

## **BRYOCRUMIA VIVICOLOR, A RHEOPHYTIC, HYPNACEOUS MOSS, NEW TO THE WESTERN HIMALAYAS, INDIA**

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The Indian Himalayan sector is well known to support the diversified bryophyte species and communities due to varied phytoclimatical conditions met within different dissected topographical zones. Many potential wilderness areas are still waiting to be explored in terms of their exuberant bryodiversity. During a bryoexploratory survey of an unexplored high-altitude area in the Garhwal Himalayan region, we came across an interesting rheophytic moss *Bryocrumia* L. E. Anderson. The genus *Bryocrumia* is represented in India by two species, viz. *B. vivicolor* (Broth. et Dixon) W. R. Buck and *B. malabarica* Manju, Prajitha, Prakashkumar et W. Z. Ma. Both of these pleurocarpous species are known to be confined in the southern part of the country. From the Indian Himalayan sector, this moss genus has never been documented earlier. Recently, *B. vivicolor* has been reported for the first time from the Tungnath area (2,100–3,000 m above sea level) in the Garhwal region of Uttarakhand state as a new addition to the Western Himalayan moss flora, indicating its new distributional range. This hypnaceous moss was found colonising the slopy, wet, submerged rock surfaces along small streams and seepages in mixed oak forests on way to Tungnath. The key characteristics include its rheophilic habit, stem lacking central strand, variable leaf forms, indistinct double costa and round to obtuse leaf apex with prorate tip cells. The present paper provides taxonomic details of this rare moss, representing its wide geographical distribution in India.

Key words: hypnaceous, moss flora, pleurocarpous, rheophyte, Western Himalayas

### INTRODUCTION

The floristical study of Indian bryophytes particularly the Himalayan sector has received little attention in spite of the rich and diversified natural wealth. There are many potential, unexplored areas where thorough habitat wise survey has not been given proper attention. While exploring the bryophyte vegetation en route to Tungnath area, a rare pleurocarpous moss *Bryocrumia* L. E. Anderson was recognised. The genus name *Bryocrumia* refers to “Gorge Moss” due to its slender habit and occurrence on wet rocky substrates along a stream. Anderson (1980) segregated the genus *Bryocrumia* from *Glossadelphus* M. Fleisch. and *Taxiphyllum* M. Fleisch. Buck (1987) separated *Phyllo-don* Schimper, and considered *Glossadelphus* as a synonym of *Phyllo-don*. O’Shea

and Buck (2001) distinguished three genera based on distinct leaf characteristics. The position and current status of *Bryocrumia* have been thoroughly compiled by Ma *et al.* (2016) and Kim and Yamaguchi (2020), considered it as a monotypic genus, represented by a single species *B. vivicolor* (Broth. et Dixon)

