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## Research

### Two new endemic species of *Ophiorrhiza* L. (Rubiaceae: Ophiorrhizeae) from Davao Oriental, Philippines

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Two new species of *Ophiorrhiza* collected from Mt Hamiguitan Range Wildlife Sanctuary in Davao Oriental, Philippines, are herein described and illustrated. *Ophiorrhiza erythropilosa* is the third Philippine species possessing involuclral bracts and is further characterized by its predominantly villose stems that appear red due to strikingly red-violet trichomes, subsistent bifid stipules, linear involuclral bracts without prominent midrib, and 4 mm long urceolate corolla that is villose outside and lightly puberulous inside. *Ophiorrhiza hamiguitanensis* is characterized by its coriaceous, lanceolate leaves with attenuate apex and base, brochidodromous venation, subsistent bilobed stipules with slightly recurved acute tips, presence of 1.5–2.5 mm long linear ensiform bracts, heterostylous flowers, clavate calyces and broadly obcordate capsules.

Keywords: *Ophiorrhiza*, Philippines



## Introduction

*Ophiorrhiza* L. is the fifth largest genus in Rubiaceae, comprising around 320 species distributed in tropical to subtropical Asia, China and the Pacific, and with its greatest diversity in New Guinea and southeastern Asia (Davis et al. 2009, Hareesh 2017, Hareesh and Sabu 2018, Wu et al. 2019). Members of *Ophiorrhiza* are annual to perennial suffrutescent herbs to small shrubs ranging from 3 cm to 1 m tall, with cymose inflorescences, and laterally flattened, dry, papery and loculicidally dehiscent capsules that are broadly obcordate (Lo 1990, Deb and Mondal 1997, Chen and Taylor 2011, Hareesh 2017, Wu et al. 2018). Taxonomic studies and enumerations of *Ophiorrhiza* have been widely conducted in some geographic regions such as Australia (Halford 1991), China (Lo 1990, Chen and Taylor 2011), India (Deb and Mondal 1997, Hareesh and Sabu 2018) and the Pacific (Darwin 1976) but are still wanting in the floristic region of southeast Asia, specifically in the Philippines. The accounts of Merrill (1923) and Alejandro (2007) enumerated 17 endemic Philippine *Ophiorrhiza* species out of the 18 occurring species. Pelser et al. (2011 onwards) in their updates of Philippine flora, recorded the presence of 29 *Ophiorrhiza* species wherein 27 are considered endemic. Though with a relatively high number of endemic species, the



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genus remains understudied as its species exhibit high morphological variation (Chen and Taylor 2011, Wu et al. 2019). Alejandro (2007) identified it as one of the Philippine rubiaceous genera in need of comprehensive revision. Furthermore, the recent phylogenetic treatment of Razafimandimbison and Rydin (2019) for the tribe Ophiorrhizeae of subfamily Rubioideae necessitates the representation of Philippine species to determine both placement and relationships with other related species.

In the recent floristic surveys conducted in southern Philippines, two enigmatic *Ophiorrhiza* species were collected in Mt Hamiguitan, Davao Oriental, Mindanao. Detailed morphological examination and comparison of the species to the relevant literature and available herbarium specimens (Darwin 1976, Lo 1990, Halford 1991, Deb and Mondal 1997, Shanzer 2005, Chen and Taylor 2011, Hareesh et al. 2015a, b, 2017, Wu et al. 2018, 2019) revealed that the two species are divergent and new to science. Hence, two new endemic Philippine *Ophiorrhiza* species are hereby described and illustrated.

