



***Gynura tambuyukonensis* (Asteraceae), an obligate ultramafic species endemic to Mount Tambuyukon (Kinabalu Park, Sabah, Malaysia)**

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Abstract

A new endemic species of *Gynura* is described and illustrated. *Gynura tambuyukonensis* is found exclusively ('obligate') on ultramafic soils between bare peridotite bedrock at 2450–2550 m above sea level on Mount Tambuyukon (Kinabalu Park) in Sabah (Malaysia) on Borneo Island. On the basis of the morphological features, this new taxon appears to be related to *G. sundaiaca* F.G. Davies of the Lesser Sunda Islands and Timor. The diagnostic morphological characters are discussed and information about its habitat, ecology and distribution is provided.

Key words: Compositae, Endemic, Mount Tambuyukon, Senecioneae, Ultramafic

Introduction

The genus *Gynura* Cassini comprises of 44 species in total (Vanijajiva & Kadereit 2011). It is largely palaeotropical in distribution, with the main center of diversity and endemism in Southeast Asia. The genus has been placed within the tribe Senecioneae of the Daisy family (Asteraceae) because it has one series of involucre bracts with usually homogamous disciform capitula, often yellow corollas and mostly long and exerted style arms (Nordenstam 2007).

Mount Tambuyukon, in Sabah on Borneo Island, is Malaysia's third highest mountain at 2579 m above sea level after Mount Kinabalu (4095 m above sea level) and Mount Trus Madi (2642 m above sea level) and the mountain lies entirely in Kinabalu Park, a World Heritage Site. Kinabalu Park is renowned for harboring what is perhaps the highest plant diversity per unit area globally with in excess of 5000 species in less than 1200 km² (Beaman 2005). To date, relatively little research effort has been devoted to Mount Tambuyukon, but it is clear from recent studies by the first author that its vegetation is exceptionally species-rich.

The geology of Mount Tambuyukon is dominated by ultramafic bedrock, mainly peridotite. Soils derived from ultramafic (also called 'serpentine') geology are widely known for hosting endemic floras (Brooks 1987, Boyd *et al.* 2009, Harrison & Rajakaruna 2011). This can be partly explained by the unusual chemical properties of ultramafic soils, which includes nutrient deficiencies, cation imbalance and metal toxicities (Proctor 1999, 2003). In Kinabalu Park, where ultramafic soils occur as insular features, such habitats have been associated by high levels of species-richness and endemism (Beaman & Beaman 1990). Typical for tropical ultramafic mountains in the region, it is that the altitudinal sequence of vegetation zonation is compressed, as reported from Mount Silam (884 m above sea level) on Sabah's east coast (Proctor *et al.* 1988, Bruijnzeel *et al.* 1993). As Mount Tambuyukon is the highest ultramafic mountain on the island of Borneo, this compression is much more pronounced than on Mount Silam and manifests itself in graminoid shrub vegetation with several endemic plant species (Van der Ent 2011, Van der Ent & Wood 2012).

As part of fieldwork undertaken in 2011–2013, a new species of *Gynura* was found on the main summit ridge of Mount Tambuyukon.

Material and Methods

Fieldwork was undertaken by the first author on Mount Tambuyukon Sabah, Borneo, Malaysia during 2011–2013. Specimens were examined from the Sabah Parks Herbarium (SNP). Measurements of the dried specimens were made using a Nikon MZ 645 stereomicroscope. A soil sample was collected from near the roots of *Gynura tambuyukonensis*, air-dried at room temperature and separately extracted with DTPA (for potentially plant-available nickel and manganese) and silverthioarea (for exchangeable cations: calcium, magnesium, potassium and sodium) extraction solutions (Becquer *et al.* 1995, Dohrmann 2006). Total soil elemental concentrations were analysed by digestion with concentrated nitric (70%) and hydrochloric (37%) acid in a specialised microwave. The soil pH was measured in a 1:2.5 soil:water mix. Plant samples of a mature specimen of *G. tambuyukonensis* were washed with demineralised water, oven-dried at 70°C and digested with concentrated nitric acid (70%) and hydrogen peroxide (30%) in a specialised microwave. Both soil and leaf sample extracts were then measured with ICP-AES for Ni, Co, Mn, Fe, Mg, Ca, Na, K and P. The ICP-AES instrument was calibrated using a 6-point multi-element standard prepared in each extraction solution. The laboratory work was undertaken at the University of Queensland in Australia.

Taxonomic Treatment

Gynura tambuyukonensis Vanij. & Ent *sp. nov.* (Fig. 1 & Fig. 2)

TYPE:—MALAYSIA. Sabah. Kinabalu Park, Mount Tambuyukon, 4 May 2011, *A. Van der Ent et al.* SNP 26317 (holotype SNP, isotype BKF).