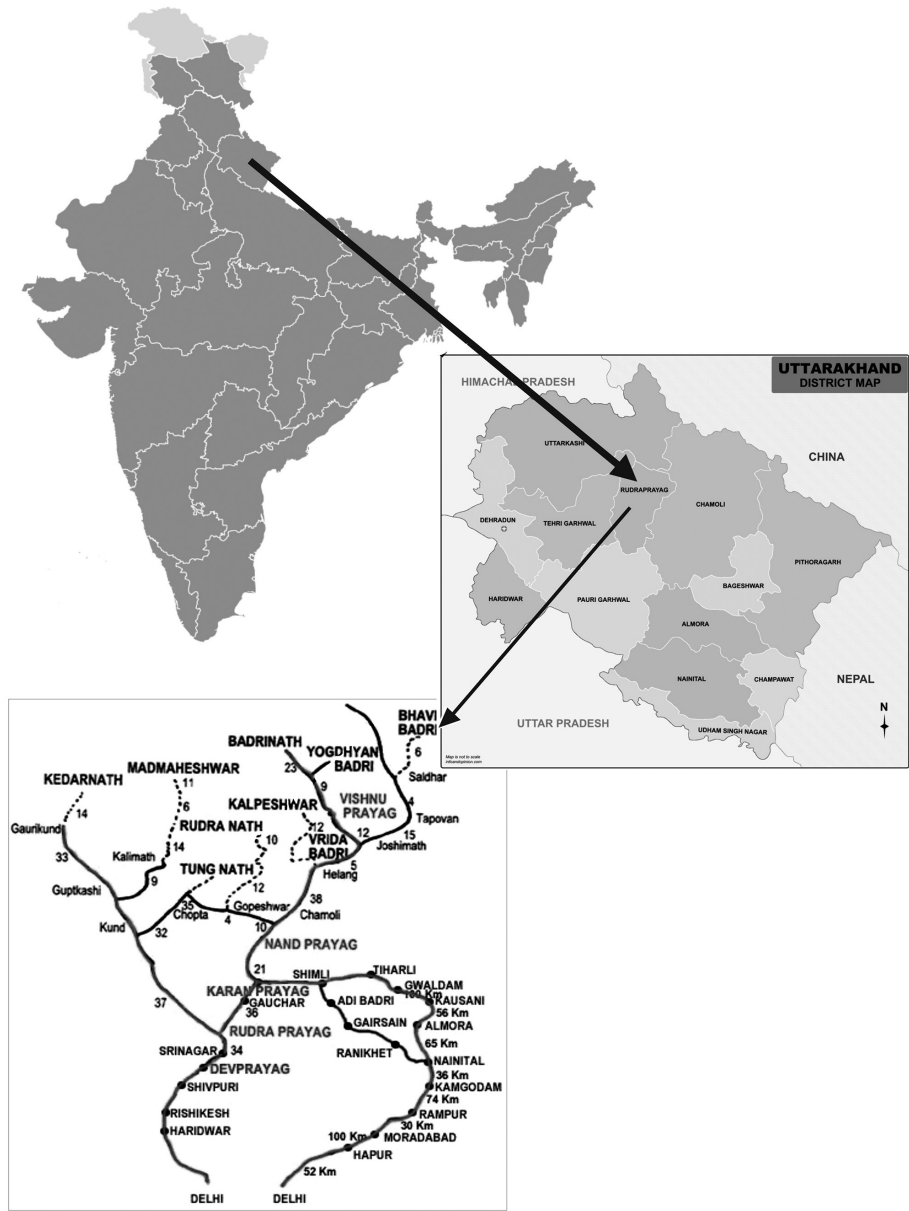


Fig. 1. Location map showing the study area

W. R. Buck. Manju *et al.* (2021) recently reported and described a new species of *Bryocrumia* (*B. malabarica* Manju, Prajitha, Prakashkumar *et al.* W. Z. Ma) with the mention of a dichotomous key to the identification of *Bryocrumia* species from Malabar Wildlife Sanctuary in the Western Ghats of Kerala in Peninsular India. Both species of *Bryocrumia* were reported only from the southern part of India (Dandotiya *et al.* 2011, Manju *et al.* 2021). *Bryocrumia malabarica* shows specific characters to separate it from *B. vivicolor*, such as distinct tricostate leaves compared to indistinct bicostate leaves of *B. vivicolor* (Manju *et al.* 2021). *Bryocrumia vivicolor*, a hypnaceous, rheophytic moss species was found in rare occurrence on wet, submerged, rocky surfaces along the small streams on way to the Tungnath area of mixed oak forest site within an elevational range of 2,100–3,000 m in the Garhwal region of district Rudraprayag (Uttarakhand). The presently reported species turned out to be a new addition to the Western Himalayan moss flora.

## MATERIAL AND METHODS

The bryophytes were collected between 29th August 2019 and 2nd September, 2019 from the diverse habitat and localities on way to the Tungnath, 30° 29' 26.3" N, 79° 09' 37.7" E with GPS extent 9–4.90 km within an elevational range of 2,100–3,000 m (Fig. 1). The collected bryophyte specimens were brought to the laboratory for further examination. The specimens were determined to be *Bryocrumia vivicolor* after microscopical study in the laboratory. Slides were prepared in the gum chloral mounting medium (Watson 1955). Microphotographs of different plant parts including stem cross section were taken. Further confirmation of identification was performed with the help of the relevant literature, monographs, floras, and also by seeking advice from experts. The voucher specimens (No. TS (TS = Tungnath-Sapana) 24-B, 42-A) 30/08/2019, are deposited in the herbarium of Botany Department I.P.G.G.P.G. College of Commerce, Haldwani, Nainital (IPGGPGCC).

## TAXONOMY

*Bryocrumia vivicolor* (Broth. *et* Dixon) W. R. Buck  
Mem. N. Y. Bot. Gard. 45: 522 (1987)

Plants rheophytic, thin, forming shiny light-yellow mats; stem creeping, irregularly branched about 1 to 2 cm long. Cross section of stem ovate, 3–4  $\mu\text{m}$  in diameter, outer yellowish; cortical cells 3–4 layered thick, inner 5–6 layered medullary cells without a distinct central strand. Leaves small, 0.7–0.8  $\times$  0.2–0.3 mm wide, tip round-obtuse with variety of forms; costa double to indistinct; alar cells few, short rectangular to quadrate 17.5  $\times$  7  $\mu\text{m}$  in basal angles; median cells oblong-rhomboid, 10–28  $\times$  5  $\mu\text{m}$ , apical cells shorter 17–21  $\times$  5  $\mu\text{m}$ ,