## Material and methods

The *Ophiorrhiza* species were collected from Mt Hamiguitan Mountain Range Wildlife Sanctuary, San Isidro, Davao Oriental, Philippines, in subsequent field surveys conducted in July 2016 and April 2017. High resolution color images of the samples were taken in the field. The collected samples were mounted on herbarium sheets while reproductive parts were preserved in 70% ethyl alcohol solution. Measurements and descriptions were based on morphological characteristics obtained from field notes and laboratory observations. Examination of morphological details was aided by an Olympus SZ51 dissecting microscope. Terminology is based on Beentje (2010) and aligned with descriptions from regional revisions of *Ophiorrhiza* (Deb and Mondal 1997, Chen and Taylor 2011). Available *Ophiorrhiza* species from local herbaria (PNH, PUH and USTH) and digital images of types from international herbaria (E, HUH-A, K, L, NY, MO, P and US) were examined for comparison. Herbarium specimens of the new species have been deposited in the University of Santo Tomas Herbarium (USTH) and the Philippine National Herbarium (PNH).

### *Ophiorrhiza erythropilosa* Alfeche & Alejandro sp. nov. (Fig. 1–2)

A species similar to *O. ciliata* Elmer, *O. involucrata* Elmer and *O. pseudofasciculata* Schanzer due to the presence of involucre bracts, but is distinguished by its predominantly villose stems that appear red due to the striking red-violet trichomes (versus crisply pubescent with dirty brown trichomes in *O. ciliata*, glabrous to with reddish brown trichomes in *O. involucrata* and tomentose with white to rusty trichomes in *O. pseudofasciculata*), subsistent bifid stipules (versus



Figure 1. *Ophiorrhiza erythropilosa* sp. nov. (A) habit, (B) terminal inflorescence top view, (C) inflorescence with calyces surrounded by linear involucre bracts, (D) dehiscent mature capsule with numerous, small brown seeds in two equal locules. Photos: (A–C) by R. V. Docot; (D) by N. K. Alfeche.

subpersistent lacinate in *O. involucrata* and persistent or caducous, narrowly triangular to subulate in *O. pseudofasciculata*), linear involucre bracts without prominent midrib (versus linear lanceolate bracts with stout midrib in *O. ciliata*, thin nerved foliaceous bracts in *O. involucrata* and linear to narrowly lanceolate bracts in *O. pseudofasciculata*), and urceolate corolla tubes which are villose outside and lightly puberulous inside (versus tubular and glabrous in *O. ciliata* and cylindrical to narrowly infundibular with trichomes on both sides in *O. pseudofasciculata*) (Table 1).

**Type:** Philippines, Mindanao: Mt Hamiguitan Range Wildlife Sanctuary, San Isidro, Davao Oriental, 6°44'20.6"N, 126°09'42.3"E, Jul 2016, C. I. Banag, R. V. A. Docot and D. A. Tandang CB16-214 (holotype: USTH).

#### Etymology

The specific epithet comes from the words 'erythro' and 'pilous' in reference to the species' prominent red-violet trichomes that give it its striking and highly recognizable reddish color in the field (Fig. 1).

#### Description

Erect herb, 6–17 cm tall. Stems terete, rarely branched, villose, light green but appearing reddish due to the color of the trichomes; trichomes red-violet, somewhat lighter on young stem parts, 1.0–1.5 mm long. Petioles 2–3 mm long, villose. Leaves decussate, present mainly on the younger upper half of the stem, thick, sub-anisophyllous; blades thick, ovate to lanceolate, 24–45 × 12–20 mm, acute at apex, cuneate to obtuse at base, with entire margin, adaxially dark green, abaxially pale green, dark brown when dried, at both sides vesicular and with villose,

