

## A REVISION OF *AMOMUM* (ZINGIBERACEAE) IN CAMBODIA, LAOS AND VIETNAM

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The species of *Amomum* Roxb. (Zingiberaceae) in Cambodia, Laos and Vietnam are revised. Thirty-five species and two varieties are recognised, most names are typified, and detailed descriptions and a key are provided. Conservation assessments of all species are given. Eleven new species are described: *Amomum calcaratum* Lamxay & M.F.Newman, *Amomum calcicolum* Lamxay & M.F.Newman, *Amomum celsum* Lamxay & M.F.Newman, *Amomum chevalieri* Gagnep. ex Lamxay, *Amomum chryseum* Lamxay & M.F.Newman, *Amomum glabrifolium* Lamxay & M.F.Newman, *Amomum plicatum* Lamxay & M.F.Newman, *Amomum prionocarpum* Lamxay & M.F.Newman, *Amomum rubidum* Lamxay & N.S.Lý, *Amomum stephanocoleum* Lamxay & M.F.Newman and *Amomum tenellum* Lamxay & M.F.Newman.

*Keywords.* *Amomum*, Cambodia, Laos, taxonomic revision, Vietnam, Zingiberaceae.

### INTRODUCTION

Species belonging to the monocotyledonous family Zingiberaceae have ethereal oils in their tissues and are widely used in cooking and medicine. The three most valuable species are *Zingiber officinale* Roscoe, ginger, *Curcuma longa* L., turmeric, and *Elettaria cardamomum* (L.) Maton, cardamom. The last of these is the true cardamom but there are several species in the related genus *Amomum* Roxb., such as *Amomum subulatum* Roxb., the brown cardamom of the Himalayas, which have similar properties.

Wild cardamoms belonging to *Amomum* are the most important non-timber forest product (NTFP) and agricultural export product in Laos (Foppes & Ketphanh, 2000), generating a substantial contribution to rural household cash income. Official statistics indicate that from 1995 to 1999 an average of 285 tonnes, at US\$4.8/kg (dry fruits), was exported. Currently 1000–1800 tonnes are exported each year, at around US\$2.5–3/kg (dry seed), mostly to China, but also to Korea, Thailand and Vietnam. China sells cardamom via the internet as a single herb extract for US\$17.4 per 100 g. Every year 400–500 tonnes of dried seeds are exported to China, where they are used as an ingredient in Chinese medicine, known as ‘sha ren’. Roughly 70% of the

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cardamom produced in Laos comes from the wild, and 30% from cultivated gardens. The export price was around US\$7 per kg of dry seed over five years in the 1990s (Saint-Pierre, 1998; Foppes & Ketphanh, 2000).

As well as being an important NTFP resource for food, medicine and trade, *Amomum* species are also an important component in many tropical forest ecosystems.

Although cardamom has a very high value, scientific knowledge of the species being traded is poor, owing to lack of scientific research, in particular in taxonomy. The most important and highest value species are ‘mak naeng kham’ *Amomum microcarpum*, ‘mak naeng khieo’ *A. villosum* and *A. uliginosum*, and ‘mak naeng daeng’ *A. longiligulare*, all of them wild plants. In addition, ‘mak naeng kouang toung’ *Amomum villosum* var. *xanthioides* has been introduced from China and cultivated for more than 10 years in northern Laos, and ‘mak naeng daeng’, *A. longiligulare*, is very commonly cultivated in southern Laos where it is not native.

*Amomum* Roxb. is estimated to have c.150 (Mabberley, 2008) to 176 (World Checklist of Selected Plant Families, 2011) species, the majority of which are found in tropical Asia. Nineteen species were recognised in the most recent account of the genus in Cambodia, Laos and Vietnam (Gagnepain, 1908). More recent accounts covering single countries cite 11 species in Laos (Newman *et al.*, 2007), and 15 species in Vietnam (Pham Hoang Ho, 2000).

This paper is the first comprehensive taxonomic revision of *Amomum* in Cambodia, Laos and Vietnam since that of Gagnepain, over 100 years ago, and will form a significant contribution to a new revision of the Zingiberaceae in the ‘Flore du Cambodge, du Laos et du Vietnam’. Cooperation has been sought with taxonomists studying *Amomum* in Thailand and in Sumatra because there is considerable overlap in species and many common problems relating to type specimens. Several of the species occurring in Cambodia, Laos and Vietnam have a wider distribution in China, Burma, Thailand and even the Himalayas.

#### IUCN CONSERVATION ASSESSMENTS

Provisional IUCN conservation assessments have been made for all species using the IUCN (2001) criteria. The following Red List Category abbreviations are used in the accounts below: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LC = Least Concern and DD = Data Deficient. The assessments are global but, as we do not have detailed information from outside Cambodia, Laos and Vietnam, we have sometimes had to assess species as DD when a local assessment might have indicated greater cause for concern. These assessments will inevitably change as more extensive exploration of the region and/or of each country takes place.

#### MATERIAL STUDIED

Material from the following herbaria was studied: A, AAU, BK, BKF, E, G, GH, HITBC, K, KUN, L, MO, NLS, NY, P, SING, UPS, US, VNM. NLS is the

herbarium of the Faculty of Science, National University of Laos, Dong Dok, Vientiane. The future of this unregistered herbarium is uncertain; its collections may be merged with those of the National Herbarium of Lao PDR which was inaugurated on 22 July 2011 and registered with the code HNL.

More than 680 collections from all major herbaria in Asia, Europe and America were examined. A total of 409 of these collections were made by the authors, the majority in Laos, but some also in Cambodia and Vietnam; most are deposited at E and NLS; others are also duplicated at P, RUPP, UPS and VNM.

A record of each herbarium specimen was made in the Padme taxonomic database developed and used at the Royal Botanic Garden Edinburgh ([www.rbge.org.uk/science/major-floras/biodiversity-informatics](http://www.rbge.org.uk/science/major-floras/biodiversity-informatics)). Information recorded included the collector's name, collection date and collection locality. Latitude and longitude coordinates, and collecting altitudes, given on specimen labels were recorded. When coordinates were not given on specimen labels, they were sought using gazetteers such as GNS (<http://earth-info.nga.mil/gns/html/index.html>). The points on the distribution maps derive from specimens alone; none derive from unverified literature or field reports. It was not possible to find the coordinates of every collecting locality. Thus, although a specimen of *Amomum elephantorum* from Vietnam has been seen (*Poilane* 21292, P), the coordinates of the collecting locality could not be found so Fig. 9 shows this species only in Cambodia and Laos.

The altitude ranges given under each species are those found in Cambodia, Laos and Vietnam. Wider ranges may be found in species which occur beyond these countries.

## MORPHOLOGY

A morphological species concept is employed. Taxa are recognised by discontinuities in characters or complexes of characters.

*Amomum* is diverse in morphology, showing differences of habit, inflorescence and capsule. The inflorescence and capsule structure have been found to be extremely important in identifying species. As mentioned below, there is some evidence that fruit character is phylogenetically informative (Xia *et al.*, 2004; Kress *et al.*, 2007) so a more detailed molecular phylogenetic study of *Amomum* is under way.

It should be noted that the differences between *Amomum* and *Elettariopsis* are very slight. Species of *Elettariopsis* usually have one or a few leaves per shoot, loosely tufted or more rarely forming a pseudostem, bracteoles open to the base and a prominent anther crest. These characters all occur in *Amomum* though not together in one species. Small species of *Amomum*, such as *A. biflorum* of southern Thailand and Peninsular Malaysia, are frequently misidentified as *Elettariopsis*. In this account, only the species of *Amomum sensu stricto* are treated.

*Habit.* The pseudostems are usually more than 5, arising near each other to form a clump, with short intervals of 0–10 cm between the pseudostems, or a loose clump

with intervals of 10–15 cm between the pseudostems. Alternatively, there may be long intervals of 20 cm or more between the pseudostems, each new one arising at a distance from the previous pseudostem, sometimes as far as a metre away, so that the pseudostems appear solitary. This habit is termed creeping.

The rhizome usually grows at the soil surface or slightly above or below it but may be deep in the soil in a few species. In some species the rhizome is raised above the soil on stilt roots.

*Leaves.* The leaves consist of a sheath, petiole, ligule and a simple blade. As in most Zingiberaceae, the leaf sheaths clasp each other to form pseudostems which may be conspicuously swollen at the base or not. The surface of the sheaths is usually striate but may also be reticulate or smooth. The petiole may be very short or absent; if present, it is usually canaliculate. The ligule is coriaceous or membranous, entire or lobed, glabrous or with a ciliate margin, to c.4 cm long. The leaf blades are arranged distichously and the plane of distichy is transverse to the direction of growth of the rhizome; the blade varies from oblong to elliptic, oblong-elliptic or oblong-lanceolate with an acute, caudate or long caudate apex and attenuate to long attenuate base; the margin may be entire, wavy or straight; the primary vein is always prominent on the abaxial surface and the secondary veins sunken or prominent on both sides.

*Inflorescence.* The inflorescence is invariably radical in *Amomum*. It may be partially subterranean, lie at ground level or be held above it on a peduncle, arising from or near the base of new or old shoots, or anywhere on the rhizome of creeping species (e.g. *Amomum schmidtii*), sometimes arising vertically or looping downwards from the rhizome and then turning up. The peduncle is usually short but may be erect and c.2 m long in *Amomum celsum*, elongating in fruit in some species, with overlapping peduncle scales which are broadly triangular at the base of the peduncle to narrowly triangular or lanceolate above, often striate, coriaceous or papery. The flowering part of the inflorescence is ovoid, ellipsoid or globose. The peduncle scales gradually merge into the bracts which arise from the main axis without an involucre of sterile bracts of the kind seen in *Etilingera* Giseke. They are usually arranged in a spiral, imbricate, boat-shaped, narrowly triangular to lanceolate-oblong, often cucullate, usually subtending a single flower, rarely in cincinni of 2–3 flowers. The bracteole is tubular, at least at the base, or, as in most *Amomum* species with winged fruit, open to the base and ovate to lanceolate, or even absent.

*Flowers.* The flowers are always trimerous, white or coloured, two to a few (> 10) open at any one time, maturing from the base to the apex of the inflorescence, very shortly pedicellate. The calyx is tubular, usually with 2–3 teeth. The corolla consists of a tube with three cucullate, acute or rounded corolla lobes, the central one often largest, usually cucullate, with or without a subapical spur. Lateral staminodes, if present, are small. The labellum is always clawed, generally white with a yellow central stripe, with or without red marks, variously lobed or entire, the apex

spreading or reflexed; rarely the base of the labellum is adnate to the base of the filament forming a very short tube above the insertion of the corolla lobes (not a distinct tube as in *Etilingera*). The filament often has a groove which grasps the style and the anther has one pair of thecae which dehisce by longitudinal, parallel slits; an anther crest is usually present and may be entire or variously lobed but not petaloid. The stigma is globose to funnel-shaped, ciliate or glabrous. Epigynous glands are always present and the inferior ovary is usually trilocular with axial placentation and numerous ovules.

*Fruits.* The fruit is either a smooth, fleshy berry or a dehiscent or indehiscent capsule which may be prickly, winged, ridged, or lobed, globose to ovoid, often with a persistent bract and calyx; the prickles, if present, are simple or branched, and the wings straight or wavy. The seeds are round or angular, with endosperm, arillate, scented and spicy to taste.

#### LAO NAME AND USES

All the local names and uses reported in this revision come from a study of the ethnobotany of *Amomum* in Laos carried out by the first author (Lamxay, 2011). This taxonomic account covers Cambodia and Vietnam as well as Laos but it has not been possible to gather the local names or uses from Cambodia or Vietnam.

#### INFRAGENERIC CLASSIFICATION

The name *Amomum* was first used by Linnaeus in his *Flora Zeylanica* (1747) where he classified three species in the Monandria monogynia: *Amomum scapo nudo*, *spica oblonga obtusa*, *Amomum scapo nudo*, *spica ovata* and *Amomum scapo bracteis alternis laxis caule brevior*. In his *Species Plantarum* (1753), Linnaeus gave these species binomials, *Amomum zerumbet*, *A. zingiber* and *A. cardamom* respectively, and added a fourth species, *Amomum grana-paradisi*. As these species have all been transferred to other genera, namely *Aframomum*, *Elettaria* and *Zingiber* (Burt & Smith, 1972), a later concept of the genus, *Amomum* Roxb. (Roxburgh, 1820), has been conserved with *Amomum subulatum* Roxb. as its conserved type (Burt & Smith, 1968; McVaugh, 1970).

Petersen (1889), in the first edition of Engler's *Die natürlichen Pflanzenfamilien*, was among the first to attempt a classification of *Amomum*. Petersen's system consisted of three sections, *Amomum* sect. *Geanthus*, *A.* sect. *Euamomum* and *A.* sect. *Cenolophon*, and also included species which would now be placed in *Aframomum* and *Etilingera*.

Some years later, in Engler's *Das Pflanzenreich*, Schumann (1904) divided *Amomum* into two sections and four series based on the structure of

the anther crest, as shown in his key. This remains the most recent classification of *Amomum*.

*A. Anther crest absent*

Section: ***Geanthus***

*a. Flowers few 3–4*

Series 1: ***Oliganthae***

*b. Flowers many*

Series 2: ***Polyanthae***

*B. Anther crest present*

Section: ***Euamomum***

*a. Anther crest bilobed or trilobed*

Series 3: ***Lobulatae***

*b. Anther crest entire*

Series 4: ***Integrae***

Like Petersen, Schumann had a broad concept of *Amomum*. More recently, all the species of his *Amomum* series *Oliganthae* have been transferred to *Etligeria* along with most of *Amomum* series *Polyanthae*. The large section *Euamomum* has been maintained in *Amomum*. *Amomum* section *Euamomum* and *Amomum* series *Integrae* contain the type species of the genus, *A. subulatum*, so they must now be called *Amomum* section *Amomum* and *Amomum* series *Amomum*.

While Schumann worked on a worldwide monograph of Zingiberaceae in Berlin, Gagnepain in Paris was studying the material being sent back from the French colonies of Indo-China. He too took a broad view of *Amomum*, including species which would now be placed in *Etligeria* and *Elettariopsis*, and, in his revision of the Zingiberaceae of that region (Gagnepain, 1908), he described 19 species with a key to the species based on the presence and structure or absence of an anther crest. Of Gagnepain's 19 species, four have been transferred to *Etligeria* (*Amomum harmandii*, *A. pavianum*, *A. laoticum* and *A. repens*) and another three have been transferred to *Elettariopsis* (*A. trilobum*, *A. monophyllum* and *A. unifolium*).

The most important distinguishing characters of *Amomum* are its inflorescence which is partially subterranean or raised above the ground, bracts closely imbricating and usually subtending a single flower, flowers almost always bracteolate, and main axis elongating in fruit (Smith, 1981). In addition, an anther crest is usually present, the bracteoles are usually tubular, the labellum is usually spatulate and white with yellow stripes and red marks, and the leaves are several to many forming a distinct pseudostem.

Kress *et al.* (2002) have published a molecular phylogenetic study of the Zingiberaceae which strongly supports a realignment of the genera into four subfamilies: Siphonochiloideae (*Aulotandra* and *Siphonochilus*), Tamijioideae (*Tamijia*), Alpinioideae (Alpinieae and Riedelieae, with > 20 genera) and Zingiberoideae (Zingibereae and Globbeae, with > 20 genera). This study confirmed the placement of *Amomum*, *Alpinia* and *Etligeria* in the large tribe Alpinieae of subfamily Alpinioideae based on the

following characters: evergreen herbs with fibrous rhizomes, plane of distichy of the leaves perpendicular to the direction of growth of the rhizome, extrafloral nectaries absent, lateral staminodes small or absent, never petaloid, filament medium length, sometimes arching, anther crest petaloid or absent, ovary trilocular, placentation axial or free central, and fruit an indehiscent capsule or fleshy.

Sequencing of the nuclear ribosomal internal transcribed spacer (ITS) and the chloroplast *matK* coding and non-coding region (Xia *et al.*, 2004) was used to examine the evolutionary relationships of 31 accessions of *Amomum* and indicated that *Amomum* as currently defined is polyphyletic with three major groups of species that do not correspond to any of the earlier classifications based on anther appendage type alone (Schumann, 1904; Smith, 1985, 1989). This research also identified *Paramomum* as sister to *Elettariopsis*, which are both embedded in one clade of *Amomum*. These results were confirmed by Kress *et al.* (2007). It seems likely that the status of *Elettariopsis* will have to be reconsidered when better-supported phylogenies become available but, in this paper, *Elettariopsis* is excluded from *Amomum* on morphological grounds (see above).

Xia *et al.* (2004) tentatively divided *Amomum* into three groups based on the results of their molecular analysis, namely: (1) the *Amomum tsaoko* clade, distinguished by bilobed or trilobed anther crest and smooth fruit; (2) the *Amomum villosum* clade, distinguished by bilobed or trilobed anther crest, variable labellum shape, an obviously elongate inflorescence and prickly fruit; and (3) the *Amomum maximum* clade, distinguished by entire anther crest, a partially elongate infructescence and winged fruit.

In this morphological study, we tentatively accept the classification of *Amomum* based on distinct types of fruit, though the placement of a few species is different. Further research is necessary into the phylogeny of *Amomum* in Cambodia, Laos and Vietnam, and more widely, and we acknowledge that once this research is done the genus as currently circumscribed is likely to be radically altered, possibly in line with these three groups. Therefore, the species revised below are arranged into the three groups of Xia *et al.*, as follows:

**The *Amomum maximum* group:** These are clump-forming herbs (except *Amomum glabrum*, *A. longipetiolatum* and *A. prionocarpum*); ligule often partly or wholly bifid; bracts subtending 1–5 flowers; bracteole absent or, if present, usually open, lanceolate; filament sometimes adnate to the labellum forming a short tube above the insertion of the corolla lobes; anther crest usually entire; fruits usually winged, never smooth. The 11 members of this group are: *Amomum calcicolum*, *A. chevalieri*, *A. chryseum*, *A. dealbatum*, *A. glabrum*, *A. longipetiolatum*, *A. odontocarpum*, *A. plicatum*, *A. prionocarpum*, *A. repoeense* and *A. subcapitatum*.

**The *Amomum villosum* group:** These are usually loosely clump-forming or creeping herbs; ligule ovate or lanceolate, coriaceous (one species has membranous ligules); leaf blade narrowly oblong; bracts subtending single flowers; bracteoles always

tubular; anther crest usually lobed; filament always free from the labellum; anther crest variable; fruits prickly. The 15 species and one variety which belong to this group are: *Amomum calcaratum*, *A. celsum*, *A. chinense*, *A. echinocarpum*, *A. elephantorum*, *A. gagnepainii*, *A. glabrifolium*, *A. longiligulare*, *A. microcarpum*, *A. muricarpum*, *A. schmidtii*, *A. stephanocoleum*, *A. tenellum*, *A. uliginosum*, *A. villosum* and *A. villosum* var. *xanthioides*.

**The *Amomum tsaoko* group:** These are of variable habit, from clump-forming to creeping; ligule always ovate or lanceolate; bracts subtending single flowers; bracteoles always tubular; filament always free from labellum; anther crest entire to finely lobed; fruits smooth. The nine species and one variety which belong to this group are: *Amomum koenigii*, *A. petaloideum*, *A. pierreanum*, *A. rubidum*, *A. sericeum*, *A. tomrey*, *A. tomrey* var. *stenophyllum*, *A. tsaoko*, *A. verum* and *A. vespertilio*. This group has the greatest number of differences from the classification of Xia *et al.* (2004) in which *Amomum koenigii* and *A. krervanh* (= *A. verum*) were placed in the *A. villosum* group, *A. petaloideum* with *Elettariopsis* and *A. sericeum* in the *A. maximum* group. All species with smooth fruits are placed together here.

#### SYSTEMATIC TREATMENT

**Amomum** Roxb., Pl. Coromandel 3: 75 (1820), nom. cons. – Type species: *Amomum subulatum* Roxb., Fl. Ind. 1 (1820), designated by Burt & Smith (1968).

*Meistera* Giseke, Prael. Ord. Nat. Pl. 199 (1792), nom. rej., vs *Amomum* Roxb.

*Paludana* Giseke, Prael. Ord. Nat. Pl. 199 (1792), nom. rej., vs *Amomum* Roxb.

*Wurfbainia* Giseke, Prael. Ord. Nat. Pl. 199 (1792), nom. rej., vs *Amomum* Roxb.

*Geocallis* Horan., Prodr. Monogr. Scitam. 33 (1862). – Type species: *Geocallis fasciculata* (Roscoe) Horan. (probably = *Amomum aromaticum* Roxb.).

*Cardamomum* Kuntze, Revis. Gen. Pl. 2: 685 (1891). – Type species not designated.

*Conamomum* Ridl., J. Straits Branch Roy. Asiat. Soc. 32: 121 (1899). – Type species: *Conamomum utriculosum* Ridl. (= *Amomum utriculosum* (Ridl.) Holttum), designated by Turner (2000).

*Paramomum* S.Q.Tong, Acta Bot. Yunnan. 7: 309 (1985). – Type species: *Paramomum petaloideum* S.Q.Tong (= *Amomum petaloideum* (S.Q.Tong) T.L.Wu).

Clump-forming to creeping herbs, rhizomatous, c.1–3.5(–4) m tall; *rhizome* subterranean, shallow, creeping on or above ground or deeply buried, 0.5–4 cm diameter; *stilt roots* sometimes present; *interval between pseudostems* short to fairly long (to 70 cm). *Pseudostems* c.2 cm diameter; *leaves* distichous, simple; *leaf sheaths* striate, reticulate or smooth, hairy or glabrous; *ligule* coriaceous or membranous, toothed, lobed or entire; *petiole* canaliculate or cylindrical, sometimes striate; *blade* oblong to lanceolate or elliptic, young leaves rotate, base attenuate to long attenuate, apex acuminate to long caudate, margin entire, glabrous to ciliate. *Inflorescence* always arising from the rhizome, sometimes at a distance from the pseudostems;



*peduncle* short or elongate (to 2 m tall in *Amomum celsum*), erect or looping downwards then erect, often elongating after flowering; *peduncle scales* almost triangular at base to ovate or lanceolate above, striate, sometimes cucullate, with or without a small spur; *flowers* > 10 in the inflorescence (except *A. glabrifolium* and *A. schmidtii*), often many more, *bracts* arising spirally or symmetrically overlapping, boat-shaped, ovate, lanceolate or oblong, sometimes cucullate, with or without spur, coriaceous or soon rotting, usually subtending a single flower, rarely to 5; *bracteoles*, if present, usually tubular with 2–3 teeth or open, lanceolate. *Flower* white or coloured, opening from base to top of inflorescence, shortly pedicellate; *calyx* tubular, 2–3-toothed. *Corolla* tubular with 3 oblong lobes, the central lobe often largest, usually cucullate, with or without spur, the laterals narrower, usually adnate to the labellum; *labellum* generally clawed or spathulate, white with yellow central stripe edged by red dots spreading to the margin, yellow, orange or yellowish-green, margin lobed, bifid or entire, apex spreading or reflexed, labellum and filament rarely connate into a very short tube above the insertion of the corolla lobes; *lateral staminodes*, if present, usually small, triangular. *Filament* flattened; *anther* with two thecae, held at an obtuse angle to the labellum, curved over the labellum, dehiscing by longitudinal slits; *anther crest* usually present, lobed, spreading, truncate or semi-lunar. *Stigma* globose to funnel-shaped, ciliate or not; *style* held between anther thecae; *epigynous glands* 1 pair, glabrous; *ovary* inferior, trilocular, placentation axile; *ovules* numerous, c.15–90. *Fruit* a fleshy berry or dehiscent capsule, prickly, smooth, lobed, ridged or winged, with persistent calyx. *Seeds* rounded or angular, arillate.

*Distribution.* Tropical and warm subtropical Asia, Sri Lanka and India to Australia, c.150–176 species. Thirty-five species and two varieties found in Cambodia, Laos and Vietnam.

*Key to the species in Cambodia, Laos and Vietnam*

- 1a. Fruit prickly; usually creeping herb, rarely clump-forming \_\_\_\_\_ 2  
 1b. Fruit winged, lobed or smooth; usually clump-forming herb, rarely creeping \_\_\_\_\_ 16
- 2a. Flowers 4–6 per inflorescence; peduncle 1–3 cm long; fruit sparsely prickly \_\_\_\_\_ 3  
 2b. Flowers > 10 per inflorescence; peduncle  $\geq$  4 cm long (usually 2–4 cm in *Amomum villosum* var. *villosum*); fruit densely prickly \_\_\_\_\_ 4
- 3a. Leaves c.5–10 per pseudostem, hairy beneath \_\_\_\_\_ **25. A. schmidtii**  
 3b. Leaves c.16 per pseudostem, glabrous beneath \_\_\_\_\_ **11. A. glabrifolium**
- 4a. Leaves tomentose beneath, blade plicate; inflorescence pyramidal; fruits with simple prickles \_\_\_\_\_ **16. A. microcarpum**  
 4b. Leaves glabrous beneath, blade flat; inflorescence not pyramidal; fruits with branched or simple prickles \_\_\_\_\_ 5

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- 5a. Inflorescence on an erect peduncle at least 150 cm tall \_\_\_\_\_ **3. A. celsum**
- 5b. Inflorescence otherwise \_\_\_\_\_ 6
- 6a. Infructescence, including peduncle, 25–35 cm long \_\_\_\_\_ 7
- 6b. Infructescence, including peduncle, not more than 20 cm long \_\_\_\_\_ 8
- 7a. Fruit with curved or hooked prickles; inflorescence cylindrical, not gelatinous  
\_\_\_\_\_ **10. A. gagnepainii**
- 7b. Fruit with straight prickles; inflorescence globose, gelatinous \_\_\_\_\_  
\_\_\_\_\_ **9. A. elephantorum**
- 8a. Clump-forming herb \_\_\_\_\_ 9
- 8b. Creeping herb \_\_\_\_\_ 13
- 9a. Pseudostem 2–2.5 m tall; corolla reddish orange, labellum yellowish-orange  
\_\_\_\_\_ **17. A. muricarpum**
- 9b. Pseudostem  $\leq 1.8$  m tall; corolla white or pale yellow, labellum white with  
yellow central line and red dots or pale yellow \_\_\_\_\_ 10
- 10a. Pseudostem c.1 m tall, flowering part oblong-ellipsoid; flower pale yellow  
\_\_\_\_\_ **29. A. tenellum**
- 10b. Pseudostem  $> 1$  m tall, flowering part ovoid or ellipsoid; flower white with  
yellow central line and red dots on labellum \_\_\_\_\_ 11
- 11a. Ligule glabrous; fruits green \_\_\_\_\_ **8. A. echinocarpum**
- 11b. Ligule tomentose; fruits red \_\_\_\_\_ 12
- 12a. Labellum bifid; fruits with branched prickles \_\_\_\_\_ **27. A. stephanocoleum**
- 12b. Labellum trilobed; fruits with simple prickles \_\_\_\_\_ **1. A. calcaratum**
- 13a. Ligule membranous, 3–4 cm long \_\_\_\_\_ **14. A. longiligulare**
- 13b. Ligule coriaceous, 0.4–1.5 cm long \_\_\_\_\_ 14
- 14a. Pseudostem distinctly reticulate; ligule red; peduncle 15–20 cm long \_\_\_\_\_  
\_\_\_\_\_ **5. A. chinense**
- 14b. Pseudostem smooth or obscurely reticulate; ligule reddish or green; peduncle to  
15 cm long \_\_\_\_\_ 15
- 15a. Lateral staminodes present; bracts hard, coriaceous, light brown \_\_\_\_\_  
\_\_\_\_\_ **32. A. uliginosum**
- 15b. Lateral staminodes absent; bracts papery, soon rotting, dark brown \_\_\_\_\_  
\_\_\_\_\_ **35. A. villosum**
- 16a. Fruit winged, at least when young; anther crest entire, truncate, or lobed; ovary  
ridged \_\_\_\_\_ 17
- 16b. Fruit smooth, ridged or lobed; anther crest lobed; ovary smooth or  
hairy \_\_\_\_\_ 27
- 17a. Stilt roots present; inflorescence c.30 cm long \_\_\_\_\_ **4. A. chevalieri**

- 
- 17b. Stilt roots absent; inflorescence  $\leq$  22 cm long (to 31 cm in *A. subcapitatum*) \_\_\_\_\_ 18
- 18a. Loosely creeping herb, interval between pseudostems c.30–40 cm \_\_\_\_\_ 19
- 18b. Clump-forming herb, interval between pseudostems c.3–10 cm \_\_\_\_\_ 20
- 19a. Pseudostem > 1 m tall; leaves whitish tomentose below \_\_\_\_\_ **15. *A. longipetiolatum***
- 19b. Pseudostem < 1 m tall; leaves glabrous below \_\_\_\_\_ **22. *A. prionocarpum***
- 20a. Corolla yellow, lip yellow with red dots at base \_\_\_\_\_ **6. *A. chryseum***
- 20b. Corolla white, lip white with yellow central line, often edged with minute red dots or with clear venation radiating towards the margin \_\_\_\_\_ 21
- 21a. Bracts subtending single flowers \_\_\_\_\_ 22
- 21b. Bracts subtending 2 or more flowers \_\_\_\_\_ 25
- 22a. Leaves glabrous below \_\_\_\_\_ 23
- 22b. Leaves hairy below \_\_\_\_\_ 24
- 23a. Leaf blade plicate; C and S Laos at 335–880 m altitude \_\_\_\_\_ **21. *A. plicatum***
- 23b. Leaf blade flat; N Laos and N Vietnam at 1200–1530 m altitude \_\_\_\_\_ **18. *A. odontocarpum***
- 24a. Silky white hairs on abaxial surface of leaves; ligule truncate; fruits globose \_\_\_\_\_ **2. *A. calcicolum***
- 24b. Hairs on abaxial surface of leaves not silky white; ligule bifid; fruit ovoid \_\_\_\_\_ **7. *A. dealbatum***
- 25a. Petiole > 30 cm long; bracteole absent; anther crest semi-lunar \_\_\_\_\_ **28. *A. subcapitatum***
- 25b. Petiole < 30 cm long; bracteole present; anther crest trilobed \_\_\_\_\_ 26
- 26a. Leaf blade flat, sheath reticulate; fruits globose with straight wings \_\_\_\_\_ **23. *A. repoeense***
- 26b. Leaf blade plicate, sheath smooth; fruits ovoid with wavy wings \_\_\_\_\_ **21. *A. plicatum***
- 27a. Creeping herb, rhizome deep in the soil \_\_\_\_\_ 28
- 27b. Clump-forming herb, rhizome at ground level or on stilt roots \_\_\_\_\_ 30
- 28a. Pseudostem c.1 m tall with c.5–9 leaves; fruit ridged \_\_\_\_\_ **12. *A. glabrum***
- 28b. Pseudostem c.1.5–2.5 m tall with c.15–20 leaves; fruit smooth, fleshy \_\_\_\_\_ 29
- 29a. Ligule and margin of blade ciliate; fruit hairy \_\_\_\_\_ **30. *A. tomreyi***
- 29b. Ligule and margin of blade glabrous; fruit glabrous \_\_\_\_\_ **13. *A. koenigii***
- 30a. Stilt roots present; bracts thick, apex with thick pointed spur \_\_\_\_\_ 31
- 30b. Stilt roots absent; bracts thin, apex without thick pointed spur \_\_\_\_\_ 32

- 31a. Leaf sheath distinctly reticulate; petioles > 10 cm long; leaf blade plicate  
 \_\_\_\_\_ **19. A. petaloideum**
- 31b. Leaf sheath obscurely reticulate; petioles < 10 cm long; leaf blade flat  
 \_\_\_\_\_ **20. A. pierreanum**
- 32a. Blade purplish-red abaxially \_\_\_\_\_ **24. A. rubidum**
- 32b. Blade green or whitish green abaxially \_\_\_\_\_ 33
- 33a. Petiole 5–14 cm long; fruits lobed with impressed apex \_\_\_\_\_ **26. A. sericeum**
- 33b. Petiole not more than 1 cm long; fruits not impressed at apex \_\_\_\_\_ 34
- 34a. Bracteoles open, boat-shaped; ligules and bracts glabrous \_\_\_\_\_ **34. A. vespertilio**
- 34b. Bracteoles tubular; ligules and bracts hairy \_\_\_\_\_ 35
- 35a. Leaves c.30–40 per pseudostem, glabrous below; fruits dark reddish violet; N  
 Laos and N Vietnam \_\_\_\_\_ **31. A. tsaoko**
- 35b. Leaves c.18 per pseudostem with ciliate margin; fruits pale brown; Cambodia  
 \_\_\_\_\_ **33. A. verum**

**1. Amomum calcaratum** Lamxay & M.F.Newman, **sp. nov.**

*Amomo echinocarpo* Alston pseudocaulibus foliisque glabris nitidis, floribus albis et fructibus aculeos simplices ferentibus simile, sed pedunculi squamis lanceolatis duris coriaceis ad apicem calcaratis, ligulis villosis ciliatis, labello trilobato et fructibus rubris aculeos molles ferentibus differt. – Type: Laos, Khammouan, Hin Boun, Bane Khoun Ngeun, 18°10'50"N, 104°29'32"E, 285 m, 19 v 2008, V. Lamxay et al. VL1290 (holo NLS; iso E). **Figs 1, 2.**

Clump-forming herb, 1.8 m tall, c.10 pseudostems per clump; *rhizome* c.0.5–0.8 cm diameter, red then reddish-brown, striate, glabrous; *stilt roots* absent; *interval between pseudostems* c.7 cm long, scales broadly ovate, 1–2 cm long, pink then dark reddish-brown, coriaceous, striate, outer surface tomentose with long soft hairs, apex acute, margin ciliate. *Pseudostem* with 5–22 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, 0.5–1.5 cm diameter, reddish-green then green, glabrous, striate or smooth, shiny, outer surface tomentose at base, margin of leaf sheaths ciliate; *ligule* ovate, 0.1–0.5 cm long, red then light green, coriaceous, outer surface tomentose, apex emarginate, margin ciliate; *petiole* very short, 0.1–0.2 cm long, canaliculate, green, glabrous, hairy at the base; *blade* oblong to elliptic to oblanceolate, 13–25 × 2–7 cm, green, glabrous, shiny, base attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* arising near base or from base, 1–2 per pseudostem; *flowering part* ellipsoid, c.5 × 3 cm, c.4 flowers open at once; *peduncle* 10 × 0.4–0.8 cm, red, glabrous, shiny; *scales* tubular at base, 1–2.5 × 0.8 cm, to broadly ovate above, 2–5 × 1.8–2 cm, red then dark reddish-brown, hard coriaceous, striate, outer surface tomentose, apex acute with short spur, margin ciliate with long white hairs; *bracts* boat-shaped to lanceolate, 2.3–3 × 0.5–0.7 cm, to c.4.5–5 × 2 cm when fruiting, red then dark reddish brown,

hard coriaceous and papery above, striate, soon rotting, subtending a single flower, outer surface tomentose, apex acute with small oblong spur c.0.5 cm long, margin ciliate; *bracteole* tubular, 2-toothed,  $1.2\text{--}1.3 \times 0.4$  cm, light brown, membranous, very thin, glabrous, outer surface tomentose at base, apex acute, bracteole tube 0.9–1 cm long, teeth 0.1–0.2 cm. *Calyx* tubular, 2-toothed,  $1.5\text{--}1.6 \times 0.3$  cm, pinkish-light brown, membranous, very thin; calyx tube 1–1.2 cm long; teeth 0.4–0.5 cm long, apex acute with thick small spur. *Corolla* white, 3–3.2 cm long, corolla tube 1.5 cm long, coriaceous, outer surface tomentose, inner surface glabrous; lateral corolla lobes  $1.5 \times 0.7\text{--}0.8$  cm, membranous, apex cucullate, glabrous; central corolla lobe  $1.5 \times 1$  cm, membranous, apex cucullate, glabrous; *labellum* clawed, trilobed,  $1.7 \times 1.6\text{--}1.8$  cm, white with yellow central stripe edged with red dots and red lines of minute red dots radiating to margin, tomentose at base, membranous, undulate; *lateral staminodes* oblong, 0.3 cm long, white. *Filament* flattened, 0.2 cm long, white, glabrous; *anther* oblong,  $0.8 \times 0.4$  cm, white, glabrous; *anther crest* shallowly trilobed, 0.8 cm wide, central lobe 0.15 cm long, white, rounded, membranous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.3 cm long, apex ciliate; *ovary* 0.3 cm diameter, smooth, hairy; *ovules* globose, c.5 per locule. *Infructescence* peduncle  $c.6\text{--}10 \times 0.4\text{--}0.7$  cm, red, tomentose; *scales* boat-shaped to lanceolate,  $c.4.5\text{--}5 \times 2$  cm, reddish-green then dark reddish-brown, very hard, thick and coriaceous, outer surface tomentose, apex acute with small oblong spur  $c.0.5 \times 0.2$  cm, margin ciliate; *fruiting part* ovoid to globose,  $4\text{--}5 \times 5$  cm, c.3–5 fruits per infructescence; *fruits* globose, 1 cm diameter, pink, prickles very soft, hairy. *Seeds* globose, 0.3–0.4 cm diameter, glabrous, c.3–5 per locule.

