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A TAXONOMIC REVISION OF *GLOBBA* SECT. *NUDAE* SUBSECT. *MEDIOCALCARATAE* (ZINGIBERACEAE)

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Globba sect. *Nudae* subsect. *Mediocalcaratae* (K.Schum.) K.J.Williams is revised. Nineteen species are recognised. Eight names are lectotypified, three names are newly placed in synonymy, and two names are neotypified. A key to the species and descriptions are provided. Nine new species are described and illustrated: *Globba argyrocycnos* Sangvir. & M.F.Newman, *G. cataractarum* Sangvir. & M.F.Newman, *G. chrysochila* Sangvir. & M.F.Newman, *G. decora* Sangvir. & M.F.Newman, *G. lilacina* Sangvir. & M.F.Newman, *G. newmanii* Sangvir., *G. nitens* Sangvir. & M.F.Newman, *G. pycnostachys* Sangvir. & M.F.Newman and *G. pyrrhopoikila* Sangvir. & M.F.Newman. Six names based on five types from Thailand and the Philippines remain doubtful. Andromonoecy in this subsection is defined. Provisional IUCN conservation assessments of all species are supplied.

Keywords. Andromonoecy, anther appendage, infrageneric classification, Schumann, Southeast Asia.

Introduction

Globba L. is one of the three genera of the tribe Globbeae, subfamily Zingiberoideae, Zingiberaceae (Kress *et al*., 2002; Williams *et al*., 2004). It comprises c.100 species distributed in Sri Lanka, India, and throughout Southeast Asia to Australia. Classifications of *Globba* by Horaninow (1862), Schumann (1904) and Larsen (1972) used the number of anther appendages (none, two or four) as the main character to delimit the infrageneric taxa.

Globba sect. *Nudae* K.Larsen was described in 1972 by Larsen, with *G. nuda* K.Larsen the sole species and, by definition, the type species. The section was diagnosed by its affinity to *Globba* sect. *Globba*, with which it shares a four-appendaged anther and from which it differs by its rudimentary and scale-like or entirely absent bracts, and leafless inflorescence shoots. In addition, the chromosome number of the only species is n = 17.

The most recent classification of *Globba* incorporates information from morphology and molecular systematics and recognises seven sections in three subgenera (Williams *et al*., 2004). The crucial changes made by Williams *et al*. that are relevant to this paper concern the three groups of species with two-appendaged anthers. These are found in three clades on the phylogenetic trees of Williams *et al*. (2004).

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1. A clade sister to the remainder of *Globba*, containing *G. geoffrayi* Gagnep., *G. leucantha* Miq. and *G. pendula* Roxb. This clade was retained by Williams *et al.* (2004) as *Globba* sect. *Ceratanthera* (Horan.) Petersen.
2. A clade including *Globba gracilis* K.Schum., *G. paniculata* Valeton and *G. xantholeuca* Craib, which is sister to *Globba* sect. *Nudae* subsect. *Nudae*. This clade was newly recognised as *Globba* sect. *Nudae* subsect. *Mediocalcaratae* (K.Schum.) K.J.Williams by Williams *et al.* (2004).
3. A clade of species that had been classified in a separate genus, *Mantisia*, but were transferred to *Globba* as *Globba* sect. *Mantisia* (Sims) K.J.Williams.

It should be noted that, as a result of the work of Williams *et al.* (2004), the number of appendages cannot always be used to place species into a section, because *Globba* sect. *Nudae* now comprises a subsection of seven four-appendaged species (subsect. *Nudae*) (Sangvirotjanapat *et al.*, 2019) and another of two-appendaged species (subsect. *Mediocalcaratae*) (Table).

Although Williams *et al.* (2004) discussed circumscription of the sections in terms of morphological characters and biogeography, they could not clearly circumscribe *Globba* sect. *Nudae*, because morphological support was scarce. Ellipsoid fruit with deep, longitudinal ridges was the only character noted as a synapomorphy of the two subsections, *Nudae* and *Mediocalcaratae*.

Sangvirotjanapat *et al.* (2019) revised the taxonomy of *Globba* sect. *Nudae* subsect. *Nudae* using morphological evidence and demonstrated that andromonoecy is the main synapomorphic character of the section. All species of both subsections possess dimorphic flowers, hermaphrodite and functionally male flowers, on the same inflorescence. This supports the phylogenetic result of Williams *et al.* (2004), which shows grouping of four- and two-appendaged species. Moreover, the differences in anther appendage shape between hermaphrodite and functionally male flowers exhibited by subsect. *Nudae* (Sangvirotjanapat *et al.*, 2019) had been noticed in subsect. *Mediocalcaratae* as well.

In this paper, we revise *Globba* sect. *Nudae* subsect. *Mediocalcaratae* (K.Schum.) K.J.Williams, mainly using morphological evidence. As in subsect. *Nudae*, typification is an important part of this revision. Names published in the early twentieth century often need to be lectotypified or neotypified. Specifically, neotypification is necessary for the Philippine species, because both the Philippines National Herbarium and parts of the Berlin Herbarium were destroyed in the Second World War, with the loss of many type specimens. The types of *Globba brevifolia* K.Schum. (*Warburg* 14066), *G. gracilis* (*Warburg* 15480) and *G. parvifolia* var. *brevifolia* K.Schum. (*Warburg* 14060) are not found at B and are assumed to have been lost in the fire of 1943 (Robert Vogt, B, personal communication). In the revision of subsect. *Mediocalcaratae* that follows, 19 species are recognised and their diagnostic characters are discussed. Firm conclusions concerning the taxonomic status of six names cannot be reached because of poor type specimens and uninformative descriptions, so they are noted as doubtful names. Field surveys at the type localities will be necessary before the status of these names can be clarified.

TABLE. Comparison of classifications using morphological characters only (Schumann, 1904; Larsen, 1972), and molecular and morphological characters combined (Williams *et al.*, 2004)

Schumann (1904) and Larsen (1972)		Williams *et al.* (2004)		
Section	No. of anther appendages	Subgenus	Section	No. of anther appendages
Globba sect. *Haplanthera* (Horan.) Petersen	0	*Globba* subg. *Mantisia* (Sims) K.J.Williams	*Globba* sect. *Haplanthera*	0
			Globba sect. *Substrigosa* K.J.Williams	0
			Globba sect. *Mantisia* K.J.Williams	2
Globba sect. *Ceratanthera* (Horan.) Petersen		*Globba* subg. *Ceratanthera* (Horan.) K.J.Williams	*Globba* sect. *Ceratanthera*	2
Series *Basicalcaratae* K.Schum.	2			
Series *Mediocalcaratae* K.Schum.	2			
Series *Apicicalcaratae* K.Schum.	2			
Globba sect. *Globba*	4	*Globba* subg. *Globba*	*Globba* sect. *Globba*	4
Globba sect. *Nudae* K.Larsen	4		*Globba* sect. *Nudae* subsect. *Nudae*	4
			subsect. *Mediocalcaratae* (K.Schum.) K.J.Williams	2
			Globba sect. *Sempervirens*	4

MATERIALS AND METHODS

The names of *Globba* sect. *Ceratanthera* (Horan.) Petersen, mainly recorded in Baker (1890), Schumann (1904), Ridley (1909) and Holttum (1950), were intensively examined and their general morphology was used to extract the members of subsect. *Mediocalcaratae*, following the classifications of Williams *et al.* (2004) and Sangvirotjanapat *et al.* (2019). The protologues and types of 22 names were then studied. Herbarium, spirit specimens and photographs at A, AAU, B, BK, BKF, BM, BO, C, CMU, E, FI, GH, HBG, K, L, MICH, MO, P, PR, PSU, QBG, S, SING and US were also studied, about 400 sheets in total. Photographs of Philippine *Globba* spp. on *Co's Digital Flora of the Philippines* website (Pelser *et al.*, 2011–) were examined and their characteristics and collection localities were compared with information in the literature.

Field surveys were carried out widely in Southeast Asia. Flowers were dissected in the field and from plants cultivated at Queen Sirikit Botanic Garden (QSBG) and the Royal Botanic Garden Edinburgh (RBGE). Assessments of conservation status were carried out following IUCN guidelines (IUCN Standards and Petitions Subcommittee, 2017). Specimen data were stored in Padme (Miller *et al.*, 2015), and for each species, an Excel file was generated listing the following fields for each specimen: species name, collector, collection number, collection date, herbarium code, locality, latitude, longitude and altitude. These data were imported into QGIS version 2.18.20 (QGIS Development Team, 2018) and used to produce distribution maps. Larger symbols on the maps indicate type specimens.

Morphology

The main distinguishing characteristics of subsect. *Mediocalcaratae* are the lax conical inflorescence and flowers with two triangular, falcate, linear anther appendages in both hermaphrodite and functionally male flowers (Fig. 1A,B). The indumentum on the lateral staminodes and the cup-shaped stigma differentiate this subsection from sect. *Ceratanthera*, whose members also have two triangular anther appendages but often with glabrous lateral staminodes and a clavate stigma, which often protrudes from the connective tissue (Fig. 1C). Subsection *Mediocalcaratae* differs from sect. *Mantisia*, whose members also have two anther appendages, by the fact that they are triangular, falcate or linear. In sect. *Mantisia*, the anther appendages are subulate or spathulate (Fig. 1D).

Vegetative morphology

All species are lithophytic or terrestrial herbs varying from 30 to 150 cm in height. The fresh rhizome is composed of usually five to eight consecutive units, which are globose, three to five subtending the current year's growth and the others without stems. Each unit has storage roots, which are narrowly fusiform as in *Boesenbergia* Kuntze. The important function of these roots is to store starch for the plant during dormancy, particularly for those species distributed in monsoon areas. As in all Zingiberoideae, the plane of distichy of the leaf blades is parallel to the direction of growth of the rhizome. The leaf blades are elliptic, oblong or ovate with acute or acuminate apices. They are often plain green, but some are variegated with grey-silvery patches on the upper surface (e.g. *Globba albiflora* Ridl., *G. decora* Sangvir. & M.F.Newman and *G. lilacina* Sangvir. & M.F.Newman) and grey or purple-tinged below. The indumentum is sparsely strigillose on the midrib and veins above (rarely absent, as in *Globba newmanii* Sangvir.), puberulent below.

Inflorescences

The inflorescence is terminally produced (sometimes on a separate, leafless shoot in *Globba ranongensis* Picheans. & Tiyaw.), erect, conical and lax. The cincinni are numerous, spirally arranged on the rachis; the basal one is the longest, then they become gradually shorter towards the top. The bracts and bracteoles are caducous and similar in shape but the bracts are bigger, particularly the lower ones, either green or white, with

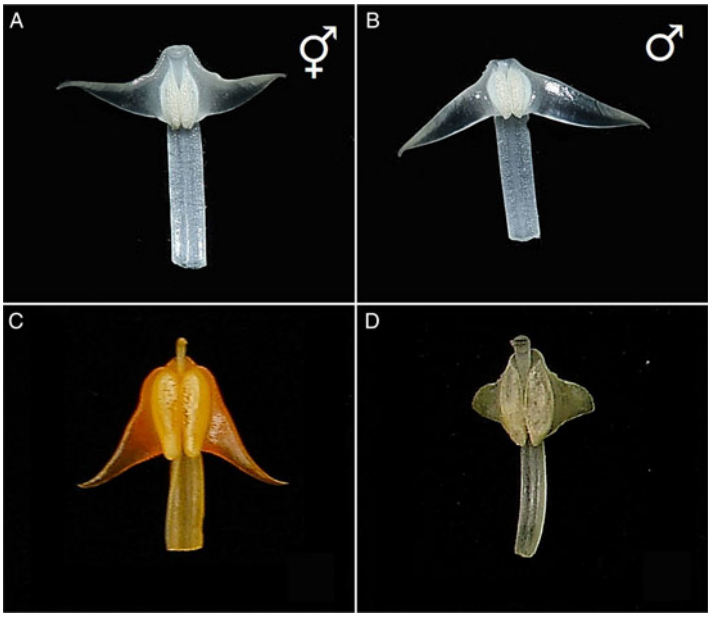


FIG. 1. Anthers of *Globba* spp. with two appendages. A and B, *Globba* sect. *Nudae* subsect. *Mediocalcaratae* (*G. xantholeuca* Craib, *Sangvirotjanapat* 734): A, ♀ appendages; B, ♂ appendages. C, *Globba* sect. *Ceratanthera* (*G. fasciata* Ridl., RBGE accession no. 19860743). D, *Globba* sect. *Mantisia* (*G. spathulata* (Roxb.) K.J.Williams, RBGE accession no. 19982548). Photographs: A and B, Sunisa Sangvirotjanapat; C and D, Jana Leong-Škorničková.

ciliate or glabrous margins. The inflorescence structure of subsect. *Mediocalcaratae* is very similar to that of subsect. *Nudae*, so if there is no flower information on a dried specimen, it may be impossible to determine to section and species level.

Flowers

This subsection produces hermaphrodite and functionally male flowers (the latter are termed 'male flowers' in this paper) (Fig. 2), as does subsect. *Nudae*, and the overall morphology of both subsections shows the same pattern (Sangvirotjanapat *et al.*, 2019). Hermaphrodite flowers are usually bigger and occur on lower cincinni. The ovary and anther appendages are good traits by which to separate each floral type. The flowers in this subsection can often be identified to a major group by the flower colour, which may be a single colour throughout or differ on each part of the flower, usually white, pale yellow, yellowish orange or orange. The floral tube is formed by fusion of the corolla tube and androecium into a capillary tube, which is very thin and translucent so that the level of nectar can be seen through it. In subsect. *Mediocalcaratae* the floral tube is curved, whereas in sect. *Globba* there is a sharp right angle near the base and the distal part of the tube is held upright. The corolla lobes are elliptic to obovate, hooded; the dorsal one slightly bigger, obtuse at apex to long mucronate.

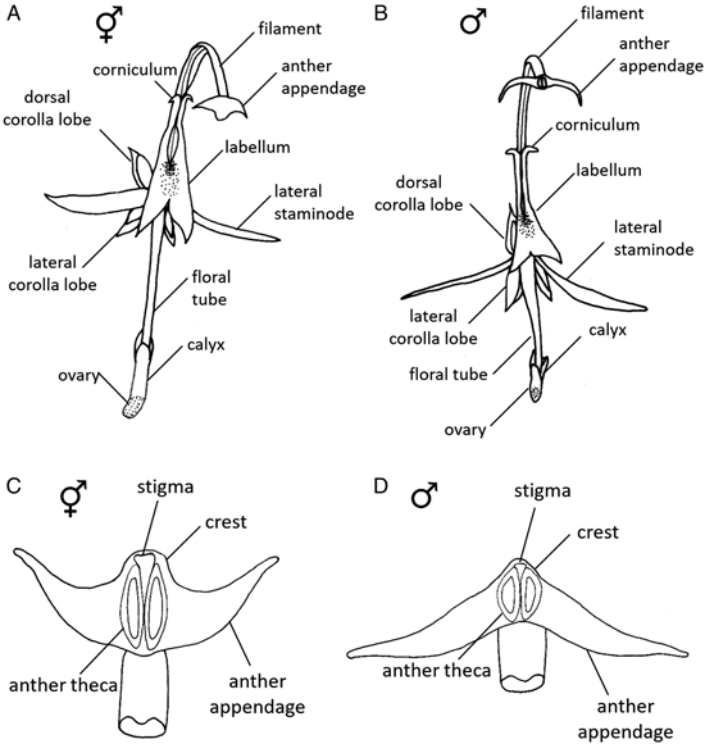


FIG. 2. Floral dimorphy in *Globba* subsect. *Mediocalcaratae*. A and C, Hermaphrodite flower. B and D, functionally male flower. Drawn from *Globba lilacina* Sangvir. & M.F.Newman (*Sangvirotjanapat* 755) by Sunisa Sangvirotjanapat.

Androecium

The lateral staminodes are placed at the sides of the flower, above the lateral corolla lobes. In this subsection, they can be linear, oblong or obovate (e.g. *Globba chrysochila* Sangvir. & M.F.Newman and *G. ranongensis*) with the apex obtuse, acute or acuminate. The ratio of the length of the lateral staminodes to the length of the corolla lobes often distinguishes related species. A dense indumentum on the upper surface is also a good character to differentiate subsect. *Mediocalcaratae* from sect. *Ceratanthera*.

The labellum is a part of the androecium that has become petaloid, situated between the lateral staminodes. The proximal part, or base of the labellum, is defined as the zone above the opening to the nectar tube (Fig. 3). Subsection *Mediocalcaratae* is the only group in the genus in which a variety of types of base occur. These types have been found to be taxonomically informative and are used in the key to species provided here to separate the species into major groups. The labellum base can be categorised into three types (see Fig. 3).

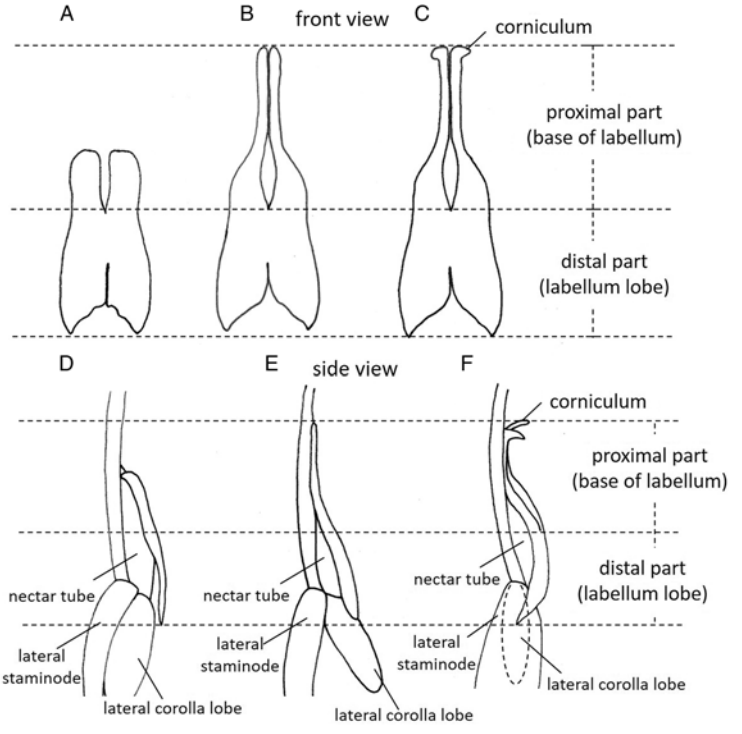


FIG. 3. Three types of labellum in *Globba* subsect. *Mediocalcaratae* (A–C, front views; D–F, side views). A and D, Base truncate. B and E, Base decurrent on filament. C and F, Base decurrent with cornicula. Drawn by Sunisa Sangvirotjanapat.

1. Truncate, obtuse (not decurrent on the filament) (Fig. 3A,D). This type is common in *Globba*. It forms a firm border (e.g. *Globba albiflora*, *G. cataractarum* Sangvir. & M.F.Newman, *G. paniculata* and *G. pycnostachys* Sangvir. & M.F.Newman).
2. Long decurrent on the filament without cornicula (Fig. 3B,E). The part above the opening of the nectar tube is decurrent as lines fused throughout their length with the filament; the tips have no cornicula. This character is usually found in the white-flowered species, namely *Globba chrysochila* and *G. xantholeuca*. There are orange-flowered species, *Globba argyrocycnos* Sangvir. & M.F.Newman and *G. decora*, that possess this labellum type, but it is rather hard to observe, as the labellum base of *G. decora* becomes membranaceous in texture and that of *G. argyrocycnos* is paler than the lobes so that its colour harmonises to the filament colour (see Fig. 5H,I).
3. Long decurrent on the filament with cornicula (Fig. 3C,F). This type resembles type 2 but the tips are free and protrude like small horns. It is found in *Globba campsophylla* K.Schum., *G. gracilis*, *G. lilacina*, *G. newmanii* and *G. thorelii* Gagnep. The cornicula of *Globba campsophylla*, *G. gracilis* and *G. macrocarpa* Gagnep. are small and may be difficult to observe.

The filament may be orange or white and is the same colour as the other parts in most species. It differs in colour from the corolla lobes or anther appendages in *Globba argyrocycnos*, *G. cataractarum* and *G. pycnostachys*. The anther appendage shape depends on the floral type, as in subsect. *Nudae*. The appendages of hermaphrodite flowers are somewhat bigger, particularly at the base, and also wider than those of male flowers (see Fig. 1A,B and Fig. 2C,D). They are triangular and slightly falcate with an acuminate apex, whereas those of male flowers are narrowly falcate and longer. The crest, which is usually found to support the stigma in hermaphrodite flowers, can be truncate or obtuse. In *Globba argyrocycnos* and *G. virginea* I.M.Turner, the anther appendages are not falcate but rather obviously triangular, and the crest is obtuse. The appendages can be orange, white or purple (e.g. *Globba lilacina*).

Gynoecium

The ovary is unilocular with parietal placentation. In hermaphrodite flowers, the ovary is elliptic, c.4 mm long, whereas male flowers have much-reduced ovaries and aborted ovules. The style is filiform and as long as the flower. The junction of the style and stigma is held between the anther thecae. The stigma is cup-shaped with a ciliate margin, and in the male flower it is drastically reduced and inactive. The stigmatic cup of the hermaphrodite flower is full of fluid, in which pollen germination has been observed under a fluorescence microscope.

Fruit

Two fruit shapes occur in subsect. *Mediocalcaratae*. The first is long ellipsoid with longitudinal ridges (e.g. *Globba decora*, *G. macrocarpa* and *G. xantholeuca*) and the other is ovoid or flask-shaped with a shallowly ridged or smooth surface (e.g. *G. albiflora*, *G. argyrocycnos* and *G. cataractarum*). Dehiscence runs the entire length of the fruit.

Seed

The seeds are small, about 2 mm in diameter, ovoid and light brown. The surface is covered by dense hair, and a white or pale brown aril with lacerate margins is produced close to the hilum. There are 20–80 seeds per fruit.

Bulbils

These are vegetative propagules, usually produced in the late rainy season. In this study, we recognise two types: corky and bamboo-like bulbils. The first type can be globose, ovate or fusiform, with a corky texture, and tan or grey. Most species with corky bulbils grow in rather dry areas (e.g. *Globba lilacina*, *G. thorelii* and *G. xantholeuca*). They vary in size from about 0.5 to 3 cm and are produced at the lower part of peduncle (Fig. 4A) or the tips of the cincinni (Fig. 4B), and sometimes protrude from the leaf sheaths. Bamboo-like

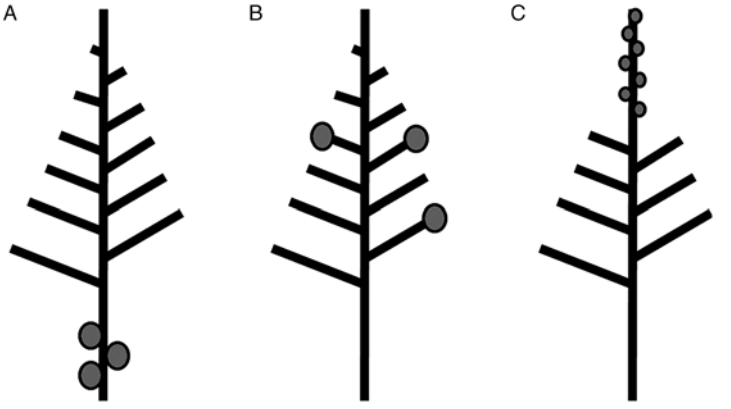


FIG. 4. Positions of bulbil production (bulbils indicated by grey circles). A, Lower part of peduncle. B, Tip of cincinni. C, Tip of inflorescence. Diagrams by Sunisa Sangvirotjanapat.

bulbils are embraced by small brown or green scales. They are rather large, to about 2 cm wide, and only a few are produced on each leafy shoot at the lower part of the peduncle or tips of the cincinni (Fig. 4A,B). A bamboo-like bulbil often grows while still attached to the mother plant, and the production of a single shoot (*Globba cataractarum*) or many shoots (*G. nitens* Sangvir. & M.F.Newman) can distinguish closely related species. The production of bulbils at the tip of the inflorescence (Fig. 4C), which is reduced abruptly to a linear structure on which are small corky bulbils subtended by bracteoles, commonly found in *Globba* sect. *Haplanthera*, occurs once in subsect. *Mediocalcaratae* (*G. campsophylla*).

TAXONOMIC REVISION

Globba subg. **Globba** sect. **Nudae** subsect. **Mediocalcaratae** (K.Schum.) K.J.Williams, Amer. J. Bot. 91(1): 114 (2004). – *Globba* sect. *Ceratanthera* ser. *Mediocalcaratae* K.Schum., Pflanzenr. IV, 46 (Heft 20): 133 (1904). – Type: *Globba gracilis* K.Schum. (lecto, designated by Williams *et al.*, 2004: 114).

