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A new diminutive species of *Schismatoglottis* (Araceae) from Samar Island, Philippines

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Abstract. *Schismatoglottis minuta* (Araceae) is described as a new species and illustrated based on accessions collected from Samar Island, Philippines. The new species, belonging to the Calyptrata clade *sensu* Hay and Yuzammi is distinct from previously reported taxa. Due to its habitat preferences and low (<100) estimated number of mature individuals, we recommend that this noteworthy species should be considered as critically endangered.

Keywords: Araceae, *Schismatoglottis*, Calyptrata Clade, endemic species, Samar Island Natural Park.

INTRODUCTION

The aroid genus *Schismatoglottis* Zoll. & Moritzi (1846: 83) comprises about 139 species distributed across the Malay Archipelago, with extensions towards the Pacific Islands (e.g., Vanatu), Indo-China, and tropical to subtropical China (Hay 1996; Hay and Yuzami 2000; Wong et al. 2016; Wong et al. 2018). The islands of the Philippines host about 9% of its diversity, with most species restricted to one or few islands (Wong et al. 2010; Pelser

et al. 2011 onwards; Boyce et al. 2015). *Schismatoglottis* in Samar Island is represented by four species: *S. calyptrata* (Roxb.) Zoll. & Moritzi (1846:590), *S. edanoi* A.Hay (2000: 121), *S. plurivenia* Alderw. (1922: 209), and *S. samarensis* A.Hay (2000:143), of which two species (*S. edanoi* and *S. samarensis*) are endemic. Given the recent descriptions of many new species of *Schismatoglottis* from Borneo and the Malay Peninsula (Boyce and Wong 2015; Wong 2012; Wong et al. 2020; Wong and Boyce 2021; Wong et al. 2022), it is plausible that the diversity of this numerous genus has not been fully assessed in the Philippines, especially at remote biological hotspots such as Samar Island.

While exploring Samar Island Natural Park at Paranas, Samar Island, the second author photographed a *Schismatoglottis* whose morphological characteristics did not fully match with any of the currently known Philippines species. The most notable features were its remarkably diminutive habit of about 3–6 cm tall and 21 cm wide, the cordate base of its leaves, and the size, slender shape, sharp tip, and white color of its inflorescences. Examinations of vegetative and floral characters suggest that this taxon belongs to the Calyptrata informal species group (*sensu* Hay and Yuzammi, 2000), which is characterized by having a long and persistent leaf sheath fully attached to stems, deciduous spathe limb, minute sessile stigmas, and inflorescences bearing an appendix of sterile male flowers that demarcate the pistillate and staminate sections (Hay and Yuzammi, 2000).

Further expeditions in Samar Island located a second population between Can-avid and Taft, and examinations of herbarium specimens revealed a third one at Matuguinao. Given the unique combination of characters that do not fit within the variation reported from conspecifics in the Philippines and the centralized location of Samar Island at the eastern edge of the Philippine Archipelago (Figure 1), we consider that this taxon represents an undescribed member of *Schismatoglottis*. Hence, here we propose considering it as a new species, which appears to be restricted to Samar Island.

MATERIALS AND METHODS

Fieldwork conducted in March 2016, between June and October 2021, and in October 2022 aimed to document the occurrence of native and introduced species to prepare an updated floristic account for the Samar province.

