Hide and seek of *Monosolenium tenerum* Griff. (Hepaticae: Monosoleniaceae) in Indian bryoflora

Monosolenium tenerum Griff., a phylogenetically aberrant yet interesting liverwort, was instituted by Griffith[1] in 1849 based on his own collections from agricultural fields of Sadiya (Suddya) and humid forests of Tingrai (Tingrei), both in Assam, during his famous 'tea expedition' to the state during 1835–36. Griffith's specimens, however, are not available in any herbarium within or outside the country[2], and the cryptic description and illustration of the taxon provided by Griffith[1] initially led to its erroneous reference to genus *Cyathodium* Kunze[3,4]. Over eight decades later the species was again collected from Presidency Garden, Imphal, Manipur in 1920 by Hora[5]. Kapila and Kumar[6] reported the species from Himachal Pradesh (HP) in Western Himalaya on the basis of their own collections from Baijnath and Sundernagar in Kangra and Mandi districts respectively, in 1984. During all these years, while the species was being collected and reported from different parts of East Asia, like China[2,7], Taiwan[7–9], Japan[10], Ryukyu[11,12] and Hawaii[13], interestingly, it could never be collected again from any of the above Indian locations, nor the reference specimens available for study. However, during a routine survey of bryoflora in and around Dehradun, Uttarakhand in 2002, the authors chanced upon an altogether new location of its occurrence in Swarna Jayanti Udyan of the Botanical Survey of India. The phenology of growth and development of the plants, in two excellent populations close by, were monitored from October 2002 to March 2003 when the sporophytes were fully mature.

The species is characterized by translucent green to pale green, dichotomously branched, thalloid plants which are 18–35 mm long, 3–6 mm wide with entire to undulated margins (Figure 1 *a*). The thallus is not differentiated into assimilatory and storage zones and lacks pores. The midrib is prominent, 11–14 cells thick in cross-section and gradually passes into three-layered lamina. The epidermal cells are quadrate to sub quadrate, 13.3–23.3 × 23.3–26.6 μm in size, whereas the inner cells are parenchymatous, pentagonal–polygonal, 33.3–66.6 × 16.6–69.9 μm in size. The ventral scales are small, 210–280 × 70–98 μm, hyaline, and rhizoids are both smooth-walled and tuberculate. Plants are monoecious, with the antheridiophores usually situated just behind the archegoniophores. The antheridiophores are sessile–sub-sessile, with shallowly branched receptacle 1–1.5 mm in diameter and stalk without rhizoidal furrow. The archegoniophores initially terminal, but later becoming dorsal, with shallowly 4–7-lobed receptacle, 3–5 mm in diameter and 0.9–1 mm long stalk. The mature sporogonium has a more or less globose,