Herb, small to stout, 30–150 cm tall. *Leaf sheaths* 3–5, bladeless, glabrous or pubescent; ligule truncate or bilobed, c.2 mm long, glabrous or ciliate; blades 4–15, sessile, linear, lanceolate-elliptic or ovate, 4.5–35 × 1–15 cm, base obtuse or cuneate, apex acuminate, usually glaucous below, sparsely strigillose along veins above or glabrous, green, occasionally with silver stripe along midrib. *Inflorescence* erect, lax, conical or linear, 6–30 × 3–14 cm; peduncle 2–8 cm long; rachis green or white, glabrous or pubescent; bracts and bracteoles caducous, sometimes remaining on condensed cincinni, lanceolate or elliptic, 3–25 × 1.5–6 mm, apex acute, glabrous or ciliate, white, green with paler margin, reddish green; cincinni numerous, lax, 1–8.5 cm long. *Flowers* 2.6–3.5 cm long; ovary ellipsoid, 2–4 mm long (♂), green or white; calyx infundibuliform, 3–5 mm long, trilobed with acute apices, green, green with white lobes, or white; floral tube curved, 2–6 mm long, sparsely glandular hairy, white, cream or orange,

dorsal and lateral corolla lobes elliptic, 3–9 × 1.5–5 mm, apex acute, hooded, green becoming white at tip, white, yellowish orange, orange; lateral staminodes linear, oblong or obovate, 4–15 × 1–2.5 mm, apex long acuminate, white, cream, yellowish orange, orange; labellum triangular, 5–10 × 2.5–7.5 mm, bilobed, white, yellowish orange or orange, spot orange, red, brown or yellow, base truncate, long decurrent on filament, with or without cornicula, apex obtuse or obliquely truncate, nectar tube 2–6 mm long; filament c.20 mm long, white, cream or orange; anther elliptic, c.1.5 mm long, connective tissue, crest and two triangular appendages white, purple or orange, semitranslucent, crest truncate or round, c.1 mm long at tip, ♀ appendages falcate or triangular, c.3.5 mm long, held ± perpendicular to anthers, base covering whole length of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers with round crest or without, appendages falcate or triangular, narrower than ♀, c.4.5 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* nearly globose, oblate or ellipsoid, 10–23 × 6–8 mm, shallowly or longitudinal ridged, green. *Bulbils* corky, produced at peduncle, within the leaf sheath, tips of cincinni or tips of inflorescence, globose, ovoid, (3–)13–26 × (3–)8–9 mm, or bamboo-like, produced at peduncle or tips of cincinni, producing one or many shoots, ovoid, 1.5–3 × 1 cm.

Key to the species

1a. Labellum base long decurrent on filament with cornicula, c.1.5 mm long _____ 2
1b. Labellum base long decurrent on filament or truncate, without distinct cornicula _____ 8

2a. Flower white with yellow patch on labellum _____ 3
2b. Flower orange throughout with or without red spot on labellum _____ 6

3a. Labellum with brown or dark green on yellow patch; dorsal corolla lobe mucronate, c.1.5 mm long _____ 4
3b. Labellum with bright yellow spot; dorsal corolla lobe obtuse or short mucronate _____ 5

4a. Labellum base long decurrent on filament with distinct cornicula, c.2 mm long; appendages usually purple sometimes white; bulbils corky _____ **9. G. lilacina**
4b. Labellum base short decurrent on filament with short cornicula, c.1 mm long; appendages white; bulbils absent _____ **10. G. macrocarpa**

5a. Medium clump plant, 40–80 cm; blades lanceolate, 1–4.5 cm wide; inflorescence 9–18 cm long; flowers c.3 cm; bulbils produced at tip of inflorescence **3. G. campsophylla**
5b. Small clump plant, to 50 cm; blades oblong to elliptic, 0.7–1.7 cm wide; inflorescence 6–7 cm long; flowers c.2.6 cm; bulbils produced at peduncle _____ **8. G. gracilis**

6a. Labellum with red spot at centre; dorsal corolla lobe short mucronate, < 1 mm long; bulbils many ____ **17. G. thorelii**
6b. Labellum with red spot or without; dorsal corolla lobe long mucronate, c.1.5–2 mm long; bulbils rare ____ 7

7a. Labellum triangular, without spot; cincinni crowded ____ **11. G. newmanii**
7b. Labellum oblong, with red spot or absent; cincinni lax ____ **7. G. francisci**

8a. Base of labellum long decurrent on filament ____ 9
8b. Base of labellum truncate or obtuse or triangular ____ 15

9a. Corolla white; labellum with yellow patch ____ 10
9b. Corolla yellow or golden orange, sometimes with white filament; labellum pure colour or red, brown spot ____ 14

10a. Labellum with two green-brown spots on yellow patch, apex round; dorsal corolla lobe long mucronate ____ **10. G. macrocarpa**
10b. Labellum with yellow spot, apex acute or truncate usually pushed forwards (observed laterally); dorsal corolla lobe short mucronate ____ 11

11a. Labellum with yellow patch nearly covering the labellum lobes; lateral staminodes sparsely hairy ____ 12
11b. Labellum with yellow spot at centre; lateral staminodes dense glandular hairs __13

12a. Leaf linear to narrowly oblong; ligule ciliate (rarely glabrous); bracts and bracteoles glabrous; bulbils fusiform, corky, many ____ **19. G. xantholeuca**
12b. Leaf lanceolate to elliptic; ligule glabrous; bracts and bracteoles ciliate; bulbils absent **5. G. chrysochila**

13a. Medium clump plant, 40–80 cm; blades lanceolate, 4.5–18 × 1–4.5 cm; inflorescence 9–18 cm long; flowers c.3 cm; bulbils produced at tip of inflorescence **3. G. campsophylla**
13b. Small clump plant, to 50 cm; blades oblong to elliptic, 4.5–15 × 0.7–1.7 cm; inflorescence 6–7 cm long; flowers c.2.6 cm; bulbils produced at peduncle **8. G. gracilis**

14a. Corolla yellow or golden orange with red spot on labellum; filament and anther appendages white; lateral staminodes oblong, 4–7 × 2 mm; blades elliptic to ovate, 5–28 × 3.6–9 cm, plain green ____ **2. G. argyrocycnos**
14b. Corolla pure orange except red spots on labellum; filament orange; lateral staminodes linear, 11–15 × 1 mm; blades narrowly elliptic, 19–22.5 × 3–3.5 cm, usually bearing silver stripes along midrib ____ **6. G. decora**

15a. Flower pure orange; labellum without spot ____ 16
15b. Flowers white or orange; labellum with orange-red, red or brown spot _____18

16a. Fruit globose, shallowly ridged ____ **13. G. paniculata**
16b. Fruit ellipsoid, deeply ridged ____ 17

17a. Dorsal corolla lobe obtuse; lateral staminodes obovate, 6–8 mm wide **16. G. ranongensis**
17b. Dorsal corolla lobe mucronate; lateral staminodes linear, 1.5 mm wide **11. G. newmanii**

18a. Flowers white, spot on labellum red or orange _____ **15. G. pyrrhopoikila**
18b. Flowers pale yellow, cream; spot on labellum orange or brown _____ 19

19a. Flowers orange with red or brown spot on labellum; filament orange; appendages white _____ 20
19b. Flowers cream, pale yellow or white; filament colour same as corolla lobe; appendages white _____ 21

20a. Inflorescence narrowly conical, 12–25 × 4–8 cm; all cincinni stalked, labellum with two brown spots _____ **4. G. cataractarum**
20b. Inflorescence linear, 16–35 × 3–10 cm; cincinni in upper two-thirds sessile, labellum with two red spots _____ **14. G. pycnostachys**

21a. Lateral staminodes as long as corolla lobes, linear, c.8 × 1.5 mm, cream; fruit ellipsoid, deeply ridged _____ **12. G. nitens**
21b. Lateral staminodes much longer than corolla lobes, linear, 10–14 × 1.5 mm, white; fruit ovoid to ellipsoid, shallowly ridged _____ 22

22a. Labellum triangular, anther appendages falcate, apex acuminate, white; crest truncate _____ **1. G. albiflora**
22b. Labellum oblong, anther appendages triangular, apex acute, pale yellow; crest round _____ **18. G. virginea**

Species Descriptions

1. Globba albiflora Ridl., J. Straits Branch Roy. Asiat. Soc. 32: 96 (1899); Holttum, Gard. Bull. Singapore 13(1): 31 (1950). – Type: Peninsular Malaysia, Pulau Pinang, 1 vi 1892, *Curtis* 2851 (lecto K, designated by Turner, 2000: 29); isolecto SING [SING0044058]). **Fig. 5A–F.**

Stout herb, 70–120 cm tall. *Leaf sheaths* c.4, bladeless, glabrous; ligule bilobed, c.2 mm long, glabrous; blades c.13, sessile, elliptic, 11–22 × 2.1–5.1 cm, base obtuse, apex long acuminate, glaucous below, sparsely strigillose along veins, shiny green, occasionally with silver stripe along midrib. *Inflorescence* conical, 8–20 × 6.5–14 cm; peduncle 2–8 cm long; rachis green, glabrous; bracts and bracteoles caducous, elliptic, 3–5 × 1.5 mm, apex acute, glabrous, green with paler margin; cincinni numerous, jointed, lax, 1–8 cm long. *Flowers* c.3.5 cm long; ovary ellipsoid, c.4 mm long (♀), green; calyx infundibuliform, 3–5 mm long, unequally trilobed with acute apices, green becoming white at lobes or white; floral tube c.12 mm long, with sparse glandular hairs, white, dorsal and lateral corolla lobes elliptic, c.6 × 1.5 mm, apex acute, hooded, green becoming white at tip; lateral staminodes linear, c.14 × 1.5 mm, apex long acuminate, about twice as long as lateral corolla lobes,

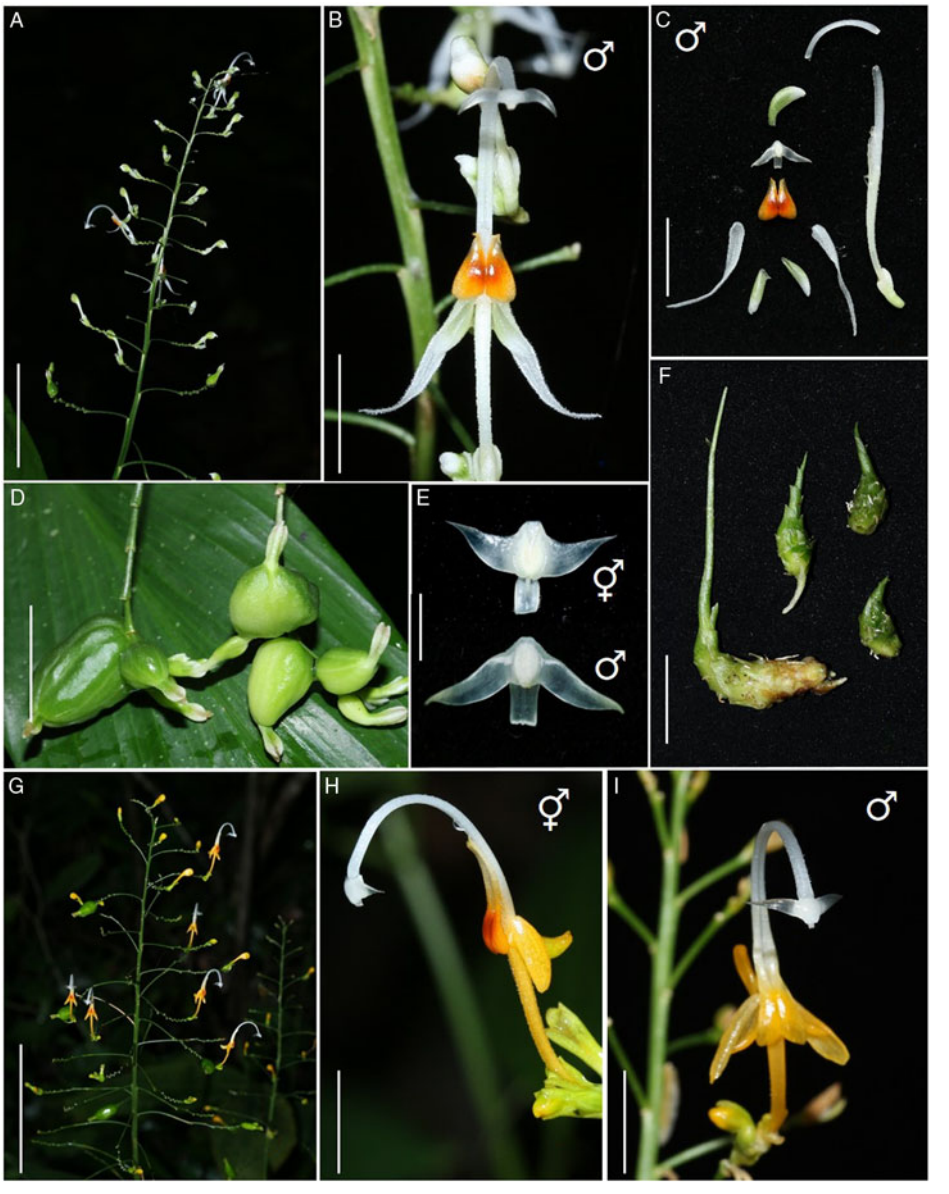


FIG. 5. *Globba albiflora* Ridl. (*Sangvirotjanapat* 788): A, inflorescence; B and C, ♂ flower; D, fruit; E, anther appendages; F, bulbils. *Globba argyrocycnos* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* et al. 787): G, inflorescence; H, ♀ flower; I, ♂ flower. Scale bars: A, 5 cm; B–D, F, H and I, 1 cm; E, 2 mm; G, 10 cm. Photographs: Sunisa Sangvirotjanapat.

white or cream; labellum triangular, 5–6.5 × 4–6.5 mm, bilobed, white with orange blot or mostly orange with dark orange spot at centre, base truncate, apex obtuse or obliquely truncate, nectar tube c.5 mm long; filament c.20 mm long, white; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest truncate, c.1 mm long at tip, ♀ appendages falcate, c.3.5 mm long, held ± perpendicular to anthers, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.4.5 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ovoid to ellipsoid, c.10–12 × 6–8 mm, shallowly ridged, green. *Bulbils* produced at peduncle or tips of cincinni, bamboo-like, producing one shoot, ovoid, 1.5–3 × 1 cm, scaly.

Distribution. Peninsular Malaysia, Thailand (Fig. 6).

Habit and ecology. Growing in shaded, humid forest on low hills or mountains or along streams, at 150–350 m.

Proposed IUCN conservation status. Near Threatened (NT). This species has a restricted range but is locally common. It is known to occur at five locations, three of which are in protected areas. However, there are localised threats because of tourism activities in some localities and there is no record of *ex situ* conservation. The extent of occurrence (EOO) is about 29,000 km^2 and the area of occupancy (AOO) is 32 km^2. The species is assessed as Near Threatened because it is close to qualifying as threatened under criterion B1+2.

Specimens examined. MALAYSIA. **Pulau Pinang**: 16 viii 1916, *Burkill* 1546 (SING); *Curtis s.n*. (SING, 3 sheets); viii 1886, *Curtis* 956 (SING); 8 viii 1966, *Lim* 8221 (K); 27 vii 1978, *Reilly* 19 (K); Pinang Hill, 12 xi 2016, *Sangvirotjanapat* 791 (QBG [cultivation voucher, QSBG, accession no. 20130763A]).

THAILAND. **Phangnga**: Takua Pa, 14 vii 1972, *Larsen* et al. 30940 (AAU, K). **Songkhla**: Boriphat Waterfall, 16 x 1970, *Charoenpol* et al. 3900 (AAU, K); ibid., 16 vi 1984, *Newman* 4 (PSU); ibid., 16 viii 1984, *Maxwell* 84-64 (A, BKF); ibid., 13 xi 1987, *Sirirugsa* 1122 (PSU); ibid., 1990, *Larsen* et al. 41242 (AAU); ibid., 8 xi 2016, *Sangvirotjanapat* 788 (BKF, QBG). **Surat Thani**: Ban Na San, 8 viii 1927, *Kerr* 13218 (BK, C, K, P); ibid., 11 viii 1927, *Kerr* 13294 (BK, C, K). **Trang**: Khao Chong National Park, 13 viii 1975, *Maxwell* 75-832 (AAU, BK); ibid., 28 viii 1986, *Maxwell* 86-603 (A, BKF).

Ridley described this species in 1898 from Pinang Hill ("Penang Hill"), Malaysia. Later, Holttum (1950) described *Globba albiflora* var. *aurea* Holttum from material gathered at Gua Musang, Kelantan, Malaysia (*Henderson SFN* 29715). In this revision, we treat *Globba albiflora* var. *aurea* as a synonym of *G. newmanii*. The differences between *Globba albiflora* and *G. newmanii* are white flower with orange spots (versus orange flower throughout), truncate base of labellum (versus with cornicula), and flask-shaped fruit with shallow ridges (versus elliptic fruit with deep longitudinal ridges). Morphologically, this species is similar to *Globba virginea* in its white flower, shallowly ridged fruit and bamboo-like bulbils but differs

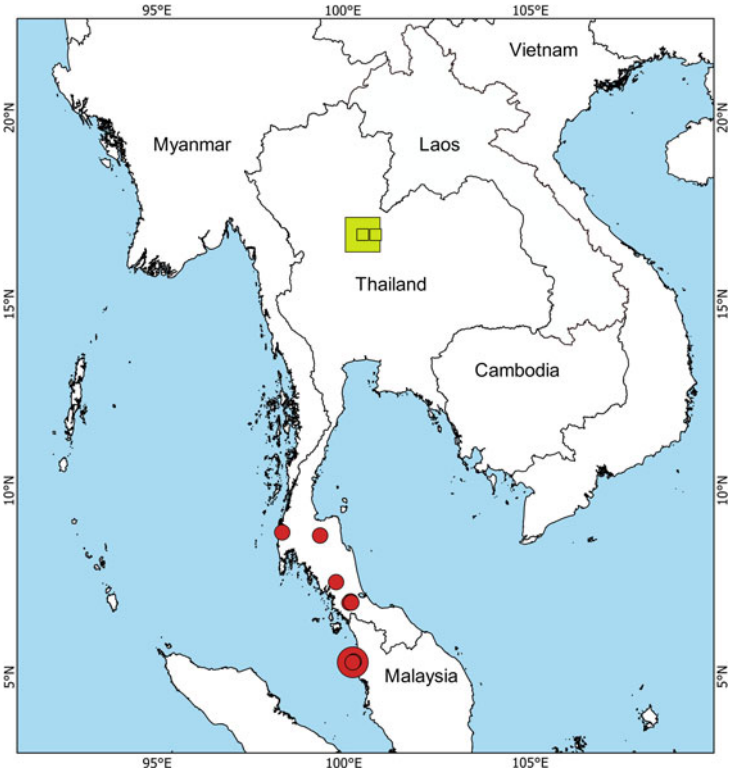


FIG. 6. Distribution range of *Globba albiflora* Ridl. (circles) and *G. argyrocycnos* Sangvir. & M.F.Newman (squares). The type locality of each species is indicated with a bigger symbol.

by its anther appendage shape. Whereas the appendages of *Globba albiflora* are triangular and falcate, those of *G. virginea* are only triangular.

The specific epithet '*albiflora*', indicating white flowers, has led to all white-flowered specimens being determined to this name. The morphological traits of *Globba chrysochila*, *G. lilacina*, *G. macrocarpa*, *G. pyrrhopoikila* Sangvir. & M.F.Newman and *G. virginea* have been clarified, and as a result, it has been found that each of these species is restricted to a geographical region.

2. Globba argyrocycnos Sangvir. & M.F.Newman, **sp. nov.**

Similar to *Globba nitens* Sangvir. & M.F.Newman in its yellowish orange labellum, white filament and anther appendages but differs by its long decurrent labellum with red spot (versus truncate labellum with orange or brown spot) and yellow or golden orange floral tube, corolla lobes and lateral staminodes (versus white floral tube, greenish cream corolla lobes and cream lateral staminodes). – Type: Thailand, Phitsanulok, Wang Thong, Ban Wang Dinsao, 16°52′4″N, 100°30′22″E, 5 x 2016, *Sangvirotjanapat, Sitawan & Muang-Phang* 787 (holo BKF; iso E, K, QBG). **Figs 5G–I, 7.**

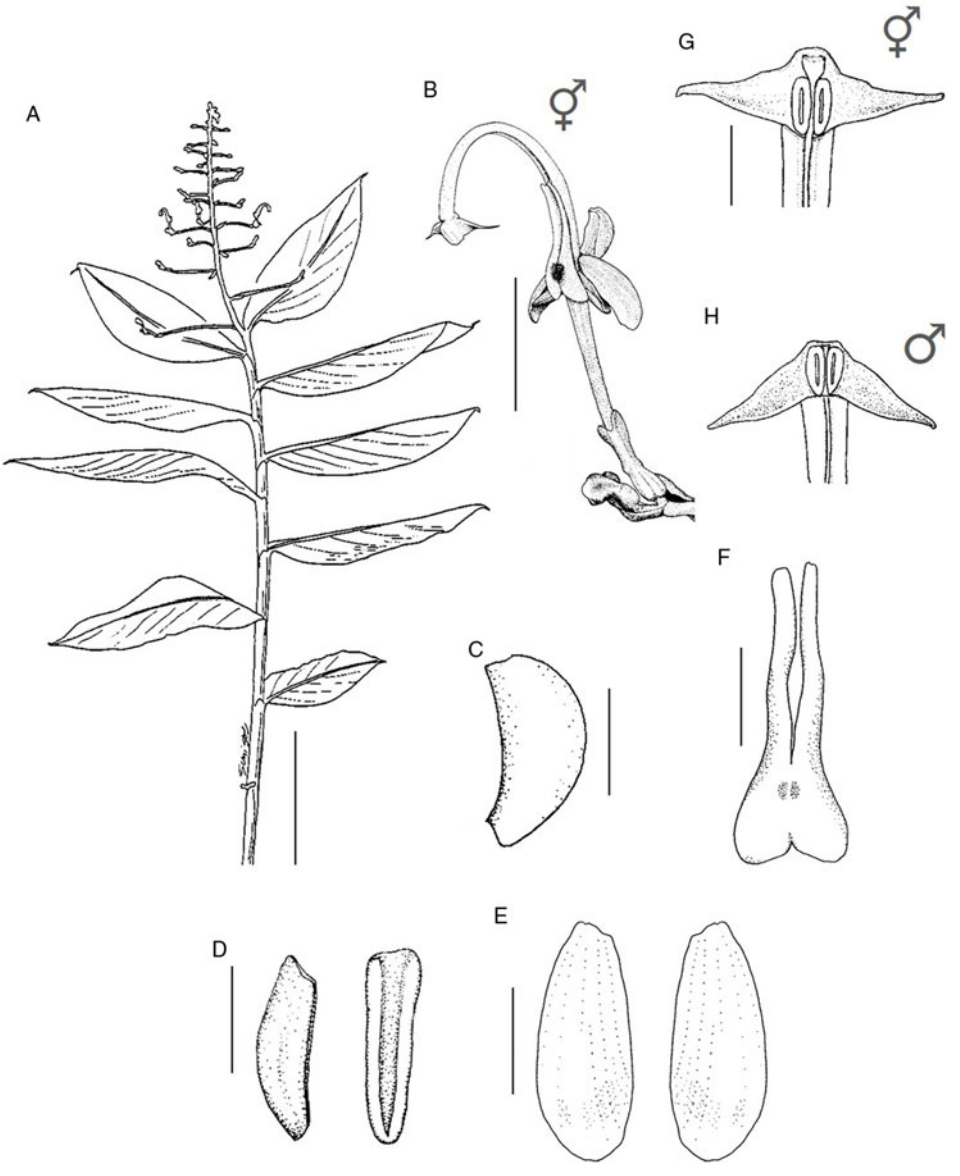


FIG. 7. *Globba argyrocycnos* Sangvir. & M.F.Newman, sp. nov. A, Habit; B, ♀ flower; C, dorsal corolla lobe; D, lateral corolla lobes; E, lateral staminodes; F, labellum; G, ♀ appendages; H, ♂ appendages (same scale as G). Scale bars: A, 10 cm; B, 1 cm; C–H, 3 mm. Drawn from *Sangvirotjanapat* et al. 787 by Sunisa Sangvirotjanapat (A, C–H) and Anupong Amornkitphung (B).

Stout herb, 80–120 cm tall. *Leaf sheaths* c.4, bladeless, glabrous, green or light brown at basal sheaths; ligule shallowly bilobed to truncate, c.2 mm long, ciliate; blades 6–11, sessile, elliptic, base obtuse, apex acuminate, glaucous below, nearly glabrous below and above. *Inflorescence* conical, 20–30 × 12–15 cm; peduncle 2–4 cm long; rachis green, glabrous; bracts and bracteoles caducous, linear to elliptic, 5–23 × 1.5–2 mm, apex acute, margin sparsely hairy, green or yellowish green; cincinni numerous, 1–8 cm long, pedicel 1–3 mm long. *Flowers* 2.7–3.5 cm long, corolla yellow or golden orange, red spot on labellum or absent, filament and anther appendages white; ovary ovoid to ellipsoid, 2–4 × 1–2 mm (♀), ridged, green; calyx infundibuliform, 5–7 mm long, trilobed with acuminate apices and pubescent margins, yellowish green; floral tube 11–13 mm long, glandular hairy, corolla lobes elliptic, 4–5 × 1.5–2 mm, apex acute; lateral staminodes oblong, 4–7 × 2 mm, apex obtuse, slightly longer than lateral corolla lobes; labellum triangular, 8–10 × 3–4 mm, bilobed, yellow or golden orange, base attenuate, long decurrent on filament, c.4 mm long, white, apex obtuse, red spot at centre or absent, nectar tube c.3 mm long; filament c.20 mm long, white; anther elliptic, c.1 mm long, connective tissue, crest and appendages white, semitranslucent, crest round, c.1 mm long at tip, ♀ appendages triangular or slightly falcate, c.3 mm long, held ± perpendicular to anthers, base covering whole side of anther, apex acuminate, ♂ anther crest as ♀, appendages falcate, narrower than ♀, c.3.5 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved. *Fruit* ellipsoid, c.20 × 7 mm, shallowly ridged, randomly produced on a whole inflorescence, green. *Bulbils* not seen.