Initial taxonomic descriptions and photo-documentation of key plant structures from collected specimens were done *in situ* at the type locality. Type specimens were kept in a field press treated with denatured alcohol prior to being transported to the Systematics Laboratory at the Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños, where they were pressed and dried. Some ripe inflorescences were preserved in alcohol vials to conserve the delicate structures of flowers at anthesis. Living plants were collected and cultivated by the first author (M.D.D.A.) to further observe developmental stages of structures, especially inflorescences. Morphological and microscopic characters of fresh specimens were carefully examined using a stereomicroscope and a compound translucent microscope. Measurements of large structures were taken using a ruler and a digital caliper (Tactix: 150 mm). Images of structures were analyzed using the software ImageJ (version 1.53o). After examinations, specimens were dried and mounted into herbarium sheets using standard procedures. Scientific illustrations were based on photos taken in the field using a Nikon D3400 camera or from material preserved in spirit collections. The terminology used in the description section concords with the one used by Hay and Yuzammi (2000) for descriptions of *Schismatoglottis* species. The holotype specimen was deposited at the Philippine National Herbarium (PNH), while isotypes were sent to the College of Agriculture Herbarium at the University of the Philippines Los Baños (CAHUP) and to the Forest Herbarium and Wood Collection (LBC). Herbarium acronyms follow Thiers (2021).

Besides our bibliographic survey, we studied the *Schismatoglottis* collection at the University of the Philippines Los Baños (LBC), PNH, CAHUP, and CMUH herbaria to search for previous collections of the putative new species. We were not able to locate any voucher matching the combination of morphological characteristics defining *S. minuta* except at CAHUP, where we identified two vouchers from the Province of Western Samar collected by M. Price and B.F. Hernaez in July 1975. It is worthy to note that the species delimitation concept being applied here is based on phenetics, which assumes that all operational taxonomic units sharing a set of morphological characters form a cohesive evolutionary assemblage (De Queiroz 2007). Based on the consistency in the range of the morphological characters observed among all known localities of the species here described and the fact that they are phenetically distinguishable from other members of the genus reported for the Philippines, we assume that they represent an independent evolutionary lineage distinct enough to merit recognition as a new species. However, this hypothesis is open to debate when biological and phylogenetic data become available and we can resolve relationships within

