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Aspidistra cylindrica (Asparagaceae), a New Species from Southern Vietnam

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Abstract*—*Aspidistra cylindrica, a new species from southern Vietnam (Kon Tum province), is described and illustrated. The new species possesses a unique combination of cylindrical shape of pistil and shoot system with foliage leaves crowded in groups and not divided into petiole and lamina. ***Aspidistra cylindrica*** resembles *A. muricata* but differs in longer leaves, shorter and wider perigone, shorter pistil, shape and colour of perigone lobes, anther position, and stigma shape. The conservation status of ***A. cylindrica*** is assessed. A key for species of *Aspidistra* in southern Vietnam is provided.

Keywords—biodiversity, conservation, Kon Tum province, key, monocots, tropical forest.

Knowledge about the genus *Aspidistra* Ker Gawl. has increased rapidly during the past several decades. Most of the currently known species of this genus were described after 1980 (e.g. Lang 1981; Chen and Fang 1982; Li and Tang 2002; Tillich 2005, 2006). Taking into account permanent discovery of new species, diversity of this genus should currently be considered as far from completely investigated (Leong-Škorničková et al. 2014; Vislobokov et al. 2014 b, c; Colin 2015; Lin et al. 2015b; Vislobokov 2015; etc.). *Aspidistra* is a genus of herbaceous plants that is currently placed within the family Asparagaceae (Chase et al. 2009). The genus comprises more than 130 species which inhabit southeast Asia (Vislobokov et al. 2013; Averyanov and Tillich 2014), including at least 50 species in Vietnam (Gagnepain 1934; Bogner and Arnautov 2004; Bräuchler and Ngoc 2005; Averyanov and Tillich 2012, 2013; Tillich 2014; Vislobokov et al. 2014b, 2014c; Vislobokov 2015). Most of the Vietnamese species of this genus were discovered in northern Vietnam, while in southern Vietnam only 14 species are currently known (Tillich 2014).

The genus *Aspidistra* shows extremely high diversity of flower structure and especially of flower merism. While number of tepals and stamens is typically six for most monocots (Remizowa et al. 2010), it varies from two-three (*A. paucitepala* N. Vislobokov, Nuraliev & D. D. Sokoloff, see Vislobokov et al. 2014c) to 12 or occasionally more (*A. longiloba* G. Z. Li, *A. dodecandra* (Gagnep.) Tillich, *A. grandiflora* Tillich, *A. chunxiuensis* C. R. Lin & Yan Liu, see Li 1988; Tillich 2005; Tillich et al. 2007; Lin et al. 2015a) within the genus *Aspidistra*. A number of original hypotheses were suggested regarding the pollination system of *Aspidistra* (Wilson 1889; Vogel 1978; Kato 1995; Conran and Bradbury 2007); however, pollination by dipteran insects (myiophily) is most probably typical for at least some species of this genus (Vislobokov et al. 2013, 2014a).

In the present paper we provide description of a new species of *Aspidistra* from southern Vietnam and a morphological key for all species and varieties of *Aspidistra* currently known in this area.

Materials and Methods

Materials are represented by a large individual collected in Kon Tum province (Kon Plong district) during the expedition of the Joint Russian-Vietnamese Tropical Scientific and Technological Center in spring 2015 (holotype) and by an individual collected in Vietnam and cultivated in Komarov Botanical Institute of the RAS (paratype). It included herbarium specimens, liquid collections, and living shoots. Three inflorescences from the holotype specimen were observed and collected, one in the field and two under cultivated conditions. Five inflorescences from the paratype specimen were observed additionally. Morphological studies were performed using a ruler, a caliper, and a stereoscopic microscope MBS-10. In addition, observations and collections of a number of non-flowering individuals, which cannot be reliably identified to species level, were made. In present work we understand the area "southern Vietnam" as part of Vietnam south of Thua Thien Hue province.

Taxonomic Treatment

Aspidistra cylindrica sp. nov. N. Vislobokov & Nuraliev.—HOLOTYPE: VIETNAM. Kon Tum province: Kon Plong district, Mang Canh municipality, Thach Nham protected forest, 14 km NNE from Mang Den town, in the forest, epilithic, 14°43′55″ N, 108°17′58″ E, elev. 1,150 m, 14 Apr 2015, *A. N. Kuznetsov, S. P. Kuznetsova, M. S. Nuraliev 1357* (MW).