Distribution. Endemic to Thailand (see Fig. 6).

Etymology. From Greek, *argyro-* ('silvery') and *cycnos* ('swan'), reflecting the appearance of its flowers, and the Thai local name *hong ngoen*, which means 'silver swan'.

Habit and ecology. Growing near streams in deciduous forest, at about 55 m.

Proposed IUCN conservation status. Least Concern (LC). This species is endemic in Thailand, where it is restricted to two localities in Phitsanulok Province. One of the two localities is a protected area and the other is a natural educational centre. Both are likely to secure the future of the plants. Moreover, this species is in cultivation at Queen Sirikit Botanic Garden. It is therefore assessed as Least Concern.

Specimens examined. THAILAND. **Phitsanulok**: Thung Salaeng Luang National Park, 19 vii 1966, *Larsen* et al. 486 (AAU, P); ibid., 20 vii 1966, *Larsen* et al. 591 (AAU); ibid., 28 vi 2014, *Sangvirotjanapat* 668 (QBG).

Initially, this species was noticed as one of the species in Mr Watcharasak Makerd's *Globba* collection. These images were gathered around northern and central Thailand during fieldwork for a master's degree in 2009. Merely by observing the photographs, we could be confident that this was a new species because of its unique flower colour. Mr Makerd then, in 2016,

accompanied the first author to Wang Thong District, Phitsanulok Province, where in its natural habitat, *Globba argyrocycnos* was locally common and well protected by the local forester.

The conspicuous colour of the flower is highly diagnostic of this species. The contrasting golden corolla and white filament are found only in this species of subsect. *Mediocalcaratae*. Another interesting feature of *Globba argyrocycnos* is that the hermaphrodite and male flowers are randomly arranged in the inflorescence (see Fig. 5G), unlike in other species.

3. Globba campsophylla K.Schum., Pflanzenr. IV, 46 (Heft 20): 145 (1904); Ridley, Philipp. J. Sci., C 4(2): 159 (1909). – Type: Philippines, Nueva Ecija, *Cuming* 1390 (lecto K [K000255269], designated here; isolecto E [E00149930], FI [FI011945], K [K000255268], MO [MO934294]).

Globba merrillii Ridl., Publ. Bur. Sci. Gov. Lab. (35): 83 (1905). – Type: Philippines, Bataan, Mount Mariveles, viii 1904, *Merrill* 3869 (lecto K [K000255265], designated here; isolecto BM [BM000617548], K [K000255266], US [US00092873]); Mount Mariveles, viii 1904, *Borden* 1598 (syn BM [BM000617547], E [E00149937], SING [SING0044069]), Mount Mariveles, *Whitford* 481 (syn K [K000255267], SING [SING0044070]). Philippines, Zamboanga, *Copeland s.n.* (syn MICH n.v.), **syn. nov.**

Clump-forming herb, 40–80 cm tall, leaning with upright inflorescence. *Leaf sheaths* c.3, bladeless, green or light brown at basal sheaths; ligule truncate to shallowly bilobed, c.2 mm long; blades 7–10, lanceolate, 4.5–18 × 1–4.5 cm, base cuneate or obtuse, apex acuminate, pubescent below, sparsely puberulous above, sessile. *Inflorescence* conical, 9–18 × 7–10 cm; peduncle 2–4 cm long; rachis glabrous, green; bracts and bracteoles caducous, obovate, 2–5 × 2 mm, apex acute, glabrous, green with white margin; cincinni lax, 3–5 cm long, pedicel c.1 mm long. *Flowers* c.3 cm long, white except labellum with orange spot; ovary ellipsoid, c.2 mm long (☿), green or white; calyx infundibuliform, c.5 mm long, trilobed with obtuse apices and glabrous margins; floral tube c.12 mm long, dorsal and lateral corolla lobes elliptic, 3–5 × 1.5–2 mm long; lateral staminodes linear, c.5 × 1.5 mm, apex acute, slightly longer than lateral corolla lobes, glandular hairy; labellum triangular, c.5 × 3 mm, base long decurrent on filament, c.2 mm long, with short cornicula at tip, c.1.5 mm long, apex obtuse, nectar tube c.3 mm long; filament c.20 mm long; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest obtuse, c.1 mm long at tip; ☿ appendages falcate, c.3 mm long, held ± perpendicular to anthers, base covering lower half of side of anther, apex acuminate and curved upwards, ♂ anthers without crest, appendages falcate, narrower than ☿, c.4 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid to globose, c.14 × 7 mm, shallowly ridged, green. *Bulbils* corky, subtended by bracteoles, terminal on inflorescence, globose, c.3–6 mm long.

Distribution. Endemic to the Philippines (Fig. 8).

Habit and ecology. Growing in semishade along trails, at 350–1566 m.

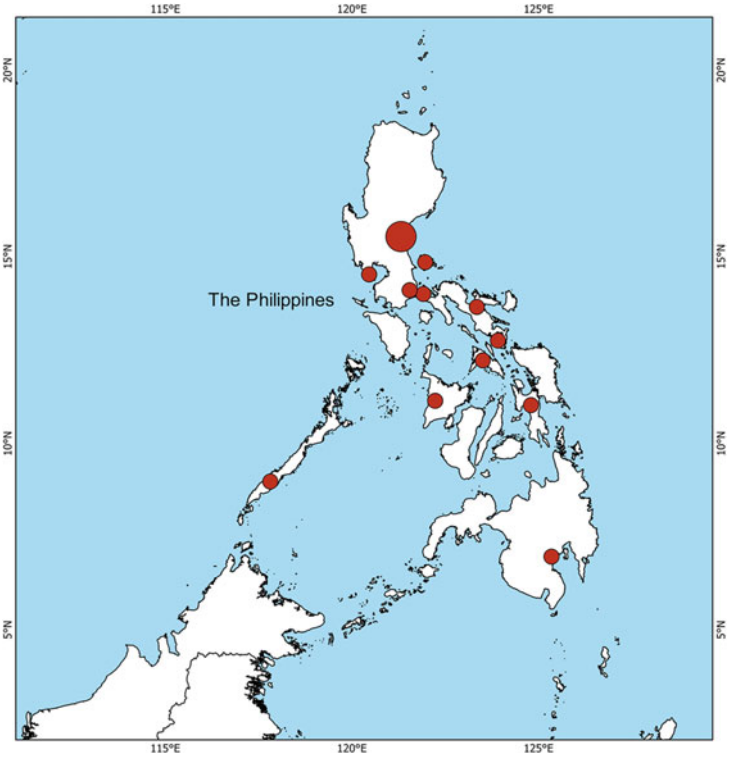


FIG. 8. Distribution range of *Globba campsophylla* K.Schum. (circles). The type locality is indicated with a bigger symbol.

Proposed IUCN conservation status. Least Concern (LC). This species is endemic to the Philippines. The EOO and AOO are 514,435 km^2 and 72 km^2, respectively. Most localities are in protected areas. This species is therefore assessed as Least Concern.

Specimens examined. PHILIPPINES. 1906, *Loher* 6998 (K); 9 vi 1890, *Loher* 689 (K); 16 viii 1988, *Nagata* 3878 (E [cultivation voucher, Lyon Arboretum, accession no. L-87.663]). **Benguet**: Twin Peaks, v 1904, *Elmer* 6465 (K, US). **Camarines Sur**: Mount Isarog, 28 vii 1997, RBGE accession no. 19972553, vouchered as *Newman* 848 (E). **Capiz**: Mount Baloy, 8 iv 1995, *Garcia & Romero PPI* 15972 (L). **Davao del Sur**: Todaya, vii 1909, *Elmer* 11284 (C). **Leyte**: Mount Lobi, 6 xi 1999, *Mendum* et al. 99200 (E). **Masbate**: 12 ii 1994, *Barbon* et al. *PPI* 12672 (L). **Palawan**: Mount Gantung, 19 viii 1996, *Pipoly PPI* 38076 (L). **Rizal**: 1 vii 1906, *Ramos* 1110 (K). **Sorsogon**: Lake Bulusan, 16 vi 1958, *Sinclair & Edaño* 9566 (E, SING). **Tayabas**: Polillo Island, 2 viii 1995, *Romero* et al. *PPI* 15409 (L); Atimonan, 11 iii 1996, *Castro* et al. *PPI* 22171 (L).

Globba campsophylla is widespread in the Philippines. It is one of four names used for specimens with white flowers in the Philippines, along with *Globba gracilis*, *G. leucocarpa* Ridl. and *G. merrillii* Ridl. Of these, we consider *Globba merrillii* to be a synonym of *G. campsophylla*, and *G. leucocarpa* is synonymous with *G. gracilis*. *Cuming* 1390 (K),

which is selected as the lectotype here, demonstrates the main diagnostic character of *Globba campsophylla*, which is unique in *Globba* sect. *Nudae*, namely that bulbil production is at the tip of the inflorescence. This zone is reduced abruptly to a linear structure (Fig. 4C) on which are small corky bulbils subtended by bracteoles. Three photographs (references 30568, 30569 and 30570) on *Co's Digital Flora of the Philippines* website, which were taken in Luzon, clearly show this character. One of the syntypes of *Globba merrillii*, *Merrill* 3869 (K), also shows this character. We lectotypify *Globba merrillii* on this specimen so that this name becomes a synonym of *G. campsophylla* K.Schum.

Although bulbils are not produced at the tip of the inflorescence in other species of this subsection, they are produced in this position by some members of *Globba* sect. *Haplanthera* Horan.

4. Globba cataractarum Sangvir. & M.F.Newman, **sp. nov.**

Similar to *Globba pycnostachys* Sangvir. & M.F.Newman in its orange filament and white anther appendages and bamboo-like bulbils but differs by its narrowly conical inflorescence (versus linear inflorescence) and stalked cincinni (versus sessile cincinni on upper two-thirds of inflorescence). – Type: Thailand, Nan, Bo Kluea, 19°12′N, 101°01′59′′E, 780 m, 2 ix 2000, *Srisanga* 1586 (holo QBG, iso E [E00596912]). **Figs 9, 10A–C.**

Stout herb, 60–100 cm tall. *Leaf sheaths* c.4, bladeless, green or light brown at basal sheaths, sparsely pubescent; ligule truncate or shallowly bilobed, c.3 mm long; blades 8–12, elliptic to ovate, 16–26 × 4.7–5.6 cm, base obliquely cuneate to obtuse, apex acuminate, strigillose along midrib and vein, sessile. *Inflorescence* narrowly conical, 12–25 × 4–8 cm; peduncle 2–5.5 cm long; rachis glabrous, green; bracts caducous, linear, c.12 × 2 mm; bracteoles caducous, oblong to elliptic, 2–5 × 0.5–1 mm, sparsely pubescent at margin, yellowish to light green; cincinni numerous, 0.5–3.2 cm long, to 8 flowers per cincinnus, c.2 mm apart. *Flowers* c.3 cm long; ovary ovoid, c.2 mm long (☿), shallowly ridged; calyx infundibuliform, c.2 mm long, trilobed with obtuse apices, pubescent at margins, yellowish to green; floral tube 14–16 mm long, orange, dorsal and lateral corolla lobes elliptic, c.5 × 1–2 mm, greenish orange; lateral staminodes lanceolate, c.10 × 1.5 mm, apex acuminate, longer than lateral corolla lobes, orange, glandular hairy; labellum triangular, c.6 × 5 mm, pure orange or with two brown spots at centre, base truncate, apex round to acute, nectar tube c.4 mm long; filament c.27 mm long, orange; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest c.1 mm long at tip, ☿ appendages falcate, c.2 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ☿, c.3 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid to nearly globose, 7–16 × 6–12 mm, shallowly ridged, shiny green. *Bulbils* bamboo-like, 1 or 2, produced at peduncle, obovoid, c.10 × 8 mm, scaly.

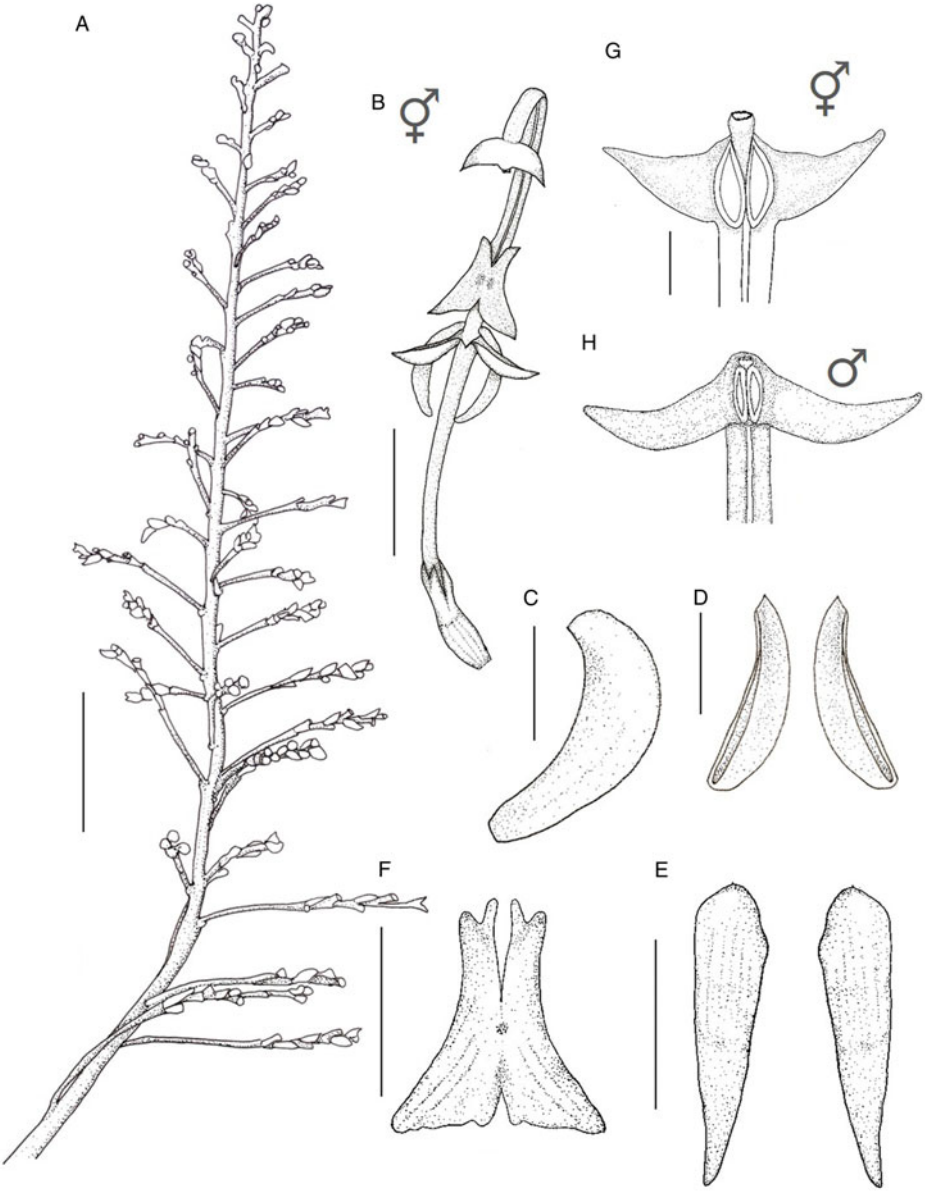


FIG. 9. *Globba cataractarum* Sangvir. & M.F.Newman, sp. nov. A, Inflorescence; B, ♀ flower; C, dorsal corolla lobe; D, lateral corolla lobes; E, lateral staminodes; F, labellum; G, ♀ appendages; H, ♂ appendages (same scale as G). Scale bars: A, 3 cm; B, 1 cm; C and D, 3 mm; E and F, 5 mm; G and H, 2 mm. Drawn from *Sangvirotjanapat* 793 by Sunisa Sangvirotjanapat.

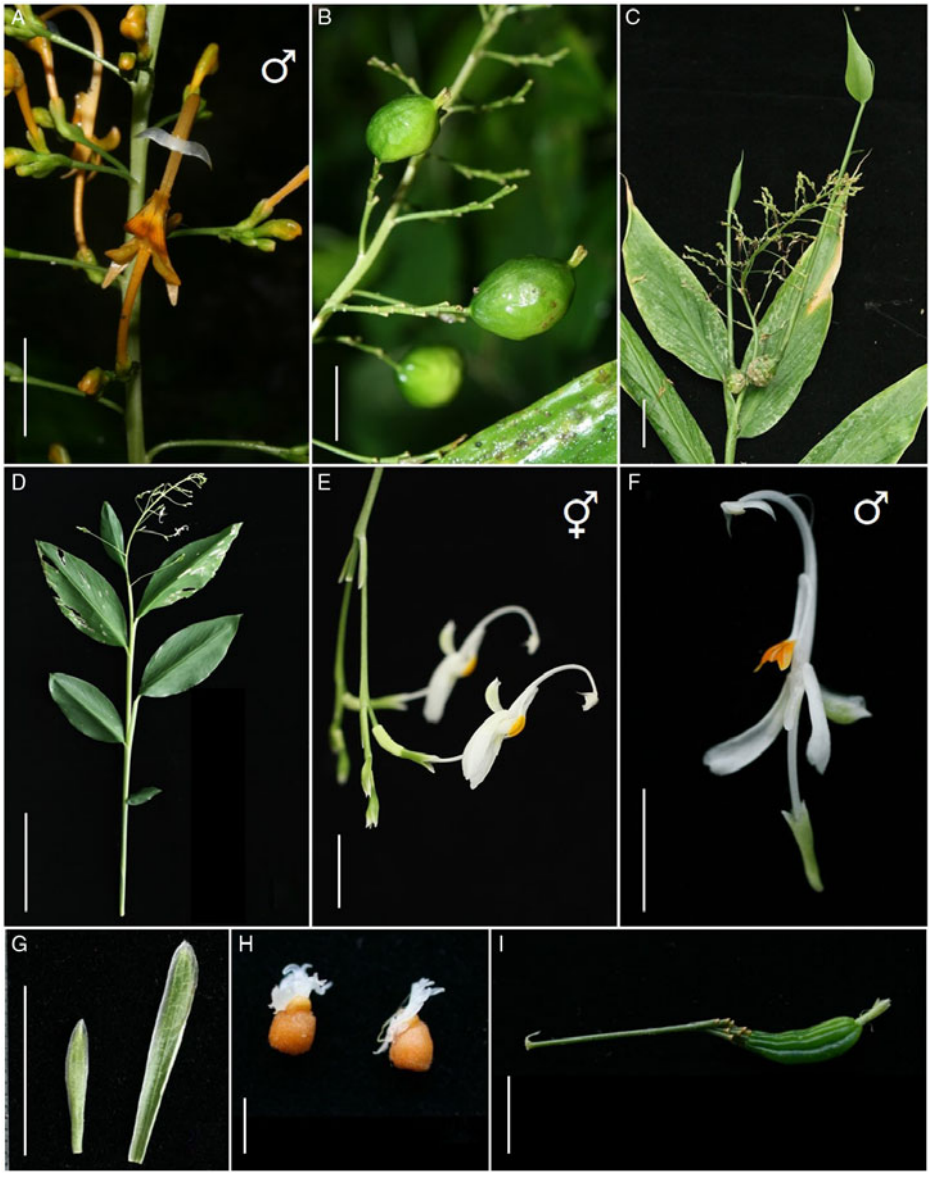


FIG. 10. *Globba cataractarum* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 793): A, ♂ flower; B, fruit; C, bulbils. *Globba chrysochila* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 778): D, habit; E, ⚥ flower; F, ♂ flower; G, bract; H, seed; I, fruit. Scale bars: A–C, E–G and I, 1 cm; D, 15 cm; H, 3 mm. Photographs by Sunisa Sangvirotjanapat.

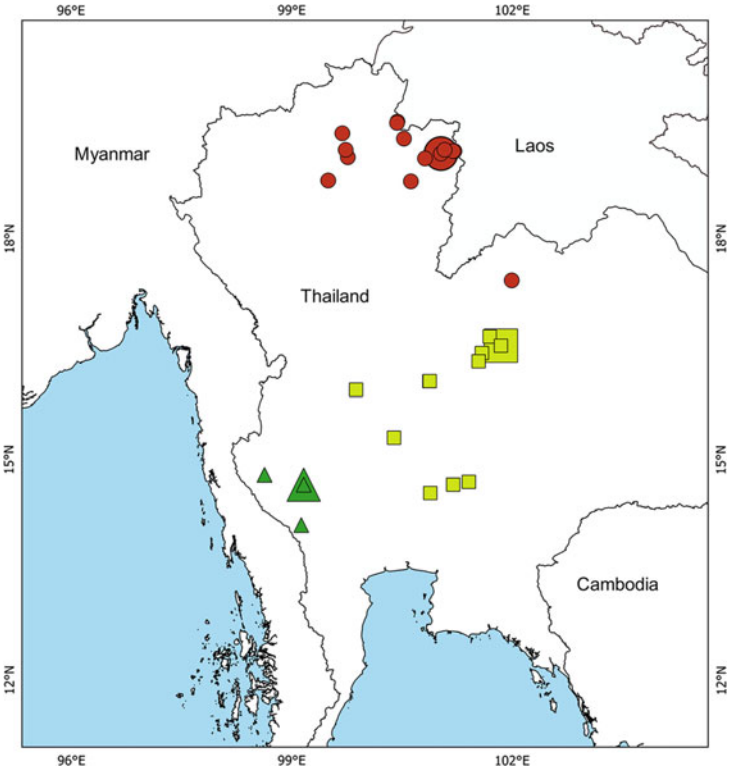


FIG. 11. Distribution range of *Globba cataractarum* Sangvir. & M.F.Newman (circles), *G. chrysochila* Sangvir. & M.F.Newman (squares) and *G. decora* Sangvir. & M.F.Newman (triangles). The type locality of each species is indicated with a bigger symbol.

Distribution. Thailand (Fig. 11).

Etymology. From Latin *cataractarum*, meaning 'of waterfalls', reflecting its habitat.

Habit and ecology. Growing on limestone or well-drained soil in limestone bedrock. Tending to be found in shaded areas and always near streams, at 350–1025 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba cataractarum* is endemic to Thailand. It has an EOO of 27,982 km^2 and an AOO of 56 km^2, suggesting a status of Near Threatened. However, no threats to the species are known, because three localities are in protected areas and, furthermore, it is grown *ex situ* in Queen Sirikit Botanic Garden. This species is therefore assessed as of Least Concern.

Specimens examined. THAILAND. **Chiang Rai**: Doi Luang National Park – Chiang Rai, 27 viii 2015, *Norsaengsri* 12509 (QBG). **Lampang**: Chae Son National Park, 27 vi 1996, *Maxwell* 96-922 (A, BKF, L). **Loei**: Na Haeo, 30 vii 1995, *Nanakorn* 4041 (QBG); ibid., 10 vii 2008, *Maknoi* 2565 (QBG). **Nan**: Tha Wang Pha, 22 vii 1994, *Maxwell* 94-776 (BKF, L); Bo Kluea, 7 ix 1995, *Larsen* et al. 46175 (AAU, L); Doi Phu Kha, 6 vii 2001, *Srisanga* 1949 (QBG); ibid., 24 viii 2001, *Srisanga &*

Maknoi 2100 (QBG); ibid., 26 vi 2002, *Srisanga* 2543 (BKF, QBG); Mueang Nan, Ban Mai Santiphap, 25 vii 2009, *Srithi* 670 (QBG); Song Khwae, 26 vii 2011, *La-ongsri* et al. 1762 (QBG). **Phayao**: Doi Luang National Park – Phayao, 10 viii 1997, *Maxwell* 97-851 (A, L); Chiang Kham, Doi Pha Dam, 15 viii 2013, *La-ongsri* et al. 3029 (QBG); ibid., 25 vi 2014, *La-ongsri* et al. 3445 (QBG); Mueang Phayao, Champa Thong waterfall, 25 vi 2015, *Sangvirotjanapat* 793 (QBG [cultivation voucher, QSBG, accession no. PNP107]).

5. Globba chrysochila Sangvir. & M.F.Newman, **sp. nov.**

Similar to *Globba xantholeuca* Craib in its white flower, labellum that is long decurrent on the filament with a bright yellow spot and almost entire lobes but differs by its lanceolate to elliptic leaves (versus linear to narrowly oblong leaves) and the absence of bulbils (versus many bulbils). – Type: Thailand, Chaiyaphum, Khon San, Tham Sihanat Decha Priest's Camp Site, 440 m, 9 viii 2013, 16°33′0′′N, 101°50′57′′E, *Newman, Sangvirotjanapat, Sirimongkol, Fér, Záveská & Pospíšilová* 2638 (holo BKF; iso E, PR, QBG, SING). **Fig. 10D–I.**

Herb 40–70 cm tall. *Leaf sheaths* c.4, bladeless, green or light brown at basal sheaths; ligule bilobed, c.2 mm long, glabrous; blades 4–10, lanceolate to elliptic, 9.5–20 × 1.4–4 cm, base cuneate or obtuse, apex acuminate, glaucous and pubescent below, glabrous above, sessile. *Inflorescence* conical, 10–26 × 9–15 cm; peduncle 1–2 cm long; rachis glabrous, white or green; bracts and bracteoles caducous, linear to oblong, 5–25 mm long, apex acute, green, ciliate; cincinni lax, 3–10 cm long, pedicel c.1 mm long. *Flowers* c.3 cm long, corolla white with yellowish orange spot on labellum; ovary ellipsoid, 1–3 mm long (♀), ridged; calyx infundibuliform, 5–7 mm long, trilobed with acute apices, green becoming white at margin; floral tube 11–13 mm long, dorsal and lateral corolla lobes narrowly elliptic, c.6 × 1 mm; lateral staminodes oblong to obovate, 11–13 × 2–2.5 mm, apex obtuse; labellum triangular, c.5 × 4 mm, base long decurrent on filament, c.3 mm long, apex obtuse, nectar tube 2–3 mm long; filament c.19 mm long; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest elliptic, c.2 mm long at tip; ♀ appendages falcate, c.2.5 mm long, held ± perpendicular to anthers, base covering whole side of anther, apex acuminate and curved upwards, margins parallel almost to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3.5 mm long, held at c.45° to anthers, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.17 × 5 mm, longitudinally ridged, green. *Bulbils* absent.

