

Taxonomic notes on Philippine *Hornstedtia* (Zingiberaceae) including a description of a new species

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ABSTRACT. A new species, *Hornstedtia olivacea* Docot & Pranada, from the province of Quezon, Philippines is described here with information on its distribution, habitat and phenology, along with a provisional IUCN conservation assessment. A second-step lectotypification of *Hornstedtia conoidea* Ridl. is proposed and a previous lectotypification of *Hornstedtia microcheila* Ridl. is clarified. Examination of the collection *Ramos & Edaño 44454* supports the occurrence of *Hornstedtia havilandii* (K.Schum.) K.Schum. in the Philippines but new material is needed to check if the populations in the province of Sulu are distinct enough from the populations in Borneo to be recognised as a distinct taxon. An updated key to the *Hornstedtia* species of the Philippines is also provided.

Keywords. Critically endangered, endemic, *Hornstedtia conoidea*, *Hornstedtia havilandii*, *Hornstedtia microcheila*, lectotypification

Introduction

The genus *Hornstedtia* Retz. in the Zingiberaceae is characterised by a radical inflorescence with a rigid involucre of sterile bracts (which encloses the uppermost part of the open flowers) and a flat or condensed rachis (Smith, 1985; Lamb et al., 2013). The genus currently comprises 41 species with its centre of diversity in Continental Asia and Malesia, extending to the Himalayas in the west and to northern Queensland in the east (Docot et al., 2019). Recent molecular data (De Boer et al., 2018) demonstrated that *Hornstedtia* is not monophyletic with species in three distinct clades of the tribe Alpinieae, namely 1) *Hornstedtia* I clade which includes the type of the genus, *Hornstedtia scyphifera* (J.Koenig) Steud.; 2) *Etingera* + *Hornstedtia* II clade, where a species, *Hornstedtia leonurus* (J.Koenig) Retz., is paraphyletic with *Etingera* Giseke; and 3) *Amomum* IX + *Hornstedtia* III clade, where two *Amomum* Roxb. s.l. species are intermixed with *Hornstedtia* species. It is likely that *Hornstedtia* will be split into several genera when the sampling of taxa is expanded.

In the Philippines, *Hornstedtia* is currently represented by seven species, six of which are endemic (Docot et al., 2019). Several species of gingers with radical inflorescences from the Philippines have been placed at various times in *Hornstedtia* because generic delimitations among ginger genera with this type of inflorescence were not always clear (see Table 1 for the full list of species in the Philippines that have been included in *Hornstedtia*). Ridley (1905) described two species of *Hornstedtia*, namely *H. paradoxa* Ridl. and *H. philippinensis* Ridl., which are now in *Adelmeria* Ridl. and *Etlingera*, respectively. Ridley (1909) published three more species, *Hornstedtia conoidea* Ridl., *H. lophophora* Ridl. and *H. microcheila* Ridl., based on collections by A.D.E. Elmer in the Cuernos de Negros Mountains, Negros Oriental. Elmer (1915) described *Hornstedtia dalican* Elmer which was moved into *Amomum* by Merrill (1923) and then into *Etlingera* by Poulsen (2003). Elmer (1919) moved five species of *Amomum* into *Hornstedtia*, namely *H. lepnicarpa* (Ridl.) Elmer, *H. muricarpa* Elmer, *H. pandanicarpa* (Elmer) Elmer, *H. propinqua* (Ridl.) Elmer and *H. pubescens* (Ridl.) Elmer, which are all now in *Etlingera* or *Meistera* Giseke. In the same paper, Elmer described *Hornstedtia purpurea* Elmer, *H. sorsogonensis* Elmer and *H. subviridis* Elmer which are now all placed in *Etlingera*. In addition, two species also from Mount Bulusan, *Hornstedtia peninsularis* Elmer and *H. irosinensis* Elmer, were described by Elmer (1919). Merrill (1923), however, transferred *Hornstedtia irosinensis* to *Amomum* and synonymised *H. peninsularis* under it. Furthermore, Pelsner et al. (2011 onwards) formally reported the occurrence of the Bornean *Hornstedtia havilandii* (K.Schum.) K.Schum. in the Philippines based on the specimen *M. Ramos & G.E. Edaña 44454* from the province of Sulu. Recently published *Hornstedtia* species in the Philippines include *Hornstedtia annadeguzmaniae* Naive & Alejandro, *H. garbosa* Naive & Alejandro, and *H. crispata* Docot. Altogether, 20 *Hornstedtia* species have been recorded for the Philippines, of which 13 are now treated as synonyms in other genera and seven are currently recognised in *Hornstedtia* (see Table 1).

