

Diversity of Some Members of Podostemaceae in Meghalaya, North-east India

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ABSTRACT

The members of Podostemaceae are popularly known as "river-weeds". They have markedly specialized and are adapted to extreme habitats such as river-rapids and waterfalls. The members have unique morphological, anatomical and ecological features and stand clearly apart from all other angiospermous families. The diversity within this family is remarkable, resembling that of Algae, Bryophytes and Lichens. The present paper describes the three species from Meghalaya, viz. *Hydrobryum griffithii* (Wall. ex Griff.) Tul., *Podostemum subulatus* Gard. and *Polypleurum wallichii* (R. Br. ex Griff.) Warm. which are of great phytogeographical interests.

Key words: *Hydrobryum griffithii* (Wall. ex Griff.) Tul., *Podostemum subulatus* Gard., *Polypleurum wallichii* (R. Br. ex Griff.) Warm., Meghalaya, north-east India.

Introduction

The family Podostemaceae is the only representative of the order Podostemales, it consists of aquatic angiosperms that typically grow on rocks in cascades, waterfalls and rapids where there are great fluctuations in water levels in the river. They grow firmly attached to rocks and stones by means of adhesive rhizoid-like root system or haptera that secrete mucilage. The vegetative plants grow submerged during the rainy season, but are exposed to air when the water level recedes, followed by flowering and fruit setting, dehydrating and eventually dying.

The plants are cosmopolitan in tropical and warm regions, extending into temperate north-east America and east Asia. The

pioneering work on Podostemaceae in India was carried out by Willis (1902a, b). There are about 48 genera and 270 species worldwide; of which, about 11 genera and 42 species are reported from India (Cook, 1996; Mohan Ram and Seghal, 2001; Mathew, 2003). There are 21 endemic species, largely confined to Kerala and Karnataka. The previous floristic studies of north-east India (Haridasan and Rao, 1985; Joseph, 1982; Balakrishnan, 1983) did not mention anything about the existence of Podostemaceae members in Meghalaya state, India. However, Kanjilal and Bor (1940) reported two species of Podostemaceae, which too, they referred from Hooker's Flora of British India (1885). The present paper deals with three members from Meghalaya, viz., *Hydrobryum griffithii* (Wall. ex Griff.) Tul., *Podostemum subulatus* Gard. and *Polypleurum wallichii* (R. Br. ex Griff.) Warm. which are of great phytogeographical interest. The voucher specimens have been deposited at the Botanical Survey of India, Eastern Circle, Shillong, India.

