

***Habenaria diwata* (Orchidaceae: Orchidoideae), a new species from Mount Malinao, Albay Province, Luzon Island, Philippines**

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ABSTRACT. A new species, *Habenaria diwata* R.Bustam., J.Collantes & M.R.B.Altamirano (Orchidaceae: Orchidoideae), is described from Mount Malinao, Luzon Island, Philippines. *Habenaria diwata* most closely resembles the Taiwanese species *H. tsaiana* T.P.Lin in having bipartite petals with an entire posterior lobe and a tripartite labellum with an entire mid-lobe and subdivided side lobes, but differs by its shorter lateral sepals (9–11 mm long vs 12.5–13.5 mm long in *H. tsaiana*), anterior petal lobes that are mostly entire, with the lower margin lacerate or unequally bifid at the apex (vs subdivided into two segments), shorter labellum base (1 mm vs 1.5–2 mm) and labellum side lobes subdivided into two filiform segments (vs subdivided into three filiform segments). Differences of *H. diwata* from a similar Philippine species, *H. lingulosa* Ames, are briefly discussed. This discovery raises the current number of recognised *Habenaria* species in the Philippines to 22. Illustrations and information on its distribution, habitat, phenology, and proposed conservation status are provided.

Keywords. Bicol Region, endemic, *Habenaria* sect. *Medusaeformes*, mossy forest, terrestrial orchid

Introduction

Habenaria Willd. is one of the largest genera of Orchidaceae, with 897 described species (POWO, 2025). The genus is distributed in both the tropical to subtropical regions of the Old and New Worlds, with Brazil, southern and central Africa and East Asia as the centres of diversity (Kurzweil & Weber, 1992). Most *Habenaria* species are perennial, deciduous geophytes that grow during the wet season and undergo a dormant period in the form of underground tubers during the dry season (Batista et al., 2013). *Habenaria* is distinguished by its flowers that are mostly greenish, whitish or yellowish, usually with a tripartite labellum that is spurred and a column with the stigma lobes freely projecting (Kurzweil, 2017). The only worldwide revisions of *Habenaria* based on morphological features were carried out by Kraenzlin (1891, 1901) who identified 32 sections based on the degree of dissection of the labellum and the morphology of the petal and column. Over time, species that were formerly included in *Habenaria* (sensu Willdenow, 1805) were placed in various other genera in treatments by later authors (as reviewed in Pridgeon et al., 2001; Batista et al.,

2013; Kolanowska, 2015). The taxonomy and phylogeny of *Habenaria* have been investigated for years (Batista et al., 2011; Jin et al., 2014; Ngugi et al., 2020). Limited sampling, however, has hindered the delimitation of the genus and the clarification of infrageneric relationships, indicating the need for further studies (Kurzweil & Weber, 1992; Pridgeon et al., 2001; Batista et al., 2011; Jin et al., 2014; Ngugi et al., 2020; Kurzweil et al., 2023).

Ames (1908) enumerated 14 *Habenaria* species in the Philippines, which included his descriptions of six new species and one new variety. By the 1920s, he had updated the list to 28 species (Ames, 1924), 13 of which he described since the original enumeration. Some of the species in the list are presently classified under *Platanthera* Rich. (Orchidaceae) or *Peristylus* Blume (Orchidaceae) (Pelser et al., 2011–onwards; POWO, 2025). More recently, Cootes (2011) and Altamirano et al. (2022) reported new Philippine distribution records of *Habenaria* species. To date, *Habenaria* is represented by 21 species in the Philippines, 13 of which are endemic (Pelser et al., 2011–onwards). The new species herein described belongs to the morphologically defined section *Medusaeformes* (sensu Kraenzlin, 1901), a small group from Indo-Malaya that is distinguished by bipartite petals and a tripartite labellum with lobes that are more or less fringed or divided (Kraenzlin, 1901; Seidenfaden, 1977). In the Philippines, the only species that match the morphological delimitation of section *Medusaeformes* are *Habenaria lingulosa* Ames and *H. polytricha* Rolfe (Ames, 1908; Pelser et al., 2011–onwards).