Distribution. Thailand (see Fig. 11).

Etymology. From the Greek *chryso-* ('golden') and *chilos* ('lip'), which describes the appearance of its labellum.

Habit and ecology. Growing on well-drained soil in rather dry and semishaded places, at 100–440 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba chrysochila* is endemic to Thailand. It has an EOO of 27,439 km^2 and an AOO of 44 km^2, suggesting a status of

Near Threatened. No threats to the species are known, because three localities are in protected areas and it is grown *ex situ* in Queen Sirikit Botanic Garden. This species is therefore assessed as of Least Concern.

Specimens examined. THAILAND. **Chaiyaphum**: Khon San, 29 viii 2015, *Suddee* et al. 4946 (BKF, E); Tham Sihanat Decha Priest's Camp Site, 21viii 2016, *Sangvirotjanapat* 778 (QBG [cultivation voucher, QSBG, accession no. 20130811]). **Khon Kaen**: Phu Pha Man National Park, 26 vii 2010, *Norsaengsri* 7005 (QBG). **Nakhon Ratchasima**: Pak Chong, 15 v 1931, *Kerr* 20449 (BK, C, K, P). **Nakhon Sawan**: Takhli, 10 vii 2007, *Maknoi* 1636 (QBG); Banphot Phisai, Ban Taen, 5 ix 2011, *Pooma* et al. 7762 (E). **Phetchabun**: Nam Nao National Park, 1 viii 2015, *Middleton* et al. 5852 (BKF, E); Chondaen, Sap Phutsa, Khao Nho, 28 viii 2010, *Maknoi* 3897 (QBG). **Saraburi**: 3 vi 1923, *Kerr* 7043 (C, K); Muak Lek, 4 ix 1924, *Kerr* 9138 (BK, K); ibid., 2 x 1963, *Smitinand & Sleumer* 1326 (BKF).

This species resembles *Globba xantholeuca* except for its habit, which seems to be weaker and the leaf broader. *Globba chrysochila* does not produce bulbils at all, whereas *G. xantholeuca* always has bulbils on the lower part of the peduncle in the middle of the rainy season.

6. Globba decora Sangvir. & M.F.Newman, **sp. nov.**
Similar to *Globba thorelii* Gagnep. and *G. newmanii* Sangvir. in its pure orange flowers but differs by its labellum base without cornicula and membranaceous texture (versus having cornicula and thick texture) and lateral staminodes three times longer than the corolla lobes (versus to two times longer). – Type: Thailand, Kanchanaburi, Si Sawat, 14°40′0′′N, 99°09′59′′E, 700 m, 28 vi 1974, *Larsen & Larsen* 33883 (holo AAU; iso K, P [P00234444]). **Figs 12, 13A,B.**

Herb, 70–90 cm tall. *Leaf sheaths* c.4, bladeless, green or light brown at basal sheaths; ligule truncate to deeply bilobed, 3–7 mm long, margin hispid; blades 9–11, sessile, elliptic, 19–22.5 × 3–3.5 cm, base obtuse, apex long acuminate, pubescent and glaucous below, glabrous above, dark green or with silver stripes along midrib. *Inflorescence*: rachis and cincinni rather thin, conical, 12–18 × 9–11 cm; peduncle 1–2 cm long; rachis green, pubescent or glabrous; bracts and bracteoles caducous, yellowish green, linear to elliptic, 3–6 mm long, apex acute, glabrous; cincinni lax, 1–7.5 cm long, pubescent, pedicel 1–3 mm long. *Flowers* c.3.5 cm long, corolla orange with red spot at labellum; ovary ellipsoid, 4–6 mm long (⚥), ridged, green; calyx infundibuliform, c.4 mm long, trilobed with acute apices, yellowish green; floral tube c.20 mm long, dorsal and lateral corolla lobes narrowly elliptic, c.5 × 1 mm; lateral staminodes linear, 11–15 × 1 mm, apex long acuminate, more than three times longer than lateral corolla lobes, glandular hairy; labellum triangular, c.7 × 5 mm, base attenuate with thin texture decurrent on filament, c.4 mm long, apex praemorse, nectar tube c.4 mm long; filament 19–24 mm long; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages orange, semitranslucent, crest c.1 mm long at tip, ⚥ appendages falcate, c.2.5 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anther crest as ⚥, appendages falcate, narrower than ⚥, c.4 mm long, held

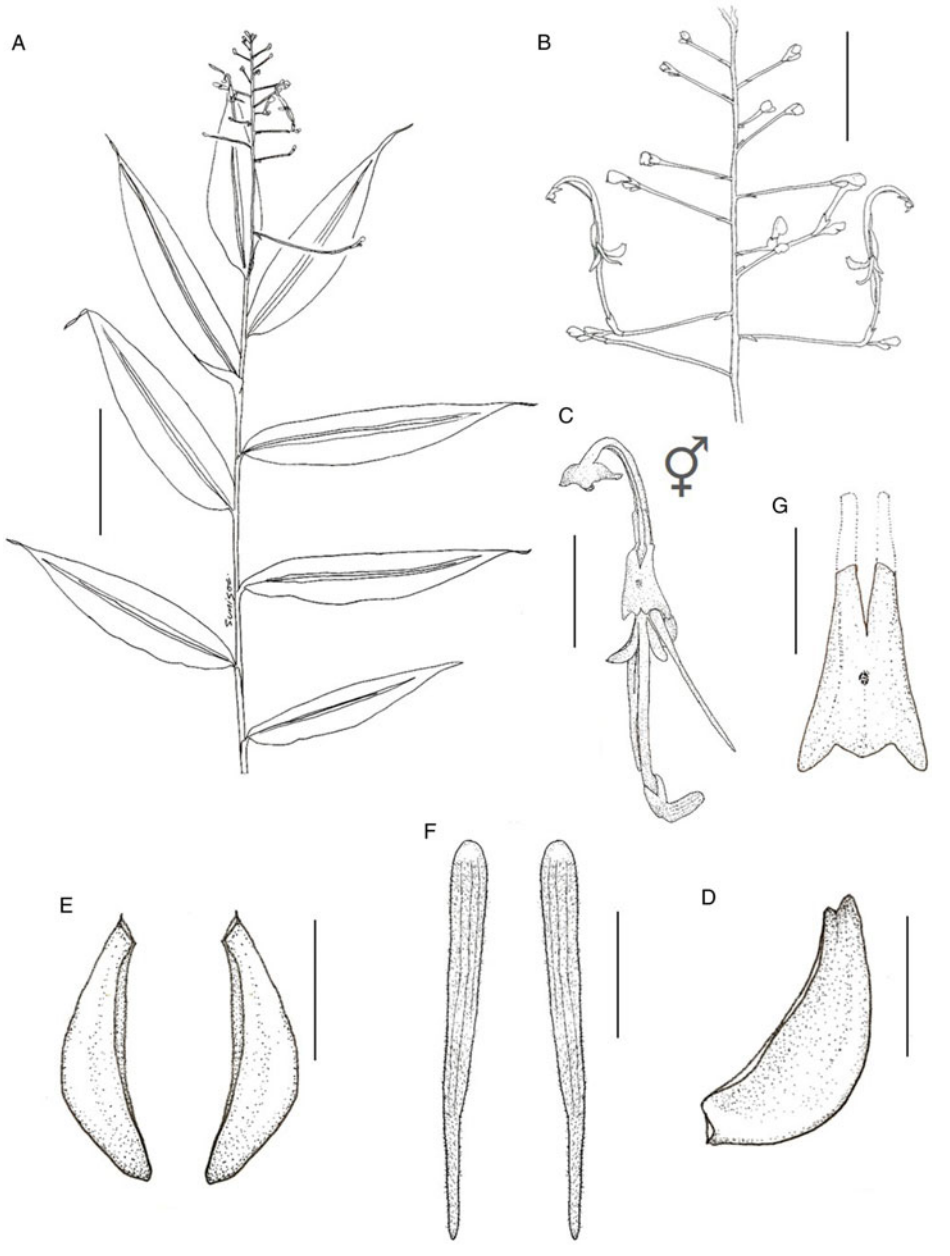


FIG. 12. *Globba decora* Sangvir. & M.F.Newman, sp. nov. A, Habit; B, inflorescence; C, ♂ flower; D, dorsal corolla lobe; E, lateral corolla lobes; F, lateral staminodes; G, labellum. Scale bars: A, 10 cm; B, 3 cm; C, 1 cm; D–G, 3 mm. Drawn from *Sangvirotjanapat* 653 by Sunisa Sangvirotjanapat.

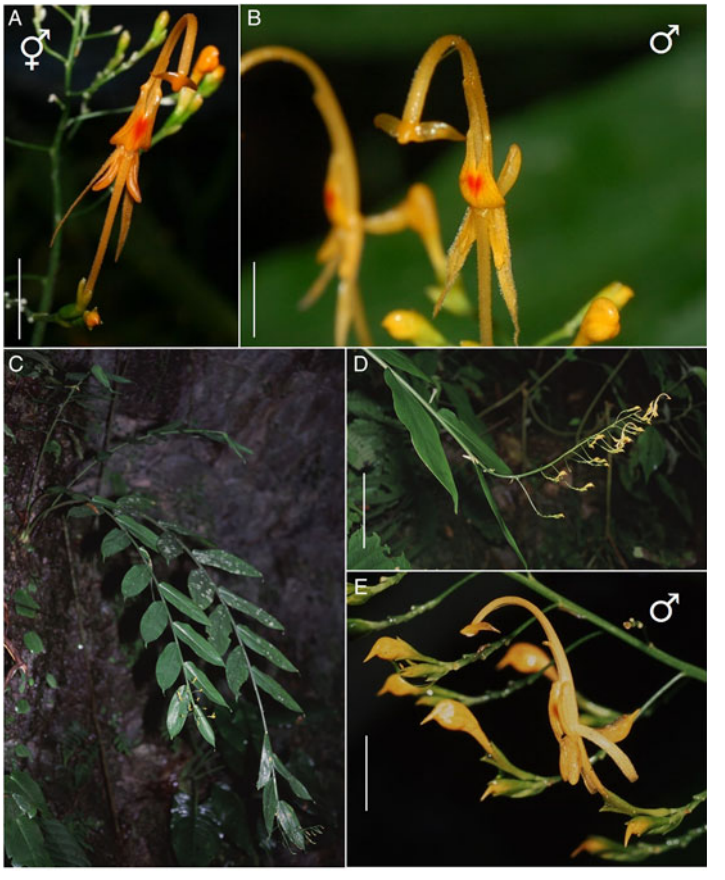


FIG. 13. *Globba decora* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 653): A, ♀ flower; B, ♂ flower. *Globba francisci* Ridl. (*ADP* 2063) from Sabah: C, habit; D, inflorescence; E, ♂ flower. Scale bars: A, B and E, 1 cm; D, 5 cm. Photographs: A and B, Sunisa Sangvirotjanapat; C–E, Axel Dalberg Poulsen.

at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.1.5 × 0.8 cm, longitudinally ridged, green. *Bulbils* corky, produced at peduncle and within leaf sheaths, fusiform.

Distribution. Kanchanaburi Province, Thailand (see Fig. 11).

Etymology. From Latin *decora*, meaning 'elegant', referring to its flower shape.

Habit and ecology. Growing in semishade along trails. Usually found growing on slopes of small hills, at 200–700 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba decora* is endemic to Thailand (Kanchanaburi Province). It has a small EOO (1784 km^2) and AOO (12 km^2). These suggest a status of Endangered. Some localities, however, are in protected areas and

plants are grown *ex situ* in Queen Sirikit Botanic Garden. This species is therefore assessed as of Least Concern.

Specimens examined. THAILAND. **Kanchanaburi**: Sai Yok, 23 ix 2000, *Phengklai* 14001 (BKF); Thong Pha Phum, 31 v 2000, *Triboun* 858 (BK); ibid., 29 vi 2000, *Phengklai* 14088 (BKF); ibid., 23 ix 2000, *Phengklai* 14025 (BKF); ibid., 19 vi 2014, *Sangvirotjanapat* 653 (QBG [cultivation voucher, QSBG, accession no. 20135640A]).

This species is endemic to Thailand and has a unique labellum characteristic. The base of its labellum is membranaceous, which is a good characteristic to distinguish it from other orange-flowered species. Although the label of *Larsen & Larsen* 33883 (AAU) states that there is a liquid collection, it has not been possible to locate it (Birgitte Bergmann, AAU, personal communication).

7. Globba francisci Ridl., J. Linn. Soc., Bot. 42: 162 (1914). – Type: Malaysia, Sabah, *Gibbs* 2932 (lecto BM [BM000617540], designated by Smith, 1988: 6).

Globba argentiana R.M.Sm., Bot. J. Linn. Soc. 85: 38 (1982). – Type: Malaysia, Sarawak, Gunung Mulu National Park, 100 m, 19 xi 1977, *Argent & Kerby* 802 (holo E [E00149844]).

Stout herb, 60–150 cm tall. *Leaf sheaths* 3–5, bladeless, green or maroon at basal sheath; ligule bilobed, 1–2 mm long; blades 7–12, lanceolate, 10–35 × 2–4.5 cm, base obliquely obtuse, apex acuminate, strigillose at midrib and margin above, pubescent below. *Inflorescence* conical, 10–30 × 3–15 cm long; peduncle 1–3 cm long; rachis pubescent, green with maroon dots; bracts and bracteoles caducous, elliptic, 4–10 mm long, sparsely pubescent, green; cincinni numerous, to 20 flowers each. *Flowers* c.3 cm long, orange with red spot on labellum; ovary ellipsoid, c.3.5 mm long (♀), green, ridged; calyx infundibuliform, c.3.5 mm long, trilobed with acuminate apices and sparsely hairy margins, yellowish green; floral tube c.14 mm long, glandular hairy, dorsal and lateral corolla lobes elliptic, 3–4 × 2.5–3 mm, dorsal lobe slightly longer, mucronate at apex, c.1 mm long; lateral staminodes linear, 9–12 × 1–2 mm, apex long acuminate, slightly longer than lateral corolla lobes, patent, glandular hairy; labellum triangular, c.8 × 6 mm, base truncate, long decurrent on filament, c.3 mm long, cornicula at tip c.1 mm long, apex round to acute, nectar tube c.2.5 mm long; filament c.20 mm long; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages orange, semitranslucent, crest c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.15 × 7 mm, longitudinally ridged. *Bulbils* corky, produced at peduncle or cincinni, globose to fusiform, c.5–15 mm long.

Distribution. Borneo (Fig. 14).

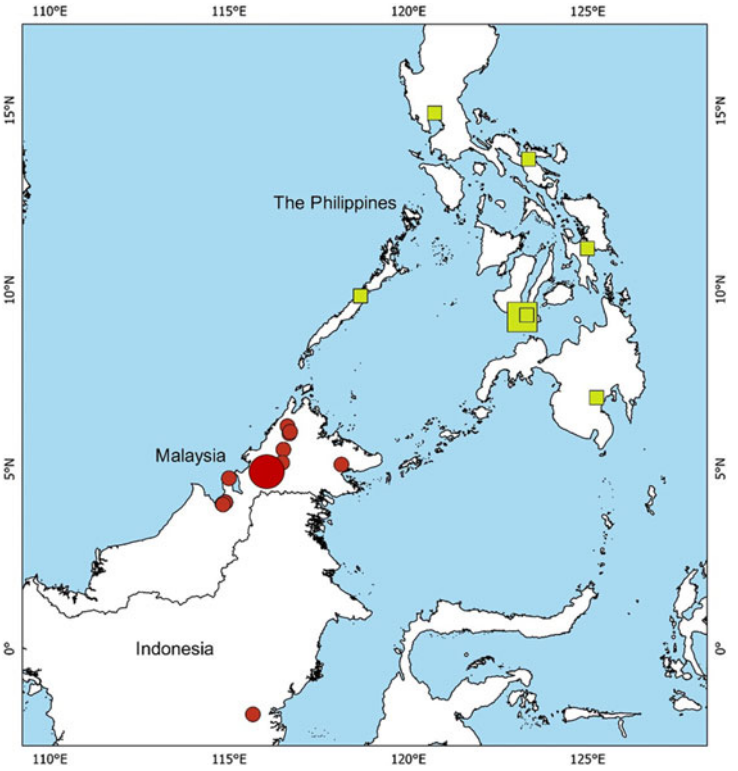


FIG. 14. Distribution range of *Globba francisci* Ridl. (circles) and *G. gracilis* K.Schum. (squares). The type locality of each species is indicated with a bigger symbol.

Habit and ecology. Growing in humid places, lithophyte, at 70–1520 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba francisci* is widespread in Borneo (Sarawak, Sabah and Kalimantan). The EOO and AOO are 163,704 km^2 and 60 km^2, respectively. Some localities are in protected areas and there is no evidence of threats to this species. It is therefore assessed as of Least Concern.

Specimens examined. INDONESIA. **Kalimantan Selatan**: Muarauya, 9 xi 1972, *Vogel* 2118 (L).

MALAYSIA. **Sabah**: Witti Range, 18 i 1986, *Sumbing* SAN 113292 (L); Poring Hot Springs, 18 vi 1986, *Smith* 33/86 (E); Trusmadi Forest Reserve, viii 1977, *Gardner* 68 (E); ibid., 11 vi 1984, *Beaman* 10080 (E); ibid., 5 iv 1984, *Beaman* 9209 (E); ibid., 10 vi 1986, *Smith* 4/86 (E); Mount Kinabalu National Park, 17 ii 1931, *Clemens & Clemens* 30278 (HBG). **Sarawak**: Gunung Mulu National Park, 31 vii 1978, *Jermy* 14229 (E); ibid., 7 x 1971, *Sinclair* 31806 (E); ibid., 30 x 1977, A*rgent & Kerby* 629 (E); ibid., x 1977, *Argent & Kerby* 630/A (E); ibid., 16 i 1978, *Hansen* 16 (C); ibid., 16 i 1978, *Nielsen* 12 (AAU); Limbang, 9 ix 1980, *George & Othman* S42376 (AAU); Marudi, 9 ii 1966, *Chew* 1018 (AAU, HBG [as cf.]).

Globba francisci is a common species in Borneo, growing in lowland mountains to 1500 m on Mount Kinabalu (Lamb *et al*., 2013). Ridley (1914) described this species from a plant collected in Sabah, to honour A.B.C. Francis. In the protologue, he mentioned that *Globba francisci* was allied to *G. pendula* but that the labellum had no brown spot. Smith (1988) treated *Globba argentiana* as synonymous with *G. francisci* and mentioned that this species was close to *G. albiflora* and *G. paniculata*. Two distinct diagnostic characters of *Globba francisci* are the labellum base with cornicula, which are emphasised in the text and figure by the term "the curious appendages on the filament", and the cucullate dorsal corolla lobe.

Our morphological study of the lectotype of *Globba francisci*, *Gibbs* 2932 (BM), confirms the information just given. The cornicula on the labellum are easily seen. In addition, information received from researchers studying gingers in Borneo indicates that a variation of this species with a dark orange spot on the labellum can also be found (Lamb *et al*., 2013). Most recently, *Globba francisci* has also been recorded in Palawan island, the Philippines (Docot *et al*., 2019).

8. Globba gracilis K.Schum., Pflanzenr. IV, 46 (Heft 20): 145 (1904). – Type: Philippines, Mindanao, Davao del Sur, Mount Apo, 7°N, 125°15′E, 1200 m, 21 ii 1976, *Sands & Gutiérrez* 3167 (neo K, designated here); Philippines, Mindanao, Davao District, mixed and high forest on Mt Gagapan, 300–1000 m, vi 1888, *Warburg* 15480 (B destroyed). **Figs 15, 16A,D,G.**

Globba leucocarpa Ridl., Philipp. J. Sci., C 4(2): 161 (1909). – Type: Philippines, Leyte, Palo, *Elmer* 7298 (lecto E [E00149933], designated here); Mindoro Oriental, Baco River, iv–v 1905, *McGregor* 201 (syn NY); ibid., iv 1903, *Merrill* 1789 (syn HBG n.v.); ibid., iii 1905, *Merrill* 4064a (syn K), **syn. nov.**

Clump-forming herb, 40–50 cm tall, leaning with upright inflorescence. *Leaf sheaths* c.3, bladeless, green or light brown at basal sheaths; ligule truncate to shallowly bilobed, c.2 mm long; blades 9–11, oblong to narrowly elliptic, 4.5–15 × 0.7–1.7 cm, base cuneate or obtuse, apex long acuminate, pubescent below, sparsely puberulous above, sessile. *Inflorescence* conical, 6–7 × 3.5–6 cm; peduncle 2–5 cm long; rachis glabrous, green; bracts and bracteoles caducous, obovate, 2–3 mm long, apex obtuse, glabrous, green; cincinni lax, 0.7–2 cm long, pedicel c.1 mm long. *Flowers* c.2.6 cm long, white with yellowish orange spot at labellum; ovary ellipsoid, c.2 mm long, pale green; calyx infundibuliform, c.5 mm long, trilobed with obtuse apices and glabrous margins; floral tube c.12 mm long, dorsal and lateral corolla lobes narrowly elliptic, 3–5 mm long; lateral staminodes oblong, c.5 × 1.5 mm, apex obtuse, slightly longer than lateral corolla lobes, glandular hairy; labellum triangular, c.5 × 3 mm, base long decurrent on filament, c.2 mm long, cornicula at tip c.1 mm long, apex obtuse, nectar tube c.4 mm long; filament c.20 mm long; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest obtuse, c.1 mm long at tip; ♀ appendages falcate, c.2.5 mm long, held ± perpendicular to anthers, base covering lower half of side of anther, apex acuminate and curved upwards, margins parallel almost to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex

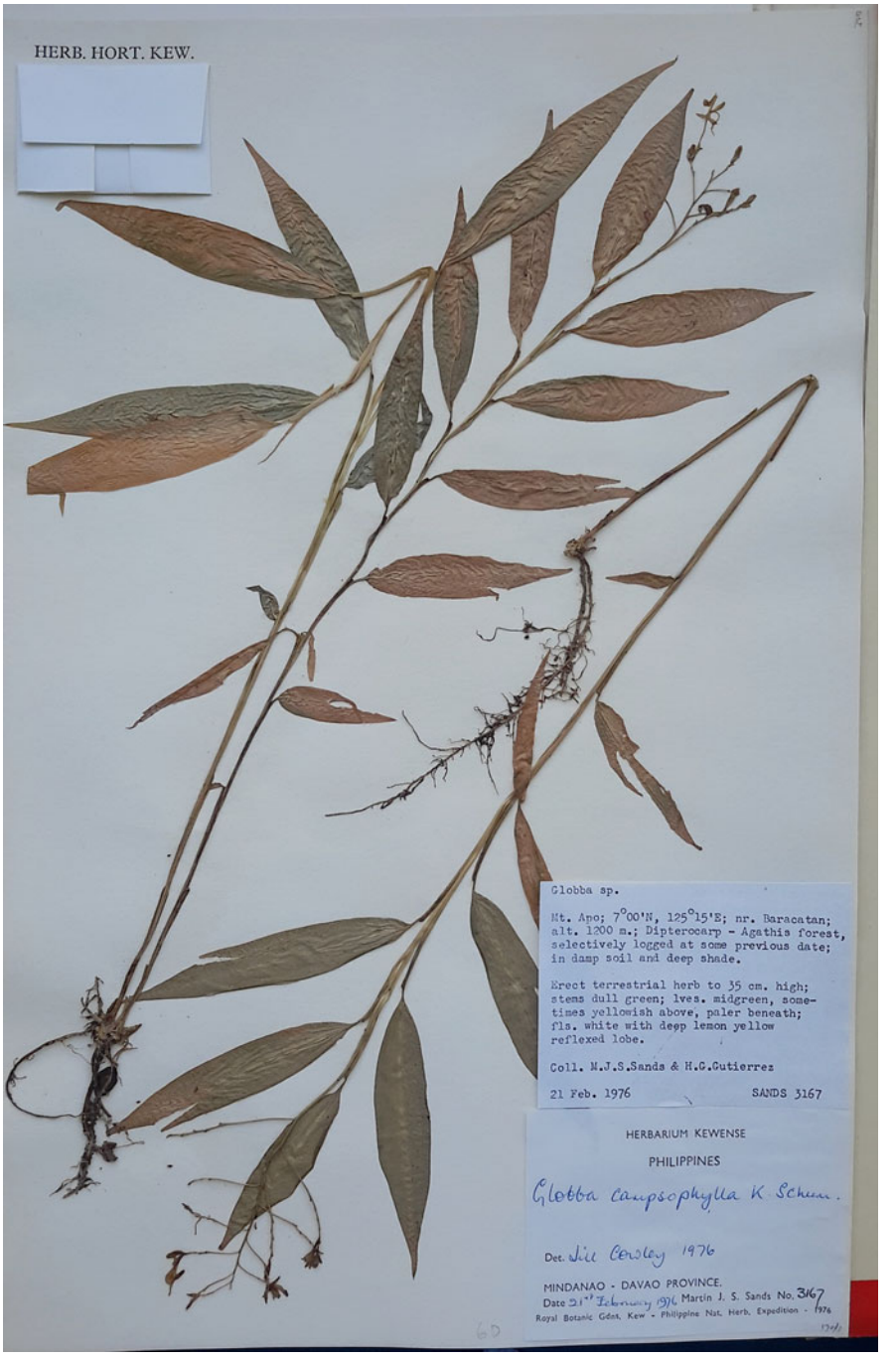


FIG. 15. Neotype of *Globba gracilis* K.Schum., *Sands & Gutiérrez* 3167 (K). Photograph: Sunisa Sangvirotjanapat.

