

Notes on the aquatic ferns in West Bengal, India

M. Chowdhury¹, Anurag Chowdhury and A. P. Das

Plant Taxonomy & Environmental Biology Lab., Department of Botany, University of North Bengal, Siliguri 734013, Darjeeling, West Bengal, India
E-mails: mono_malda@yahoo.co.in; anuragchowdhury10@gmail.com & apdas.nbu@gmail.com

¹*Corresponding author*

[Received 22.03.2015; Revised 17.05.2015; Accepted 24.05.2015; Published 30.06.2015]

Abstract

Recent survey on the distribution of true aquatic ferns and fern allies in different fresh and salt water wetlands of West Bengal recorded the occurrence of eight species. These are enumerated in the article along with their protologues, local names, description, sporulating time, distribution, use, identification Key and photographs.

Key words: Aquatic ferns, Wetlands, Distribution, West Bengal

INTRODUCTION

Wetlands are the unique fragile ecosystems having great importance of their biodiversity. These are the wet habitats including marshes, swamps, bogs, fens and similar areas lies between the land and water interface to form *ecotonal* zone provide enormous supports to form a rich biodiversity (Tiner 1999; Mitsch & Gosselink 1986; Clark 1954; Odum 1959). Among various micro and macrophytes, pteridophytes are one of the common and crucial inhabitants in various water bodies. Over 1200 species of fern and fern allies have been reported from the territory of India (Dixit 1984; Chandra 2000). Indian wetlands are quite rich of various species of fern and fern allies (Mehra & Bir 1964; Cook 1996; Singh & Upadhyay 2012). West Bengal is one of the bottle neck states of Eastern India having wide range of fresh and salt water wetlands distributed from the hills of Darjeeling, Terai-Duars of northern parts, gangetic plains to the mangroves in southernmost part. It lies between 85°50' and 89°50' E longitude and 21°38' and 27°10' N latitude and covering a total of 88,752 km², sharing international border with Bangladesh along with its east side and with Nepal and Bhutan on its North-West and North-East sides respectively. The water bodies of this state are very rich in aquatic and semi-aquatic macro-flora including fern and fern allies (Chowdhury & Das 2009, 2010, 2011, 2013, 2014).

MATERIALS AND METHODS

Floristic and ecological survey on the wetlands of West Bengal was initiated by this laboratory earlier in 2003 and is continued till date, mainly through random sampling. Plants were collected from different water bodies and processed to prepare mounted herbarium sheets following Jain & Rao (1977). Identification was done by using different taxonomical literature (Prain 1903; Ghosh *et al.* 2004) and confirmed by matching at NBU and CAL. Binomial and author citation of the entire collected voucher specimens were verified through checking with The Plant List (www.theplantlist.org), The International Plant Name Index (IPNI) and Index Kweinsis (IK). The voucher specimens are deposited at NBU-Herbarium.

OBSERVATION AND ENUMERATION

The present article is focused mainly on true aquatic ferns *i.e.*, epiphydrates, hyperhydrates and pleustophyte and wet loving or terrestrial invaders are not included in this article. Considering this, eight species of six genera representing 5 families were recorded during this study. Keys of recorded taxa, taxonomic details, vernacular names, photographs are provided for their easy recognition.

Key to the families:

- 1a. Habit like onion plants or grass like; corm small button like, underground; sporangia at leaf base **Isoetaceae**
- 1b. Plants otherwise **2**
- 2a. Plants free floating; fronds/ leaves sessile **Salviniaceae**
- 2b. Plants rooted; fronds/ leaves with distinct stipe **3**
- 3a. Leaflets 4, palmate; sporangia in specialized minute sporocarps **Marsileaceae**
- 3b. Leaves simple, deeply pinnatisect; sporangia in large fertile fronds.. **Pteridaceae**

SALVINIACEAE Saguier, Fl. Veron. 3: 52. 1754.

Key to the Genera:

- 1a. Sporocarps in pair; leaves minute, imbricate; roots present, simple **Azolla**
- 1b. Sporocarps in cluster; leaves dimorphic, floating ones entire; submerged leaves much dissected, root-like **Salvinia**

AZOLLA Lamarck, Encycl. Meth. 1. 343. 1783.