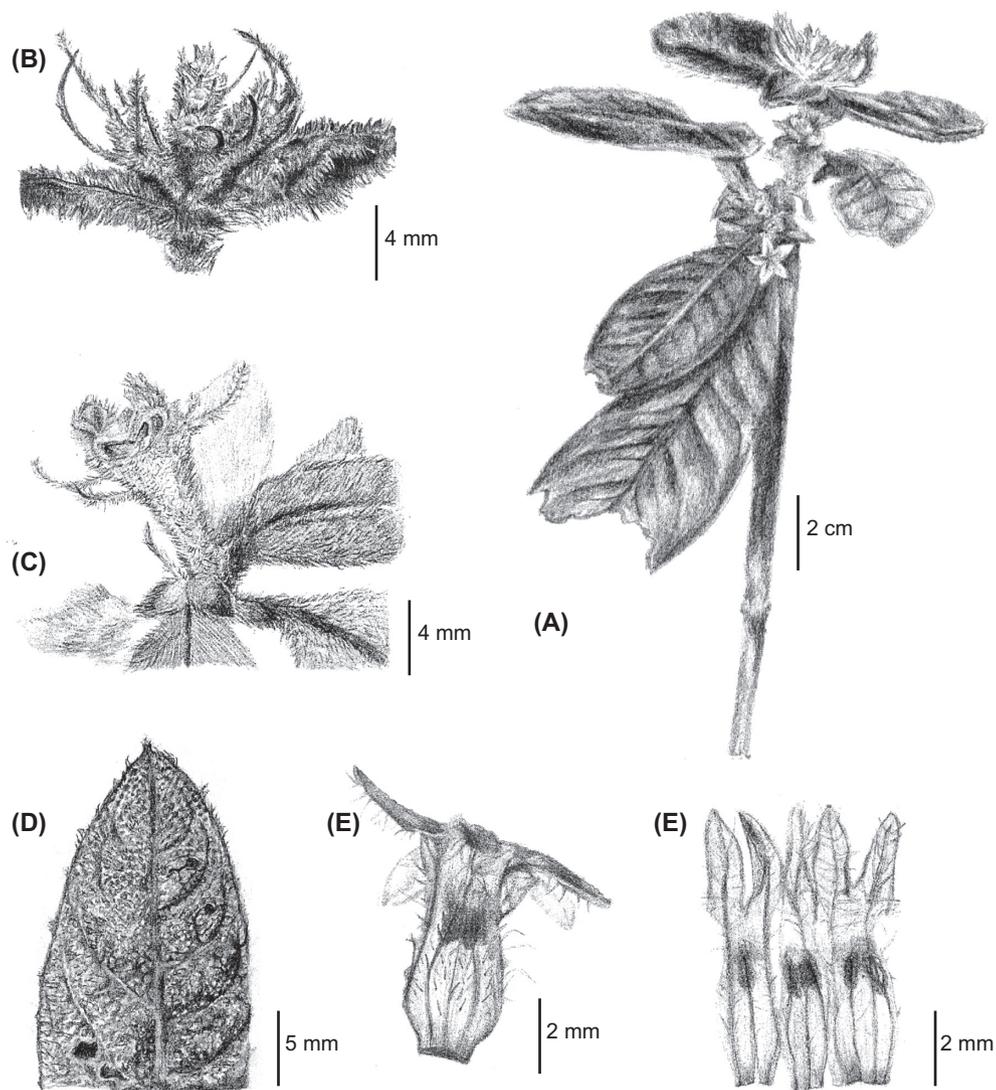


Figure 2. *Ophiorrhiza erythropilosa* sp. nov. (A) flowering branch, (B) inflorescence bracts, (C) dehiscent capsule, (D) adaxial leaf surface, (E) corolla (with anthers visible through corolla tube), (F) longitudinal section of the corolla tube showing the position of the anthers. Illustration by P. G. Campos.

red-violet trichomes aggregated on the midrib, lateral nerves and margin; midrib prominent, with 7–9 lateral nerves on each side; venation eucamptodromous. Stipules filiform from a narrowly triangular base, bifid for about  $\frac{3}{4}$  of their length, 4–5 × 0.5–1.5 mm, setaceous, subsistent. Inflorescences terminal, simple compact cymes with 3–5 flowers; peduncle 3 mm long, densely villose. Bracts persistent, linear, forming an involucre and subtending the inflorescence, without a prominent midrib, 5–7 mm long, light yellow-green and covered with 1 mm long reddish trichomes. Flowers 7–8 mm long, white, surrounded by 3–4 bracts; pedicels very short (flowers appearing sessile). Calyx hairy, conical, densely covered with red trichomes, with five linear-lanceolate teeth; hypanthium obovoid, ca 1.25–1.50 mm. Corolla white, urceolate, ca 4 mm long, slightly villose outside, lightly puberulous inside with a