Gynura tambuyukonensis Vanij. & Ent is a new species related to *Gynura sundaiaca* F.G. Davies that differs from the latter in stems prominently dark-purple, subsucculent, and leaves usually clustered particularly in lower part of stems.

Plants 20–80 cm long, roots fibrous, stems subsucculent, usually creeping, dark purple, glabrous. *Leaves* shortly petiolate, 0.3–1 cm, exauriculate, prominently clustered particularly in lower part of stems, subsucculent, glabrous; blade elliptic to rhomboid, 3–12 × 2–4 cm, dark green above, prominently purple beneath, glabrous; base cuneate; apex acute or obtuse; margin coarsely and distantly dentate. *Capitula* homogamous, discoid, 3–7 per cymose panicle, 5–8 mm in diameter; peduncle 1–4 cm long, pubescent, bracts 3–5, 3–6 mm long, glabrescent; phyllaries 12–14, 10–13 mm long, 1–1.5 mm broad, glabrous; calycular bracts 4–7, 3–5 mm long, pubescent. *Florets* ca. 20; corollas orange to yellow, 9–15 mm long, exceeding phyllaries by 2–4 mm. *Stamens*: anthers 2.5 mm long, filaments 1–2 mm long, collars subcylindrical, elongated. *Style* arms 3 mm long, appendage shortly conical, 0.5 mm long, papillose with some larger papillae at base and apex. *Cypselas* 4–5 mm long, brown, sparsely pilose to glabrous; carpodium cylindrical, yellowish; pappus 8–10 mm long, white, scabrid.

Etymology—The specific epithet “*tambuyukonensis*” denotes Mount Tambuyukon in Sabah, Malaysia, Borneo, where the species was first found and appears to be endemic.

Phenology—Flowering and fruiting occurs year-round.

Distribution and Habitat—The species is, as far as is known, endemic to Mount Tambuyukon (Kinabalu Park) in Sabah (Malaysia) on Borneo Island (Fig. 3). It was only found growing on the summit ridge on ultramafic soils between bare peridotite rock boulders between 2450–2550 m above sea level. The vegetation of the summit ridge of Mount Tambuyukon is characterised by short ligneous shrubs and graminoids. Co-occurring species include: *Machaerina falcata* (Cyperaceae), *Tristaniopsis elliptica* (Myrtaceae), *Lithocarpus rigidus* (Fagaceae), *Leptospermum javanicum* (Myrtaceae), and *Dacrydium gibbsiae* (Podocarpaceae). Other plants endemic to the summit ridge of Mount Tambuyukon include the herb *Begonia vaccinioides* (Begoniaceae), and the small trees *Rhododendron meijeri*, *R. baconii* (Ericaceae) and *Scaevola verticillata* (Goodeniaceae).

Additional Specimens Examined (Paratypes)—MALAYSIA. Borneo: Sabah. Kinabalu Park, Mount Tambuyukon, 3 May 2011 *A. Van der Ent et al.* SNP 27794 (SNP) and 5 May 2011, *A. Van der Ent et al.* SNP 26702/26696 (BKF).

Note—In Vanijajiva & Kadereit’s (2011) key, *Gynura tambuyukonensis* would be placed near to *G. sundaiaca* F.G. Davies due to it being glabrous and having fibrous roots, usually exauriculate leaves, a cuneate leaf base, shortly petiolate petioles (0.3–1 cm long), minutely denticulate leaf margins, and involucre bracts 8–13 mm long. However, *G. tambuyukonensis* differs from *G. sundaiaca* by its usually creeping stem, leaves prominently clustered

particularly in the lower part of the stem and sparsely pilose to glabrous cypselas. These two species also grow in different habitats: whereas *G. sundaiaca* is found growing on limestone soils of the Lesser Sunda Islands and Timor at 5–300 m above sea level, *G. tambuyukonensis* grows at high elevations (circa 2500 m above sea level) on ultramafic soils on Mount Tambuyukon on Borneo Island.