Azolla pinnata R. Brown in Prodr. 167. 1810; Prain, Beng. Pl. 2: 1266. 1903. Holttum, Fl. Malaya 2: 621. 1968; Cook, Aqua. Wetl. Pl. Ind. 22.1996. Ghosh *et al.*, Pterid. Fl. East. Ind. 1: 184. 2004. [Plate I; Fig. E]

Small, triangular, free floating ferns; roots hanging downward. Fronds two lobed, close together. Sori indusiate on submerged lobes of leaf; microsporangium many with microspores; megasporangia few with one megaspore.

Fertile: May - August.

Exiccatus: Gabgachi-chatral Beel complex, *Monoranjan & AP Das 0150* dated 24.09.2003; Mahananda Barrage, *Anurag & AP Das 0864*, dated 19.03.2012.

Distribution: Tropical Asia; throughout the Bengal- plains; abundant.

Uses: Plants widely used as green manure.

SALVINIA Seguir, Plantae Veronenses 3. 1754.

Key to the species:

- 1a. Floating leaves multiaxillary; leaves large, spongy and crowded ... *S. adnata*
- 1b. Floating leaves uniaxillary; leaves smaller, neither crowded nor spongy ... **2**
- 2a. Floating leaves solitary, cup shaped *S. cucullata*
- 2b. Floating leaves flat, not cup shaped *S. natans*

Salvinia adnata Desvaux, Mem. Soc. Linn. Paris 6: 177. 1827. *Salvinia molesta* D.S. Mitchell, Brit. Fern. Gaz. 10 (5): 251 – 252. 1972; Cook, Aqua. Wetl. Pl. Ind. 30. 1996. Ghosh *et al.*, Pter. Fl. East. Ind. 1: 179. 2004. [Plate I; Fig. C]

Floating, aquatic ferns. Frond compressed, oval, folded, covered with arching, spongy. Sporocarps globose, densely hairy, short stalked. Macrosporocarps 2 - 3, with 20 – 25 macrosporangia. Microsporocarps pubescent, sessile or sub-sessile, containing mostly empty microsporangia.

Fertile: November – March.

Exiccatus: Gabgachi-chatral Beel complex, *Monoranjan & AP Das 5150* dated 24.09.2003; Gajoldoba, *Anurag & AP Das 01012*, dated 04.05.2013.

Distribution: Native to S America, naturalized in tropics of old World; abundant in water bodies of southern and central parts of West Bengal; less common in North Bengal.

Uses: Sometimes used as green manure.

Salvinia cucullata Roxburgh *ex* Bory in C.P. Belanger, Voy. Indes. Or. 2(1): 6. 1833; Roxburgh, Calc. Jour. 4: 470. 1844; Prain, Beng. Pl. 2: 1265. 1903; Cook, Aqua. Wetl. Pl. Ind. 29. 1996. [Plate I; Fig. B]

Free floating, rhizome hairy. Uppermost fronds in row, entire, edged infolded, papillae not regular. Sporocarps in cluster, globose, on submerged leaves. Around 55 sporocarps in 2 rows, first 2 – 3 with macrosporocarp and rest with microsporocarp.

Fertile: May – December.

Exiccatus: Gabgachi-chatral beel complex, *Monoranjan & AP Das 0070*, dated 02.10.2003; Gajoldoba, *Anurag & AP Das 01018*, dated 04.05.2013.

Distribution: Endemic to NE India & Myanmar; throughout the plains of North Bengal; abundant.

Uses: Plant used as green manure.

Salvinia natans (Linnaeus) Allioni, Fl. Pedemont. 2: 289. 1785; Prain, Beng. Pl. 2: 1265. 1903; Ghosh *et al.*, Pterido. Fl. East. Him. 181. 2004. *Mersilea natans* Linnaeus, Sp. Pl. ed. 2: 1099. 1762. *Salvinia verticillata* Roxburgh *ex* Griffith, Calc. J. Nat. Hist. 4: 469. 1844. [Plate I; Fig. A]

Free floating ferns, rhizome hairy. Uppermost frond flat, ovate to oblong, upper surface with hooked papillae, stalk hairy. Sporocarps arise from nodes, globose, hairy, contains 25 microsporangia in each.