During a botanical exploration to the southern portion of the Sierra Madre Mountain Range (the longest mountain range in the Philippines), particularly to Barangay Pesa, General Nakar, Quezon province in July 2019, a specimen of an unknown *Hornstedtia* species was collected. Examination of the material and comparison to all known *Hornstedtia* species in the Philippines and species found on neighbouring islands (e.g., Borneo) led us to conclude that the species is new and is, therefore, described below. In addition, a second-step lectotypification of *Hornstedtia conoidea* is proposed and a clarification of a previous lectotypification of *H. microcheila* is discussed. A taxonomic note on *Hornstedtia havilandii* is provided as a result of recent examination of relevant specimens and a key to *Hornstedtia* species in the Philippines is presented.

Table 1. All Philippine species which have been included in *Hornstedtia*. Names in bold are species currently placed in *Hornstedtia*.

Name in <i>Hornstedtia</i>	Currently accepted name	First published occurrence in the Philippines	First placed in <i>Hornstedtia</i>
<i>Hornstedtia annadeguzmaniae</i> Naive & Alejandro	<i>Hornstedtia annadeguzmaniae</i>	Naive & Alejandro (2018)	Naive & Alejandro (2018)
<i>Hornstedtia conoidea</i> Ridl.	<i>Hornstedtia conoidea</i>	Ridley (1909)	Ridley (1909)
<i>Hornstedtia crispata</i> Docot	<i>Hornstedtia crispata</i>	Docot et al. (2019)	Docot et al. (2019)
<i>Hornstedtia dalican</i> Elmer	<i>Etlingera dalican</i> (Elmer) A.D.Poulsen	Elmer (1915)	Elmer (1915)
<i>Hornstedtia garbosa</i> Naive & Alejandro	<i>Hornstedtia garbosa</i>	Naive et al. (2019)	Naive et al. (2019)
<i>Hornstedtia havilandii</i> (K.Schum.) K.Schum.	<i>Hornstedtia havilandii</i>	Pelser et al. (2011 onwards)	Schumann (1904)
<i>Hornstedtia irosinensis</i> Elmer	<i>Amomum irosinense</i> (Elmer) Merr.	Elmer (1919)	Elmer (1919)
<i>Hornstedtia lepigarpa</i> (Ridl.) Elmer	<i>Etlingera alba</i> (K.Schum.) A.D.Poulsen	Ridley (1909)	Elmer (1919)
<i>Hornstedtia lophophora</i> Ridl.	<i>Hornstedtia lophophora</i>	Ridley (1909)	Ridley (1909)
<i>Hornstedtia microcheila</i> Ridl.	<i>Hornstedtia microcheila</i>	Ridley (1909)	Ridley (1909)
<i>Hornstedtia muricarpa</i> Elmer	<i>Meistera muricarpa</i> (Elmer) Škorničk. & M.F.Newman	Elmer (1915)	Elmer (1919)
<i>Hornstedtia pandanicarpa</i> (Elmer) Elmer	<i>Etlingera fimbriobracteata</i> (K.Schum.) R.M.Sm.	Elmer (1915)	Elmer (1919)
<i>Hornstedtia paradoxa</i> Ridl.	<i>Adelmeria paradoxa</i> (Ridl.) Merr.	Ridley (1905)	Ridley (1905)
<i>Hornstedtia peninsularis</i> Elmer	<i>Amomum irosinense</i> (Elmer) Merr.	Elmer (1919)	Elmer (1919)
<i>Hornstedtia philippinensis</i> Ridl.	<i>Etlingera philippinensis</i> (Ridl.) R.M.Sm.	Ridley (1905)	Ridley (1905)
<i>Hornstedtia propinqua</i> (Ridl.) Elmer	<i>Meistera propinqua</i> (Ridl.) Škorničk. & M.F.Newman	Ridley (1905)	Elmer (1919)
<i>Hornstedtia pubescens</i> (Ridl.) Elmer	<i>Etlingera pilosa</i> A.D.Poulsen & Docot	Ridley (1909)	Elmer (1919)
<i>Hornstedtia purpurea</i> Elmer	<i>Etlingera purpurea</i> (Elmer) A.D.Poulsen	Elmer (1919)	Elmer (1919)
<i>Hornstedtia sorsogonensis</i> Elmer	<i>Etlingera sorsogonensis</i> (Elmer) A.D.Poulsen	Elmer (1919)	Elmer (1919)
<i>Hornstedtia subviridis</i> Elmer	<i>Etlingera subviridis</i> (Elmer) A.D.Poulsen	Elmer (1919)	Elmer (1919)

