

## A new species of *Hornstedtia* and a new species record of *Globba* (Zingiberaceae) from Palawan, Philippines

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**ABSTRACT.** During recent botanical exploration in the province of Palawan, Philippines specimens were collected of a new species, *Hornstedtia crispata* Docot, and a new species record for the Philippines, *Globba francisci* Ridl., both from the ginger family Zingiberaceae. The new species is described and illustrated here along with an assessment of its conservation status.

**Keywords.** Borneo, endangered, *Globba aurea*, *Hornstedtia hainanensis*, *Hornstedtia sanhan*

### Introduction

Palawan is an archipelagic province comprising of approximately 1,780 islands and islets at about 14,897 km<sup>2</sup>, making it the largest province in the Philippines (Fernandez et al., 2002). About 48% of the province is covered with vegetation, including tropical lowland evergreen rainforest, lowland semi-deciduous (seasonal/monsoon) forest, montane forest, and forest-over-limestone (PCSDDS, 2015). Within this remaining forest are unique species of terrestrial flora and fauna, including 1700–3500 angiosperms, of which 15–20% are endemic to the country (Sopsop & Buot, 2009).

There is strong evidence that Borneo and Palawan were once connected by a land bridge based on bathymetric data (Woodruff, 2010) and from animal distributions (Heaney, 1986). This hypothesis is further supported by plant distributions (e.g. Poulsen & Docot, 2018 for *Etilingera sessilanthera* R.M.Sm.) and through biogeographical studies using molecular data to explain colonisation of the Philippines from Borneo via Palawan (e.g. Brown & Guttman, 2002 for *Rana*), or the other way around (e.g. Hughes et al., 2015 for *Begonia* L. sect. *Baryandra* A.DC.) Despite these efforts, further studies are still needed to support this hypothesis.

Our knowledge of the Zingiberaceae of the Philippines has been updated as a result of recent botanical explorations focused on the collection of gingers (e.g. Naive, 2017; Naive & Alejandro, 2018; Naive et al., 2018; Ambida et al., 2018; Poulsen & Docot, 2018; Acma et al., 2019; Docot et al., 2019a, b). Ridley (1905) enumerated 19 species of Philippine Zingiberaceae but now 122 species are known, of which 68% are endemic (Pelser et al., 2011 onwards; Zingiberaceae Resource Centre, 2019). Thirteen of these species occur in Palawan, five of which are endemic to the province (see Table 1 for a list of species in Palawan).

*Hornstedtia* Retz., as currently circumscribed, comprises c. 40 species distributed from the Himalayas to Queensland with a centre of diversity in continental Southeast Asia and Malesia. Sixteen species are found in Borneo (Lamb et al., 2013; Zingiberaceae Resource Centre, 2019). The genus can be easily recognised by the involucre of tightly overlapping sterile bracts that enclose the flowers near or at the uppermost part of the corolla tube and by the flat receptacle or condensed rachis (Smith, 1985). In the Philippines, *Hornstedtia* is represented by six species of which five are endemic and one, *Hornstedtia havilandii* (K.Schum.) K.Schum., is also found in Borneo (Pelser et al., 2011 onwards).

*Globba* L. species are distributed from Sri Lanka to Australia with a centre of distribution in monsoonal continental Southeast Asia (Williams et al., 2004). Members of this genus are easily distinguished by their small, delicate flowers with small labellum and elongated, arched stamen (Smith, 1988; Leong-Škorničková & Newman, 2015). A total of eight species of *Globba* are currently known in the Philippines, all of which are endemic except *Globba marantina* L., a species which is naturalised in tropical regions around the world (Pelser et al., 2011 onwards).

Botanical fieldwork focused on collecting gingers conducted by the authors in Palawan in 2017–2018 led to the collection of unidentified *Globba* and *Hornstedtia* species. After careful morphological comparison with known Philippine species and those occurring on neighbouring islands (e.g. Borneo and Sulawesi), the authors concluded that the *Hornstedtia* species is new to science, and the *Globba* species is *Globba francisci* Ridl., a species hitherto endemic to Borneo (Lamb et al., 2013). The new species is described and illustrated here along with an assessment of its conservation status. It is likely that there are still numerous species awaiting discovery in Palawan and many species already known from Borneo will eventually be discovered in Palawan or vice versa.