ring of trichomes in the throat; lobes ca 2–3 × 0.75–1.25 mm, acute at apex and slightly revolute, with a prominent ridge in the middle leading to the corolla throat, outer and inner part of the lobes covered with fine white trichomes. Stamens 1.5–2.0 mm long, attached to the basal part of the tube, below the ring of trichomes at the corolla throat; filaments ca 0.5–1.0 mm long, white, glabrous; anthers ca 1 mm long, bifid and basifixed, inserted directly below the trichome ring. Style at anthesis not extending beyond the corolla throat, reaching slightly below anthers, ca 2.0–2.5 mm long; stigmatic portion puberulent, cleft at the apex. Capsules 3–4 per infructescence, laterally flattened, obcordate, wider than long, their upper margin slightly concave, glabrous inside, villose with red-violet trichomes outside, bilocular, splitting along the top. Seeds numerous, brown.

Table 1. Comparative morphology of *Ophiorrhiza erythropilosa* sp. nov. and allied species, *O. ciliata* Elmer (1934), *O. involucrata* Elmer (1908) and *O. pseudofasciculata* Schanzer (2005).

Character	<i>O. erythropilosa</i>	<i>O. ciliata</i>	<i>O. involucrata</i>	<i>O. pseudofasciculata</i>
Height (cm)	6–17	10–30	30–50	25–35
Leaf blade				
Base	cuneate to obtuse	subcuneate to obtuse	obliquely subcuneate to subtruncate	cuneate to broadly cuneate
Apex	acute	acute to obtuse or rounded	acute	acuminate
Texture	thick but not succulent or coriaceous, vesicular and villose	thinly membranous and ciliate	thin and glabrous	thin and tomentose
Size (mm)	25–45 × 12–20	60–90 × 25	80 × 35–40	65–160 × 30–70
Stipules	4–5 mm long, subpersistent, filiform from a triangular base but ¾ of length bifid	4–5 mm long, persistent, slender and linear with broad base	5–8 mm long, subpersistent, lacinate	2–9 mm long, subpersistent, narrowly triangular to subulate
Inflorescences				
Peduncle	ca 3 mm long, villose	5–15 mm long, subglabrous	20–30 mm long, subglabrous	20–40 mm long, tomentose
Bracts	5–7 mm long, linear involucrel without a prominent midrib	20 mm long, linear lanceolate involucrel with a prominent midrib	25–35 mm long, thin nerved foliaceous involucrel, midrib not described	5–12 mm long, linear lanceolate involucrel, midrib not described
Corolla tube length and shape	ca 4 mm, tube urceolate	ca 4 mm, broadly tubular	not described	8–13 mm, cylindrical to narrowly infundibular
Corolla indumentum	tube villose outside, lightly puberulous inside; lobes covered with fine white hairs on both sides	glabrous except for hyaline trichomes on outer portion	glabrous	exterior hairy or tomentose on both tube and lobes
Style position	homostylous; situated slightly below anthers, not extending above the corolla throat	not described	not described	distylous; longistylous form: extending above the corolla throat; brevistylous form: situated below anthers in corolla throat
Distribution	Mt Hamiguitan Range Wildlife Sanctuary, Davao, Philippines	Mt Makiling, Los Baños, Laguna, Philippines	Polilio Islands and Mt Tayabas, Quezon, Philippines	northern and northeastern Thailand

### Phenology

Mature individuals of *O. erythropilosa* were collected with flowers and young fruits in April and with dehisced fruits in July.