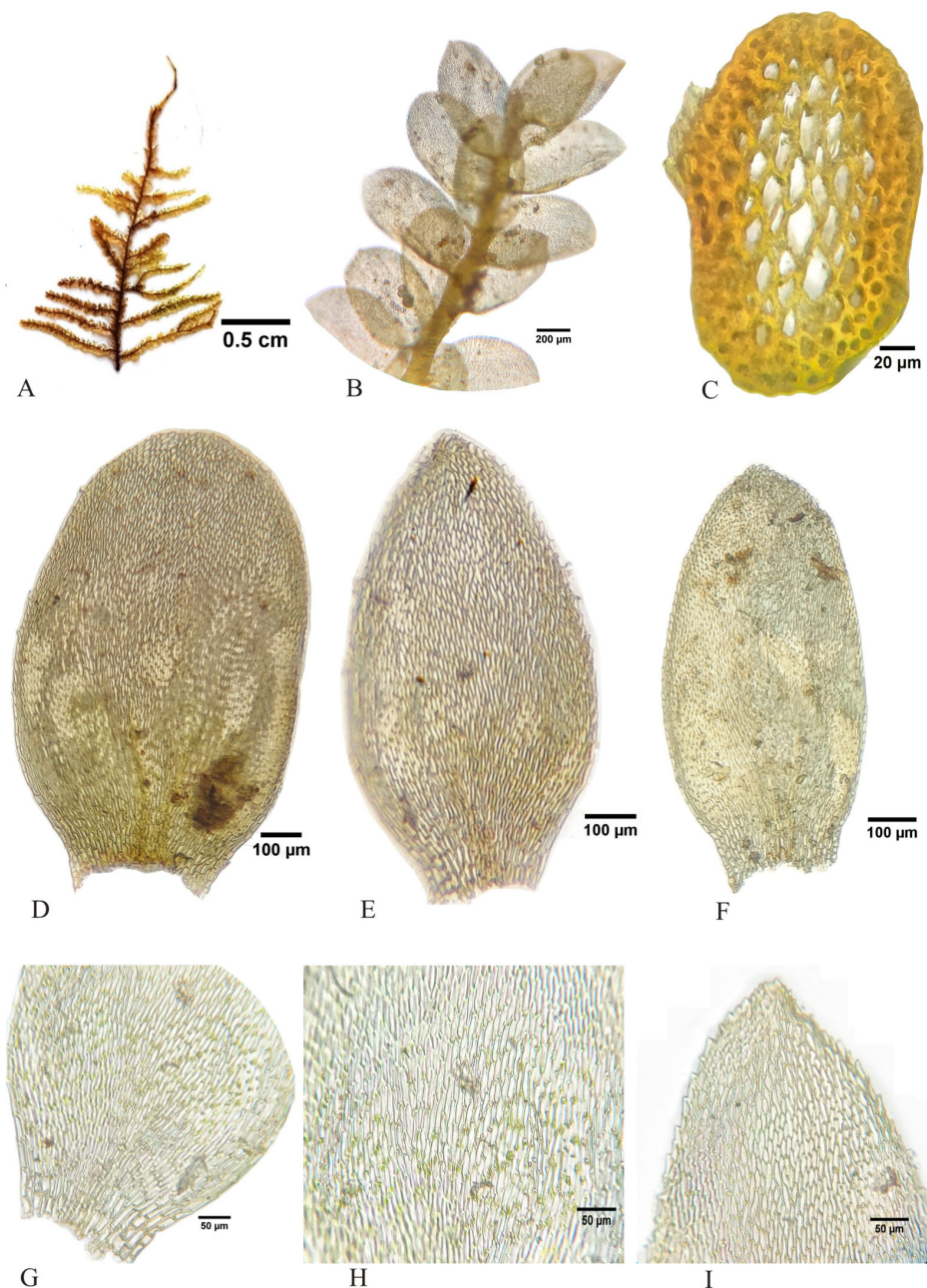


Fig. 2. *Bryocrumia vivicolor* – A = habit; B = enlarged leafy branch; C = stem cross section; D–F = varied leaf shapes with double or indistinct costa; G = extreme basal region showing distinct alar cells; H = mid-leaf cells; I = prorate leaf tip cells with slightly dentate margin

slightly prorate; margin firm, slightly dentate at the tip (Fig. 2). Sporophyte not seen.

Habitat: Growing on wet, submerged, slopy rock surfaces in a mixed oak forest along small perennial streams and seepages in association with other liverworts, viz. *Pellia endiviifolia* (Dicks.) Dumort., *Chiloscyphus polyanthos* (L.) Corda; and mosses like *Ectropothecium cyperoides* (Hook. ex Harv.) A. Jaeger, *Fissidens grandifrons* Brid. and *Plagiomnium rostratum* (Schrad.) T. J. Kop.