*Distribution.* Laos.

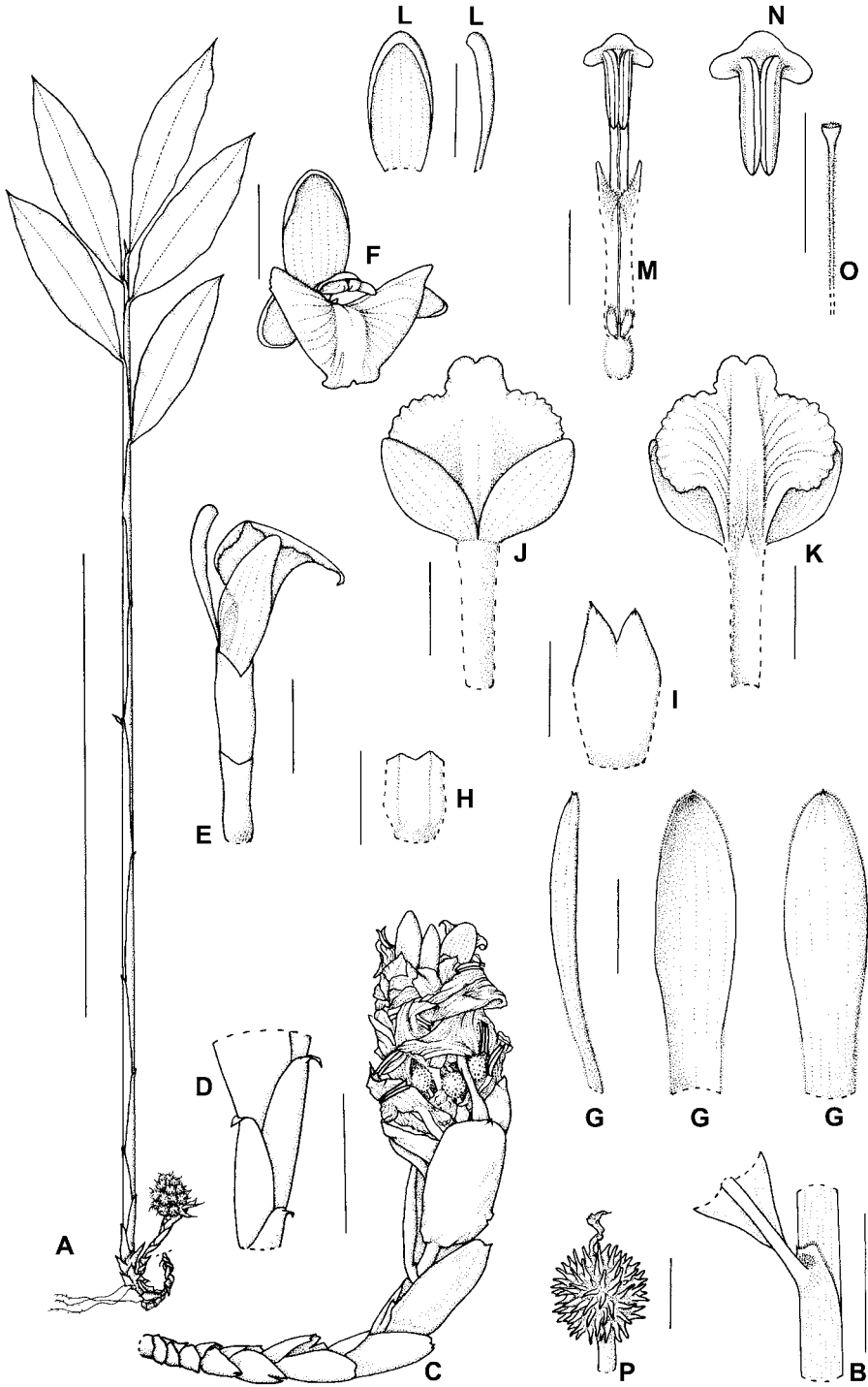
*Habitat and ecology.* Evergreen forest on limestone, at 285–381 m altitude.

*Proposed IUCN status.* VU D1. This species is known only from a very small area, with an area of occupancy less than 4 km<sup>2</sup>. This is all within a protected area and there are no threats and hence no continuing decline. The population is estimated to be very small, however, numbering fewer than 1000 mature individuals, and therefore qualifies for listing as Vulnerable under criterion D1.

*Specimens examined.* LAOS. **Khammouan:** Hin Boun, Bane Khoun Ngeun, 381 m, 19 v 2008, *V. Lamxay et al.* VL1293 (E, NLS); *ibid.*, 381 m, 28 iv 2009, *V. Lamxay* VL1713 (E, NLS, P, UPS); *ibid.*, 381 m, 23 viii 2009, *V. Lamxay* VL2065 (NLS).

*Amomum calcaratum* has only been found in one locality in central Laos. It is very close to *Amomum echinocarpum* by its glabrous, shiny pseudostems and leaves, white flowers and simple prickles on the fruits but the peduncle scales are lanceolate, hard, coriaceous, spurred at the apex, the ligule villose, ciliate, the labellum trilobed and fruits pink with soft prickles.

In its glabrous and shiny leaves, and fruits with simple prickles, it also looks like *Amomum uliginosum* and *A. villosum* but it is distinguished from *A. uliginosum* by its



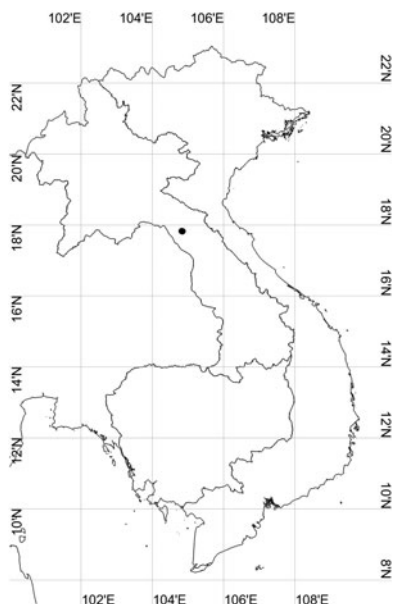


FIG. 2. Distribution of *Amomum calcaratum* Lamxay & M.F.Newman in Cambodia, Laos and Vietnam.

small, very short lateral staminodes, and from *A. villosum* by its clump-forming habit, long peduncle with scales c.5 cm long, and semi-lunar or entire anther crest.

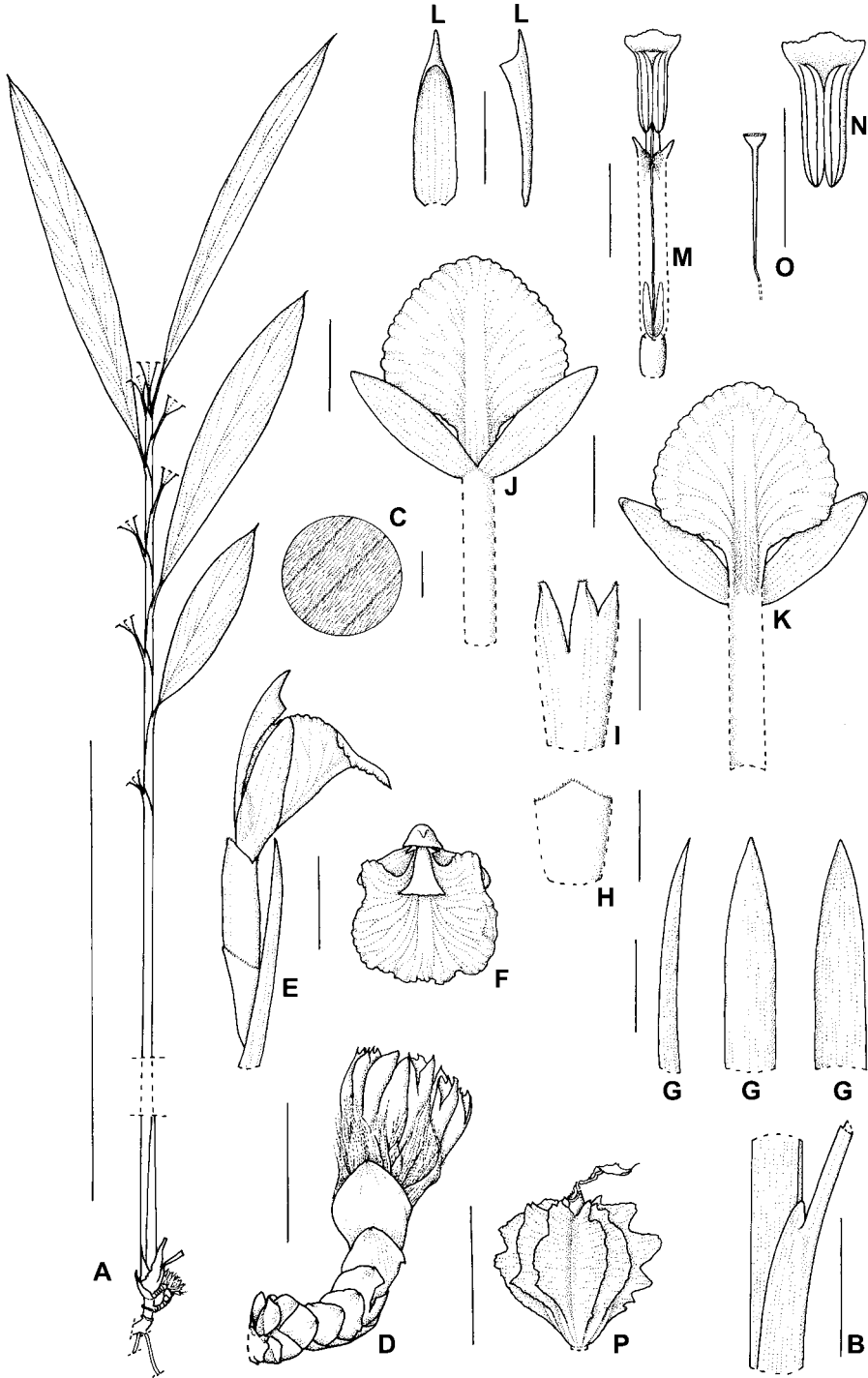
## 2. *Amomum calcicolum* Lamxay & M.F.Newman, *sp. nov.*

*Amomo dealbato* Roxb. habitu caespitoso, labello integro, corollae lobo centrali cucullato, antherae crista rotundata et fructibus alatis affine, sed ligulis nunquam fissis, in laminae pagina infera pilis sericeis albis, floribus simul apertis paucis et fructibus globosis alas 11 ferentibus differt. – Type: Laos, Khammouan, Hin Boun, 18°10'50"N, 104°29'32"E, 285 m, 19 v 2008, *V. Lamxay et al.* VL1291 (holo NLS; iso E, P, UPS). **Figs 3, 4.**

Clump-forming herb, c.1.2 m high, 3–5 pseudostems per clump; *rhizome* c.0.5–1.2 cm diameter, white then reddish-brown; *stilt roots absent*; *interval between pseudostems* c.5 cm long; *scales* ovate, 0.5–2 cm long, reddish then dark brown, coriaceous,



FIG. 1. *Amomum calcaratum* Lamxay & M.F.Newman. A, habit; B, ligule; C, inflorescence; D, peduncle sheaths; E, whole flower from side; F, whole flower from above; G, bract, inner, outer and lateral views; H, bracteole; I, calyx; J, labellum & lateral corolla lobes from below; K, labellum & lateral corolla lobes from above; L, dorsal corolla lobe, inner and lateral views; M, ovary, lateral staminodes and stamen; N, anther; O, stigma; P, fruit. Scale bars: A = 60 cm; B = 2 cm; C, D = 3 cm; E–P = 1 cm. Drawn from *Lamxay* VL1290, dried material & photos (A, B), spirit material (P); *Lamxay* VL1293, dried material (C, D), spirit material & photos (E–O).





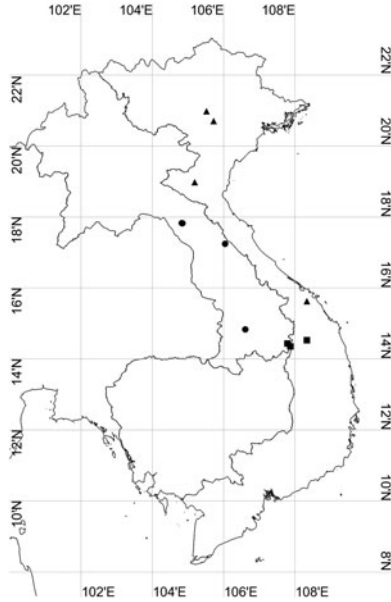


FIG. 4. Distribution of *Amomum calcicolum* Lamxay & M.F.Newman (●), *Amomum celsum* Lamxay & M.F.Newman (■) and *Amomum chevalieri* Gagnep. ex Lamxay (▲) in Cambodia, Laos and Vietnam.

striate, outer surface tomentose, rough, apex acute, margin ciliate. *Pseudostem* with c.12 leaves per pseudostem, becoming slightly smaller towards apex, slightly swollen at base, 1–1.5 cm diameter, red then green when old, glabrous, outer surface striate, rough, inner surface smooth, shiny; *ligule* ovate, 0.3–0.5 cm, light green then darker, glabrous, coriaceous, apex truncate; *petiole* canaliculate, 2–4 cm long, green, striate, glabrous; *blade* oblong, somewhat plicate, 37–50 × 5–6 cm, upper surface glabrous, dark green, lower surface tomentose with shiny, silky white hairs, base attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* arising from base, c.2 inflorescences per pseudostem; *flowering part* broadly ovoid to globose, 3 × 4 cm, a few flowers open at once; *peduncle* 2–5 × 0.5–0.6 cm, whitish-brown, striate, glabrous; scales broad, ovate, 0.5–1.5 × 1.5–2.2 cm, red then dark reddish-green, hard and thickly coriaceous, striate, glabrous, shiny, apex acute, margin ciliate; *bracts* boat-shaped to lanceolate, 2.5–3 × 0.3–0.5 cm,



FIG. 3. *Amomum calcicolum* Lamxay & M.F.Newman. A, habit; B, ligule; C, indumentum on leaf blade; D, inflorescence; E, whole flower from side; F, whole flower from above; G, bract, inner, outer and lateral views; H, bracteole; I, calyx; J, labellum & lateral corolla lobes from below; K, labellum & lateral corolla lobes from above; L, dorsal corolla lobe, inner and lateral views; M, ovary, lateral staminodes and stamen; N, anther; O, stigma; P, fruit. Scale bars: A = 60 cm; B, D, P = 2 cm; C = 5 mm; E–O = 1 cm. Drawn from Lamxay VL2122, dried material (A–D), spirit material (P); Lamxay VL1714, spirit material & photos (E–O).

light brown, very thin, papery, striate, soon rotting, subtending a single flower, glabrous, apex caudate to acute; *bracteole* tubular, 1–1.2 × 0.3 cm, light brown, membranous, very thin, outer surface scabrous with short hairs, bracteole tube 0.5–0.6 cm long, apex truncate, 1-toothed. *Calyx* tubular, 3-toothed, 1.8–2.2 × 0.3 cm, pinkish to light brown, very thin and membranous, outer surface scabrous with short hairs, inner surface glabrous; calyx tube 1.2–1.4 cm long; teeth 0.4–0.7 cm long. *Corolla* 4–4.6 cm long, white, corolla tube 2–2.3 cm long, coriaceous, glabrous, inner surface pilose above; lateral corolla lobes 2–2.3 × 0.7–0.8 cm, membranous, glabrous, apex cucullate, margin ciliate; central lobe 2–2.3 × 1–1.2 cm, membranous, glabrous apex cucullate with pink, thick and pointed spur; *labellum* clawed, 2–2.3 × 2.2–2.5 cm, white with transparent veins radiating from yellow central stripe to margin and minute red dots at base, adaxial surface tomentose at base and central part, apex rounded, margin membranous; *lateral staminodes* triangular, 0.2 cm long, white with red dots at base. *Filament* flattened, 0.4 cm long, white, glabrous; *anther* oblong, 0.8 × 0.4 cm, white, glabrous; *anther crest* rounded, 0.3 cm long, membranous, white, glabrous. *Stigma* rounded, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.6 cm long, glabrous; *ovary* globose, 0.35–0.5 cm diameter, faintly 9–11-ridged, hairy; *ovules* globose, c.5–10 per locule. *Infructescence* peduncle 3–5 × 0.3–0.5 cm, brown, glabrous; *fruiting part* 5 × 4–5 cm, c.15–20 fruits per infructescence; *fruits* globose, 0.5–0.7 cm diameter, 9–11-winged, c.0.2–0.3 cm wide, bullate and ridged, hairy, young fruits green. *Seeds* globose, 0.3 cm diameter, glabrous, c.5–10 seeds per locule.

*Distribution.* Laos.

*Habitat and ecology.* Lowland and montane evergreen forest on limestone, in shade, at 285–1307 m altitude.

*Proposed IUCN status.* NT. This species has a small extent of occurrence (15,244 km<sup>2</sup>) but the population is not severely fragmented and only one of the three subpopulations is in decline, hence there are no locations. The species is therefore listed as Near Threatened as it almost qualifies for a Threatened listing under criterion B1ab(iii).

*Specimens examined.* LAOS. **Champasak:** Tad Gneuang, 1307 m, 11 v 2009, *V. Lamxay* VL1726 (E, NLS, P). **Khammouan:** Bane Khoun Ngeun, 381 m, 28 iv 2009, *V. Lamxay* VL1714 (NLS); *ibid.*, 381 m, 29 iv 2009, *V. Lamxay* VL1723 (NLS); *ibid.*, 381 m, 23 viii 2009, *V. Lamxay* VL2066 (NLS); *ibid.*, 381 m, 9 vi 2010, *V. Lamxay* VL2122 (E, NLS, P); along Pakang stream, Nam On catchment, Phou Ak escarpment, Nakai Nam Theun NPA, 790 m, 25 v 2006, *M.F. Newman et al.* LAO1302 (E).

This species resembles *Amomum dealbatum*, *A. repoeense*, *A. chryseum* and *A. maximum* by its winged fruits but it differs from *A. dealbatum* and *A. maximum* by its loosely clump-forming habit, small rhizome, leaf blade with silky white hairs on the lower surface and fruits with 11 wings, from *A. repoeense* by its bracts only bearing single flowers, and from *A. chryseum* by its white flowers.

**3. *Amomum celsum* Lamxay & M.F. Newman, sp. nov.**

*Amomo koenigii* J.F. Gmel. habitu laxe caespitoso, rhizomate profundo, pseudo-caulibus juvenibus foliorumque pagina abaxiali glaucis et labello trilobato simile, sed ab eo speciebusque *Amomi* omnibus aliis pedunculis praeter modum longis, ad 2 m circiter, differt. – Type: Laos, Attapeu, Phouvong, Bane Phou Keua, 14°42'30"N, 107°31'28"E, 481 m, 15 v 2008, V. Lamxay et al. VL1253 (holo NLS; iso E, P, UPS). Figs 4, 5.

Loosely clump-forming herb, c.2.5 m tall, 3–15 pseudostems per clump; *rhizome* growing deep in the soil, c.0.7–1 cm diameter, white, slightly striate, glabrous; *stilt roots* absent; *interval between pseudostems* c.15 cm long, scales broadly ovate, 1–2 cm long, pink then dark brown, coriaceous, striate, soon rotting, glabrous, inner surface shiny, apex acute. *Pseudostem* with c.20 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, 1–1.5 cm diameter, pink then green, glabrous, outer surface glaucous, striate, inner surface smooth, shiny; *ligule* ovate, 0.5–0.7 cm long, pink then light green, coriaceous, outer surface tomentose, apex truncate to rounded, margin ciliate; *petiole* very short, 0.2–0.5 cm long, canaliculate, green, glabrous; *blade* oblong to oblong-lanceolate, 14–35 × 2–8 cm, glabrous, upper surface dark green, lower surface glaucous, light green, base attenuate, apex long caudate, cauda c.3.5 cm long, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* arising near base, 1 per pseudostem; *flowering part* cylindrical, elongate, c.10 × 3–5 cm, 1–2 flowers open at once; *peduncle* c.200 × 0.5 cm, green, glabrous at base, tomentose above; *peduncle scales* broadly ovate at base, 1–2 × 1–1.5 cm, oblong-linear in middle, 10–20 (rarely to 25) × 1.5–2 cm, and oblong-lanceolate above, 3–5 × 1.3–1.5 cm, reddish-green then brown, hard coriaceous, striate, glabrous, outer surface scabrous, tomentose above, inner surface shiny, apex acute, with leaf-like spur c.1 × 0.2 cm, margin papery at base to ciliate above; *bracts* oblong to boat-shaped, 1.5–2.5 × 0.5–1 cm, pink then dark brown, hard coriaceous, striate and papery, shiny, outer surface tomentose, subtending a single flower, apex truncate to rounded, margin ciliate with long, white hairs; *bracteole* tubular, 1-toothed, 0.5–0.6 × 0.2 cm, pink, very thin and membranous, apex acute with long hairs, outer surface tomentose, bracteole tube 0.3 cm long, teeth 0.2 cm long. *Calyx* tubular, 3-toothed, 1–1.2 × 0.2 cm, light brown, membranous, thin, outer surface tomentose, inner surface glabrous, apex cucullate; calyx tube 0.5–0.6 cm long; teeth 0.2–0.6 cm long. *Corolla* 2–2.5 cm long, glabrous, membranous, corolla tube 1–1.2 cm long, coriaceous, white, glabrous; lateral corolla lobes 1–1.3 × 0.6–0.7 cm, apex cucullate; central corolla lobe 1–1.3 × 0.8–1 cm, glabrous, membranous, apex cucullate; *labellum* clawed, trilobed, 1.5–1.6 × 1.5–1.6 cm, white with yellow central stripe, membranous, tomentose at base on adaxial surface and along central part, apex rounded with 3 lobes, undulate; *lateral staminodes* subulate, 0.3–0.4 cm long, white. *Filament* flattened, 0.3 cm long, white, glabrous; *anther* oblong, 0.6 × 0.3 cm, white but dark reddish-brown along slit, glabrous; *anther crest* trilobed, 0.2 cm wide, rounded, membranous, white, glabrous. *Stigma* cup-shaped,

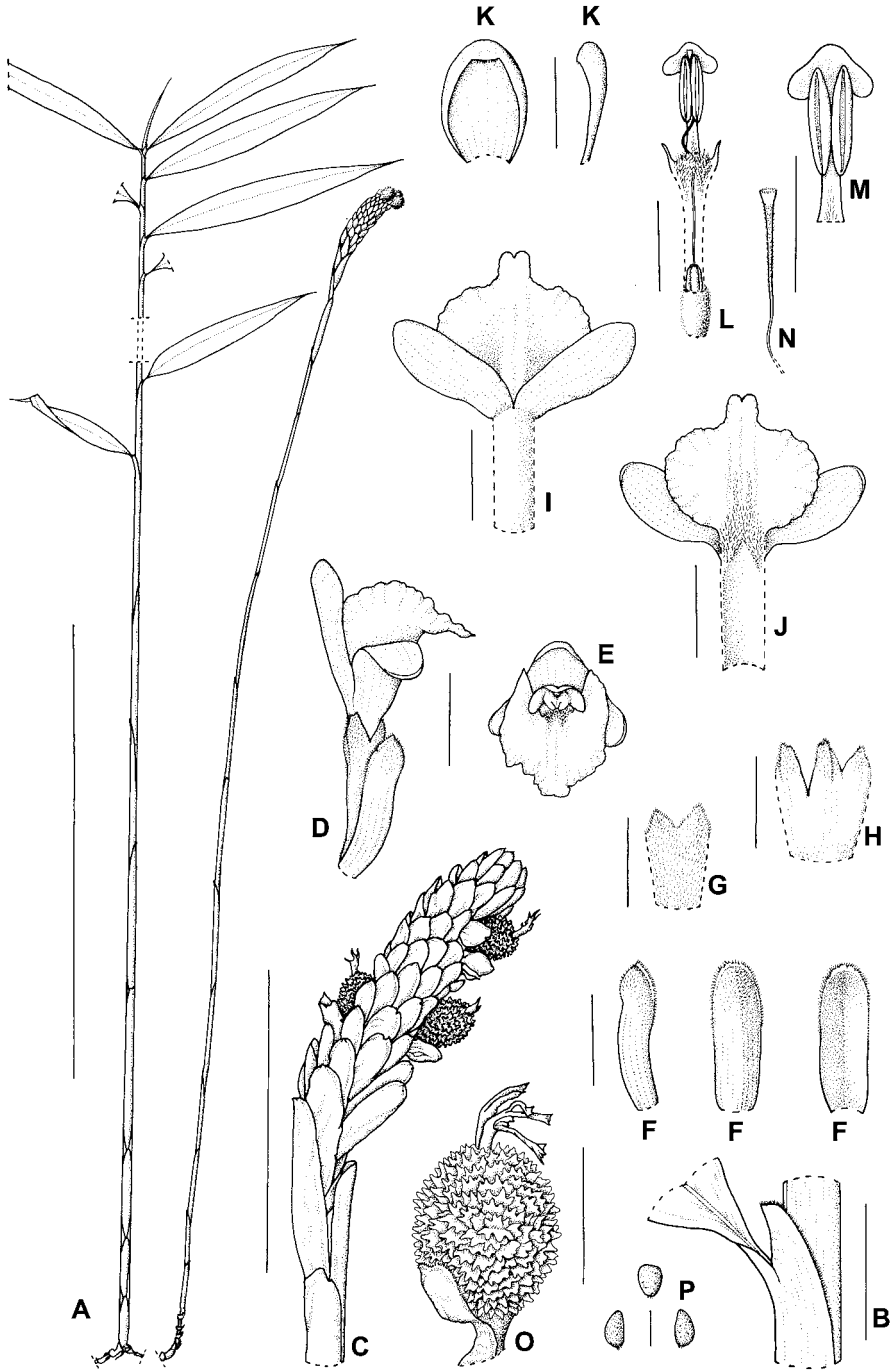


FIG. 5. *Amomum celsum* Lamxay & M.F. Newman. A, habit; B, ligule; C, inflorescence; D, whole flower from side; E, whole flower from above; F, bract, inner, outer and lateral views; G, bracteole; H, calyx; I, labellum & lateral corolla lobes from below; J, labellum &

glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.2 cm long, glabrous; *ovary* 0.3 cm diameter, bullate or strumose, hairy; *ovules* globose, c.12 ovules per locule. *Infructescence* peduncle 150–200 × 0.5 cm, green then brown, glabrous at base, tomentose above; *fruiting part* elongating, oblong, c.10 × 5 cm, c.15 fruits per infructescence; *fruits* globose, 1.5–2.5 × 1–2 cm, light green, prickly, hairy. *Seeds* globose, 0.3–0.4 cm diameter, yellowish-brown, glabrous, bullate, c.10–12 seeds per locule.

*Distribution.* Vietnam, Laos.

*Habitat and ecology.* Lowland evergreen forest, mixed deciduous forest, open forest, at 349–481 m altitude.

*Proposed IUCN status.* EN B1ab(iii). This species has a very small extent of occurrence (EOO) of 314 km<sup>2</sup>, including the Vietnamese locality which is probably no longer extant so the EOO is an over-estimate. It is known at present only from two locations and there is continuing decline in the habitat due to logging and road building. Another population may exist in Laos; *Poilane* 13692 (P) was collected in 1927 in Savannakhet, Laos, ‘between L.G. Xinh xa ne and Lang Xoane’. These place names are unknown nowadays so we have not been able to confirm the presence of *Amomum celsum* in Savannakhet.

*Specimens examined.* LAOS. **Attapeu:** Bane Houay Pik, 349 m, 27 vii 2007, V. Lamxay & Bounlop VL1189 (E, NLS, P, UPS). **Savannakhet:** between L.G. Xinh xa ne and Lang Xoane, 10 iv 1927, E. Poilane 13692 (P).

VIETNAM. **Kon Tum:** Tu Mô Rông – Dak ha, 12 iii 1941, E. Poilane 32294 (P).

This species, with its exceptionally long, erect peduncle, has only been seen by us in one small site in southern Laos. Two other collections were made by Poilane in 1927 (*Poilane* 13692, P) and in 1941 (*Poilane* 32294, P). The collection locality for *Poilane* 13692 has not been identified but Savannakhet was larger at that time, including Attapeu Province, so Poilane’s collection may come from the same locality where we have collected this species.

#### 4. *Amomum chevalieri* Gagnep. ex Lamxay, **sp. nov.**

*Amomo repoeensi* Pierre ex Gagnep. bractibus florum plurium quam singulorum cincinnos ferentibus, foliis glabris et fructibus alatis simile, sed radicibus gralliformibus, foliorum vaginis striatis, ligulis truncatis glabris, pedunculis multo longioribus, pedunculorum squamis longis, bracteis bracteolisque caliceque glabris et antherae crista semilunari manifeste distinguatur. – Type: Vietnam, Phu Tho, 18–19 iv 1914, Fleury s.n. (holo P). **Fig. 4.**



lateral corolla lobes from above; K, dorsal corolla lobe, inner and lateral views; L, ovary, lateral staminodes and stamen; M, anther; N, stigma; O, fruit; P, seeds. Scale bars: A = 70 cm; B = 2 cm; C = 10 cm; D–O = 1 cm; P = 5 mm. Drawn from *Lamxay* VL1189, dried material (A–C); *Lamxay* VL1253, spirit material & photos (D–P).

Clump-forming herb, c.50 cm tall; *rhizome* c.1 cm diameter, glabrous; *stilt roots* present, c.5 × 0.5–0.7 cm; *interval between pseudostems* short, scales soon rotting, papery, glabrous. *Pseudostem* with c.7 leaves per pseudostem, 1 cm diameter, striate, glabrous; *ligule* ovate, c.0.5 cm long, coriaceous, glabrous, apex truncate, margin ciliate; *petiole* canaliculate to cylindrical, c.10–15 (rarely to 20) × 0.3 cm, glabrous; *blade* broadly elliptic, 20–35 (rarely to 60) × 5–10 cm, dark green above, grey below, glabrous, base cuneate, apex acute, margin entire, ciliate at apex, primary vein prominent below. *Inflorescence* arising from base or near base, 1 per leafy shoot; *flowering part* oblong, c.10 × 2–3 cm; *peduncle* c.20 × 0.3–0.5 cm, striate, glabrous; *peduncle scales* broadly triangular at base, 1 × 1.5 cm, narrowly lanceolate-oblong above, 3 × 1 cm, coriaceous, striate, glabrous, apex acute; *bracts* lanceolate-oblong, c.2.5–3 × 1–1.2 cm, subtending a few flowers, coriaceous, striate, glabrous, apex acute, margin ciliate; *bracteole* open, narrowly lanceolate, c.1–1.5 × 0.7 cm, as long as pedicel, membranous, striate, glabrous, apex acute, margin ciliate. *Calyx* tubular, 3-toothed, c.1.5 × 0.5 cm, glabrous, as long as corolla tube; calyx tube c.1 cm long, membranous; teeth c.0.5–0.75 cm long. *Corolla* membranous, glabrous, apex acute, corolla tube as long as corolla lobes, c.0.4 cm diameter; corolla lobes oblong, c.1.5 × 0.8 cm, central lobe the same size and shape as lateral lobes, membranous; *labellum* clawed, glabrous, c.1.5 × 1–1.3 cm, apex rounded; *lateral staminodes* small, c.0.3 cm long. *Filament* flattened, c.1 cm long, glabrous; *anther* oblong, c.1 cm long, glabrous; *anther crest* large, semi-lunar, 0.7 × 1 cm, membranous, glabrous. *Stigma* cup-shaped, apex ciliate; *style* glabrous; *epigynous glands* oblong, c.0.4 cm long, apex rounded, glabrous; *ovary* ridged, c.0.4 × 0.3 cm, glabrous, *pedicel* c.1–1.5 × 0.2–0.3 cm. *Fruits* globose, c.1 cm diameter, winged.

*Distribution.* Vietnam.

*Habitat and ecology.* In high mountains, at c.1500 m altitude.

*Proposed IUCN status.* DD. This species has not been collected since 1923 so the current extent of occurrence is not known. Although most of the known localities have been visited by ginger experts, there has been no concerted attempt to search for this species. No threats have been identified. The species is listed as Data Deficient as there is insufficient information to apply the criteria.

*Specimens examined.* VIETNAM. **Hanoi:** Ba Vi, 24 vii 1888, *B. Balansa* 4205 (P). **Nghe An:** 5 v 1914, *Fleury* 32344 (P). **Phu Tho:** 17 iv 1914–18 iv 1914, *Fleury* 32143 (P). **Quang Nam-Da Nang:** Ba Na, 1500 m, 17 vii 1923, *E. Poilane* 7227 (P).

The first collection of this species dates from 1888 (*Balansa* 4205, P) but the others were collected in 1914 and 1923, after Gagnepain had published his revision of the Indochinese Zingiberaceae (Gagnepain, 1908). The name was written onto the specimens at P but has not been published until now.

Two specimens were found in a type cover at P, *Fleury* 32143 and *Fleury* s.n. The first of these is dated 17–18/4/1914 while the second is annotated, ‘a déjà reçu un no.

18–19/4/1914'. As the dates differ, they cannot be regarded as being a single gathering, though they seem to have been collected together. Although the annotation on the second sheet says it has received a number, no number is attached to the sheet.

This species is close to *Amomum repoense* by its bracts bearing cincinni of more than one flower, glabrous leaves and winged fruits but may be clearly distinguished by its stilt roots, striate leaf sheaths, truncate, glabrous ligules, much longer peduncle, long peduncle scales, glabrous bracts, bracteoles and calyx, and semi-lunar anther crest.