## Materials and methods

Herbarium collections, including high-resolution images of specimens, from BISH, BM, BO, E, F, FEUH, G, GH, K, L, MO, NY, P, PNH, S, SING, U, US, USTH and Z, along with published morphological descriptions of most similar species (e.g. Smith, 1988; Newman, 1995; Ye et al., 2018), especially those from the Philippines and neighbouring islands, were examined and compared to our recently collected specimens. Specimens seen only as a digital image available online are denoted

**Table 1.** The 15 Zingiberaceae species currently known in Palawan including their distribution status in the Philippines and publication record for Palawan. An asterisk (\*) indicates that the species is endemic in Palawan.

Species	Distribution	First recorded in Palawan
<i>Alpinia foxworthyi</i> Ridl. *	Endemic	Ridley (1909)
<i>Alpinia galanga</i> (L.) Willd.	Widespread and cultivated	Merrill (1923)
<i>Alpinia haenkei</i> C.Presl	Endemic	Ridley (1909)
<i>Alpinia illustris</i> Ridl. *	Endemic	Ridley (1909)
<i>Curcuma zedoaria</i> (Christm.) Roscoe	Widespread and cultivated	Merrill (1923)
<i>Etilingera philippinensis</i> (Ridl.) R.M.Sm.	Endemic	Ridley (1909)
<i>Etilingera sessilanthera</i> R.M.Sm.	Native	Poulsen & Docot (2018)
<i>Geocharis fusiformis</i> (Ridl.) R.M.Sm. var. <i>fusiformis</i>	Endemic	Pelser et al. (2011 onwards)
<i>Globba aurea</i> Elmer *	Endemic	Elmer (1915)
<i>Globba francisci</i> Ridl.	Native	here
<i>Globba marantina</i> L.	Widespread and cultivated	Merrill (1923)
<i>Globba ustulata</i> Gagnep. *	Endemic	Gagnepain (1901)
<i>Hornstedtia crispata</i> Docot	Endemic	here
<i>Wurfbainia hedyosma</i> (I.M.Turner) Škorničk. & A.D.Poulsen	Endemic	Merrill (1923)
<i>Wurfbainia palawanensis</i> (Elmer) Škorničk. & A.D.Poulsen *	Endemic	Elmer (1915)

with an asterisk (\*). The herbarium acronyms follow Thiers (continuously updated). The species description of the new species follows the style of recently published species of *Hornstedtia* (e.g., Leong-Škorničková et al., 2016; Ye et al., 2018) and the terminology in Beentje (2012).

The extent of occurrence (EOO) and area of occupancy (AOO) of the new species were calculated using the Geospatial Conservation Assessment Tool (GeoCAT) (Bachman et al., 2011: [www.geocat.kew.org](http://www.geocat.kew.org)). These data were then compiled to assess its conservation status using the International Union for Conservation of Nature criteria (IUCN, 2016). Furthermore, the coordinates of the localities based on information