Mount Malinao is a potentially active stratovolcano located at the centre of the Bicol volcanic arc, southeast of Luzon Island in the Philippines (Knittel-Weber & Knittel, 1990; Andal et al., 2005). It has an elevation of 1548 m and a base diameter of around 15 km, dominated by medium to high-K calc-alkaline, high-Al basalts, basaltic andesites, and andesites (Knittel-Weber & Knittel, 1990). Its vegetation is characterised by agro-ecosystems at elevations up to 50 m, secondary dipterocarp and fern montane forest at 301–800 m, and mossy forest at elevations above 800 m (De Guzman et al., 2014). Mount Malinao has been an important site for taxonomic discoveries and investigations (e.g., James, 2006; Brown & Gonzalez, 2007; Balete et al., 2013; Pelser et al., 2017; Dela Cruz et al., 2022). In 2022, while conducting taxonomic studies on the vascular plants in the forests of Mount Malinao, researchers of the Philippine Taxonomic Initiative, Inc. (PTI) collected specimens of a terrestrial orchid from the mossy forest in Mount Malinao. After examination of its morphological features and comparison with similar *Habenaria* species from the Indo-Malaya-Pacific region, several distinctive differences were identified. We concluded that these differences are sufficient to recognise the population as a new *Habenaria* species, following the morphological species concept (Cronquist, 1978). Here we name and describe the new species, provide information on its distribution and habitat, and propose its IUCN conservation status.

Materials and methods

In-situ observations of the morphology, distribution, habitat, and phenology of the species were made in May 2022 and March 2023 on the southeast slope of Mount Malinao (Fig. 1). Voucher specimens were collected under the Gratuitous Permit No. R5-148 issued by the Department of Environment and Natural Resources (DENR) Region 5. The plants were photographed in the field and two flowering individuals were collected and pressed. Flowers were preserved in Copenhagen solution. Measurements from fresh and preserved specimens were obtained with a ruler and a calliper. Details of the flower were examined using a stereomicroscope and measured using ToupView image analysis software (ToupTek Photonics, 2021). The terminology used to describe the new species follows Beentje (2010). The observations were compared with relevant literature (Ames, 1908; Seidenfaden, 1977; Kurzweil, 2009; Lin, 2014), digitised type specimens of *Habenaria lingulosa* Ames and *H. tsaiiana* T.P.Lin from AMES and TAI (Appendix 1), respectively (herbarium acronyms follow Thiers, continuously updated), and in-situ photos of *H. tsaiiana* taken at the type locality in 2019 and 2021 by Sheng-Kun Yu and Da-Ming Huang, respectively (courtesy of T.P. Lin). The area of occupancy (AOO) of the new species was estimated with GeoCAT, using the default value of 2 km² cell size (Bachman et al., 2011). The preliminary conservation status of the species was assessed based on IUCN criteria and categories (IUCN, 2012; IUCN Standards and Petitions Committee, 2024).

The new species

Habenaria diwata R.Bustam., J.Collantes & M.R.B.Altamirano, **sp. nov.**

Habenaria diwata most closely resembles the Taiwan endemic *H. tsaiiana* T.P.Lin in its bipartite petals with an entire posterior lobe and a tripartite labellum with an entire midlobe and subdivided side lobes. *Habenaria diwata* differs by its shorter lateral sepals (9–11 mm long vs 12.5–13.5 mm long in *H. tsaiiana*), anterior petal lobes that are mostly entire, lacerate or unequally bifid at the apex (vs subdivided into two segments), shorter labellum base (1 mm vs 1.5–2 mm), and labellum side lobes subdivided into two filiform segments (vs subdivided into three filiform segments). Detailed morphological differences between the species are presented in Table 1. – TYPE: Philippines, Luzon Island, Albay Province, Municipality of Malinao, Mount Malinao, mossy forest, 1227 m, 15 May 2022, J.P.R. Collantes & C.J.P. Dela Cruz PTI-SLP1 27 (holotype PNH [herbarium sheet and flowers in alcohol]). (Figs 2, 3).