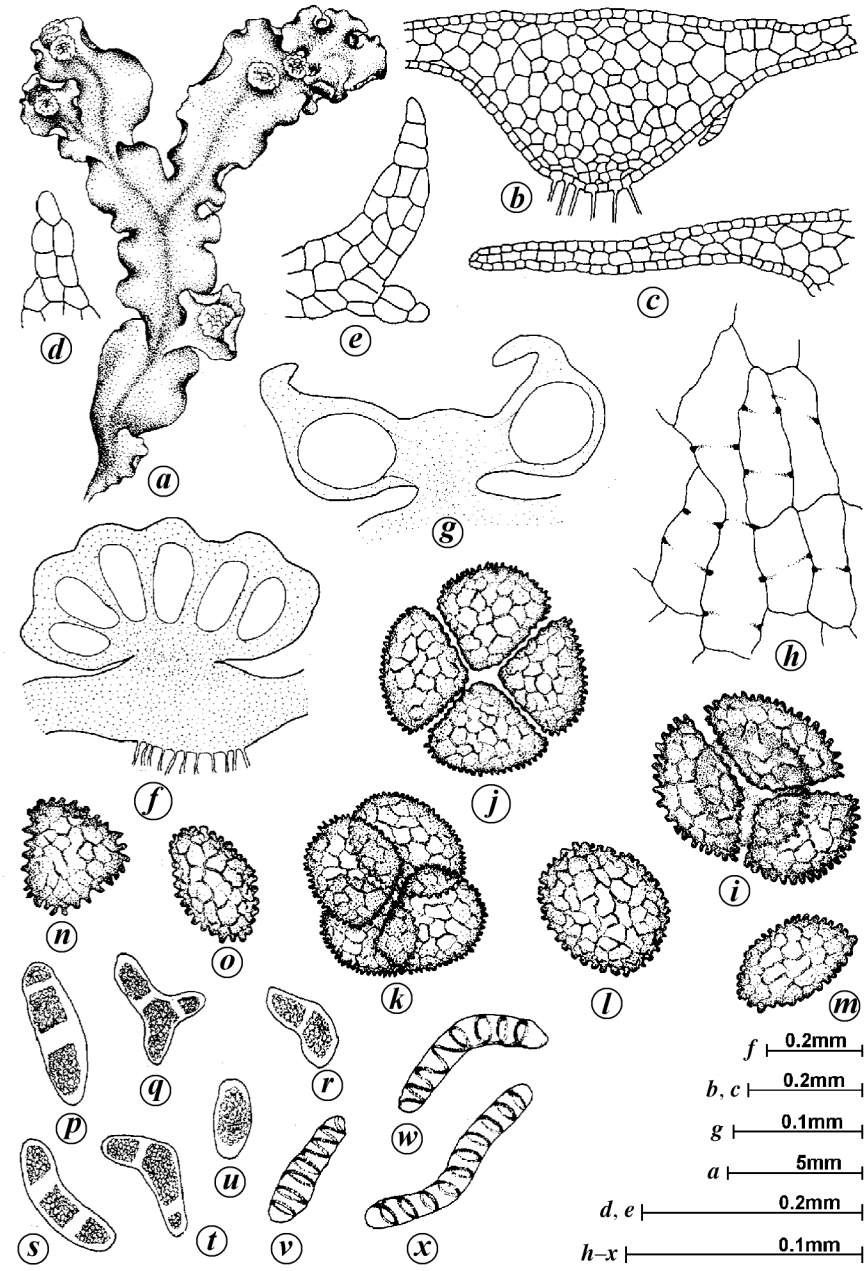

Figure 1. *Monosolenium tenerum* Griff. ***a***, Monoecious thallus. ***b***, ***c***, Cross-section of thallus passing through middle region (***b***) and wing (***c***). ***d***, ***e***, Ventral scales. ***f***, ***g***, Cross-section of thallus passing through antheridiophore (***f***) and archegoniophore (***g***), ***h***, Capsule wall in surface view, ***i***, Tetrahedral spore tetrad, ***j***, Isobilateral spore tetrad, ***k***, Tetragonal spore tetrad, ***l–o***, Spores, ***p–u***, Young elaters, ***v–x***, Mature elaters.

Table 1. Comparative account of plants from Himachal Pradesh and Uttarakhand

Character	Himachal Pradesh[6]	Uttarakhand
Length of thallus (mm)	15–22	18–35
Length of stalk of archegoniophore (mm)	2.0–3.5	0.9–1.0
Spore	Tetrahedral, 37–43 μm in diameter	Ovoid–ellipsoid, 29.9–53.3 × 33.3–46.6 μm
Elaters	45.9–103.7 μm long, 11.8–28.1 μm wide, without distinct thickening bands.	46.0–93.2 μm long, 9.9–16.6 μm wide, with weak spiral–annular thickening bands.