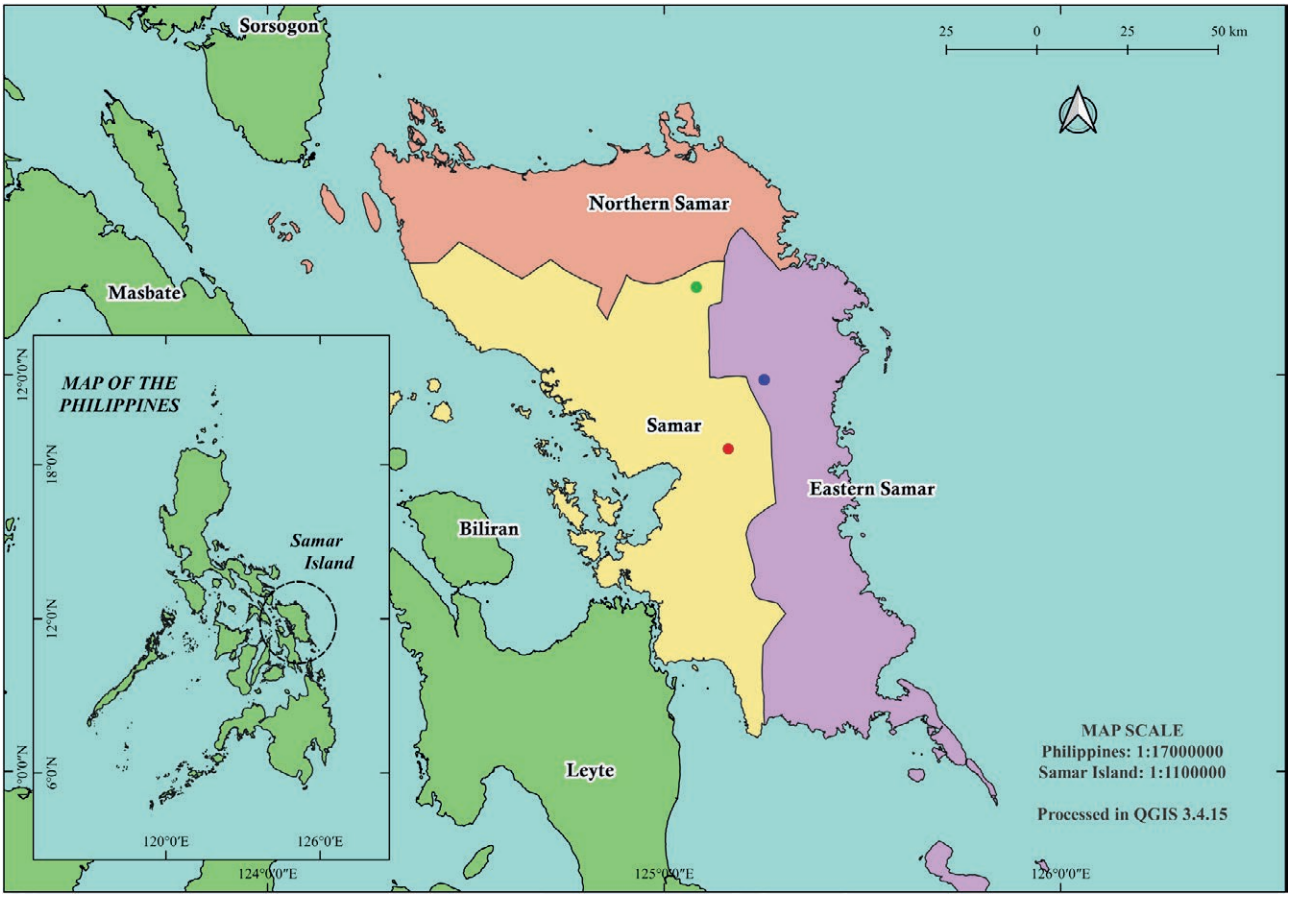

Figure 1. Distribution of *Schismatoglottis minuta* Tandang & M.D.Angeles within Samar Island, Philippines. Localities are as follows: Samar Island Natural Park, Paranas (red circle); Can-avid, Taft (blue circle); Matuguinao (green circle). Map generated by Ren Divien Obeña using QGIS.

Schismatoglottis and delimit species under the framework of a unified species concept (De Queiroz 2007).

TAXONOMIC TREATMENT

Schismatoglottis minuta Tandang & M.D.Angeles, **sp. nov.** (Figure 2)

Type: Philippines, Visayas region, Samar Island, Province of Samar, Municipality of Paranas, Barangay Tenani, Samar Island Natural Park, forest over limestone, 11.814056°, 125.160820°, 132 m, 2 June 2021, *M.D. delos Angeles 274* (holotype PNH!; isotypes CAHUP!, LBC!), CMUH!.

Diagnosis

Schismatoglottis minuta can be distinguished from *S. prietoi* by its longer petioles 5–7 cm (*vs* 3–5 (–9) cm long); narrowly lanceolate to narrowly cordate or rarely cordate leaf outline (*vs* ovate to oblong-ovate to narrowly elliptic leaf outline); leaf apex acute (*vs* leaf apex acuminate); leaf base rounded with posterior lobes sometimes overlapping (*vs* leaf base cuneate); spathe white below the constriction and whitish green at the upper portion (*vs* lower spathe light green and white with orange tip above); and limb with one constriction (*vs* limb with two weak constrictions).

Description

A hapaxanthic stoloniferous diminutive evergreen herbaceous plant usually 3.33–6.23 mm tall when flowering, individual plants forming small clusters (colonial). *Juvenile plants* terrestrial, emerging from seeds, from the tip of stolons, and from clonal buds present at the connection point between leaf blade and petiole. *Stems* epigeal, decumbent, terete, light yellow on older part becoming pale green on apical part, glabrous;