Terrestrial herb, deciduous, above-ground parts glabrous throughout. **Tubers** several, fusiform-elongate, 8–25 × 1–1.3 cm, covered with trichomes. **Roots** filiform, short, unbranched. **Stem** dull reddish brown at the lower portion, turning green towards the middle and upper portions, terete, including the inflorescence 107–119 × 0.7–1 cm, lower portion covered with tubular sheaths. **Leaves** 6–8, cauline, clustered in the middle of the stem, spiral, spreading, adaxial side grass-green, abaxial side pale silvery

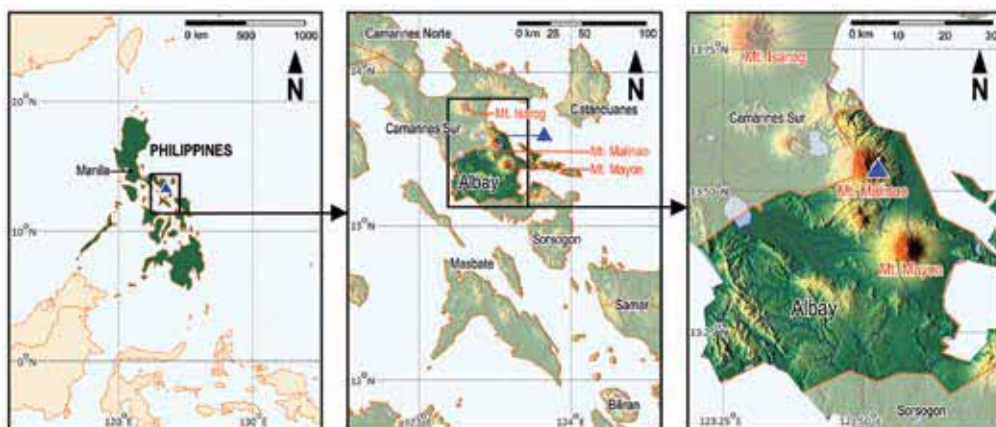


Fig. 1. Land cover map showing the known occurrence of *Habenaria diwata* on Mount Malinao, Albay Province, Bicol Region, Philippines (denoted by blue triangle).