FIG. 16. *Globba gracilis* K.Schum. (RBGE accession no. E19972553B): A and D, ♂ flower (front and side views, respectively); G, habit. *Globba lilacina* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 755): B and E, ♂ flower (front and side views, respectively); H, habit. *Globba macrocarpa* Gagnep. (RBGE accession no. E20100769A): C and F, ♂ flower (front and side views, respectively). Scale bars: A–F, 1 cm. Photographs: A and D, Axel Dalberg Poulsen; B, C and E–G, Sunisa Sangvirotjanapat; H, Watcharasak Makerd.

acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.7 × 10 mm, longitudinally ridged. *Bulbils* corky, produced at peduncle, globose, c.3 mm in diameter.

Distribution. The Philippines (see Fig. 14).

Habit and ecology. Growing in moist, shady places, at 300–1200 m.

Proposed IUCN conservation status. Least Concern (LC). This species is endemic to the Philippines. The EOO and AOO are 370,756 km^2 and 32 km^2, respectively. Most localities are in protected areas and it is cultivated at RBGE. This species is therefore assessed as of Least Concern.

Specimens examined. PHILIPPINES. **Camarines Sur**: Mount Isarog, 1 v 2007, *Newman & Škorničková* 2006 (E [cultivation voucher, RBGE, accession no. 19972553A]). **Negros Oriental**: Dumaguete, vi 1908, *Elmer* 10038 (E, SING). **Palawan**: 15 vi 1988, *Soejarto & Madulid* 6134 (E). **Sorsogon**: Bulusan Lake, 2 xi 1996, *Garcia & Fernando PPI* 22908 (L).

Schumann (1904) described three new species from the Philippines, *Globba brevifolia*, *G. campsophylla* and *G. gracilis*, which all seem to be based on variable traits such as leaf shape and indumentum. For instance, *Globba gracilis*, originally from Davao, Mindanao, at 300–1000 m, is related to *G. brevifolia* and *G. campsophylla* but is supposed to be distinct by its leaf surface indumentum. *Globba brevifolia* from Luzon was noted to have only four or five leaves, with round bases, making it distinct from *G. campsophylla*.

In this revision, two of these species are accepted, *Globba campsophylla* and *G. gracilis*. Here, *Sands & Gutiérrez* 3167 (K) is designated as the neotype of *Globba gracilis*, because it corresponds well to the protologue and was collected from Mount Apo. According to Schumann (1904), *Warburg* 15480 was collected at Mount Gagapan in Davao District, which was thought by Copeland (1910) to be a misprint for Mount Dagatpan. This mountain, spelled Dagatpan, is probably on the southeastern side of Mount Apo in Santa Cruz Municipality (Rudolph Valentino Docot, Far Eastern University, Manila, personal communication), very near Warburg's original locality.

The protologue of *Globba leucocarpa* cites five syntypes from Luzon, Leyte and Mindoro islands. Two duplicates of *Elmer* 6465A (K, US), collected in Benguet Province, have been seen by us and identified as *Globba campsophylla*. The lectotype and remaining syntypes cited here, which are all from Leyte and Mindoro, are *Globba gracilis*. A further collection, *Merrill* 4064 (SING 0044065), is marked as a type but the protologue clearly cites *Merrill* 4064a, so the status of the specimen at SING is uncertain.

Globba gracilis resembles *G. campsophylla* in its white flower with a yellow spot on the labellum but differs by its small leafy shoot, 40–50 cm tall, and inflorescence, 6–7 × 3.5–6 cm, as well as producing bulbils on the lower part of inflorescence, whereas *G. campsophylla* has a bigger leafy shoot, 40–80 cm, and inflorescence, 9–18 × 7–10 cm. Importantly, bulbil production is at the tip of the inflorescence.

9. Globba lilacina Sangvir. & M.F.Newman, **sp. nov.**
Similar to *Globba macrocarpa* Gagnep. in its white flower with yellow spot on the labellum but differs by the tip of its long decurrent labellum with cornicula (versus short decurrent with very small cornicula) and combination of purplish anther appendages with white on the rest of the flower (versus white only). – Type: Thailand, Kanchanaburi, Thong Pha Phum, 14°48′N, 98°37′59′′E, 500 m, 5 vii 1973, *Maxwell* 73-131 (holo BK, iso AAU). **Figs 16B,E,H, 17.**

Herb, 30–80 cm tall, leaning with upright inflorescence. *Leaf sheaths* c.3, bladeless, green or light brown at basal sheaths, margin ciliate; ligule bilobed, 2–5 mm long, ciliate; blades 5–9, sessile, narrowly elliptic to ovate, 10–22 × 1.6–8.2 cm, base obliquely obtuse, apex acuminate, pubescent below, sparsely strigillose along midrib above, greenish grey sometimes with grey stripes along midrib. *Inflorescence* conical, 8–20 × 6.5–15 cm; peduncle 1–2 cm long; rachis pubescent, white or green; bracts and bracteoles caducous, occasionally persistent, oblong to elliptic, 2.5–10 × 1–6 mm, pubescent, green with white margin; cincinni 1–8 cm long, pubescent. *Flowers* 2.8–3.5 cm long; ovary cylindrical, c.2 mm long, shallowly ridged, pubescent, green; calyx infundibuliform, 3–5.5 mm long, trilobed with obtuse apices, green with white margin; floral tube 12–18.5 mm long, white, dorsal and lateral corolla lobes hooded, elliptic, 4–5 × 1.5–2 mm, dorsal one mucronate at apex, greenish white; lateral staminodes variably linear to obovate, 10–15 × 2–5 mm, apex acute to acuminate, glandular hairy, about twice as long as lateral corolla lobes, white; labellum triangular, 6–8 × 4–5.5 mm, bilobed, white with two yellow patches or two brown spots within two yellow-orange patches at centre, base attenuate, long decurrent on filament, 3–4 mm long, cornicula at tip c.1 mm long, apex acute, nectar tube 4–6 mm long; filament 21–26 mm long, white; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages purplish or white, semitranslucent, crest c.1 mm long at tip; ♀ appendages falcate, c.2 mm long, held ± perpendicular to anthers, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, 3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved upwards, margins parallel almost to apex. *Fruit* ellipsoid, c.15 × 6 mm, longitudinally ridged, green. *Bulbils* corky, produced at peduncle and within leaf sheaths, ellipsoid to fusiform, c.13 × 8 mm.

Distribution. Endemic in Thailand (Fig. 18).

Etymology. From Latin *lilacinus*, meaning 'lilac-coloured', referring to the colour of the anther appendages.

Habit and ecology. Mixed forest in semishaded areas, at 50–800 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba lilacina* is endemic to Kanchanaburi Province in Thailand. The EOO and AOO are 16,226 km^2 and 40 km^2, respectively, suggesting a status of Vulnerable. It grows in a protected area, however, and

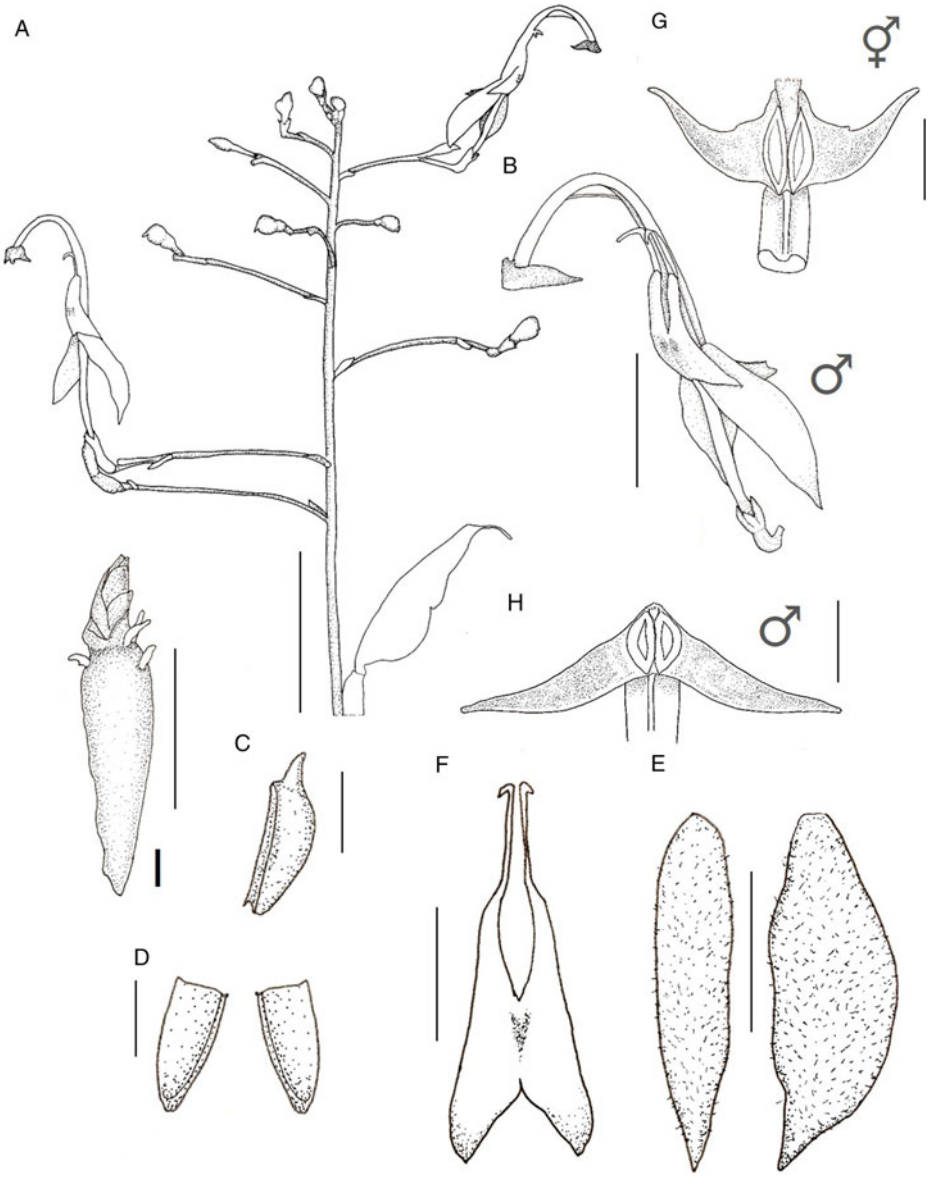
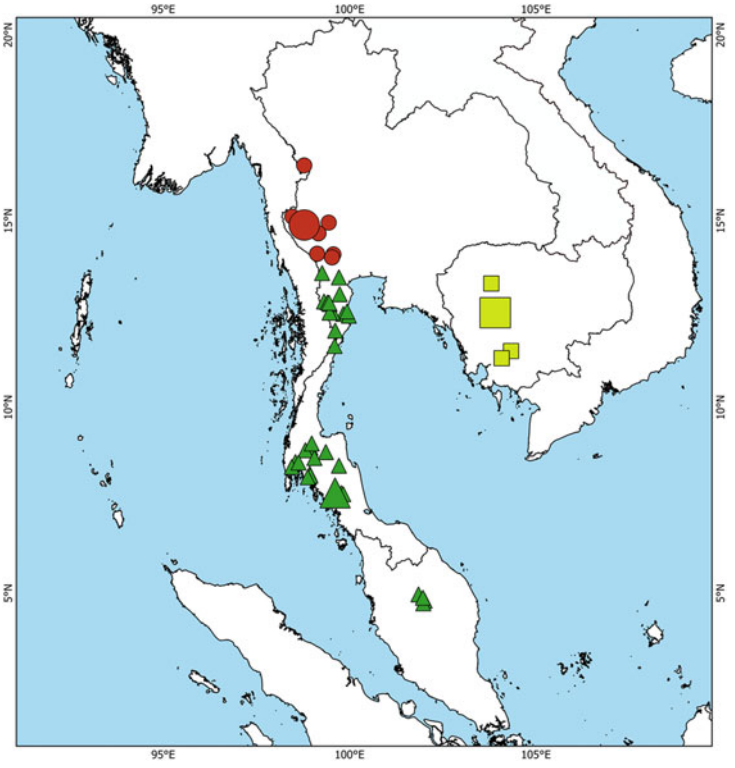


FIG. 17. *Globba lilacina* Sangvir. & M.F.Newman, sp. nov. A, Inflorescence; B, ♂ flower; C, dorsal corolla lobe; D, lateral corolla lobes; E, lateral staminodes, showing variation in shape; F, labellum; G, ♀ appendages; H, ♂ appendages; I, bulbil. Scale bars: A, 5 cm; B and I, 1 cm; C and D, 3 mm; E and F, 5 mm; G and H, 2 mm. Drawn from *Sangvirotjanapat* 755 by Sunisa Sangvirotjanapat.



F I G . 1 8 . Distribution range of *Globba lilacina* Sangvir. & M.F.Newman (circles), *G. macrocarpa* Gagnep. (squares) and *G. newmanii S*angvir. (triangles). The type locality of each species is indicated with a bigger symbol.

is cultivated at Queen Sirikit Botanic Garden. This species is therefore assessed as of Least Concern.

Specimens examined. THAILAND. **Kanchanaburi**: 18 vii 1926, *Put* 170 (BK, C, K); 13 vii 1930, *Kerr* 19550 (BK, K); *Thitimetharoch & Faden* 750 (BKF); Sai Yok, 30 vii 1928, *Put* 1771 (BK, K); ibid., 2 viii 1928, *Marcan* 2392 (K); ibid., 27 vii 1946, *Kostermans* 1385 (A); ibid., 3 vii 1963, *Larsen* 10468 (AAU); ibid., 7 vii 1963, *Larsen* 10583 (AAU, BKF); ibid., 2 vii 2006, *Chongko* 541 (CMU, QBG); Sai Yok, Khao Soi Dao, 1 vii 1963, *Larsen* 10414 (AAU, BKF); Huay Ban Kao, 7 xi 1971, *Beusekom* et al. 3490 (BKF); ibid., 4 vii 1973, *Geesink & Phengklai* 6099 (BKF); ibid., 12 vii 1973, *Geesink & Phengklai* 6240 (AAU, BKF, C, E, P); Thong Pha Phum, 13 vii 1973, *Maxwell* 73-288 (AAU, BK); ibid., 1 vi 2000, *Triboun* 884 (BK); Si Sawat, 26 vi 1974, *Larsen & Larsen* 33809 (AAU, K); Sangkhla Buri, 18 viii 2001, *Suksathan* 3040 (QBG). **Suphan Buri**: Phu Toei National Park, 31 vii 2012, *Tanming* 829 (QBG). **Tak**: Phop Phra, Ban Pha Kracho, 3 viii 2015, *Sangvirotjanapat* 755 (QBG [cultivation voucher, QSBG, accession no. 20161670]).

This species is unique in its white flower with purple anther appendages including the labellum base bearing distinct cornicula. Another species, *Globba geoffrayi* Gagnep., of

sect. *Ceratanthera*, also has a purple anther appendage but has two pairs of anther appendages. Moreover, its labellum is also pure white.

10. Globba macrocarpa Gagnep., Bull. Soc. Bot. France 48: 205 (1901); Gagnepain, Fl. Indo-Chine 6(1): 31 (1908). – Type: Cambodia, Pursat, 18 vi 1875, *Godefroy-Lebeuf* 488 (lecto P [P032715], designated here; isolecto E [E00147691], MPU [MPU018312 and MPU018313], P [P032714, P00686485 and P00686486]). **Fig. 16C,F.**

Globba macrocarpa var. *densa* Gagnep., Fl. Indo-Chine 6(1): 32 (1908). – Type: Cambodia, Khnong Repeu, v 1870, *Pierre s.n.* (lecto P [P032716], designated here; isolecto E [E00147692], P [P00686487 and P00686488]), **syn. nov.**

Herb, 70–100 cm tall. *Leaf sheaths* c.4, bladeless, green or light brown at basal sheaths; ligule bilobed, c.2 mm long, glabrous; blades c.8, lanceolate to elliptic, 10–19 × 2–4.5 cm, base cuneate or obtuse, apex acuminate, glaucous and pubescent below, glabrous above, sessile. *Inflorescence* conical, c.24 × 14 cm; peduncle 1–2 cm long; rachis glabrous, green; bracts and bracteoles caducous, elliptic, 3–5 mm long, apex acute, glabrous, green; cincinni lax, 1.5–8.5 cm long, pedicel c.1 mm long. *Flowers* c.3.2 cm long; ovary ellipsoid, c.7 mm long, ridged, green; calyx infundibuliform, c.5 mm long, trilobed with acute apices, green becoming white at margin; floral tube 15–18 mm long, white, dorsal and lateral corolla lobes narrowly elliptic, c.5–7 × 1.5 mm, dorsal lobe long mucronate, c.2 mm long, white; lateral staminodes oblong, c.8 × 2 mm, apex obtuse, slightly longer than lateral corolla lobes, glandular hairy, white; labellum triangular, c.10 × 4 mm, base long decurrent on filament, c.3 mm long, small cornicula at tip, apex obtuse, white with two greenish brown spots on yellow patches, nectar tube 2–3 mm long; filament c.20 mm long, white; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest elliptic, c.2 mm long at tip; ♀ appendages falcate, c.2.5 mm long, held ± perpendicular to anther, base covering whole side of anther, apex acuminate and curved upwards, margins parallel almost to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3.5 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, longitudinally ridged, green. *Bulbils* not seen.

Distribution. Cambodia (see Fig. 18).

Habit and ecology. Growing along trails in deciduous forest, at about 620 m.

Proposed IUCN conservation status. Data Deficient (DD). *Globba macrocarpa* is endemic to Cambodia (Pursat and Kampong Spoe Provinces). The EOO and AOO are 3379 km^2 and 20 km^2, respectively. According to herbarium specimens, the localities are near protected areas. It is assumed that there may be other populations that have not been recorded yet. Because there is no evidence of threats to this species, it is assessed as Data Deficient.

Specimens examined. CAMBODIA. **Kampong Spoe**: 15 vi 1930, *Poilane* 17633 (P); Kirirom, 29 v 2010, *Newman* et al. 2415 (E); ibid., 14 x 2010, *Cheng & Leti* CL1300 (SING); ibid., 25 vi 2015, *Pospíšilová* 63 (E [cultivation voucher, RBGE, accession no. 20100769]).

Similar to *Globba chrysochila* in its white flower with yellow patch on the labellum but differs by its lateral corolla lobes and lateral staminodes of almost equal length (versus

lateral staminodes about twice as long), round labellum apices (versus acute labellum apices) and long mucronate dorsal corolla lobe (versus very short mucronate). So far, this species has been found only in Cambodia.

11. Globba newmanii Sangvir., **sp. nov.**

Similar to *Globba thorelii* Gagnep. in its orange flowers but differs by its pure orange labellum (versus red spot on labellum), its plain green leaf sheaths, rachis and cincinni (versus sparse maroon dots), glabrous leaf above (versus strigillose hairs at midrib) and long (1.5–2 mm) mucronate dorsal corolla lobe (versus absent or short mucronate, to 1 mm long, dorsal corolla lobe). – Type: Thailand, Trang, Huai Yot, Wat Tham Iso, 10 viii 2005*, Pooma, Phattarahirankanok, Sirimongkol & Poopath* 5635 (holo BKF, iso E). **Figs 19, 20A–C.**

Globba albiflora var. *aurea* Holttum, Gard. Bull. Singapore 13(1): 32 (1950). – Type: Peninsular Malaysia, Kelantan, 16 vii 1935*, Henderson SFN* 29715 (holo SING n.v.).

Herb, 50–120 cm tall, leaning with upright inflorescence. *Leaf sheaths* c.3, bladeless, sparsely pubescent, green or light brown at basal sheaths; ligule bilobed, round, c.4 mm long, glabrous; blades 8–14, elliptic to ovate, 6.5–19 × 1.5–5 cm, base obliquely obtuse, apex acuminate, pubescent below, glabrous above, sessile. *Inflorescence* conical, 5.5–16 × 4–5 cm; peduncle 1.5–2 cm long; rachis pubescent, plain green; bracts and bracteoles caducous, elliptic, 1–3 × 0.5–1 mm, pubescent, yellowish green; cincinni numerous, pedicel 1–3 mm long. *Flowers* 2.8–3.5 cm, pure orange; ovary cylindrical, c.3.5 mm long (♀), ridged; calyx infundibuliform, 4–6 mm long, trilobed with acuminate apices and pubescent margins, yellowish green; floral tube 15–16 mm long, glandular hairy, dorsal and lateral corolla lobes elliptic, 5–9 × 1–3 mm, dorsal lobe long mucronate at apex, 1.5–2 mm long; lateral staminodes linear, 8–11 × 1.5 mm, apex acuminate, slightly longer than lateral corolla lobes, glandular hairy; labellum triangular to oblong, 5.5–7.5 × 5.5–7 mm, pure orange, base attenuate, long decurrent on filament, 3–5 mm long, cornicula at tip c.2 mm long, sometimes shorter in ♀ flowers, apex round to acute, nectar tube 3–5 mm long; filament c.24 mm; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages orange, semitranslucent, crest c.1 mm long at tip, ♀ appendages falcate, c.2.5 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.4 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.2.3 × 0.7 cm, deeply ridged, green. *Bulbils* corky, produced at peduncle, fusiform, 1–4 cm long, rarely produced.

Distribution. Peninsular Malaysia, Thailand (see Fig. 18).

Etymology. This species is named in honour of Dr Mark Newman, who inspired the first author to study sect. *Nudae* and who spent two years exploring gingers in southern Thailand, in the range of distribution of this plant.

Habit and ecology. Lithophyte. Usually found on limestone bedrock at 10–1830 m.

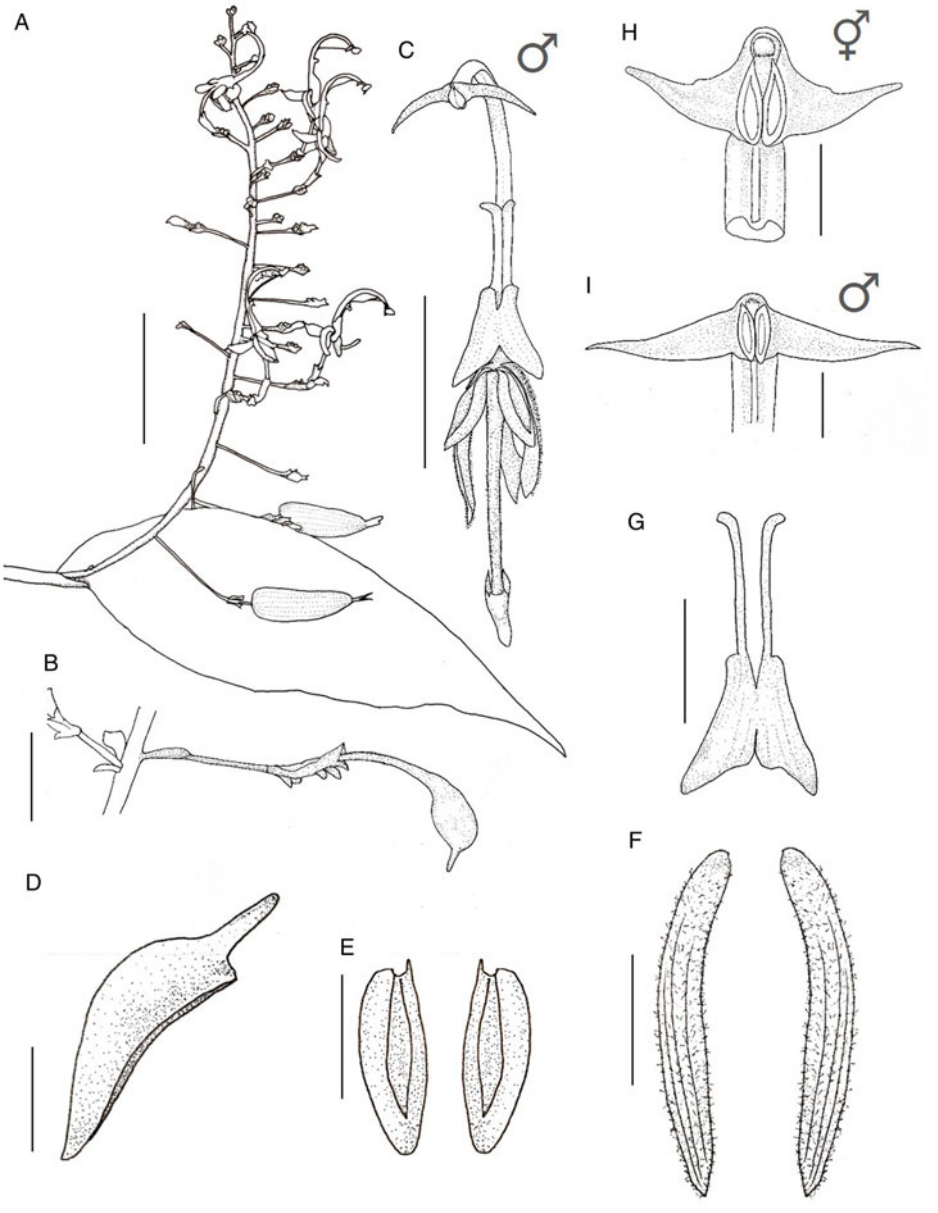


FIG. 19. *Globba newmanii* Sangvir., sp. nov. A, inflorescence; B, flower bud; C, ♂ flower; D, dorsal corolla lobe; E, lateral corolla lobes; F, lateral staminodes; G, labellum; H, ♀ appendages; I, ♂ appendages. Scale bars: A, 5 cm; B and C, 1 cm; D–G, 3 mm; H and I, 2 mm. Drawn from *Sangvirotjanapat* 746 by Sunisa Sangvirotjanapat.