Specimen examined: India. Western (Garhwal) Himalayas: Rudraprayag District, on way to Tungnath near Mukku Band in mixed oak forests, 2,300 m. S. D. Tewari, Sapana Pant, Manisha Bhandari, Prachi Joshi, Neha Kohli and Neha Binwal, 30th August 2019, TS (Tungnath-Sapana) 24 (B), 42 (A). Bryology Lab, I.P.G.G.P.G.C.C. Haldwani, Nainital, Uttarakhand, India (IPGGPGCC).

## RESULTS AND DISCUSSION

*Bryocrumia*, a rheophytic moss genus is represented by a single species. *Bryocrumia vivicolor* is turned out to be a new addition to the Western Himalayan bryoflora.

Indian Himalayan (Eastern and Western) sector is well known to support the great variety of bryophytes (both liverworts and mosses) in diversified habitat and localities. Despite of the rich bryodiversity, the Himalayan bryophytes are poorly explored in terms of their habitat preference. Many of the potential, unexplored, wilderness, mountainous streams, springs, waterfalls and rivers in Uttarakhand (Garhwal and Kumaun region) of the Western Himalayas may be the preferred habitat for the growth of many rheophytic bryophytes. One of the highly specialised bryophyte taxa, *Bryocrumia*, which has been earlier reported from South India is being documented for the first time from the Western Himalayas. In morphological appearance, *Bryocrumia* is generally mistaken with the members of *Homalia* (Manju *et al.* 2021). The present collection of a rare moss, *B. vivicolor* was made in the sterile state from the rheophytic habitat along a small stream on way to the Tungnath area of Rudraprayag district in the Western Himalayas. The fruiting population of the moss could not be located from the collection site. Ochyra and Shevock (2012) stated that bryophytes dwelling in rheophytic habitats rarely produce sporophytes, primarily due to demanding requirements during the fertilisation process in a running water environment. Recently Ma *et al.* (2016) discovered the sporophyte of *B. vivicolor*, which confirms the hypnaceous status of the moss. To understand the biogeographical processes of *B. vivicolor* the molecular data will be useful.



## CONCLUSIONS

The rare genus, *Bryocrumia*, is being reported for the first time from the Western Himalayas as an addition to the Indian Himalayan moss flora. In the future, a more bryoexploratory study is needed to gather reproductive and ecological pieces of information on this fascinating rheophytic, hypnaceous moss from the various wilderness, unexplored areas in the Indian Himalayas. This baseline study will promote future interest in the field of bryo-systematics.

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## REFERENCES

- Anderson, L. E. (1980): *Bryocrumia*, A new genus of Hypnaceae (Musci). – *Phytologia* **45**: 63–66. <https://doi.org/10.5962/bhl.part.28282>
- Buck, W. R. (1987): Notes on Asian Hypnaceae and associated taxa. – *Mem. N. Y. Bot. Gard.* **45**: 519–527.
- Dandotiya, D., Govindaparyi, H., Suman, S. and Uniyal, P. L. (2011): Checklist of bryophytes of India. – *Arch. Bryol.* **88**: 1–126.
- Kim, W. and Yamaguchi, T. (2020): *Bryocrumia vivicolor*, new localities in Japan and Taiwan. – *Bryophyte Div. Evol.* **42**(1): 56–60. <https://doi.org/10.11646/bde.42.1.5>
- Ma, W. Z., Shevock, J. R. and He, S. (2016): The first discovery on the sporophytes of a rheophytic moss: *Bryocrumia vivicolor* (Bryophyta, Hypnaceae). – *Phytotaxa* **265**(1): 73–78. <https://doi.org/10.11646/phytotaxa.265.1.7>
- Manju, C. N., Prajitha, B., Prakashkumar, R. and Ma, W. Z. (2021): *Bryocrunia malabarica* spec. nova (Bryophyta, Hypnaceae), a second species of the genus from the Western Ghats of India. – *Acta Bot. Hung.* **63**(1–2): 165–170. <https://doi.org/10.1556/034.63.2021.1-2.9>
- Ochyra, R. and Shevock, J. R. (2012): A fruiting plant of *Handeliobryum sikkimense* (Bryopsida, Thamnobryaceae) from Yunnan, China. – *Nova Hedwigia* **94**: 307–321. <https://doi.org/10.1127/0029-5035/2012/0021>
- O'Shea, B. J. and Buck, W. R. (2001): Bryophytes of Uganda. 5. *Bryocrumia* L. E. Anderson (Hypnaceae), a monotypic genus new to Africa. – *Tropical Bryology* **20**: 103–107. <https://doi.org/10.11646/bde.20.1.18>
- Watson, E. V. (1955): *British mosses and liverworts*. – Cambridge University Press, Cambridge, 419 pp. <http://www.worldfloraonline.org/taxon/wfo-0001195449>