green, elliptic to oblanceolate, $12.3\text{--}18.3 \times 3\text{--}5.6$ cm, sheathing, entire to undulate, acuminate, 3-veined, transitioning to reduced, bract-like leaves towards the upper portion of the stem; bract-like leaves 6–8, erect, spiral, lanceolate, sheathing, entire, acuminate. ***Inflorescence*** solitary, terminal, a raceme, dense and many-flowered (c. 50), 40–45 cm long, rachis ridged. ***Floral bracts*** erect, green, lanceolate, $16\text{--}18 \times 3\text{--}4$ mm, sheathing, entire, attenuate. ***Flowers*** resupinate, $2.5\text{--}3 \times 2\text{--}2.3$ cm, sepals whitish green, column, petals and labellum pale yellowish-green, stigma lobes pale green, odourless. ***Dorsal sepal*** concave, forming a hood over the column, narrowly-ovate to ovate, $8\text{--}9 \times 4\text{--}5$ mm, apiculate, 3-veined. ***Lateral sepals*** reflexed, ovate, $9\text{--}11 \times 4\text{--}5$ mm, oblique, caudate, 3-veined. ***Petals*** bipartite, divaricate, ascending; posterior petal lobe entire, linear, $8\text{--}9(9.5) \times 0.8\text{--}1$ mm, apex obtuse, 3-veined; anterior petal lobe mostly entire, lacerate or unequally bifid at the apex, $(9\text{--})10.5\text{--}12 \times 0.8\text{--}0.9$ mm, about 1.3 times longer than the posterior lobe, 3-veined. ***Labellum*** tripartite just above the base, base c. $1 \times 2.5\text{--}3.5$ mm; midlobe narrowly lorate, $9\text{--}10 \times 1\text{--}1.4$ mm, apex obtuse, 3-veined; side lobes linear, subdivided into 2 filiform segments at $\frac{1}{3}\text{--}\frac{1}{2}$ of the length from the base, $11\text{--}13 \times 0.8\text{--}1$ mm, 1.2–1.3 times longer than the midlobe, 2-veined; spur cylindrical, clavate towards the apical half, 20–21.5 mm long, obtuse. ***Column*** erect, connective pale green, apex truncate to emarginate, $3\text{--}4 \times$ c. 3.5 mm. ***Anther locules*** erect, separated by a narrow connective, $2.8\text{--}3.2 \times 1.5\text{--}1.6$ mm; pollinia pale yellow, obovoid, $1.9\text{--}2 \times 1.1\text{--}1.3$ mm, caudicles c. 2.9 mm long, viscidia c. 0.3 mm wide; auricles appressed laterally to the base of the anther channels, white, round, $0.8\text{--}1.2 \times 0.9\text{--}1.2$ mm, warty. ***Rostellum*** c. 1×2.5 mm; rostellum midlobe placed between the anther locules, triangular, apex obtuse, about half as tall as the anther locules; rostellum lobes adnate to the base of the anther channels, elongate, 1.5–2 mm long. ***Ovary*** plus *pedicel* arched, green, cylindrical-fusiform, 22–23.5 mm long (pedicel 7–8 mm long), ribbed. ***Stigma lobes*** separate, freely projecting, $2\text{--}2.5 \times$ c. 1 mm, apex acute. ***Fruit*** a capsule, green, fusiform, c. 2 cm long during flowering (immature), ridged.

Table 1. Comparison of selected characters of *H. lingulosa*, *H. tsaiana* and *H. diwata*. Data on plant morphology are based on observations of herbarium material, except where a reference is cited.

	<i>H. lingulosa</i>	<i>H. tsaiana</i>	<i>H. diwata</i>
Plant height (cm)	46–61	c. 50	107–119
Inflorescence rachis length (cm)	4–7	c. 8	25–27
Number of flowers per inflorescence	8–11	c. 13	c. 50
Floral bract dimensions (mm)	21.4–26 × 3.2–4.5	18.5–21 × c. 3	16–18 × 3–4
Dorsal sepal length (mm)	13–14	8.5–9.2	8–9
Dorsal sepal shape and apex	Narrowly-ovate, caudate	Elliptic, caudate	Narrowly ovate to ovate, apiculate
Lateral sepal length (mm)	13–15	12.5–13.5	9–11
Lateral sepal shape and apex	Narrowly-ovate, caudate	Ovate, caudate	Ovate, caudate
Anterior petal lobe shape and segmentation	Filiform, entire or subdivided into 2, 3, or 4 segments nearly to the base (Ames, 1908)	Linear, subdivided into 2 segments nearly to the middle of its length	Entire, lacerate or unequally bifid at the apex
Labellum base length (mm)	c. 1	1.5–2	c. 1
Labellum midlobe length (mm)	10–12	12–13	9–10
Labellum midlobe segmentation and shape	Subdivided into 3 filiform segments	Entire, linear	Entire, narrowly lorate
Labellum side lobe length (mm)	9.5–10	11–13	11–13
Labellum side lobe segmentation and shape	Subdivided into 2 or 3 filiform segments (Ames, 1908)	Subdivided into 3 filiform segments	Subdivided into 2 filiform segments at $\frac{1}{3}$ – $\frac{1}{2}$ of the length from the base