Plant herbaceous, perennial, rhizomatous, evergreen (Fig. 1A). Rhizome creeping, with short internodes, epigeous, ascending to vertical with prop roots, 8–9.1 mm in diam. Roots grey or greenish, 2–3.3 mm in diam, with dense hairs persistent up to root base. Rhizomes with regularly repeating units, each comprising distichously arranged phyllomes: 4–8 cataphylls followed by 2–5 foliage leaves (Fig. 1F, G). Cataphylls oblong, 5.5–9.2 × 1.1–1.5 cm. Foliage leaves not divided into petiole and lamina, gradually narrowing towards base. Leaf base dark to light green, adaxially sulcate, 3.7–4.5 mm wide. Leaf blade dark to light green, linear, distally narrowly acuminate, 57–85 × 1–1.4 cm, with one secondary vein at each side of midvein (Fig. 1B). Margin finely serrate. Midvein prominent abaxially (Fig. 1C). Peduncle (specialized reproductive shoot) pale green with purple spots, 0.9–2.3 cm long, 1.9–3.1 mm in diam, curved at top so that perigone mouth directed downwards, with 3–5 distichously arranged widely ovate scale leaves 7.1–9.5 × 5–7.8 mm. Flower solitary at top of peduncle (Fig. 2A, B). Perigone campanulate, 8.1–11.9 mm long, 7.4–11.6 mm in diam; tube greenish-white at both sides, 4.2–6.2 mm long, 6.2–7.8 mm in diam; lobes 6 (very rarely 5) (Fig. 1D, E), purple-spotted to completely purple adaxially, greenish-white with purple spots along margin abaxially, triangular-ovate, slightly acuminate, 4.1–6.4 × 3.7–4.7 mm, lobes basally with

