

## Lectotypification and epitypification of *Radula tjibodensis* (Radulaceae: Marchantiophyta)

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### Abstract

Goebel's original material of *Radula tjibodensis* K.I.Goebel has not been seen since it was examined by Schiffner for his *Über Exotische Hepaticae* of 1893. A search for extant specimens of this original material was unsuccessful, and we infer all such specimens are either lost or destroyed. The only element of original material remaining extant, therefore is the illustrations of *Radula tjibodensis* provided by Goebel, one of which we designate as the lectotype. To aid the interpretation of this lectotype and reduce ambiguity in the application of the name we select and designate an epitype among the specimens of *Radula tjibodensis* gathered at Tjibodas that are currently held in Farlow Herbarium.

### Introduction

The genus *Radula* Dumort. is represented by around 250 accepted species and intraspecific taxa worldwide (Söderström *et al.* 2016), 27 of which occur in India (Singh *et al.* 2016). The genus is nearly cosmopolitan in distribution, with high species diversity in the wet tropics and sub-tropics.

*Radula* species occur in a wide range of microhabitats, from on rocks under running fresh water to the surfaces of angiosperm leaves. Epiphyllous species have a characteristic flattened growth habit, often produce large discoidal gemmae, and long, prominent tubular perianths, features that, in combination with their distinctive microhabitat, motivated the recognition of a distinct section to accommodate them, sect. *Epiphyllae* Castle ex Grolle. This section is now regarded as polyphyletic, with the epiphyllous habit occurring in several lineages.

*Radula* are a conspicuous and diverse component of the epiphyllous communities in rainforests of the subcontinent and south-east Asia. One of the more widespread species is *Radula tjibodensis* K.I.Goebel, whose reported range extends from India (Singh *et al.* 2016) and Sri Lanka (Long and Rubasinghe 2014), through Malaysia (Chuah-Petiot 2011), Philippines (Tan and Engel 1986), Indonesia, Papua, New Guinea (Yamada and Pippo 1989), Thailand (Promma and Chantanaorrapint 2015), and into the Pacific on Fiji and Samoa (Söderström *et al.* 2011).

*Radula tjibodensis* was described based on specimens collected from Tjibodas (presently Cibodas), Java, growing on the leaves of some Zingiberaceae plants, by Goebel (1887). Goebel did not explicitly cite any specimens as original material. The first and only person to provide an indication of which specimens Goebel might have based his new species on was Victor Felix Schiffner (1893), who cited three gatherings as part of his treatment of *Radula tjibodensis*, including one 'Habit. Java, Tjibodas; ad folia viva (Zingiberaceae cujusdam et aliar. plt.); lgt. Prof. K. Goebel Hiberno 1885/86' (Schiffner 1893, p. 249). Schiffner was also the only person, other than Goebel, to document an investigation of Goebel's material. Many bryologists since have worked

Paul M, Singh D (2025)  
Lectotypification and  
epitypification of *Radula  
tjibodensis* (Radulaceae:  
Marchantiophyta).  
*Telopea* 29: 279–283.  
[doi:10.7751/telopea21341](https://doi.org/10.7751/telopea21341)

Received: 7 July 2025  
Accepted: 13 October 2025  
Published: 12 November 2025

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on *Radula tjibodensis*, however none of them have located specimens of original material (Hattori 1966; Yamada 1979; Udar and Kumar 1984; So 2006; Dey and Singh 2012; Promma and Chantanaorrapint 2015). According to Castle (1939) most of the liverwort specimens of Prof. Goebel were destroyed due to some unknown reasons.

A search in relevant herbaria failed to identify specimens of *Radula tjibodensis* collected by Goebel, and it appears that the only extant original material are those illustrations presented by Goebel (1887). Here, we lectotypify *R. tjibodensis* on one of these illustrations, and designate an interpretive epitype.

## Taxonomic Treatment

***Radula tjibodensis*** K.I.Goebel, *Ann. Jard. Bot. Buitenzorg* 7(1): 53 (1887)

**Original material:** Java, Tjibodas, ad folia viva (Zingiberaceae cujusdam et aliar. plt.), lgt. Prof. K. Goebel, Hiberno 1885/86 (no material located).