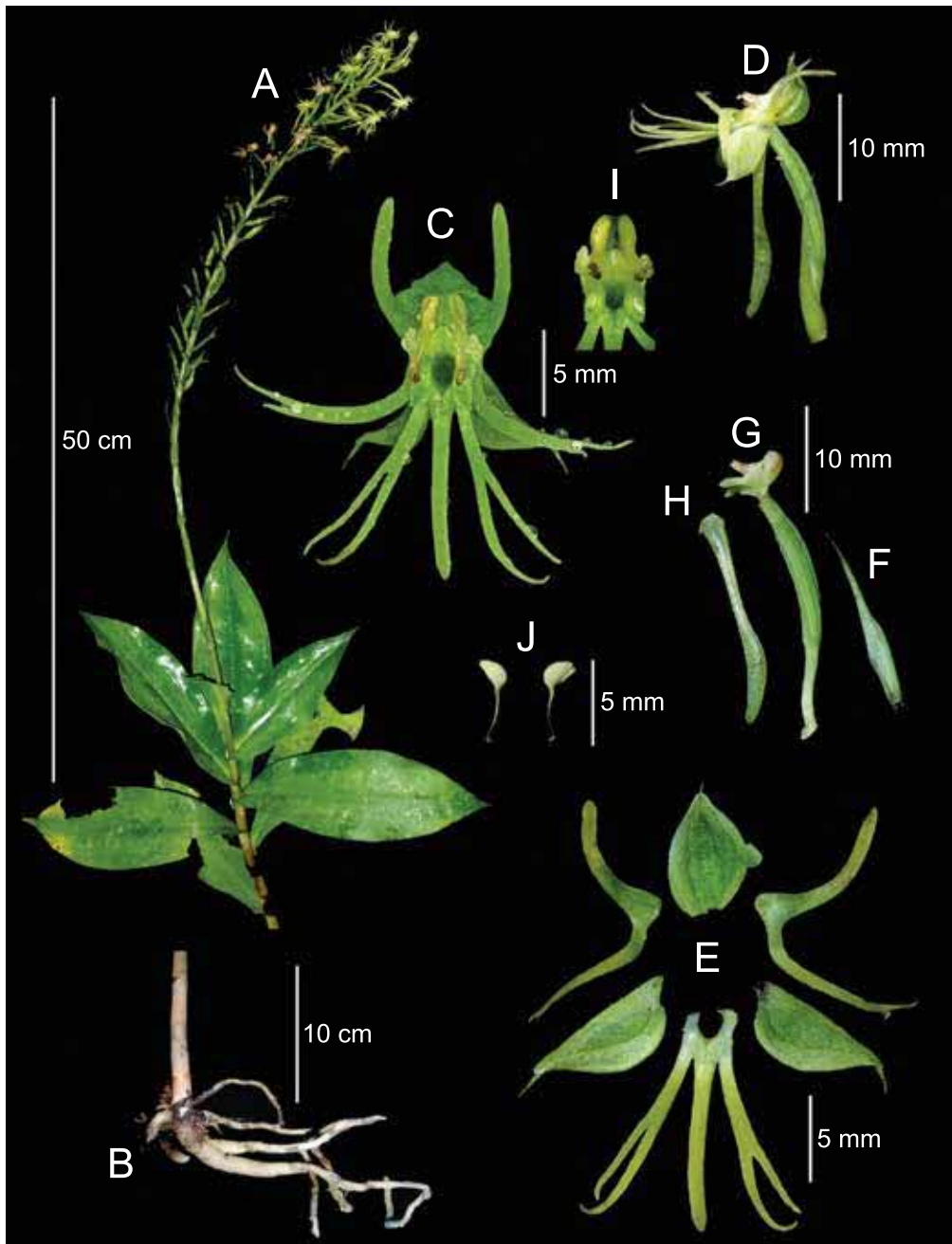


Fig. 2. *Habenaria diwata* R.Bustam., J.Collantes & M.R.B.Altamirano. **A.** Flowering plant, upper part. **B.** Basal part showing stem and roots. **C.** Ventral view of perianth and column. **D.** Lateral view of flower. **E.** Dissected perianth with ventral view of sepals, petals and labellum. **F.** Floral Bract. **G.** Lateral view of column and ovary. **H.** Lateral view of spur. **I.** Ventral view of column. **J.** Pollinaria. From the holotype, *PTI-SLP1* 27. (Photos: J.P.R. Collantes)