Materials and methods

Herbarium specimens, including types and digital images of specimens relevant to *Hornstedtia*, deposited in the herbaria of B, BISH, BM, BO, CAHUP, E, F, FEUH, G, GH, HBG, K, NY, PNH, SING, US, USTH and Z, and protologues and published morphological descriptions of most similar species (e.g., Ridley, 1909; Naive, 2018), were examined. All specimens have been seen by the authors unless otherwise indicated; specimens examined via digital images are indicated with an asterisk (*). A distribution map was generated using SimpleMappr (Shorthouse, 2010). The area of occupancy (AOO) was calculated using the Geospatial Conservation Assessment Tool (GeoCAT) (Bachman et al., 2011: <http://geocat.kew.org/>) to assess the conservation status of the new species using the International Union for Conservation of Nature (IUCN) criteria (IUCN Standards and Petitions Committee, 2019).

Taxonomy

Hornstedtia olivacea Docot & Pranada, **sp. nov.**

Similar to *Hornstedtia microcheila* Ridl. but differs in the generally longer petiole (1.5–3 cm vs 1–2 cm long in *H. microcheila*), shape and margin of the lamina (linear and undulate vs narrowly elliptic and plane), colour and apex of the sterile bract (olive-green and mucronate vs red and acute), number of flowers open at anthesis (1 only vs 1 or 2), colour of the corolla lobes (red vs white), colour of the base of the labellum (red vs yellow), and presence of petaloid lateral staminodes. – TYPE: Philippines, Luzon, Quezon, General Nakar, Barangay Pesa, along trail to Kidadayaig Falls, 230–250 m, 14°43'15.0"N 121°34'35.7"E, 21 July 2019, *M.A.K. Pranada* 2 (holotype PNH; isotypes FEUH including spirit, L). (Fig. 1)

Terrestrial herb in loose clumps. **Rhizome** 5–10 mm in diam., yellowish brown, scales thick, brown; **stilt roots** absent. **Leafy shoot** 1–2.5 m tall, arching to various extents, base swollen, 1–2 cm wide; **sheath** light green, slightly puberulent; **ligule** ovate, 10–15 × 4–6 mm, red, puberulent, apex rounded; **petiole** 1.5–3 cm long, mid green; **lamina** linear, 30–46 × 1.5–3.5 cm, mid green above, light green beneath, glabrous on both sides, base unequal, attenuate, apex sharply acuminate, margin reddish, moderately undulate. **Inflorescence** narrowly ovoid, 10–15 × 1.5–2.5 cm, arising near the base of the leafy shoot or at some distance from the rhizome, receptacle flat, with many flowers, one open at time; **peduncle** nodding to various degrees, 4.5–7 cm long; **peduncular bracts** ovate, 15–30 × 20–35 cm, olive-green, margin red, the base sericeous, central part tufted with white hairs, puberulent towards the mucronate apex; **sterile bracts** ovate, 5–7 × 1.5–3 cm, becoming narrower towards the centre of the inflorescence, the base and margin reddish, becoming olive-green towards the apex, the base sericeous, central part tufted with white hairs, puberulent towards the mucronate apex; **fertile bract** oblong-ovate, 5–6.5 × 1.5–2 cm, white, glabrous on both sides, apex acute; **bracteole** linear-ovate, 40–55 × 5–10 mm, white, glabrous on both sides, apex acute.