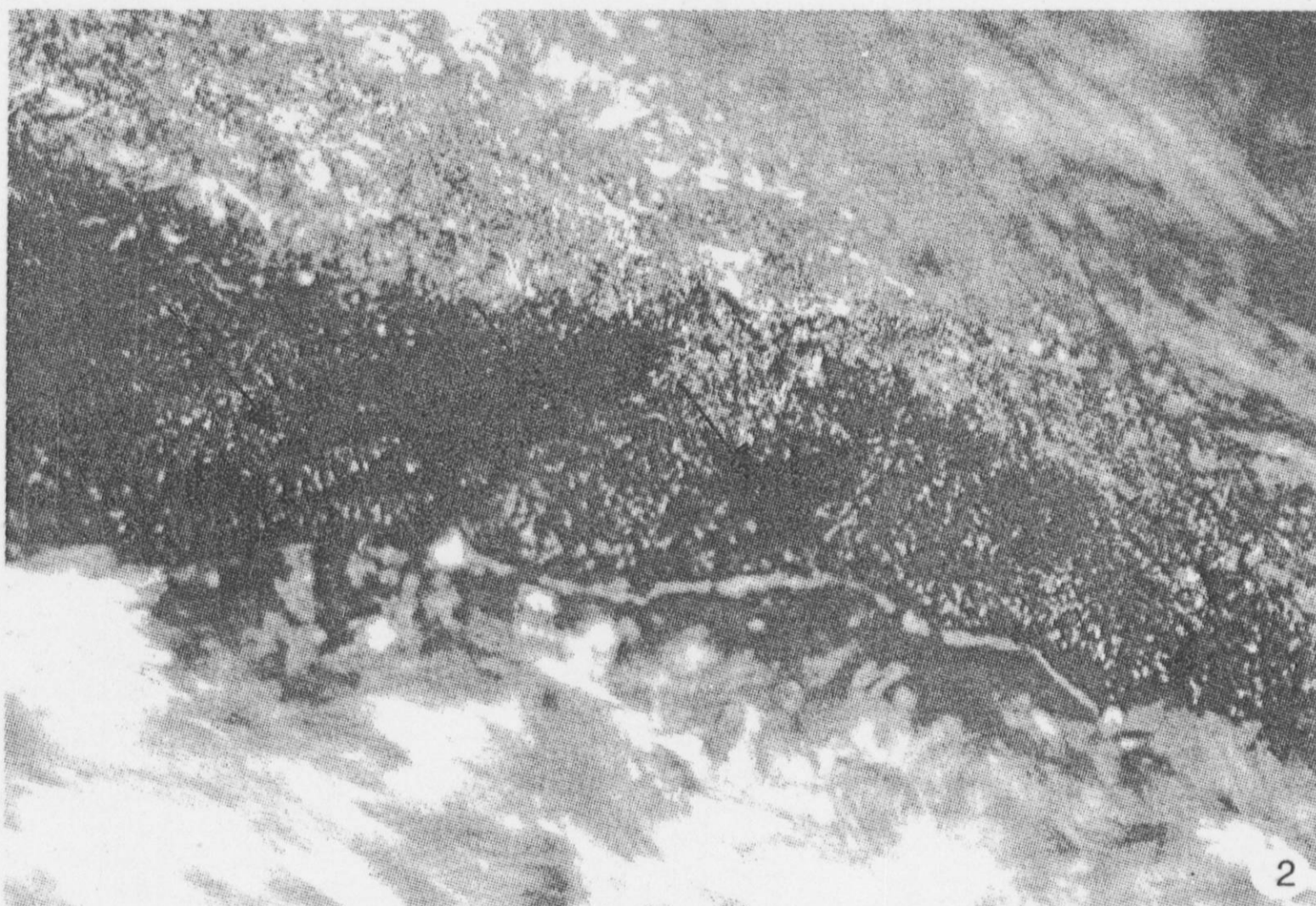
Observations

Flowers of *Hydrobryum griffithii* (Wall. ex Griff.) Tul., *Podostemon subulatus* Gard and *Polypleurum wallichii* (R. Br. ex Griff.) Warm. at various stages were collected from Janiaw locality, Mawsynram (91°50'N–25°20'E) and Umtienger locality (91°70'N–25°40'E) respectively, in the East Khasi Hills, Meghalaya (Figs. 1 and 2).

Hydrobryum griffithii

The plants are aquatics, growing on rocky surfaces in tropical streams, closely appressed to substrate and spreading over stones, more or less ovoid to circular outline. Frond coriaceous, green, lobed, patches about 10–15 cm wide, sending up buds clothed at the base with distichously scale-like imbricate leaves, enlarged at the base, tips caducous. Leaves filiform-linear, greenish, scattered in groups of 2–3 on the upper surface of the thallus, up to 12 mm long (Fig. 3). Flowers sessile, zygomorphic, pedicellate, pedicels 2–6 mm long, remaining within the spathe.

Stamens 2, borne on an andropodium, as long as the ovary, anther lobes golden yellowish, staminodes 2; ovary subtriangular, greenish; stigma bifid, entire, wedge-shaped, brownish (Fig. 4). Fruit capsule, isolobous, distinctly 12-ribbed. Seeds minute, numerous, elliptical-patelliform, surface granular.