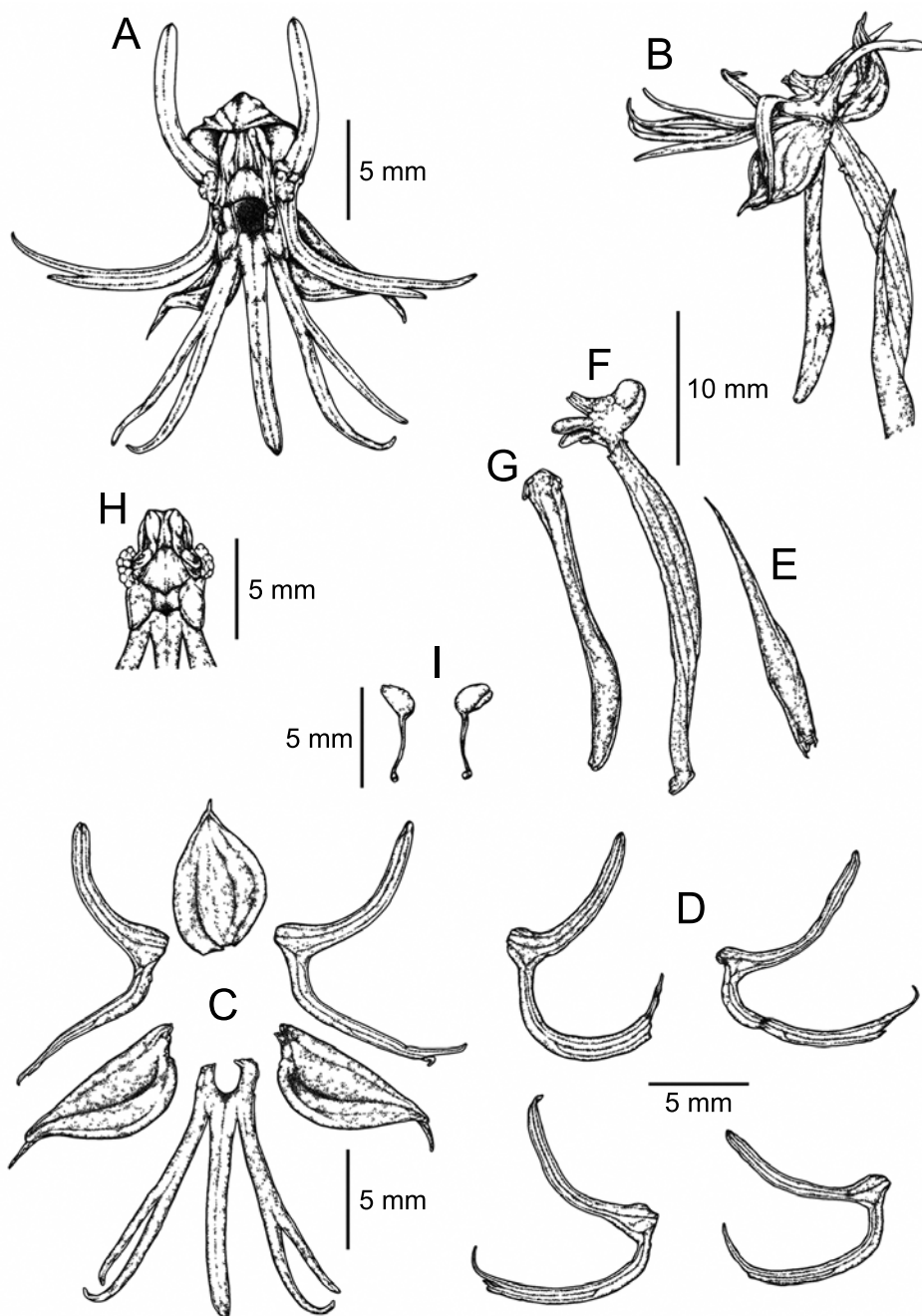


Fig. 3. *Habenaria diwata* R.Bustam., J.Collantes & M.R.B.Altamirano. **A.** Ventral view of perianth and column. **B.** Lateral view of flower. **C.** Dissected perianth with ventral view of sepals, petals and labellum. **D.** Petals showing variation in the shape of the apex of the anterior lobe. **E.** Bract. **F.** Lateral view of column and ovary. **G.** Lateral view of spur. **H.** Ventral view of column. **I.** Pollinaria. Based on *PTI-SLP1* 27. Illustrated by Julieferd Torres.

Distribution. Endemic to Mount Malinao, Luzon Island, Philippines.

Habitat and ecology. The mossy forest of Mount Malinao where *Habenaria diwata* was found growing exhibits a complex, multilayered structure with no single dominant species. Plants documented in the area include species of *Adinandra* Jack (Pentaphylacaceae), *Calophyllum* L. (Calophyllaceae), *Gnetum* L. (Gnetaceae), *Lithocarpus* Blume (Fagaceae), *Mussaenda* Burm. ex L. (Rubiaceae), and *Sterculia* L. (Malvaceae). The canopy reaches a maximum height of 30 m, but usually 20 m or less, overtopped by species of *Calamus* L. (Arecaceae), and *Strongylodon* Vogel (Fabaceae). Below the canopy, the understorey is rich in epiphytes including *Dendrobium ceraula* Rchb.f. (Orchidaceae), palms, notably *Heterospathe* Scheff. (Arecaceae), shrubs such as *Psychotria* L. (Rubiaceae), and vines from the family Menispermaceae. The forest floor is blanketed by humus overtopped with thick leaf litter, mosses, and a diverse ground cover of herbaceous plants like gingers, notably *Adelmeria isarogensis* Docot & Banag (Zingiberaceae), and ground orchids such as *Vrydagzynea* Blume (Orchidaceae). *Habenaria diwata* occurs on the wind-sheltered side of Mount Malinao, opposite the much harsher Pacific-facing side, thus cloud cover is usual in the area. The canopy is uneven and results in a contrast of more