### Distribution, habitat and conservation status

*Ophiorrhiza erythropilosa* has only been observed and collected within Mt Hamiguitan Mountain Range and Wildlife Sanctuary, along the trail and near a shaded waterfall at around 500 m a.s.l. All individuals were observed to be at different stages of flowering to fruiting from April to July. Like other *Ophiorrhiza* species, *O. erythropilosa* grew in abundance in a shaded, relatively wet area beside rocks and other understory herbs and shrubs. In the two separate surveys conducted, only a single population with less than 10 individuals was encountered in the area. Though the mountain is considered a protected area and human intervention is limited there, the species seems to have a very limited distribution range. Following IUCN (2017), we propose this species to be treated as ‘data deficient’ (DD). Further surveys are needed as there is insufficient information to assess the status of this

species with only limited distributional data and no information on population size, trends or threats.

### Additional specimens examined (paratypes)

Philippines. Mindanao: Mt Hamiguitan Range Wildlife Sanctuary, San Isidro, Davao Oriental, Apr 2017, C. I. Banag, N. K. G. Alfeche and S. G. S. Zamudio CB17-025 and NK17 (USTH).

### *Ophiorrhiza hamiguitanensis* Alfeche and Alejandro sp. nov. (Fig. 3–4)

A species closely resembling the Philippine species *O. stenophylla* Merr. and the Chinese *O. lignosa* Merr. due to their characteristic lanceolate leaves that are pubescent to glabrous, and, minutely pubescent to hispidulous calyxes, but distinguished by its highly coriaceous leaves with attenuate leaf base and apex and brochidodromous venation (versus chartaceous with subequally narrowed to somewhat acuminate to acute base and apex in *O. stenophylla* and papery to submembranous with acuminate apex and long cuneate base in

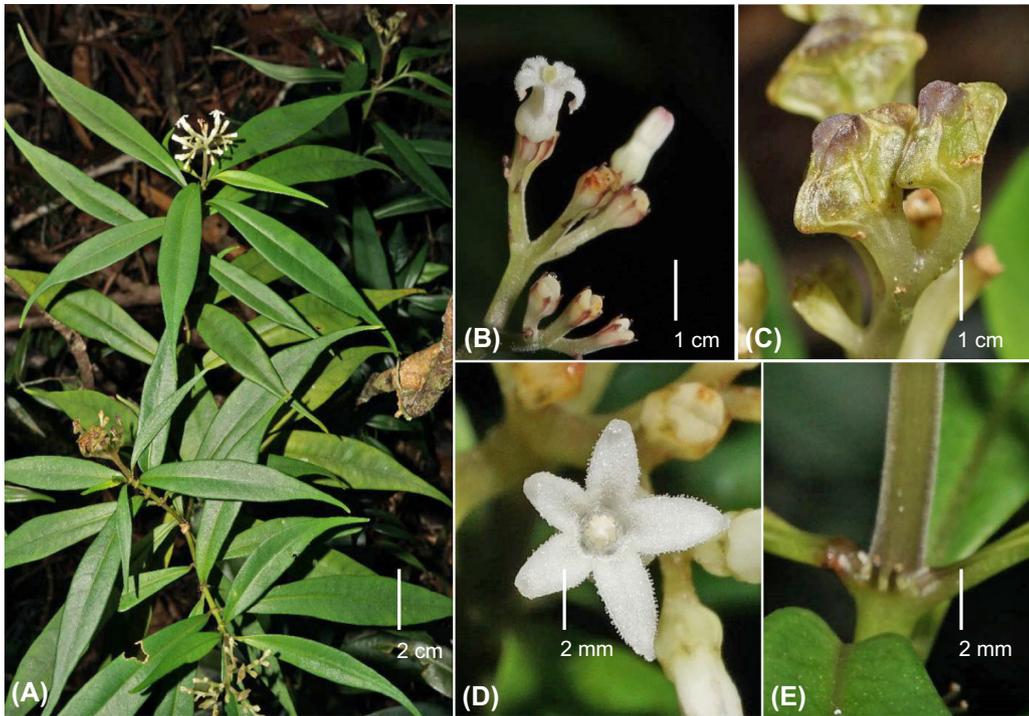


Figure 3. *Ophiorrhiza hamiguitanensis* sp. nov. (A) habit, (B) terminal inflorescence, (C) mature capsules of the infructescence, (D) flower showing exerted stigma and finely pubescent corolla lobes, (E) stipules bi-lobed, acute tips slightly recurved. Photos by R. V. Docot.