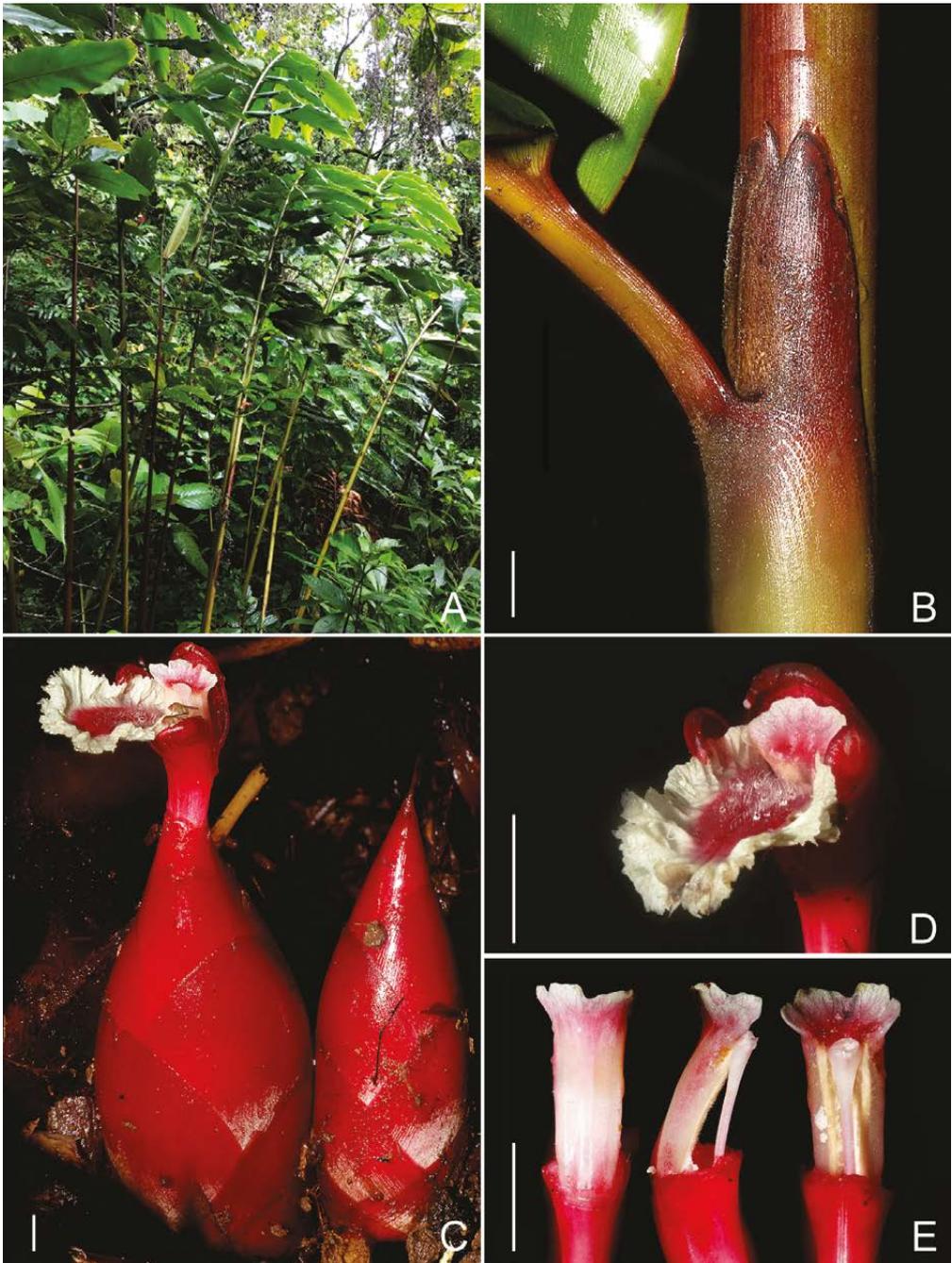
on herbarium labels were collected and generated in QGIS v. 2.18 (Quantum GIS Development Team, 2016), creating a distribution map (Fig. 4).

### Taxonomy

#### *Hornstedtia crispata* Docot, sp. nov.

Similar to *Hornstedtia sanhan* M.F.Newman but differs in the petiolate lamina (vs sessile); significantly wider lamina (10–16 vs 5–7 cm); oblong labellum (vs spatulate); presence of a 3–4 mm long petaloid and crispate anther crest; and subglobose epigynous glands (vs subulate). – TYPE: Philippines, Luzon, Palawan, Brooke's Point, Barangay Malis, Mount Mantalingajan, 8°45'20.7"N 117°39'25.0"E, 1228 m, 28 September 2018, *R.V.A. Docot et al. 0191* (holotype PNH [accession no. 256990]; isotypes FEUH incl. spirit, L, USTH). (Fig. 1 & 2).

Terrestrial herb in loose clumps. **Rhizome** 1.5–3 cm in diameter, yellowish-brown, scales thick, brown. **Leafy shoot** 4–8 m tall, arching to various degrees, base swollen, 5–6 cm wide; **sheath** reticulated, reddish-green when young, becoming light green when mature, glabrous; **ligule** ovate, 15–20 × 10–15 mm, reddish when young, becoming mid green when mature, the centre sericeous, becoming glabrous towards the margin, apex rounded; **petiole** 15–25 mm long, reddish when young, becoming light green when mature; **lamina** oblong, 55–70 × 10–16 cm, mid to dark green above, paler beneath, glabrous on both sides, base rounded, apex acute, margin reddish, slightly undulate, ciliate. **Inflorescence** 7–13 × 4–6 cm, emerging from the ground, receptacle flat, with many flowers, one open at a time; **peduncle** erect, 2–3 cm long, covered with thick and brown peduncular bracts; **sterile bract** ovate, largest 40–60 × 30–45 mm, becoming narrower towards the centre of the inflorescence, lower half sericeous, the hairs white, upper half bright red, glabrous and coriaceous, margin entire, apex rounded and emarginate; **fertile bract** oblong, 40–55 × 15–25 mm, split to the base, translucent white, apex acute; **bracteole** oblong, 20–30 × 7–12 mm, split to the base, translucent white, apex acute; **flower** sessile, 8–10 cm long; **calyx** tubular, upper portion sub-inflated, 35–45 × 10–15 mm when flattened, white, glabrous except the pubescent base, coriaceous, apex 3-dentate, brownish; **corolla tube** 5–6 cm long, both ends reddish, the centre white, glabrous outside, pubescent inside; **corolla lobes** bright red, glabrous, apex rounded and cucullate; **dorsal corolla lobe** ovate, 25–30 × 15–25 mm; **lateral corolla lobes** oblong, 25–35 × 10–20 mm; **labellum** oblong, 30–45 × 15–20 mm, thick, fleshy, and bright red at the centre, glabrous except the pubescent base, margin petaloid, crispate, white, apex entire, auricles absent at the base of the labellum; **lateral staminodes** absent; **stamen** 15–20 mm long, adnate to the base of the labellum; **filament** fully reduced; **anther** 15–20 × 5–7; **theca** yellowish, dehiscing throughout its length, pubescent; **anther crest** 3–4 × 6–7 mm, petaloid, reddish-pink at the base, the crispate margin white; **style** 6–7 cm long, white, pubescent except the lower half; **stigma** ovoid in shape, c. 2 mm wide, ostiole pubescent and facing forwards; **ovary** 5–7 × 2–4 mm, subglobose, white, slightly pubescent, coriaceous;