deeply to lightly shaded areas in the understory. *Habenaria diwata* was observed to prefer deeply shaded areas that are usually associated with streams or streamlets, growing in humus-laden rock walls or in sloping to semi-vertical clay-loam substrate. The first occurrence was observed at an elevation of 1227 m, within a streamlet near a hiking trail. The second occurrence was documented at around 1000 m elevation, along a stream located within the headwaters of a waterfall. There were no other species of *Habenaria* observed within the immediate vicinity where *H. diwata* was found, although *H. alagensis* Ames was sighted at around 870 m and at the lower elevations of Mount Malinao.

Phenology. The species was observed flowering with basally immature capsules from March to May.

Etymology. The specific epithet refers to Philippine mythology and folklore deities who guard the natural world (Landa, 1968). The pale, whitish green flowers are reminiscent of the ghostly white female representations of diwata in popular culture, while the dormancy in its life cycle in turn echoes the ephemeral nature of these spiritual beings.

Provisional IUCN conservation assessment. The species is rare, and so far, known only from two occurrences, about 2 km apart. In the first location near a hiking trail, five individuals were seen, with only one individual bearing an inflorescence. Further searches within this location did not yield additional individuals. In the second location within the headwaters of a waterfall, seven individuals were seen, with only one bearing an inflorescence. Further searching of the second site did not yield additional sightings. The estimated AOO is 8 km². The vegetation in both sites is relatively intact. While wildlife hunting and abaca plantations were observed on the lower slopes of Mount Malinao at elevations of around 860 m and 700 m, respectively, the first