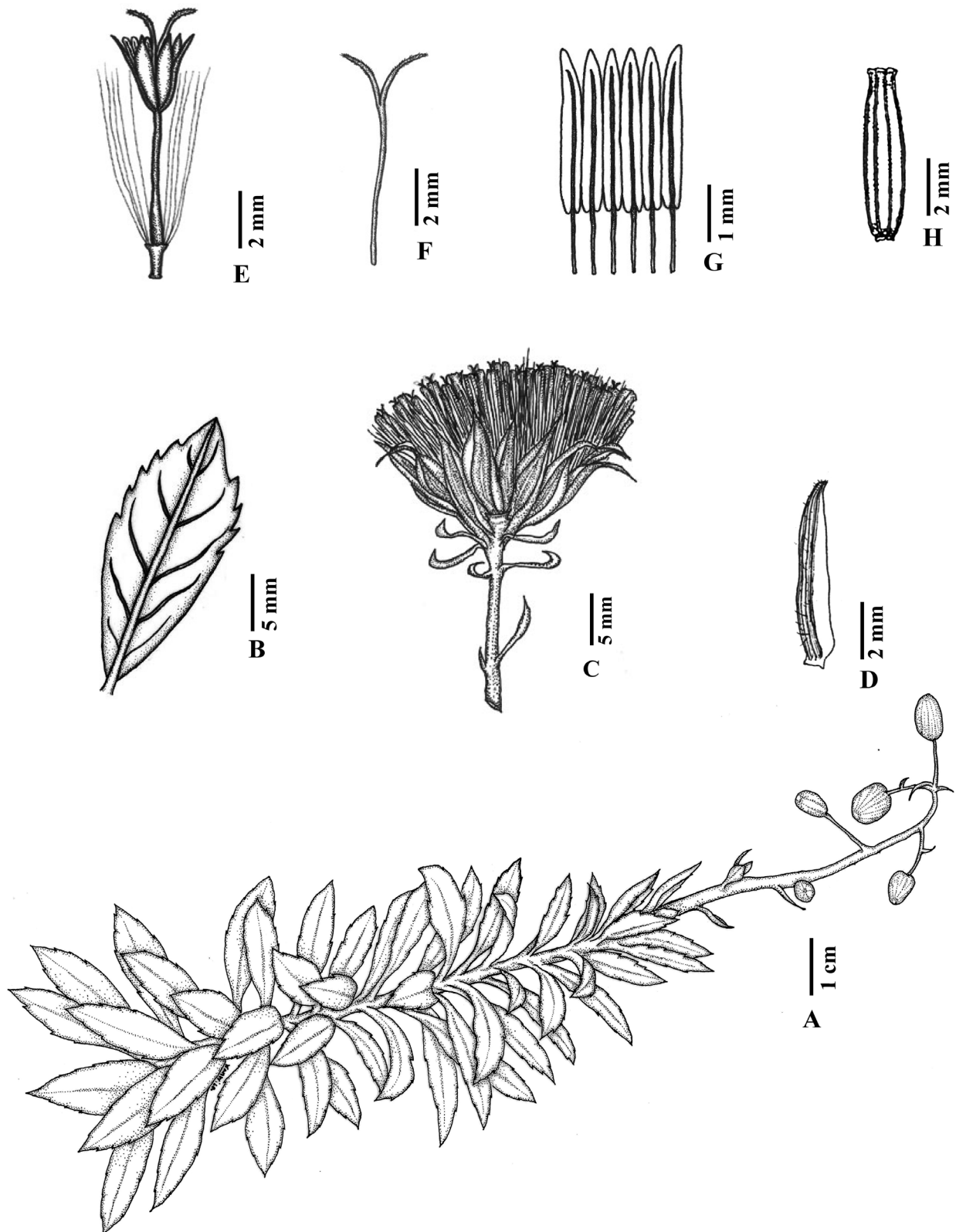


FIGURE 1. *Gynura tambuyukonensis*. A habit; B leaf; C capitulum; D phyllary; E floret with pappus; F style; G anthers; H cypselas. Illustration by Wanwisa Bhuchaisri and Pornphen Supachok.