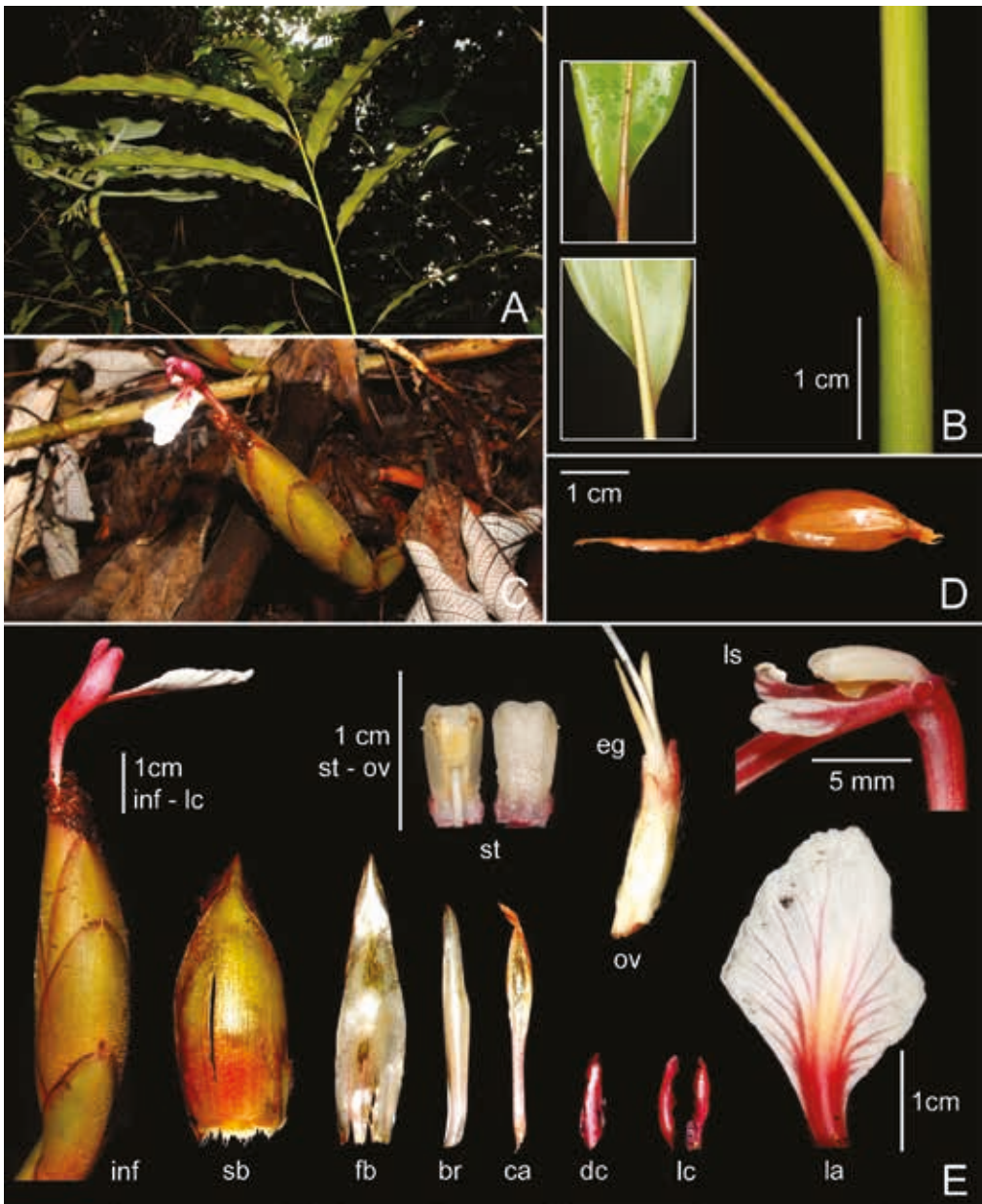


Fig. 1. *Hornstedtia olivacea* Docot & Pranada. **A.** Habit. **B.** Ligule. Insets: base of the lamina (front and back view). **C.** Inflorescence. **D.** Fruit from spirit material. **E.** Floral parts. Abbreviations: *br*, bracteoles; *ca*, calyx tube; *dc*, dorsal corolla lobe; *eg*, epigynous glands; *fb*, fertile bract; *inf*, inflorescence; *la*, labellum; *lc*, lateral corolla lobes; *ls*, lateral staminodes; *ov*, ovary; *sb*, sterile bract; *st*, stamen. All from the type *M.A.K. Pranada 2*. (Photos: M.A.K. Pranada)

Flower: *calyx* tubular, the upper half sub-inflated, 5–6 cm long, reddish at the base, white towards the apex, slightly villose, apex acute and pubescent; *corolla tube* 4–5 cm long, reddish pink, glabrous outside, slightly villose inside; *dorsal corolla lobe* linear, 15–20 × 4–6 mm, red, glabrous, apex cucullate; *lateral corolla lobes* linear, 13–18 × 2–3 mm, red, glabrous, apex cucullate; *labellum* spatulate, 2.7–4 × 1.5–3 cm, the base narrow and fleshy, reddish, pubescent, the upper part petaloid, white with yellow patch at the centre, glabrous, margin lacerate, apex rounded, auricles present at the base of the labellum; *lateral staminodes* ovate, 5–8 × 2–4 mm, white, the centre red, glabrous, apex rounded; *stamen* 5–7 mm long, adnate to the base of the labellum; *filament* fully reduced; *anther* triangular, 5–7 × 3–5 mm, white; *thecae* yellowish, dehiscing throughout their length, puberulent; *anther crest* somewhat petaloid, c. 2 mm long, white, horns present on each side; *style* 4–5.6 cm long, white, pubescent; *stigma* ovoid, c. 2 mm wide, ostiole pubescent; *epigynous glands* subulate, 8–10 mm long, yellow, glabrous; *ovary* oblong, 