**5. *Amomum chinense*** Chun, Fl. Hainan. 4: 533 (1977); Wu & Larsen, Fl. China 24: 354 (2000). – Type: China, Hainan, Yaichow, iii–vii 1933, *F.C. How* 70635bis (holo IBSC n.v.; iso NY). **Figs 6, 7.**

Creeping herb, to 3 m tall; *rhizome* deep, c.0.5–2 cm diameter, white then green; *stilt roots* absent; *interval between pseudostems* c.20–50 cm long, scales tubular, 1–4 cm long, light brown, papery, striate, glabrous, outer surface rough, inner surface smooth, apex acute or truncate. *Pseudostem* with c.15 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, 1–1.5 cm diameter, green, glabrous, outer surface striate, conspicuously reticulate, inner surface smooth, shining, margin of leaf sheaths red; *ligule* c.0.4–0.5 cm long, red then reddish-brown, coriaceous, glabrous, apex rounded to emarginate, margin ciliate; *petiole* very short, 0.5–1.2 cm long, canaliculate, green, striate, glabrous; *blade* oblong-elliptic, 25–33 × 6–8 cm, glabrous, lower surface whitish, glaucous, base attenuate, apex long caudate, cauda c.2 cm long, margin entire, primary vein prominent below, whitish, secondary veins sunken. *Inflorescence* arising from rhizome c.5 cm from base of mature shoots, 2–3 per pseudostem; *flowering part* ellipsoid to globose, c.4 cm diameter, c.4 flowers open at once; *peduncle* c.16–20 × 0.3 cm, pinkish then whitish-brown, glabrous at base, tomentose above, rough; *scales* tubular at base, 1.3–1.5 × 0.6 cm, broadly ovate to lanceolate above, 3.5–4 × 1–1.5 cm, light pink then dark brown, coriaceous, striate, glabrous to tomentose at base, apex acute or cucullate, margin glabrous or ciliate; *bracts* boat-shaped to lanceolate, 2–3 × 1–1.5 cm, greenish-pink then dark brown, coriaceous, striate, soon rotting, subtending a single flower, tomentose at base, apex cucullate to rounded, margin ciliate to glabrous; *bracteole* tubular, 2-toothed, 1.5–1.6 × 0.6 cm, light pink, membranous, striate, tomentose at base, bracteole tube 1–1.1 cm long, tomentose at base, teeth 0.5–0.6 cm, apex acute. *Calyx* tubular, 3-toothed, 1.5–1.6 × 0.4 cm, light pink then light brown, glabrous, outer surface tomentose at base, membranous; calyx tube 1–1.2 cm long; teeth 0.2–0.3 cm long, apex acute. *Corolla* 3–3.2 cm long, light pinkish-white, corolla tube 1.5–1.6 cm long, coriaceous, striate, outer surface pilose, tomentose at base, inner surface tomentose at base; lateral corolla lobes 1.5–1.6 × 0.5–0.7 cm, membranous, glabrous, apex cucullate; central corolla lobe 1.5 × 0.8–1 cm, membranous, glabrous, apex cucullate; *labellum* clawed, trilobed, 1.5–1.7 cm long, whitish-pink with yellow central stripe edged with lines of red dots

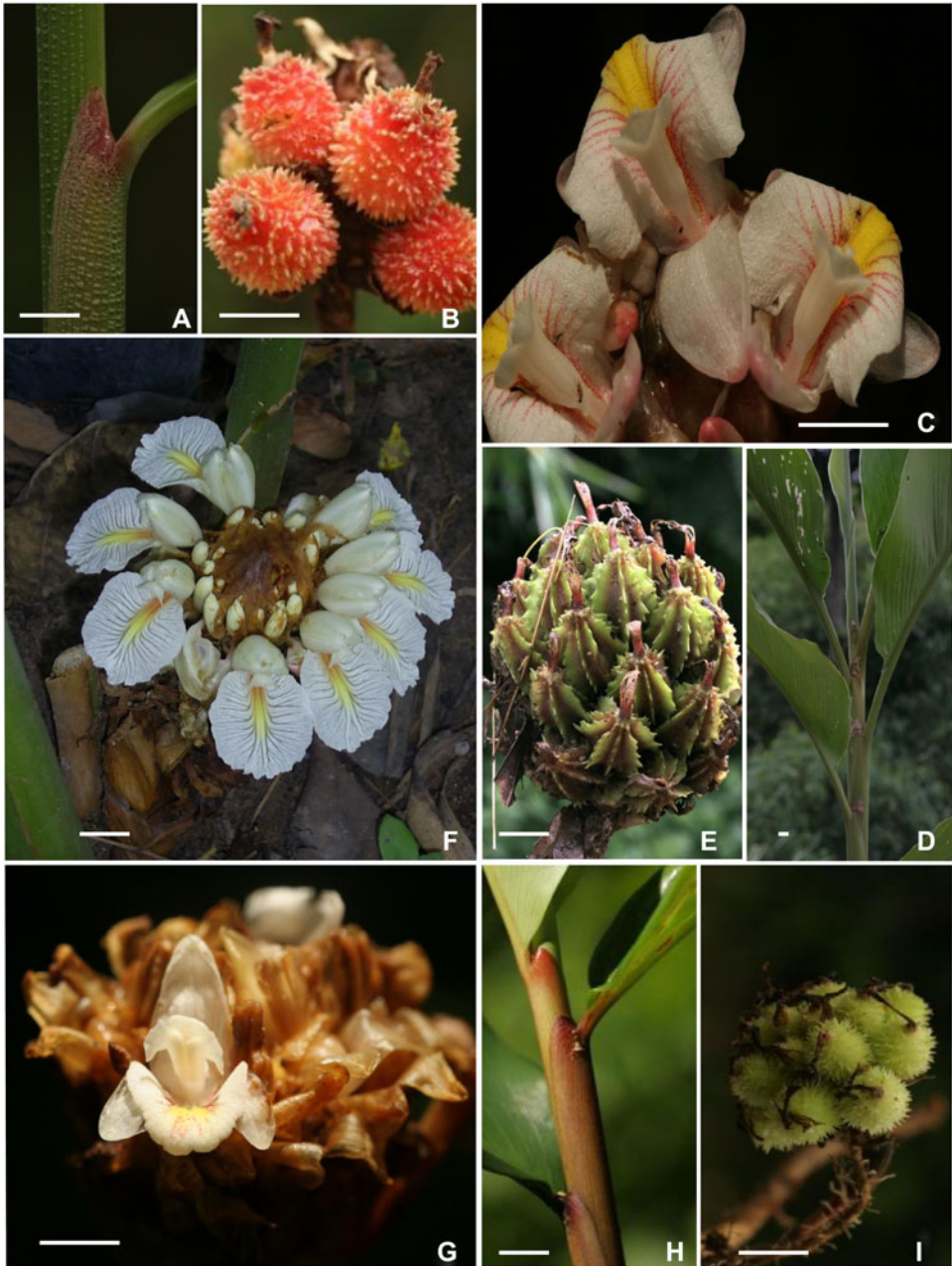


FIG. 6. A–C: *Amomum chinense*. A, ligule; B, infructescence; C, inflorescence. *Lamxay* VL1230. D–F: *Amomum dealbatum*. D, ligule; E, infructescence; F, inflorescence. *Lamxay* VL1151. G–I: *Amomum echinocarpum*. G, inflorescence; H, ligule; I, infructescence. *Lamxay* VL1306. Scale bar = 1 cm.



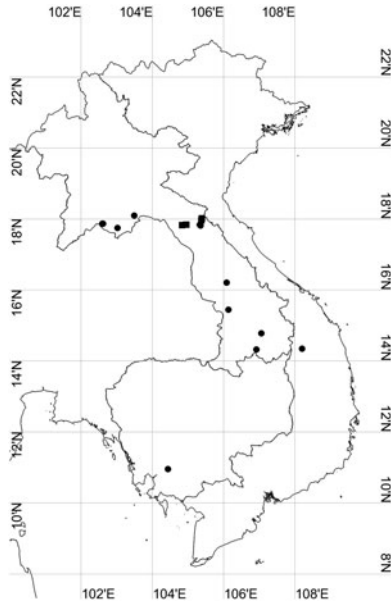


FIG. 7. Distribution of *Amomum chinense* Chun (●) and *Amomum chryseum* Lamxay & M.F.Newman (■) in Cambodia, Laos and Vietnam.

radiating to margin, two longitudinal lines of long hairs at base, membranous, apex emarginate; *lateral staminodes* oblong, 0.2 cm long, white. *Filament* flattened, 0.3–0.4 cm long, white, glabrous; *anther* oblong, 0.7–0.8 × 0.5 cm, white, glabrous; *anther crest* rounded, entire, 0.5 × 0.2 cm, white, membranous, glabrous. *Stigma* rounded, coriaceous, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.6 cm long, glabrous; *ovary* 0.4 cm diameter, tomentose with long white hairs; *ovules* globose, c.30 per locule. *Infructescence* peduncle 15–20 × 0.3 cm, brown, glabrous; *fruiting part* 5 × 5 cm, more than 10 fruits per infructescence; *fruits* globose, 1–1.5 cm diameter, tomentose, short hairy, with flattened, simple spines, cream at base, red at apex then dark red when ripe. *Seeds* globose, 0.3 cm diameter, yellowish, glabrous, c.30 per locule.

*Distribution.* China (Hainan), Thailand, Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland forest, mixed deciduous forest, open forest, on many soil types, at 90–628 m altitude.

*Lao name and uses.* Mak sa. The fruits are slightly sweet and acidic when ripe and are eaten. The seeds taste of camphor and are used for treating toothache.

*Proposed IUCN status.* LC. This species has a very large extent of occurrence and is common with no major threats so it is listed as Least Concern.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** Kirirom, 628 m, 29 v 2010, *M.F. Newman et al.* 2414 (E); Samrong Tong, 10 iv 1870, *J.B.L. Pierre* 542bis (P).

LAOS. **Attapeu:** Bane Bak, Dong Bak Protected Area, 90 m, 11 ix 2006, *V. Lamxay & Bounlop* VL1089 (E, NLS, P); Bane Lak 62, 291 m, 17 v 2008, *V. Lamxay & M.F. Newman* VL1282 (E, NLS, P). **Bolikhambxai:** Bane Had Khai, 404 m, 9 v 2008, *V. Lamxay et al.* VL1243 (E, NLS); Bane Nam Phao, 499 m, 17 vi 2006, *V. Lamxay* VL1015 (E, NLS, P); *ibid.*, 523 m, 28 iv 2009, *V. Lamxay* VL1715 (NLS); *ibid.*, 527 m, 24 viii 2009, *V. Lamxay* VL2071 (NLS). **Khammouan:** Phone Than, *O. Spire* 4074 (P); Bane Mak Feuang, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella12 (E); Bane Na Wa, 590 m, *V. Lamxay* VL1878 (NLS). **Salavan:** Bane Kham Toey, 180 m, 3 vi 2000, *Lee* 106 (E, P). **Savannakhet:** Bane Na Thong, 207 m, 7 viii 2007, *V. Lamxay* VL1195 (NLS). **Vientiane Capital:** Bane Phia Lat, 607 m, 6 v 2008, *V. Lamxay* VL1230 (E, P); Bane Po, 185 m, 6 v 2006, *V. Lamxay* VL1001 (NLS); Xaythani, Bane Dane Xang, 179 m, 3 v 2008, *V. Lamxay et al.* VL1222 (E, NLS, P, UPS); *ibid.*, 179 m, 27 i 2010, *V. Lamxay* VL2114 (NLS).

VIETNAM. **Kon Tum:** Dak To, 800 m, 13 ix 1930, *E. Poilane* 18326 (P).

The main distinguishing characters of *Amomum chinense* are its loosely creeping habit, with its rhizome c.10 cm deep in the soil, the leaf sheath markedly reticulate, ligule red, peduncle erect, c.20 cm long, anther crest semi-lunar, and pink or reddish, prickly fruits grouped at the top of the infructescence. It resembles *Amomum villosum* and *A. uliginosum* but is distinguished from them by its semi-lunar anther crest and long peduncle. It differs from *Amomum elephantorum* by its white flowers and its fruits with simple spines.

## 6. *Amomum chryseum* Lamxay & M.F.Newman, *sp. nov.*

*Amomo repoeensi* Pierre ex Gagnep. inflorescentiis duorum florum cincinnos interdum ferentibus, bracteolis apertis et fructibus alatis persimile, sed ligulis ovatis ad apicem emarginatis, foliorum lamina angusta (minus quam 10 cm lata), floribus magis quam 4 cm longis, labello corollaeque lobis luteis praeditis, et fructibus ovoideis differt. – Type: Laos, Bolikhambxai, Kham Keut, Bane Na Heuang, 18°22'31"N, 105°2'2"E, 724 m, 29 iv 2009, *V. Lamxay* VL1719 (holo NLS; iso E, P, UPS). **Figs 7, 8.**

Clump-forming herb, c.80 cm tall, with c.20 pseudostems per clump; *rhizome* c.0.8 cm diameter, red; *stilt roots* absent; *interval between pseudostems* c.5 cm long, scales broadly triangular, 1–2 cm long, dark brown, coriaceous, striate, glabrous, apex acute, margin entire. *Pseudostem* with c.5–8 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, c.1 cm diameter, red then greenish-red, striate, glabrous; *ligule* coriaceous, c.1 cm long, green, glabrous, apex emarginate or shortly bilobed, margin entire; *petiole* canaliculate, c.5–17 × 0.3 cm, green, striate, glabrous; *blade* obovate-elliptic to oblong or elliptic, 25–50 × 6–10 cm, green, glabrous, plicate, base attenuate, apex acute to long caudate, margin entire, primary veins prominent on lower surface, secondary veins prominent. *Inflorescences* arising near the base or from base, few per pseudostem; *flowering part* ellipsoid, 3–5 × 1–2 cm, 1–2 flowers open at once; *peduncle* c.3–5 × 0.5 cm, reddish-pink,

glabrous; scales broadly triangular at base,  $1-1.5 \times 1.5-2$  cm, ovate above,  $3-4 \times 2-2.5$  cm, pink, coriaceous, finely striate, glabrous and shiny, apex soon drying and rotting, truncate to emarginate with short spur, margin entire, with very short cilia; *bracts* oblong-lanceolate,  $2.5-4 \times 1.5-2$  cm, light pink, coriaceous, striate, glabrous, subtending 1–2 flowers, apex truncate to rounded, cucullate, margin entire; *bracteole* open, oblong-lanceolate,  $1-1.5 \times 0.3-0.5$  cm, whitish-pink, coriaceous, striate, glabrous, apex acute, margin ciliate. *Calyx* tubular, 3-toothed,  $2-2.5 \times 0.3-0.5$  cm, pinkish-white, coriaceous, striate, glabrous; calyx tube 1–1.25 cm long; teeth 0.4–0.5 cm long, apex acute, cucullate with spur c.0.2 cm long. *Corolla* 4–5 cm long, yellow, glabrous, corolla tube c.  $2-2.5 \times 0.5$  cm; corolla lobes oblong,  $3-4 \times 1$  cm, apex cucullate; central lobe pointed at apex; *labellum* clawed,  $3-4 \times 3-4$  cm, yellow with red dots at base and transparent lines radiating to margin, apex with 3 broad lobes, membranous and plicate; *lateral staminodes* oblong, membranous,  $1 \times 0.2-0.3$  cm, yellowish-white. *Filament* flattened,  $1 \times 0.3-0.4$  cm, white, glabrous; *anther* oblong,  $1 \times 0.5$  cm, yellow, glabrous; *anther crest* trilobed, lateral lobe c.0.5 cm long, central lobe c.1.5 cm wide, yellow, membranous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* glabrous; *epigynous glands* 0.5 cm long, glabrous, covered with small dark dots, apex truncate; *pedicel* glabrous, c.0.5 cm long; *ovary* c.0.5 cm diameter, ridged, glabrous; *ovules* globose, c.20 per locule. *Infructescence* c.  $7-10 \times 1$  cm, pink to greenish-red, glabrous, with 3–5 fruits clustered at apex; *fruiting part* c.3–5 cm; *fruits* ovoid,  $1.5-2 \times 0.8-1$  cm, pointed at apex, with persistent calyx, 9-winged, margin of wings straight and entire, wings c.0.5 cm wide, greenish, glabrous. *Seeds* obovoid to globose, 0.3 cm diameter, white then black, aril white, 15–20 per locule.

*Distribution.* Laos.

*Habitat and ecology.* Mid-elevation evergreen forest on limestone, among rocks, in shady conditions, at 381–724 m altitude.

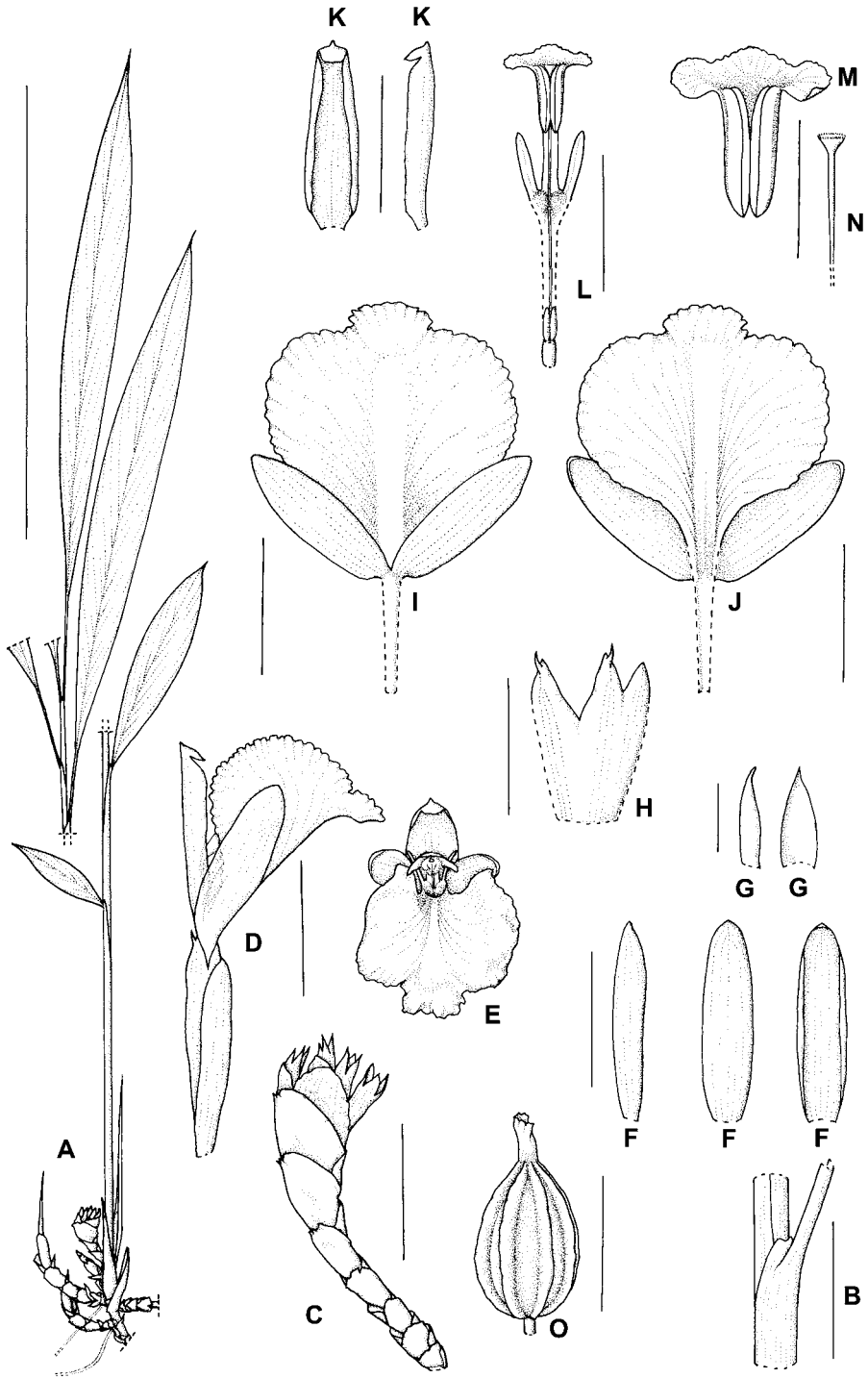
*Proposed IUCN status.* LC. Although this species has a very small extent of occurrence (200 km<sup>2</sup>), there are no threats and all the known localities are in protected areas. The species is therefore listed as Least Concern.

*Specimens examined.* LAOS. **Bolikhambxai:** Bane Na Heuang, 18 vii 2007, *V. Lamxay et al.* VL1171 (E, NLS); Phou Hai, 9 vi 2010, *V. Lamxay* VL2119 (E, NLS, P, UPS). **Khammouan:** Bane Khoun Ngeun, 381 m, 29 iv 2009, *V. Lamxay* VL1724 (NLS).

This species resembles *Amomum repoeense* in its sometimes two-flowered cincinni, open bracteoles and winged fruits but its ovate ligule is emarginate to slightly bilobed, the leaf blades are narrow, the flowers are longer than 4 cm, the labellum and corolla lobes are yellow and the fruit is ovoid.

**7. *Amomum dealbatum* Roxb., Fl. Ind. 1: 42 (1820); Wu & Larsen, Fl. China 24: 354 (2000). – *Cardamomum dealbatum* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 686 (1891).**

– Type: See notes below. **Figs 6, 9.**



Clump-forming herb to 2.5 m tall, 3–5(–15) pseudostems per clump; *rhizome* c.2–4 cm diameter, white then yellowish-brown; *stilt roots* absent; *interval between pseudostems* c.5 cm long, scales ovate to broadly ovate, 1–5 × 5 cm, brown, coriaceous, striate, shiny, glabrous, apex acute, margin entire. *Pseudostem* with c.8–10 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, 1.5–2 cm diameter, light green, striate, outer surface tomentose, smooth, shiny, margin of leaf sheaths ciliate; *ligule* lanceolate, bifid, c.4–5 cm long, light brown, membranous, outer surface tomentose, margin ciliate; *petiole* canalliculate, > 10 cm long, green, striate, tomentose; *blade* oblong, 40–90 × 9–15 cm, light or pale green, plicate, upper surface glabrous, lower surface tomentose but not covered with silky white hairs, base long attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins prominent on both sides. *Inflorences* arising from base, c.3 per pseudostem; *flowering part* ellipsoid, 5–6 × 6 cm, c.10–11 flowers open at once in a circle; *peduncle* 12–15 × 0.6–1 cm, light brown, striate, glabrous; *scales* broadly ovate to broadly lanceolate, 1.5–7 × 1–6 cm, light brown then dark brown, coriaceous, thick, hard, striate, glabrous, shiny, apex acute with short spur, margin entire; *bracts* boat-shaped to lanceolate, 2–4.5 × 1–1.5 cm, light brown, striate, soon rotting, subtending a single flower, outer surface scabrous to glabrous, apex acute with papery wing, margin entire; *bracteole* absent. *Calyx* tubular, 3-toothed, 2.5–3 × 0.3–0.5 cm, white, transparent colourless, membranous, outer surface pilose, inner surface glabrous; calyx tube 1.5–1.6 cm long; teeth 0.5–1 cm long, apex acute with thick, small spur. *Corolla* c.4–5 cm long, white, transparent, colourless, corolla tube 2–2.5 cm long, outer surface glabrous, inner surface glabrous at base, pilose to strigose and tomentose above; lateral corolla lobes 2–2.5 × 0.6–0.9 cm, membranous, glabrous, apex cucullate; central corolla lobe 2.3–2.5 × 0.8–1.2 cm, membranous, glabrous, apex cucullate; *labellum* clawed, 3.5–4 × 1.5–2 cm, white with red and yellow central stripe and clear venation radiating to margin, labellum and filament connate into a very short tube c.0.2 cm above insertion of corolla lobes, entire, membranous, rounded, hairy; *lateral staminodes* triangular, 0.2 cm long, white. *Filament* flattened, 0.2–0.3 cm long, white, adaxial surface pilose; *anther* oblong, 1.3–1.5 × 0.4 cm, white, glabrous; *anther crest* truncate, entire, 1 × 0.3 cm, membranous, white, glabrous. *Stigma* rounded, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.8 cm long,



FIG. 8. *Amomum chryseum* Lamxay & M.F.Newman. A, habit; B, ligule; C, inflorescence; D, whole flower from side; E, whole flower from above; F, bract, inner, outer and lateral views; G, bracteole, lateral and inner views; H, calyx; I, labellum & lateral corolla lobes from below; J, labellum & lateral corolla lobes from above; K, dorsal corolla lobe, inner and lateral views; L, ovary, lateral staminodes and stamen; M, anther; N, stigma; O, fruit. Scale bars: A = 40 cm; B, D–F, H–L, O = 2 cm; C = 3 cm; G, M, N = 1 cm. Drawn from Lamxay VL1719, dried material (A–C), spirit material & photos (D–N); Lamxay VL1171, dried material & photos (O).

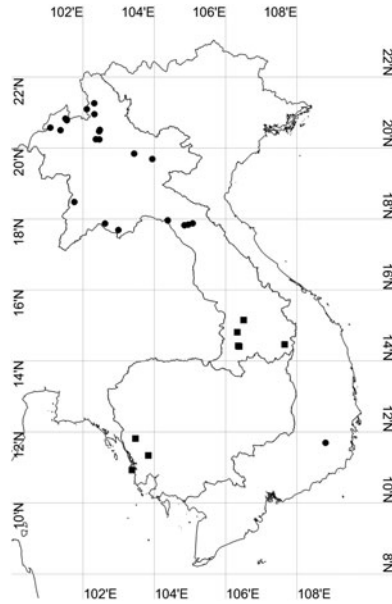


FIG. 9. Distribution of *Amomum dealbatum* Roxb. (●) and *Amomum elephantorum* Pierre ex Gagnep. (■) in Cambodia, Laos and Vietnam.

glabrous; *pedicel* c.0.5 cm long, hairy; *ovary* 0.4 cm diameter, with 9 longitudinal ridges, hairy; *ovules* round, c.15 per locule. *Infructescence* peduncle c.10–15(–20) × 0.5 cm, brown, glabrous; *fruiting part* c.20 fruits per infructescence, 6–7 cm diameter; *fruits* ovoid, 2–2.5 × 1–1.5 cm, 9-winged, green then reddish-green, wings 0.2–0.3 cm wide, margin serrate, hairy. *Seeds* globose, 0.3 cm diameter, glabrous, black, aril yellowish, c.15–20 per locule.

*Distribution.* India (Assam), Bhutan, Sikkim, Burma, Thailand, Laos, Vietnam.

*Habitat and ecology.* Lowland to montane forest, mixed deciduous forest, limestone forest, open forest, at 120–1280 m altitude.

*Lao name and uses.* Mak kouk. The fruits of this species, which is very common in northern Laos, taste sweet and slightly acid. They are collected in August and September for eating at home and for local trade. Fruits have also been seen at the central market of Louangphabang. Some families have collected plants from the forest and planted them in their own gardens to provide a crop for local trade.

*Proposed IUCN status.* DD. This is a species complex and although, as currently circumscribed, it has a very wide range and is common, it may be resolved into a number of more restricted-range species. Hence for now it has to be assessed as Data Deficient.

*Specimens examined.* LAOS. **Bolikhamsai:** 30 iv 1932, *A.F.G. Kerr* 21315 (K, P); Bane Kouan Chane, 16 v 2007, *V. Lamxay* VL1134 (NLS); Bane Phone Xay, 13 v 2008, *V. Lamxay & M.F. Newman* VL1248 (E, NLS); *ibid.*, 27 iv 2009, *V. Lamxay* VL1710 (NLS). **Khammouan:** Bane Khoun Ngeun, 18 vii 2007, *V. Lamxay* VL1180 (E, NLS); *ibid.*, 19 v 2008, *V. Lamxay & M.F. Newman* VL1289 (E, NLS, P). **Louangnamtha:** Mueang Sing, 22 v 1936, *E. Poilane* 26280 (P); Bane Sop Y, 17 viii 2009, *V. Lamxay* VL2052 (NLS); Bane Thong Lat, 3 v 2007, *V. Lamxay & P. Phaphouampheng* VL1129 (E, NLS); Bane Xiang Kok, 30 vi 2007, *V. Lamxay & P. Phaphouampheng* VL1156 (E, NLS). **Louangphabang:** Bane Nam Soy, 15 i 2010, *V. Lamxay* VL2107 (NLS). **Oudomxai:** Bane Lak 32, 4 vii 2007, *V. Lamxay & K. Khounsirivong* VL1165 (E, NLS); Bane Mok Kok, 20 viii 2009, *V. Lamxay* VL2061 (NLS); Bane Mouang La, 17 viii 2009, *V. Lamxay* VL2050 (NLS); *ibid.*, 17 viii 2009, *V. Lamxay* VL2051 (NLS); Bane Na Vene, 7 vii 2007, *V. Lamxay & S. Phommachak* VL1168 (E, NLS). **Phongsali:** Bane Na Mak, 28 vi 2007, *V. Lamxay & S. Ounmixay* VL1151 (E, NLS); Bane Pa Kha, 26 vi 2007, *V. Lamxay & S. Phounsinouang* VL1142 (E, NLS); Say Phou Thaleng Protected Area, 22 iv 2009, *V. Lamxay* VL1708 (NLS). **Vientiane Capital:** Bane Phia Lat, 17 iii 2006, *V. Lamxay* VL1012 (E, NLS, P). **Xiangkhoang:** Bane Nong Pet, 13 i 2010, *V. Lamxay* VL2094 (NLS).

VIETNAM. **Lam Dong:** Lang Bian, 29 iv 1919, *A.J.B. Chevalier* 40401 (P) [as cf. *Amomum dealbatum* Roxb.].

**8. *Amomum echinocarpum* Alston, Handb. fl. Ceylon 6: 283 (1931). – *Amomum echinatum* Thwaites, Enum. Pl. Zeyl. 316 (1861), non Willd. – Type: Sri Lanka, *sin loc.*, *G.H.K. Thwaites* C.P. 3020 (syn BM, CGE n.v., K n.v., PDA n.v.). Figs 6, 10.**

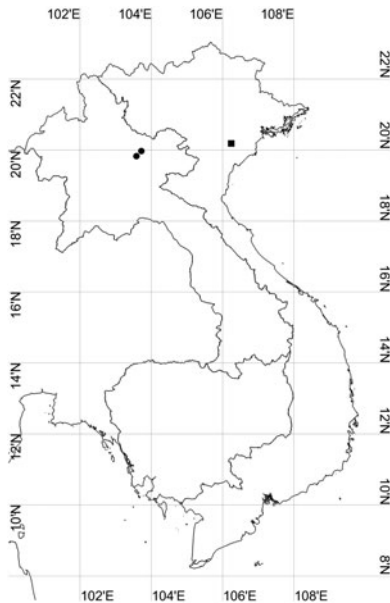


FIG. 10. Distribution of *Amomum echinocarpum* Alston (●) and *Amomum gagnepainii* T.L.Wu, K.Larsen & Turland (■) in Cambodia, Laos and Vietnam.

Clump-forming herb, 1.8 m tall, 2–3 pseudostems per clump; *rhizome* c.0.5–1 cm diameter, white then brown; *stilt roots* absent; *interval between pseudostems* c.10 cm long, scales tubular, 1–3 cm long, red then brown, papery, striate, glabrous, apex acute. *Pseudostem* with c.19 leaves per pseudostem, becoming smaller towards apex, slightly swollen at base, 0.8–1 cm diameter, green, glabrous, outer surface striate, inner surface smooth, shining, margin of leaf sheaths ciliate above; *ligule* c.0.1–0.3 cm long, light green, coriaceous, glabrous, apex truncate; *petiole* very short, c.0.1–0.2 cm long, canaliculate, green, glabrous; *blade* oblong, 12–30 × 3–7 cm, lower surface light green, glabrous, shiny, base attenuate, apex long caudate, cauda c.2 cm long, margin entire, primary veins prominent and hairy below, secondary veins sunken. *Inflorescence* arising near base or from base, 1–2 per pseudostem; *peduncle* 15 × 0.5 cm, red, striate, glabrous; scales tubular at base, 1–1.5 × 0.3 cm, and lanceolate above, 3–3.5 × 1–1.2 cm, red then dark reddish-brown, coriaceous, striate, glabrous to scabrous, apex acute; *flowering part* ovoid, c.5 × 4 cm, c.4 flowers open at once; *bracts* boat-shaped, 2–2.5 × 0.7–1 cm, dark brown, striate, soon rotting, subtending a single flower, glabrous, apex acute; *bracteole* tubular, 2-toothed, 1–1.2 × 0.3 cm, light brown, membranous then soon rotting, outer surface pilose at base, bracteole tube 0.7–0.9 cm long, teeth 0.2–0.3 cm long, apex acute to cucullate. *Calyx* tubular, 2-toothed, 1.5–1.6 × 0.3 cm, white, membranous, glabrous; calyx tube 0.7–0.8 cm long; teeth 0.4–0.8 cm long, apex acute. *Corolla* 2.8–3 cm long, white, corolla tube 1.3–1.5 cm long, coriaceous, glabrous; lateral corolla lobes 1.5 × 0.6–0.7 cm, membranous, glabrous, apex cucullate; central corolla lobe 1.5–1.7 × 0.9–1.2 cm, membranous, glabrous, apex cucullate; *labellum* clawed, 1.5 × 1.2–1.3 cm, white with yellow central stripe edged with lines of red dots, entire or somewhat bifid, membranous, undulate, long white hairs at base; *lateral staminodes* oblong, 0.3 cm long, white with red dots. *Filament* flattened, 0.3–0.4 cm long, white, glabrous; *anther* oblong, 0.8 × 0.4–0.5 cm, white, glabrous; *anther crest* entire, 0.3 cm wide, membranous, rounded to truncate, white. *Stigma* rounded, hairy, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.3 cm long, glabrous; *ovary* 0.4 cm diameter, prickly, hairy; *ovules* globose, 3–5 per locule. *Infructescence* peduncle c.10–15 × 0.5 cm, reddish, glabrous; *fruiting part* to 5 × 5 cm, c.10 fruits per infructescence; *fruits* globose, 0.8–1 cm diameter, light green, prickly, hairy. *Seeds* globose, 0.4 cm diameter, glabrous, c.3–5 per locule.

*Distribution.* Sri Lanka, Laos, Indonesia (Java, Sulawesi), New Guinea, Bismarck Archipelago.

*Habitat and ecology.* Montane evergreen forest, mixed deciduous forest, in shady conditions, at 1034–1103 m altitude.

*Proposed IUCN status.* DD. This is a species complex and although, as currently circumscribed, it has a very wide range and is common, it may be resolved into a number of more restricted-range species. Hence for now it has to be assessed as Data Deficient.



*Specimens examined.* LAOS. **Houaphan:** Bane Dan Cheng, 23 v 2008, *V. Lamxay & M.F. Newman* VL1304 (E, NLS); *ibid.*, 23 v 2008, *V. Lamxay & M.F. Newman* VL1306 (E, NLS); Bane Sa Kok, 24 v 2008, *V. Lamxay & M.F. Newman* VL1315 (E, NLS).

The main distinguishing characters of this species are the glabrous, shiny leaf sheath and blade, ligule ovate with emarginate apex, long peduncle, bifid labellum, large, entire, semi-lunar anther crest which is curved inwards, and fruit with simple prickles.

Further research is required to establish whether these Lao collections belong to *Amomum echinocarpum*. Species delimitation in the complex of species which includes *Amomum aculeatum*, *A. echinocarpum*, *A. flavum* and *A. elephantorum* is uncertain. All are robust plants with spiny fruits. Many collections belonging in this complex have been determined to *Amomum aculeatum* but this is now thought to occur in Java, Peninsular Malaysia, Sumatra and Thailand (J. Droop, in prep.). The Lao collections cited above are distinguished from *Amomum aculeatum* and *A. elephantorum* by their white flowers and lanceolate, papery bracts, and from *Amomum villosum* by their large, entire, semi-lunar anther crest, bifid labellum and long peduncle. When the name of this taxon has been ascertained, it may be necessary to review the IUCN status of the species.

In addition to the syntypes, only one of which has been seen, there is reported to be a high quality colour painting at K (J. Leong-Škorničková, pers. comm.).