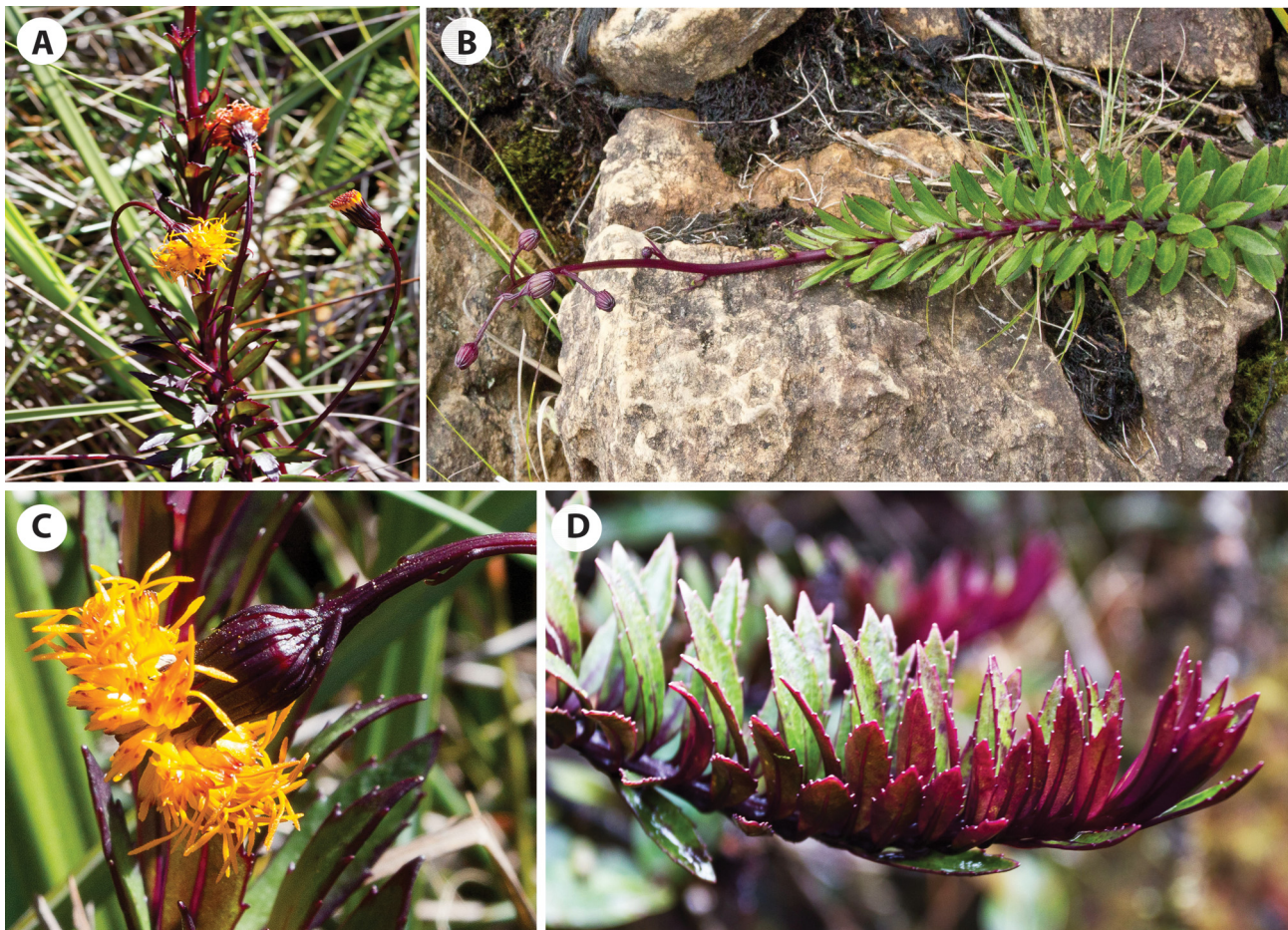


FIGURE 2. *Gynura tambuyukonensis* in the field. **A** Synflorescence; **B** Habit of plant creeping over bare ultramafic bedrock (peridotite); **C** Capitulum; **D** leaves. Photographs by Antony van der Ent.

Soil chemistry and foliar chemistry—The analyses of a soil sample collected near the roots of an individual of *G. tambuyukonensis*, and foliar analyses are presented in Tables 1 and 2 below. The soil is medium acidic (pH 5.7), and contains very high total and exchangeable magnesium (Mg), and exceptionally high nickel (Ni) and manganese (Mn). As such these soil chemical properties might induce phytotoxicity, and *G. tambuyukonensis* must be ostensibly tolerant. The plant appears effective at excluding phytotoxic elements (Ni, Mn) but is efficient in sequestering essential elements (Ca, K, Na, P) despite low concentrations of these elements in the soil. Foliar magnesium (Mg) concentrations are, however, very high (Table 2).

TABLE 1. Chemistry of soil sampled from between the roots of *Gynura tambuyukonensis*. Elemental concentrations as totals, except if otherwise indicated.

Al $\mu\text{g/g}$	Ca $\mu\text{g/g}$	Ca $\text{cmol}^{(+)}\text{/kg}$	K $\text{cmol}^{(+)}\text{/kg}$	Mg $\text{cmol}^{(+)}\text{/kg}$	Mg mg/g	Na $\mu\text{g/g}$	K $\mu\text{g/g}$
5300	928	2.3	0.2	14	11.5	54	54
Co $\mu\text{g/g}$	Cr $\mu\text{g/g}$	Fe mg/g	Mn mg/g	Ni $\mu\text{g/g}$	P $\mu\text{g/g}$	Mn DTPA $\mu\text{g/g}$	Ni DTPA $\mu\text{g/g}$
283	1340	181	5.4	1500	124	192	135

TABLE 2. Foliar chemistry of a specimen of *Gynura tambuyukonensis* ($\mu\text{g/g}$).