**Fig. 1.** *Hornstedtia crispata* Docot. **A.** Habit. **B.** Ligule. **C.** Inflorescences. **D.** Flower. **E.** Anther (back, side, and front view). All from the type specimen *R.V.A. Docot et al. 0191* (type). Scale bars = 1 cm. (Photos: R.V.A. Docot).

*epigynous glands* subglobose, 2–3 mm long, enveloping the style. **Infructescence** 7–13 × 6–7 cm, with numerous fruit developing; *fruit* 2.3–3 × 1–2.5 cm, subglobose, slimy, whitish-pink, pubescent at both ends, glabrous at the middle, coriaceous, calyx persistent (observations taken from immature fruits, dimensions of mature fruits maybe larger); *seed* irregularly globose, 1–2 mm wide, brown with slimy white aril.

*Distribution and habitat.* *Hornstedtia crispata* is known only in Mount Mantalingajan, Brooke's Point, Palawan where it inhabits slopes of primary forest at 1000–1300 m.

*Phenology.* Both flowering and fruiting individuals were observed in late September.

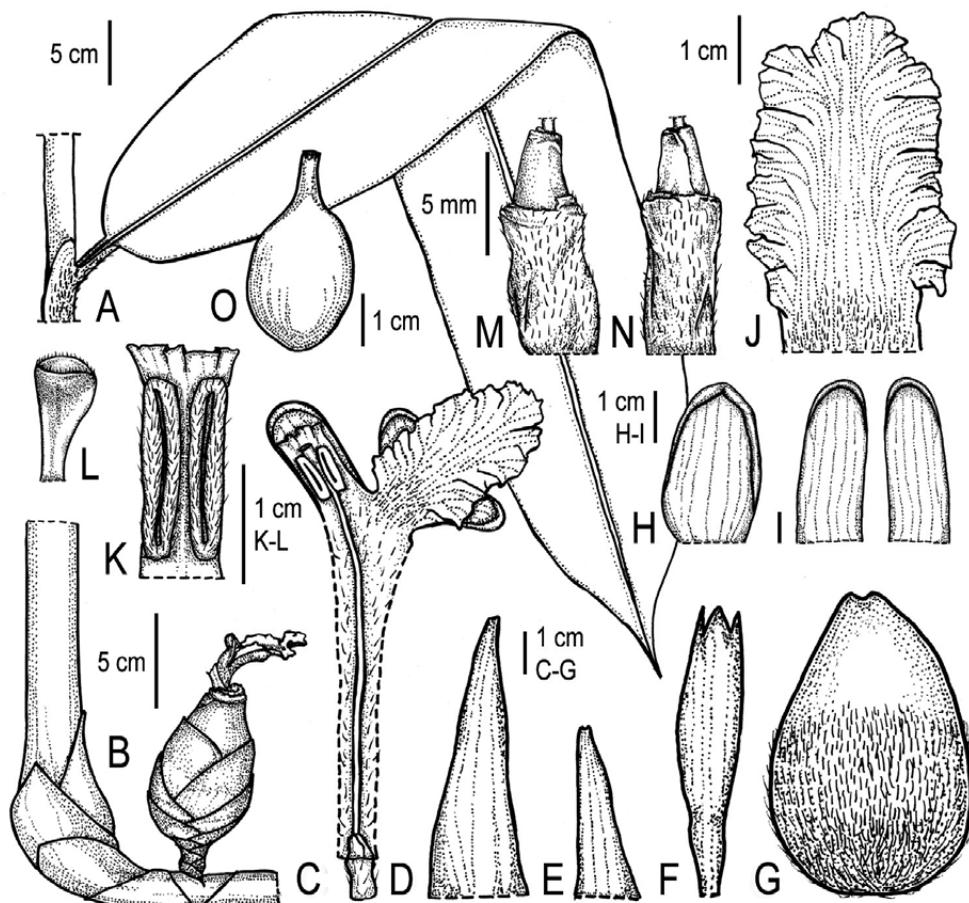
*Etymology.* The specific epithet refers to the crispate anther crest.