**9. *Amomum elephantorum*** Pierre ex Gagnep., Bull. Soc. Bot. France 53: 137 (1906); Gagnepain, Fl. Indo-Chine 6: 114 (1908). – Type: Cambodia, Cardamom Mountains, vi 1870, *J.B.L. Pierre* 630 (lecto P [barcode P032753], designated here). **Figs 9, 11.**

Clump-forming herb, to 3–4 m high, c.15 pseudostems per clump; *rhizome* c.1–2 cm diameter, green; *stilt roots* absent; *interval between pseudostems* c.10 cm long, scales ovate to broadly ovate, 1.5–4.5 cm long, whitish then dark brown, coriaceous, striate, glabrous, inner surface shining, apex acute to cucullate, margin ciliate. *Pseudostem* with c.50 leaves per pseudostem, becoming smaller towards apex, swollen at base, 1–1.5 cm diameter, light green then dark green, glabrous, outer surface striate, inner surface shining; *ligule* ovate, emarginate, 0.5–1 cm long, brown, glabrous, coriaceous, margin ciliate; *petiole* very short or sessile; *blade* oblong to lanceolate, 15–35 × 1.5–10 cm, green, shiny, glabrous, base long attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* arising from base, c.2 inflorescences per pseudostem; *flowering part* globose, gelatinous, 5 × 5 cm, c.3 flowers open at once; *peduncle* 20 × 1–1.7 cm, white then reddish-brown, striate, rough, glabrous at base, tomentose above; *peduncle scales* ovate to broadly ovate, 2–6 × 1–5 cm, green to reddish-orange above, hard, thick, coriaceous, striate, tomentose above, inner surface tomentose at base, apex acute; *bracts* broadly ovate to rounded, 3–3.5 cm wide, 3–3.2 cm long, reddish then dark brown, hard, thick, coriaceous, ruminant, gelatinous, rotting soon,

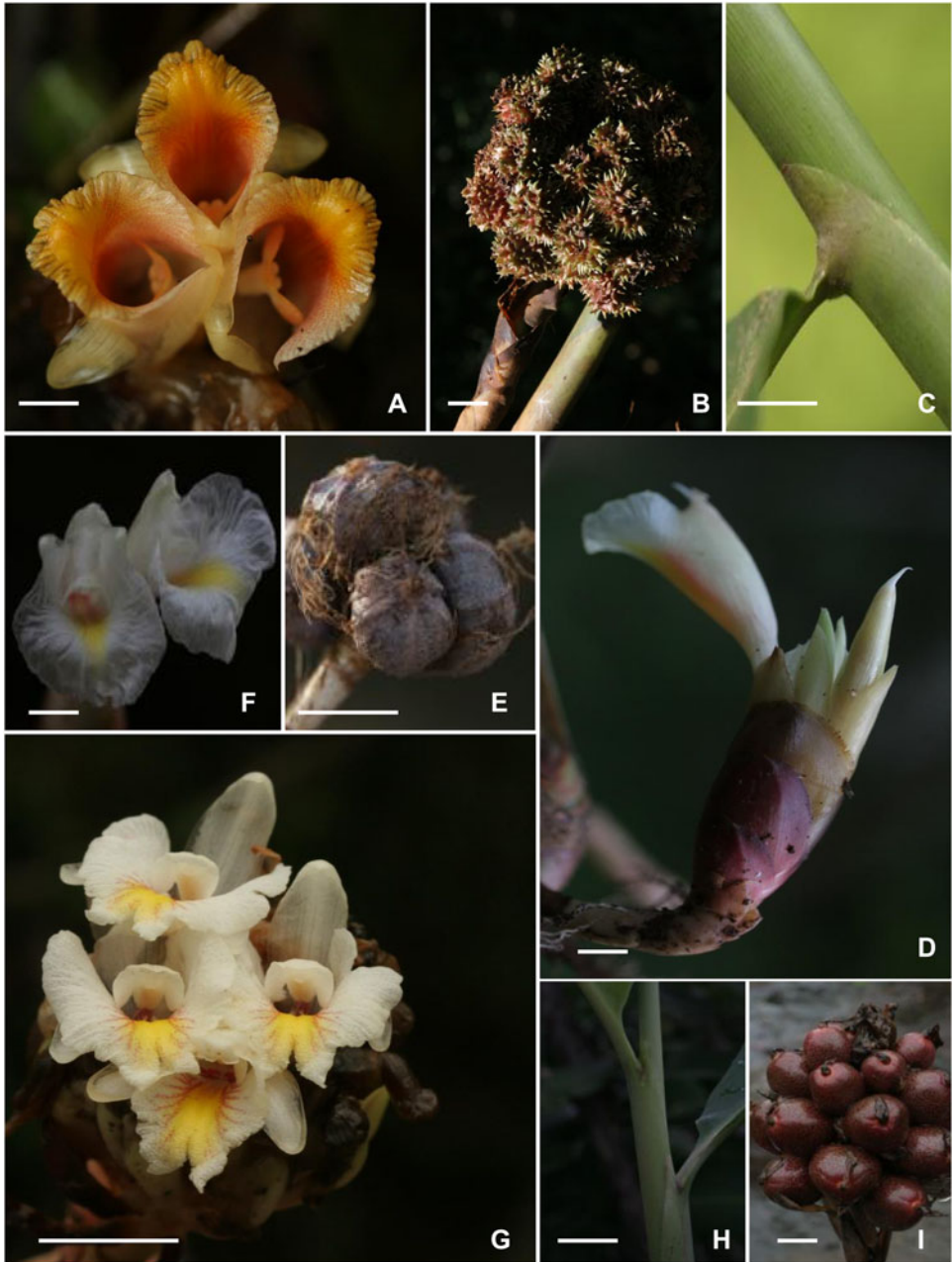


FIG. 11. A–C: *Amomum elephantorum*. A, inflorescence; B, infructescence; C, ligule. *Lamxay* VL1277. D–F: *Amomum glabrum*. D, inflorescence; E, infructescence; F, flowers. *Lamxay* VL1126. G–I: *Amomum koenigii*. G, inflorescence; H, ligule; I, infructescence. *Lamxay* VL1323. Scale bar = 1 cm.

subtending only one flower, outer surface ruminant, rough, tomentose, inner surface ruminant, glabrous but tomentose at base, apex acute to cucullate; *bracteole* tubular, 2-toothed,  $1.5\text{--}1.6 \times 0.5$  cm, reddish-light brown, coriaceous, outer surface tomentose, bracteole tube  $1\text{--}1.2$  cm long, teeth  $0.3\text{--}0.5$  cm long. *Calyx* tubular, 3-toothed,  $2.5\text{--}2.6 \times 0.3\text{--}0.6$  cm, whitish-red, coriaceous, outer surface tomentose, inner surface glabrous, apex acute; calyx tube  $1.5\text{--}1.6$  cm long; teeth  $0.4\text{--}0.8$  cm long. *Corolla*  $5\text{--}5.5$  cm long, pale, whitish-yellow cream corolla tube  $2.5\text{--}2.6$  cm long, coriaceous, glabrous; lateral corolla lobes  $2.5\text{--}3 \times 0.6\text{--}0.8$  cm; membranous, glabrous, apex cucullate; central corolla lobe  $2.5\text{--}3 \times 1\text{--}1.2$  cm, membranous, glabrous apex cucullate; *labellum* bowl-shaped to clawed,  $2.5\text{--}3 \times 3$  cm, yellowish orange with dark yellow patch on distal part of central lobe and covering of minute red dots, lobe entire, membranous, glabrous, apex rounded, margin plicate, entire; *lateral staminodes* oblong,  $0.3$  cm long, pink, unbranched. *Filament* flattened,  $1.3\text{--}1.5$  cm long, yellowish-orange covering of minute red dots, glabrous; *anther* oblong,  $0.7\text{--}0.8 \times 0.4$  cm, yellow covering of minute red dots, glabrous; *anther crest* entire,  $1.5 \times 0.5$  cm, pink, membranous, glabrous. *Stigma* rounded, hairy, apex ciliate; *style* hairy; *epigynous glands* oblong, 1 pair,  $0.5$  cm long, glabrous; *ovary*  $0.5$  cm diameter,  $0.3$  cm long, bullate, glabrous, shining; *ovules* globose, to 20 ovules per locule. *Infructescence*  $25\text{--}35$  cm long, peduncle  $15\text{--}25 \times 0.5$  cm, brown, glabrous; *fruiting part*  $10 \times 10$  cm, subtending to 25 fruits; *fruit* globose,  $1\text{--}1.5$  cm diameter, prickly with hard, sharp, straight prickles, hairy, dark red. *Seeds* globose,  $0.3$  cm diameter, glabrous, to 20 per locule.

*Distribution.* Thailand, Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland to mid-elevation evergreen forest, mixed deciduous forest, open forest, in shady conditions, at  $223\text{--}545$  m altitude.

*Proposed IUCN status.* LC. This species has a large extent of occurrence and although there is some loss of habitat, this is not thought to be significant so the species is listed as Least Concern.

*Specimens examined.* CAMBODIA. **Koh Kong:** Thma Bang, 18 iii 2003, *J. Kanstrup* 221 (E); Veal Veng, road from Pramaoy to O Soam, 26 v 2010, *M.F. Newman et al.* 2394 (RUPP).

LAOS. **Attapeu:** Bane Dak Toud, 16 v 2008, *V. Lamxay & M.F. Newman* VL1277 (E, NLS). **Champasak:** Pathoumphone, Xepiane NPA, 9 ix 2006, *V. Lamxay* VL1084 (E, NLS); Bane Khouang Sy, 30 viii 2009, *V. Lamxay* VL2087 (NLS); Bane Kiat Ngong, 24 vii 2007, *V. Lamxay* VL1185 (NLS [2]). **Salavan:** Bane Na Fang Ham, 14 ix 2006, *V. Lamxay* VL1106 (E, NLS, P).

VIETNAM. **Dong Nai:** Bien hoa, 28 x 1932, *E. Poilane* 21292 (P).

*Amomum elephantorum* is close to *A. aculeatum* by its clump-forming habit, glabrous, shiny leaf blade, ligule ovate, emarginate, globose, gelatinous inflorescence, unbranched lateral staminodes, sub-trilobed anther crest, inflexed, yellowish-orange labellum, infructescence globose on top and fruits with hard, sharp, branched prickles but is distinguished from it by its very wide, rounded bracts,  $c.3\text{--}3.5$  cm wide

at the base of the inflorescence, central lobe of the anther crest much broader, hairy style, and infructescence which never elongates.

The protologue of *Amomum elephantorum* cites the type as follows: 'INDO-CHINE. – Cambodge: prov. de Tpong, dans les monts Krervanh, juin 1870 [*Pierre*]'. No collection number is given in the protologue. Two sheets at P match this information, one with collection number *Pierre* 630 (barcode P032753) and the other *Pierre* 630? and 551? (or 591?, the handwriting is not clear) (barcode P032754). Both are Gagnepain's original material and sheet 1 (barcode P032753) has a detailed description written in Gagnepain's hand of the new species, though it bears no date of collection. Sheet 2 (barcode P032754) bears the locality and collection date of the protologue but it cannot be said to be part of the same gathering as sheet 1 because it bears two collection numbers, both with question marks. We choose *Pierre* 630 (barcode P032753) as lectotype because it matches the protologue more closely than the other sheet. Sheet 2 (barcode P032754) is either an isolectotype or a syntype.

Tpong Province no longer exists. Thpong, in the modern spelling, is a district of Kampong Speo Province. Krervanh is a transliteration of the word for cardamom in Khmer so 'les monts Krervanh' means the Cardamom Mountains.

**10. *Amomum gagnepainii*** T.L.Wu, K.Larsen & Turland, *Novon* 10(1): 90 (2000); Wu & Larsen, *Fl. China* 24: 353 (2000). – *Amomum thyrsoideum* Gagnep., *Bull. Soc. Bot. France* 49: 256 (1903), non Ruiz & Pav.; Gagnepain, *Fl. Indo-Chine* 6: 116 (1908). – Type: Vietnam, Nam Ha, Lat Son, 11 vi 1884, *H-F. Bon* 2687 (holo P). **Fig. 10.**

Clump-forming herb, c.1 m tall; *rhizome* c.0.8 cm diameter, glabrous; *stilt roots* absent; *interval between pseudostems* short, scales coriaceous, striate, glabrous. *Pseudostem* c.1 cm diameter, slightly swollen at base, striate, glabrous; *ligule* c.0.3–0.5 cm long, coriaceous, glabrous, apex truncate to rounded; *petiole* very short or absent, canaliculate, c.0.5 cm long, glabrous; *blade* lanceolate to oblong-lanceolate, 20–30 × 3–6 cm, glabrous, base long attenuate, apex long caudate, cauda c.3–4 cm long, margin entire, primary vein prominent below, secondary veins sunken. *Inflorescence* arising near the base, 1 per pseudostem; *peduncle* 20–26 × 0.4 cm, glabrous; *scales* broadly triangular, c.0.5 × 1 cm, to broadly ovate, 1 × 1.5–2 cm, coriaceous, striate, glabrous, apex broadly acute to rounded; *flowering part* cylindrical, rhachis 8–14 cm long; *bracts* narrowly oblong-lanceolate, 2 × 1 cm, coriaceous, striate, subtending a single flower, outer surface tomentose at base, apex finely cucullate with small spur; *bracteole* tubular, c.0.3–0.4 × 1 cm, membranous, striate, outer surface tomentose at base. *Calyx* tubular, 3-toothed, c.1 × 0.3 cm, membranous, striate, outer surface tomentose at base, apex of teeth acute. *Corolla tube* as long as calyx, outer surface hairy; corolla lobes membranous, glabrous, as long as corolla tube. *Filament* flat, as long as anther, glabrous; *anther* oblong, glabrous. *Stigma* cup-shaped, apex ciliate, hairy; *style* hairy; *epigynous glands* 1 pair, glabrous; *pedicel* c.1 × 0.2 cm, tomentose; *ovary* oblong-globose, dotted, tomentose

with long white hairs. *Infructescence* elongate, c.30 cm long; *peduncle* 20–26 × 0.4 cm, glabrous at base then tomentose with white hairs above; *fruiting part* 8–14 cm long, spicate, fruit stalk c.1 × 0.2–0.3 cm, tomentose; *fruits* ovoid, hairy, c.2 × 1–1.5 cm, calyx persistent, prickles curved or hooked, c.0.2–0.3 cm long. *Seeds* unknown.

*Distribution.* China (Guangxi), Vietnam.

*Habitat and ecology.* Montane forest.

*Proposed IUCN status.* DD. A poorly known species with very little information on the range and no information on population size, trends or threats. It is therefore listed as Data Deficient. Targeted searches for this species are required.

The description above is made from the type alone. *Amomum gagnepainii* has a deep rhizome and lanceolate leaves like *A. tomrey* but differs by its prickly fruits. It has lanceolate leaves and a long peduncle like *Amomum elephantorum* but differs by its elongate inflorescence and fruits with simple, hooked spines.

#### 11. *Amomum glabrifolium* Lamxay & M.F.Newman, *sp. nov.*

*Amomo bifloro* Jack habitu texturaque maxime simile, sed foliis foliorumque vaginis glabris, bracteolis brevissimis tubularibus, filamento quam anthera duplo longiore et calycis tuba quam dentibus duplo longiore differt. – Type: Laos, Khammouan, Hin Boun, Bane Khoun Ngeun, 9 vi 2010, 18°10'57"N, 104°28'27"E, V. Lamxay VL2121 (holo NLS; iso E). **Figs 12, 13.**

Creeping herb, c.1.2 m tall; *rhizome* c.0.5 cm diameter, brown; *stilt roots* present, 2–3 roots per mature shoot; *interval between pseudostems* c.50 cm, scales tubular, 2–4 cm long, light brown, papery, striate, outer surface tomentose, apex acute. *Pseudostem* with c.16 leaves per pseudostem, becoming smaller towards apex, slightly swollen at base, 0.5–1 cm diameter, reddish-brown, glabrous, outer surface striate, inner surface smooth, shiny; *ligule* ovate, 0.2–0.3 cm long, green, coriaceous, apex acute, margin ciliate; *petioles* canaliculate, 0.5–1 cm long, green, striate, glabrous; *blade* elliptic to oblong, 16–25 × 1.5–4 cm, green, glabrous, base attenuate, apex long caudate, cauda c.3 cm long, margin ciliate, primary veins prominent below, secondary veins prominent. *Inflorescence* arising vertically at any point of rhizome, c.40–50 cm from base of mature shoots, 2–3 inflorescences per pseudostem; *flowering part* ellipsoid, 5 × 3 cm, all parts with long white hairs, 1–2 flowers open at once, usually 4–6 in total; *peduncle* 1–3 × 0.2 cm, red, striate, glabrous at base, tomentose above; *scales* tubular at base, 0.5 × 0.3 cm, and broadly ovate above, 3 × 2.5 cm, brownish, coriaceous, striate, outer surface tomentose, apex acute, margin ciliate; *bracts* boat-shaped to lanceolate, 2.5–3 × 0.5–1 cm, pink to pinkish-brown, papery, striate, subtending a single flower, apex acute with short, hairy spur, margin ciliate; *bracteole* tubular, at least at base, 2-toothed, 1.5–2 × 0.3 cm, pink to light brown, membranous, bracteole tube 0.3–0.5 cm long, shorter tooth c.0.3 cm long, longer

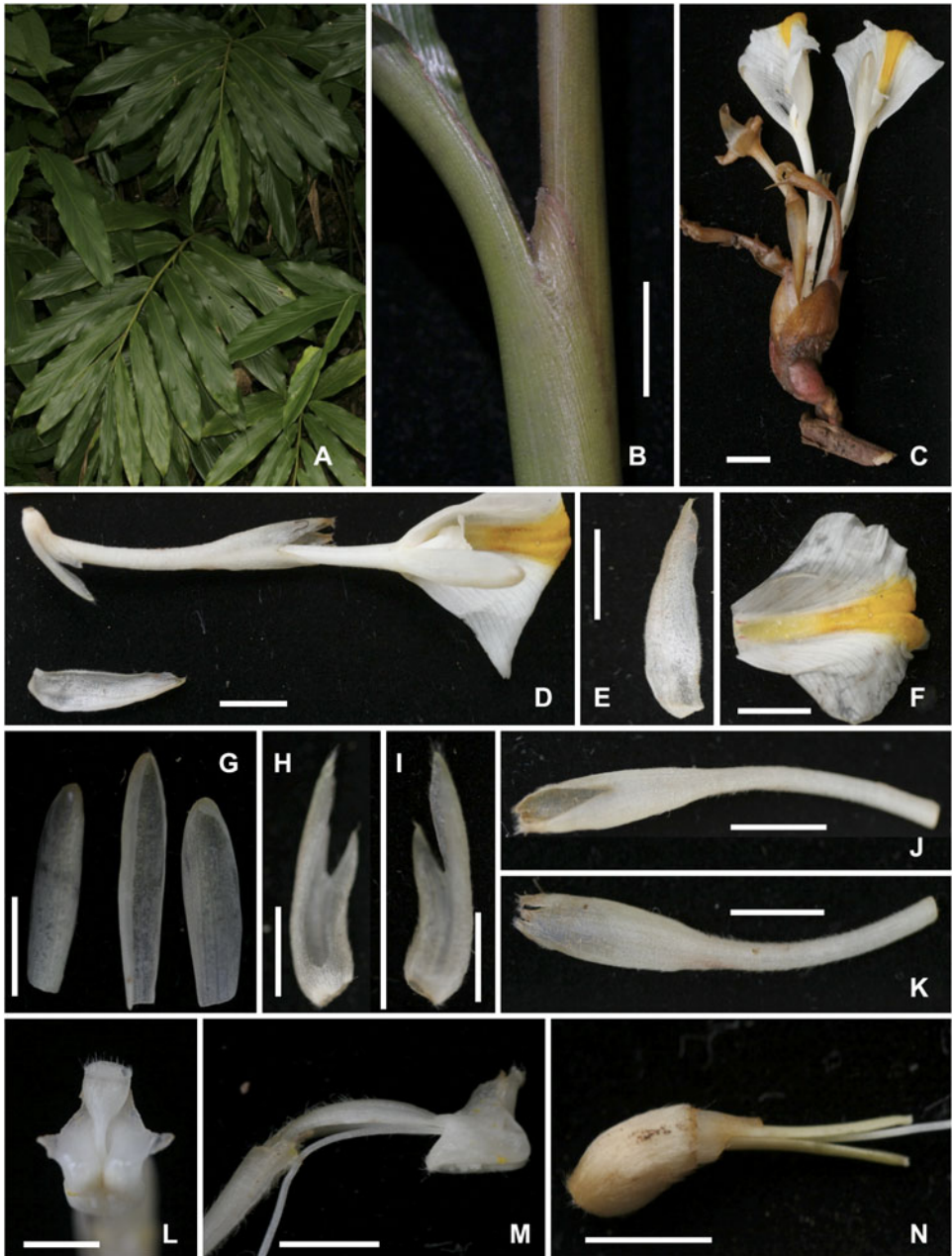


FIG. 12. *Amomum glabrifolium* Lamxay & M.F.Newman. A, habit; B, ligule; C, inflorescence; D, flower and inner view of bract (below); E, outer view of bract; F, labellum from above; G, corolla lobes; H, bracteole showing tube; I, bracteole outer view; J, calyx; K, calyx; L, anther and stigma; M, filament and anther; N, ovary and epigynous glands. Scale bars: B–G = 1 cm; H–N = 0.5 cm. Photo by V. Lamxay.

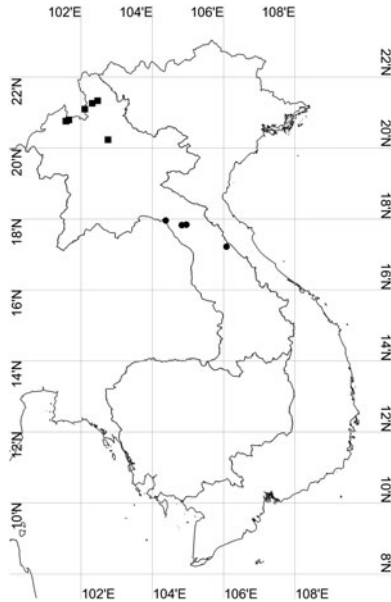


FIG. 13. Distribution of *Amomum glabrifolium* Lamxay & M.F.Newman (●) and *Amomum glabrum* S.Q.Tong (■) in Cambodia, Laos and Vietnam.

tooth 1–1.5 cm long, apex long caudate. *Calyx* tubular, 3-toothed,  $2.5\text{--}3 \times 0.3$  cm, whitish-light brown, membranous; calyx tube 1.5–2 cm long; shortest tooth 0.2 cm long, longest tooth c.0.8–1 cm long, apex caudate, margin ciliate. *Corolla* 5.5–6 cm long, white, corolla tube 3.5–4 cm long, pilose at base, tomentose with soft hairs above; lateral corolla lobes  $1.5 \times 0.7\text{--}0.8$  cm, membranous, abaxial surface hairy at base, apex cucullate; central corolla lobe  $1.5 \times 0.8\text{--}1$  cm, membranous, abaxial surface hairy at base, apex cucullate without spur; *labellum* clawed,  $3.5\text{--}4 \times 2.8\text{--}3$  cm, white with yellow central stripe, membranous, shiny, adaxial surface tomentose at base to central part, apex emarginate with 2 small, reflexed lobes, margin undulate; *lateral staminodes* absent. *Filament* flattened,  $0.8 \times 0.3$  cm, white, hairy at base; *anther* oblong,  $0.3 \times 0.4$  cm, white, adaxial surface hairy; *anther crest* 3-lobed, lateral lobes  $0.2 \times 0.3$  cm, central lobe  $0.3 \times 0.4$  cm, membranous, white, glabrous. *Stigma* cup-shaped, apex ciliate; *style* glabrous; *epigynous glands* oblong, 1 pair, 0.6 cm long, glabrous; *ovary*  $0.5 \times 0.5$  cm, covered with long white hairs; *ovules* globose, c.10 per locule. *Infructescence* peduncle  $3\text{--}5 \times 0.2$  cm, pink, glabrous; *fruit* globose,  $1 \times 1$  cm, sessile or very shortly stalked, tomentose, pink to green, with sparse, short spines. *Seeds* globose with membranous seed coat, 0.2 cm diameter, black, c.10 per locule, aril white.

*Distribution.* Laos.

*Habitat and ecology.* Only found in mixed deciduous forest over limestone, along watercourses, in shady conditions, at 197–574 m altitude.

*Proposed IUCN status.* LC. Although this species has a small extent of occurrence, all the known localities are within protected areas and there are no known threats. It is therefore listed as Least Concern.

*Specimens examined.* LAOS. **Bolikhamxai:** Bane Phone Xay, 27 iv 2009, *V. Lamxay* VL1712 (NLS); Phou Hai, 9 vi 2010, *V. Lamxay* VL2120 (E, NLS). **Khammouan:** Boualapha, 20 v 2006, *M.F. Newman et al.* LAO1207 (E); Hin Boun, Phou Hin Nam No NPA, 19 v 2008, *V. Lamxay* VL1286 (E, NLS, P); Bane Khoun Ngeun, 18 vii 2007, *V. Lamxay* VL1178 (E, NLS); *ibid.*, 29 iv 2009, *V. Lamxay* VL1722 (NLS); *ibid.*, 23 viii 2009, *V. Lamxay* VL2068 (NLS); *ibid.*, 2 viii 2011, *V. Lamxay* VL2207 (NLS).

This species' main distinguishing characters are its spreading habit, c.50 cm between pseudostems, stilt roots, long, glabrous leaves, apex of blade long caudate, short inflorescence arising at a distance from the base of mature pseudostems, and only one or two flowers open at a time.

**12. *Amomum glabrum*** S.Q.Tong, *Acta Phytotax. Sin.* 27(4): 282 (1989); Wu & Larsen, *Fl. China* 24: 355 (2000). – Type: China, Yunnan, Jinghong, 15 v 1958, *Expedition Yunnan–Universitatis* 952 (holo HBYU n.v.). **Figs 11, 13.**

Creeping herb, c.1 m tall, glabrous throughout; *rhizome* c.0.3–0.7 cm diameter, white, pink or reddish then brown, deep and spreading underground, c.10 cm deep; *stilt roots* absent; *interval between pseudostems* c.20–35 cm, scales broadly triangular to ovate, 1–2 × 1–1.5 cm, reddish then brown, outer surface striate, apex acute. *Pseudostem* with c.5–9 leaves per pseudostem, becoming gradually smaller towards apex, slightly swollen at base, c.1 cm diameter, whitish pink when young then green, striate; *ligule* ovate, 0.3–0.5 cm long, coriaceous, apex emarginate to shallowly bifid; *petiole* c.2–4 × 0.2–0.3 cm, canaliculate, green; *blade* oblong, the lower ones elliptic, 20–40 × 5–10 cm, lower surface light green, shiny, base attenuate, apex long caudate, margin with short, sharp, spine-like hairs, primary veins prominent below, secondary veins sunken. *Inflorescence* arising from base or near base, c.10 cm long; *scales* broadly triangular, 0.5 × 1 cm below to boat-shaped and lanceolate, 2–3 × 1–2 cm above, reddish to pink, coriaceous, striate, apex acute to cucullate with short spur; *flowering part* ellipsoid, apex pointed, c.4–6 × 2–3 cm; *bracts* lanceolate, 3–4 × 1–1.5 cm, white, red or reddish-white or pinkish-white, papery, coriaceous then soon rotting, apex acute; *bracteole* tubular, c.1 cm long, 2-toothed, white, very thin, membranous, tube 0.5–0.7 cm long, teeth 0.3–0.5 cm long, apex acute. *Calyx* tubular, 3-toothed, white, membranous; calyx tube c.2 cm long; calyx teeth c.1 cm long, apex cucullate. *Corolla* c.5–6 cm long, white, corolla tube c.3 cm long, inner surface pilose or strigose with white hairs; lateral corolla lobes oblong, 2.5–3 × 0.6–0.8 cm, apex cucullate without spur; central corolla lobe oblong, 2.5–3 × 0.8–1 cm, apex cucullate with short pointed spur, c.0.3 cm long; *labellum* clawed, 3–4 × 2–3 cm,



white, pink or red at base, central yellow stripe edged by transparent venation radiating to margin, membranous, glabrous; *lateral staminodes* ovate to lanceolate, c.0.5 cm long, white. *Filament* flattened, 0.7–1 × 0.2 cm; *anther* c.1.3–1.5 cm long, white; *anther crest* truncate, white, membranous. *Stigma* cup-shaped, ostiole ciliate; *epigynous glands* c.1 cm long; *ovary* globose, sessile or on very short pedicel, c.0.5 cm diameter, lightly ridged and dotted above; *ovules* globose, c.15 per locule. *Infructescence* peduncle elongate, c.15 cm long; *fruiting part* with c.3–6 fruits grouped at top; *fruits* globose, c.1–1.5 cm diameter, blackish-grey, with short wings or ridges, smooth to bullate, surrounded by white fibres of rotting bracts, fruit stalk very short or absent. *Seeds* globose with membranous aril, c.0.5 cm diameter, white, c.10–15 per locule.

*Distribution.* China (Yunnan), Laos.

*Habitat and ecology.* Montane evergreen forest, in shady conditions, at 886–1546 m altitude.

*Proposed IUCN status.* DD. The extent of occurrence is estimated to be 13,062 km<sup>2</sup> but most of the population occurs in Lao PDR where all the known sites are in protected areas. The situation in China is not known and, if there was any evidence of continuing decline, the species could qualify as Near Threatened. Thus, it is listed as Data Deficient pending clarification on the situation in China.

*Specimens examined.* LAOS. **Louangnamtha:** between Mueang Sing and Mueang Louang Namtha, 19 viii 2009, *V. Lamxay* 2057 (NLS); Bane Sop Y, 30 iv 2007, *V. Lamxay* & *P. Phaphouampheng* VL1126 (E, NLS, P); *ibid.*, 1 vii 2007, *V. Lamxay* & *P. Phaphouampheng* VL1157 (E, NLS); *ibid.*, 18 viii 2009, *V. Lamxay* VL2053 (NLS). **Oudomxai:** Bane Lak 62, 4 vii 2007, *V. Lamxay* & *K. Khounsirivong* VL1167 (E, NLS). **Phongsali:** Bounnea, Lao–China Border Protected Area, 26 vi 2007, *V. Lamxay* & *S. Phounsouang* VL1143 (E, NLS); Phou Fa Ecotourism Area, 25 vi 2007, *V. Lamxay* & *S. Phounsouang* VL1137 (E, NLS); Say Phou Thaleng Protected Area, 25 v 2008, *V. Lamxay* & *M.F. Newman* VL1318 (E, NLS); *ibid.*, 25 v 2008, *V. Lamxay* & *M.F. Newman* VL1321 (E, NLS, P).

The distinguishing characters are the loosely spreading habit, deep rhizome, all parts glabrous, ligule very short, inflorescence arising near or at base of pseudostem, ellipsoid, pointed, filament and labellum connate into a short tube above insertion of corolla lobes, and fruits ridged, globose. The leaves and rhizomes are scented in fresh material.

The type of *Amomum glabrum*, *Expedition Yunnan–Universitatis* 952, is in an unregistered herbarium, HBYU, which we could not locate. We have, however, matched our material to a paratype specimen (*S.Q. Tong* & *A.M. Li* 32801, KUN).

**13. *Amomum koenigii*** J.F.Gmel., *Syst. Nat.*, ed. 13, 2: 6 (1791); Wu & Larsen, *Fl. China* 24: 352 (2000). – *Cardamomum koenigii* (J.F.Gmel.) Kuntze, *Revis. Gen. Pl.* 2: 686 (1891). – Type: Not located. See notes below. **Figs 11, 14.**

*Amomum corynostachyum* Wall., *Pl. Asiat. Rar.* 1: 48, t. 58 (1829). – *Zingiber corynostachyum* (Wall.) Steud., *Nomencl. Bot.* ed. 2, 2: 798 (1841). – *Cardamomum corynostachyum* (Wall.) Kuntze, *Revis. Gen. Pl.* 2: 686 (1891). – Type: See notes below.

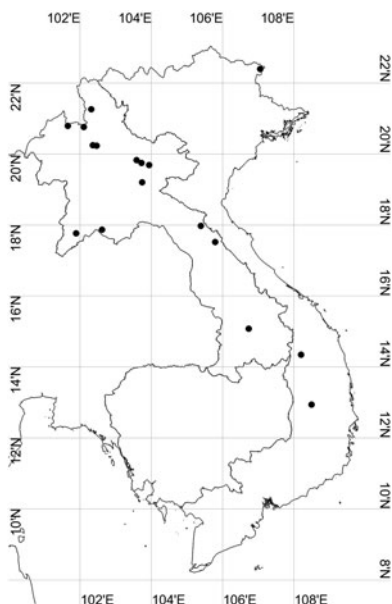


FIG. 14. Distribution of *Amomum koenigii* J.F.Gmel. in Cambodia, Laos and Vietnam.

Creeping herb, to 2.5 m tall, with only 2–5 pseudostems per clump; *rhizome* growing 10–15 cm deep in soil, c.1–1.5 cm diameter, white then reddish-brown; *stilt roots* absent; *interval between pseudostems* c.25 cm, scales broadly ovate, 2–3 cm long, brown, papery, striate, soon rotting, glabrous, apex acute. *Pseudostem* with c.17 leaves per pseudostem, becoming slightly smaller towards apex, 1–1.3 cm diameter, green, glabrous, outer surface striate, glaucous, margin of leaf sheaths red; *ligule* ovate, bilobed, 0.5–1 cm long, red then dark brown, coriaceous, swollen at base, glabrous, glaucous; *petiole* very short, 0.1–0.5 cm long, canaliculate, green, glabrous; *blade* oblong, 35–40 × 6–7 cm, lower surface pale, glaucous, glabrous, base long attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* single, arising near base of mature pseudostem on long, erect peduncle; *flowering part* elongate-ovoid, 3 × 2 cm, 2 flowers open at once; *peduncle* c.20–30 × 0.4–0.5 cm, reddish-brown, striate, glabrous; *scales* broadly ovate to lanceolate, 1.5–3.5 × 1–1.5 cm, reddish then dark reddish-brown, hard, coriaceous, striate, glabrous, glaucous, shiny, apex acute; *bracts* lanceolate, 1.8–2 × 1–1.2 cm, red then dark brown, striate, coriaceous, soon rotting, subtending a single flower, tomentose at base, apex acute; *bracteole* tubular, 2-toothed, 1–1.2 × 0.4 cm, light reddish-brown, membranous, outer surface tomentose at base, bracteole tube 0.8–0.9 cm long, glabrous, teeth c.0.2–0.4 cm long, apex acute. *Calyx* tubular, 3-toothed, 1.4–1.5 × 0.4 cm, light pinkish-brown, membranous, outer surface tomentose at base; calyx tube 0.7–0.8 cm long; teeth 0.3 and 0.7 cm long, apex acute. *Corolla* 3–3.2 cm long, pinkish-white, corolla tube 1.5–1.6 × 0.3 cm, coriaceous, outer

surface pilose, inner surface glabrous; lateral corolla lobes  $1.5\text{--}1.6 \times 0.6\text{--}0.7$  cm, membranous, glabrous, apex cucullate; central corolla lobe  $1.5\text{--}1.6 \times 1\text{--}1.2$  cm, membranous, glabrous, apex cucullate; *labellum* clawed,  $1.5\text{--}1.6 \times 1.5$  cm, connate with filament into a tube c.0.1–0.2 cm above insertion of corolla lobes, trilobed, white with yellow central stripe edged with lines of pink dots which radiate to margin, membranous, tomentose at base and along the central part, apex rounded and finely lobed; *lateral staminodes* oblong, 0.2 cm long, white. *Filament* flattened, 0.4–0.5 cm long, white, glabrous; *anther* oblong,  $0.7\text{--}0.8 \times 0.4\text{--}0.5$  cm, white, glabrous; *anther crest* semi-lunar, entire, 0.2–0.3 cm, membranous, white. *Stigma* rounded-flattened, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.1–0.2 cm long, glabrous; *ovary* 0.5 cm diameter, hairy; *ovules* round, c.15–20 per locule. *Infructescence* peduncle c.20–30  $\times$  0.5 cm, red, glabrous at base, tomentose above; *fruiting part* subglobose, 8  $\times$  6 cm, subtending as many as 20 fruits; *fruits* ovoid,  $1\text{--}1.5 \times 1.5\text{--}2$  cm, dark reddish-violet, glabrous, shining, lenticellate. *Seeds* round, 0.3 cm diameter, glabrous, to 15–20 per locule.

*Distribution.* Burma, Thailand, Laos, Vietnam.

*Habitat and ecology.* In a variety of forest and habitat types, such as montane evergreen forest, mixed deciduous forest, open forest, at 481–1291 m altitude.

*Proposed IUCN status.* LC. An extremely widespread and common species which, although threatened in places, is considered to be Least Concern.

*Specimens examined.* LAOS. **Bolikhambxai:** Bane Na Heuang, 29 iv 2009, *V. Lamxay* VL1721 (NLS). **Champasak:** Bane Kong Ta Youne, 26 viii 2009, *V. Lamxay* VL2078 (NLS). **Houaphan:** Viengthong, Bane Hom Thong, 13 i 2010, *V. Lamxay* VL2095 (NLS); Bane Sa Kok, 24 v 2008, *V. Lamxay* VL1314 (E, NLS); Bane Sop Lap, 22 v 2008, *V. Lamxay* & *M.F. Newman* VL1302 (E, NLS). **Khammouan:** Bane Vang Le, 30 v 2009, *V. Lamxay* VL1876 (NLS). **Louangnamtha:** border between Sing and Louang Namtha districts, 19 viii 2009, *V. Lamxay* VL2056 (NLS). **Oudomxai:** Bane Lak 32, 4 vii 2007, *V. Lamxay* VL1166 (E, NLS). **Phongsali:** Bane Pa Kha, 26 vi 2007, *V. Lamxay* VL1139 (NLS); Say Phou Thaleng Protected Area, 25 v 2008, *V. Lamxay* & *M.F. Newman* VL1323 (E, NLS). **Vientiane:** Khok Khao Do Protected Area, 28 v 2008, *V. Lamxay* & *M.F. Newman* VL1326 (E, NLS). **Vientiane Capital:** Bane Phia Lat, 6 v 2008, *V. Lamxay* VL1232 (E, NLS). **Xiangkhoang:** Tad Peub Protected Area, 22 v 2008, *V. Lamxay* & *M.F. Newman* VL1296 (E, NLS).