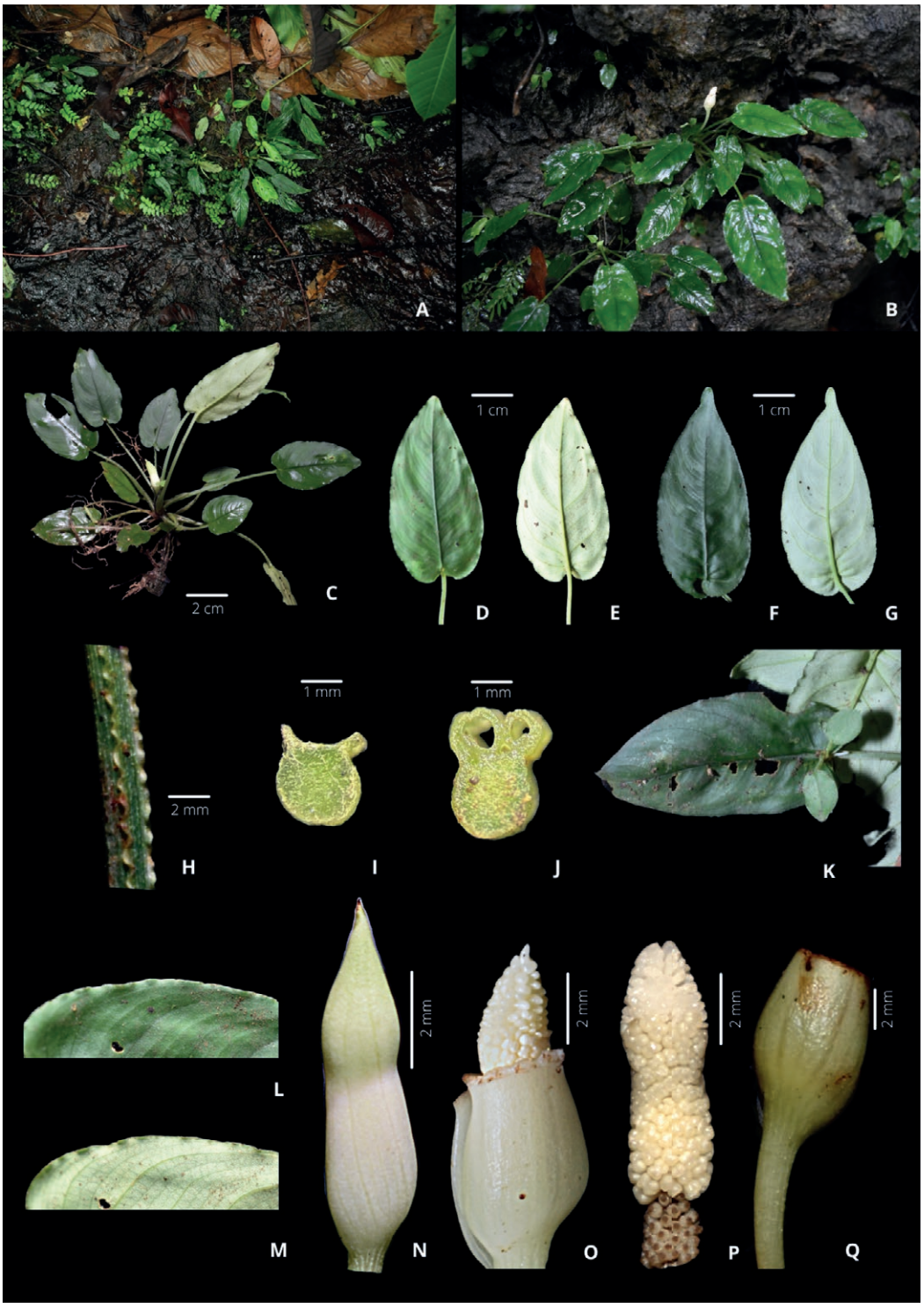

Figure 2. *Schismatoglottis minuta* Tandang & M.D.Angeles— A. Humid habitat along river edges habitat B. Rocky habitat on crevices of Forests over limestone habitat C. Habit D. Leaf with non-overlapping posterior lobes (adaxial view) E. Leaf with non-overlapping posterior lobes (abaxial view) F. Leaf with overlapping posterior lobes (adaxial view) G. Leaf with overlapping posterior lobes (abaxial view) H. Petiole margin I. Cross section of petiole J. Leaf sheath of petiole showing incurved margins K. Viviparous plant emerging from the base a leaf blade L. Leaf margin (adaxial view) M. Leaf margin (abaxial view) N. Mature inflorescence O. Inflorescence with flowers at staminate anthesis (spathe partially removed to show