location has no anthropogenic disturbance apart from hiking trails. There is also some anthropogenic disturbance at the second location, such as wild pig trapping at 1200 m elevation. The designation of the whole Albay Province as a UNESCO Biosphere Reserve offers some level of protection to the species (Batisse, 1982). Additionally, the ephemeral nature of this species makes it difficult to find. With a predicted increase in intense and frequent typhoons and extreme rainfall events in the area due to climate change (Uy et al., 2011; Hong et al., 2022), a potential major threat to the second site is the occurrence of landslides and flooding. Other threats include the potentially active status of Mount Malinao, as well as the potential eruption hazard (i.e., heavy ash falls and debris-laden rockfalls) from the nearby Mount Mayon, the Philippines' most active volcano. These natural hazards could cause the degradation of riparian microhabitats and population decline. Based on the available information, we provisionally assess the species as Critically Endangered (CR B2ab(iii,iv,v)).

Additional specimen examined. PHILIPPINES: **Luzon Island:** Albay Province, Municipality of Malinao, Mount Malinao, mossy forest, c. 1000 m, 15 May 2022, J.P.R. Collantes & C.J.P. Dela Cruz PTI-SLP1 22 [*Philippine Taxonomic Initiative-South Luzon Project1 22*] (PNH).

Notes. The new species is very similar to the Taiwanese *Habenaria tsaiana*, and the distinction from it has been explained above. *Habenaria diwata* also resembles the Philippine endemic *H. lingulosa* in its bipartite petals with an entire posterior lobe, and a tripartite labellum with the side lobes subdivided into segments. *Habenaria diwata* is distinguished from *H. lingulosa* by having more flowers per inflorescence (c. 50 flowers vs 8–11 flowers), a labellum midlobe that is entire (vs divided into three filiform segments), lateral sepals that are shorter (9–11 mm vs 13–15 mm), anterior petal lobes that are mostly entire, lacerate or bifid at the apex (vs entire or subdivided into two, three or four filiform segments; Ames, 1908), and labellum side lobes that are subdivided into two filiform segments (vs subdivided into two or three filiform segments) (Table 1). The other Philippine species that matches the morphological delimitation of *Habenaria* sect. *Medusaeformes*, *H. polytricha* Rolfe, can be clearly distinguished from *H. diwata* by its posterior petal lobe that is subdivided into two long filiform segments (vs entire in *H. diwata*), anterior petal lobe that is divided into three to five filiform segments (vs mostly entire, lacerate or bifid at the apex), and a tripartite labellum with the lobes further divided into three to eight filiform segments (vs labellum midlobe entire, side lobes subdivided into two segments). In *H. diwata*, we note the variation in the shape of the apex of the anterior petal lobe among flowers on the same plant, with the lower margin appearing torn in some flowers, very shallowly lobed in others, or distinctly and unequally bifid (Fig. 3).

With the description of *Habenaria diwata*, this publication raises the current number of recognised *Habenaria* species in the Philippines to 22. This bridges the gap in understanding the diversity of the vascular flora on Mount Malinao, more so in characterising its diverse orchid flora. This also highlights the importance of Mount Malinao in biodiversity studies in the Philippines.

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Appendix 1. Digital images examined for the morphological comparisons of *Habenaria* species in Table 1.

***Habenaria lingulosa* Ames**

Philippines, Luzon, Benguet, Bued River, 19 Nov. 1905, *E.D. Merrill 4845/4846* (holotype AMES [acc. no. 10101]); Bontoc Subprovince, Nov.–Dec. 1910, *M. Vanoverbergh 900* (AMES [acc. no. 12151]); Bauco, Sep.–Oct. 1912, *M. Vanoverbergh 1525* (AMES [acc. no. 13463, 13464]).

***Habenaria tsaiiana* T.P.Lin**

Taiwan, Hsinchu, Chienshih, 500 m, 14 Sep. 2013, *Sheng Kun Yu* (holotype TAI [acc. no. 283132]).