*Provisional IUCN conservation assessment.* Based on the IUCN red list categories and criteria (IUCN, 2016), *Hornstedtia crispata* is categorised as Endangered EN B2ab(iii). The area of occupancy is estimated to be less than 500 km<sup>2</sup> (total area of occupancy is c. 16 km<sup>2</sup>) and is known only at two locations on Mount Mantalingajan which is fortunately a protected area. Although the observed populations are within a protected area, the species may decline significantly if mining activities and conversion of forest into agricultural lands (e.g. rice plantations) are continued within the area.

*Additional specimens examined.* PHILIPPINES: **Palawan:** Brooke's Point, Barangay Malis, Mount Mantalingajan 8°45'19.8"N, 117°39'26.0"E, 1202 m, 28 September 2018, *Docot et al. 0190* (FEUH, USTH).

*Notes.* No common names or uses were reported by our Palaw'an tribe local guides. The most similar species in morphology is *Hornstedtia sanhan* M.F.Newman of Vietnam (west of Palawan). Although of similar habit (leafy shoots of both species can reach at least 4 m in length), the lamina of *Hornstedtia crispata* has a 15–25 mm long petiole while the lamina of *H. sanhan* is sessile. Moreover, *Hornstedtia crispata* has a significantly wider lamina (10–16 cm) than *H. sanhan* (5–7 cm), and the base and apex is rounded and acute rather than narrowly cuneate and acuminate as in *H. sanhan* (see table 2 for the full morphological differences between *H. crispata* and *H. sanhan*).

The main differences between the two species are in the floral morphology. Both species have bright red and ovate sterile bracts but the hairs in the lower half are white in *Hornstedtia crispata* while rufous (red) in *H. sanhan*. The most obvious similarity between the two species is the petaloid and crispate margin of the labellum (Fig. 1D & 2J). This labellum morphology can also be observed in *Hornstedtia gracilis* R.M.Sm. of Sabah, Borneo (south of Palawan) but is distinct by its slender peduncle that can reach up to 1 m long (vs 2–4 cm long in *H. crispata*). This labellum morphology is also found in *Hornstedtia hainanensis* T.L.Wu & S.J.Chen of Hainan, China (northwest of Palawan) but is distinct in the pink and bifid labellum (vs white and entire in *H. crispata*) and the absence of a bracteole and anther crest (vs present in *H. crispata*). In *Hornstedtia gracilis*, *H. hainanensis* and *H. sanhan*, however, only



**Fig. 2.** *Hornstedtia crispata* Docot. **A.** Leaf. **B.** Base of the leafy shoot and rhizome with inflorescence. **C.** Flower, dissected. **D.** Fertile bract. **E.** Bracteole. **F.** Calyx. **G.** Sterile bract. **H.** Dorsal corolla lobe. **I.** Lateral corolla lobes. **J.** Labellum. **K.** Stamen. **L.** Stigma. **M.** Epigynous gland on top of ovary (abaxial). **N.** Adaxial. **O.** Immature fruit. A–N from type *R.V.A. Docot et al. 0191*; O from *Docot et al. 0190*. Both collected from Brooke's Point, Palawan. Drawn from the spirit material by K.D. Gutierrez.

$\frac{1}{2}$  or less than  $\frac{3}{4}$  of the total length of the labellum has a petaloid and crispate margin in contrast to *H. crispata* in which it is present throughout its length. As a result, the labellum of *Hornstedtia gracilis*, *H. hainanensis* and *H. sanhan* appears spatulate rather than oblong as in *H. crispata*. *Hornstedtia crispata* also has a petaloid and crispate anther crest (Fig. 1E & 2K) which is entirely absent in *H. hainanensis* and *H. sanhan* and present in *H. gracilis* as small lobes on each theca. Although the fruits are fully embedded in a juicy aril, the local people of the Palaw'an tribe do not consume them, unlike the fruits of *Hornstedtia hainanensis* and *H. sanhan* which are gathered for their edible and medicinal fruits in the regions where they occur (Newman, 1995; Ye et al., 2018).