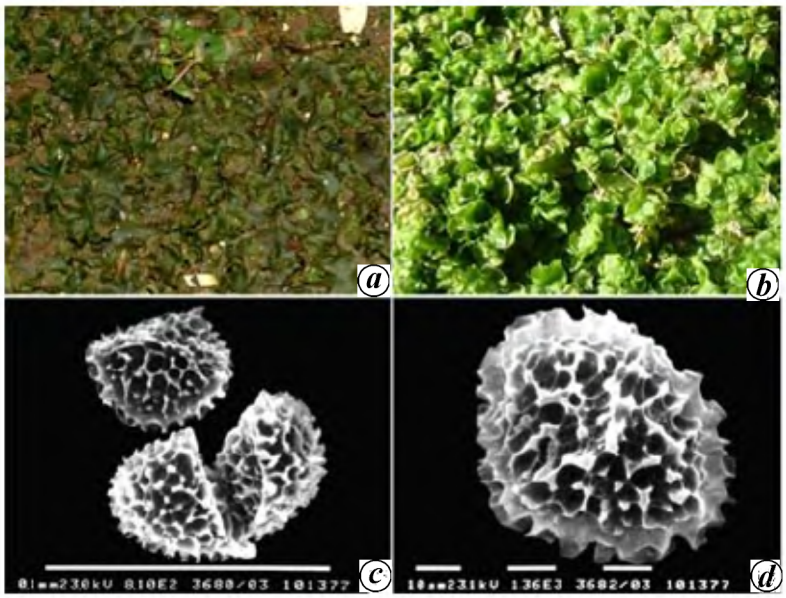

Figure 2. *M. tenerum* Griff. ***a***, Young population. ***b***, Mature plants. ***c***, ***d***, SEM of a spore tetrad (***c***) and spore (***d***).

deep brown capsule, 1–1.5 mm in diameter and a small seta. The capsule wall is single-layered with the cells 36.6–73.2 × 9.9–29.9 μm in size, with or without weak, incomplete transverse thickenings. Spores are dark brown, usually united in tetrahedral, tetragonal or isobilateral tetrads, but often single spores are also present, with the individual spores ovoid–ellipsoid, 29.9–53.3 × 33.3–46.6 μm in size, with denticulate–irregularly reticulate sporoderm. SEM of the sporoderm reveals radially oriented baculae with rounded, angular or uneven apices, whereas their bases and interstices are more or less anastamosing to form incomplete reticulations. The elaters are simple or branched, green, chlorophyllose when young, 46–93.2 μm long, 9.9–16.6 μm wide with weak spiral–annular thickening bands.

M. tenerum is terrestrial, growing in moist and shady places in pure population or in association with *Marchantia palmata* Nees. Young plants of the species at the beginning of the growing season are dull green–translucent and could be easily mistaken with species of *Pellia* Raddi (Figure 2 *a*). The present location lies within an *ex situ* conservation area of a premier research institute mandated for survey, documentation and conservation of the plant diversity of the country. The *in situ* conservation thus bestowed on these populations, by default, is likely to end the 'hiding' tendency of the species.

Exsiccate: Uttarakhand, Dehradun, Botanical Survey of India, Swarna Jayanti Udyan (altitude ca. 750 m), 21 October 2002, D. K. Singh 101240; 17 January 2003, S. K. Singh 101291; 27 January 2003, S. K. Singh 101297; 16 February 2003, S. K. Singh 101299; 26 February 2003, S. K. Singh 101300; 10 March 2003, S. K. Singh 101362; 26 March 2003, S. K. Singh 101377. All the specimens are deposited in the cryptogamic section of the herbarium of Botanical Survey of India, Dehradun (BSD).

The Uttarakhand populations of *M. tenerum* fully conform to the ones from Assam and HP, except for some minor variations in the size of plants, stalk of the archegoniophore, spores and elaters, as summarized in Table 1.

While the above differences could be ecological, attributable to the growth conditions of different populations, occurrence of sub-sessile stalk of antheridiophore and spiral–annular thickenings in elaters in the plants from Uttarakhand, as against sessile antheridiophores and elaters devoid of distinct thickening bands in plants from both Assam and HP[1,6] is interesting. The tendency towards the development of antheridiophore stalk and weak yet distinct thickening bands in elaters in the plants from Uttarakhand suggests that this particular population might be under active state of evolution.