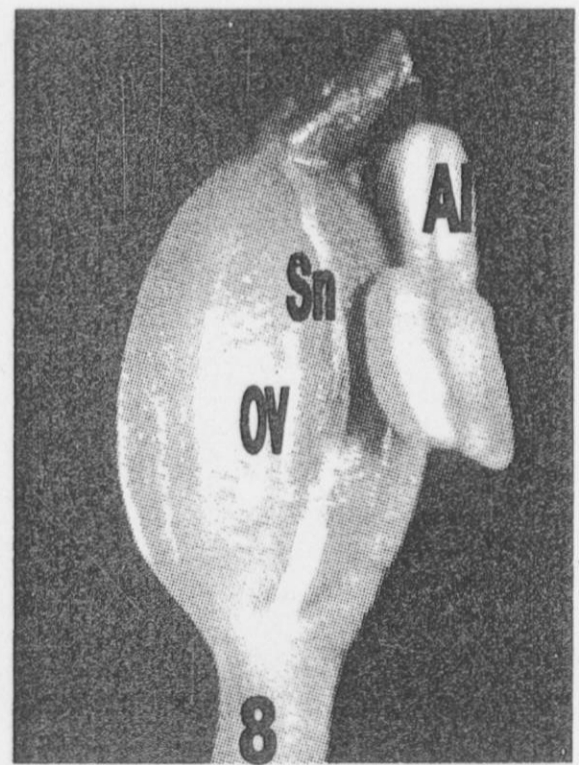
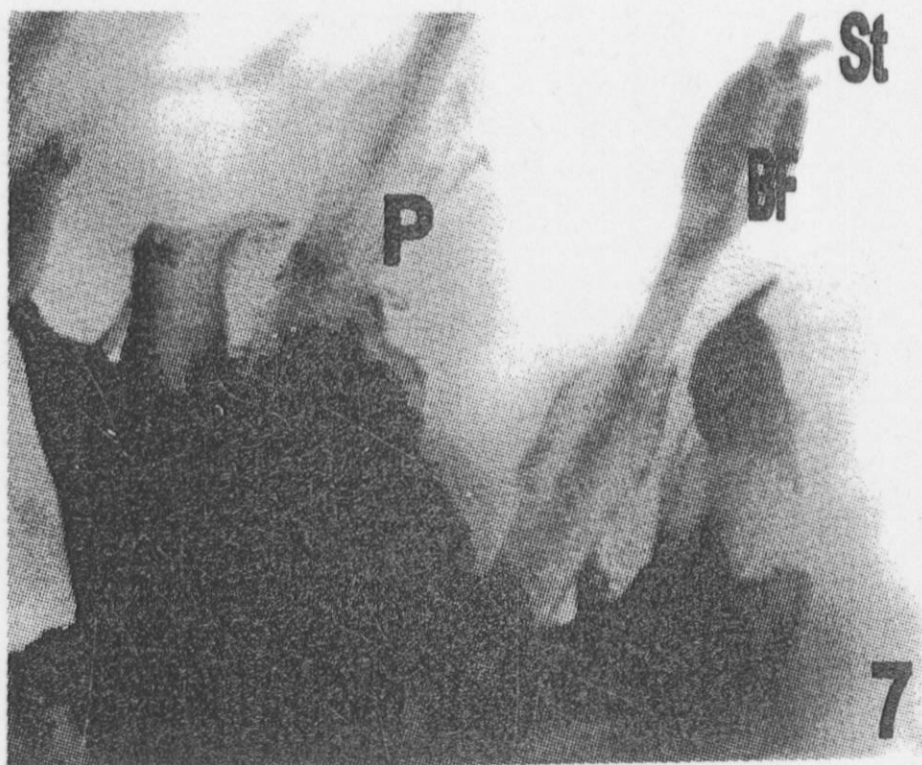
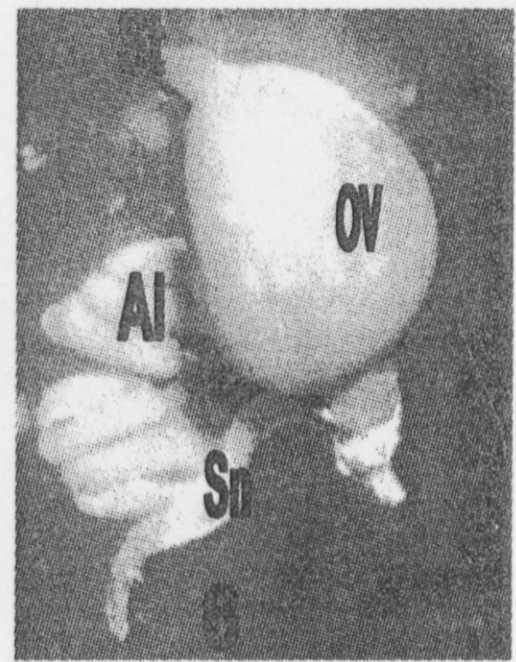