*O. lignosa*), subsistent bi-lobed stipules with slightly recurved acute tips (versus persistent, triangular-ovate with acute apex in *O. stenophylla*), presence of 1.5–2.5 mm long, linear ensiform bracts with a narrow triangular base (versus ebracteate in *O. stenophylla* and 1.5–3.0 mm long, ensiform-linear or linear and acuminate in *O. lignosa*), clavate calyces (versus urceolate in *O. stenophylla* and compressed turbinate in *O. lignosa*), and broadly obcordate capsules (versus compressed capsules in *O. stenophylla*) (Table 2).

**Type:** Philippines, Mindanao: Mt Hamiguitan Mountain Range, San Isidro, Davao Oriental, 6°44'22.3"N, 126°09'30.8"E, Jul 2016, C. I. Banag and R. V. A. Docot CB16-227 (holotype: USTH).

#### Etymology

The name refers to the type locality from where the species was collected, Mt Hamiguitan in Davao Oriental, Mindanao.

#### Description

Suffrutescent herb, 60–80 cm tall. Stems woody at base, branched, puberulous, light to dark green with areas of dark brown coloration at nodes. Petioles 2–3 mm long, with sparse trichomes. Leaves decussate, present on younger fleshy branches, caducous at the older woody main stem, thick and coriaceous, equal in size; blades linear-lanceolate, 45–80 × 7–12 mm, attenuate at apex and base, with entire margin, adaxially olivaceous, darker when dried, abaxially lighter almost whitish green, glabrous to puberulent; midrib

depressed at upper side and prominent at lower side, with 7–9 lateral nerves per side; venation brochidodromous. Stipules 2 mm long, bilobed, their tips acute and slightly recurved, subsistent. Inflorescences terminal, loose helioid cymes with 20–25 flowers, 25–35 × 30–40 mm; peduncle 15–20 mm long, lightly puberulent with minute white trichomes all over. Bracteoles present, linear ensiform with a narrow triangular base, dark brown in color, 1.5–2.5 mm long. Flowers white (with a light purple tinge in the bud tips), 6–8 mm long, distylous. Calyx light green, puberulent with minute white trichomes, about 4 mm long, somewhat clavate; calyx teeth deltoid, with dark brown tinge along center. Corolla white, cupuliform with bulging base, outer part glabrous, inner part pubescent with a ring of minute white trichomes at the throat; tube ca 3 mm long; corolla lobes 2 mm long, keeled, arcuate, their tips acuminate and slightly involute at anthesis. Short-styled flowers: stamens inserted at middle of the corolla tube and extending above the ring of appressed hairs, pale yellow; anthers oblong-linear, 1.00–1.75 mm long, subbasifixed and longitudinally dehiscent; filaments 2.00–2.50 mm long, glabrous; style 1.15–1.75 mm long; stigma globose, finely ciliate, included in tube at anthesis. Long-styled flowers: stamens inserted from the base of the tube and located right below the ring of loosely appressed hairs; anthers oblong-linear, 0.75–1.00 mm long, subbasifixed and longitudinally dehiscent; filaments 0.50–0.75 mm long; style exerted from the corolla throat, 2.50–3.00 mm long; stigma somewhat globose, ca 1 mm wide, finely ciliate. Capsules broadly obcordate, 2–3 × 4–5 mm, wider than long,