The all-round reduction exhibited by *M. tenerum* in both its haploid and diploid phase, like lack of assimilatory zone, presence of reduced yet plate-like ventral scales, dorsal 'composite' sexual receptacles, absence or presence of weak thickening bands in the cells of capsule wall and green sterile cells (elaters) with or without thickenings, formed the basis for the theory of retrogressive evolution amongst Marchantiales[2]. From a phylogenetic point of view, the species is further interesting in the presence of three types of spore tetrads, viz. tetrahedral, tetragonal and isobilateral. While in addition to normal tetrahedral tetrads, tetragonal tetrads have also been recorded in some liverworts and hornworts[14–16], there seems to be apparently no report of isobilateral tetrads in Bryophytes. Mehra[17] considered the tetrahedral type of tetrads, which are of universal occurrence in all the land plants, including Bryophytes, as primitive. Therefore, *M. tenerum* not only combines both primitive as well as derived features in this regard, but this trait suggests its evolution from forms with tetrahedral tetrads.

M. tenerum is common in all its range countries (Hallingbäck, pers. lit.), except India from where it is regarded as extremely rare with narrow ecological range[18,19]. In India, it is generally confined to the sub-

Himalayan tract from East to West between the altitudinal range of about 550–1000 m. Its present record from Uttarakhand suggests its once continuous distribution across the Himalayan foothills. Singh[20] considered the major earthquakes, that rocked Assam towards the close of the nineteenth and mid-twentieth century, as the possible cause for its total annihilation from the state. Depletion from other localities was assigned to biotic factors, like developmental activities and destruction of habitat[20]. The entire range of its distribution from Assam in the east to HP in the west, including the Imphal Valley in Manipur, is under considerable anthropogenic pressure, be it for destruction of habitat for developmental activities or expansion of agriculture. In addition, the 'hide and seek' of the species in Indian bryoflora can also be ascribed to the lack of awareness and intensive bryological explorations in the country. The chronology of its collections in India reveals a progressively narrowing gap between two encounters, which is directly related to intensification of bryological activities in recent years.

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Ex situ conservation of *Alectra chitrakutensis* (Rau) R. Prasad & R.D. Dixit

Alectra chitrakutensis (Rau) R. Prasad & R.D. Dixit (Scrophulariaceae) is a root parasite on white-flowered *Vitex negundo* L. (Verbenaceae). It is an endemic and critically endangered plant locally known as 'Nirgundi' found in confined localities of Chitrakoot region, Madhya Pradesh, and also in Uttar Pradesh, India.

The species grows as a parasite on the thread-like roots of white-flowered *V. negundo* L. It is a small parasitic herb of 15–30 cm height, stem rhizomatous, well developed, orange–yellow, black on drying; leaves linear or oblong, up to 6 mm long, obtuse at apex; flowers in terminal racemes, yellow with purple streaks; capsules globose, ca. 5 mm across; seeds minute, cuneiform, black. Plants grow from October to April mainly on sandy soils.

Chitrakoot is a holy town of pilgrimage for the Hindus. It is situated at the border of Satna District, Madhya Pradesh and Chitrakoot District, Uttar Pradesh. According to the epic *Ramayana* Lord Rama, Sita and Lakshmana had stayed in this region on Kamadgiri hill during their 14 years of exile. This region is rich in medicinal plants since antiquity, as mentioned in the most ancient epic, *Valmiki Ramayana*.

The genus *Alectra* Thunb., family Scrophulariaceae is represented by more than 50 species of parasitic herbs which are distributed in tropical regions of Africa, South America and Asia. Three species are so far known from India, viz. *Alectra sessiliflora* (Vahl) Kuntze, *A. thompsoni* Hook. *f.* and *A. chitrakutensis* (Rau) R. Prasad & R.D. Dixit.

A. chitrakutensis (Rau) R. Prasad & R. D. Dixit, was first described by Rau[1] in 1961 from Chitrakoot as a variety of *A. parasitica* A. Rich. Prasad and Dixit[2] carried out a detailed taxonomic study and raised the status of the plant from varietal to species level.

The plant came to light after Prasad[3] obtained encouraging results in preliminary clinical trials of the rhizome in the treatment of leprosy. Rajgopalan and Seshadri[4] worked out its chemical composition. Bedi[5] published detailed information on its availability, collection and local uses. Saxena *et al.*[6] studied the soil properties of the habitat of the plant.

Ethnobotanically the species is used for treatment of leprosy, constipation, malaria, oedemic swelling, piles, paralysis and as a tonic, anthelmintic and blood