8–10 × 30–40 mm, white, pubescent except the glabrous middle part, coriaceous, trilocular, placentation axile. **Infructescence** conical, 10–14 × 2–3.5 cm. **Fruit** oblong, 2–3 × 1–1.5 cm, white, glabrous except pubescent at apex, coriaceous, calyx persistent. **Seed** globose to subglobose, c. 2 mm wide, black, covered with white aril.

Distribution and habitat. Only known from the type locality (Fig. 2A). The species grows near streams or on shaded slopes at 230–250 m.

Phenology. Flowering and fruiting between June and September.

Etymology. The specific epithet refers to the olive-green sterile bracts.

Provisional IUCN conservation assessment. Based on the IUCN red list categories and criteria (IUCN Standards and Petitions Committee, 2019), *Hornstedtia olivacea* is assessed as Critically Endangered (CR B2ab(iii), D). The area of occupancy (AOO) is estimated to be less than 10 km² (total AOO is c. 4 km²) as the species is only known from the type locality. Only three mature individuals were observed and are c. 700 m apart. Fortunately, the forest in which Kidadayaig Falls (Fig. 2B) are found is within an unnamed national park protected under presidential proclamation no. 1636 of 1977. Most of the surrounding forest at the locality is secondary growth as a result of previous logging and slash-and-burn activities which have stopped according to the locals (although we did observe small areas in which these activities are still being practiced). This may contribute to a decline in the population of *Hornstedtia olivacea* in the area. The assessment shall be updated as more information becomes available as it is likely that *Hornstedtia olivacea* also occurs in other parts of the Sierra Madre Mountain Range.