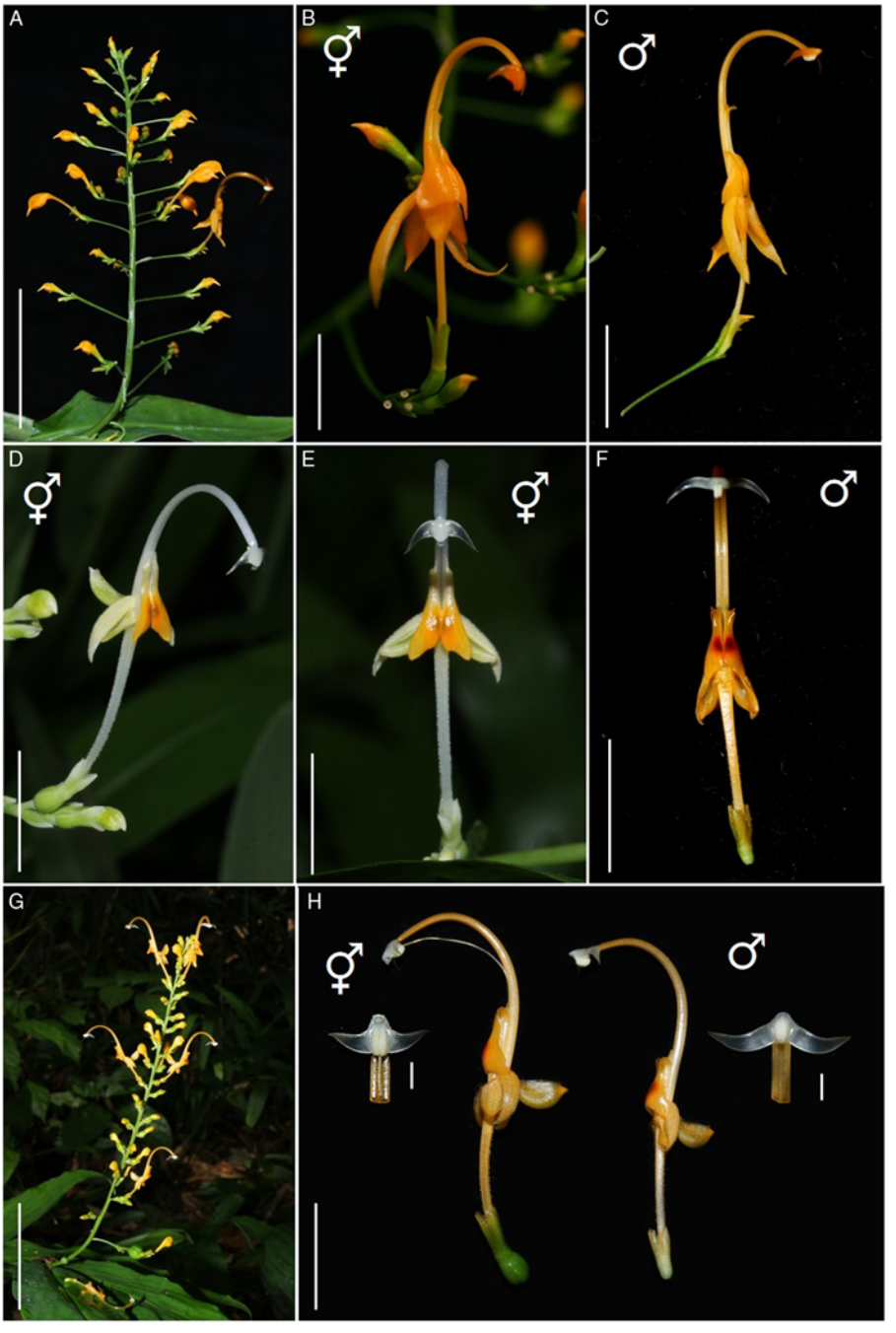


FIG. 20. *Globba newmanii* Sangvir., sp. nov. (*Sangvirotjanapat* 746): A, inflorescence; B, ♀ flower; C, ♂ flower. *Globba nitens* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 794): D and E, ♀ flower. *Globba pycnostachys* Sangvir. & M.F.Newman, sp. nov. (*Sangvirotjanapat* 747): F, ♂ flower (front view); G, inflorescence; H, ♀ and ♂ flowers (side views) with the appendages. Scale bars: A and G, 10 cm; B–F and H, 1 cm. Photographs by Sunisa Sangvirotjanapat.

Proposed IUCN conservation status. Least Concern (LC). *Globba newmanii* is fairly widespread in Thailand and Malaysia, with an EOO of 156,905 km^2. Many populations grow in national parks and the species is cultivated at Queen Sirikit Botanic Garden, so we assess it as of Least Concern.

Specimens examined. MALAYSIA. **Kelantan**: Gua Puyu, 11 viii 2009, *Julius* FRI56245 (E, SING); Gua Musang, 11 viii 1971, *Chin* 1420 (K); ibid., 28 ix 2006, *Yao* et al. FRI53179 (K). **Pahang**: Merapoh, *Ong* FRI88689 (KEP).

THAILAND. **Krabi**: 10 vii 1992, *Larsen* et al. 43252 (AAU, PSU); Khao Phanom Bencha, 11 vii 1992, *Larsen* et al. 43290 (AAU, PSU); Sai Thai, 17 vi 2006, *Williams* 1839 (A, BKF, E). **Nakhon Si Thammarat**: Khao Luang, 24 viii 1995, *Larsen* et al. 45980 (AAU [as cf.]). **Phangnga**: Thap Put, 24 viii 1967, *Shimizu* et al. 7947 (AAU); Takua Thung, 25 viii 1967, *Shimizu* et al. 8050 (AAU); Khao Nang Hong, 20 vii 1972, *Larsen* et al. 31177 (AAU, K, P). **Phattalung**: Khao Puu Khao Yaa National Park, 26 x 1993, *Larsen* et al. 44045 (AAU). **Phetchaburi**: *Pierre* 48 (P, 2 sheets [as cf.]); Kaeng Krachan National Park, 3 viii 1995, *Larsen* et al. 45365 (AAU, L); ibid., 4 viii 1995, *Larsen* et al. 45401 (BKF, SING); ibid., 5 viii 1995, *Larsen* et al. 45421 (AAU, K); ibid., 23 vi 2000, *Newman* et al. 1013 (E); ibid., 28 vi 2000, *Newman* et al. 1120 (BKF, E); ibid., 10 viii 2002, *Middleton* et al. 917 (A); ibid., 5 vii 2015, *Sangvirotjanapat* 746 (QBG); ibid., 20 ix 2002, *unknown collector 95 KL* 46988 (AAU). **Prachuap Khiri Khan**: 3 vii 1926, *Kerr* 10782 (BK, K); Pak Thawan, 2 viii 1931, *Kerr* 20542 (K); Hua Hin, Khao Tao, 1 viii 1976, *Maxwell* 76-467 (AAU, BK); Kui Buri, 19 viii 2002, *Middleton* et al. 1219 (A, AAU, CMU, E). **Ratchaburi**: Ban Khao Nam Tok, 10 viii 1966, *Larsen* et al. 1384 (AAU, K); Suan Phueng, Ban Huai Nam Nak, 28 v 1987, *Paisooksantivatana & Sangkhachand* Y2082-87 (BK, BKF). **Surat Thani**: Ban Na San, 13 viii 1927, *Kerr* 13328 (BK, C, K); Khao Phra Rahu, 20 ix 1963, *Smitinand & Sleumer* 1171 (AAU, K); 25 ix 1963, *Smitinand & Sleumer* 1276 (AAU, K); Khirirat Nikhom, 8 ix 2008, *Middleton* et al. 4367 (E, K); Tham Nang Phanthurat, 31 vii 2009, *Triboun* 4304 (E). **Trang**: 11 x 1970, *Charoenpol* et al. 3639 (AAU); 16 xi 1990, *Larsen* et al. 41447 (AAU); Huai Yot, Wat Tham Iso, 14 vi 2006, *Williams* 1740 (A, BKF).

Because the labellum is used in the first couplet of the identification key in this paper, it is essential to understand whether or not the labellum has cornicula when determining material in this subsection. *Globba newmanii* is a complicated case, because in the same inflorescence, male flowers consistently have distinct cornicula whereas those of hermaphrodite flowers are much smaller (Fig. 20B). Populations in southern Thailand and in Peninsular Malaysia vary slightly in labellum shape. Thai specimens have a triangular labellum, whereas Malaysian ones have an oblong labellum.

Holttum published a new variety of *Globba albiflora* in 1950, comparing his material with *G. paniculata* from Sumatra. He differentiated *Globba paniculata* from *G. albiflora* var. *aurea* by the colour of the flower, which was orange in the specimen from Kelantan. This orange-flowered specimen was then compared with *Globba albiflora* specimens from Pinang Hill, because they were both limestone plants. *Globba albiflora* var. *aurea* was recognised based on its flower colour and the length of its labellum.

No record of the deposition of the holotype of *Globba albiflora* var. *aurea*, *Henderson SFN* 29715, from Gua Lambok at SING, can be found. We have investigated other specimens collected near Gua Lambok (*Julius* FRI56245) and found an orange-flowered

plant that we recognise as *Globba newmanii*. This is very likely to be Holttum's *Globba albiflora* var. *aurea*, which we treat at species rank because the epithet *aurea* at species rank is not available.

12. Globba nitens Sangvir. & M.F.Newman, **sp. nov.**
Similar to *Globba xantholeuca* Craib in its habit and inflorescence characteristic but differs by its cream flower with brown spot on dark orange patch on the labellum (versus white flower with yellow patch on the labellum) and bamboo-like bulbils (versus corky bulbils). – Type: Thailand, Phayao, Mueang Phayao, Champa Thong waterfall, 19°13′N, 99°44′16.1′′E, 21 ix 2016, *Sangvirotjanapat* 794 (holo BKF; iso E, QBG, SING). **Figs 20D,E, 21.**

Clump-forming herb, 80–100 cm tall. *Leaf sheaths* c.4, bladeless, basal ones dark green, glabrous; ligule shallowly bilobed, 2–4 mm long, pubescent; blades c.11, oblong-lanceolate, base obliquely obtuse, apex acuminate, glaucous below, glabrous, sessile, shiny green. *Inflorescence* conical, c.20 × 8.5 cm; peduncle c.4.5 cm long; rachis glabrous, green; bracts and bracteoles caducous, linear to elliptic, 3.5–5 × 2–8 mm long, apex acute, glabrous, green becoming white at margin; cincinni lax, 1–6.5 cm long, pedicel c.3 mm long. *Flowers* c.3.5 cm long; ovary ovoid to ellipsoid, 1–4 mm long (♀), ridged; calyx infundibuliform, 3–4 mm long, trilobed with acuminate apices, pubescent or glabrous at margins, yellowish green; floral tube c.18 mm long, glandular hairy, white, dorsal and lateral corolla lobes hooded, narrowly elliptic, 4–5 × 1–1.5 mm, apex acute, greenish yellow; lateral staminodes oblong, c.8 × 1.5 mm, apex acute, slightly longer than lateral corolla lobes, cream; labellum triangular, c.8 × 5 mm, bilobed, pale yellow at base with brown spot on dark orange patch, base attenuate with very small teeth, apex acute, nectar tube c.4 mm long; filament c.24 mm long, white; anther elliptic, c.1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest round, c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, c.20 × 7 mm, deeply ridged, green. *Bulbils* bamboo-like, 3–5 per plant produced at peduncle, producing many shoots, ovoid, c.10 × 8 mm, scaly.

Distribution. Thailand (Fig. 22).

Etymology. From Latin *nitens*, meaning 'shining', which describes its leaf surface.

Habit and ecology. Usually found at high altitude, particularly in humid areas by waterfalls and streams, at about 615 m.

Proposed IUCN conservation status. Endangered (EN). *Globba nitens* is endemic in Thailand, restricted to two localities with a small population of fewer than 250 mature individuals. One of the two localities is in a protected area, but the plants grow along a

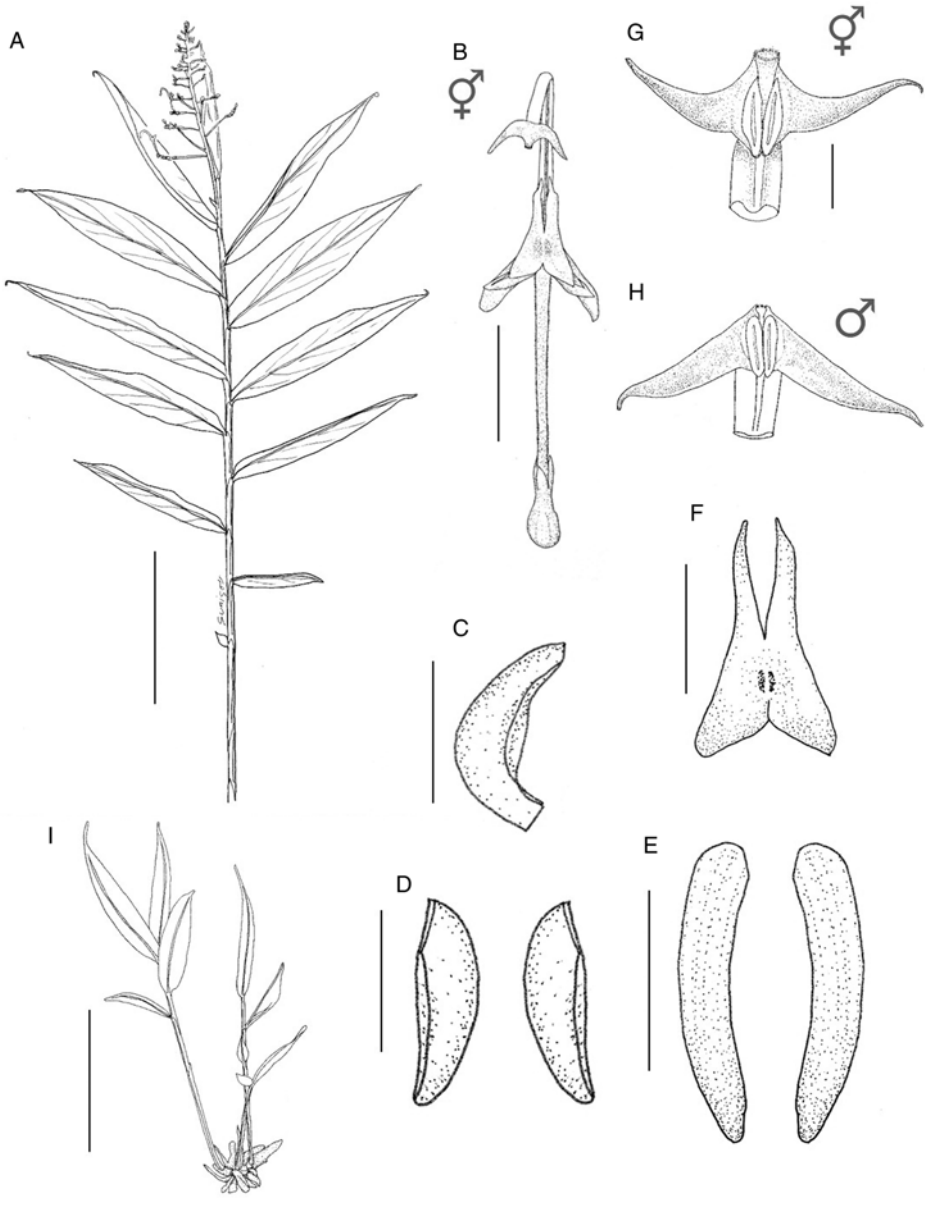


FIG. 21. *Globba nitens* Sangvir. & M.F.Newman, sp. nov. A, Habit; B, ♀ flower; C, dorsal corolla lobe; D, lateral corolla lobes; E, lateral staminodes; F, labellum; G, ♀ appendages; H, ♂ appendages (same scale as G); I, bulbil. Scale bars: A, 10 cm; B, 1 cm; C and D, 3 mm; E and F, 5 mm; G and H, 2 mm; I, 5 cm. Drawn from *Sangvirotjanapat* 794 by Sunisa Sangvirotjanapat.

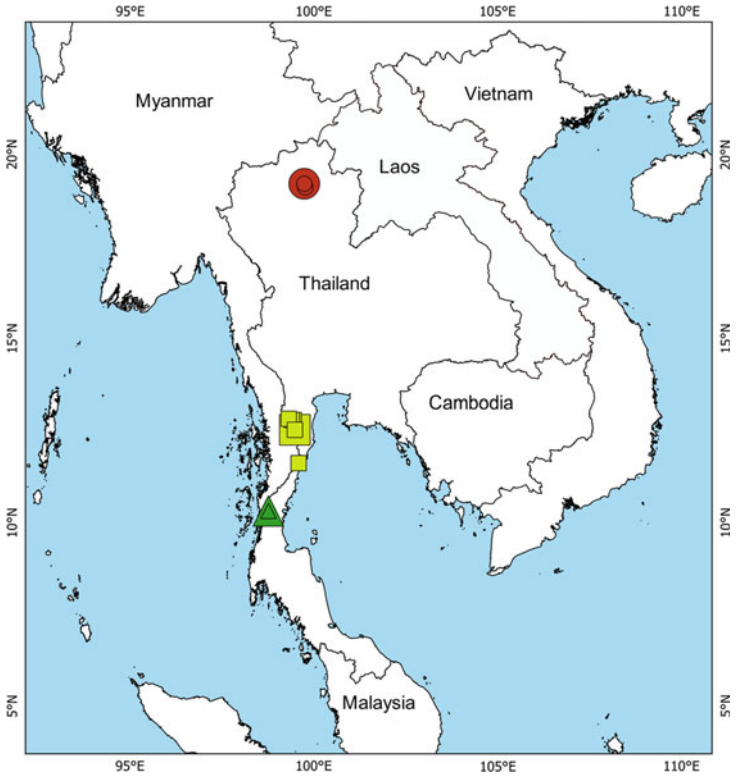


FIG. 22. Distribution range of *Globba nitens* Sangvir. & M.F.Newman (circles), *G. pycnostachys* Sangvir. & M.F.Newman (squares) and *G. ranongensis* Picheans. & Tiyaw. (triangles). The type locality of each species is indicated with a bigger symbol.

waterfall at which some subpopulations can be easily accessed. The other locality also has tourism activities by the local community. Taking these facts into account, *Globba nitens* is considered Endangered under criterion D.

Specimen examined. THAILAND. **Phayao**: Doi Luang National Park – Phayao, 25 vii 1997, *Petrmitr* 36 (A, BKF).

Globba nitens resembles *G. xantholeuca* in its habit, but their ecological habitats are quite different. Whereas *Globba xantholeuca* grows in somewhat dry places, *G. nitens* is found only in moist habitats.

13. Globba paniculata Valeton, Ann. Jard. Bot. Buitenzorg 31: 18 (1921). – Type: Indonesia, Sumatera Utara, Sibolangit, *Lörzing* 4479 (lecto BO [BO0084793], designated by Takano & Okada, 2003: 529).

Herb, 60–140 cm tall. *Leaf sheaths* c.4, bladeless, glabrous; ligule bilobed, c.2 mm long; blades c.13, sessile, elliptic, 16–25 × 2.1–5.1 cm, base obtuse, apex long acuminate, pubescent below. *Inflorescence* conical, 13–25 cm long; peduncle 2–8 cm long; rachis

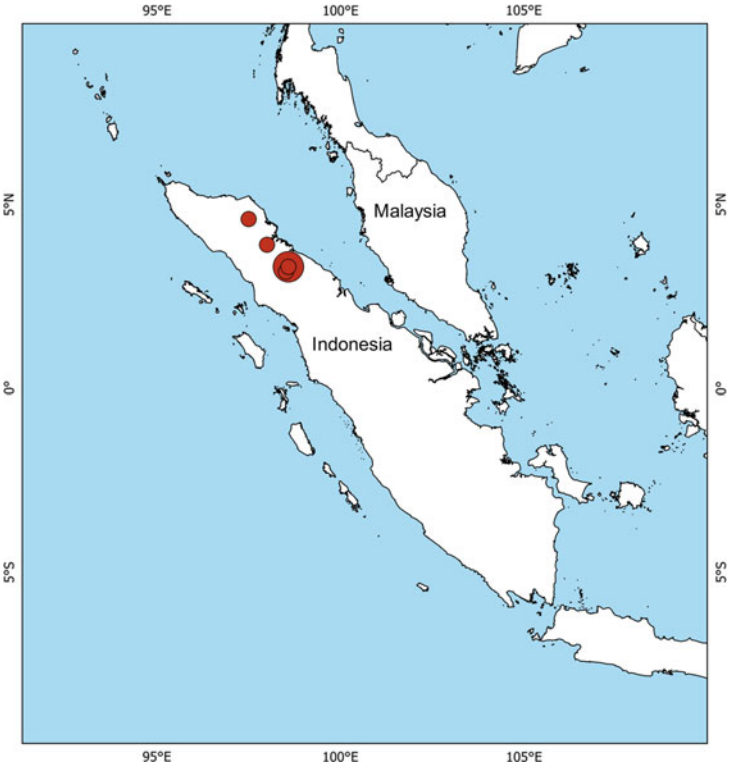


FIG. 23. Distribution range of *Globba paniculata* (circles). The type locality is indicated with a bigger symbol.

green, glabrous; bracts and bracteoles caducous, elliptic, 3–5 × 1.5 mm, apex acute, glabrous; cincinni numerous, 1–8 cm long. *Flowers* 3.5–4 cm long; ovary ellipsoid, c.4 mm long (♀), green; calyx infundibuliform, c.6 mm long, unequally trilobed with acute apices, bright orange; floral tube c.10 mm long, dorsal and lateral corolla lobes elliptic, c.6 × 3 mm, apex acute, hooded; lateral staminodes elliptic, c.14 × 8 mm, apex obtuse; labellum triangular, 8 mm long, base truncate, apex obtuse or obliquely truncate; filament c.20 mm long, orange; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages orange, semitranslucent, crest round, c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, coloured as ♀, appendages, falcate, narrower than ♀, c.5 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* globose, c.15 × 12 mm, shallowly ridged, green. *Bulbils* bamboo-like, scaly.

Distribution. Indonesia (Fig. 23).

Habit and ecology. Growing in shaded, tall, humid forest at 350–800 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba paniculata* is endemic to Sumatra. The EOO and AOO are 1429 km^2 and 16 km^2, respectively, suggesting a status of Critically Endangered. However, these data are based on information from herbarium specimens, with the assumption that there may be other populations that have not been recorded yet. Therefore, its IUCN conservation status would be overestimated and needs to be updated in the future. Because at least one population is in a natural park, this species is assessed as Least Concern.

Specimens examined. INDONESIA. Sumatera. **Aceh**: Aceh Tenggara, Mount Leuser National Park, 13 viii 1991, *De Wilde* et al. 21381 (L); Gunung Kemiri, 27 viii 1971, *Iwatsuki* et al. S822 (AAU). **Sumatera Utara**: Berastagi, i 1927, *Bartlett* 6501 (S); Sibolangit, *Lörzing* 4785 (BO); ibid., *Lörzing* 3913 (BO).

Valeton cited five collections in the protologue of *Globba paniculata*, which must be regarded as syntypes. He stated that the flowers could be orange or white. The notes accompanying *Lörzing* 4479 state, 'Herb, one of a few stems suberect ± 1 m high. Fl. orange coloured'. Because Takano & Okada (2003) designated *Lörzing* 4479 the lectotype of *Globba paniculata*, we must assume that this is an orange-flowered species. Indeed, it is the only one known in this subsection in Sumatra to have a bright orange flower. According to the description in the protologue and the notes on *De Wilde & De Wilde-Duyfjes* 21381 (L), *Globba paniculata* resembles *G. pyrrhopoikila* in its inflorescence shape, which is wider than in *G. virginea*.

