; <http://www.plantsoftheworldonline.org>/Retrieved 05 June 2023.
- Prain, D. 1903a. *Bengal Plants*. Vols. **1 & 2**. Indian reprint 1963. Botanical Survey of India, Calcutta, pp. 1–1013.
- Prain, D. 1903b. *The Flora of Sundarbans*. Records of Botanical Survey of India. Vol. **II**. No. 4. The Government Central Printing Office, Calcutta, India, pp. 231–270. *Rec. Bot. Surv. Ind.* **2**(4): 231–270.
- Rahman, M.O. 2009. *Bacopa* (Scrophulariaceae) *In*: Ahmed, Z.U., Hassan, M.A., Begum, Z.N.T., Khondker, M., Kabir, S.M.H., Ahmad, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. **10**. Asiatic Society of Bangladesh, Dhaka, pp. 233–235.
- Rahman, M.S. and Khatun, H. 2014. Four new records of Acrocarpous mosses for Bangladesh, *Bangladesh J. Bot.* **43**(3): 301–308.
- Rahman, M.S., Hossain, G.M., Khan, S.A. and Uddin, S.N. 2015. An annotated checklist of the vascular plants of Sundarbans Mangrove Forest of Bangladesh. *Bangladesh J. Plant Taxon.* **22**(1): 17–41.

- Rahman, M.S., Sultana, M., Rahman, N. and Tariqul, M. 2022. Three new angiosperm records for Bangladesh. *Bull. Bangladesh National Herb.* **8**: 103–106.
- Richardson, A. and Keng, K. 2010. *Plants of Deep South Texas: A Field Guide to the Woody and Flowering Species*. A & M University Press, Texas, 457 pp.
- Roy, G.K. and Khan, S.A. 2020a. Preliminary taxonomic study on homestead flora of four districts of Bangladesh: Magnoliopsida. *Bangladesh Journal of Plant Taxon.* **27**(1): 37–65.
- Roy, G.K. and Khan, S.A. 2020b. Preliminary taxonomic study on homestead flora of four districts of Bangladesh: Liliopsida (Monocotyledons) and Pteridophyta. *Bangladesh J. Plant Taxon.* **27**(2): 407–425.
- Sarker, S.K. and Hossain A.B.M.E. 2009. Pteridophytes of greater Mymensingh district of Bangladesh used as vegetables and medicines. *Bangladesh J. Plant Taxon.* **16**(1): 47–56.
- Shetu, S.S., Hossain, G.M., Khan, S.A. and Rahim, M.A. 2022. An inventory of vascular flora of Lamai Hills and their adjacent areas of Cumilla district, Bangladesh. *Bangladesh J. Plant Taxon.* **29**(2): 203–240.
- Shetu, S.S., Khan, S.A. and Uddin, S.N. 2018. Checklist of angiosperms extant in Mirpur area of Dhaka city. *Jahangirnagar Univ. J. Biol. Sci.* **7**(2): 47–64.
- Siddiqui, K.U., Islam, M.A., Ahmed, Z.U., Begum, Z.N.T., Hassan, M.A., Khondker, M., Rahman, M.M., Kabir, S.M.H., Ahmed, M., Ahmed, A.T.A., Rahman, A.K.A. and Haque, E.U. (Eds). 2007. *Encyclopedia of Flora and Fauna of Bangladesh*. Vols. **5** & **11**. Asiatic Society of Bangladesh, Dhaka, Bangladesh.
- Singh, H.B. and Subramaniam, B. 2008. *Field Manual on Herbarium Techniques*. National Institute of Science Communication and Information Resources, pp. 1–297.
- Sosa, M.D.L.M., Moroni, P. and O’leary, N. 2018. A taxonomic revision of the genus *Bacopa* (Gratiolaceae, Plantaginaceae) in Argentina. *Phytotaxa* **336**(1): 001–027.
- Stevens, W.D., Ulloa, C.U., Pool, A. and Montiel, O.M. 2001. *Flora de Nicaragua*, Tropicós Project. Loaded from Tropicós Project: October 2017.
- Sultana, M. and Rahman, M.S. 2021. *Justicia comata* (L.) Lam. (Acanthaceae). A new angiosperm record for Bangladesh. *Bull. Bangladesh National Herb.* **7**: 145–148.
- Sultana, M., Rahman, M.S., Hoque, M.A. and Uddin, S.N. 2022. Discovery of three new records of angiosperm for Bangladesh from Sylhet Division. *Bull. Bangladesh National Herb.* **8**: 93–102.
- Tabassum, N. 2018. A taxonomic account of pteridophytic flora of Adampur forest, Moulvibazar District, Bangladesh. *Dhaka Univ. J. Biol. Sci.* **27**(1): 101–111.
- Tabassum, N., Begum, M. and Rahman, M.O. 2020. *Jungermannia exertifolia* steph. - a new Bryophyte record from Bangladesh, Dhaka Univ. J. Biol. Sci. **29**(1): 133–136.
- Tropicós, 2023. Tropicós.org. <www.tropicós.org>. Missouri Botanical Garden, Saint Louis, Missouri, USA.
- Uddin, M.S. and Uddin, S.B. 2022. *Struchium sparganophorum* (L.) Kuntze (Asteraceae): a new angiosperm record for the flora of Bangladesh. *Bangladesh J. Plant Taxon.* **29**(2): 431–435.
- Uddin, S.N. and Hassan, M.A. 2018. *Vascular Flora of Chittagong and the Chittagong Hill Tracts: Vols. 1–3*. Bangladesh National Herbarium, Zoo Road, Mirpur 1, Dhaka.
- Vavilov, N.I. 1926. *Studies on the origin of cultivated plants*. Leningrad: Institute of Applied Botany and Plant Breeding, 78 pp.
- WFO, 2023. World Flora Online. Published on the Internet; <http://www.worldfloraonline.org>.
- Xianchun, Z., Liu, Q. and Sahashi, N. 2013. Ophioglossaceae. *In*: Wu, Z.Y., Raven P.H. and Hong D.Y. (Eds), *Flora of China*. Vol. **2** (Aspleniaceae, Ophioglossaceae, Woodsiaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis, pp. 73–80.

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