**Lectotype** (here designated): pl. V, fig. 33 in Goebel, *Annales du Jardin botanique de Buitenzorg* 7: (1887).

**Epitype** (here designated): Java: Forest de Tjibodas – ad *Elettaria* folia, l, 1895, lgt. J. Massart (epi: FH 00781517).

=*Radula flavescens* Steph., *Sp. Hepat.* 4: 203 (1910).

=*Radula reineckeana* Steph., *Sp. Hepat.* 4: 225 (1910).

=*Radula tayabensis* Steph., *Sp. Hepat.* 6: 516 (1924).

**Typification:** *Radula tjibodensis* was published with a technical description and illustration that focused on asexual reproductive structures (Goebel 1887: 25, 71–72; illustrations pl. V, fig. 33 & pl. VI, fig. 60). This focus was a natural concomitant of Goebel's interest in documenting gamma development diversity among several genera of leafy liverwort, including *Cololejeunea*, and *Radula*, and Goebel showcased this diversity in single plates that presented comparable structures from many different species. In the protologue Goebel described his species as having a strongly blistered protruding pocket on the leaf lobule and that it was found on the leaves of Zingiberaceae in Tjibodas. He also described the presence of brood buds (presently called gemmae) from which young plantlets develop. Additionally, he described and illustrated scathe lobules from the base of which tufts of rhizoid arise. After Goebel, V. Schiffner (1893) examined and diagnosed the original material of *R. tjibodensis*. Schiffner mentioned a letter which he received from Prof. Goebel, requesting him to examine the liverwort specimens collected by Goebel from West Java, particularly from Salak and Gede, during the winter of 1885/86, from a systematic point of view. Schiffner (1893: 249) cited three gatherings as part of his treatment of *Radula tjibodensis*, including one 'Habit. Java, Tjibodas; ad folia viva (Zingiberaceae cujusdam et aliar. plt.); lgt. Prof. K. Goebel Hiberno 1885/86'. Schiffner was the only person, other than Goebel himself, to document an investigation of Goebel's material. Since Goebel provided all his liverworts specimens from West Java to Schiffner, the existence in FH of original material of *R. tjibodensis* remained a possibility (Stafleu and Cowan 1985).

During the study, only four herbarium specimens (FH00781515, FH00781516, FH00781517, FH00781518) have been located at FH which were from Tjibodas, Java, none of which were collected by Goebel. The specimens were collected by Jean Massart, a Belgian botanist in the year 1894/95 (Stafleu and Cowan 1981) during his expedition to Java. So, neither the collector nor the date of collection is similar in the herbarium specimens of FH. Yamada (1989) followed by Zhu and So (2001) mentioned in their articles about the presence of a 'holotype' of *Radula tjibodensis* at JE herbarium. This is a correctible error for 'lectotype', meaning Yamada (1989) could have inadvertently designated a lectotype in JE. However, the curator of JE, (pers. comm.) has confirmed that no such type specimen of *Radula tjibodensis* is present in JE. Goebel's specimens were deposited in B (ferns, mosses and hepatics collected in 1885–86), ROST (Java collection collected in 1885–86) and M (fruits in alcohol collected in 1924–25). In addition to FH, original material of *R. tjibodensis* was sought at B, JE, M, and ROST without success. We therefore conclude that the original material is either lost or destroyed.

The only extant elements of original material are, therefore, illustrations on the two plates i.e. pl. V, fig. 33 and pl. VI, fig. 60 in Goebel (1887). Goebel's figures were compilations of structures of interest from more than one species, hence a specific selection must be made of one or more elements within the figures to define the species. Plate VI, fig. 60 corresponds to the development of young thallus from the brood bud where the habit, leaves and lobules of the plant are very immature, hence is not the illustration most representative of the plants. Another plate i.e. pl. V, fig. 33 illustrates a short shoot segment, with the leaves and lobules with rhizoids as mentioned in Goebel's protologue. Although the oblique view makes inference of lobe and lobule shape challenging, this is the most complete representation of the plant among the illustrations provided by Goebel. Hence the illustration of pl. V, fig. 33 is here designated as the lectotype of *Radula tjibodensis* (Turland et al. 2025, Art. 9.3, 9.4 d, e & 9.12).