VIETNAM. **Cao Bang:** Ha Lang, Thang Loi municipality, vicinity of Lung Sam village, 24 iv 1999, *K.L. Phan et al.* 1671 (MO, P). **Dak Lak:** Ea H'Leo village, 29 vii 2009, *H.D. Tran* 171 (E). **Dong Nai:** Xa Trang Bom, 20 viii 2009, *V. Lamxay* VL2062 (NLS). **Kon Tum:** Dak To, 18 xi 1946, *E. Poilane* 35517 (P).

This species resembles *Amomum tomrey* by its smooth berry but may be distinguished by its glabrous, lenticellate berry, semi-lunar anther crest, and labellum and filament adnate into a short tube above the insertion of the corolla lobes.

We have observed and compared *Amomum koenigii* and *A. corynostachyum* and have found that they represent a single species. Therefore, *Amomum corynostachyum*

becomes a synonym of *A. koenigii*. Both names will be typified when *Amomum* is revised for the Flora of Thailand (Kaewsri, in prep.).

**14. *Amomum longiligulare*** T.L.Wu, Fl. Hainan. 4: 533 (1977); Wu & Larsen, Fl. China 24: 353 (2000). – Type: China, Hainan, Ya Xian, 24 ix 1970, *Working team* 0536 (holo IBSC). Figs 15, 16.

Creeping herb, c.1.5–3 m tall; *rhizome* scented, c.1–1.5 cm diameter, light brown, glabrous; *stilt roots* present; *interval between pseudostems* c.50 cm, scales triangular, 1–2 cm long, white then brown, outer surface tomentose, apex rounded. *Pseudostem* with c.25–40 leaves per pseudostem, becoming rapidly smaller towards apex, 1–1.5 cm diameter, red when young then brown, swollen at base, striate, glabrous, shiny; *ligule* entire, 3–4 cm long, light brown, membranous, tomentose; *petiole* very short, c.0.3 cm long, or absent, glabrous; *blade* oblong, 15–40 × 2–10(–15) cm, lower surface light green, glabrous, shiny, base attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins sunken. *Inflorescence* arising c.20 cm from base of mature shoots or c.5–10 cm from base of new shoots; *peduncle* c.4–6 × 0.3–0.5 cm, glabrous at base, tomentose above; *scales* triangular to ovate, 1–2 cm long, dark brown, coriaceous, pilose, margin ciliate; *flowering part* ovoid to ellipsoid, 4–5 × 3–4 cm, c.2–4 flowers open at once; *bracts* boat-shaped, 2–2.3 × 0.7–1 cm, brown, soft, papery, soon rotting, outer surface tomentose at base, pilose above, inner surface pilose at base, apex cucullate; *bracteole* tubular, 2-toothed, c.2 cm long, light brown then dark brown, membranous, very thin, outer surface pilose and tomentose at base, bracteole tube c.1 cm long, teeth c.1 cm long, apex cucullate, margin ciliate. *Calyx* tubular, 3-toothed, 2.5–3 × 0.3 cm, pink then light brown, membranous, thin, outer surface pilose and tomentose with long white hairs at base; calyx tube c.1.5–2 cm long; longer tooth c.0.5–1 cm long, shorter tooth c.0.2–0.5 cm long, apex cucullate with short, coriaceous spur. *Corolla* white, 5–6 cm long, corolla tube c.2.5–3 cm long, outer surface pilose and tomentose at base, inner surface pilose to strigose above; lateral corolla lobes 2.5–3 × 0.7–0.8 cm, membranous, abaxial surface hairy, adaxial surface glabrous, apex cucullate; central corolla lobe 2.5–3 × 0.8–1 cm, membranous, abaxial surface hairy at base, adaxial surface glabrous, apex cucullate; *labellum* clawed, 2–3 × 2–2.5 cm, white with yellow central stripe edged red with minute dots and clear venation radiating to margin, glabrous, membranous, apex rounded with 2 small, reflexed lobes; *lateral staminodes* absent. *Filament* flattened, 0.5–0.7 cm long, white, pilose; *anther* 0.5–0.7 cm long, white, abaxial surface hairy, adaxial surface glabrous; *anther crest* trilobed, lateral lobes small, c.0.2 cm wide, rounded, central lobe c.0.3 cm wide, membranous, glabrous. *Stigma* rounded, glabrous; *epigynous glands* 1 pair, 0.3 cm long, glabrous; *ovary* c.0.4 cm diameter, bullate, tomentose with long white hairs, on a hairy pedicel c.0.2 cm long; *ovules* globose, c.10 per locule. *Infructescence* peduncle c.3–4 × 0.3–0.5 cm, glabrous at base, tomentose above; *fruiting part* c.5 cm long, with few to 15 fruits per infructescence; *fruits* globose to ovoid, 1–1.2 cm diameter, prickly with

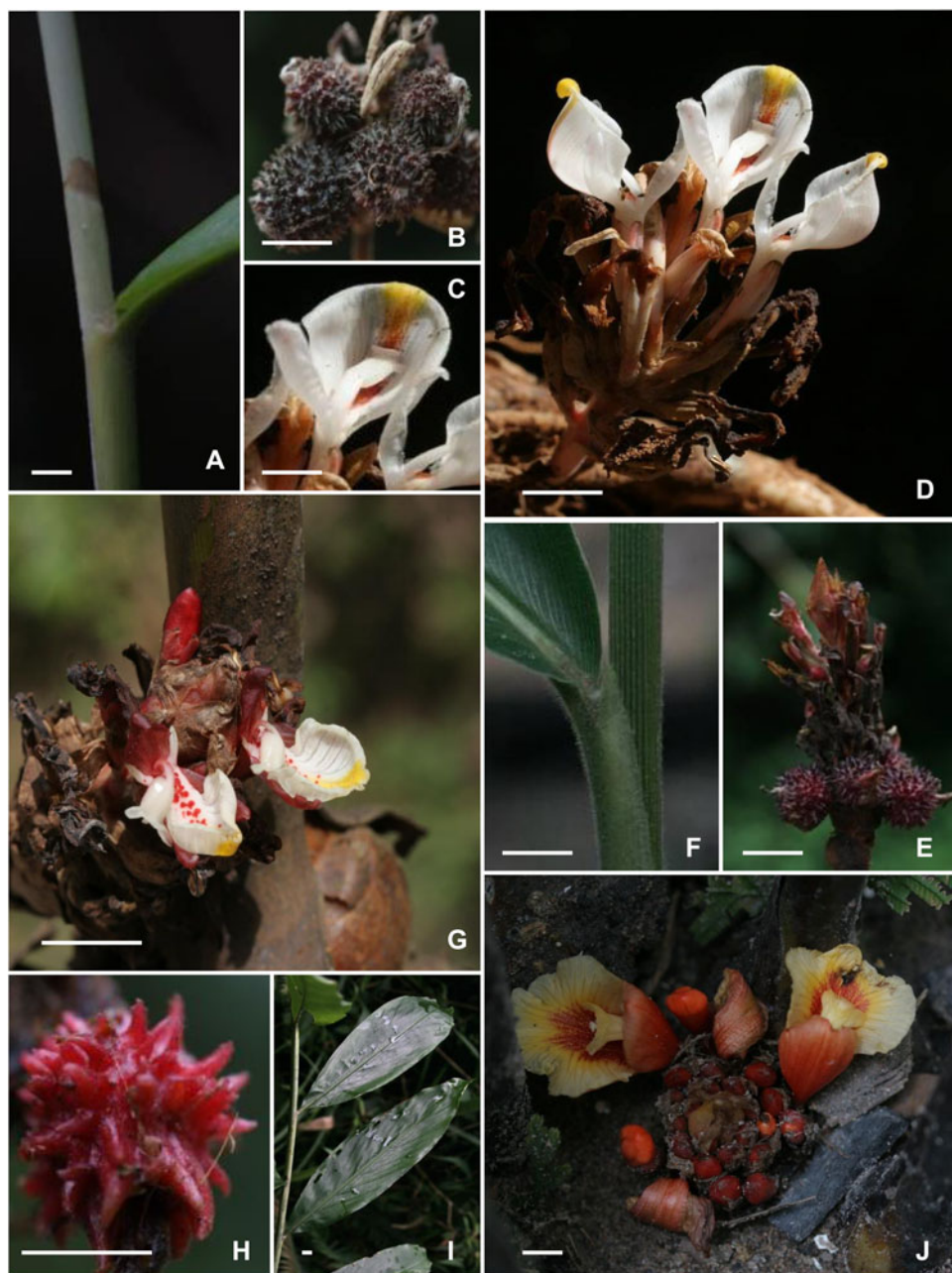


FIG. 15. A–D: *Amomum longiligulare*. A, ligule; B, infructescence; C, flower; D, inflorescence. *Lamxay* VL1805. E–G: *Amomum microcarpum*. E, infructescence; F, ligule; G, inflorescence. *Lamxay* VL1144. H–J: *Amomum muricarpum*. H, fruit; I, part of pseudostem; J, inflorescence. *Lamxay* VL1172. Scale bar = 1 cm.

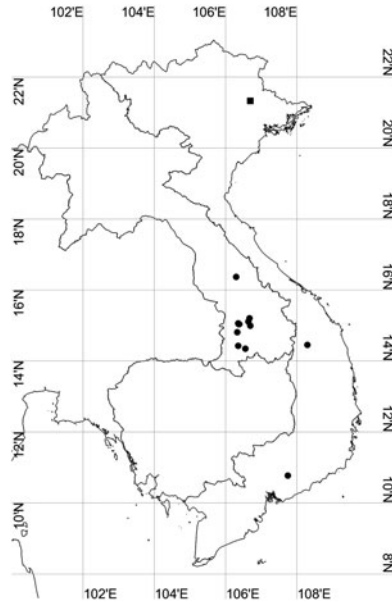


FIG. 16. Distribution of *Amomum longiligulare* T.L.Wu (●) and *Amomum longipetiolatum* Merr. (■) in Cambodia, Laos and Vietnam.

simple prickles, red or reddish-brown or reddish-green then dark reddish-brown, stalk very short, c.0.3 cm long. *Seeds* angular, 0.2–0.3 cm diameter, c.7–12 per locule, brown then black, aril yellow.

*Distribution.* China (Guangdong, Hainan), Thailand, Vietnam, Laos.

*Habitat and ecology.* Lowland and montane evergreen forest, mixed deciduous forest, open forest, at 100–1017 m altitude.

*Lao name and uses.* Mak naeng daeng (red fruit). It is widely cultivated in southern Laos for commerce.

*Proposed IUCN status.* LC. This species has a very wide range and is a common species so it is listed as Least Concern.

*Specimens examined.* LAOS. **Champasak:** Ba Chiang Chaleunsouk, 7 vi 2000, *V. Lamxay* 02 (E); *ibid.*, 15 ix 2006, *V. Lamxay* VL1115 (E, NLS); Bane Khouang Sy, 20 x 1928, *E. Poilane* 16056 (P); *ibid.*, 27 viii 2009, *V. Lamxay* VL2081 (NLS); *ibid.*, 27 viii 2009, *V. Lamxay* VL2083 (NLS); Bane Nong Hin, 7 vi 2000, *Boualy* 88 (E); Bane Nong Soung, 26 viii 2009, *V. Lamxay* VL2077 (NLS); Bane Tha Hou, 27 viii 2009, *V. Lamxay* VL2084 (NLS); Bane Thang Beng, 9 ix 2006, *V. Lamxay* VL1085 (E, NLS, P). **Salavan:** Bane Dou Chai Gnai, 14 v 2009, *V. Lamxay* VL1733 (NLS); Bane Katanglavang, 13 ix 2006, *V. Lamxay* VL1102 (E, NLS). **Savannakhet:** Bane Houay Xay, 9 viii 2007, *V. Lamxay* VL1197 (E, NLS).

VIETNAM. **Dong Nai:** Tan Phu forest, 17 vi 2008, *H.D. Tran et al.* 38 (E). **Kon Tum:** Dak Ha – Dak To, 3 x 1930, *E. Poilane* 18471 (E, P).

*Amomum longiligulare* has been found from central Laos to southern Vietnam in many types of forest on fertile soil.

Material collected in Laos and Vietnam matches the description of this species in the *Flora of China* and a photograph of the type of *Amomum longiligulare* at IBSC which we have seen. All this material appears to be indistinguishable from *Amomum gracile* Blume of Java but we are unable to place *A. longiligulare* in synonymy under *A. gracile* until we have examined all relevant type material more closely.

*Amomum longiligulare* looks like *A. villosum* and *A. uliginosum* which are also spreading herbs with shiny, glabrous leaves, a swollen base to the pseudostem, short inflorescence with oblong-lanceolate, boat-shaped bracts, white flowers with a yellow central stripe on the labellum and fruit with simple prickles. It differs from both these species by its very long, membranous ligule, c.3–4(–5) cm long, and from *Amomum uliginosum* by its lack of lateral staminodes.

**15. *Amomum longipetiolatum* Merr.,** *Lingnan Sci. J.* 11: 40 (1932); Wu & Larsen, *Fl. China* 24: 349 (2000). – *Elettariopsis longipetiolata* (Merr.) D.Fang, *Guihaia* 10: 293 (1990). – Type: China, Hainan, Hung Mo Shan, 15 v 1929, *U.K. Tsang et al.* 17692 (holo NY). **Fig. 16.**

Creeping rhizomatous herb, 2.5 m tall; *rhizome* c.0.5 cm diameter, striate, glabrous, pink to white; *stilt roots* absent; *interval between pseudostems* > 40 cm, scales narrowly triangular, 3–4 × 1–1.5 cm, pink, striate, glabrous, apex acute. *Pseudostem* leaves many, becoming slightly smaller towards apex, slightly swollen at base, c.1–1.5 cm diameter, green, striate, glabrous; *ligule* c.1–2 cm long, membranous, glabrous, apex bilobed to truncate; *petiole* canaliculate, c.7–10 × 0.3–0.4 cm, green, striate, glabrous; *blade* oblong-elliptic, 40–45 × 7–9 cm, green, whitish soft hairy below, glabrous above, base long attenuate, apex long caudate, margin entire, primary vein prominent below. *Inflorescence* arising 40–50 cm from base of mature shoots, 1–2 per pseudostem; *flowering part* narrowly ellipsoid, 4–5 × 1–2 cm, white, 1–2 flowers open at once; *peduncle* c.3–5 (rarely to 15) × 0.3–0.4 cm, glabrous; *scales* narrowly triangular at base to broadly triangular above, 1.5–2.5 × 1–1.5 cm, brown, striate, glabrous, apex truncate; *bracts* narrowly lanceolate, 4 × 1–2 cm, white, striate, papery, glabrous, subtending a single flower, apex acute, with spur; *bracteole* narrowly lanceolate, 2–2.5 × 0.4–0.5 cm, striate, membranous, glabrous, apex acute, margin ciliate. *Calyx* tubular, 3-toothed, 5–6 cm long, membranous, outer surface hairy, margin ciliate, apex cucullate; calyx tube 4.5–5 × 0.3–0.5 cm; teeth c.0.5 and c.1.5 cm long. *Corolla* 10–11 cm long, mostly white, corolla tube c.5–6 cm long, outer surface hairy, corolla lobes oblong, membranous; lateral lobes c.3 × 0.5–0.7 cm; central lobe c.3 × 0.7–1 cm, membranous, adaxial surface hairy, abaxial surface glabrous, apex acute, cucullate; *labellum* c.3 × 1–2 cm, white with yellow to red-pink at base, abaxial surface hairy, adaxial surface glabrous, apex rounded; *lateral*

*staminodes* oblong, flattened, membranous, c.0.5 × 0.1–0.2 cm, apex acute. *Filament* flattened, very short, c.0.3 cm long, white, glabrous; *anther* oblong, c.2 cm long, white, glabrous; *anther crest* deeply trilobed, c.0.5 cm long, white, membranous. *Stigma* cup-shaped, white, glabrous, ciliate with long white flat hairs; *style* hairy; *epigynous glands* 1 pair, oblong, flattened, apex acute, glabrous, 1 cm long; *ovary* 0.5 cm diameter, ridged, hairy; *fruits* not seen.

*Distribution.* China (Guangxi, Hainan), Vietnam.

*Habitat and ecology.* Inundated forest, cultivated fields in inundated forest, sometimes extending onto adjacent limestone hills, at c.110 m altitude.

*Proposed IUCN status.* DD. There is insufficient information to assess the status of this species as there is only limited distribution information and no information on population size, trends or threats to the species in China. Further surveys are required.

*Specimens examined.* VIETNAM. **Lang Son:** Huu Lung district, Huu Lien municipality, Lan Dat, 2 iv 1998, D.K. Harder et al. 4144 (E).

This species has only been recorded in Hainan and in northern Vietnam, near the border with China. Wu & Larsen (2000) treated this species in *Amomum*, although Fang (1990) had transferred it to *Elettariopsis longipetiolata* (Merr.) D.Fang.

We have examined Tsang et al. 17564 (NY), which is a paratype, but have only seen the type itself, Tsang et al. 17692 (NY), on the C.V. Starr Virtual Herbarium of New York Botanical Garden. *Amomum longipetiolatum* resembles *A. biflorum* by its short inflorescence arising vertically from the rhizome c.50 cm from the nearest pseudostem and in having only one or two flowers per inflorescence but it differs by being much bigger than *A. biflorum* and having pale whitish, soft hairs on the leaf blade below.

**16. *Amomum microcarpum*** C.F.Liang & D.Fang, Acta Phytotax. Sin. 16(3): 49 (1978); Wu & Larsen, Fl. China 24: 352 (2000). – Type: China, Guangxi, Da Zha, 29 iv 1975, Fang Ding 76564 (holo IBK n.v.). **Figs 15, 17.**

Creeping herb, 1–2 m tall; *rhizome* c.1 cm diameter, red when young then greenish-yellow to brown; *stilt roots* c.5 cm long, c.0.5 cm diameter, dark reddish-brown; *interval between pseudostems* c.70 cm, scales ovate, 1.5–2 cm long, red then dark brown or black, striate, shiny, coriaceous, outer surface tomentose, apex cucullate, margin ciliate. *Pseudostem* with c.18–25 leaves per pseudostem, becoming gradually smaller towards apex, swollen at base, 0.7–1.5 cm diameter, red then dark brown, outer surface tomentose, striate; *ligule* 0.7–1 cm long, coriaceous, outer surface tomentose, apex ovate, emarginate to bilobed, margin ciliate; *petiole* very short, 0.2–0.3 cm long, tomentose; *blade* oblong, 10–50 × 2–12 cm, dark green, plicate, tomentose beneath, base attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins prominent. *Inflorescence* arising near base,



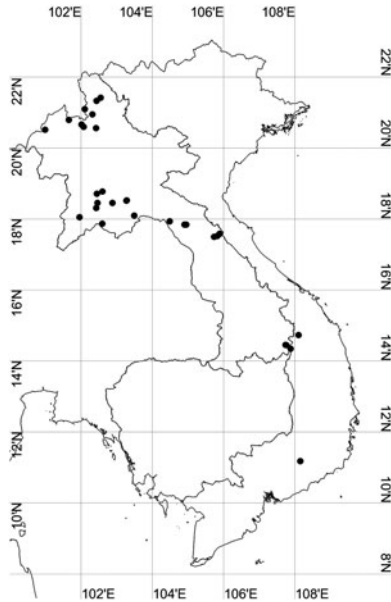


FIG. 17. Distribution of *Amomum microcarpum* C.F.Liang & D.Fang in Cambodia, Laos and Vietnam.

1–2 inflorescences per pseudostem; *flowering part* pyramidal,  $5 \times 4$  cm, 1–2 flowers open at once, dark reddish; *peduncle* 10–12  $\times$  0.5–0.7 cm, red, tomentose; *scales* tubular at base, ovate to lanceolate above,  $0.5\text{--}2 \times 0.3\text{--}0.7$  cm, reddish-brown, coriaceous at base, papery above, outer surface tomentose, apex acute to cucullate with long spur c.0.2 cm, margin ciliate to glabrous; *bracts* boat-shaped to lanceolate,  $1.8\text{--}2 \times 0.5\text{--}0.7$  cm, reddish then dark brown, papery, striate then soon rotting, subtending a single flower, outer surface tomentose, inner surface tomentose at base, apex acute; *bracteole* tubular, 2-toothed,  $1.5\text{--}1.6 \times 0.2$  cm, light brown, membranous, very thin, outer surface tomentose, bracteole tube 0.7–0.8 cm long. *Calyx* tubular, 3-toothed,  $1.2\text{--}1.3 \times 0.2$  cm, light pink to red, coriaceous, outer surface tomentose, inner surface glabrous; calyx tube 0.7–0.8 cm long; teeth 0.3–0.4 cm long, apex acute to cucullate with spur. *Corolla* white, 2–2.5 cm long, corolla tube 1–1.2 cm long, coriaceous, outer surface pilose, inner surface pilose to strigose above; lateral corolla lobes  $1.2 \times 0.5\text{--}0.6$  cm, membranous, glabrous, apex cucullate with thick spur; central corolla lobe  $1.2\text{--}1.3 \times 0.7\text{--}0.8$  cm, membranous, glabrous, apex cucullate with thick spur; *labellum* clawed,  $1.2\text{--}1.3 \times 1\text{--}1.2$  cm, trilobed, white with yellow central stripe marked with minute red dots at base and transparent veins radiating to margin, coriaceous, glabrous, adaxial surface pilose at base and centre; *lateral staminodes* oblong, filiform, 0.3–0.5 cm long, white, glabrous. *Filament* flattened, 0.7 cm long, white, glabrous; *anther* oblong,  $0.3\text{--}0.4 \times 0.4$  cm, curved over labellum, white, glabrous; *anther crest* trilobed, lateral lobes 0.2–0.3 cm wide,

central lobe 0.4 cm wide, white, membranous, glabrous. *Stigma* rounded, glabrous, apex entire; *style* glabrous; *epigynous glands* oblong, 0.2–0.3 cm long, glabrous; *ovary* 0.4 cm diameter, on very short, hairy pedicel c.0.2 cm long, bullate, tomentose; *ovules* round, c.20 per locule. *Infructescence* peduncle c.10–20 × 0.5 cm, red, tomentose; *fruiting part* subtending c.5 fruits, 10–12 × 5–8 cm; *fruits* globose, 1–1.5 cm diameter, dark red, prickly, hairy. *Seeds* globose, 0.2 cm diameter, glabrous, c.15 per locule.

*Distribution.* China (Guangxi), Vietnam, Laos.

*Habitat and ecology.* Lowland to montane evergreen forest, mixed deciduous forest, open forest, on a variety of soil types, at 185–1190 m altitude.

*Lao name and uses.* Mak naeng kham (golden fruit). The fruits are very commonly collected from the forest in Laos for trade and medicinal use.

*Proposed IUCN status.* LC. This species has a very large extent of occurrence and is common, and although there are some threats these are not of significant concern. The species is therefore assessed as Least Concern.

*Specimens examined.* LAOS. **Attapeu:** Bane Dak Lia, 27 vii 2007, *V. Lamxay & Bounlop* VL1190 (E, NLS); Bane Lak 52, 16 v 2008, *V. Lamxay* VL1265 (NLS); Bane Phou Keua, 15 v 2008, *V. Lamxay et al.* VL1263 (E, NLS). **Bolikhambxai:** Bane Had Khai, 9 v 2008, *V. Lamxay et al.* VL1241 (E, NLS); Bane Nam Deua, 31 viii 2009, *V. Lamxay* VL2091 (NLS); Phou Hai, 25 viii 2009, *V. Lamxay* VL2076 (NLS). **Khammouan:** Bane Ka Oy, 14 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella1 (E); Bane Khoun Ngeun, 18 vii 2007, *V. Lamxay* VL1177 (E, NLS); Bane Mak Feuang, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella15 (E); *ibid.*, 20 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella35 (E); Bane Maka Kang, 27 v 2009, *V. Lamxay* VL1746 (NLS); Bane Na Wa, 1 vii 2006, *V. Lamxay* VL1050 (NLS); Bane Thong Noi, 25 vi 2006, *V. Lamxay* VL1046 (E, NLS). **Louangnamtha:** border between Sing and Louang Namtha districts, 19 viii 2009, *V. Lamxay* VL2055 (NLS); 20 v 1936, *E. Poilane* 26242 (P); Bane Xiang Kok, 28 iv 2007, *V. Lamxay* VL1123 (NLS). **Oudomxai:** road from Oudomxai to Bane Nam Pheng, 22 vi 1999, *M.F. Newman* 867 (E); Bane Nam Pheng, 19 viii 2009, *V. Lamxay* VL2059 (NLS); *ibid.*, 22 vi 1999, *M.F. Newman* 870 (E); Bane Tad Mouane, 27 v 2000, *Somsak* 61 (E). **Phongsali:** Bane Chane Tane, v 2006, *V. Lamxay* PPS08 (E, P); Bane Had Sa, v 2006, *V. Lamxay* PPS09 (E); Bane Na Mak, 28 vi 2007, *V. Lamxay* VL1149 (NLS); Bane Pa Kha, 26 vi 2007, *V. Lamxay* VL1144 (E, NLS, P). **Vientiane:** Feuang, Phou Keo Kan-Phou In Thin NPA, 1 v 2008, *V. Lamxay et al.* VL1218 (E, NLS); Bane Houay Mo, 17 i 2010, *V. Lamxay* VL2111 (NLS); Bane Houay Pa Mak, 10 v 2008, *V. Lamxay & C. Vongsombath* VL1245 (E, NLS); Bane Mouang, 4 iv 2008, *V. Lamxay* VL1208 (NLS); Bane Na Xeng, 1 v 2008, *V. Lamxay et al.* VL1214 (E, NLS); Bane Phone Savane, 11 v 2008, *V. Lamxay & C. Vongsombath* VL1246 (E, NLS); Kasi, Bane Bouam Phouk, 17 i 2010, *V. Lamxay* VL2110 (NLS); Xaisomboun, Bane Nam Mo, 24 iv 2007, *V. Lamxay* VL1118 (E, NLS, P). **Vientiane Capital:** Bane Po, 6 v 2006, *V. Lamxay* VL1002 (E, NLS, P).

VIETNAM. **Kon Tum:** Dak Gley, c.10 km N of Dak Gley town, between Dak Nen and Mang Khen (Dak Che) villages, 19 xi 1995, *L.V. Averyanov* VH1835 (MO, P). **Lam Dong:** Blao, 3 v 1953, *M. Schmid* (P); *ibid.*, vi 1953, *M. Schmid* VN1647 (P).

*Amomum microcarpum* is similar to *A. villosum* and *A. uliginosum* in its red, prickly fruit but it differs from them by its hairy leaf sheaths, leaves plicate, hairy below,

young stem and rhizome red, inflorescence pyramidal and flowers with anther arched over the labellum.

**17. *Amomum muricarpum*** Elmer, Leaflet Philipp. Bot. 8: 2896 (1915); Wu & Larsen, Fl. China 24: 354 (2000). – Type: Philippines, Mindanao, Davao del Sur, Todaya, vi 1909, *A.D.E. Elmer* 10947 (syn BO n.v., C n.v., FI n.v., G n.v., GH, HBG, L, MICH, U). Figs 15, 18.

Loosely clump-forming herb, 2–2.5 m tall, c.10 pseudostems per clump; *rhizome* 1–1.5 cm diameter, brown then white, striate, glaucous; *stilt roots* absent; *interval between pseudostems* c.15 cm, scales broadly ovate, 1–2.5 cm long, blackish-brown, papery, striate, glabrous, apex acute, margin ciliate. *Pseudostem* c.30 leaves per pseudostem, becoming smaller towards apex, swollen at base, 1–1.5 cm diameter, green, glabrous, outer surface striate; *ligule* c.0.7–1 cm long, glabrous, coriaceous, apex ovate to rounded, margin ciliate; *petiole* very short, 0.3–0.5 cm long, canaliculate, striate, glabrous; *blade* oblong to oblong-lanceolate, 25–30 × 6–7 cm, lower surface light green, glabrous, base long attenuate, apex long caudate, margin entire, primary veins prominent below, secondary veins prominent on both sides. *Inflorescence* arising near base, 1–2 inflorescences per pseudostem; *flowering part* ovoid, 4–5 × 4–5 cm, 1–2 flowers open at once; *peduncle* 10 × 0.5 cm, red, tomentose; *scales* broadly ovate to ovate, 1–3 × 1.5–2.5 cm, reddish, coriaceous, striate, outer surface pilose above, apex acute, margin ciliate; *bracts* boat-shaped to oblanceolate, 2.5–3 × 0.8–1 cm, reddish

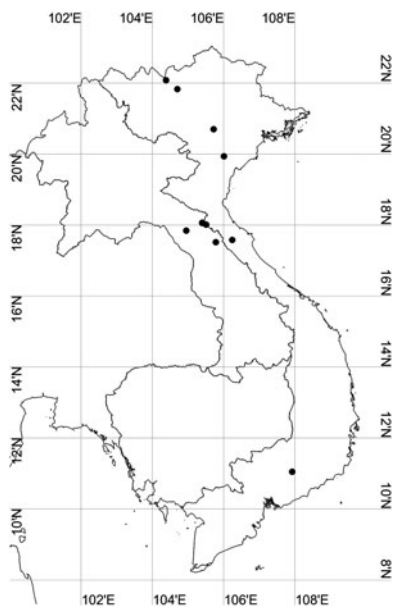


FIG. 18. Distribution of *Amomum muricarpum* Elmer in Cambodia, Laos and Vietnam.

then brown, coriaceous, rough, subtending a single flower, outer surface tomentose, inner surface tomentose at base, apex acute, margin ciliate; *bracteole* tubular, 2-toothed,  $1.5\text{--}2 \times 0.4\text{--}0.6$  cm, red, membranous, outer surface tomentose, bracteole tube 1.5 cm long, shorter tooth c.0.4 cm, longer tooth c.0.5 cm long, apex acute. *Calyx* tubular, 3-toothed,  $2.5\text{--}3 \times 0.3\text{--}0.6$  cm, red, membranous, glabrous except outer surface hairy at base; calyx tube c.2 cm long; shorter tooth c.0.5 cm, longer tooth c.1 cm long, apex cucullate, margin ciliate. *Corolla* reddish-orange,  $5 \times 0.3$  cm, corolla tube 2.5 cm long, coriaceous, inner surface pilose above; lateral corolla lobes  $2.5 \times 0.6\text{--}0.7$  cm, membranous, glabrous, apex cucullate; central corolla lobes  $c.2.5 \times 1.5\text{--}1.7$  cm, membranous, glabrous, apex cucullate; *labellum* clawed,  $2.8\text{--}3 \times 2.4\text{--}2.5$  cm, yellowish-orange with yellow central stripe and line of minute red dots radiating to margin, membranous, glabrous, apex rounded to somewhat bifid, margin undulate; *lateral staminodes* oblong, acute, 0.4 cm long, red. *Filament* flattened, 1.2 cm long, red, glabrous; *anther* oblong,  $1.2 \times 0.5$  cm, red, glabrous; *anther crest* entire,  $1.5 \times 0.5$  cm wide, reddish-orange, coriaceous, glabrous. *Stigma* cup-shaped, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.6 cm long, glabrous; *ovary* 0.4 cm long, smooth, white hairy, pedicel 0.4 cm long; *ovules* globose, glabrous, 5–10 per locule. *Infructescence* peduncle c.  $10\text{--}12 \times 0.5$  cm, brown, tomentose; *fruiting part* 3–4 cm long, subtending 1–3 fruits per infructescence; *fruits* globose, 1–1.2 cm diameter, prickly with thick, soft prickles, reddish-pink, hairy. *Seeds* round, 0.3 cm diameter, glabrous, 5–10 seeds per locule.

*Distribution.* China (Guangdong, Guangxi, Hainan), Laos, Vietnam, Philippines.

*Habitat and ecology.* Lowland and montane evergreen forest, at 216–1112 m altitude.

*Proposed IUCN status.* LC. This species is a widespread and very common species with no significant threats and is therefore assessed as Least Concern.

*Specimens examined.* LAOS. **Bolikhambxai:** Bane Na Heuang, 15 v 2007, *V. Lamxay et al.* VL1130 (E, NLS); *ibid.*, 18 vii 2007, *V. Lamxay et al.* VL1172 (E, NLS); *ibid.*, 18 vii 2007, *V. Lamxay et al.* VL1173 (E, NLS); Bane Nam Phao, 29 iv 2009, *V. Lamxay* VL1718 (NLS); Bane Thong Pe, 24 viii 2009, *V. Lamxay* VL2073 (NLS). **Khammouan:** Bane Maka Neua, 27 vii 2009, *V. Lamxay* VL2030 (NLS); Bane Vang Le – Bane Na Wa, 30 v 2009, *V. Lamxay* VL1879 (NLS).

VIETNAM. **Hanoi:** Ba Vi, Tu Phap, v 1887, *B. Balansa* 4212 (P). **Lam Dong:** Da Hoai district, Deo Chuoi, 20 vi 2008, *H.D. Tran et al.* 60 (E). **Lao Cai:** Ban Ly, Cam Duong district, 20 vii 1989, *D.L. Phuong* s.n. (K). **Ninh Binh:** Nho Quan district, Cuc Phuong N.P., 27 vii 1999, *D.D. Soejarto* 10925 (MO). **Yen Bai:** Bao ha, 21 ii 1936, *E. Poilane* 25270 (E, P).

*Amomum muricarpum* is close to *A. aculeatum* and *A. elephantorum* by its orange or yellowish-red flower and fruits with hard prickles but it differs from *A. aculeatum* by its clawed, bifid labellum and from *A. elephantorum* by its lanceolate to oblong bracts and short peduncle. It also resembles *Amomum echinocarpum* by its bifid labellum and oblong-lanceolate bracts, but may be distinguished by its yellowish-orange flowers, and oblong-ovoid fruit with hard prickles.

Lectotypification of this name must await detailed study of material from the Philippines.

**18. *Amomum odontocarpum*** D.Fang, Acta Phytotax. Sin. 18: 224 (1980); Wu & Larsen, Fl. China 24: 356 (2000). – Type: China, Guangxi, Xilin Xian, 1550 m, D. Fang & Y.L. Li 26123 (holo GXMI n.v.). **Figs 19, 20.**

Clump-forming herb, to 1.5 m tall, 3–5 pseudostems per clump; *rhizome* c.0.7–1 cm diameter, white then green; *stilt roots* absent; *interval between pseudostems* c.3–5 cm, scales ovate, 1–1.5 cm long, brown, papery, striate, soon rotting, apex acute, margin ciliate. *Pseudostem* with c.7 leaves per pseudostem, becoming smaller towards apex, slightly swollen at base, 0.8–1.5 cm diameter, green, striate, glabrous; *ligule* ovate, bilobed, c.1.5–3 cm long, light brown, papery, glabrous, apex acute; *petiole* canaliculate, 0.7–1.5 cm long, striate, glabrous; *blade* oblong-elliptic, 50–55 × 8–12 cm, glabrous, base long attenuate, apex caudate, primary veins prominent below, secondary veins prominent. *Inflorescences* arising near base, c.3 per pseudostem; *flowering part* ellipsoid, 3–5 × 4 cm, 4–many flowers open at once; *peduncle* 4 × 0.5 cm, reddish-brown, striate, glabrous; *scales* ovate to lanceolate, 0.7–1.8 × 1–1.5 cm, red then dark reddish-brown, coriaceous, striate, shiny, apex acute, margin ciliate; *bracts* boat-shaped to lanceolate, 3.5–4 × 1.5–2 cm, light brown, striate then soon rotting, subtending a single flower, glabrous, apex acute; *bracteole* ovate to lanceolate, 0.7–1.2 × 0.4–0.6 cm, light brown, membranous, very thin, glabrous, apex acute. *Calyx* tubular, 3-toothed, 2.5 × 0.3–0.6 cm, light brown, membranous, glabrous; calyx tube 1.5–1.6 cm long; teeth 0.5 and 1 cm long, apex acute. *Corolla* white, 5.5–6 cm long, corolla tube 2.5–3 cm long, coriaceous, inner surface pilose to strigose and tomentose above; lateral corolla lobes 2.5–3 × 0.7–0.8 cm, membranous, apex cucullate, margin ciliate; central corolla lobe 2.5–3 × 1–1.2 cm, membranous, glabrous, apex cucullate; *labellum* clawed, 3–3.5 × 2.5–3 cm, white with yellow central stripe edged with minute red dots and clear venation radiating to margin, labellum and filament connate into a tube c.0.5 cm above insertion of corolla lobes, abaxial surface glabrous, adaxial surface hairy at base and in centre, apex rounded, margin membranous, undulate; *lateral staminodes* oblong, 0.2 cm long, white. *Filament* flattened, 0.5 cm long, white, abaxial surface pilose with short hairs, adaxial surface glabrous; *anther* oblong, 1.5 × 0.4 cm, white, glabrous; *anther crest* truncate, entire, 0.6 × 0.2 cm, white, membranous, glabrous. *Stigma* globose, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.7 cm long, glabrous; *ovary* 0.5 cm diameter, pedicel c.0.2 cm long, 9–10 longitudinal ridges at base, hairy; *ovules* globose, c.25 per locule. *Infructescence* peduncle 3–4 × 0.5 cm, red then brown, glabrous; *fruits* (only very young fruits have been seen) ovoid, c.2 × 1–1.5 cm, reddish-brown. *Seeds* not seen.