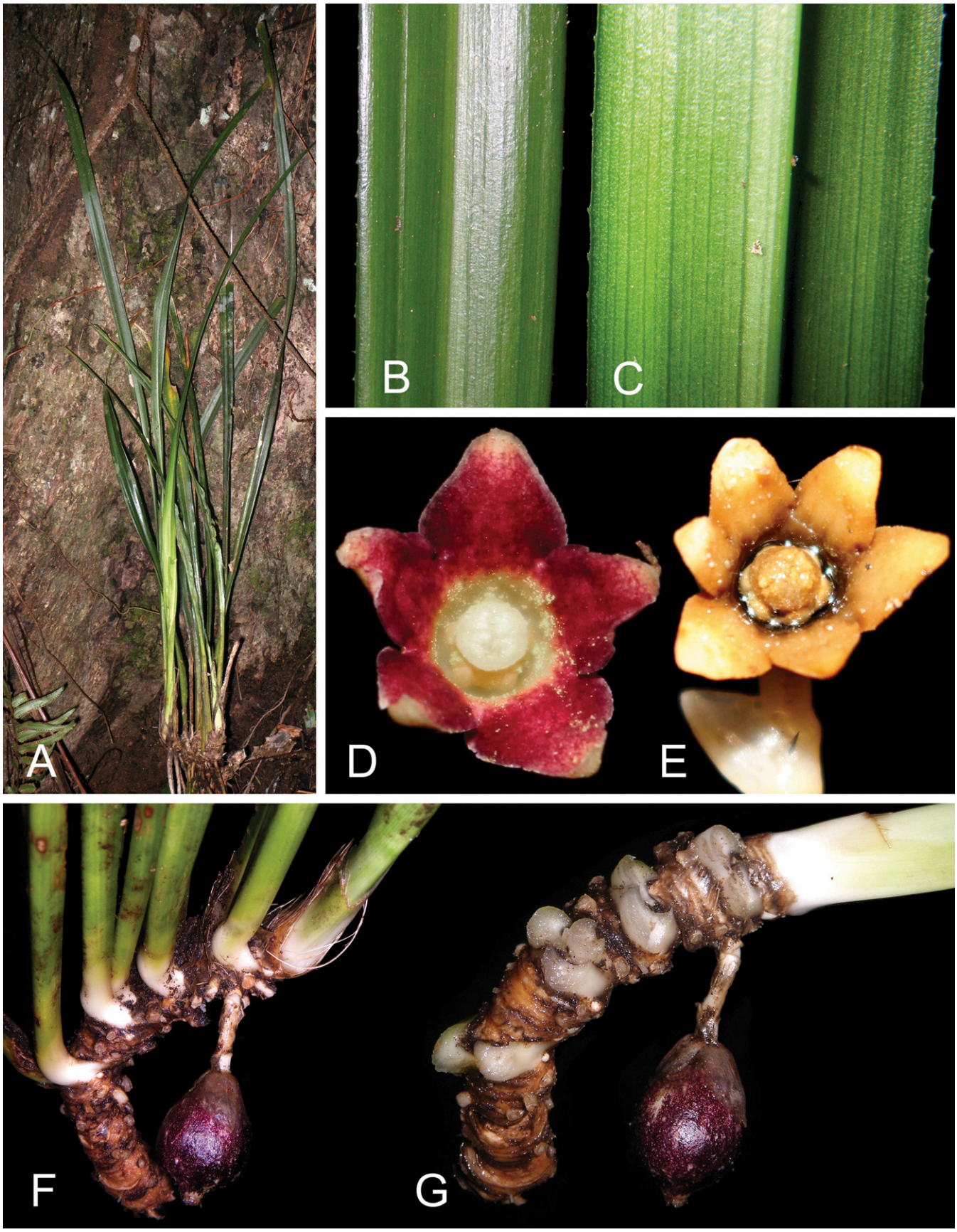

FIG. 1. *Aspidistra cylindrica.* A. Plant habit (excavated and leaned against tree trunk). B. Leaf adaxial surface. C. Leaf abaxial surface. D. Flower with five tepals and stamens. E. Flower with six tepals and stamens (stored in alcohol). F. Rhizome with fruit. G. The same rhizome as in F with leaves cut off, showing groups of leaves. All photos from the holotype specimen; A–C, F, G by M. Nuraliev in field; D, E by N.Vislobokov from the cultivated plant.

