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New occurrences of the liverwort *Treubia insignis* (Treubiaceae, Marchantiophyta) from the southern Philippines and insights into its distribution and habitat preferences

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Abstract

Treubia insignis, previously known for the Philippines from a single collection obtained in 1913, is rediscovered just over a century later, this time from the southern Philippines. Habitat preference, at least in the southern Philippines, is along riparian corridors of small streams in high-quality montane hardwood tropical rainforests.

Key words: biodiversity inventories, disjunct populations, Treubiaceae

Introduction

Ongoing botanical explorations of the southern Philippines has yielded numerous bryophyte collections from multiple mountain ranges. These ongoing inventory expeditions are under the auspices of a U.S. National Science Foundation grant in partnership with colleagues from Central Mindanao University and Bukidnon State University, Mindanao. To date, five month-long expeditions have yielded nearly 7,000 bryophyte collections. Many bryophyte species identified represent new distribution records for Mindanao and several taxa are also new for the Republic of the Philippines (Ellis 2023). We provide one such range extension here, *Treubia insignis* Goebel (1890: 1) as new for the southern Philippines.

Since its initial discovery over 135 years ago on Mt. Gedeh near Tjibodas, western Java, *Treubia* Goebel (1890:1) remains a genus of evolutionary importance and interest. It is in the earliest diverging liverwort lineage, Haplomitriopsida, Treubiidae, (Crandall-Stotler, & Stotler 2000, Stotler & Crandall-Stotler 2008). Considering that *Treubia insignis* is both large and showy, it is rather remarkable that in the intervening years so few new populations have been discovered. Early bryologists found *Treubia* so unusual that several papers were published describing its general morphology as well as the archegonium and sporophyte (Goebel 1890, Grün 1914, Campbell 1916). Speculation on its position among the liverworts was finally resolved by molecular evidence (Frey & Stech 2005) and further reinforced by more recent phylogenetic studies (de Sousa et al, 2019, Puttick et al. 2018, Rensing 2018). *Treubia* is also unique among the liverworts in its association with endophytic fungi (Duckett et al. 2006). While only mucoromycote fungi are found in *Treubia* and the Haplomitriopsida, a mixture of glomeromycote and mucoromycote fungi occur in other

liverwort groups (Field et al. 2015a, b). Initially, *Treubia* encompassed one species from Java (*T. insignis*) and another named soon after from Samoa (*T. bracteata* Stephani [1896: 302]), but subsequent discoveries of *Treubia* were then documented for Tahiti, Tasmania, New Zealand, Patagonia (Schuster & Scott 1969; Hässel de Menéndez 1994), and more recently, from Vanuatu (Higuchi 2005). The distribution of *Treubia insignis* is widespread across Malesia from Java eastward to Papua New Guinea although populations apparently are widely scattered. Even though the genus *Treubia* was monographed by Schuster & Scott (1969), the actual number of taxa remains somewhat unresolved, and few taxa across its wide geographic distribution have received molecular investigation. For example, a recent phylogenetic study of *Treubia* in New Zealand determined that there are two species of *Treubia* instead of 3-4 (Glenny et al. 2015). Some bryologists segregated each distant population of *Treubia* as distinct species (at the time most were named from only a type specimen), while others viewed these occurrences to be of subspecies rank. Schuster & Scott (1969) took the later approach. Regardless of the number of taxa and their associated rank within the genus, *T. insignis* has the widest geographic distribution (Schuster & Scott 1969, Piippo 1988). Additional studies proposed to elevate two species of *Treubia* to the newly established genus *Apotreubia* Hattori & Mizutani in Hattori et al. (1966: 491) although Schuster & Scott (1969) placed them at the subgenus level. The first species transferred into *Apotreubia* was *Treubia nana* Hattori & Inoue (1954: 99) now documented to occur in Japan and Taiwan with disjunct occurrences discovered from western North America in British Columbia (Schofield 1962). The North American populations were later given species rank as *Apotreubia hortoniae* Schuster & Konstantinova ex Konstantinova in Konstantinova et al. (2013: 33). Another as *Treubia pusilla* Schuster (1968: 515) endemic to Papua New Guinea was subsequently also transferred into *Apotreubia*. A fourth species, *Apotreubia yuannanensis* Higuchi (1995: 321) was described from Yunnan, China. *Apotreubia* as a segregate genus from *Treubia* has between 2-4 species although Bakalin & Vilnet (2017) placed *Apotreubia hortoniae* and *A. yuannanensis* as synonyms of *A. nana*. The family Treubiaceae is small with no more than 10 species contained within two genera.