14. Globba pycnostachys Sangvir. & M.F.Newman, **sp. nov.**

Similar to *Globba cataractarum* Sangvir. & M.F.Newman in its rather stout and tall leafy shoot (60–100 cm) and orange filament contrasting with white anther appendages but differs by its linear inflorescence (versus narrowly conical) and sessile cincinni in the upper two-thirds of the inflorescence (versus cincinni stalked). – Type: Thailand, Prachuap Khiri Khan, Hua Hin, 12°32′N, 99°28′59′′E, 260 m, 15 viii 2002, *Middleton, Suddee, Davies & Hemrat* 1090 (holo BKF; iso A, E [E00196140]). **Figs 20F–H, 24.**

Stout herb, 35–150 cm tall. *Leaf sheaths* c.5, bladeless, sparsely pubescent, green or light brown at basal sheaths; ligule bilobed, 2–5 mm long, glabrous, light green with white margin; blades 8–12, elliptic to ovate, 12.5–27.5 × 3–5.4 cm, base obliquely obtuse, apex acuminate, sparsely strigillose along midrib and veins, sessile. *Inflorescence* linear, 2–4 lowest cincinni much longer than upper ones, 16–35 × 3–11 cm; peduncle 3–5.5 cm long; rachis glabrous, green; bracts and bracteoles caducous, sometimes remaining on condensed cincinni, oblong to elliptic, 2–5 mm long, glabrous, green with white margin; cincinni numerous, stalked, 3–30 mm long, upper two-thirds sessile or to 1 mm long, pedicel 3–10 mm long (♀), sessile to 1 mm long (♂), flowers condensed, up to 14 per cincinnus. *Flowers* 2.8–3.5 cm long; ovary ovoid, c.4 × 3 mm (♀), shallowly ridged, green; calyx infundibuliform, 3–5 mm long, trilobed with obtuse apices and glabrous margins, yellowish green; floral tube 11–16 mm long, orange, dorsal and lateral corolla lobes greenish orange, elliptic, 2–4 × 2–4.5 mm, dorsal lobe short mucronate at apex; lateral staminodes lanceolate, 4.5–5 × 1–1.5 mm,

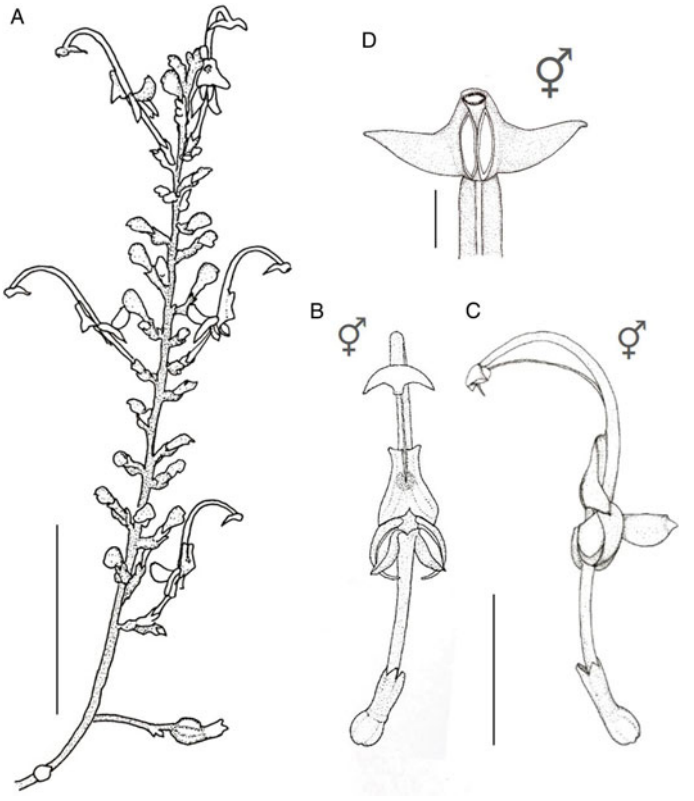


FIG. 24. *Globba pycnostachys* Sangvir. & M.F.Newman, sp. nov. A, Inflorescence; B and C, ♀ flower (front and side views); D, ♀ appendages. Scale bars: A, 10 cm; B and C, 1 cm; D, 2 mm. Drawn from *Sangvirotjanapat* 747 by Sunisa Sangvirotjanapat.

apex acuminate, as long as lateral corolla lobes, glandular hairy, orange; labellum triangular, 5–6 × 6.5–7.5 mm, orange with two red spots at centre, base truncate, apex acute, nectar tube 3–4 mm long; filament c.20 mm long, orange; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest round, c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, coloured as ♀, appendages, falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ovoid, c.10 × 8 mm, shallowly ridged, shiny green. *Bulbils* bamboo-like, 1 or 2, produced at peduncle, one shoot produced, ovoid, c.13 × 8 mm.

Distribution. Thailand (see Fig. 22).

Etymology. From the Greek *pycno-* ('narrow') and *stachys* ('spike'), referring to its narrow inflorescence.

Habit and ecology. Growing in moist areas in high mountains at 260–1000 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba pycnostachys* is endemic to Thailand (Phetchaburi and Prachuap Khiri Khan Provinces). The EOO and AOO are 949 km^2 and 20 km^2, respectively. These suggest a status of Endangered. All localities, however, are in protected areas and recent surveys found that the plants grow well in their habitat. This species is therefore assessed as of Least Concern.

Specimens examined. THAILAND. **Phetchaburi**: Kaeng Krachan National Park, 5 viii 1995, *Larsen* et al. 45421-2 (AAU); ibid., 6 viii 1995, *Larsen* et al. 45435 (AAU, K); ibid., 7 vii 2015, *Sangvirotjanapat* 747 (QBG [cultivation voucher, QSBG, accession no. 20135625]). **Prachuap Khiri Khan**: 4 vii 1926, *Kerr* 10819 (BK, K).

This species is restricted to parts of the Tenasserim Hills in Thailand. There are only a few collections from one small area. One sympatric species, *Globba stenothyrsa* Baker, which is a member of sect. *Ceratanthera*, is similar in its linear inflorescence but the fruit is globose. Although its inflorescence is unique, the flowers of *Globba pycnostachys* look like those of *G. cataractarum*, especially in having an orange filament and white appendages.

15. Globba pyrrhopoikila Sangvir. & M.F.Newman, **sp. nov.**

Similar to *Globba virginea* I.M.Turner in its habit but differs by its white flower with orange-red spot on labellum (versus pale yellow flower with brown spot on labellum). – Type: Indonesia, Sumatera, Aceh, Ketambe Research Station, 3°40′46′′N, 97°38′37′′E, 350 m, 6 iii 2008, *Wilkie, Hughes, Sumadijaya, Rasnovi & Marlan PW* 605 (holo E [E00416691]). **Figs 25, 26.**

Clump-forming herb, stout, 70–150 cm tall. *Leaf sheaths* c.5, bladeless, green or light brown at basal sheaths, glabrous; ligule bilobed, c.2 mm long, glabrous; blades 9 or 10, elliptic, 9.5–30 × 3.5–9 cm, base obtuse, apex acuminate, pubescent below, glabrous above, sessile. *Inflorescence* conical, 30–35 × 10–14 cm; peduncle 2–5 cm long; rachis glabrous, green or white; bracts and bracteoles caducous, elliptic, c.4.5 mm long, apex acute, glabrous, white or green with paler margin; cincinni numerous, 1–4.5 cm long, pedicel c.2 mm long. *Flowers* c.3 cm long, white except red spot on orange patch on labellum; ovary globose, c.3 mm long (♀); calyx infundibuliform, c.5 mm long, trilobed with acute apices; floral tube 7–10 mm long, dorsal and lateral corolla lobes elliptic, c.7 × 5 mm, apex acute, dorsal lobe long mucronate, c.2 mm long; lateral staminodes linear, c.8 × 2 mm, apex acuminate; labellum triangular, c.6 × 2.5 mm, base attenuate, apex truncate, nectar tube c.5 mm long; filament c.19 mm long; anther elliptic, c.2 mm long, connective tissue, crest and appendages pale cream, semitranslucent, crest obtuse, c.1 mm long at tip, ♀ appendages subtriangular, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex acuminate and slightly curved; ♂ anther crest and appendages as ♀, appendages falcate, narrower than ♀, c.4 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins

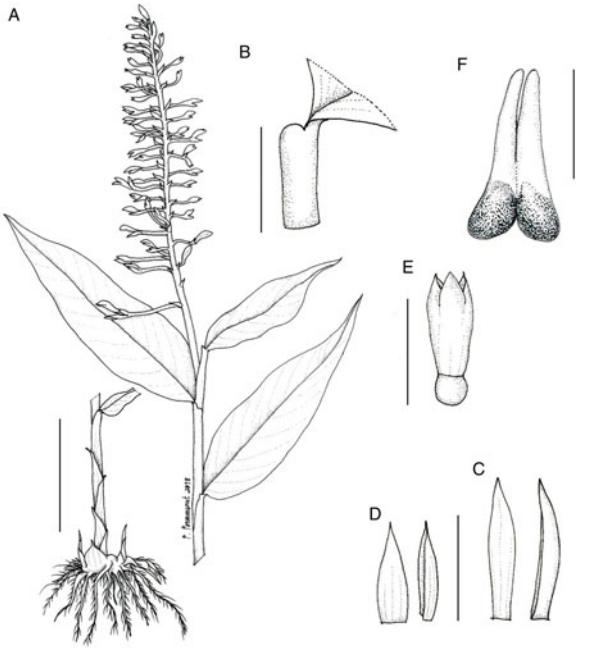


FIG. 25. *Globba pyrrhopoikila* Sangvir. & M.F.Newman, sp. nov. A, Habit; B, ligule; C, bracts; D, bracteoles; E, calyx; F, labellum. Scale bars: A, 10 cm; B, 2 mm; C and D, 3 mm; E, 3 mm; F, 3 mm. Drawn from *Wilkie* et al. *PW* 605 by Phattaravee Prommanut.

parallel almost to apex. *Fruit* nearly globose to ellipsoid, c.12 × 10 mm, shallowly ridged. *Bulbils* bamboo-like, produced at peduncle, producing many shoots, ovoid, 1.5–3 × 1 cm.

Distribution. Sumatra (Fig. 27).

Etymology. From the Greek *pyrrho-* ('flame-coloured') and *poikila* ('spotted'), describing the orange-red spot on its labellum.

Habit and ecology. Growing in high humid areas, lithophyte, at 300–550 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba pyrrhopoikila* is endemic to Sumatra. The EOO and AOO are about 4700 km^2 and 32 km^2, respectively, suggesting a status of Endangered. However, this species seems to be well protected at Ketambe Research Station. Also considering that specimens were collected at least seven times between 1972 and 2008, this species is assessed as Least Concern.

Specimens examined. INDONESIA. Sumatera. **Aceh**: Aceh Tenggara, 5 xii 1997, *Kato* et al. 8614 (AAU, E); ibid., 28 ii 1980, *Prawiroatmodjo* 2477 (L); Ketambe Research Station, 19 i 1999, *Argent* 9921 (E); ibid., 4 ii 1975, *De Wilde & De Wilde-Duyfjes* 14500 (L); ibid., iv 1982, *Widjaja* 1444 (L); ibid., 17 v 1972, *De Wilde & De Wilde-Duyfjes* 12025 (L); Kutacane, 22 vi 1979, *De Wilde & De Wilde-Duyfjes* 18371 (L).

FIG. 26. *Globba pyrrhopoikila* Sangvir. & M.F.Newman, sp. nov. (*Wilkie* et al. *PW* 605). A, Habit; B, inflorescence; C, ♂ flower. Scale bars: B, 10 cm; C, 1 cm. Photographs by Peter Wilkie.

Globba paniculata Valeton *sensu lato* was discussed by Takano & Okada (2003), who found that this species had two differentiable cytotypes in Sumatra: 2n = 32 and 2n = 48. In their treatment, they did not recognise these cytotypes as species or varieties, merely noting that 2n = 48 individuals were bigger plants with white flowers and with a red spot on the labellum.

As noted in this paper's descriptions of *Globba paniculata* and *G. virginea*, *G. paniculata* is an orange-flowered species whereas *G. pyrrhopoikila* and *G. virginea* are white-flowered. Having examined herbarium and living specimens of white-flowered individuals, we conclude that, morphologically, *Globba pyrrhopoikila* can be separated from *G. virginea* by the red spot on its labellum (versus a brown spot on a yellow patch) and triangular and falcate anther appendages in both floral types (versus only triangular). Taking these characters together, we recognise *Globba pyrrhopoikila* Sangvir. & M.F.Newman as a new species.

We have not undertaken further cytological studies but have worked instead on molecular phylogenetics. The samples used to represent *Globba pyrrhopoikila* and *G. virginea* are *Wilkie* et al. *PW* 605 (E) and RBGE accession no. 20010323A, respectively. The sequence labelled *Globba paniculata* in the GenBank database was also included in our analysis. The combined ITS–*matK* phylogenetic tree showed that *Globba pyrrhopoikila* and *G. virginea* formed different clades, whereas *G. paniculata* was paired to *G. pyrrhopoikila* with 100% bootstrap support. This is further evidence to indicate that there are at least two white-flowered species of subsect. *Mediocalcaratae* in Sumatra.

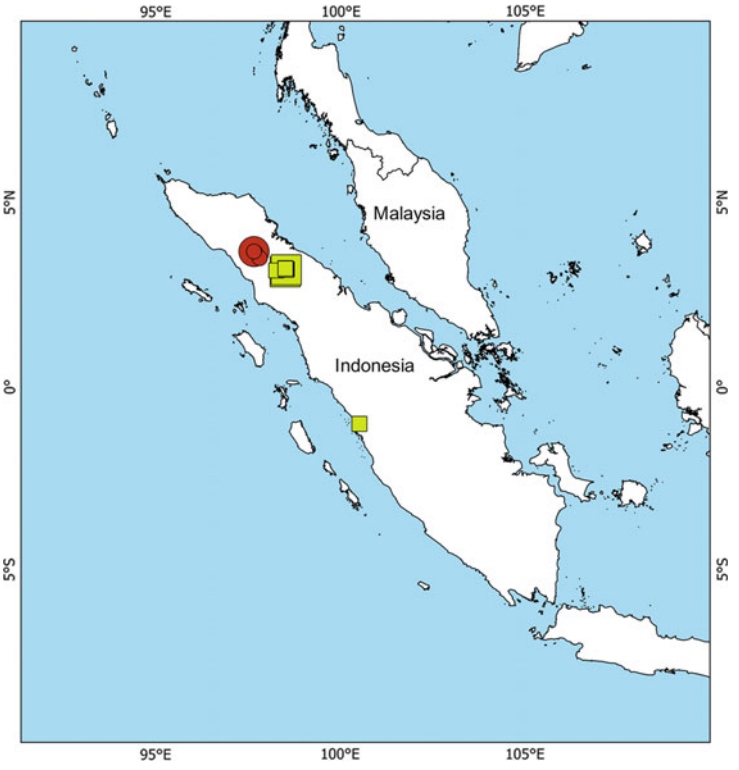


FIG. 27. Distribution range of *Globba pyrrhopoikila* Sangvir. & M.F.Newman (circles) and *G. virginea* I.M.Turner (squares). The type locality of each species is indicated with a bigger symbol.

16. Globba ranongensis Picheans. & Tiyaw., J. Jap. Bot. 85: 25 (2010). – Type: Kra Buri, Ban Lam Liang, Tham Phra Khayang, 24 vi 2006, *Williams, Pooma & Poopath* 2132 (neo BKF, designated here; isoneo A); Thailand, Ranong, Kra Buri, Ban Lam Liang, 10°19′26′′N, 98°45′49′′E, 51 m, 30 v 2008, *Picheansoonthon* 1032 (holo BKF n.v.; iso BK n.v., SING n.v.).

Clump-forming herb, growing on limestone, stems rather thin, 50–80 cm tall, producing separate inflorescence shoots early in rainy season and again at tips of leafy shoots in middle of rainy season. *Leaf sheaths* c.3, bladeless, puberulent, light green or reddish brown at basal sheaths; ligule bilobed, c.2 mm long, ciliate; blades 6–8, sessile, oblong to narrowly elliptic, 11.3–16.6 × 1.6–2.4 cm, base obliquely obtuse, apex long acuminate, margin undulate, puberulent below, strigillose along veins above, green and reddish green when young. *Inflorescence* conical, 7.5–18 × 4–16.5 cm, all parts reddish green and puberulent; peduncle 3.5–4.5 cm long; bracts and bracteoles caducous, elliptic, 5–15 × 2–3 mm, apex acute, reddish green; cincinni c.4, 2–4 cm long, pedicel c.1 mm long. *Flowers* c.3 cm long; ovary elliptic, 2 mm long (♂), green, hairy; calyx infundibuliform, c.4 mm long, trilobed with acute apices, yellowish green; floral tube c.15 mm long, yellow, dorsal

and lateral corolla lobes elliptic, c.5–6 × 3–4 mm, reddish yellow; lateral staminodes obovate, 13–15 × 6–8 mm, apex obliquely obtuse, yellowish orange; labellum triangular, 7–9 × 5–7 mm, base attenuate, apex round, yellowish orange; filament 18–20 mm long, yellow; anther c.3 mm long, connective tissue, crest and appendages yellowish orange, semitranslucent; ♀ appendages falcate, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ovoid to ellipsoid, 0.8–1.3 × 5–8 mm, deeply ridged, pubescent. *Bulbils* not seen.

Distribution. Thailand (see Fig. 22).

Habit and ecology. Growing on limestone, 20–51 m.

Proposed IUCN conservation status. Endangered (EN). *Globba ranongensis* is endemic in Thailand, restricted to a single locality in Ranong Province with a small population of fewer than 250 mature individuals. The plants grow on an inaccessible cliff, so there are no major threats to the species at present. However, given the small population size, it qualifies for listing as Endangered under criterion D.

Specimen examined. THAILAND. **Ranong**: Kra Buri, Ban Lam Liang, Tham Phra Khayang, 25 vii 2007, *Picheansoonthon* 962 (BKF).

This endemic species is known only from the type locality. It is a lithophyte growing on vertical cliffs on isolated limestone hills in mangrove forest.

Picheansoonthon 1032 was sought in all three herbaria where types were said to be deposited. No duplicates were found, so *Williams* 2132, which was collected at the type locality, is designated as neotype.

17. Globba thorelii Gagnep., Bull. Soc. Bot. France 54: 112 (1907); Fl. Indo-Chine 6(1): 32 (1908). – Type: Cambodia, Stoeng Treng, *Thorel* 2185 (lecto P [P032728], designated here; isolecto P [P00686492]). **Fig. 28A–D.**

Stout herb, 50–150 cm tall, leaning with upright inflorescence. *Leaf sheaths* 3–5, bladeless, green or maroon at basal sheaths, usually with sparse, maroon patches throughout; ligule bilobed, 1–2 mm long, light green with white margin, glabrous; blades 6–10, lanceolate to narrowly ovate, 10–28 × 2–4 cm, base obliquely obtuse, apex acuminate, strigillose at midrib and margin above, pubescent below. *Inflorescence* conical, 6–17 × 3–12 cm; peduncle 1–3 cm long; rachis pubescent, green with maroon dots; bracts and bracteoles caducous, elliptic, 2–5 mm long, sparsely pubescent, greenish yellow; cincinni numerous, 1.5–6 cm long. *Flowers* 2.4–2.9 cm long, the parts beyond calyx orange except labellum with red spot, sometimes very pale (Vietnamese specimens); ovary green, ellipsoid, c.3.5 mm long (♀), ridged; calyx infundibuliform, c.3.5 mm long, trilobed with acuminate apices and sparsely hairy margins, yellowish green; floral tube c.12 mm long, glandular hairy, dorsal and lateral corolla lobes, elliptic, 3–4 × 2.5–3 mm, dorsal lobe obtuse or short

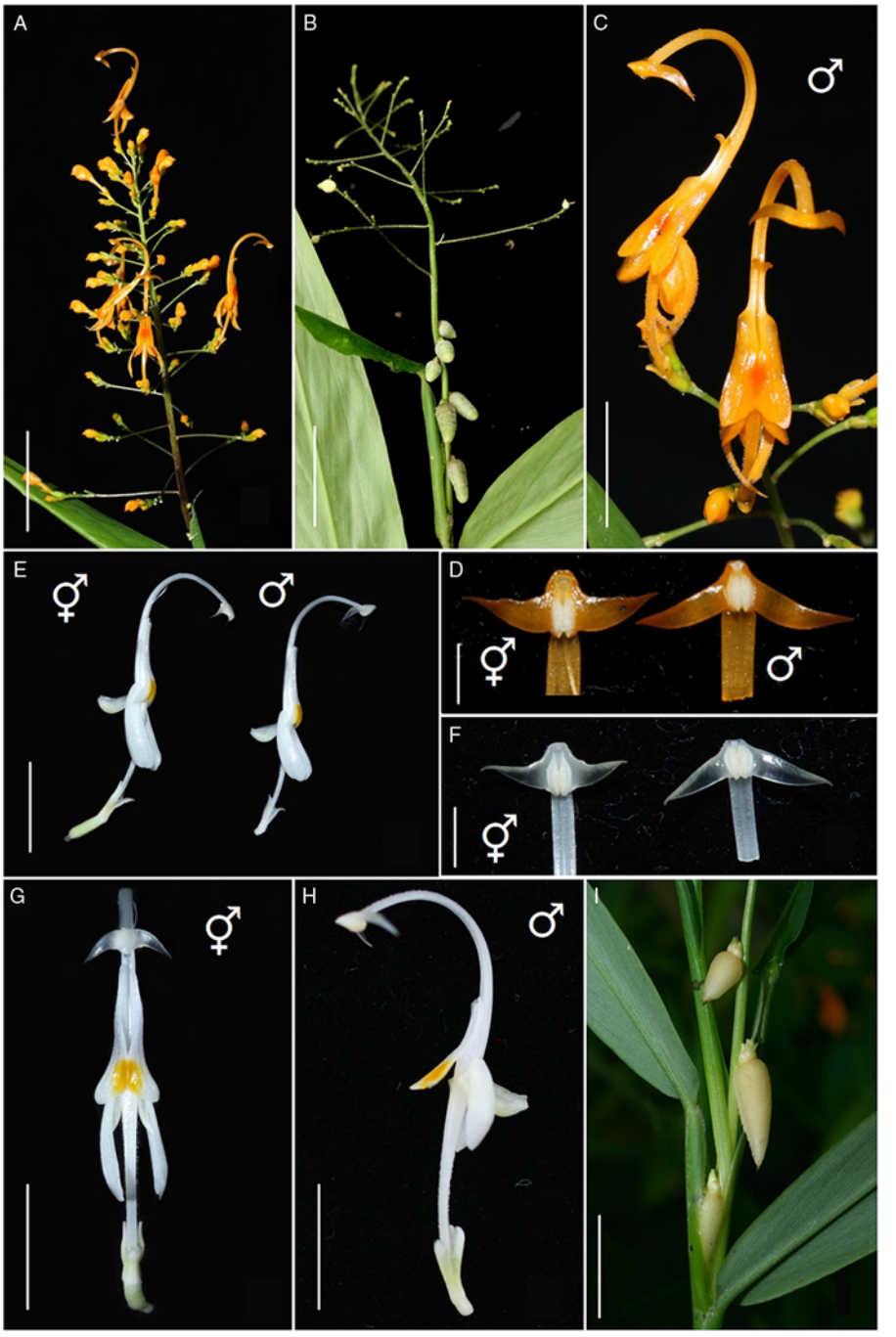


FIG. 28. *Globba thorelii* Gagnep. (*Sangvirotjanapat* 683): A, inflorescence; B, inflorescence in bulbil production period; C, ♂ flower; D, ♀ and ♂ appendages. *Globba xantholeuca* Craib (*Sangvirotjanapat* 734): E, ♀ and ♂ flowers; F, ♀ and ♂ appendages; G, ♀ flower; H, ♂ flower showing reflexed labellum; I, bulbils. Scale bars: A and B, 5 cm; C, E, G and H, 1 cm; D and F, 2 mm; I, 2 cm. Photographs: Sunisa Sangvirotjanapat.

mucronate at apex, c.1 mm long; lateral staminodes linear, c.9 × 1 mm, apex long acuminate, about twice as long as lateral corolla lobes, glandular hairy; labellum triangular, c.8 × 5 mm, base attenuate, long decurrent on filament, c.3 mm long, cornicula at tip c.1 mm long, apex round to acute, nectar tube c.2.5 mm long; filament 22–24 mm long; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages orange, semitranslucent, crest c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* ellipsoid, 15–20 × 6 mm, longitudinally ridged. *Bulbils* corky, produced at peduncle or cincinni, many, globose to fusiform, c.5–15 mm long.

Distribution. Cambodia, Laos, Thailand and Vietnam (Fig. 29).

Habit and ecology. Growing on somewhat dry or well-drained substrates, lithophytic or terrestrial. Adaptation to dry environments is marked, at 5–1200 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba thorelii* is fairly widespread in Thailand, Cambodia, Laos and Vietnam, with an EOO of 448,017 km^2. Threats to the species are mostly localised and are not of major concern. Many populations grow in national parks, so the species is assessed as of Least Concern.

Specimens examined. CAMBODIA. **Kampong Spoe**: 21 vi 1930, *Poilane* 17736 (P). **Otdar Mean Cheay**: Phumi Khtum, 1 xi 1927, *Poilane* 13893 (P). **Pursat**: 14 vi 1875, *Godefroy-Lebeuf* 450 (A, P).

LAOS. **Bolikhamxay**: Tha Phabath, Tad Leuk Waterfall, 28 viii 2008, *Newman & Škorničková* 2050 (E [cultivation voucher, RBGE, accession no. 20060805]). **Salavane**: Lao Ngam, Nasia Nyai village, 17 vi 2009, *Lamxay* et al. VL1977 (BKF, E). **Savannakhet**: 28 vi 1929, *Poilane* 16340 (P). **Vientiane Capital**: Hatxayfong, 6 i 1999, *Soejarto & Sydara* 10817 (K [as aff.], L [as aff.]).