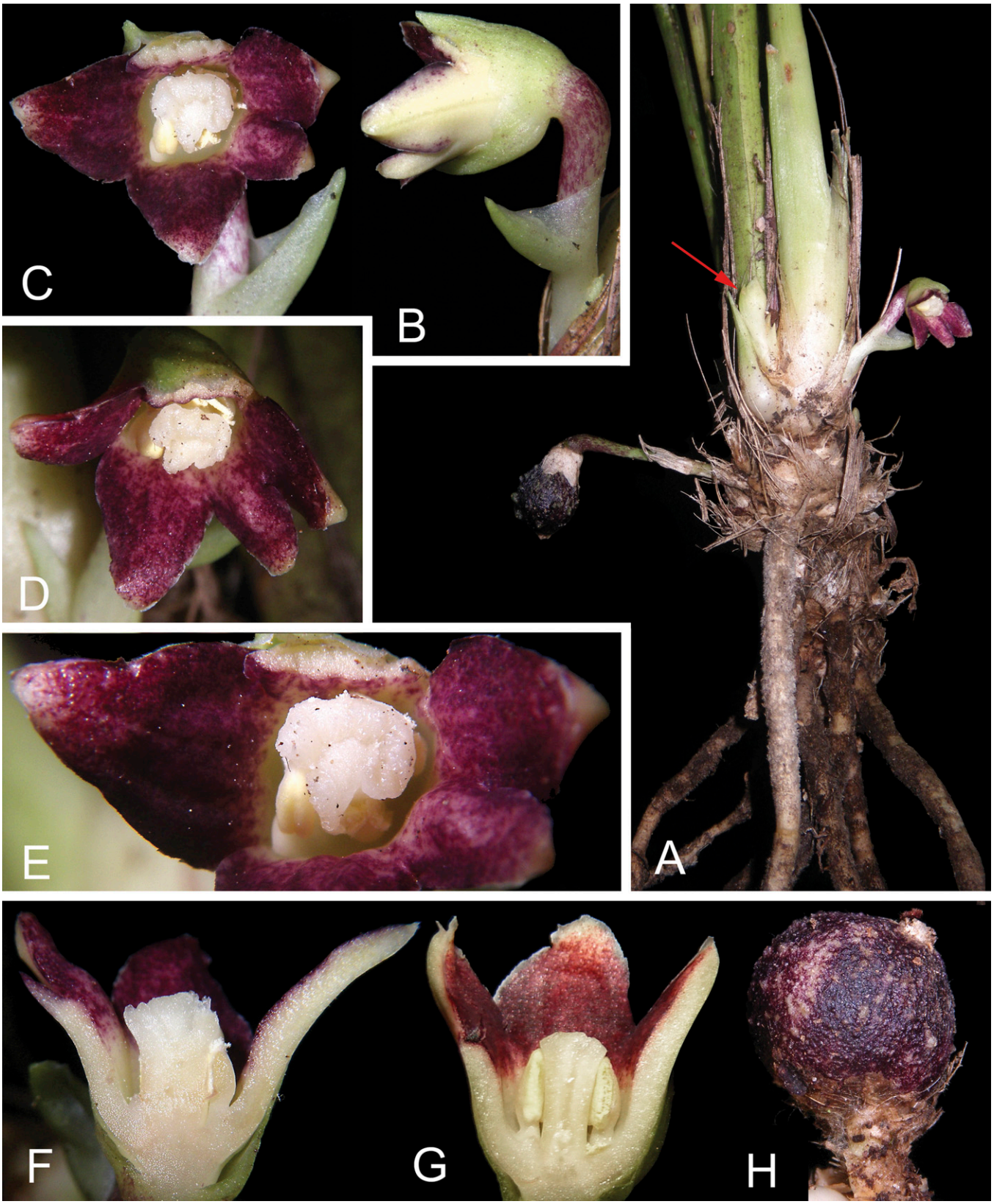

Fig. 2. *Aspidistra cylindrica.* A. Rhizome with three reproductive shoots: fruiting, flowering and under-developed (arrow). B. Reproductive shoot with flower. C, D. Flower, front view (one perigone lobe removed). E. Details of stigma. F, G. Longitudinal section of flower. H. Fruit. All photos from the holotype specimen; G by N. Vislobokov from the cultivated plant, others by M. Nuraliev in field.

2 slightly prominent longitudinal keels (Fig. 2C–E). Stamens 6 (very rarely 5), in the same number as perigone lobes, inserted at base of perigone tube, at radii of tepals; anthers subsessile, 0.8–1.1 × 1.9–2.7 mm, introrse, closely appressed to style. Pistil greenish-white, cylindrical, 1.9–2.5 mm high (Fig. 2F, G). Style 4.4–5 mm long, 1.7–2.5 mm in diam. Stigma slightly widened, subglobose, shallowly 3-lobed, rugose with 3 bifurcated radial grooves at upper surface, up to 3 mm in diam (Fig. 2E). Ovary inconspicuous, superior, 3-locular. Fruit spotted to completely dark-violet, subspherical, 14.5–26 mm high, 9.5–18 mm in diam, with short protuberances (Fig. 2A, H). Lower third of fruit narrowed and elongated forming carpophore 4–7 mm long. Figures 1, 2.

Additional Specimens Studied—PARATYPE: VIETNAM. 28 Aug 2015, *L. V. Averyanov AL 84* (LE). The herbarium specimen was prepared from a plant cultivated in Komarov Botanical Institute of the RAS (garden number 1285). The plant was collected in southern Vietnam before 2000 by unknown collector without indication of exact location.

Etymology—The specific epithet *cylindrica* refers to cylindrical shape of pistil which clearly distinguishes the new species from all its congeners, characterized by shoot system with leaves crowded in groups and not divided into petiole and lamina.