*Distribution.* China (Guangxi), Vietnam, Laos.

*Habitat and ecology.* Montane evergreen forest, mixed deciduous forest, open forest, at 1200–1523 m altitude.



FIG. 19. A–C: *Amomum odontocarpum*. A, inflorescence; B, ligule; C, young fruit. *Lamxay* VL1300. D–F: *Amomum petaloideum*. D, flower; E, inflorescence; F, ligule. *Lamxay* VL1154. G–H: *Amomum pierreanum*. G, inflorescence; H, ligule. *Newman et al.* 2289. Scale bar = 1 cm.

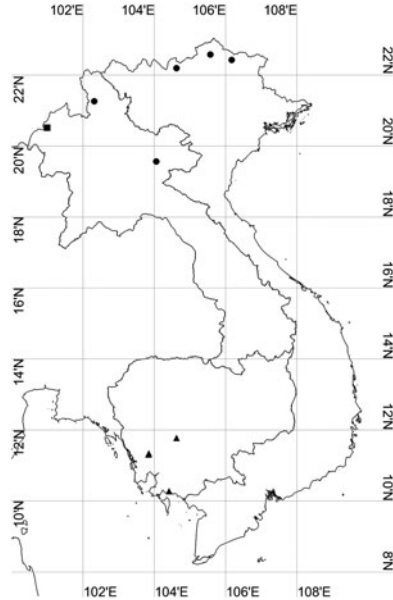


FIG. 20. Distribution of *Amomum odontocarpum* D.Fang (●), *Amomum petaloideum* (S.Q.Tong) T.L.Wu (■) and *Amomum pierreanum* Gagnep. (▲) in Cambodia, Laos and Vietnam.

*Proposed IUCN status.* VU B2ab(iii). Although this species has a large extent of occurrence, the area of occupancy is much more restricted; well under 500 km<sup>2</sup> and perhaps as low as 28 km<sup>2</sup>. It is known from about seven locations and there is continuing decline in the extent and quality of the habitat. The species is therefore listed as Vulnerable under criterion B2.

*Specimens examined.* LAOS. **Phongsali:** Say Phou Thaleng Protected Area, 25 v 2008, *V. Lamxay & M.F. Newman* VL1322 (E, NLS). **Xiangkhoang:** Bane Tha, 22 v 2008, *V. Lamxay & M.F. Newman* VL1300 (E, NLS).

VIETNAM. **Cao Bang:** Bao Lac district, Dinh Phung municipality, Man Lung ridge, 18 iv 1999, *K.L. Phan et al.* CBL1498 (MO). **Ha Giang:** Yen Minh district, Du Gia municipality, E slopes of Phu Tha Ca mountain, 3 v 1999, *K.L. Phan et al.* CBL2031 (MO, P). **Lao Cai:** Pakha (*sic* – Bac Ha district?), 11 xii 1935, *E. Poilane* 25070 (P).

This species is very close to *Amomum dealbatum* in its clump-forming habit, inflorescence arising from near the base of the pseudostems, many flowers open at once, bracts soon rooting, and winged fruits, but it differs by its glabrous leaves, bracteole present, and filament and labellum connate into a tube c.0.5 cm above the insertion of the corolla lobes. It also resembles *Amomum subcapitatum* and *A. repoeense* by its winged fruit but may be distinguished from both species by its very long and wide leaves, bracts subtending single flowers, rounded labellum and truncate anther crest.

The type, *Fang & Li* 26123 (GXMI), has not been seen but our material matches the description in the *Flora of China*. The protologue indicates that the type is at HGM. This is an unregistered code for GXMI.

**19. *Amomum petaloideum*** (S.Q.Tong) T.L.Wu, *Novon* 7(4): 441 (1998); Wu & Larsen, *Fl. China* 24: 355 (2000). – *Paramomum petaloideum* S.Q.Tong, *Acta Bot. Yunnan.* 7: 310 (1985). – Type: China, Yunnan, Mengla, Menglun, 10 vi 1981, *S.Q. Tong* 24801 (holo HITBC; iso HITBC, KUN). **Figs 19, 20.**

Clump-forming herb, c.2 m high, 5–10 pseudostems per clump; *rhizome* c.1–1.5 cm diameter, red then green, scabrous; *stilt roots* c.10–15 × 0.5 cm, dark reddish-brown; *interval between pseudostems* c.10 cm, scales tubular, at least at the base, 1–2.5 cm long, red then dark brown, coriaceous, striate, outer surface hairy, apex acute. *Pseudostem* with c.5–7 leaves per pseudostem, slightly swollen at base, 1–1.5 cm diameter, red then green, striate, glabrous, outer surface markedly reticulate, inner surface glaucous, smooth, shining; *ligule* ovate, bilobed, 0.5–1 cm long, coriaceous, outer surface hairy, scabrous, apex acute; *petiole* 5–15 cm long, canaliculate, striate, glabrous; *blade* oblong-elliptic, 25–80 × 9–15 cm, rough, glabrous, base attenuate, apex caudate, primary veins prominent below, secondary veins prominent both sides. *Inflorescences* arising near base of pseudostems, c.2–4 per pseudostem; *flowering part* ellipsoid, c.10 × 6 cm diameter, only 1 flower open at once; *peduncle* c.5 × 1 cm, red, striate, glabrous; *scales* ovate to broadly ovate, 2–2.5 × 1–1.5 cm, reddish, hard coriaceous, striate, outer surface scabrous, hairy, apex acute, margin ciliate; *bracts* broadly ovate, 3.5–4 × 1.8–2 cm, reddish-green with green margin, coriaceous, ridged, subtending a single flower, glabrous except outer surface scabrous with short hairs above, inner surface ridged, apex pointed with thick, pointed spur c.0.3 cm long, margin ciliate towards apex, papery then soon rotting; *bracteole* oblong-lanceolate, with a single tooth, 1.8–2 × 0.5 cm, light brown, membranous, thin and transparent, hairy only at acute apex. *Calyx* tubular, 3-toothed, 2–2.2 × 0.2–0.5 cm, light brown, membranous, glabrous, except hairy above; calyx tube c.1–1.2 cm long; larger tooth c.1 cm, shorter teeth c.0.1 cm long, apex caudate. *Corolla* pinkish-white, 3.5–4 cm long, outer surface scabrous with short hairs, inner surface scabrous at base, tomentose above, corolla tube 2–2.2 cm long; lateral corolla lobes 1.5 × 0.5–0.7 cm, membranous; central corolla lobe 1.5 × 0.8–1 cm, membranous, apex cucullate with thick spur; *labellum* clawed, 2–2.5 × 1.5–2 cm, white except yellow central stripe and stripe of minute red dots at base, transparent veins radiating to margin, membranous with thick coriaceous, glabrous central ridge, apex rounded, margin undulate; *lateral staminodes* absent. *Filament* thick, coriaceous, flattened, 0.5 cm long, abaxial surface glabrous, adaxial surface hairy, red; *anther* ellipsoid, 0.5 × 0.5 cm, abaxial surface glabrous, adaxial surface hairy, red; *anther crest* entire, acute, 0.3 cm long, white, glabrous. *Stigma* rounded, glabrous, apex entire; *style* glabrous; *epigynous glands* oblong, 0.3 cm long, glabrous; *ovary* 0.3 cm diameter, smooth, ridged or winged at apex, glabrous; *ovules* round, c.10 per locule; *fruits* not seen. *Seeds* not seen.



*Distribution.* China (Yunnan), Laos.

*Habitat and ecology.* Evergreen forest, on limestone, open forest, on steep hills with rocky soil, at 447–452 m altitude.

*Proposed IUCN status.* VU A2ac. The only subpopulation known from Laos was destroyed by the planting of a rubber plantation between 2007 and 2009. The species may have suffered a similar fate in the Chinese part of its range. Thus, there has been at least a 30% population reduction in the last 30 years, resulting in a Vulnerable listing. The population reduction could, in fact, be larger but there is no information on the situation in China. Survey work is required to confirm this and to discover whether this species occurs in Burma.

*Specimens examined.* LAOS. **Louangnamtha:** Bane Xiang Kok, 28 iv 2007, V. Lamxay & P. Phaphouampheng VL1122 (E, NLS); *ibid.*, 30 vi 2007, V. Lamxay VL1154 (E, NLS, P).

In the original description of the monotypic *Paramomum*, Tong (1985) compared his new genus to *Costus* L. The habit and all characters of *Paramomum petaloideum* S.Q.Tong ally it to *Amomum*, however. It is a clump-forming herb with stilt roots, leaves arranged distichously, anther crest present, and stigma unbranched. These characters led Wu (1998) to publish a new combination in *Amomum*.

The main diagnostic characters of this species are: stilt roots present, young shoots reddish and markedly reticulate, inflorescence gelatinous with broadly ovate, coriaceous bracts that have an acute apex with a thick, pointed spur. *Amomum petaloideum* is similar to *A. pierreanum* in its bracts but it may be clearly distinguished by its white flower, thick, red, coriaceous filament and pointed anther crest.

**20. *Amomum pierreanum*** Gagnep., Bull. Soc. Bot. France 53: 143 (1906); Gagnepain, Fl. Indo-Chine 6: 112 (1908). – Type: Cambodia, monts Schval, Samrong Tong, 29 iv 1870, J.B.L. Pierre 591 (lecto P [barcode P00599243], designated here; isolecto P [barcodes P00599242 & P00599276]). **Figs 19, 20.**

Clump-forming herb, 1.5–2 m tall; *rhizome* c.1 cm diameter; *stilt roots* present, c.1 cm diameter, dark brown, c.10–15 cm long, hairy; *interval between pseudostems* c.5 cm, scales hairy, broadly triangular, c.1 × 1.5 cm, coriaceous, striate, outer surface tomentose, apex broadly acute. *Pseudostem* with c.10–18 leaves per pseudostem, gradually becoming smaller towards apex, slightly swollen at base, c.2 cm diameter, striate, glabrous, outer surface finely reticulate; *ligule* ovate, c.1 cm long, coriaceous, glabrous, swollen at base of petiole, apex bifid; *petiole* canaliculate, c.2–3 × 0.5 cm, striate, glabrous; *blade* oblong, 30–50 × 5–7 cm, glabrous, base long attenuate, apex long caudate, primary vein prominent below, secondary veins sunken. *Inflorescences* arising near base, 2–3 per pseudostem; *flowering part* globose to ovoid, c.5–6 × 4–5 cm; *peduncle* cylindrical, c.3–5 × 1 cm, hairy; *scales* broadly triangular at base c.1–1.2 × 1.2–1.5 cm, narrowly triangular above, c.3–4 × 1–1.5 cm, striate, coriaceous, tomentose with soft hairs, apex acute, margin ciliate; *bracts* broadly ovate

to boat-shaped,  $2.5\text{--}4 \times 1.5\text{--}2$  cm, dark brown, hard, thick, coriaceous, subtending a single flower, outer surface striate, tomentose, apex cucullate with pointed spur; *bracteole* tubular, 3-toothed,  $c.1.5\text{--}2 \times 0.5\text{--}0.8$  cm, reddish-brown, membranous, striate, outer surface hairy, tube  $c.1$  cm long. *Calyx* tubular, 3-toothed,  $c.2\text{--}2.5 \times 0.4\text{--}0.5$  cm, membranous, striate, glabrous, apex acute. *Corolla* tubular, corolla tube  $c.2 \times 0.5$  cm, glabrous, corolla lobes glabrous, reddish, with darker red, narrow stripes; lateral lobes  $2 \times 1.5$  cm; central lobe  $2.5 \times 2$  cm; *labellum* bowl-shaped,  $c.2.5 \times 1\text{--}1.5$  cm, margin turned forward, apex markedly trilobed, the central lobe emarginate and turned backward, glabrous, yellow with red lines radiating to margin; *lateral staminodes* bifid, apices pointed, reddish. *Filament* flat,  $c.1$  cm long, glabrous, white; *anther*  $c.0.5$  cm long, yellowish-white; *anther crest* trilobed, lateral lobes oblong, pointed and turned forward, central lobe triangular, yellowish. *Stigma* cup-shaped, yellowish, glabrous; *style* hairy; *epigynous glands* 1 pair, glabrous,  $c.0.3$  cm long; *ovary*  $c.0.3$  cm diameter, brown, glabrous. *Infructescence* peduncle  $c.4\text{--}5 \times 1$  cm, hairy; *fruiting part*  $c.6\text{--}8 \times 4\text{--}5$  cm, subtending many fruits; *fruit* globose, smooth with fine ridges,  $c.1$  cm diameter, pale, calyx persistent. *Seeds* not seen.

*Distribution.* Thailand, Cambodia.

*Habitat and ecology.* Lowland evergreen forest over sandstone, at 511–960 m altitude.

*Proposed IUCN status.* LC. This species has a large extent of occurrence and all the known occurrences are within protected areas so the species is secure and not declining. It is therefore assessed as Least Concern.

*Specimens examined.* CAMBODIA. **Kampong Chhnang:** Phnom Chom, i 1939, *E. Poilane* s.n. (P). **Kampong Spoe:** Monts Schral, Samrong Tong, 25 iv 1870, *J.B.L. Pierre* 591 (K); *ibid.*, 28 iv 1870, *J.B.L. Pierre* 591 (K, NY, P [2]). **Kampot:** Bokor N.P., 28 iii 2006, *C. Long et al.* CL133 (P). **Koh Kong:** Thma Bang, 21 iii 2003, *J. Kanstrup* 222 (E [2]); *ibid.*, 15 v 2010, *M.F. Newman et al.* 2289 (E).

By its yellowish-orange flowers, divided lateral staminodes and anther crest turned forward it resembles *Amomum aculeatum* and *A. elephantorum* but it differs from both these species by its broadly ovate to boat-shaped bracts with cucullate, mucronate apex and globose, ridged fruits.

The protologue of *Amomum pierreanum* cites the type as follows: 'INDO-CHINE. – Cambodge: monts Schval, prov. de Samrong-tong, n° 591 [*Pierre*]'. The name of the mountains, Schval, cannot be traced with certainty. It is printed Schval in the protologue but looks more like Schral on the handwritten labels on the specimens. Assuming that the letter r has been misread as v, and that the initial sound Sch should be transliterated as Ch, it may be that Pierre's collection comes from the village of Phumi Stoeng Chral which is in or very near Kirirom National Park in Koh Kong Province. Samrong-tong is now a district of Kampong Spoe Province.

Eight sheets of *Pierre* 591 have been seen, with duplicates in various herbaria collected on a number of days in late April 1870. Thus, they are not a single

gathering. The lectotype was collected on 29 April 1870. It and two isoelectotypes are at P. The other five sheets were collected on other dates and so they are not to be considered types.

**21. *Amomum plicatum* Lamxay & M.F.Newman, sp. nov.**

*Amomo repoeensi* Pierre ex Gagnep. cincinnis praesentibus, labello trilobato, ligulis bifidis et bracteolis lanceolatis simile, sed foliorum lamina plicata vaginae laevi glabra, labello filamentoque supra corollae loborum insertionem in tubam adnatis et fructibus ovoideis alas undulatas ferentibus manifeste differt. – Type: Laos, Attapeu, Saysetha, Bane Dak Toud, 7 vi 2010, 14°49'25"N, 107°21'36"E, V. Lamxay VL2117 (holo NLS; iso E, P). **Figs 21, 22.**

Clump-forming herb, to 1–1.2 m tall, 6–7 pseudostems per clump; *rhizome* c.0.5–1 cm diameter, pink then reddish-brown; *stilt roots* absent; *interval between pseudostems* 3–5 cm long, scales triangular to ovate, 1–2 × 0.5–1.5 cm, light brown then dark brown, coriaceous, striate, glabrous, apex acute. *Pseudostem* with 5–8 leaves per pseudostem, slightly swollen at base, 0.5–0.8 cm diameter, pinkish then reddish-brown, striate, smooth, shining, glabrous; *ligule* lanceolate to ovate, bifid, 0.3–1 cm long, light brown, coriaceous, glabrous, apex rounded to acute, margin ciliate to glabrous; *petioles* canaliculate at base, cylindrical above, 7–15 cm long, striate, glabrous; *blade* elliptic to oblong, 12–35(–50) × 5–10(–20) cm, dark green above, pale green below, plicate, glabrous, base attenuate, apex caudate, margin entire, primary veins prominent below, secondary veins prominent. *Inflorescences* arising from base, 1–3 per pseudostem; *flowering part* ellipsoid to ovoid, 2–5 × 2–3 cm, c.4 flowers open at once; *peduncle* 2–5 × 0.5 cm, pink then red, glabrous; *scales* triangular 0.5 × 0.3 cm at base, to broadly ovate 1.5–2 × 1–1.2 cm above, greenish-pink then dark reddish-green, hard, coriaceous, striate, glabrous, apex emarginate, cucullate with short spur; *bracts* boat-shaped to lanceolate, 1.5–2 × 1 cm, light brown, hard coriaceous, striate, glabrous, subtending 1–2 flowers, apex acute, margin ciliate towards apex; *bracteole* ovate to lanceolate, 1.5–2 × 0.5–0.8 cm, light brown, membranous, very thin, striate, glabrous, apex cucullate with thick, short, coriaceous spur c.0.2 cm long, margin ciliate. *Calyx* tubular, 3-toothed, 1.3–1.5 × 0.3 cm, light brown, membranous, striate, glabrous; calyx tube 0.8–1 cm long; teeth 0.2 and 0.5 cm long, apex cucullate with thick, short spur. *Corolla* white, 2.8–3 cm long, corolla tube 1.5–1.7 cm long, coriaceous, inner surface pilose to strigose above; lateral corolla lobes 1.5–1.7 × 0.5–0.7 cm, membranous, glabrous, apex cucullate; central corolla lobe 1.5–1.7 × 0.8–1 cm, membranous, glabrous, apex cucullate with long, thick, coriaceous spur c.0.3 cm long; *labellum* clawed, 1.5–2 × 1.5–2 cm, white with yellow central stripe and clear venation radiating to margin, base adnate to filament forming tube c.0.4 cm long above insertion of corolla lobes, glabrous, adaxial surface with two lines of long hairs at base and centre, apex membranous, trilobed; *lateral staminodes* triangular to oblong, 0.1 cm long, white. *Filament* flat, 0.3 cm long, white, glabrous; *anther* oblong, 0.6 × 0.3 cm, white, glabrous; *anther*

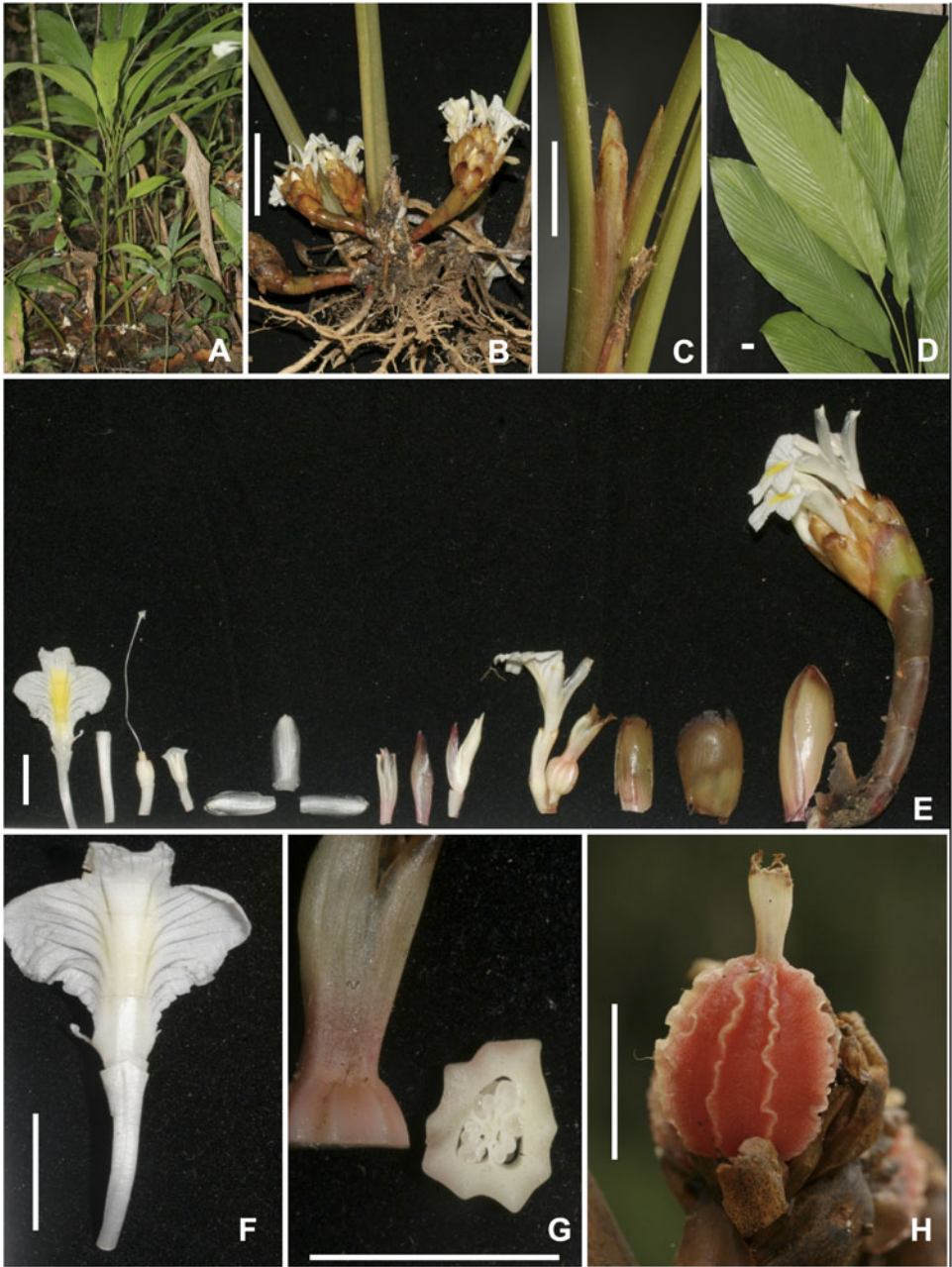


FIG. 21. *Amomum plicatum* Lamxay & M.F.Newman. A, habit; B, clump with inflorescences; C, ligule; D, leaves; E, dissection of flower and inflorescence on the right (left to right: labellum, longitudinal section of corolla tube, ovary with epigynous glands and style, stamen, dorsal and lateral corolla lobes, calyx, bract, bracteole and buds, cincinnus with flower and young fruit, three peduncle scales and inflorescence); F, corolla tube and labellum from below; G, cross section of ovary; H, fruit. Scale bar = 1 cm. Photo by V. Lamxay.

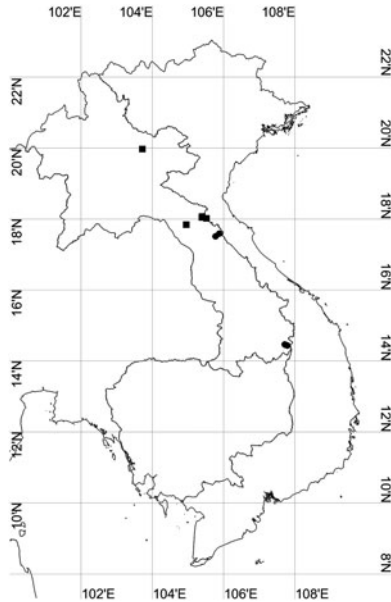


FIG. 22. Distribution of *Amomum plicatum* Lamxay & M.F.Newman (●) and *Amomum prionocarpum* Lamxay & M.F.Newman (■) in Cambodia, Laos and Vietnam.

*crest* trilobed, lateral lobes rounded, small, c.0.1–0.2 cm wide, central lobe c.0.3 × 0.2 cm, white, membranous, glabrous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.5 cm long, glabrous; *ovary* 0.3 cm diameter, c.9–10-ridged, glabrous, pedicel glabrous, c.0.5 cm long; *ovules* globose, c.35 per locule. *Infructescence* peduncle 5–10 × 0.5 cm, greenish-dark brown, glabrous; *fruiting part* 5 × 3 cm, subtending c.3–5 fruits; *fruits* on stalks 0.5–0.8 cm long, ovoid, pinkish, glabrous, 1.2–2 × 1–1.5 cm, 9-winged, wings 0.2 cm wide, undulate. *Seeds* globose, 0.2–0.3 cm diameter, glabrous, c.25 per locule.

*Distribution.* Laos.

*Habitat and ecology.* Low to mid-elevation evergreen forest, on limestone hills near waterfalls or along streams, at 335–877 m altitude.

*Proposed IUCN status.* LC. Although the species is known from only a few localities and the extent of occurrence in Laos alone is well within the threshold for a Threatened listing, all the known subpopulations are within protected areas. There are no significant threats and the population is stable so it is assessed as Least Concern.

*Specimens examined.* LAOS. **Attapeu:** Bane Dak Lia, 27 vii 2007, *V. Lamxay & Bounlop* VL1191 (E, NLS, P, UPS); Bane Houay Pik, 27 vii 2007, *V. Lamxay & Bounlop* VL1188 (E, NLS, P, UPS); Bane Lak 52, 16 v 2008, *V. Lamxay & M.F. Newman* VL1264 (E, NLS, P, UPS). **Khammouan:** Bane Maka Kang, 27 v 2009, *V. Lamxay* VL1790 (NLS); Bane Vang Le, 30 v 2009, *V. Lamxay* VL1880 (NLS).

*Amomum plicatum* is similar to *A. repoeense* by its bifid ligules, lanceolate bracteoles, presence of cincinni and trilobed labellum but differs clearly by the plicate leaf blades and smooth, glabrous sheaths, the tube formed above the insertion of the corolla lobes by the base of the labellum and base of the filament, and the ovoid fruits with undulate wings.

It shares a number of characters with *Amomum subcapitatum*, namely its clump-forming habit with rather few leaves, bracts sometimes subtending cincinni of more than one flower, trilobed labellum, bifid ligule and winged fruit, but it differs by having ovoid fruits with wavy wings rather than globose fruits with straight wings.

**22. *Amomum prionocarpum* Lamxay & M.F.Newman, sp. nov.**

*Amomo glabro* S.Q.Tong affine, sed bracteolis hirsutis unidentatis, labelli pagina adaxiali pilis longis albis pilosa, in fructibus juvenilibus alis biserratis, et fructibus maturis aculeos breves acutos ferentibus notabile. – Type: Laos, Bolikhamxai, Kham Keut, Bane Na Heuang, 15 v 2007, 18°25'29"N, 105°2'40"E, *V. Lamxay et al.* VL1131 (holo NLS; iso E, P, UPS). **Figs 22, 23.**

Creeping herb, c.1 m tall; *rhizome* c.0.5 cm diameter, red then white when old, deep underground; *stilt roots* absent; *interval between pseudostems* c.30 cm, scales soon rotting. *Pseudostem* with c.7–9 leaves per pseudostem, gradually becoming smaller towards apex, red at base, yellowish-green above, striate, glabrous; *ligule* ovate, bifid, c.0.5 cm long, green to light brown, coriaceous, glabrous; *petiole* canaliculate, c.2–3 cm long, glabrous; *blade* oblanceolate-oblong or oblanceolate, 15–25 × 5–7 cm, lower surface light green, glabrous, primary vein prominent below, secondary veins sunken. *Inflorescence* c.10 cm long, arising from or near base; *flowering part* ellipsoid, becoming pointed towards apex, a few or only 1 flower open at once; *peduncle* c.5 cm long, glabrous; *scales* ovate, 2–2.5 × 1.5–1.7 cm, red or pink, reddish-brown, coriaceous, hard, apex with long hairs, margin ciliate; *bracts* boat-shaped, 5–6 × 2–3 cm, whitish brown or reddish-pink, glabrous, papery at base but hard coriaceous above, apex acute; *bracteole* tubular, c.2.5–3 × 0.5 cm, white to light brown, 1-toothed, bracteole tube 1/2 as long as tooth, clear transparent white, membranous, thin, outer surface pilose, margin ciliate, apex long caudate. *Calyx* tubular, 2–3-toothed, coriaceous, glabrous; calyx tube c.3 cm long; teeth c.2 cm long, apex cucullate with short pointed hairy spur. *Corolla* white, outer surface glabrous, inner surface pilose with white hairs; lateral lobes c.3 × 0.8 cm, membranous, glabrous, apex cucullate with long spur; central corolla lobe c.3 × 1.2 cm, glabrous; *labellum* clawed, 3–3.5 × 2–3 cm, labellum and filament connate into a tube c.0.3–0.5 cm above insertion of corolla lobes, white except central red stripe at base becoming yellow apically and transparent lines radiating to margin, adaxial surface pilose with long white hairs, margin membranous and undulate; *lateral staminodes* triangular to ovate, 0.3 cm long, white, glabrous, apex acute. *Filament* flat, c.0.5 × 0.2 cm, white, glabrous; *anther* twice as long as filament, white; *anther crest* c.1 cm long, truncate, entire, membranous. *Stigma* cup-shaped, apex ciliate with long hairs;

*style* glabrous; *epigynous glands* 1 pair, glabrous, cylindrical, c.1 cm long, acute; *ovary* globose, ridged at apex; *ovules* globose, glabrous. *Infructescence* peduncle c.5 cm long; *fruiting part* subtending only one to a few fruits; *young fruit* obovoid, winged, margin of wings double serrate; *mature fruit* 1–1.5 cm diameter, globose with short sharp prickles, blackish-dark brown to blackish-pink, apex truncate, stalk very short or absent, glabrous. *Seeds* globose, dark brown, 0.2–0.3 cm diameter.

*Distribution.* Laos.

*Habitat and ecology.* Moist evergreen forest and montane evergreen forest, at 573–1050 m altitude.

*Proposed IUCN status.* LC. Although the species is known from only a few localities and the extent of occurrence is well within the threshold for a Threatened listing, all the known subpopulations are within protected areas. There are no significant threats and the population is stable so it is assessed as Least Concern.

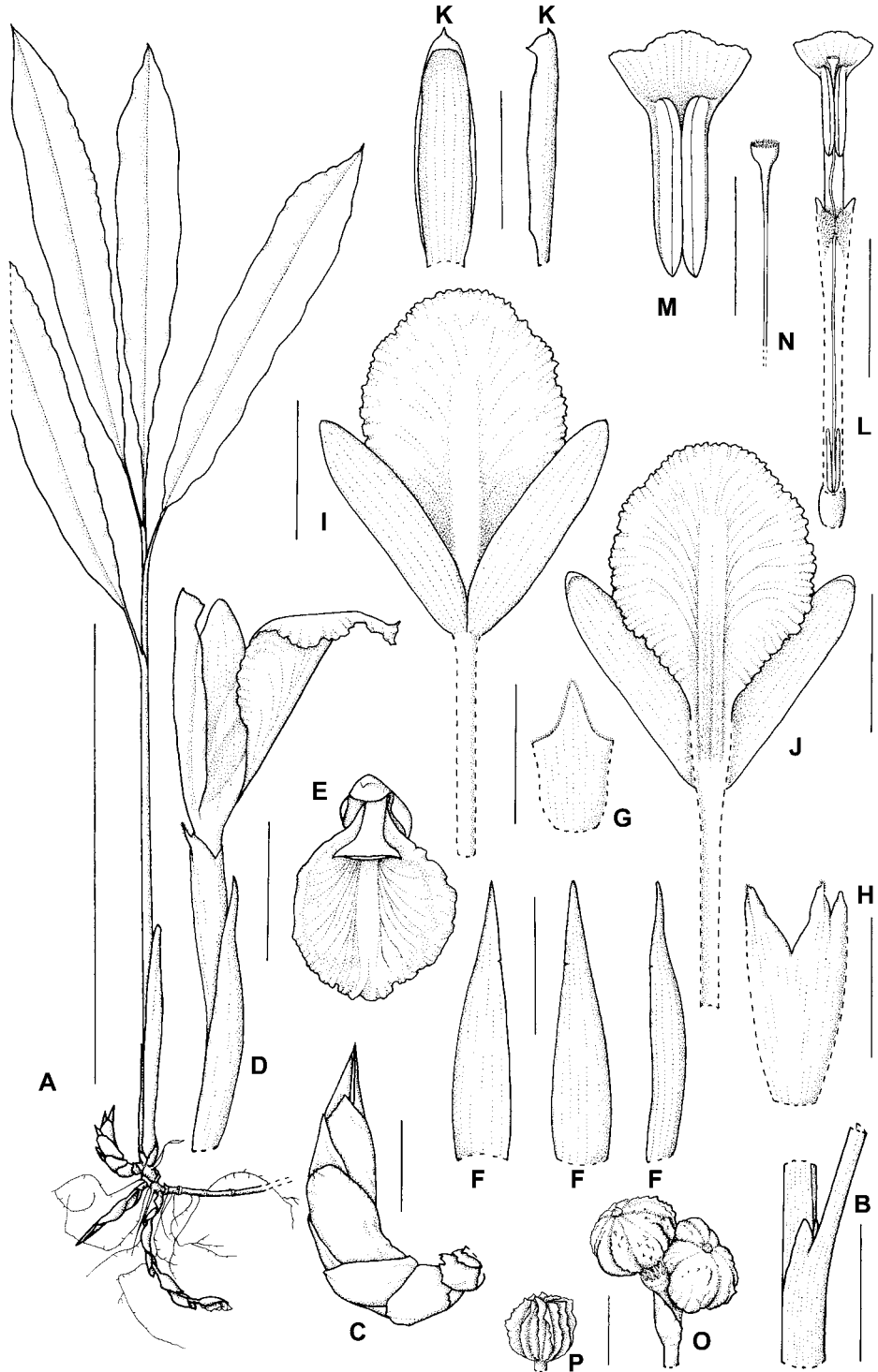
*Specimens examined.* LAOS. **Bolikhambxai:** Kham Keut, Nam Phao checkpoint, Lao–Vietnam border, Nakai–Nam Theum NPA, 29 iv 2009, *V. Lamxay* VL1717 (NLS); *ibid.*, 24 viii 2009, *V. Lamxay* VL2074 (NLS); Bane Na Heuang, 18 vii 2007, *V. Lamxay et al.* VL1174 (E, NLS, P, UPS). **Houaphan:** Bane Dan Cheng, 23 v 2008, *V. Lamxay et al.* VL1303 (E, NLS, P).

This species looks like *Amomum glabrum* by its loosely creeping habit with deep rhizome, white flower, truncate anther crest, cucullate central corolla lobes with pointed spur, and labellum and filament connate into a tube above the insertion of the corolla lobes, but it differs by its short sharp prickles and fruit with double serrate wings when young.

Other allied species are *Amomum repoeense* and *A. subcapitatum* which also have winged fruit and reticulate leaf sheaths, but it differs from these species by its bracts subtending single flowers. *Amomum dealbatum* has winged fruits that are like those of *A. prionocarpum* but it is a clump-forming herb with open bracteoles and many flowers open at once.