Al	Ca	Fe	K	Mg	Mn	Na	Ni	P
20	13400	99	9500	20900	122	7800	136	393

Conservation status—The habitat of *Gynura tambuyukonensis* lies entirely in Kinabalu Park and is therefore protected by law and enforced by Sabah Parks. However the restriction of this species to only a single population on the summit ridge of Mount Tambuyukon, the small area of occupancy (< 10 km²), and the small number of individuals (no more than 20 individuals have been observed to date) means that this species is particularly sensitive to natural catastrophic events, such as forest fire or severe drought which could lead to its extinction. The species can be classified as Endangered (EN) on the IUCN Red List Criteria (Version 3.1: IUCN, 2001) based on criterion (D): the population size is estimated at < 250 individuals, although no information is available about the population-dynamics and hence trends in population size.

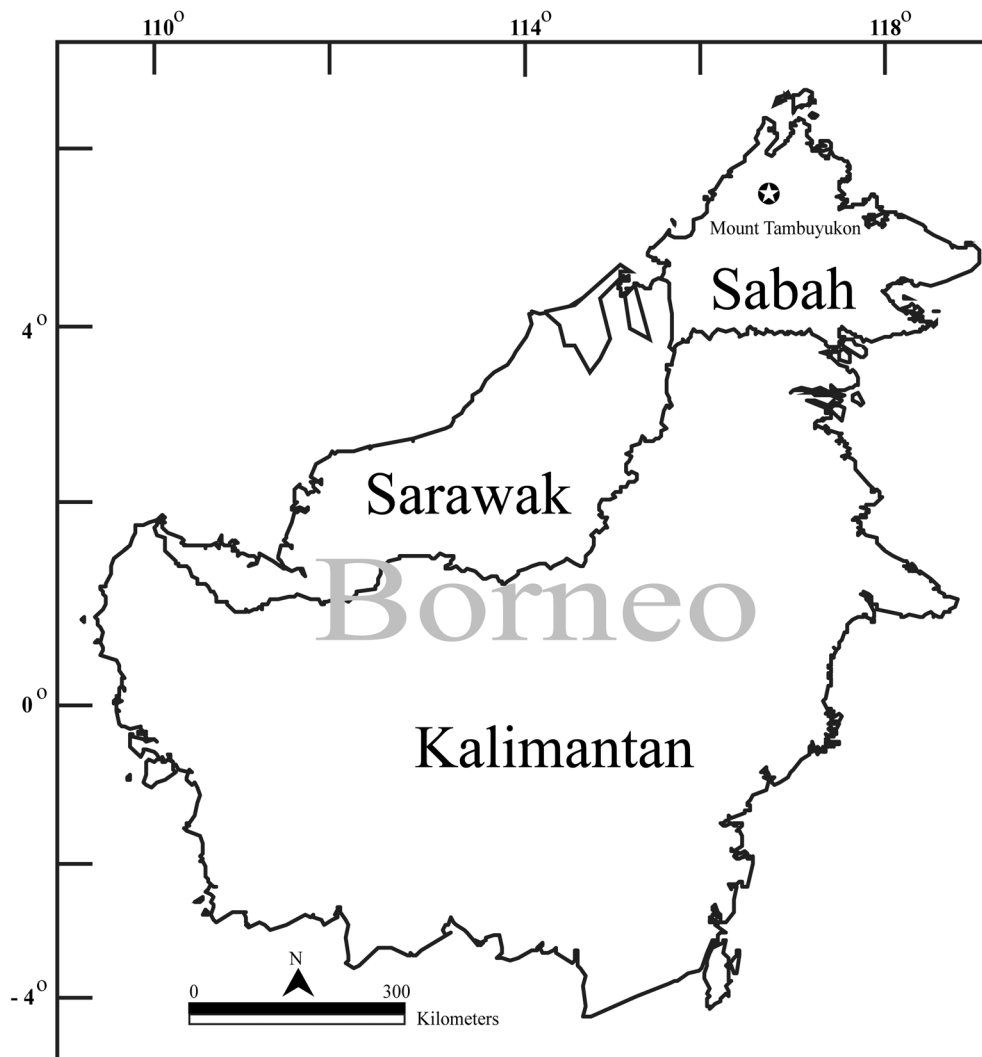


FIGURE 3. Distribution of *Gynura tambuyukonensis* [★].

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