Notes. *Hornstedtia olivacea* is distinct by its olive-green sterile bracts (Fig. 1C) which are red in most *Hornstedtia* species. Based on overall morphology, the most similar species is *Hornstedtia microcheila*, a species found on Negros and Panay Island, and

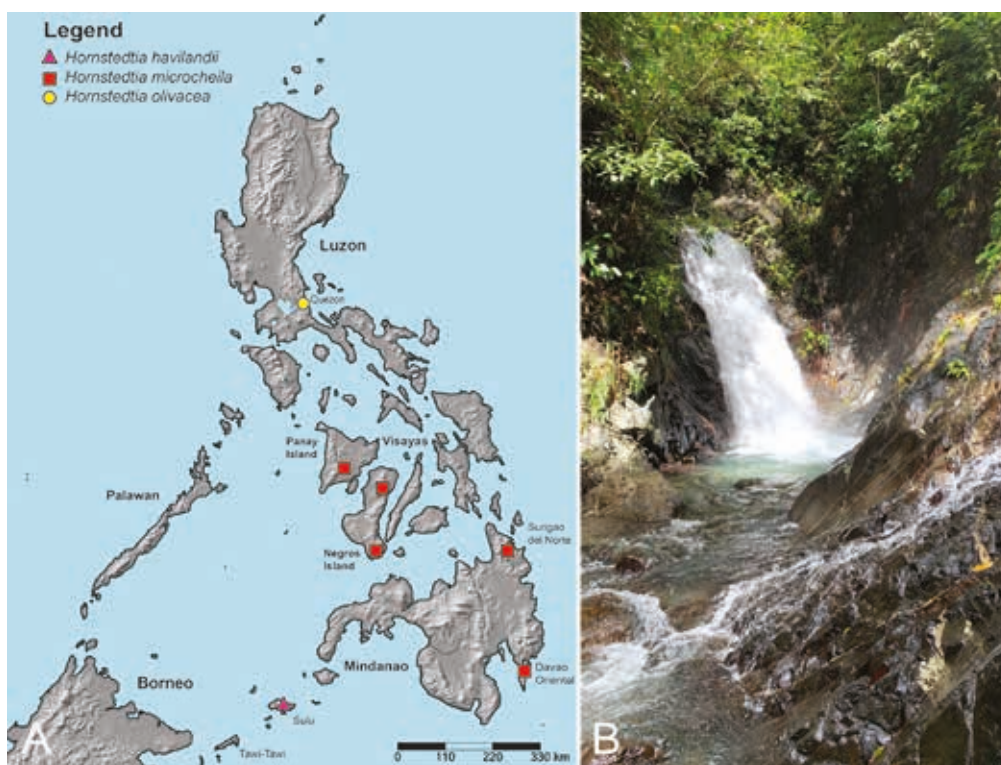


Fig. 2. A. Distribution map of *Hornstedtia havilandii*, *H. microcheila*, and *H. olivacea* in the Philippines. B. Kidadayaig Falls in General Nakar, Quezon, Philippines, the type locality. (Photo: R.V.A. Docot)

also in some provinces of Mindanao such as Davao Oriental and Surigao del Norte (whereas *H. olivacea* is so far only known from Luzon, Fig. 2A).

Although the two species are similar in their habit, which can be up to 2.5 m tall, *Hornstedtia olivacea* can be easily differentiated from its vegetative growth by the linear lamina (vs narrowly elliptic in *H. microcheila*). Moreover, *Hornstedtia olivacea* can also be differentiated by the generally longer petiole (1.5–3 cm vs 1–2 cm long in *H. microcheila*) and undulating margin of the lamina (vs entire in *H. microcheila*). The main differences between the two species are more evident in the floral morphology, particularly in the sterile bract (even the peduncular bract) of *Hornstedtia olivacea* which is olive-green but red in *H. microcheila*. At anthesis, only one flower is open at a time in *Hornstedtia olivacea* compared to *H. microcheila* which has one or two flowers open at a time. Ridley (1909) described the colour of the corolla of *Hornstedtia microcheila* as pink. Examination of recent collections of *Hornstedtia microcheila* revealed that only the corolla tube is pink and the corolla lobes are white (vs red in *H. olivacea*). Both species have auricles at the base of the labellum but in *Hornstedtia olivacea* the colour at the base is red while in *H. microcheila* it is yellow. Furthermore, *Hornstedtia olivacea* has petaloid lateral staminodes (Fig. 1E) which are entirely absent in *H. microcheila*. No common names or uses were reported by local guides.