**23. *Amomum repoeense*** Pierre ex Gagnep., Bull. Soc. Bot. France 53: 144 (1906); Gagnepain, Fl. Indo-Chine 6: 114 (1908); Wu & Larsen, Fl. China 24: 356 (2000); Newman et al., Checkl. Vasc. Pl. Lao PDR 362 (2007). – Type: Cambodia, Koh Kong, Mt. Khnang Repeu, v 1870, *J.B.L. Pierre* 625 (lecto P [barcode P032742], designated here; isolecto E, K, NY, P [6 sheets]). **Figs 24, 25.**

Clump-forming herb, 50–70 cm tall, 3–5 pseudostems per clump, scented; *rhizome* 0.5–1 cm diameter, red to reddish-brown; *stilt roots* absent; *interval between pseudostems* c.3–5 cm, scales triangular to narrowly triangular, 0.5–1 cm long, light brown, spiral, coriaceous, striate, glabrous, apex acute. *Pseudostem* with c.3–4 leaves per pseudostem, slightly swollen at base, 1–1.5 cm diameter, red then brown, glabrous, outer surface markedly reticulate, inner surface smooth, shiny; *ligule* lanceolate, bifid, 2–4 cm long, light brown, papery, outer surface tomentose, apex





acute; *petiole* canaliculate,  $15\text{--}25 \times 0.3\text{--}0.5$  cm, striate, glabrous; *blade* oblong to oblong-elliptic,  $32\text{--}45 \times 7\text{--}12$  cm, glabrous, base attenuate, apex short caudate, primary veins prominent below, secondary veins prominent or sunken. *Inflorescences* arising from base or near base, to 2–3 inflorescences per pseudostem; *flowering part* ovoid,  $5\text{--}7 \times 3\text{--}5$  cm, c.6 flowers open at once; *peduncle*  $10\text{--}15 \times 0.3\text{--}0.4$  cm, reddish-brown, striate, glabrous; *scales* boat-shaped to lanceolate, 1–4 cm long, pink then dark brown, coriaceous, striate, outer surface tomentose, apex cucullate with short spur; *bracts* ovate to boat-shaped,  $1.5\text{--}2.5 \times 0.5\text{--}1$  cm, pinkish-brown, hard coriaceous, striate, subtending 2–3 flowers, outer surface tomentose, apex acute, margin ciliate; *bracteole* open, broadly triangular,  $1.5\text{--}2 \times 1$  cm, reddish-brown, membranous, striate, outer surface pilose, apex caudate with thick spur, margin ciliate. *Calyx* tubular, 3-toothed,  $1.8\text{--}2 \times 0.4$  cm, pinkish-light brown, membranous, outer surface pilose; calyx tube 0.8–1 cm long; teeth 0.5 and 1 cm long, apex caudate with spur c.0.2 cm long, margin ciliate. *Corolla* 2.8–3 cm long, white, corolla tube 1.3–1.5 cm long, coriaceous, outer surface pilose, inner surface pilose to strigose; lateral corolla lobes  $1.3\text{--}1.5 \times 0.7\text{--}0.8$  cm, membranous, upper surface pilose, lower surface glabrous, apex cucullate; central corolla lobe  $1.3\text{--}1.5 \times 0.8\text{--}1$  cm, membranous, upper surface pilose, lower surface glabrous, apex cucullate with thick spur; *labellum* clawed, trilobed,  $3\text{--}4 \times 2\text{--}3$  cm, white with yellow central stripe edged by red dots in middle and clear venation radiating to margin, coriaceous, adaxial surface pilose, apex rounded with 3 lobes, margin membranous, undulate, entire; *lateral staminodes* triangular, 0.2 cm long, white. *Filament* flat, 0.3 cm long, white, abaxial surface scabrous, adaxial surface pilose; *anther* oblong,  $0.9\text{--}1 \times 0.3$  cm, white, abaxial surface pilose; *anther crest* trilobed, white, rounded, membranous, glabrous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.3 cm long, glabrous; *ovary*  $0.5 \times 0.3$  cm, ridged, pilose; *ovules* round, c.15 per locule. *Infructescence* peduncle  $10\text{--}20 \times 0.3$  cm, red, glabrous; *fruiting part* subtending c.10 fruits, grouped at apex,  $5\text{--}10 \times 5$  cm; *fruits* globose, 1–2 cm diameter, whitish-pink to reddish, 9-winged, wings 0.2 cm wide, margin straight, glabrous. *Seeds* globose, 0.3 cm long, glabrous, c.10–15 per locule.

*Distribution.* Thailand, Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland to mid-elevation evergreen forest, mixed deciduous forest, open forest, also in disturbed forest, on many soil types, at 120–803 m altitude.



FIG. 23. *Amomum prionocarpum* Lamxay & M.F.Newman. A, habit; B, ligule; C, inflorescence; D, whole flower from side; E, whole flower from above; F, bract, inner, outer and lateral views; G, bracteole; H, calyx; I, labellum & lateral corolla lobes from below; J, labellum & lateral corolla lobes from above; K, dorsal corolla lobe, inner and lateral views; L, ovary, lateral staminodes and stamen; M, anther; N, stigma; O, infructescence; P, single fruit. Scale bars: A = 40 cm; B–L = 2 cm; M, N = 1 cm; O, P = 1.5 cm. Drawn from Lamxay VL1131, dried material & photos (A–C); Lamxay VL1717, spirit material & photos (D–N); Lamxay VL1174, spirit material (O), dried material & photos (P).



FIG. 24. A–C: *Amomum repoense*. A, inflorescence; B, ligule; C, infructescence. *Lamxay* VL1022. D–F: *Amomum schmidtii*. D, inflorescences; E, infructescence; F, ligule. *Lamxay* VL1017. G–I: *Amomum sericeum*. G, inflorescence; H, part of leaf undersurface; I, infructescence. *Lamxay* VL1121. Scale bar = 1 cm.

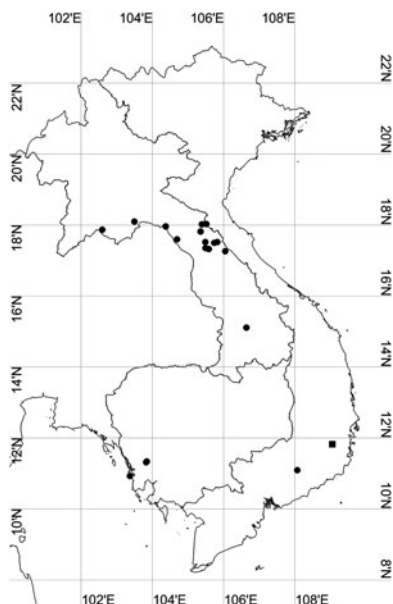


FIG. 25. Distribution of *Amomum repoeense* Pierre ex Gagnep. (●) and *Amomum rubidum* Lamxay & N.S.Lý (■) in Cambodia, Laos and Vietnam.

*Proposed IUCN status.* LC. A widespread and common species and, although there is some loss of habitat within its range, it occurs in many protected areas and is generally secure. The species is therefore listed as Least Concern.

*Specimens examined.* CAMBODIA. **Koh Kong:** Thma Baing, 23 iii 2003, *J. Kanstrup* 223 (E); *ibid.*, 15 v 2010, *M.F. Newman et al.* 2273 (E); Veal Veng, 14 ix 1999, *R. Bansok* 69 (K).

LAOS. **Bolikhamxai:** 30 iv 1932, *A.F.G. Kerr* 21317 (K, P); Bane Had Khai, 9 v 2008, *V. Lamxay* VL1244 (E, NLS); Bane Nam Deua, 16 ix 2006, *V. Lamxay* VL1117 (NLS); Bane Nam Phao, 29 iv 2009, *V. Lamxay* VL1716 (NLS); *ibid.*, 24 viii 2009, *V. Lamxay* VL2072 (NLS); Bane Phone Xay, 13 v 2008, *V. Lamxay* VL1249 (E, NLS, P); *ibid.*, 27 iv 2009, *V. Lamxay* VL1711 (NLS); Kham Keut, Nam Chad-Nam Pan NPA, 17 vi 2006, *V. Lamxay* VL1176 (E, NLS); Lak Xao, 18 vi 2006, *V. Lamxay* VL1018 (E, NLS, P). **Khammouan:** Nakai, 19 vi 2006, *V. Lamxay* VL1022 (E, NLS, P); *ibid.*, 22 vi 2006, *V. Lamxay* VL1028 (E, NLS, P); Bane Chat San, 19 v 2006, *M.F. Newman et al.* LAO1547 (E); Bane Mak Feuang, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* 14 (E); *ibid.*, 20 xii 2005, *E.C.S. Lundh & L.J. Ahnby* 30 (E); Bane Na Wa, 30 v 2009, *V. Lamxay* VL1877 (NLS); Bane Thong Noi, 25 vi 2006, *V. Lamxay* VL1047 (E, NLS); along Pakang stream, Nam On catchment, Phou Ak escarpment, Nakai Nam Theun NPA, *M.F. Newman et al.* LAO1298 (E). **Salavan:** Bane Dou Chai Gnai, 14 v 2009, *V. Lamxay* VL1732 (NLS). **Vientiane Capital:** Bane Po, 6 v 2006, *V. Lamxay* VL1003 (NLS).

VIETNAM. **Lam Dong:** Deo Bao Loc, Dai Duc Me, 22 vi 2008, *H.D. Tran et al.* 67 (E). **Quang Tri:** massif de Dong Co Pat, 4 vii 1924, *E. Poilane* 11160 (P); Dong Tam Pe, 25 viii 1938, *E. Poilane* 27557 (P).

This species is widely distributed from southern China, northern Vietnam through-out Laos to Cambodia, being found in many forest and soil types. It belongs in a group of species with winged fruit including *Amomum maximum* and *A. dealbatum* in which it is distinguished by its short, clump-forming habit, bracts subtending cincinni of flowers and trilobed labellum. It is similar to *Amomum subcapitatum* from which it differs by its glabrous leaves and short petiole and to *A. plicatum* by its white flowers, its winged fruits and its trilobed labellum but it differs from this species by its globose fruits with straight wings.

Many duplicates of *Pierre* 625 are to be found in several herbaria. The sheet with the barcode P032742 (P), which has an illustration by Gagnepain attached to it, is selected as the lectotype.

**24. *Amomum rubidum* Lamxay & N.S.Lý, sp. nov.**

*Amomo pierreano* Gagnep. antherae crista cornuata inflexa et capsulis laevibus affine, sed foliorum paginae inferioris colori purpureorubro, labello reniformi margine reflexo et antherae cristae lobo centrali lato bidentato differt. – Type: Vietnam, Lam Dong, Bi Doup-Nui Ba N.P., 25 vii 2008, 12°10'37"N, 108°41'53"E, N.S. Ly 306 (holo VNM; iso E, SING). **Figs 25, 26.**

Clump-forming herb, c.1.5 m tall with 12–19 leaves per pseudostem; *rhizome* branched, c.1.3–1.7 cm, externally yellowish brown, internally cream, slightly aromatic; *stilt roots* absent; *interval between pseudostems* c.5–10 cm, scales broadly triangular, 1–1.2 × 1 cm, brown, papery, apex acute. *Pseudostem* c.1.5 cm diameter, pink when young then green; *ligule* ovate, c.0.6–1.2 cm long, green then brown, shortly hairy, margin of leaf sheaths dark brown; *petiole* canaliculate, c.0.5–0.9 cm long, glabrous; *blade* oblong-linear, c.30–45 × 4.5–7 cm, dark green and glabrous above, pale green with purplish-red below, glabrous, base oblique, apex acuminate to long caudate, margin hairy. *Inflorescence* obovoid, arising from the base, creeping vertically then curved upwards; *flowering part* ovoid, c.5–7 × 4–5 cm; *peduncle* c.4–7 × 1 cm, hairy; *scales* ovate-triangular, 0.5–3.6 × 1–3 cm, reddish-purple then brown, coriaceous at base, papery above, hairy, apex cucullate with spur c.0.2 cm long; *bracts* obovate, 3.6–4.1 × 1.5–3.5 cm, greenish-red then dark brown, rotting soon, tomentose at base, apex acute and slightly mucronate or rounded, margin ciliate; *bracteole* tubular, c.2.4–3.1 × 1.1–1.3 cm, membranous, 2-toothed, c.4–6 mm long, hairy at base. *Calyx* tubular, c.2 × 0.5 cm; calyx tube c.1.5 cm; teeth c.0.5 cm, coriaceous, glabrous. *Corolla* tubular, corolla tube c.1.5 × 0.3 cm, glabrous; lateral corolla lobes oblong, 2–2.3 × 0.6–0.8 cm, membranous, reddish, glabrous, apex rounded; central corolla lobe oblong, c.2–2.5 × 1–1.1 cm, reddish, membranous, glabrous, apex rounded, slightly cucullate; *labellum* reniform, c.3–3.7 cm long, base c.1.3 × 0.9 cm, yellow with red stripe on margin, glandular hairy at base, apical part broadly semi-circular, trilobed, c.1.7–2.4 × 3 cm, yellow, margin undulate, reflexed; *lateral staminodes* triangular-linear, c.0.7–0.9 × 0.1–0.2 cm, sometimes with a few tiny teeth at base, pink-red at base, yellowish-white towards apex. *Filament* flat,

c.0.7–0.8 × 0.2 cm, white, glandular hairy; *anther* yellowish-cream, c.0.8–0.9 × 0.4 cm, with glandular hairs on the connective tissue; *anther crest* trilobed, lateral lobes linear, horn-shaped, c.0.5–0.6 × 0.1–0.2 cm, white at base, turning yellow at tip, with a few glandular hairs, central lobe bidentate, inflexed, c.0.4–0.5 × 0.35 cm, yellow, glabrous. *Stigma* cup-shaped, cream white, ciliate; *style* c.3.5 cm, white, sparsely hairy; *epigynous glands* 1 pair, 0.4 cm long, white; *ovary* c.0.6 × 0.4 cm, ovoid, glabrous, trilobular; *ovules* many; *fruiting part* ovoid, c.7 × 4.5 cm, bracts persistent, brown, papery; *fruits* ovoid, c.1.7 × 1.3 cm, smooth, light red. *Seeds* not seen.

*Distribution.* Vietnam.

*Habitat and ecology.* Along streams in montane evergreen forest, at 1775–1869 m altitude.

*Proposed IUCN status.* LC. This species is known from three localities with an extent of occurrence of only 159 km<sup>2</sup> but there is no continuing decline in extent and quality of habitat. The species is therefore assessed as Least Concern.

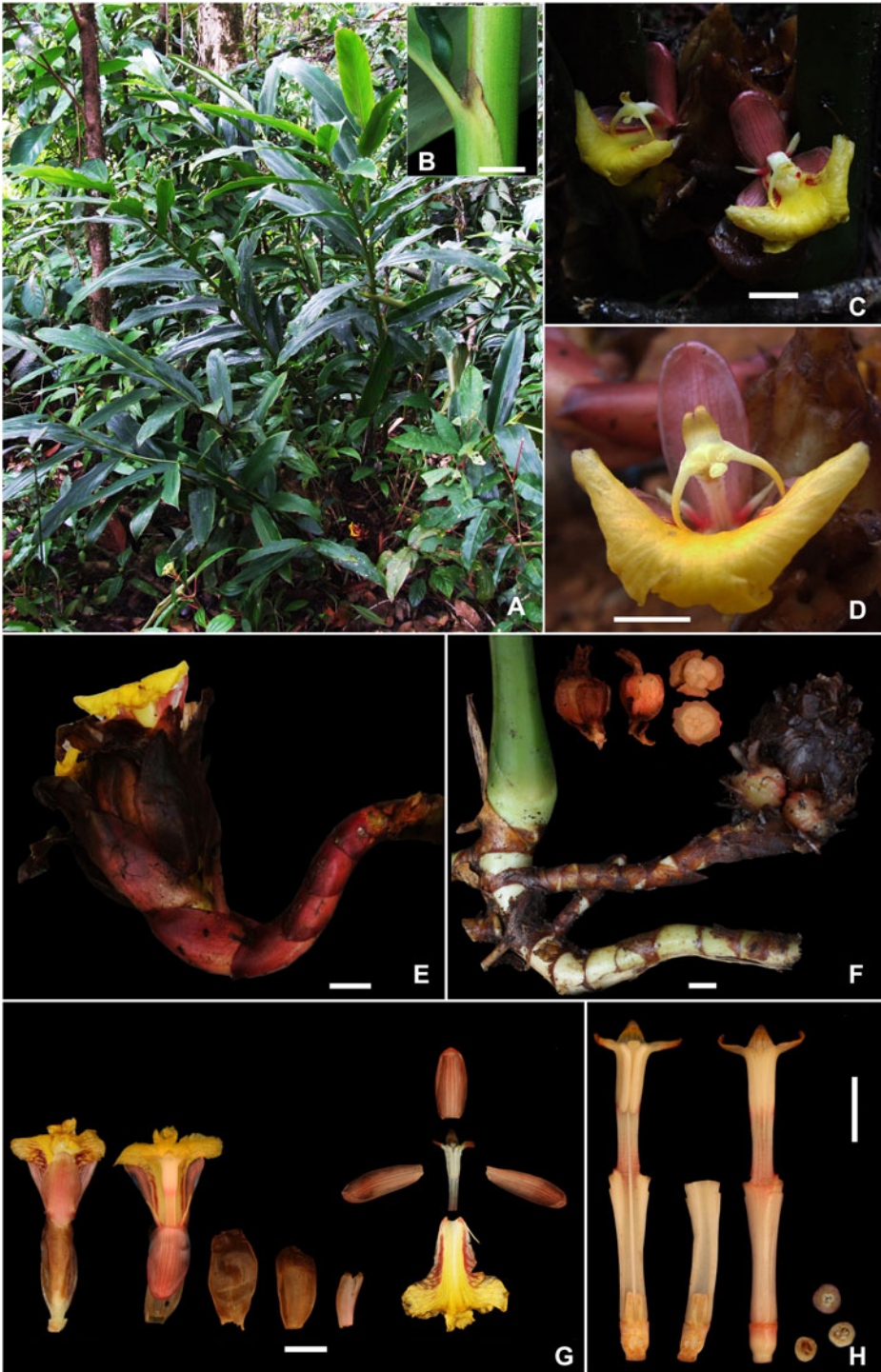
*Specimens examined.* VIETNAM. **Lam Dong:** Bi Doup-Nui Ba N.P., 25 vii 2008, N.S. Ly 305 (E); *ibid.*, 12 vi 2008, S. Hul 3567 (VNM).

The most significant characters of this species are the purplish-red lower surface of the leaf, yellow flower, reniform labellum with reflexed margin, trilobed anther crest with the two lateral lobes turned forward and lateral staminodes present.

**25. *Amomum schmidtii*** (K.Schum.) Gagnep., Fl. Indo-Chine 6(1): 111 (1908). – *Elettariopsis schmidtii* K.Schum., Bot. Tidsskr. 24(3): 269 (1902). – *Cyphostigma schmidtii* (K.Schum.) K.Schum., Pflanzenr. IV, 46 (Heft 20): 274 (1904). – Type: Thailand, Trat, Ko Chang, jungle near Klong Sarlakpet, 18 iii 1900, J. Schmidt 736 (lecto C, designated here; isolecto C, spirit collection). **Figs 24, 27.**

*Amomum biflorum auct. non* Jack: Newman et al., Checkl. Vasc. Pl. Lao PDR 361 (2007).

Creeping herb, c.1.5 m tall; *rhizome* c.0.2–0.5 cm diameter, yellowish-brown, scented; *stilt roots* absent; *interval between pseudostems* c.50–70 cm, scales tubular, 1–3 cm long, light brown, glabrous, papery, striate, outer surface tomentose, inner surface smooth, apex acute, margin ciliate. *Pseudostem* with c.5–10 leaves per pseudostem, becoming slightly smaller towards apex, swollen at base, c.0.5–1 cm diameter, reddish-brown, outer surface tomentose, reticulate or striate; *ligule* ovate, 0.2–0.5 cm long, green, coriaceous, outer surface tomentose, apex acute, margin ciliate; *petiole* canaliculate, 1–2.5 × 0.3 cm, green, striate, glaucous, tomentose; *blade* elliptic to oblanceolate-oblong, 15–23 (rarely to 50) × 1.5–10 cm, base attenuate, apex long caudate, cauda c.3–4 cm long, margin ciliate, upper surface glabrous or hairy, lower surface tomentose to pilose, primary veins prominent below, secondary veins prominent on both sides. *Inflorescences* arising at any point of rhizome to c.50 cm



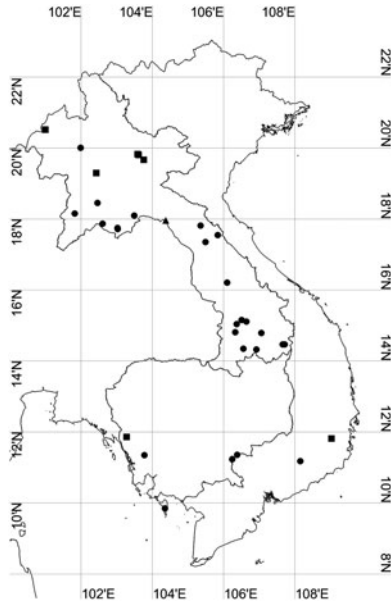


FIG. 27. Distribution of *Amomum schmidtii* (K.Schum.) Gagnep. (●), *Amomum sericeum* Roxb. (■) and *Amomum stephanocoleum* Lamxay & M.F.Newman (▲) in Cambodia, Laos and Vietnam.

from base of mature shoots; *flowering part* ellipsoid,  $3 \times 2$  cm, 1–2 flowers open at once, usually 4–6 in total; *peduncle*  $1-3 \times 0.2-0.4$  cm, glabrous at base, tomentose above; *scales* tubular at least at base, ovate to boat-shaped above,  $2-2.5 \times 0.3-1$  cm, brownish, coriaceous, striate, outer surface glabrous to pilose, apex acute with short spur; *bracts* boat-shaped to lanceolate,  $2-2.5 \times 1-1.5$  cm, pinkish, light brown, papery, striate, subtending a single flower, outer surface pilose, tomentose at base, apex acute, margin ciliate; *bracteole* tubular, 2-toothed,  $1.5-2 \times 0.3$  cm, white to pinkish-brown, membranous, apex acute, outer surface tomentose, bracteole tube 1–1.2 cm long, teeth 0.5–1 cm long. *Calyx* tubular, 3-toothed,  $5-5.6 \times 0.2-0.4$  cm, white and light brown at apex, membranous, thin, outer surface tomentose; teeth 0.5–0.6 cm long. *Corolla* white, 8–8.5 cm long, corolla tube 6–6.5 cm long, coriaceous, glabrous at base, pilose to tomentose above; lateral corolla lobes  $2 \times 0.7-0.8$  cm, membranous, apex cucullate, glabrous; central corolla lobe  $2 \times 0.8-1$  cm, membranous, apex cucullate, tomentose at base; *labellum* clawed,  $3.5-4 \times 2.8-3$  cm, white with yellow



FIG. 26. *Amomum rubidum* Lamxay & N.S.Lý. A, habit; B, ligule; C, flowers; D, close-up of flower; E, inflorescence; F, infructescence; G, dissection of flower; H, close-up of ovary, epigynous glands and stamen. Scale bar = 1 cm. Photo by Ly Ngoc Sam.

central stripe and minute red dots at base, glabrous, abaxial surface shiny, adaxial surface tomentose at base and in centre, apex emarginate, membranous, margin undulate; *lateral staminodes* absent. *Filament* flattened,  $0.5 \times 0.3$  cm, white, adaxial surface hairy; *anther* oblong,  $0.5 \times 0.4$  cm, white, abaxial surface glabrous, adaxial surface hairy; *anther crest* trilobed, lateral lobes small,  $0.2 \times 0.3$  cm, central lobe  $0.3 \times 0.4$  cm, white, membranous, glabrous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 1 pair, 0.8 cm long, glabrous; *ovary* 0.5 cm diameter, smooth, lobed, tomentose with long white hairs; *ovules* rounded, c.10 per locule. *Infructescence* peduncle c.1–3  $\times$  0.3 cm, pink, glabrous; *fruiting part* subtending a single fruit; *fruits* globose, 1  $\times$  1 cm, sessile or very shortly stalked, tomentose, pink to brown, with sparse, short spines. *Seeds* globose with membranous seed coat, 0.2 cm diameter, c.10 per locule.

*Distribution.* Thailand, Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland and montane evergreen forest, mixed deciduous forest, open forest, on various soil types, in light and shade conditions, from 25 to 800 m altitude.

*Proposed IUCN status.* LC. This is a very common and widespread species with a large extent of occurrence. It occurs in many protected areas and, although there is some loss of habitat, this does not have a significant impact on the species. It is therefore listed as Least Concern.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** Samrong Tong, 15 iv 1870, *J.B.L. Pierre* 554 (E, K, NY, P). **Koh Kong:** Thma Bang, 19 v 2010, *M.F. Newman et al.* 2363 (E).

LAOS. **Attapeu:** Sanam Xai, 11 ix 2006, *V. Lamxay* VL1090 (E, NLS, P); Saysetha, Dong Am Pham NPA, 16 v 2008, *V. Lamxay* VL1278 (E, NLS); Bane Dak Toud, 7 vi 2010, *V. Lamxay* VL2116 (NLS); Bane Lak 62, 17 v 2008, *V. Lamxay et al.* VL1283 (E, NLS). **Bolikhambxai:** Bane Had Khai, 9 v 2008, *V. Lamxay* VL1242 (E, NLS); Bane Nam Phao, 17 vi 2006, *V. Lamxay* VL1016 (E, NLS, P); *ibid.*, 17 vi 2006, *V. Lamxay* VL1017 (E, NLS, P); *ibid.*, 24 viii 2009, *V. Lamxay et al.* VL2069 (NLS). **Champasak:** Bane Khouang Sy, 27 viii 2009, *V. Lamxay* VL2086 (NLS); Bane Nong Hin, 7 vi 2000, *Boualy* 87 (E); Bane Thang Beng, 9 ix 2006, *V. Lamxay* VL1086 (E, NLS, P). **Khammouan:** Nakai, 19 vi 2006, *V. Lamxay* VL1023 (E, NLS, P); Bane Mak Feuang, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella13 (E); *ibid.*, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* Ella16 (E); *ibid.*, 19 xii 2005, *E.C.S. Lundh & L.J. Ahnby* 17 (E); Bane Teung, 23 vi 2006, *V. Lamxay* VL1032 (E, NLS, P). **Louangnamtha:** Bane Kou Lang Tai, 1 vii 2007, *V. Lamxay* VL1159 (E, NLS). **Salavan:** Lao Ngam, 14 ix 2006, *V. Lamxay* VL1108 (E, NLS); Bane Dou Chai Gnai, 14 v 2009, *V. Lamxay* VL1730 (NLS); Bane Na Fang Ham, 28 v 2008, *V. Lamxay* VL1324 (E, NLS). **Savannakhet:** Bane Na Thong, 7 viii 2007, *V. Lamxay* VL1194 (NLS). **Vientiane:** Bane Na Xeng, 1 v 2008, *V. Lamxay* VL1213 (E, NLS). **Vientiane Capital:** Xaythani, Bane Dane Xang, 3 v 2008, *V. Lamxay et al.* VL1221 (E, NLS, P); *ibid.*, 18 vi 1999, *M.F. Newman* 864 (E); *ibid.*, 27 i 2010, *V. Lamxay* VL2115 (NLS); *ibid.*, 3 v 2008, *V. Lamxay* VL1223 (E, NLS); Sang Thong, Phou Phanang NBCA, 6 v 2008, *V. Lamxay* VL1229 (E, NLS).

VIETNAM. **Kien Giang:** Phu Quoc, 1 iv 1875, *Contest-Lacour* 89 (P). **Lam Dong:** Blao, 7 v 1954, *M. Schmid* s.n. (P); *ibid.*, 28 vi 1933, *E. Poilane* 22772 (P). **Tay Ninh:** Cau Tan Phu, Lo



Go Xa Mat N.P., 11 vi 2008, *H.D. Tran et al.* 14 (E); Chang Riec forest, 14 vi 2008, *H.D. Tran et al.* 28 (E).

*Amomum schmidtii* is very widespread in northern and eastern Thailand, and in Cambodia, Laos and Vietnam. It can be easily recognised by its leaves crowded towards the apex of the pseudostem and which are hairy beneath, very long rhizome internodes, usually tubular peduncle scales, inflorescences above ground and arising vertically from the rhizome, and lobed anther crest. Holttum (1950) placed *Amomum schmidtii* in synonymy under *A. biflorum*. Detailed study of material from Thailand has revealed that these are two separate species. *Amomum biflorum* is confined to Peninsular Malaysia and southern Thailand (Kaewsri, in prep.).

The protologue of *Elettariopsis schmidtii* cites an unnumbered Schmidt collection from Ko Chang without saying in which herbarium it was lodged. Very few of Schmidt's collections seem to have been distributed and none of this species have been found. Three collections of this species have been found at C: *Schmidt* 232 from Lem Dan and *Schmidt* 736 from Klong Sarlakpet in the herbarium and *Schmidt* 736 in the spirit collection. The collection locality of the herbarium sheet of *Schmidt* 736 matches that cited in the protologue and bears the name *Elettariopsis schmidtii* n.sp. in Schumann's hand so this is original material. The sheet of *Schmidt* 736 does not refer to the spirit collection of the same number so these are to be regarded as duplicates, not parts of a single specimen (McNeill *et al.*, 2006, Art. 8.3). The sheet is chosen as lectotype and the spirit collection as isolectotype.

- 26. *Amomum sericeum*** Roxb., Fl. Ind. 1: 45 (1820); Wu & Larsen, Fl. China 24: 349 (2000). – *Cardamomum sericeum* (Roxb.) Kuntze, Revis. Gen. Pl. 2: 687 (1891).  
– *Amomum dealbatum* var. *sericeum* (Roxb.) Baker, Fl. Brit. India 6: 239 (1892).  
– Type: See notes below. **Figs 24, 27.**

Clump-forming herb, to 1.5–2 m tall, 5–8 pseudostems per clump; *rhizome* c.2.5 cm diameter, white then reddish-brown, scented; *stilt roots* absent; *interval between pseudostems* c.5 cm, scales ovate to boat-shaped, 1–2 × 1–1.5 cm, dark brown then black, papery, striate, glabrous, outer surface rough, apex acute. *Pseudostem* with c.5–10 leaves per pseudostem, gradually becoming smaller towards apex, slightly swollen at base, 0.5–2 cm diameter, reddish-green then green, outer surface hairy when young, later glabrescent, striate, rough; *ligule* ovate to lanceolate, bilobed, 0.5–1 cm long, reddish then green, coriaceous, glabrous, apex acute; *petiole* canaliculate at base and cylindrical at apex, 5–14 × 0.3–0.5 cm, striate, glabrous; *blade* variable, lower ones ovate to lanceolate, 15–60 × 6–9 cm, upper ones oblong to elliptic-oblong, 50–80 × 9–15 cm, upper surface glabrous, rough, dark green, shiny, lower surface tomentose, silky white with soft white hairs, base attenuate, apex long caudate, primary veins prominent below, secondary veins sunken. *Inflorescences* arising near the base or from base, 1–2(–5) inflorescences per shoot; *flowering part* ellipsoid, pointed at apex, 5–10 × 4 cm, c.2 flowers open at once; *peduncle* 4 × 0.5–0.7 cm, reddish then light brown, striate, glabrous; *scales* ovate to broadly ovate, 3–3.5 × 1–3 cm, reddish-brown then

brown, distichous, coriaceous, striate, rough, apex acute to cucullate with short spur, margin ciliate to glabrous; *bracts* boat-shaped to lanceolate, 5.5–6 × 1–3 cm, reddish then light brown, coriaceous, glabrous, shiny, striate, rotting to threads by time of fruit formation, subtending a single flower, apex acute then filiform, margin ciliate to glabrous; *bracteole* tubular, 1-toothed, 2–2.2 × 0.5 cm, light brown, coriaceous, glabrous, bracteole tube 1.5–1.6 cm long, tooth 0.5 cm long, apex acute and ciliate. *Calyx* tubular, 3-toothed, 3–3.3 × 0.4–0.5 cm, light brown, coriaceous, membranous, glabrous; calyx tube 1.5–2.2 cm long; teeth 0.5 and 1 cm long, apex cucullate to acute with small, hairy spur, margin ciliate. *Corolla* whitish-pink, 5.5–6 cm long, coriaceous, glabrous except inner surface pilose to strigose and tomentose above, corolla tube 2.8–3 cm long; lateral corolla lobes 2.8–3 × 0.6–0.7 cm, membranous, glabrous, apex cucullate with short spur; central corolla lobe 2.8–3 × 0.8–1 cm, membranous, glabrous, apex cucullate with long thick coriaceous spur c.0.5 cm long; *labellum* clawed, 3–3.2 × 2 cm, adnate to filament forming a tube c.0.2–0.3 cm long above insertion of corolla lobes, white with red stripe at base, yellow central stripe on tip and transparent veins radiating to margin, membranous, tomentose at base and centre of adaxial surface, otherwise glabrous; *lateral staminodes* triangular to lanceolate, 0.2–0.6 cm long, white, glabrous, apex acute. *Filament* flat, 0.5–1 cm long, white, glabrous; *anther* oblong, 1–1.5 × 0.5 cm, abaxial surface pilose with short hairs, adaxial surface white, glabrous; *anther crest* rounded, obscurely trilobed, 0.3–0.4 cm wide, white, membranous, glabrous. *Stigma* rounded, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.5–0.8 cm long, glabrous; *ovary* 0.4 cm diameter; *pedicel* c.0.5–1 cm long, smooth, glabrous; *ovules* globose, c.20 per locule. *Infructescence* peduncle 3–5 × 0.5 cm, brown, glabrous; *fruiting part* globose, 4 cm diameter, subtending c.15 fruits per infructescence; *fruits* globose to obovoid, lobed at apex, 1–1.5 × 0.6–1.5 cm, light green, smooth, glabrous, stalk c.0.5 cm long, glabrous. *Seeds* globose, 0.3 cm diameter, glabrous, c.15–20 per locule.

*Distribution.* China (Hainan), Burma, Thailand, Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland to montane evergreen forest, mixed deciduous forest, on rocky soil, at 447–1422 m altitude.

*Proposed IUCN status.* DD. This is a species complex and although, as currently circumscribed, it has a very wide range and is common, it may be resolved into a number of more restricted-range species. Hence for now it has to be assessed as Data Deficient.

*Specimens examined.* CAMBODIA. **Koh Kong:** Veal Veng, road from Pramaoy to Thmo Da, 27 v 2010, M.F. Newman et al. 2397 (E).

LAOS. **Houaphan:** Viengthong, km 12 from Viengthong to Bane Phonsong, 13 i 2010, V. Lamxay VL2097 (NLS); Bane Khok Sa-at, 15 i 2010, V. Lamxay VL2016 (NLS); Bane Sa Kok, 23 v 2008, V. Lamxay & M.F. Newman VL1312 (E, NLS). **Louangnamtha:** Bane Xiang Kok, 28 iv 2007, V. Lamxay & P. Phaphouampheng VL1121 (E, NLS); *ibid.*, 30 vi 2007,

*V. Lamxay* & *P. Phaphouampheng* VL1155 (E, NLS). **Louangphabang**: Bane Tad Kacham, 21 viii 2009, *V. Lamxay* VL2063 (NLS); *ibid.*, 16 i 2010, *V. Lamxay* VL2108 (NLS).

VIETNAM. **Lam-Dong**: Bi Doup-Nui Ba N.P., 14 vi 2008, *S. Hul* & *N.S. Ly* 3584 (E).

The diagnostic characters of this species are the silky white hairs on the undersides of its leaves and the smooth, glabrous fruits. Vegetatively, it is similar to *Amomum chryseum* which also has silky white hairs on the undersides of its leaves but it differs by its winged fruits.

Baker (1892) treated *Amomum sericeum* as a variety, *Amomum dealbatum* var. *sericeum* (Roxb.) Baker. *Amomum dealbatum* has winged fruits, while Roxburgh describes the fruit of *A. sericeum* as three-celled, three-valved, with smooth surface of brownish red colour. For this reason, we maintain *Amomum sericeum* at species rank. Further research on Roxburgh's species of *Amomum* is currently under way to typify each name and circumscribe the species in greater detail (*Droop et al.*, in prep.).