upper portion of spadix) P. Spadix (spathe artificially removed) Q. Unripe infructescence showing an enlarged spathe (Photo credits: D.N. Tandang: A; M.D. delos Angeles: B–Q).

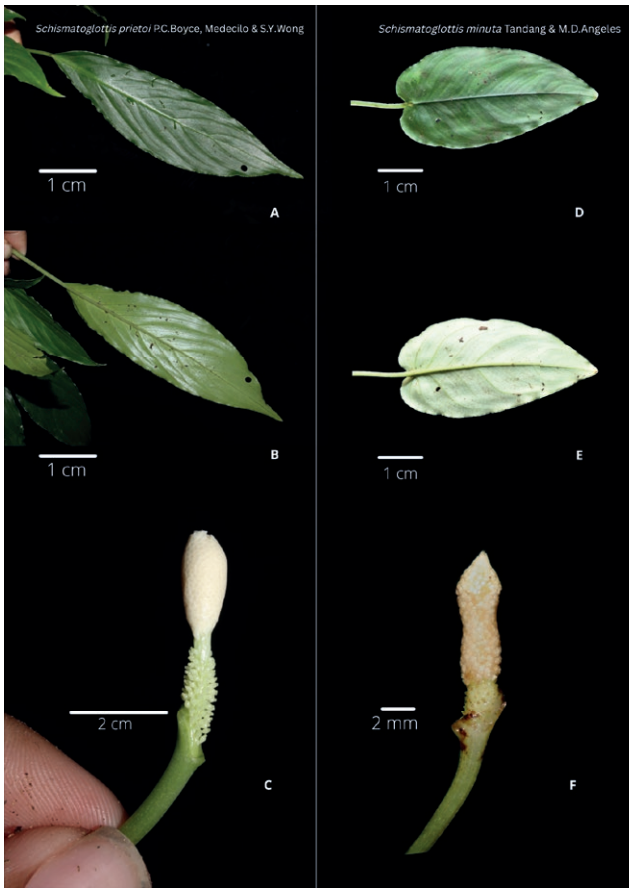

Figure 3. Differences of leaf shape and spadix between *Schismatoglottis minuta* and *S. prietoi*. A–C. *Schismatoglottis prietoi*. D–F. *Schismatoglottis minuta*. (Photos credits: J.R. Callado: A–C; M.D. delos Angeles: D–F).

Figure 4. Morphological differences of leaf shape between *Schismatogottis minuta* and *S. prietoi*. A–B. *Schismatoglottis minuta* from Samar Island C–D. *Schismatoglottis priteoi* from Iloilo, Visayas E–F. *Schismatoglottis priteoi* from Catanduanes, Luzon. (Photos credits: M.D. delos Angeles: A–B; D.N. Tandang: C–F).