As mentioned earlier, in a phylogenetic analysis of the tribe Alpinieae, De Boer et al. (2018) found *Hornstedtia* not to be monophyletic but rather has species distributed in three different clades. Based on these preliminary data, the most obvious character to distinguish the clades is the morphology of the labellum: the *Hornstedtia* I clade and the *Etlingera* + *Hornstedtia* II clade have fleshy labellums whereas the *Amomum* IX + *Hornstedtia* III clade has a petaloid labellum. Since *Hornstedtia olivacea* has a petaloid labellum, it will likely be grouped within the *Amomum* IX + *Hornstedtia* III clade.

Taxonomic notes on Philippine *Hornstedtia*

Hornstedtia conoidea Ridl., Leaf. Philipp. Bot. 2: 605 (1909). – *Amomum conoideum* (Ridl.) Elmer, Leaf. Philipp. Bot. 8: 2972 (1919). – TYPE: Philippines, Visayas, Negros Island, Negros Oriental, Dumaguete, Cuernos de Negros Mountains, 2000 ft., June 1908, *A.D.E. Elmer 10246* (lectotype K [K000255177], first step designated by Turner (2000), second step designated here; isolectotypes BM [BM000617559], E [E00507759], FI [FI016142*], G [G00008038*], HBG [HBG528080 n.v.], K [K000255175, K000255176], NY [NY00320250*], US [0092882*]).

Notes. Turner (2000) referred to a specimen at K as the ‘holotype’ which at that time was an effective lectotypification. At K, however, there are three sheets and we have chosen the specimen with barcode no. K000255177 as the lectotype since it has both vegetative and reproductive material compared to the two remaining sheets which have only either of the two. An additional seven isolectotypes have been found since Newman et al. (2004).

Hornstedtia havilandii (K.Schum.) K.Schum., Pflanzenr. IV, 46 (Heft 20): 193 (1904). – *Amomum havilandii* K.Schum., Bot. Jahrb. Syst. 27: 303 (1899). – TYPE: [Malaysia], Borneo, Sarawak, Pinindgiao, November 1871, *O. Beccari 1148* (lectotype K [K000255184], designated by Smith (1985)).

Specimens examined. INDONESIA: **East Kalimantan:** Long Sungei Barang, 17 Aug 1990, *Leaman DL 265* (E); Bengalon, KPC Area, 90 m, 0°49'59.4"N 117°33'44.8"E, 14 Apr 1996, *Ambriansyah & Arifin AA 1755* (E).

MALAYSIA: **Sabah:** Kimanis-Keningau Road, Croker Range, 9 Jun 1986, *Smith 1/86* (E); Mount Kinabalu Park, Poring Hot Springs, 18 Jun 1986, *Smith et al. S34/86* (E); Secondary forest near Imbak River, 90 m, 5°07'00.0"N 117°03'00.0"E, 13 Jun 2000, *Poulsen 1607* (E). **Sarawak:** Bukit Jebong, Bau District, 10 Jul 1970, *Lehmann S29404* (E); Gunung Manok, Padawan Distirct, 13 May 1975, *Burrt 8138* (E); Kuching, 1st Division, Sabal Forest Reserve, 18 Apr 1982, *Chai & Yii S 44452* (E); Sg. Bloh, Ulu Katibas, 18 Nov 1997, *Mohizah et al. ITTO/BC0034* (E).

PHILIPPINES: Mindanao. **Sulu:** Jolo, Sep 1924, *Ramos & Edaño 44454* (K, US*).

Notes. After examination of specimens of the collection *M. Ramos & G.E. Edaña 44454* from the province of Sulu, Mindanao, we support the report of Pelsner et al. (2011 onwards) of the occurrence of *Hornstedtia havilandii* in the Philippines but with some caveats. The width of the inflorescence of *M. Ramos & G.E. Edaña 44454* is significantly wider (4.5–6 cm vs 2–3 cm wide) than specimens from Borneo (e.g., the lectotype: *O. Beccari 1148*; *A.L. Lamb ALEO 314/91*). Unfortunately, we were unable to examine the flowers on *M. Ramos & G.E. Edaña 44454* since the remaining material in the set is in no condition for dissection. New material from the province of Sulu or from neighbouring localities (e.g., Tawi-Tawi islands) is needed in order to determine if *Hornstedtia havilandii* in the Philippines should instead be recognised as a distinct taxon.