Since the designated lectotype is an illustration of a shoot fragment presented in oblique view, an epitype is necessary to support the lectotype and eliminate ambiguity in the application of the name *Radula tjibodensis*. We consider epitype selection from the specimens collected at Tjibodas in FH, below.

**(FH00781515!):** "Java: Gorge di Tjibodas – ad *folium vivium* sparsissima, XII, 1894, lgt. J. Massart" indicates that the specimen was collected by Jean Massart in December 1894 from the gorge of Tjibodas, Java, where it was sparsely distributed on living leaves. However, this specimen is not a good choice for epitype, as no leaf traces remain and the amount of specimen is minimal and in a brittle condition.

**(FH00781716!):** "Forest de Tjibodas – ad folia viva, l, 1895, lgt. J. Massart" indicates that the specimen was collected by Jean Massart in January 1895 from the forest of Tjibodas, Java, in an epiphyllous condition. However, this is not a good choice for epitype, as the collection represents a mixed population, making it extremely difficult to isolate the authentic specimen of *Radula tjibodensis*.





**Figure 1.** A, B. Lectotype of *Radula tjibodensis* Goebel. C. Habit of the epitype. D. Leaf lobules forming protruding pocket. E. Epitype specimen growing on leaves of *Elettaria* sp. F. Epitype of *Radula tjibodensis* Goebel. A, B from Goebel (1887) pl V, fig. 33, C–F from FH00781517, supplied by the Harvard University Herbaria.



**(FH00781517!):** “Java: Forest de Tjibodas – ad *Elettaria* folia, l, 1895, lgt. J. Massart” indicates that the specimen was collected by Jean Massart in January 1895. This specimen was collected from the forests of Tjibodas, Java, where it was growing on the leaves of *Elettaria* sp., a member of the family Zingiberaceae, as noted in the original protologue by Goebel (1887). Moreover, this specimen shares with the lectotype i.e., Goebel’s illustration in plate V, figure 33, the narrowly ovate to falcate-ovate leaf lobules with a pronounced carinal region as described in Goebel’s protologue (1887). Thus, specimen FH00781517 appears to be a good match with the designated lectotype (pl. V, fig. 33) and is here designated as the epitype for *Radula tjibodensis* (Art. 9.9 and 9.20, Turland *et al.* 2025). This epitype serves to anchor the name *Radula tjibodensis* to a physical specimen and remove ambiguity in its application.

**(FH00781518!):** “Java: Forest de Tjibodas – ad *filicio* folia, l, 1895, lgt. J. Massart” indicates that the specimen was collected by Jean Massart in January 1895 from the forest of Tjibodas, Java, where it was growing on fern leaves. However, this specimen is not a good choice for epitype due to the poor and fragile condition of the leaves.

## Acknowledgements

The authors are most grateful to, Director, Botanical Survey of India, Kolkata and Head of Office, Central National Herbarium, BSI for providing the research facilities and encouragements. The authors also want to thank the curators of B, BM, CAL, FH, JE, for providing the relevant digital images of the material and their additional insights. One of the authors (MP) is thankful to Genevieve E. Tocci, Harvard University Herbarium for dissecting the type material and Jörn Hentschel, Curator Cryptogamic Division, Herbarium Haussknecht, Jena, for providing supporting evidence in the manuscript. The authors are also thankful to an anonymous reviewer for comments on the manuscript, Dr Russell Barrett for editorial assistance, and Dr John McNeill from the Royal Botanic Gardens, Edinburgh for discussion of typification options for *Radula tjibodensis*. MP is also thankful to Dr Avishek Bhattacharji, Scientist-E, Botanical Survey of India, India for providing valuable insights in the manuscript.

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