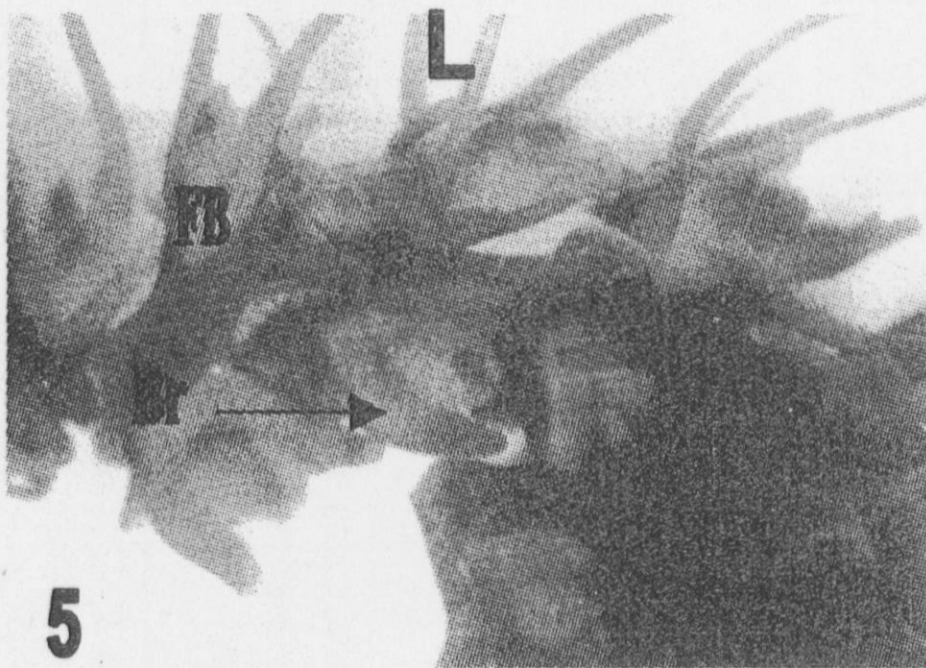
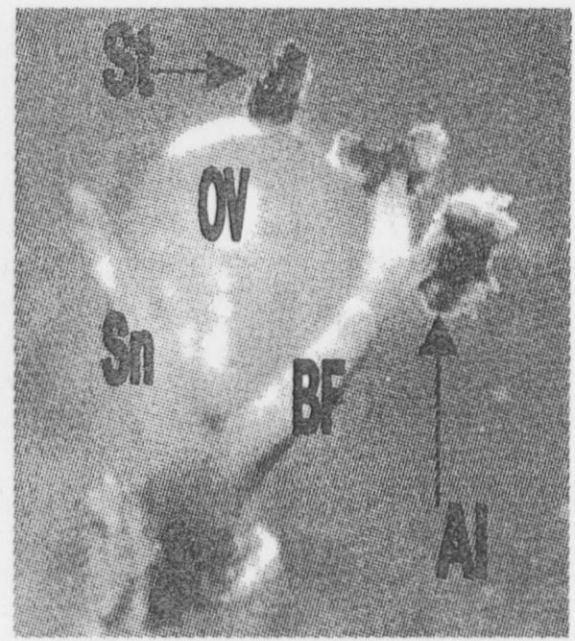
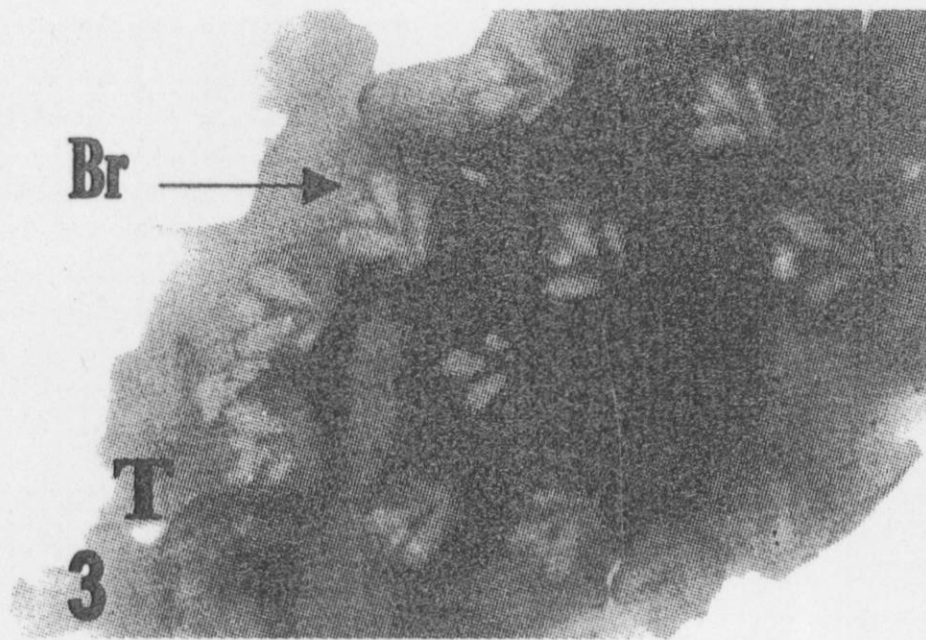