**Table 2.** Comparative morphology between *Hornstedtia crispata*, *H. gracilis*, *H. hainanensis*, and *H. sanhan*.

<b>Morphological characters</b>	<b><i>Hornstedtia crispata</i></b>	<b><i>Hornstedtia gracilis</i></b>	<b><i>Hornstedtia hainanensis</i></b>	<b><i>Hornstedtia sanhan</i></b>
<b>Height</b>	4–8 m	1.5–3 m	1.1–2.3 m	3.5–4 m
<b>Ligule</b>	Sericeous only at the centre	Glabrous	Tomentellous	Sericeous throughout
<b>Leaf attachment</b>	Petiolate (15–25 mm long)	Petiolate (c. 10 mm long)	Subsessile (c. 5 mm long)	Sessile
<b>Leaf width</b>	10–16 cm	3–6 cm	5–7 cm	5–7 cm
<b>Leaf base</b>	Rounded	Attenuate	Cuneate or rounded	Narrowly cuneate
<b>Leaf apex</b>	Acuminate	Acute	Caudate	Acute
<b>Peduncle</b>	2–3 cm long	0.2–1 m long	c. 0.5 cm long	c. 1 cm long
<b>Colour of the hairs on the base of the sterile bract</b>	White	White	White	Red
<b>Bracteole</b>	White	Absent	Absent	Pink or white
<b>Surface of the calyx</b>	Pubescent towards the base	Pubescent towards the base	Pubescent throughout	Pubescent throughout
<b>Shape and apex of the labellum</b>	Oblong, entire	Spatulate, entire	Spatulate, entire	Spatulate, entire
<b>Petaloid margin of the labellum</b>	Present throughout the length of the labellum	Present only half or less than $\frac{3}{4}$ of the length of the labellum	Present only half or less than $\frac{3}{4}$ of the length of the labellum	Present only half or less than $\frac{3}{4}$ of the length of the labellum
<b>Colour of the anther</b>	Whitish-red	Red	White	Pink or white
<b>Anther crest</b>	Present (petaloid and crispate)	Present (small lobes on each theca)	Absent	Absent
<b>Epigynous glands</b>	Subglobose	Subulate	Subulate	Subulate