THAILAND. **Chachoengsao**: Wang Nam Yen, 19 vii 1999, *Newman* 924 (E). **Chanthaburi**: 22 ix 1954, *Bunnak* 239 (AAU, BKF, C); Phliu Waterfall, 5 vi 1963, *Larsen* 9773 (AAU); ibid., 5 vi 1963, *Larsen* 9774 (AAU); Soi Dao, Khao Soi Dao, 6 vi 1963, *Larsen* 9823 (AAU); ibid., 7 vi 1963, *Larsen* 9862 (AAU); ibid., 7 vii 1974, *Maxwell* 74-694 (AAU, BK); Taka Mao waterfall, 25 viii 1972, *Larsen* et al. 31972 (AAU); Khao Phra Bat, 27 viii 1972, *Larsen* et al. 32111 (AAU, E, K); Khlong Narai, 14 iv 1973, *Maxwell* 73-33 (AAU, BK); Khlung, Makok waterfall, 9 vii 2014, *Sangvirotjanapat* 684 (QBG [cultivation voucher, QSBG, accession no. 201355571A]). **Chonburi**: Si Racha, Khao Chalak, 17 xi 1926, *Collins* 1353 (K, US); ibid., 2 viii 1975, *Maxwell* 75-725 (AAU, BK); ibid., 5 vi 1976, *Maxwell* 76-378 (AAU, BK). **Kalasin**: Phu Phan National Park – Kalasin side, 2 viii 1999, *Newman* 958 (E). **Rayong**: 24 viii 1977, *Phengklai* 3849 (BKF); Khao Wong-Khao Cha Mao National Park, 8 vii 2001, *Watthana* 1391 (QBG); Wat Khlong Ta Kuang, 17 v 2007, *Wessumritt & Sawangsawat* 64 (QBG). **Sa Kaeo**: Khlong Had, 14 vi 2006, *Poulsen & Triboun* 2386 (E); ibid., 15 vi 2006, *Poulsen* et al. 2388 (E). **Sakon Nakhon**: Phu Phan National Park – Sakon Nakhon side, ix 1987, *Yuktathat* 143 (E); ibid., 1 viii 1999, *Newman* 951 (E). **Saraburi**: Sam Lan Waterfall, 19 v 1974, *Maxwell* 74-516 (AAU, BK); ibid., 3 viii 1992, *Larsen* et al. 43747 (AAU, P).

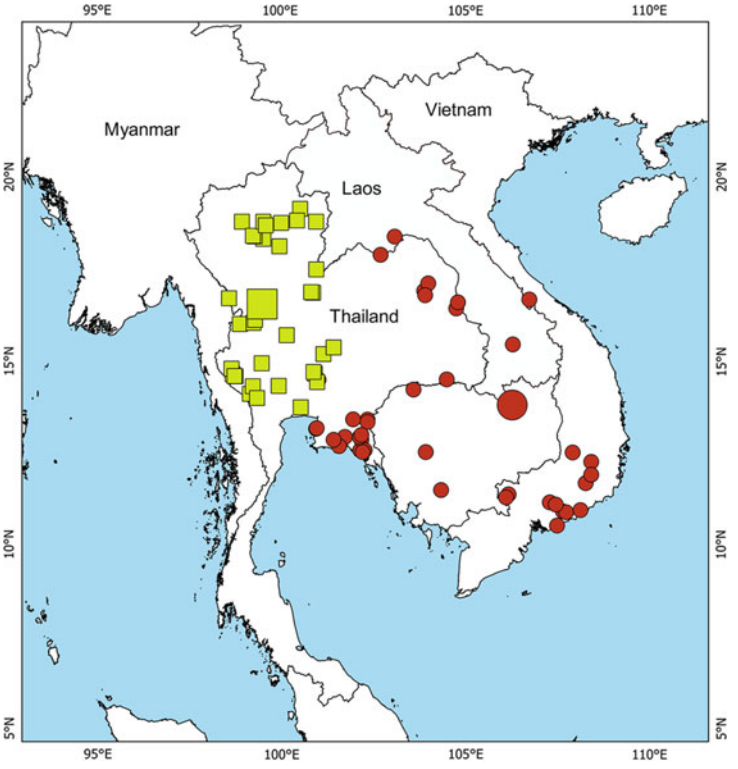


FIG. 29. Distribution range of *Globba thorelii* Gagnep. (circles) and *G. xantholeuca* Craib (squares). The type locality of each species is indicated with a bigger symbol.

Ubon Ratchathani: Samrongkiat waterfall, 9 vii 2014, *Sangvirotjanapat* 680 (QBG); ibid., 9 vii 2014, *Sangvirotjanapat* 683 (QBG [cultivation voucher, QSBG, accession no. 00/0013A]).

VIETNAM. Annam, 12 viii 1939, *Müller* 1982 (P); 13 vii 1939, *Müller* 1560 (P); 13 vii 1939, *Müller* 1546 (P). **Ba Ria-Vung Tau**: Binh Chau – Phuoc Buu reserved area, 9 ix 2008, *Trãn* 129 (E). **Dak Nong**: Gia Long waterfall, 24 vi 2008, *Trãn* et al. 72 (E). **Dong Nai**: Nui Xa du, 10 viii 1939, *Müller* 1928 (P); Tan Phu forest, 18 vi 2008, *Trãn* et al. 44 (E); ibid., 13 vii 2010, *Newman & Poulsen* 2436 (E [cultivation voucher, RBGE, accession no. 20081112A]). **Lam Dong:** Dalat, 7 vi 1932, *Squires* 911 (GH, K, P, US); Bon Kray Am, 30 iv 1941, *Poilane* 32630 (P [as aff.]); Pongour Waterfalls, 13 vii 2010, *Newman & Poulsen* 2434 (E [as aff.], [cultivation voucher, RBGE, accession no. 20081062A]). **Quang Tri**: Dong Tri, 17 vi 1924, *Poilane* 11043 (P). **Tay Ninh**: Nui Ba Den, 12 ix 1920, *Evrard* 22 (C, P). **Thuan Hai**: 14 viii 1939, *Müller* 2060 (P).

This species is similar to *Globba francisci and G. newmanii* in its orange flower and labellum with cornicula. *Globba thorelii* differs from *G. francisci* and *G. newmanii* by its obtuse dorsal corolla lobe (versus long mucronate dorsal corolla lobe) and production of numerous bulbils (versus only a few bulbils). Although variants of *Globba thorelii* and *G. francisci* with a red spot on the labellum are often found, this character has not yet been recorded in *G. newmanii*. Furthermore, the three species are also clearly localised by their geography and greatly different ecological preferences; *Globba thorelii* is restricted to

monsoon areas of Indochina and Thailand, whereas *G. francisci* is distributed in Borneo and Palawan and *G. newmanii* is localised in Peninsular Malaysia.

18. Globba virginea I.M.Turner, Asian J. Trop. Biol. 4(1): 29 (2000). – *Globba candida* Ridl., J. Malayan Branch Roy. Asiat. Soc. 1:98 (1923), non Gagnep., Bull. Soc. Bot. France 54: 112 (1907). – Type: Indonesia, Sumatera, Sumatera Utara, Berastagi, 11 ii 1921, *Ridley s.n*. (lecto K [K000255275], designated by Turner, 2000: 29). **Fig. 30.**

Clump-forming herb, stout, 70–100 cm tall. *Leaf sheaths* 3–5, bladeless, glabrous, green or light brown at basal sheaths; ligule bilobed, c.2 mm long, glabrous; blades 9 or 10, elliptic, 6.5–25 × 2.3–6.5 cm, base obtuse, apex acuminate, glaucous and pubescent below, glabrous above, sessile. *Inflorescence* conical, 13–21 × 6–7.5 cm; peduncle 2–5 cm long; rachis glabrous, green; bracts and bracteoles caducous, elliptic, 2–3 mm long, apex acute, glabrous, green with white margin; cincinni numerous, 1–4.5 cm long. *Flowers* 2.5–2.9 cm long; ovary ellipsoid, c.3 mm long (♀), green; calyx infundibuliform, c.4 mm long, trilobed with acute apices, green becoming white at margin; floral tube 8–10 mm long, white, dorsal and lateral corolla lobes elliptic, 6–7 × 1.5 mm, apex acute, dorsal lobe long mucronate, c.2 mm long, green becoming white at tip; lateral staminodes linear, c.10 × 1.5 mm, apex long acuminate, about twice as long as lateral corolla lobes, glandular hairy, white; labellum oblong, c.6 × 2.5 mm, base truncate, apex acute or praemorse, pale yellow with greenish brown spot on orange patch, nectar tube c.5 mm long; filament c.19 mm long, white; anther elliptic, c.2 mm long, connective tissue, crest and appendages pale yellow, semitranslucent, crest round, c.1 mm long at tip, ♀ appendages triangular, c.2.5 mm long, held ± perpendicular to anther, base covering whole side of anther, apex acute, ♂ anther crest and appendages as ♀. *Fruit* ovoid to ellipsoid, c.14 × 8 mm, shallowly ridged, green. *Bulbils* not seen.

Distribution. Sumatra (see Fig. 27).

Habit and ecology. Growing in humid areas at high altitude.

Proposed IUCN conservation status. Least Concern (LC). *Globba virginea* is endemic to Sumatra. The EOO and AOO are about 6300 km^2 and 12 km^2, respectively, suggesting a status of Endangered. However, it has been cultivated at Royal Botanic Garden Edinburgh in good condition since 2001. This species is therefore assessed as Least Concern.

Specimens examined. INDONESIA. Sumatera. **Aceh**: 28 viii 2008, as *Newman & Škorničková* 2047 (E [cultivation voucher, RBGE, accession no. 20010323A]). **Sumatera Barat**: 10 i 1998, *Mori & Takano* 8802 (AAU, E); Berastagi, 15 iii 2001, *Argent & Smith* 0120 (E); ibid., 6 v 2005, *Poulsen* 2352 (E); Gunung Sibayak, 24 viii 2008, *Droop* et al. 30 (E); ibid., 25 viii 2008, ibid., *Droop* et al. 39 (E).

Ridley based his *Globba candida* on a collection made in woods at Berastagi. Two sheets at K match this information: K000255274 and K000255275. The collection date is not given in the protologue and differs slightly on the two sheets: K000255274 is dated February 1921 whereas K000255275 is dated 11 February 1921. Turner (2000) cited the specimen collected on 11 February 1921 as the holotype, which may be taken as an

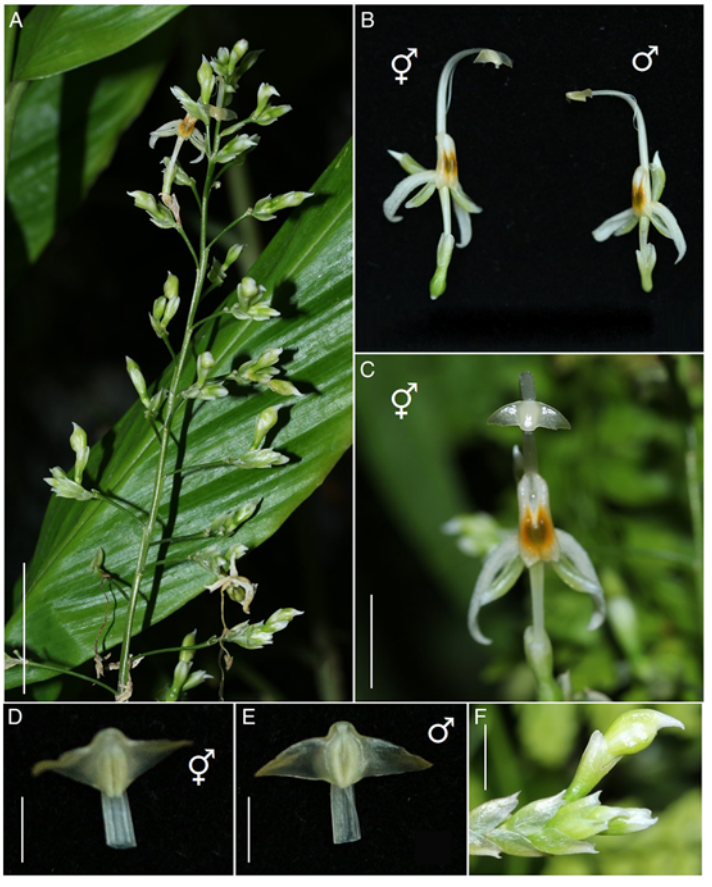


FIG. 30. *Globba virginea* I.M.Turner (RBGE accession no. 20010323A). A, Inflorescence; B, ♀ and ♂ flowers; C, ♀ flower; D, ♀ appendages; E, ♂ appendages; F, floral bud. Scale bars: A, 5 cm; C, 1 cm; D–F, 2 mm. Photographs: Sunisa Sangvirotjanapat.

effective lectotypification. The other sheet, K000255274, is a syntype and is likely to be an isolectotype, although the information available does not allow us to confirm that the two sheets are parts of a single gathering.

Valeton (1921) cited five collections in the protologue of *Globba paniculata*, which must be taken as syntypes: *Lörzing* 3913, 4479, 4736 and 4785, and *Bünnemeyer* 482. The labels of *Lörzing* 4736 and *Bünnemeyer* 482 record that the flowers were white, whereas those of *Lörzing* 3913, 4479 and 4785 had orange or yellow flowers. Flower colour variation within species has not been observed by us in this section, although in some species the colour of labellum and anther appendages may vary within the flowers, always consistently. Therefore, we conclude that the syntypes cited by Valeton represent more than one species. Takano & Okada (2003) selected *Lörzing* 4479 (BO) as the lectotype of *Globba paniculata*, so we must assume that this species has orange flowers. The syntypes

of *Globba paniculata* with white flowers (*Lörzing* 4736 and *Bünnemeyer* 482) may belong to *G. virginea* or *G. pyrrhopoikila*.

19. Globba xantholeuca Craib, Bull. Misc. Inform. Kew 1912: 399 (1912). – Type: Thailand, Kamphaeng Phet, 10 ix 1911, *Kerr* 2031 (lecto K, designated here; isolecto E [E00097513 and E00097514], K). **Fig. 28E–I.**

Herb 30–120 cm tall, stout or leaning with upright inflorescence. *Leaf sheaths* c.4, bladeless, margin ciliate, greyish green or light brown at basal sheaths; ligule truncate or shallowly bilobed, 2–5 mm long, ciliate or long strigillose, rarely glabrous; blades 9–15, linear, 8–20 × 0.9–2.6 cm, base obtuse, apex acuminate, glaucous below, pubescent or glabrous below, sparsely long strigillose above, sessile, greyish green when exposed to much sunlight. *Inflorescence* conical, 8–13 × 6–8 cm; peduncle 1–2 cm long; rachis pubescent; bracts and bracteoles caducous, elliptic, 2.5–10 × 1–6 mm, glabrous, whitish green; cincinni lax, 1.5–4.5 cm long. *Flowers* 2.8–3.2 cm long, white with yellow spot on labellum; ovary elliptic, c.3 mm long (♀), ridged; calyx infundibuliform, c.5 mm long, trilobed with acute apices and sparsely hairy margins, white or green becoming white at lobes; floral tube c.15 mm long, dorsal and lateral corolla lobes elliptic, 3.5–4.5 mm long; lateral staminodes oblong to elliptic, 6–7 × 2 mm, apex obtuse, slightly longer than lateral corolla lobes; labellum triangular, sometimes reflexed (viewed from side), c.7.5 × 4 mm, base attenuate, long decurrent on filament, c.4 mm long, apex acute or truncate, nectar tube c.3 mm long; filament c.19 mm long; anther elliptic, 1–1.5 mm long, connective tissue, crest and appendages white, semitranslucent, crest c.1 mm long at tip, ♀ appendages falcate, c.3 mm long, held ± perpendicular to anther, base covering whole side of anther, apex abruptly acuminate and curved upwards, margins parallel at base, upper margin straight or slightly curved, lower margin strongly curved to apex, ♂ anthers without crest, appendages falcate, narrower than ♀, c.3 mm long, held at c.45° to anther, base covering nearly whole side of anther, apex acuminate, slightly curved, margins parallel almost to apex. *Fruit* corky, ellipsoid, 14–17 × 5–7 mm, longitudinally ridged, green. *Bulbils* produced at peduncle and within leaf sheaths, fusiform, c.26 × 9 mm.
Distribution. Thailand (see Fig. 29).

Habit and ecology. Growing in somewhat dry places, often found in limestone hills, lithophytic or terrestrial, at 70–1000 m.

Proposed IUCN conservation status. Least Concern (LC). *Globba xantholeuca* is fairly widespread in Thailand, with an EOO of 144,909 km^2. There are no major threats to the species and many populations grow in national parks, so it is assessed as of Least Concern.

Specimens examined. THAILAND. **Bangkok**: 12 viii 1930, *Kerr* 19746 (BK, C, K). **Chaiyaphum**: Thep Sathit, Ban Huai Farang, 29 viii 2001, *Pooma* 2937 (A, BKF); ibid., Ban Huai Farang, 29 viii 2001, *Pooma* 2937 (SING). **Chiang Mai**: Doi Suthep-Pui National Park, 15 vii 1989, *Maxwell* 89-905 (A, E, L). **Kamphaeng Phet**: Mae Wong National Park – Kamphaeng Phet side, 5 vii 1999, *Newman* 876 (E); Khlong Lan, Khlong Lan waterfall, 29 vii 2001, *Suksathan* 3025 (QBG); ibid., 25 x 2001, *Watthana* 1496 (QBG). **Kanchanaburi**: Thong Pha Phum, Hin Dat, 1 vii 1926, *Put* 51 (BK, C,

K, P); ibid., 3 vii 1973, *Maxwell* 73-71 (AAU, BK); Thong Pha Phum, Ban Prang Kasi, 19 vi 1946, *Hoed & Kostermans* 584 (BK, K, P); Sai Yok, 7 vii 1946, *Kostermans* 1017 (C, P, US); Erawan National Park, 2 vii 1974, *Larsen & Larsen* 33997 (AAU, BKF, K, P); Salak Phra Wildlife Sanctuary, 26 viii 2010, *Maxwell* 1021 (QBG). **Lampang**: Muang Ngao, 15 vii 1931, *Put* 3995 (K); 22 vi 1954, *Amnat* 131 (C); Huai Tak, viii 1961, *Champion s.n.* (K); Chae Son National Park, 24 ix 1995, *Maxwell* 95-751 (A, L); Chae Hom, 6 viii 2000, *Panatkool* 377 (A). **Lamphun**: Doi Khun Taan National Park, 2 vii 1994, *Maxwell* 94-764 (A, BKF, L [2]). **Loei**: Na Haeo, Tat Hueang waterfall, 16 v 2006, *Maknoi* 834 (QBG). **Lop Buri**: Chai Badan, 10 x 1926, *Lakshnakara* 279 (K). **Nakhon Sawan**: 30 viii 1931, *Put* 4088 (A, AAU, C, E, K, P); 22 viii 1963, *Smitinand & Sleumer* 1093 (AAU, BKF, K). **Nan**: 27 vii 1992, *Larsen* et al. 43645 (AAU); Doi Cham On, 6 ix 1995, *Larsen* et al. 46136 (AAU); Ban Duu, 8 viii 1998, *Pongamornkul* 249 (QBG); ibid., 9 viii 1998, *Pongamornkul* 260 (QBG); 8 viii 2000, *Williams* 00-365 (E). **Phayao**: Doi Pha Chang, 2 viii 1998, *Maxwell* 98-774 (A). **Phitsanulok**: Thung Salaeng Luang National Park, 22 vii 1966, *Larsen* et al. 707 (AAU, SING); ibid., 24 vii 1966, *Larsen* et al. 835 (AAU, K, SING); Ban Yaeng, 25 vi 1967, *Phusomsaeng* 257 (BKF). **Phrae**: 9 ix 1929, *Franck* 435 (C, P). **Saraburi**: Ban Phu Khae, 1 v 1947, *Bunpheng* 110 (E); Sam Lan Waterfall, 29 vi 1974, *Maxwell* 74-628 (AAU); Chalerm Phra Kiat, Na Phra Lan, Wat Tham Si Wilai, 10 viii 2012, *Middleton* et al. 5556 (BKF, E); Pha Phutthabat, 22 vii 1989, *Paisooksantivatana* 238189 (BK). **Suphan Buri**: Phu Toei National Park, 29 vi 2001, *Chayamarit* et al. 2964 (BKF). **Tak**: Umphang, 10 vi 1922, *Kerr* 6116 (BK, C, K, P); Mae Sot, 19 viii 1994, *Maxwell* 94-902 (A, L). **Uthai Thani**: Khao Patthawi, 28 vi 1999, *Norsaengsri* 812 (QBG [as aff.]).

Doubtful Species

The following species are so poorly known that it is impossible to state with confidence whether they are good species or synonyms of those described earlier in this paper. Further field surveys at the original collecting localities will be needed to gather better material, which will allow the taxonomic status of these species to be assessed.

Globba brevifolia K.Schum., Pflanzenr. IV, 46 (Heft 20): 145 (1904). – *Globba parviflora* var. *brevifolia* K.Schum., *nom. nud.*, Bot. Jahrb. Syst. 27: 330 (1899). – Type: Philippines, Luzon, Samball [Zambales], near Palavig [Palauig], *Warburg* 14060 (B n.v.).

A search at B has revealed no material under the names *Globba brevifolia* or *G. parviflora* var. *brevifolia* (Robert Vogt, personal communication). It is therefore highly likely that Warburg's collections were destroyed in the fire of 1943. For the following reason, we cannot now be certain whether these two names are homotypic or heterotypic. *Globba parviflora* var. *brevifolia* was based on Warburg 14060, whereas *Globba brevifolia* was based on Warburg 14066 (Schumann, 1899, 1904). Schumann (1904) described *Globba brevifolia* from *Warburg* 14066 alone, but he also cited *Globba parviflora* var. *brevifolia* in synonymy, so it seems plausible, at least, to think that the two names are homotypic and that '14066' in *Das Pflanzenreich* is a misprint for '14060'.

Schumann distinguished *Globba brevifolia* from the closely related *G. gracilis* by the size of the leaves, shape of their bases and narrowness of the inflorescence. A few years later, Ridley (1909) accepted this species. Both authors gave differences in the leaf

indumentum as support for recognising *Globba brevifolia*, but we have found that indumentum is too variable to be taxonomically useful. Importantly, Ridley also used the difference in anther appendage shape between hermaphrodite (triangular) and functionally male flowers (linear) to differentiate *Globba campsophylla* from *G. brevifolia* and *G. merrillii*, so we have reason to doubt his species concept.

In conclusion, the lack of type material and incomplete morphological information make it impossible to assess this species until further fieldwork can be carried out.

Globba keithii Ridl., J. Straits Branch Roy. Asiat. Soc. 32: 94 (1899); Gagnepain, Fl. Indo-Chine 6(1): 34 (1908). – Type: Thailand, Prachuap Khiri Khan, Bangsaphan, 25 v 1890*, Keith* 451 (SING).

Globba keithii is based a single sheet at SING, *Keith* 451, collected in Prachuap Khiri Khan Province, Thailand. On the sheet, fragments of a broken inflorescence of *Globba* and a leaf sheath of *Curcuma* are mounted side by side. An important additional clue to the diagnosis of *Globba keithii* is a line drawing of the flower on which the colours of the flower parts are described. According to this drawing, the filament is grey, the labellum yellow, and the corolla tube also grey. We have not come across any *Globba* species in the area of Prachuap Khiri Khan with flower colours that correspond to this description. Further study at the type locality is needed to resolve this question.

Globba latifolia Ridl., Philipp. J. Sci., C 4(2): 161 (1909). – Type: Philippines, Mindanao, Zamboanga, San Ramon*, Copeland s.n*. (syn MICH); Mindanao, San Ramon, Sax River, ii 1905*, Williams* 2324 (syn US); Mindoro, Mindoro Oriental, Baco River, iii 1905*, Merrill* 4064 (syn SING).

Globba latifolia was based on three collections, two made near the type locality of *G. gracilis* in Mindanao and the third in Mindoro. When more evidence comes to hand, it may be possible to place *Globba latifolia* in synonymy under *G. gracilis*. It was separated by its broad leaf, 4 cm wide in the description, which seems insufficient evidence on which to base a species of *Globba*. Field surveys at the type locality are needed to resolve this question.

Globba parviflora C.Presl, Reliq. Haenk. 1(2): 115 (1827). – Type: Philippines, Luzon, Sorsogon, *Haenke s.n*. (syn PR, PRC).

The protologue is given in many references as ‘Reliq. Haenk. 2: 115’, dated 1833 or 1835. This appears to be a mistake that has been copied without being verified. *Reliquiae Haenkeanae* was issued in two volumes, the first with five parts and the second with two (Stafleu & Cowan, 1983). The part numbering begins at ‘1’ in each volume, so both volumes include a part 2. The protologue of *Globba parviflora* appears on page 115 of volume 1, part 2, published July–December 1827.

Both syntypes at PR and PRC are very poor, lacking any flower information or field notes. The protologue says, however, that it had a yellow corolla.

Globba pyramidata Gagnep., Bull. Soc. Bot. France 48: 204 (1901). – Type: Philippines, Mindanao, xii 1880, *Montaño* 203 (lecto P [P00686495], designated here).

Gagnepain based *Globba pyramidata* on two collections that he studied at P: *Montaño* 203 from the Philippines and *Godefroy-Lebeuf* 450 from Cambodia. He compared it with *Globba versicolor* Sm., which he thought to be a synonym of *Globba expansa* Wall. ex Horan. (Williams, 2004, discusses the nomenclature of *Globba versicolor*). We have found that the syntype from Cambodia, *Godefroy-Lebeuf* 450 (P), matches the type of *Globba thorelii* in the presence of cornicula (see the description for that species), whereas according to the line drawing on *Montaño* 203 (P), the labellum of *G. pyramidata* clearly lacks cornicula. It is our opinion that the two syntypes of *Globba pyramidata* represent different species. To avoid confusion with *Globba thorelii* and to promote stability in nomenclature, we here designate *Montaño* 203 (P) the lectotype of *Globba pyramidata*, which means that this name will apply to a species in the Philippines, if it turns out to be a good species.

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