Fertile: November – March.

Exiccata: Boalia beel, *Monoranjan & AP Das 0071*, dated 2.11.2003; Gajoldoba, *Anurag & AP Das 01018*, dated 04.05.2013.

Distribution: Europe, SE Asia, Russia, Japan; throughout the Bengal-plains; abundant.

Uses: Plant used as green manure.

ISOETACEAE Dumortier, Anal. Fam. Pl. 67. 1829.

CALAMARIA Boehmer, Def. Gen. Pl. ed. 3. 1760.

Calamaria coromandelina (Linnaeus *f.*) Kuntze, Revis. Gen. Pl. 2: 828. 1891. *Isoetes coromandelina* Linnaeus *f.*, Suppl. Pl. Sys. Veg. ed. 13: 47. 1781; Panigrahi, Biol. Mem. 6 (2): 131. 1981; Cook, Aqua. Wetl. Pl. Ind. 23.1996. [Plate I; Fig. D]



PLATE - I: Aquatic pteridophytes of West Bengal: A. *Salvinia natans* (Linnaeus) Allioni; B. *Salvinia cucullata* Roxburgh ex Bory; C. *Salvinia adnata* Desvoux; D. *Calamaria coromandelina* (Linnaeus f.) Kuntze [photo by: Dr. D. Maity]; E. *Azolla pinnata* R. Brown; F. *Ceratopteris thalictroides* (Linnaeus) Brongniart; G. *Marsilea minuta* Linnaeus

Emergent plants with 3 lobed rhizomorph or corm. Leaves widely spreading, membranous, stomata numerous. Ligule conspicuous, velum absent. Megasporengia large, circular or ovate. Megaspores flattened, tubercled. Microspores red-brown, smooth or rugose to papillate.

Fertile: July – February.

Exiccata: Kaliaganj, *Monoranjan & AP Das 4171*, dated 21.12.2005.

Distribution: India, Nepal, Myanmar, China, Thailand and Vietnam; throughout the Bengal-plains; now very rare and difficult to spot in nature.

Note: *Isoetes brachyglossa* A. Braun (Synonym: *I. coromandelina* L. f. subsp. *brachyglossa* (A. Braun) Panigrahi published in Biological Memoirs; International Journal of Biological Disciplines. Lucknow on 6(2): 131. 1981?); distributed in N.E. India (including W. Bengal) (Chandra *et al.* 2008). Present survey failed to trace the species from the state

MARSILEACEAE Mirbel in Lamarck & Mirbel, Hist. Nat. Veg. 5: 485. 1754.

MARSILEA Linnaeus, Sp. Pl. 2: 1099. 1753.

Marsilea minuta Linnaeus, Mant. 308. 1771; Prain, Beng. Pl. 2: 1266. 1903. Sledge, Bot. J. Linn. Soc. 84: 22. 1982; Cook, Aqua. Wetl. Pl. Ind. 26.1996. ‘*Susni Saak*’ [Plate I; Fig. G]

Aquatic with creeping rhizome; roots borne usually on nodes, stipes scattered, usually green. Leaves emerging, leaflets four, sessile arranged cross-wise at the tip. Sporocarps borne at the nodes in alternate clusters.

Fertile: January – April.

Exiccatus: Gabgachi-chatral beel complex, *Monoranjan & AP Das 0108*, dated 26.09.2003; Gajoldoba, *Anurag & AP Das 0922*, dated 22.03.2013.

Distribution: Tropical Africa and Asia; throughout the Bengal-plains; abundant.

Uses: Young fronds edible; a good sleep inducer.

Note: *Marsilea quadrifida* Linnaeus is sometimes confused with *Marsilea minuta* Linnaeus. *M. minuta* Linnaeus is quite frequently occurring marshland fern but *M. quadrifida* Linnaeus is not recorded from the state boundary. *M. quadrifida* Linnaeus is Eurasian species, naturalized in N. America; in India it is restricted to NW Himalayas (Cook 1996).