Distribution and Ecology—Currently only known from Kon Tum province in southern Vietnam, where a single (holotype) specimen was verified to represent the new species. Non-flowering individuals of the genus *Aspidistra* closely resembling *A. cylindrica* in vegetative features were rather frequent in several areas of Thach Nham protected forest, including a fruiting specimen *A. N. Kuznetsov, S. P. Kuznetsova, M. S. Nuraliev 1369*. For this reason, we believe that *A. cylindrica* can be treated as locally common.

Aspidistra cylindrica occurs on mountain slopes with large granite outcrops under the canopy of dense tropical mountain polydominant forest of middle elevation which can be subdivided into three storeys. The upper storey (24–26 m high) includes *Balakata baccata* (Roxb.) Esser (Euphorbiaceae), *Bischofia javanica* Blume (Euphorbiaceae), *Sloanea* sp. (Elaeocarpaceae), *Betula alnoides* Buch.-Ham. (Betulaceae), *Castanopsis* sp. (Fagaceae) and also comprises hemiepiphytic *Ficus* spp. (Moraceae).

Phenology—*Aspidistra cylindrica* was observed blooming and fruiting in mid-April in natural habitat. The flowering individual also possessed several under-developed reproductive shoots (Fig. 2A), which suggests elongated flowering period for this species.

Taxonomic Relationships—*Aspidistra cylindrica* possesses a unique combination of features, i.e. cylindrical shape of pistil and shoot system with leaves crowded in groups and not divided into petiole and lamina. Cylindrical shape of the pistil itself is a rather widespread characteristic within the genus *Aspidistra*, but it was previously known only in the species with solitary leaves distinctly divided into petiole and lamina (e.g. *A. brachystyla* Aver. & Tillich, *A. dolichanthera* X. X. Chen, *A. longipedunculata* D. Fang, *A. paucitepala*, etc.). The morphological nature of leaf crowding, described here in *A. cylindrica* and reported for several other species of this genus, consists in development of more than one foliage leaf within each partial shoot (for details of *Aspidistra* shoot system see Vislobokov et al. 2014b).

The new species mostly resembles *A. muricata* F. C. How but differs in longer leaves (66.5–85 cm vs. 35–60 cm), perigone shape (shorter and wider), shape of perigone lobes (triangular-ovate vs. narrowly oblong), colour of perigone lobes (purple adaxially, white abaxially vs. completely green), anther position (at the basal vs. middle part of the perigone tube), shorter cylindrical (vs. claviform) pistil (1.9–2.5 mm vs. 6 mm), stigma shape (3-lobed vs. 6-lobed) and diameter (3 mm vs. 4 mm).

Among the species of *Aspidistra* with solitary foliage leaves divided into petiole and lamina, *A. retusa* K. Y. Lang & S. Z. Huang partly resembles *A. cylindrica* in floral characteristics.

The morphological differences between *A. cylindrica* and its most similar species, *A. muricata* and *A. retusa*, are summarized in Table 1.

Conservation Status—Despite presence of only one blooming specimen from the type locality, we can confidently state that *A. cylindrica* can be treated as locally common (see 'Distribution and ecology'). However, extent of occurrence and occupancy of the new species are not larger than 300 km^2, which allows to assign the red list category as vulnerable VU B1a+2a (IUCN 2001).

Morphological Key to the Species and Varieties of *Aspidistra* from Southern Vietnam