Treubia insignis (Figure 1) was first collected from the Philippines in 1913 when D.H. Campbell (1916) discovered a population on Mt. Banahao, Luzon Island, and this sole collection was the basis for the entry of *Treubia insignis* in the most recent checklist of Philippine liverworts (Tan & Engel 1986). We now report additional Philippine populations over 100 years since the first documented occurrence, this time from the southern Philippines on both Negros and Mindanao islands.

Based on our field experience of encountering *Treubia insignis* at several localities in the southern Philippines, the species prefers steep to vertical clayey soil banks in shade along small streams with intact high-quality forests at mid elevations, generally between 1250-1500 m. Some Philippine populations of *Treubia* can also be on rotten wood, but all of the new occurrences we have encountered are in riparian corridors along small streams where the environment would offer higher humidity than the surrounding slopes of hardwood tropical rainforests. Common associates can be *Cyathodium* Kunze ex Lehmann (1834: 17), *Riccardia* Gray (1821: 683) and various other liverworts and mosses. It is important to note that the species does not seem to favor the highest elevations of remote mountain summits. It was found by us on the lower fringes of primary forest, often not far from disturbed or cultivated areas. These populations may be the only remnants of what was once a far wider distribution. Continued good stewardship of these areas by both government agencies and the local communities will be important for this species' survival.

Specimens examined. Philippines. Central Visayas. Negros Island, **Negros Oriental Province:** Cuernos de Negros, about 5.5 km W of Mt. Talinis, small stream in the headwaters of Kanaway River, 9.249113°N, 123.126657°E, 16 Dec 2019, 1490 m, *Brinda & Yorong 14267* (BRIT, BUKH, CAS, CMUH, L, MO-7037568, NY), <<https://www.tropicos.org/collection/4945291>>. Mindanao Island. **Misamis Oriental Province:** Mt. Balatukan Range Natural Park. Enogulan Stream, volcanic clayey soil, 8.72811°N, 125.00472°E, 18 January 2023, 1340 m, *Shevock, Lubos & Balansag 60602* (BRIT, CAS, CMUH, MO); Mintignuan Stream, on rotten tree fern log, 8.73156°N, 125.00651°E, 19 January 2023, 1400 m, *Shevock, Lubos & Balansag 60704* (BRIT, BUKH, CAS, CMUH, JENA, MO, PNH); Along small stream about 0.2 km north of Mount Balatukan Scout Camp, on soil, 8.732860°N, 125.003752°E, 20 January 2023, 1450 m, *Brinda & Salas 16115* (BRIT, CAS, CMUH, MO). **Bukidnon Province:** Mt. Kalatungan Range Natural Park. Along stream in the eastern buffer zone, on streamside rock, 7.950094°N, 124.947254°E, 7 February 2023, 1350 m, *Brinda & Yorong 16551* (BRIT, CAS, MO); Malingon Stream, clayey soil bank, 7.74992°N, 124.94616°E, 4 July 2023, 1370 m, *Shevock, Lubos & Yorong 61474* (BRIT, BUKH, CAS, CMUH, F, MO, PNH); Kamandayu Falls, Malingon Stream, clayey soil bank, 7.95018°N, 124.95068°E, 7 July 2023, 1310 m, *Shevock, Lubos & Yorong 61793* (BRIT, CAS, CMUH, JENA, MO, PNH); Along stream above large waterfall in the eastern buffer zone, on streamside rock, 7.937650°N, 124.953871°E, 8 July 2023, 1257 m, *Brinda & Salas 16769* (MO).



FIGURE 1. *Treubia insignis*, living Philippine plants *in situ*. A. Stem habit showing the dorsal lobes and conspicuous, whitish oil cells. *Brinda & Yorong 16551* (photo by John C. Brinda). B. Plant with mature sporophyte. *Brinda & Salas 16115* (photo by Daryl S. Salas).

Note: While preparing this paper we encountered a photo gallery (brp.searca.org/pdfs/flora_flyer) for Mt. Malindang Range Natural Park (Misamis Occidental Province) in NW Mindanao that includes a photograph of *Treubia insignis*. There was no other information as to when or where this liverwort was photographed or if a voucher specimen was obtained. Nonetheless, this is likely another Mindanao locality for *Treubia*.

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