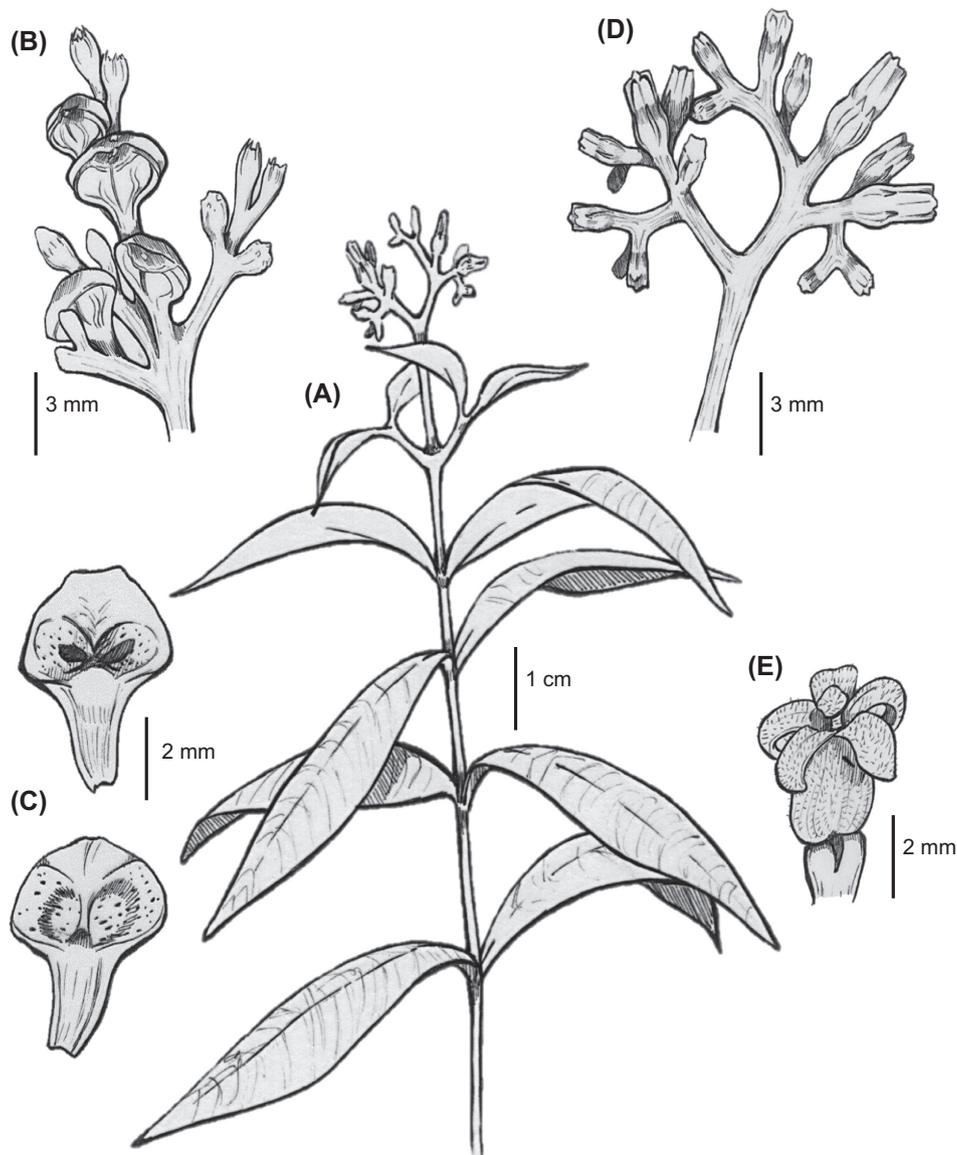


Figure 4. *Ophiorrhiza hamiguitanensis* sp. nov. (A) flowering branch, (B) infructescence, (C) dissected fruit showing locules and seeds, (D) developing inflorescence, (E) flower showing exserted stigma. Illustration by J. M. de Ocampo.

opening through longitudinal dehiscence along the top, their outer side smooth and glabrous, dark brown and inner side shiny light brown; teeth prominent. Seeds numerous, dark brown, smooth.