1. Leaves crowded at rhizome in groups by 2–5 . . . 2
   2. Perigone campanulate. Pistil cylindrical, 1.9–2.5 mm high . . . *A. cylindrica*
   2. Perigone urceolate or tubular. Pistil mushroom-shaped or table-shaped, 3–7 mm high . . . 3
      3. Stigma conoid, 7 mm in diam, with irregular curly radial crests . . . *A. carnosa* Tillich
      3. Stigma peltate, orbicular, 1.5–2.5 mm in diam, 3-lobed . . . *A. minutiflora* Stapf
1. Leaves solitary . . . 4
   4. Tepals completely fused into tube, leaving an opening of only 1–1.5 mm in diam . . . *A. locii* Arnautov & Bogner
   4. Perigone with obvious lobes . . . 5
      5. Perigone lobes (2)3–4 . . . *A. paucitepala*
      5. Perigone lobes usually more than 4 (except individual flowers) . . . 6
         6. Perigone lobes usually 8 (rarely 9–10) . . . 7
            7. Stigma shortly obpyramidal, 8–10 mm in diam, adaxial surface dirty purple-violet, irregularly folded forming prominent radial ridges and deep grooves . . . *A. elatior* Blume var. *vietnamensis* Aver. & Tillich
            7. Stigma dome-shaped, 12–17 mm in diam, adaxial surface marmorate with dark and pale purple, smooth . . . 8
               8. Perigone lobes connate at their tips and forming cage around pistil. Bowl-shaped base of perigone 1 cm in diam (2–3 cm if lobes open) . . . *A. connata* Tillich var. *connata*
               8. Perigone lobes free, open upon maturity. Bowl-shaped base of perigone 1.8–2 cm in diam (3.5–5 cm if lobes open) . . . *A. connata* Tillich var. *radiata* Tillich & Škorničk.
         6. Perigone lobes usually 6 (rarely 4–8) . . . 9
            9. Stamens twice as many as perigone lobes . . . *A. dodecandra* (Gagnep.) Tillich
            9. Stamens in the same number as perigone lobes . . . 10

Table 1. Main morphological differences between *Aspidistra cylindrica*, *A. muricata*, and *A. retusa*. The data for *A. muricata* and *A. retusa* was taken from Lang (1981), Liang and Tamura (2000), and Li (2004).

	A. cylindrica	*A. muricata*	*A. retusa*
Shape of perianth lobes	Triangular-ovate	Narrowly oblong	Triangular-ovate
Colour of perianth lobes	Purple + white	Green	Pink-purple
Anthers position	At base of perigone tube	At middle of perigone tube	At upper third of perigone tube
Shape of pistil	Cylindrical	Claviform	Cylindrical
Stigma	Shallowly 3-lobed, 3 mm in diam	6-lobed, 4 mm in diam	3-lobed, 1.5 mm in diam
Leaves	Crowded by 2–5	Crowded by 2–3	Solitary

10. Perigone campanulate or somewhat tubular 11
    11. Perigone 10–14 mm in diam. Leaf lamina narrowly elliptic to linear, 1.2–2 cm wide . . . . . *A. renatae* Bräuchler
    11. Perigone 25–35 mm in diam. Leaf lamina lanceolate to elliptic, 3–10 cm wide 12
        12. Flower upright. Perigone lobes stiff, upright, 35–40 mm long. Tepals free nearly to base, each adaxially with one very prominent median keel at proximal half . . . . . *A. stricta* Tillich
        12. Flower nutant. Perigone lobes flat, straight or slightly reflexed, 6–8(10) mm long. Tepals free for about half, without keels . . . . . *A. truongii* Aver. & Tillich
10. Perigone clearly urceolate 13
    13. Perigone lobes white or green adaxially. Perigone 13–16 mm in diam 14
        14. Stigma completely dark purple, with velvety appearance, lower half obconical, with 6 prominent longitudinal ridges, upper half truncated cone-shaped with numerous longitudinal grooves. Perigone lobes triangular, yellow-green, with 4 keels . . . . . *A. mirostigma* Tillich & Škorničk.
        14. Stigma white or violet mottled, circular, disc-shaped, 3-lobed, each lobe distally bifurcate. Perigone lobes ligulate, white, with 2 keels . . . . . *A. phanluongii* N. Vislobokov
    13. Perigone completely purple (sometimes red mottled), 17–20 mm in diam 15
        15. Perigone mouth 6 mm in diam. Stigma 15 mm in diam, adaxial surface cream-coloured with purple tinge, rough with projections; abaxial surface smooth, purple tinged with cream-coloured 12-rayed star in centre . . . . . *A. ventricosa* Tillich & Škorničk.
        15. Perigone mouth 13 mm in diam. Stigma 10 mm in diam, uniformly smooth and white 16
            16. Perigone dull-green, red mottled abaxially, with smooth surfaces . . . . . *A. opaca* Tillich var. *opaca*
            16. Perigone completely deep purple, with rugose surfaces . . . . . *A. opaca* Tillich var. *rugosa* Tillich

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