individuals with short stem showing a very condensed internode obscured by fully attached overlapping petiole sheaths which becomes distinct in plants with long naked stems; stem 2.2–7.1 × 2.5–3.6 mm, not branching, bearing numerous long light-yellow stolons along its length, 42.7–98.8 × 1.1–1.3 mm. *Leaves* spirally arranged, 8–12, crowded at tip of the stem; petioles dark green turning light green towards the stem, fleshy, slender, 5.3–6.9 cm long (including petiole leaf sheath) × 2.9–3.4 mm wide at base, becoming narrow at the middle, 1.8–2.1 mm, and towards near the base of the leaf 1.5–1.6 mm, glabrous, dorsally channeled with persistent slightly undulating minute keels along the edges, "U" shaped in cross section, sheathed at base for 1.8–2.0 cm in length, the petiole sheath margin involute slightly enrolled, entire to rugulose, 2.3–2.5 mm wide when expanded. Blades dark green adaxially, dull and paler green to whitish-green abaxially, variable in shapes from lanceolate or narrowly cordate to rarely cordate when young, glabrous on both sides, rugulose at base, length from point of attachment to, 21.1–34.8 (–54.7) mm, basal lobes to apex 25.1–37.4 (–59.0) mm, at widest point 15.2–23.4 (–26.5) mm; leaf base deep to swallow cordate with rounded posterior lobes 2.8–3.9 (–4.5) × 6.3–7.2 (–8.7) mm, sometimes overlapping 1.1–2.3 (–2.8) mm, margin minutely undulated, acute at the apex, acumen 5.3–6.0 mm, young clonal plants emerging from the leaf blade base; midrib adaxially inconspicuous, abaxially prominent with 6–7 primary lateral veins on each side, diverging at 40°–42°, arching and connecting near the margin; secondary and tertiary venation conspicuous on abaxial side. *Inflorescences* single, no odor; peduncles white, erect, glabrous, very short during bud stage and gradually elongating to a slender shape and a sharp tip as the spathe become fully opened 30.4–42.4 mm long, with longitudinal striations that are decurrent on the urceolate base spathe, tightly clasped at base by

the sheath wings of the minuscule cataphyll, the cataphyll has reduced petiole ca. 6.5 × 0.7 mm and small light-green cordate foliage ca. 6.1 × 3.4 mm. *Spathe* erect, white below the constricted part becoming whitish-green at the upper portion; spathe in mature bud, 15.6 mm long, unopened upper part conical; spathe in opened stage 19.6 mm long, the white urceolate-shaped spathe at base oblique, 11.2 × 6.2 mm, spathe constriction ca. 4.4 mm, blade of the spathe (limb) cucullate, ca. 9.6 mm long, apex acute, caducous; *Spadix* erect, sessile, 9.5–11.6 mm long; sterile section absent; pistillate flower zone oblong, 2.2 × 2.2–2.4 mm, 1/4 of its length adnate at base to the spathe; pistil subglobose, loosely arranged, glabrous, 0.4–0.5 × 0.3–0.4 mm; stigma sessile, circular, papillae, 0.1 × 0.1–0.2mm; style not distinct; sterile interstice separating male and female zones absent; staminate flower zone 3.5–6.7 × 2.3–3.7 mm, adjoining directly with female zone, oblong, longer than the female and terminal appendix; staminate flowers cream white, joined, each with 2 stamens, dumbbell-shaped with slightly sunken connective clearly separating pairs of thecae; thecae domed, 0.4–0.9 mm in length and 0.3–0.6 mm across, opening by a short terminal slit; weak constriction near the tip; appendix at the terminal section white, conical, much shorter than the male and female zones, 1.4–2.0 × 1.8–2.2 mm, apex flat-topped at mature bud becoming conoid in open flower; appendix staminodes obovoid to globose. *Fruiting spathe* asymmetrical urceolate, 8.4 × 5.7 mm. *Fruits* not observed.

Etymology

The specific epithet "*minuta*" refers to the overall small habit of this new species when compared to conspecifics.

Phenology

Observed to bear flowers during the months of March, September, and October.

Distribution and Ecology

Schismatoglottis minuta is so far only known from Samar Island, Philippines. The species is currently known from three localities in Samar, at the "Samar Island Natural Park, Municipality of Paranas", "Canavid, Municipality of Taft", and "Municipality of Matuguinao". The sites are rocky habitats with moist substrate under tropical lowland evergreen rainforest dominated by towering dipterocarp trees. The species grows as a terrestrial herbaceous lithophyte on low vertical cliffs along creeks with shallow running water and on rock crevices under full shade in forests over limestone.