PTERIDACEAE E.D.M. Kirchner, Schul_-Bot. 109, 1831

CERATOPTERIS Brongniart, Bull. Sci. Soc. Philom. Paris 186. 1821.

Key to the species:

- 1a. Sterile frond 2-3 pinnate; stipe 7 – 30 cm long..... *C. thalictroides*
- 1b. Sterile frond mostly simple or palmately lobed or cordate; stipe 5 – 9 cm long
..... *C. pteridoides*

Ceratopteris pteridoides (Hooker) Hieronymus, Bot. Jahrb. Syst. 34: 561. 1905. Lloyd, Brittonia 26 (2): 156. 1974; Cook, Aqua. Wetl. Pl. Ind. 28. 1996. *Parkeria pteridoides* Hooker, Exot. Fl. 2: plate 147. 1825. [Plate I; Fig. F]

Plants floating or rooted. Sterile leaves simple, palmate to cordate to ovate, petiole usually inflated. Fertile leaves deltate to cordate to reniform. Sporangia usually crowded between segment midvein and revolute margin. Spores 32 per sporangium.

Fertile: November – January.

Exiccata: Road-side ditches (Talma), Anurag & AP Das 0872, dated 16.03.2013.

Distribution: Cosmopolitan; throughout the Bengal- plains; common.

Uses: Young fronds edible.

Ceratopteris thalictroides (Linnaeus) Brongniart, Bull. Soc. Philom. Paris 3, 8: 186. 1821; Prain, Beng. Pl. 2: 1246. 1903; Cook, Aqua. Wetl. Pl. Ind. 29. 1996. *Acrostichum thalictroides* Linnaeus, Sp. Pl. 2: 1070. 1753.

Marshy, annual, erect fern. Stem with scales and roots. Leaves dimorphic, sterile frond slightly dissected; fertile fronds highly dissected. Lamina base cordate. Sporangia arranged on lower side of fertile frond.

Fertile: September – December.

Exiccatus: Gabgachi-chatral beel complex, Monoranjan & AP Das 0151 dated 24.09.2003; Gajoldoba, Anurag & AP Das 0903, dated 22.03.2013.

Distribution: Pantropical; throughout the Bengal-plains; Abundant.

Uses: Young fronds edible and also used as cooling agent.

DISCUSSION

Apart from these eight true aquatic ferns a good number of wet loving pteridophytes are also recorded from the peripheral regions of various water bodies. *Equisetum diffusum* D. Don, *Allantodia sikkimensis* (C.B. Clarke) Ching, *Allantodia solenopteris* Kuntze, *Asplenium ensiforme* Wallich ex Hooker, *Diplazium esculentum* (Retzius) Swartz, *Blechnum orientale* Linnaeus, *Nephrolepis auriculata* (Linnaeus) Trimen, *Dryopteris sparsa* (Hamilton ex D. Don) O. Kuntze, *Tectaria coadunata* (Wallich ex J. Smith) C. Christensen, *Dicranopteris linearis* (Burman f.) Underwood, *Adiantum caudatum* Linnaeus, *Cheilanthes anceps* Blanford, *Selaginella monospora* Spring are small herbs and *Lygodium microphyllum* (Cavanilles) R. Brown, *Lygodium flexuosum* (Linnaeus) Swartz are climbing ferns growing with satisfactory population nearby or on moist ditches or water bodies. *Acrostichum aureum* Linnaeus is only salt tolerant fern species growing in halophytic condition of mangrove or back mangrove forests of Sunderban areas. Local and poor people along with all the tribal communities of West Bengal are commonly uses the fronds of *Marsilea minuta* Linnaeus and *Diplazium esculanta* (Retzius) Swartz as vegetables as well as medicines. Farmers are uses *Azolla pinnata* R. Brown mixing with *Salvinia natans* (Linnaeus) Allioni and *S. cuculata* Roxburgh ex Bory as green manure specially in low laying paddy fields.