Hornstedtia microcheila Ridl., *Leafl. Philipp. Bot.* 2: 606 (1909). – *Amomum microcheilum* (Ridl.) Merr., *Enum. Philipp. Fl. Pl.* 1: 239 (1923). – TYPE: Philippines, Visayas, Negros Island, Negros Oriental, Dumaguete, Cuernos de Negros Mountains, June 1908, *A.D.E. Elmer 10279* (lectotype K [K000255170], first step designated by Turner (2000), second step designated by Naive (2018); isolectotypes BISH [BISH1005395*], BM [BM000617561], E [E00279173], FI [F1016057*], G [G00008037*], HBG [HBG520836 n.v.], K [K000255171, K000255172], NY [NY00320255*], Z [000069389*]).

Specimens examined. PHILIPPINES: Mindanao. **Davao Oriental:** San Isidrio, Barangay La Union, Sitio Tumulite, Mount Hamiguitan, 3 Jul 2016, *Docot et al. 0086* (USTH including spirit). **Surigao del Norte:** Bacuag, Barangay Payapag, Sittio Little Baguio, 12 Jul 2019, *Domingo et al. SDN19–017* (CAHUP, FEUH including spirit, L, PNH, USTH).

Notes. Naive (2018) designated K000255170 as the lectotype and referred to the two remaining sheets at the same herbarium (i.e., K000255171, K000255172) as isolectotypes. Turner (2000), however, had already referred to material at K as the ‘holotype’ which is an effective lectotypification, albeit without distinguishing a lectotype from among the three sheets at K. This was overlooked by Naive (2018) and, therefore, the designation in the latter paper should be regarded as a second step designation. An additional nine isolectotypes have been found since Newman et al. (2004).

Key to *Hornstedtia* species in the Philippines

- | | |
|--|----------------------|
| 1a. Peduncle > 20 cm long | <i>H. havilandii</i> |
| 1b. Peduncle < 20 cm long | 2 |
| 2a. Lamina 1.5–16.5 cm wide; labellum petaloid | 3 |
| 2b. Lamina 8–25 cm wide; labellum fleshy | 6 |

- 3a. Margin of the labellum crisped; anther crest present *H. crispat*
 3b. Margin of the labellum non-crisped; anther crest absent 4
- 4a. Lamina linear; sterile bract olive-green; lateral staminodes present *H. olivacea*
 4b. Lamina narrowly elliptic or ovate; sterile bract red; lateral staminodes absent ... 5
- 5a. Sterile bract 3–5 cm wide; corolla lobes white; base of the labellum yellow
 *H. microcheila*
 5b. Sterile bract 1.5–2 cm wide; corolla lobes red; base of the labellum red
 *H. garbosa*
- 6a. Inflorescence narrowly ovoid; labellum involute *H. conoidea*
 6b. Inflorescence ovoid; labellum flat 7
- 7a. Ligule sericeous, the hairs white; labellum light pink *H. lophophora*
 7b. Ligule lanate, the hairs brown; labellum dark pink *H. annadeguzmaniae*

ACKNOWLEDGEMENTS. We thank the curators and staff of the following herbaria for access to their collections: BM, E, FEUH, K, PNH, SING, US and USTH; the Department of Environment and Natural Resources (DENR) Region IV-A together with the Protected Area Management Board (PAMB) of PP 1636 for the collection permit; the Local Government Unit (LGU) of Barangay Pesa, General Nakar, C.J. Luna, J.C. Manulat, T. Pentecostes and the Solleza family for their assistance during fieldwork; PUPH – Institute of Science and Technology Research for support; and the University Research Center (URC) of the Far Eastern University for the laboratory facilities.

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