#### **Phenology**

Individuals of *O. hamiguitanensis* were collected with flowers and young fruits in April and with mature and dehiscent fruits in July.

#### **Distribution, habitat and conservation status**

*Ophiorrhiza hamiguitanensis* is only known from the type locality. Here, several individuals were observed along the shaded portion of a trail in both primary and secondary forests, on wet loamy soil near waterfalls and streams at around 600–800 m a.s.l. *Ophiorrhiza hamiguitanensis* did not form patches but

individuals were found ca 1–2 m from each other and were also surrounded by various ferns, herbs and small shrubs. Two distinct populations were observed: one in the secondary forest leading to the ranger's camp and another in the primary forest leading to what the locals call the 'Twin Falls'. This species warrants further observation and collections to determine whether other populations are present in similar areas within the Mt Hamiguitan Range. With the distribution currently limited to areas within the Mt Hamiguitan Range Wildlife Sanctuary, we propose this species to be treated 'data deficient' (DD) based on IUCN (2017).

#### **Additional specimens examined (paratypes)**

Philippines, Mindanao: Mt Hamiguitan Range Wildlife Sanctuary, San Isidro, Davao Oriental, Jul 2016, C. I. Banag and R. V. A. Docot CB16-219, CB16-231 and CB16-240.

Table 2. Morphological comparison of *Ophiorrhiza hamiguitanensis* sp. nov., *O. stenophylla* Merr. (Merrill 1921) and *O. lignosa* Merr (Merrill 1941).

Character	<i>O. hamiguitanensis</i>	<i>O. stenophylla</i>	<i>O. lignosa</i>
Habit and height (cm)	suffrutescent herb, 60–80	slender herb, 7–13	subshrub, up to 50
Leaf blade			
Shape	linear lanceolate	lanceolate to narrowly lanceolate	lanceolate to narrowly lanceolate
Apex	narrowly attenuate to attenuate	subequally narrowed to acuminate or merely acute	acuminate
Base	narrowly attenuate to attenuate	subequally narrowed to acuminate or merely acute	cuneate
Texture	thick and coriaceous (leathery)	thin and chartaceous (stiff, like paper)	papery to submembranous
Size (mm)	45–80 × 7–12; isophyllous	30–70 × 5–13; anisophyllous	50–110 × 10–20; anisophyllous
Stipules	subpersistent; 2 mm long, bi-lobed, tips acute and slightly recurved	persistent; 2 mm long, triangular-ovate	caducous; not seen
Inflorescences	loosely branched helicoid cyme with 20–25 flowers	solitary, few-flowered	cymose to somewhat congested-cymose; many-flowered
Bracteoles	present, linear ensiform with narrow triangular base, 1.5–2.5 mm long	ebracteolate	present, linear and acuminate or ensiform-linear, 1.5–3.0 mm long
Calyx length and shape	4 mm long, clavate	1.8 mm long, slightly urceolate	1.3 mm, long, compressed turbinate
Corolla	3 mm long tube, cupuliform with bulging base; 2 mm long lobes, ovoid	3 mm long tube, cylindrical; 1.5 mm long lobes, oblong, obtuse	10–11 mm long tube, subtubular; 3 mm long lobes
Style	heterostylous: with short- and long-styled flowers	not described	not described
Capsule length and shape	2–3 × 4–5 mm, broadly obcordate	2 × 5 mm, compressed	not described
Distribution	Mt Hamiguitan Range Wildlife Sanctuary, Davao, Philippines	Cavite Province, Philippines	Yunnan, Myanmar

Apr 2017, C. I. Banag, N. K. G. Alfeche and S. G. S. Zamudio CB17-033 & CB17-037 (USTH).

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