From the distribution point of view *Calamaria coromandelina* was known to be a rare plant in West Bengal. Only few populations were known. However, this may due to its too much similarity in habitat, habit and sedge-like external appearance in the wild condition. But, the present scenario is extremely bad as it is now quite difficult to trace the species even in their well-known habitats. So, the proper conservation strategies need to be developed and implement immediately before it is completely lost from its Bengal-habitat.

Acknowledgements

Authors are thankful to the Director, Botanical Survey of India for permitting them to work at CAL. Also, they like to convey thanks and complement to Dr. Debabrata Maity, Assistant Professor of Botany, Calcutta University for sharing the photograph of *Calamaria coromandelina* with us for this article.

LITERATURE CITED

- Chandra, S. 2000. *The ferns of India (Enumeration, Synonyms & Distribution)*. International Book Distributors, Dehradun, India. (i-xii) pp. 1-459.
- Chandra, S.; Fraser-Jenkins, C. R.; Kumari, A. & Srivastava, A. 2008. A Summary of the Status of Threatened Pteridophytes of India. *Taiwania*, 53(2): 170 – 209.
- Chowdhury, M. & Das, A.P. 2009. Inventory of some ethno-medicinal plants in wetlands areas in Maldah district of West Bengal. *Pleione* 3(1): 83 – 88.
- Chowdhury, M. & Das, A. P. 2010. Hydrophytes of different wetlands in the Maldah district of West Bengal, India. *Envir. Biol. Consr.* 15: 22 – 28.
- Chowdhury, M. & Das, A.P. 2011. Macrophytic diversity and community structure of *Adh soi* wetland of Maldah district of Paschimbanda, India. In C. Ghosh & A.P. Das (Eds.) *Recent Studies In Biodiversity And Traditional Knowledge In India*. Gour Mahavidhyalaya, Malda & Sarat Book House, Kolkata. Pp. 109 – 115.
- Chowdhury, M. & Das, A.P. 2013. Present status of flora, fauna and vegetation structure in the wetlands of Maldah district of West Bengal, India. *NBU J Pl. Sc.* 7(1): 29-34.
- Chowdhury, M & Das, A.P. 2014. Plant diversity and community structure of Hazar Takia palustrine of central West Bengal, India. *NBU J. Pl. Sc.* 25-35.
- Clark, G.L. 1954. *Elements of ecology*. John Wiley & Sons, Inc., New York.
- Cook, C.D.K. 1996. *Aquatic and Wetland Plants of India*. Oxford Publication. Pp.385.
- Dixit, R.D. 1984. *A Census of the Indian Pteridophytes*. Botanical Survey of India, Howrah-India. (i-iii) pp. 1-177.
- Ghosh, S.R.; Ghosh, B.; Biswas, A. & Ghosh, R.K. 2004. *The Pteridophytic Flora of Eastern India*. Vol. 1. Botanical Survey of India, Kolkata.
- Jain, S.K. & Rao, R.R. 1977. *A Handbook of Field and Herbarium Methods*. Today & Tomorrow's Printers and Publishers, New Delhi.
- Mehra, P.N. & Bir, S.S. 1964. Pteridophytic flora of Darjeeling and Sikkim Himalayas. *Res. Bull. Punjab Uni. Sci.* 15: 169-182.
- Mitsch, W.I. & Gosselink, I. G. 1986. *Wetlands*. Van Nostrand Reinhold, New York. 198.
- Odum, E.P. 1959. *Fundamentals of Ecology*, 2nd ed. W.B. Saunder Co. Philadelphia and London. Pp. 546.
- Prain, D. 1903. Bengal Plants. Vol. 2. W & Co. Printer & Publisher, Calcutta. Pp. 660-666.
- Singh, B.P & Upadhyay, R. 2012. Aquatic pteridophytes diversity of Hoshangabad Madhya Pradesh, India. *Asian J. Sc. Tech.* 4: 11. 045-049.
- Tiner, W.L. 1999. *Wetland Indicators: A Guide to Wetland Identification, Delineation, Classification, and Mapping*. Lewis Publishers, New York.