### New record for the Philippines

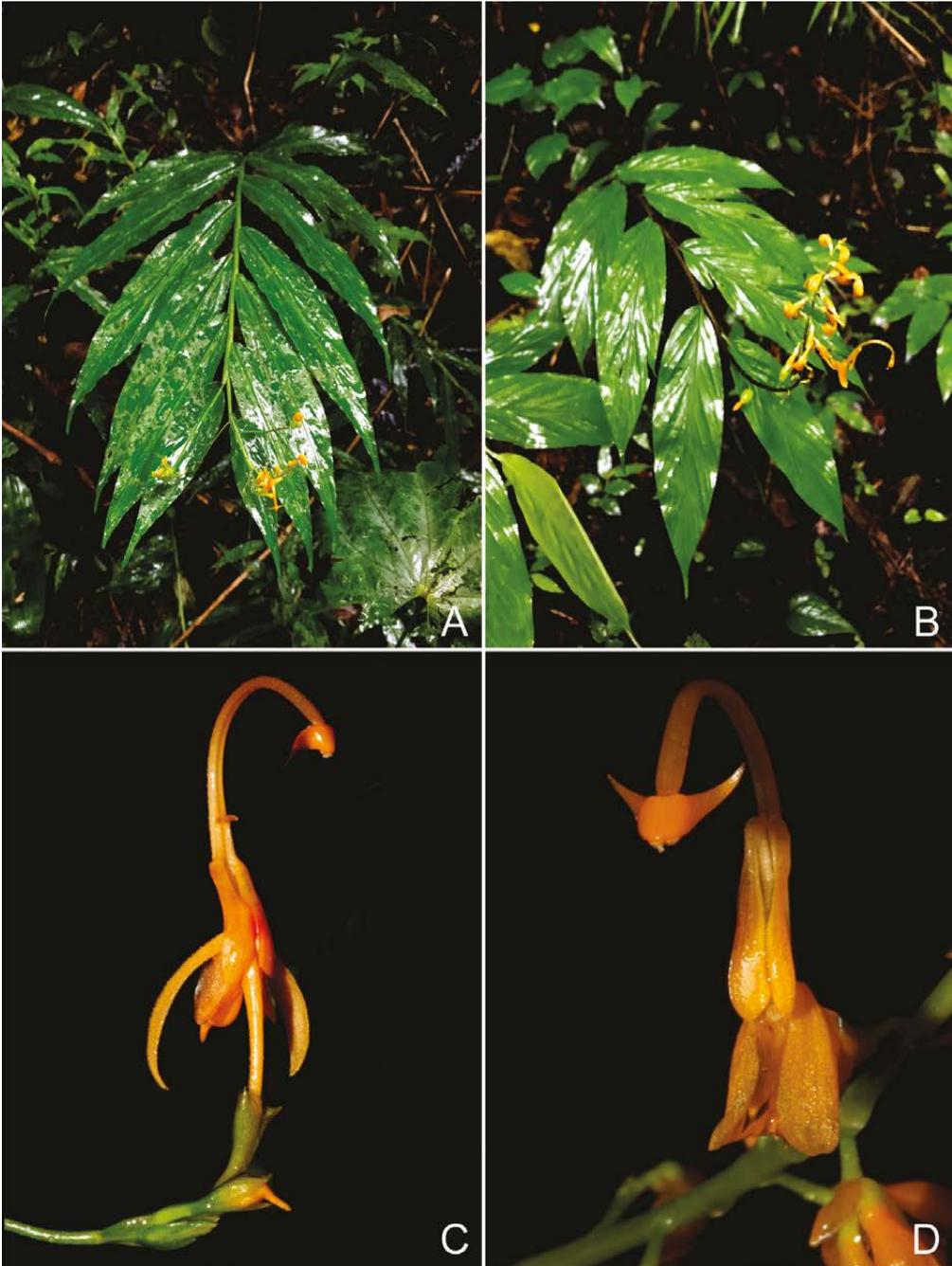
***Globba francisci*** Ridl., J. Linn. Soc., Bot. 42: 162 (1914). – TYPE: Malaysia, Sabah, L.S. Gibbs 2932 (lectotype BM [BM000617540], designated by Smith, Notes Roy. Bot. Gard. Edinburgh 45: 6 (1988)). (Fig. 3A & C)

*Notes.* *Globba francisci* is usually confused with *G. aurea* Elmer (Fig. 3B & D) in the forests of Palawan because both species have yellow flowers. Both are distributed from Central to Southern Palawan (Fig. 4) and usually grow together in wet rock crevices beside streams and ravines up to 1000 m. Unfortunately, the type of *Globba aurea* (A.D.E. Elmer 13243) cannot be located in any herbaria but our collections perfectly match the original description of the species by Elmer (1915), including in the purplish spotted sheath and the petaloid lateral staminodes. In fact, one of the collections used in this study, C.B.M. Domingo & R.V.A. Docot PL18-006, was collected near the type locality of *G. aurea* (Masagana Falls is c. 7.81 km away from Mount Pulgar = Thumb Peak). Moreover, *Globba francisci* can be readily distinguished from *G. aurea* by the green sheath (vs purplish-spotted); narrowly-linear lamina (vs narrowly-ovate); the presence of red spot in the labellum (vs absence); and subulate lateral staminodes (vs petaloid). *Globba francisci* belongs to *Globba* sect. *Nudae* K.Larsen subsect. *Mediocalcaratae* (K.Schum.) K.J.Williams while *G. aurea* is in *Globba* sect. *Ceratanthera* (Horan.) Petersen. The morphology of recent collections of *Globba francisci* in Palawan was within the range of variation of *G. francisci* in Borneo.