Conservation status

This new species, thus far, is found only at three fragmented localities. All sites contain clustered populations of less than 100 mature individuals in total, mainly in forested habitats (D.N.T., pers. obs.). Two of the known localities where *S. minuta* has been observed are not within the protected land (i.e. Can-avid and Matuguinao), and we expect that there will be a reduction in population size in more than ten years. Thus, following the IUCN Standards and Petitions Committee (2019), this noteworthy species is proposed to be categorized as critically endangered under criteria A4, B2a, C2a, and D1.

Additional specimens examined (paratypes)

PHILIPPINES: Samar Island: Province of Western Samar, Municipality of Matuguinao, primary forest on limestone and limestone-derived soils, 12°09'–12°10'N, 124°54'–124°56'E [12.15°–12.17°, 124.90°–124.93°], [243–523 m], 8–9 July 1975, *M.G. Price and B.F. Hernaez 418* (CAHUP [two sheets: accession numbers 40237 and 40238]).

DISCUSSION

The addition of *S. minuta* raises to 13 total number of *Schismatoglottis* species reported for the Philippines (Pelser et al. 2011–onwards). *Schismatoglottis minuta* is one of the smallest species in the genus, especially if compared to the rest of congeners occurring in the Philippines (Hay and Yuzammi 2000; Boyce et al. 2015). The only two other Philippine species of *Schismatoglottis* with relatively small size are *S. prietoi* P.C.Boyce, Medecilo & S.Y.Wong (2015: 407) and *S. mindanaoana* Engler (1912: 103). The former occur in Cebu and Luzon, while the latter is endemic to Mindanao. Of these, the taxon with closest morphological resemblance is *S. prietoi*.

Despite sharing an overall miniature size, *S. minuta* and *S. prietoi* can be differentiated by the shape of their leaves (blades with cordate base *vs* cuneate base; Figures 2 and 3), inflorescences with staminate to female zones contiguous *vs* very short sterile interstice (Figure 3), and flowers with two stamens *vs* 3–4 stamens. Furthermore, *S. minuta* has a white urceolate-shaped spathe *vs* pale green to white cylindric. Additional characters separating both species include cross sections of their leaf petioles ("U" *vs* "D" shapes), number and angle of primary lateral veins (6–7 diverging at 40°–42° *vs* 3–5 diverging at 30°–60°), and diameter of floral stigma (0.1–0.2 *vs* 0.3 mm).

The shallow to deeply cordate leaf base shape of *S. minuta* appears to be consistent among individuals in

the three sites where the species has been found (Figures 1 and 5). In fact, this is the most noticeable character to differentiate it from *S. prietoi*, whose all known populations have leaves with cuneate leaf and has not been reported for Samar Island.

The new species is further compared with *S. mindanaoana* because both share characteristics such as stem diameter and acute leaf apex. However, *S. minuta* can be distinguished by its lanceolate or narrowly cordate to rarely cordate leaf blades (*vs* oblong elliptic to slightly obovate leaf blades), shorter leaf length (2.1–3.5 (–5.5) cm *vs*. 3–4 (–7.5 cm), wider leaf diameter (2.5–3.7 (–5.9) *vs* 1.5–3 cm), and by having more primary veins (6–7 *vs* 2–4).

The forests of Samar Island are highly diverse but have been poorly studied, as reflected by the many species of flowering plants described from there in recent years (e.g., Adorador et al. 2021; delos Angeles et al. 2022; Tandang et al. 2022). These high levels of endemism are mainly concentrated in forests over limestone, as discussed in Tolentino et al. (2020). Future field expeditions in highly threatened habitats outside protected areas should emphasize not only collections of voucher specimens, but also samples for genomic studies and germplasm for ex-situ conservation efforts in national and international botanic gardens.

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AUTHOR CONTRIBUTIONS

MDDA collected the species from the field. MDDA and DNT took photographs of the species on site. MDDA prepared a first draft of the manuscript and revised herbaria. All authors contributed to the manuscript and approved the final version.

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