Figs. 1 and 2: Habitat of the *Hydrobryum griffithii*, *Podostemum subulatus* and *Polypleurum wallichii* respectively growing on the rocky surface under water current (arrows).

Flowering and Fruiting: Flowering starts in late September and fruiting observed in late November.

Podostemum subulatus

Plants haptophyte, submerged minute herbs in rapid mountain streams, creeping and attached to rocks; thallus filiform, thread or



Figs. 3, 5 and 7: Habitat of the *H. griffithii*, *P. subulatus* and *P. wallichii*, respectively showing the bracts (Br), filiform leaves (L), flower buds (Fb), and perianth (P). (3 = $\times 10$; 5 and 7 = $\times 5$).

Figs. 4, 6 and 8: Flowers of the *H. griffithii*, *P. subulatus* and *P. wallichii*, respectively showing the ovary (OV), stigma (St), bifurcated anther filament (BF), staminode (Sn) and anther lobes (Al). (4 = $\times 30$; 6 = $\times 10$ and 8 = $\times 15$).

ribbon like, frond lobulate, elongate, branched; buds on the edges of the lobes continuous with the veins; secondary shoots ascending. Leaves slender, subulate, very dense, obscuring the thallus when viewed from above (Fig. 5). Flowers axillary, zygomorphic, naked, enclosed by tubular or funnel shaped spathe. Stamens 2, with two transparent staminodes on either side of fertile stamen. Ovary ellipsoid, 2-locular, green, stigma bifid (Fig. 6). Fruit capsule, unequally lobed, 8–10 ribbed, pedicelate, capsule valves rounded, persistent, incurved; seeds numerous, oval, minute.

Flowering and Fruiting: Flowering starts in early September and fruiting observed in late October; seeds disperse in the middle of November.

Polypleurum wallichii

The plant body is flat, green to brownish, fucoid, dorsiventrally symmetrical thallus with wavy margins. It is fleshy, often branching exogenously and generally drifting in the free flowing water. It is attached at the base by a stout holdfast. Thallus various, usually freefloating with marginal ultimately 1-flowered secondary shoot (Fig. 7).

Flowers zygomorphic, bisexual and hypogynous. Young flower buds are enclosed by a thin transparent membranous, sac-like spathe, staminal filament is forked, and each fork bearing four loculed anthers, light brown in colour. Ovary sessile, bicarpellary, syncarpous and elliptic, green with brown longitudinal ridges; smooth when young, ripening into capsule, 8-ribbed; stigmas subulate, dark brown in colour (Fig. 8). Fruit a capsule, isolobous.

Flowering and Fruiting: Flowering starts in early September and fruiting observed in late October; seeds disperse in the middle of November.

Discussion

In India, north-eastern region and Western Ghats are the two mega-diversity hot spots (Swaminathan, 1991; Mohan Ram and Sehgal, 2001). These regions are not completely explored. The present report deals with the rediscovery of *Hydrobryum griffithii* (Wallich ex Griffith) Tul., *Podostemum subulatus* Gardner and *Polypleurum wallichii* (R. Br. ex Griff.) Warm. from Meghalaya State, India after

a gap of 118 years. These species belong to the group Podostemoideae, which are highly specialized and occupy narrow aquatic ecological niches.

Ecological significance

The riverweeds are not always treated with the respect they deserve in biodiversity conservation (Cook, 1996). The ecological role of podostemads and biota associated with them in riverine system are largely unknown, especially when river rapids are highly productive (Horne and Goldman, 1994). The unique combination of characters presented by this family is unparalleled among the angiosperms, leading to recent resurgence of worldwide interest. Riverweed habitats are under increasing pressures from poor water quality and altering water flow patterns due to dam building. Increasing impacts on tropical rivers are leading to loss of riverweed habitat, extirpation of populations and extinction of species. In the river Umiam, construction of a new bridge and extraction of limestone in the catchment area have affected population of *Podostemum subulatus*, where the size of the population has been reduced to about 50 percent compared to the observation made during the 2000. Similarly, erection of small bridges across the river Jainaw will pose threat to the existence of *Polypleurum wallichii* and *Hydrobryum grfthii*. Cross Bell (1990) have studied the effect of effluents of rubber factory in Kanyakumari District in Tamil Nadu, and observed the elimination of three species of Podostemaceae in the down stream due to acidic discharges. Global warming may also adversely affect Podostemads as they occur in seasonally pulsating rivers (Grimm, 1993). Since plants inhabit rocky mountain streams and rivers, they are subjected to seasonal changes in the level and turbidity of the water. It was observed that flowers were produced when the plants were submerged under clear water, thereby indicating the importance of light on production of flowers. Among the three plants studied, there seems to be a certain degree of variation in the individuals physiological maturity before flowering takes place, even in the same locality and under similar conditions.

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