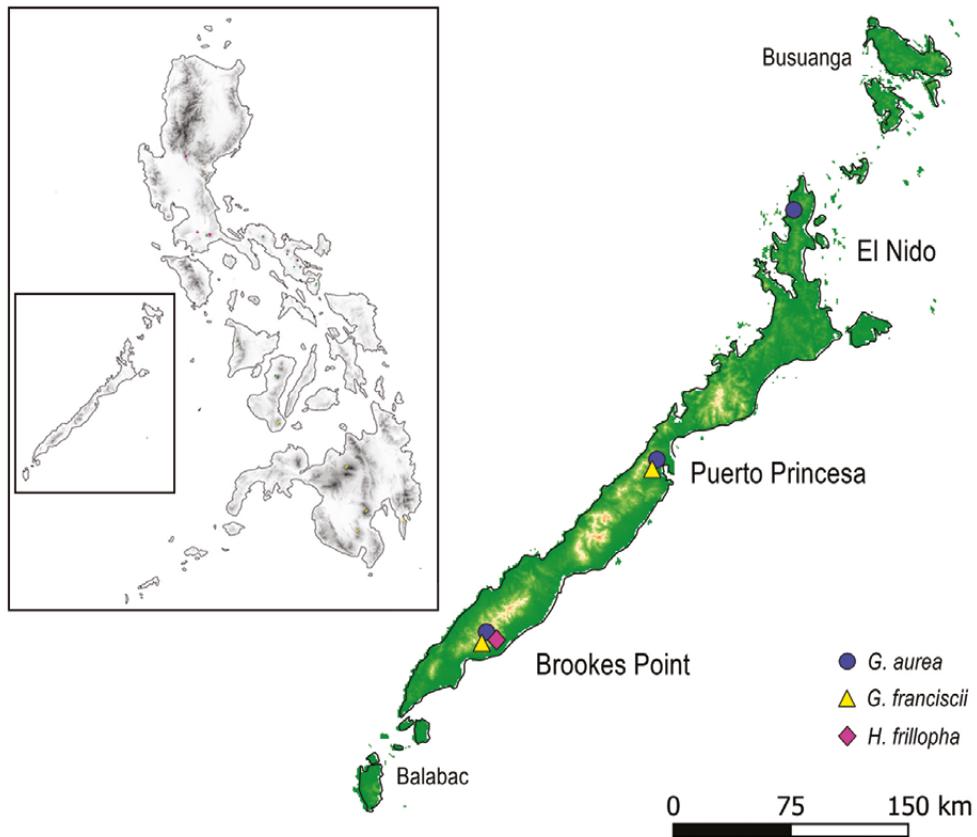
*Specimens examined.* ***Globba aurea*.** PHILIPPINES: **Palawan:** Puerto Princesa City, Barangay Irawan, Trail to Masagana Falls, 9°48'47.2"N 118°40'52.9"E, 1 Jul 2018, Domingo & Docot PL18-006 (FEUH, USTH); El Nido, Barangay Pasadena, Trail to Nagkalit-kalit Falls, 11°15'24.0"N 119°26'11.8"E, 4 Jul 2018, Zamudio & Docot SZ18-737 (FEUH, USTH); Brooke's Point, Barangay Malis, Mount Mantalingajan, 8°44'09.1"N, 117°40'17.4"E, 884 m, 27 Sept 2018, Docot et al. 0188 (FEUH, L, USTH).

***Globba francisci*.** MALAYSIA: **Sabah:** Tenom, Jan 1910, Gibbs 2932 (BM); Trusmadi Forest Reserve, South of Sino, Aug 1977, Gardner 68 (E); Ranau, Lohan River, 900 m, 5 Apr 1984, Beaman 9209 (E); Poring Hot Springs, 18 June 1986, Smith 33/86 (E); Bukit Tempadong, along Segama River, 150 m, 11 Jun 1984, Beaman 10080 (E). **Sarawak:** Miri Division, Gunung Mulu National Park, Gua Payau, 100 m, 19 Nov 1977, Argent & Kerby 802 (E); Miri Division, Gunung Mulu National Park, Gua Payau, 100 m, 31 July 1978, Jermy 14229 (E); Lobang Rusa, 7 Oct 1977, Sinclair S 31806 (E).

PHILIPPINES: **Palawan:** Puerto Princesa City, Barangay Iwahig, Thumb Peak (formerly Mount Pulgar), 9°46'21.5"N, 118°39'44.1"E, 1 Oct 2017, Docot et al. 0111 (L, NY, PNH, USTH); Barangay Irawan, Trail to Masagana Falls, 9°48'45.9"N 118°40'50.3"E, 1 Jul 2018, Domingo & Docot PL18-007 (FEUH, USTH); Brooke's Point, Barangay Malis, Mount Mantalingajan, 8°42'30.0"N 117°40'57.0"E, 268 m, 27 Sep 2018, Docot et al. 0183 (FEUH, PNH, USTH).



**Fig. 3.** A & C. *Globba francisci* Ridl. A. Habit. C. Flower. B & D. *Globba aurea* Elmer. B. Habit. D. Flower. A & C from Docot *et al.* 0111; B & D from Domingo & Docot PL18-006. All from Puerto Princesa City, Palawan (Photos: R.V.A. Docot).



**Fig. 4.** Distribution map of *Globba aurea* Elmer, *G. francisci* Ridl. and *Hornstedtia crispatata* Docot in the province of Palawan.

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