## 27. *Amomum stephanocoleum* Lamxay & M.F.Newman, **sp. nov.**

*Amomo echinocarpo* Alston foliorum lamina glabra, floribus albis, staminodiis lateralibus praesentibus, labello bifido et fructibus aculeos simplices ferentibus, sed ligulis villosis, foliorum vaginis ciliatis inque margine pilis longis brunneis vestitis, antherae crista trilobata et filamentum antheram aequanti differt. – Type: Laos, Bolikhamxai, Pakkading, Bane Phone Xay, 13 v 2008, 18°18'54"N, 104°1'22"E, *V. Lamxay et al.* VL1250 (holo NLS; iso E). **Figs 27, 28.**

Clump-forming herb, c.1.5 m tall, c.15 pseudostems per clump; *rhizome* c.0.8–1 cm diameter, whitish-brown, striate, glabrous; *stilt roots* absent; *interval between pseudostems* c.5 cm, scales broadly triangular, 0.5–1 cm long, white then light brown, papery, striate, outer surface tomentose with long, soft hairs, apex acute. *Pseudostem* with c.16 leaves per pseudostem, gradually becoming smaller towards apex, slightly swollen at base, 0.5–1 cm diameter, reddish-green then green, finely reticulate, outer surface tomentose, margin of leaf sheaths ciliate with long brown hairs; *ligule* ovate, 0.1–0.3 cm long, reddish-green, coriaceous, outer surface tomentose with long hairs, apex truncate, ciliate, margin ciliate with dense, long, hard brown hairs; *petiole* absent; *blade* sessile or with long attenuate base, elliptic-oblong, 12–30 × 1–5(–8) cm, upper surface dark green, lower surface light green, glabrous, apex long caudate, primary veins prominent below, secondary veins sunken. *Inflorescence* arising near base or from base, 1–2 inflorescences per pseudostem; *flowering part* ovoid to ellipsoid, c.3–4 × c.2–3 cm, 2–4 flowers open at once; *peduncle* c.5 × 0.4–0.6 cm, glabrous, shiny; *scales* broadly triangular at base, c.0.7 × 0.5 cm, to lanceolate or boat-shaped above, c.2.5 × 1 cm, reddish-green then dark brown when dried, coriaceous at base, hard papery above, outer surface tomentose to villous, apex acute, sometimes with spur, margin ciliate with long brown hairs; *bracts* oblong-oblongate, 2–2.5 × 0.5–0.7 cm, light brown then dark brown, papery and soon rotting, subtending a single flower, tomentose only at base, striate

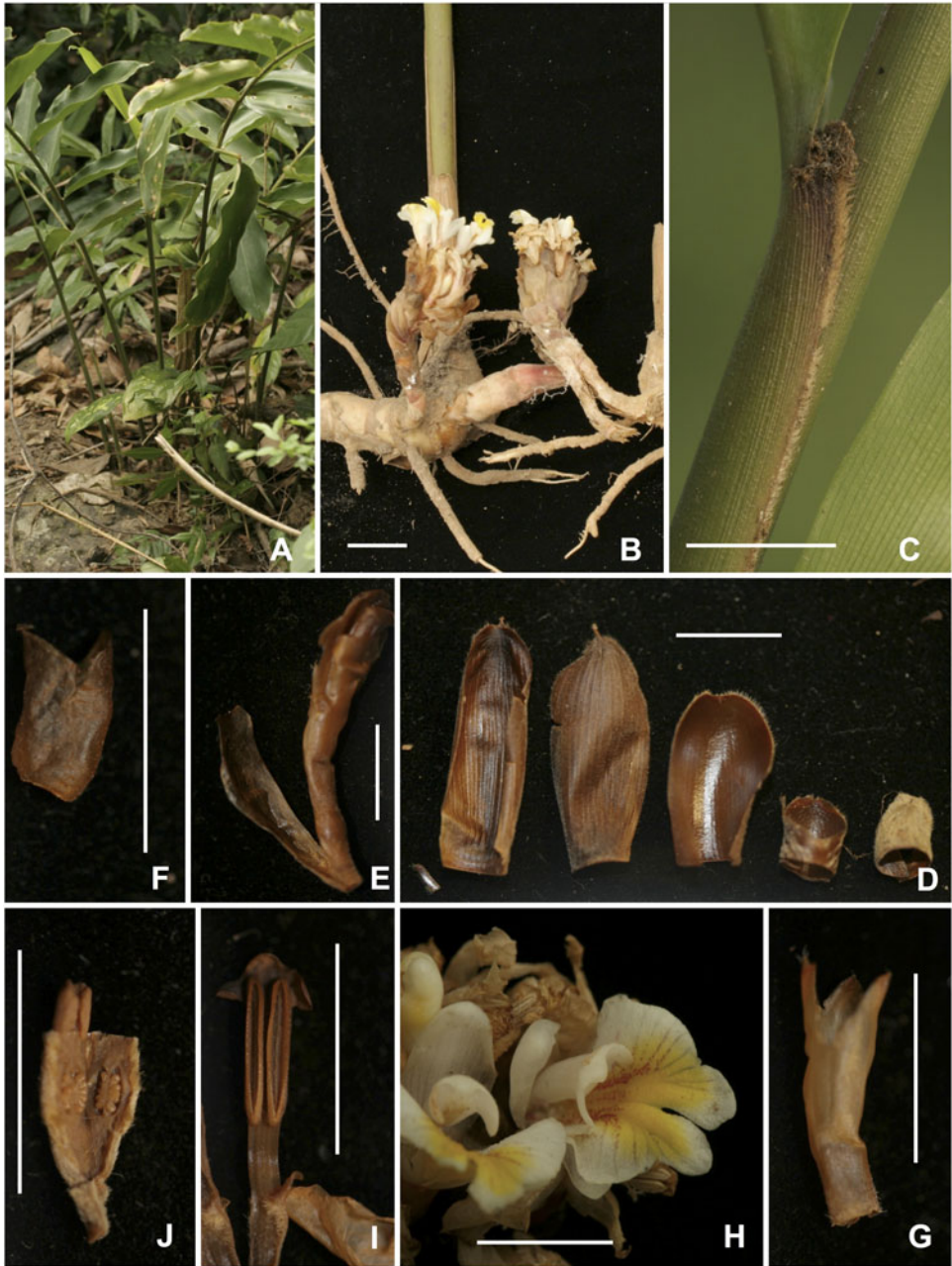


FIG. 28. *Amomum stephanocoleum* Lamxay & M.F.Newman. A, habit; B, rhizome with inflorescences; C, ligule; D, peduncle scales (left to right: above to base of peduncle); E, bract and bud; F, bracteole; G, calyx; H, labellum; I, stamen: filament, anther and anther crest; J, longitudinal section of ovary and pair of epigynous glands. Scale bar = 1 cm. Photo by V. Lamxay.

with dark dots above, apex truncate; *bracteole* tubular, 2-toothed,  $0.5\text{--}0.6 \times 0.4\text{--}0.5$  cm, pinkish-brown, thin, membranous, glabrous except outer surface tomentose at base, bracteole tube c.0.3 cm long, as long as teeth. *Calyx* tubular, 3-toothed,  $c.1.5 \times 0.4$  cm, pinkish-brown, thin, membranous, glabrous except outer surface hairy at base; calyx tube c.1 cm long; teeth c.0.3–0.5 cm long, apex acute with short hairy spur. *Corolla* 2.5–3 cm long, white, membranous, corolla tube  $c.1.5 \times 0.4$  cm, coriaceous, outer surface hairy, inner surface glabrous at base then tomentose above; lateral corolla lobes  $1.5 \times 0.5\text{--}0.6$  cm, membranous, glabrous, apex cucullate; central corolla lobe  $1.5 \times 0.9\text{--}1$  cm, membranous, glabrous, apex cucullate; *labellum* clawed,  $1.5 \times 1\text{--}1.2$  cm, white with broad central yellow stripe, edged with red dots and two lines of red dots radiating to margin, membranous, abaxial surface glabrous, adaxial surface pilose, apex bifid; *lateral staminodes* oblong, 0.2 cm long, white with pink dots at base. *Filament* flat, 0.7–0.8 cm long, white, abaxial surface glabrous, adaxial surface hairy; *anther* oblong,  $0.7\text{--}0.8 \times 0.3\text{--}0.4$  cm, white, abaxial surface glabrous, adaxial surface pilose; *anther crest* trilobed,  $0.3 \times 0.2$  cm, white, membranous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, c.0.3 cm long, glabrous, truncate at apex; *ovary* on tomentose pedicel  $c.0.4 \times 0.1$  cm, cylindrical, bullate,  $c.0.4\text{--}0.5 \times 0.2\text{--}0.3$  cm, tomentose with long white hairs; *ovules* globose, c.10–12 per locule. *Infructescence* peduncle  $c.13\text{--}15 \times 0.4\text{--}0.6$  cm, red, tomentose; *fruiting part*  $5 \times 4$  cm, subtending c.10 fruits; *fruits* globose, 1–1.2 cm diameter, dark red, prickly, tomentose, prickles with 2–3 branches. *Seeds* round,  $0.3 \times 0.2$  cm, glabrous, c.5–7 per locule, light brown, aril white.

*Distribution.* Laos.

*Habitat and ecology.* Lowland dry evergreen forest, mixed deciduous forest, in shade, at 120–238 m altitude.

*Proposed IUCN status.* EN D. This is a very restricted-range species known only from the type locality and with a very small area of occupancy of less than 4 km<sup>2</sup>. The whole population is within a protected area and there are no threats at present. The population is estimated to number fewer than 250 mature individuals (70 plants per 20 × 20 m plot). The species is therefore listed as Endangered under criterion D on the basis of the small population size.

*Specimens examined.* LAOS. **Bolikhambxai:** Bane Phone Xay, 27 iv 2009, *V. Lamxay* VL1709 (NLS); *ibid.*, 2 viii 2011, *V. Lamxay* VL2220 (NLS).

This species resembles *Amomum echinocarpum* in its glabrous leaf blades, white flowers, the presence of lateral staminodes and fruit with simple spines but can be distinguished by the margins of leaf sheaths ciliate with long brown hairs, ligule villous with long brown hairs, labellum bifid, anther crest obscurely trilobed, and filament as long as the anther.

*Amomum stephanocoleum* also resembles *A. verum* and *A. tenellum* by its villous ligule and ciliate leaf sheath margins but differs from *A. verum* by its prickly capsule,

and from *A. tenellum* by its broad leaves and ovoid-globose inflorescence. It is very similar to *Amomum villosum* by its prickly fruit and glabrous leaves but it differs by its ligule and its leaf sheath villous with long brown hairs.

**28. *Amomum subcapitatum*** Y.M.Xia, Acta Phytotax. Sin. 35: 259 (1997); Wu & Larsen, Fl. China 24: 354 (2000). – Type: China, Yunnan, Yingjiang, 26 x 1993, Y.M. Xia & Q.-J. Li 42775 (holo HITBC). Figs 29, 30.

Clump-forming herb, to 1–2 m tall, with 3–7 pseudostems per clump; *rhizome* c.0.5–1.2 cm diameter, red then reddish-brown, glabrous; *stilt roots* absent; *interval between pseudostems* c.5–10 cm, scales triangular to ovate, 0.8–2 cm long, light brown, coriaceous, striate, glabrous, apex acute to cucullate with short spur. *Pseudostem* with 3(–7) leaves per pseudostem, slightly swollen at base, 1–1.5 cm diameter, red then reddish-green, outer surface reticulate; *ligule* lanceolate, bifid, 1–4 cm long, light brown then brown, papery, outer surface tomentose, apex acute; *petiole* canaliculate, 30–70 × 0.3–0.5 cm, green then reddish-green, striate, tomentose; *blade* elliptic to oblong-elliptic, 20–50 × 6–20 cm, pilose below, base attenuate, apex short caudate, primary veins prominent below, pilose when young, secondary veins prominent. *Inflorescence* arising near base, 3–5 inflorescences per shoot; *flowering part* ellipsoid, 5–8 × 3–5 cm, c.4 flowers open at once; *peduncle* 12–23 × 0.4–0.6 cm, reddish then brown, striate, glabrous; *scales* boat-shaped to lanceolate, 0.8–4 cm long, pink then greenish-dark brown, coriaceous at base, papery above, striate, outer surface tomentose, apex cucullate with short spur, margin ciliate towards apex; *bracts* boat-shaped to broadly ovate, 2–3 × 1–2 cm, dark brown, hard coriaceous at base, papery above, striate, subtending 3–5 flowers, glabrous, outer surface scabrous and pilose above, apex acute with short spur, margin ciliate; *bracteole* ovate to broadly ovate, 1.5–2 × 1–1.5 cm, light brown, membranous, striate, glabrous, outer surface scabrous to hairy above, apex bidentate, teeth c.0.2 cm long. *Pedicel* scabrous, 1 × 0.3 cm; *calyx* tubular, 3-toothed, 1.5–2.5 × 0.5 cm, light brown or pink, membranous, striate, glabrous; calyx tube 0.8–1.3 cm long; teeth 0.4–0.5 and 0.7–1.2 cm long, apex caudate. *Corolla* white or pinkish-white, 4.5–5 cm long, corolla tube 1.5–2.5 cm long, coriaceous, outer surface glabrous, inner surface pilose below to strigose above; lateral corolla lobes 1.5–2.5 × 0.7–0.8 cm, membranous, glabrous, apex cucullate; central corolla lobe 1.5–2 × 0.8–1.2 cm, membranous, adaxial surface glabrous, abaxial surface pilose, apex cucullate with short spur; *labellum* clawed, 1.5–2 × 1.5–2 cm, trilobed, white with yellow central stripe edged by minute red dots at base and clear venation radiating to margin, adaxial surface pilose at base, margin undulate; *lateral staminodes* triangular to oblong, 0.1–0.5 cm long, white, glabrous, apex pointed. *Filament* flat, 0.2–0.5 cm long, white, abaxial surface pilose, adaxial surface glabrous; *anther* oblong, 0.9–1 × 0.3 cm, white, adaxial surface pilose with glandular hairs, abaxial surface glabrous; *anther crest* rounded, entire, c.0.3 cm wide, white, membranous, glabrous. *Stigma* cup-shaped, glabrous, apex ciliate; *style* glabrous; *epigynous glands* oblong, 0.3 cm long, glabrous;



FIG. 29. A–C: *Amomum subcapitatum*. A, flower; B, infructescence; C, ligule. Lamxay VL1140. D–F: *Amomum tomrey*. D, infructescence; E, flower; F, ligule. Lamxay VL1252. G–I: *Amomum tsaoko*. G, inflorescence; H, part of pseudostem; I, infructescence. Lamxay VL1706. Scale bar = 1 cm.

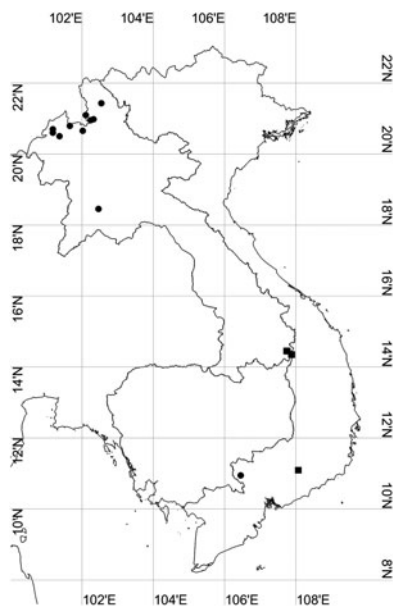


FIG. 30. Distribution of *Amomum subcapitatum* Y.M.Xia (●) and *Amomum tenellum* Lamxay & M.F.Newman (■) in Cambodia, Laos and Vietnam.

*ovary* 0.5 cm diameter, to 9-ridged, pilose; *ovules* globose, c.25 per locule, glabrous. *Infructescence* peduncle c.15–20 × 0.3 cm, greenish-dark brown, glabrous; *fruiting part* 5–10 × 5 cm, comprising c.10 fruits; *fruits* globose, 1–1.5 cm diameter, pink then dark brown, violet or green, 9-winged, wings c.0.3 cm wide, straight, glabrous. *Seeds* globose, 0.3 cm diameter, brown, glabrous, c.20–25 per locule.

*Distribution.* China (Yunnan), Thailand, Laos, Vietnam (but see note below).

*Habitat and ecology.* Evergreen and mixed deciduous forest, montane forest, open forest, in hills, along rivers, in shady conditions, at 264–1190 m altitude.

*Proposed IUCN status.* LC. This species has a large extent of occurrence, is common and, although there is some loss of habitat, this is not of significant concern. The species is assessed as Least Concern.

*Specimens examined.* LAOS. **Louangnamtha:** border between Sing and Louang Namtha districts, 19 viii 2009, *V. Lamxay* VL2058 (NLS); Bane Houay Thou, 29 iv 2007, *V. Lamxay* VL1124 (E, NLS); *ibid.*, 29 iv 2007, *V. Lamxay* VL1125 (E, NLS); Bane Thong Lat, 3 v 2007, *V. Lamxay* VL1128 (E, NLS). **Oudomxai:** Bane Nam Pheng, 19 viii 2009, *V. Lamxay* VL2060 (NLS). **Phongsali:** Bane Had Sa, v 2006, *V. Lamxay* PPS07 (E); Bane Na Mak, 28 vi 2007, *V. Lamxay* & *S. Ounmixay* VL1147 (E, NLS); Bane Pa Kha, 26 vi 2007, *V. Lamxay* VL1140 (E, NLS); Bane Sin Xay, 27 vi 2007, *V. Lamxay* VL1145 (E, NLS). **Vientiane:** Bane Na Xeng, 1 v 2008, *V. Lamxay et al.* VL1215 (E, NLS, P).

VIETNAM. **Tay Ninh:** 22 iv 1938, *E. Poilane* & *R. Müller* 29 (P).



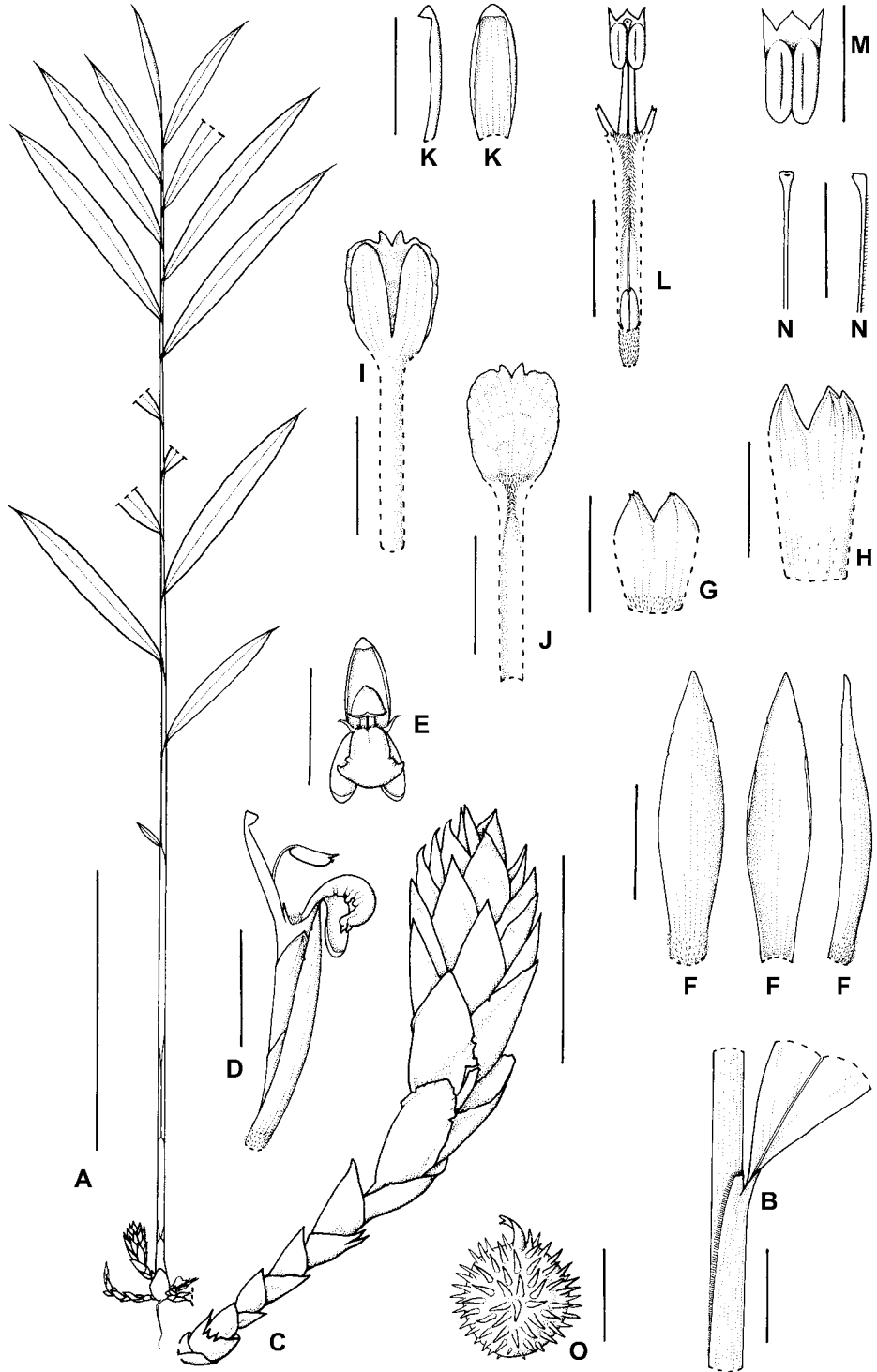
This species is widely distributed in China and northern Laos. It resembles *Amomum repoeense* in being a clump-forming herb with bracts subtending more than one flower and winged fruits, but differs by its c.30–70 cm long petiole, long peduncle and wide leaves. Its inflorescence of cincinni, trilobed labellum and trilobed anther crest distinguish it from *Amomum maximum* and *A. dealbatum*.

*Poilane & Müller* 29 (P), from Tay Ninh Province in southern Vietnam, is tentatively determined to this species as the material is incomplete. The locality, which is at a great distance from other collection localities of this species, should be searched for new material to establish the correct identity.

**29. *Amomum tenellum* Lamxay & M.F.Newman, sp. nov.**

*Amomo staminidivo* Gobilik, A.L.Lamb & A.D.Poulsen, speciei borneanae, filamento exserto anthera super labello tenta, antherae crista trilobata lobis lateralibus acutis, fructibus aculeatis persimile, sed radicibus gralliformibus absentibus, rhizomatis squamis glabris, foliorum vaginis reticulatis, foliorum laminae oblongis, fructibus atrosanguineis postremo rubrivioleaceis differt. – Type: Laos, Attapeu, Dong Ampham NPA, Bane Phou Keua, 15 v 2008, *V. Lamxay et al.* VL1260 (holo NLS; iso E). **Figs 30, 31.**

Clump-forming to loosely clump-forming herb, c.1 m tall, c.8–10 pseudostems per clump; *rhizome* 0.3–0.5 cm diameter, white, striate, glabrous; *stilt roots* absent; *interval between pseudostems* c.7–15 cm, scales broadly ovate, 1–1.5 cm long, red then dark brown, coriaceous, striate, glabrous, apex acute. *Pseudostem* with c.7–18 leaves per pseudostem, becoming smaller towards apex, slightly swollen at base, 0.4–0.5 cm diameter, red then green, reticulate, outer surface tomentose with long hairs; *ligule* c.0.3–0.5 cm long, green to dark brown, coriaceous, outer surface tomentose, apex truncate, margin ciliate with hard, long hairs; *petiole* very short, c.0.1–0.3 cm long, canaliculate, glabrous; *blade* oblong, 7–25 × 1–4 cm, lower surface light green, glabrous, base attenuate, apex long caudate, c.2 cm long, primary veins prominent below, secondary veins sunken. *Inflorescence* arising from base, 1–3 inflorescences per pseudostem; *flowering part* oblong-ellipsoid, 3–5 × 2–3 cm, 2–4 flowers open at once; *peduncle* c.5–15 × 0.3 cm, white then red, glabrous at base, tomentose above; *scales* tubular at base, ovate to lanceolate above, 0.5–2.5 cm long, red then dark brown, coriaceous, hard, striate, outer surface tomentose at base, apex cucullate with short spur, margin ciliate; *bracts* lanceolate, 2–2.5 × 0.5–0.7 cm, subtending a single flower, reddish then light brown, striate at base, coriaceous, outer surface tomentose at base, apex acute; *bracteole* tubular, 2–3-toothed, 1–1.2 × 0.2 cm, light brown, membranous, outer surface hairy at base, apex acute, bracteole tube 0.4–0.6 cm long, glabrous, teeth 0.2–0.5 cm long. *Calyx* yellowish, membranous, outer surface with a few pilose hairs near ovary; tube 1–1.2 cm long, 2–3-toothed; teeth 0.2–0.5 cm long, acute. *Corolla* whitish-yellow, coriaceous, 2.5–2.8 × 0.2 cm, corolla tube 1.5–1.6 cm long, inner surface tomentose above; lateral corolla lobes 0.8–1 × 0.3–0.8 cm, membranous, glabrous, apex cucullate; central corolla lobe 1.2–1.5 × 0.5–1 cm,



membranous, glabrous, apex cucullate; *labellum* clawed, trilobed, 1.4–1.6 × 1.5–1.6 cm, pale yellow with red dots in centre, membranous, apex lobed, glabrous, margin reflexed; *lateral staminodes* white, oblong, 0.2–0.4 cm long, acute to forked. *Filament* exerted and arched over labellum, flat, 0.5 cm long, yellowish-white, glabrous; *anther* oblong, 0.5 × 0.4 cm, yellowish-white, glabrous; *anther crest* trilobed, lateral lobes 0.1–0.15 × 0.07–0.15 cm, acute, central lobe 0.1 × 0.2 cm, whitish-yellow, rounded, membranous. *Stigma* rounded, glabrous; *style* with a dorsal line of hairs; *epigynous glands* oblong, apex lobed, 0.3–0.4 cm long, glabrous; *ovary* 0.2–0.3 cm diameter, smooth, hairy; *ovules* globose, to 10–15 per locule. *Infructescence* peduncle 5–15 × 0.3–0.5 cm, red, tomentose; *fruiting part* 5 × 2–3 cm, subtending 3 fruits per infructescence; *fruits* globose, 0.8–1 cm diameter, dark red turning reddish violet, prickly. *Seeds* globose, 0.2–0.4 cm diameter, glabrous, aril yellow, to 5–8 per locule.

*Distribution.* Laos, Vietnam.

*Habitat and ecology.* Montane evergreen forest, in fertile soil, at 481–878 m altitude.

*Proposed IUCN status.* LC. Although this species has a small extent of occurrence (11,804 km<sup>2</sup>), the two localities in Laos are in a protected area and the Vietnamese localities are also secure. As there are no threats to this species, it is assessed as Least Concern.

*Specimens examined.* LAOS. **Attapeu:** Bane Dak Lia, 27 vii 2007, *V. Lamxay & Bounlop* VL1192 (E, NLS, P); Bane Lak 52, 16 v 2008, *V. Lamxay et al.* VL1266 (E, NLS); Bane Phou Keua, 15 v 2008, *V. Lamxay et al.* VL1255 (E, NLS).

VIETNAM. **Lam Dong:** Deo Bao Loc, Dai Duc Me, 22 vi 2008, *H.D. Tran et al.* 66 (E).

The most conspicuous characters of this species are the densely clump-forming habit, absence of stilt roots, margins of leaf sheaths and ligule ciliate, blade oblong, glabrous, inflorescence elongate to oblong-ellipsoid, flowers yellowish, stamen exerted and arched over the labellum, and prickly fruits. It closely resembles *Amomum staminidivum* Gobilik, A.L.Lamb & A.D.Poulsen of Borneo by its exerted filament with anther held over the labellum, trilobed anther crest with acute lateral lobes and prickly fruits, but differs by the absence of stilt roots, rhizome scales glabrous, leaf sheaths reticulate, leaf blade oblong and fruits dark red turning reddish violet. The apex of the lateral staminodes varies from acute to forked.



FIG. 31. *Amomum tenellum* Lamxay & M.F.Newman. A, habit; B, ligule; C, inflorescence; D, whole flower from side; E, whole flower from above; F, bract, inner, outer and lateral views; G, bracteole; H, calyx; I, labellum & lateral corolla lobes from below; J, labellum from above; K, dorsal corolla lobe, inner and lateral views; L, ovary, lateral staminodes and stamen; M, anther; N, stigma; O, fruit. Scale bars: A = 30 cm; B, D–L, O = 1 cm; C = 3 cm; M, N = 0.5 cm. Drawn from *Lamxay* VL1260, dried material & photos (A–C), spirit material & photos (D–N); *Lamxay* VL1266, spirit material & photos (O).

Sometimes one of the lateral staminodes of a flower will be acute and the other forked. The dimensions of the lip are difficult to measure, owing to its strongly recurved shape. The measurements given above are made from a flattened lip.

**30. *Amomum tomrey* Gagnep.**, Bull. Soc. Bot. France 53: 145 (1906); Gagnepain, Fl. Indo-Chine 6: 113 (1908); Newman et al., Checkl. Vasc. Pl. Lao PDR 362 (2007). – Type: Cambodia, Kampong Spoe, Samrong Tong, Mt. Cherev, 12 iv 1870, *J.B.L. Pierre* 5847 (lecto P [barcode P00599247], designated here; isolecto P [barcodes P00599248 & P00599249]). **Figs 29, 32.**

**30a. *Amomum tomrey* var. *tomrey***

Loosely clump-forming herb, c.2.5 m tall; *rhizome* 1–1.5 cm diameter, deep in soil, white, striate, glaucous; *stilt roots* absent; *interval between pseudostems* c.15 cm, scales broadly ovate to elliptic, 2–3 cm long, brown, papery, striate, soon rotting, glabrous, outer surface glaucous, apex acute. *Pseudostem* with c.20 leaves per pseudostem, gradually becoming smaller towards apex, 1–1.5 cm diameter, reddish along margin towards apex, glabrous, outer surface striate, glaucous; *ligule* ovate, entire, 0.5–1 cm long, red then dark brown, coriaceous, swollen at base, apex emarginate, margin ciliate; *petiole* very short, 0.2–0.4 cm long, canaliculate, glabrous, glaucous; *blade* oblong to oblong-lanceolate, 37–45 × 7–9 cm, upper surface dark green, lower glabrous, pale

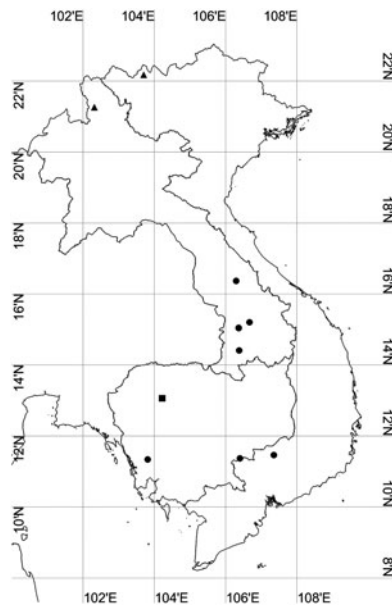


FIG. 32. Distribution of *Amomum tomrey* Gagnep. (●), *Amomum tomrey* var. *stenophyllum* Gagnep. (■) and *Amomum tsaoko* Crevost & Lemarié (▲) in Cambodia, Laos and Vietnam.

green to glaucous, base long attenuate, apex long caudate, margin ciliate to tomentose, primary veins prominent below, secondary veins sunken. *Inflorescence* arising from base of pseudostem, only 1 inflorescence per shoot; *flowering part* ovoid-oblong,  $5 \times 3$  cm, 4 flowers open at once; *peduncle* c.  $26 \times 0.5\text{--}0.8$  cm, whitish-pink then reddish-brown, striate, glabrous below, tomentose above; *scales* broadly ovate to lanceolate,  $1\text{--}2.5 \times 1\text{--}1.5$  cm, pinkish then dark reddish-brown, thin, papery below, hard, coriaceous above, striate, soon rotting, glabrous, glaucous, shiny, apex acute; *bracts* boat-shaped to lanceolate,  $2\text{--}2.2 \times 1\text{--}1.2$  cm, red then dark brown, coriaceous, striate, soon rotting, subtending a single flower, outer surface pilose and tomentose at base, inner surface tomentose at base, apex truncate, ciliate, margin ciliate; *bracteoles* tubular, 2-toothed,  $1\text{--}1.2 \times 0.4$  cm, light reddish-brown, coriaceous, striate, outer surface pilose and tomentose at base, bracteole tube 0.7–0.8 cm long, teeth 0.1–0.3 cm long, apex acute, hairy. *Calyx* tubular, 2–3-toothed,  $1\text{--}1.3 \times 0.3$  cm, light pink, coriaceous, outer surface tomentose at base; calyx tube 0.6–0.7 cm long; teeth 0.3–0.6 cm long, apex acute, margin ciliate. *Corolla* white to pinkish-white, 2.4–2.5 cm long, corolla tube 1–1.3 cm long, coriaceous, outer surface pilose, inner surface glabrous; lateral corolla lobes  $1.2\text{--}1.6 \times 0.6\text{--}0.8$  cm, membranous, glabrous, apex cucullate; central corolla lobe  $1\text{--}1.3 \times 0.7\text{--}1$  cm, membranous, glabrous except for cilia on abaxial side of margin, apex cucullate; *labellum* clawed,  $1.5\text{--}1.6 \times 1.5\text{--}1.6$  cm, pinkish-white with yellow central stripe and lines of minute pink dots radiating to margin, adnate to filament forming a tube to 0.2 cm long above insertion of corolla lobes, tomentose at base and along central line adaxially, apex rounded; *lateral staminodes* oblong, 0.2 cm long, white. *Filament* flat, 0.2 cm long, white, glabrous; *anther* oblong,  $0.8 \times 0.2\text{--}0.3$  cm, white, glabrous; *anther crest* entire, 0.2–0.3 cm wide, rounded, white. *Stigma* flat, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, 0.3 cm long, glabrous; *ovary* oblong,  $0.7\text{--}0.8 \times 0.3$  cm, smooth, tomentose with long white hairs; *ovules* globose, c. 10–12 per locule. *Infructescence* peduncle  $20\text{--}25 \times 0.5\text{--}0.8$  cm, red then dark brown, glabrous at base, tomentose above; *fruiting part* subtending c. 16 fruits,  $6\text{--}7 \times 4\text{--}5$  cm; *fruits* ovoid to globose,  $1\text{--}1.5 \times 1\text{--}1.2$  cm, green then dark reddish-violet, smooth, tomentose. *Seeds* globose, 0.1–0.2 cm diameter, glabrous, c. 10 per locule.

*Distribution.* Cambodia, Laos, Vietnam.

*Habitat and ecology.* Lowland, dry evergreen forest, mixed deciduous forest, open forest, along margins or in scattered open areas within evergreen forest, at 33–443 m altitude.

*Proposed IUCN status.* LC. This taxon has a large extent of occurrence (124,073 km<sup>2</sup>) and, although there is loss of habitat in parts of its range, this is not considered to be of great concern as the variety is common. It is therefore assessed as Least Concern. A large part of its range falls within Lao PDR and none of the known localities there are within protected areas so this species may warrant monitoring and reassessment in the near future.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** Samrong Tong, 15 iv 1870, *J.B.L. Pierre* 551 (P). **Koh Kong:** Thma Bang, 14 v 2010, *M.F. Newman et al.* 2266 (E).

LAOS. **Champasak:** Bane Khouang Sy, 15 ix 2006, *V. Lamxay* VL1114 (E, NLS); *ibid.*, 27 viii 2009, *V. Lamxay* VL2082 (NLS); Bane Kiat Ngong, 24 vii 2007, *V. Lamxay* VL1187 (E, NLS). **Salavan:** Bane Kadap, 14 v 2008, *V. Lamxay et al.* VL1252 (E, NLS); Bane Katanglavang, 13 ix 2006, *V. Lamxay* VL1100 (E, NLS). **Savannakhet:** Bane Houay Xay, 9 viii 2007, *V. Lamxay* VL1196 (NLS).

VIETNAM. **Dong Nai:** Bien Hoa, summit of Nui Ba Ra, 23 iv 1930, *E. Poilane* 17343 (P). **Tay Ninh:** Chang Riec forest, Cau 15, 14 vi 2008, *H.D. Tran et al.* 30 (E).

This species resembles *Amomum koenigii* by its smooth fruits, its creeping habit, and glaucous leaf sheaths and blades, but it is clearly distinguished by its hairy fruits and its leaves hairy along the margin.

**30b. *Amomum tomrey* var. *stenophyllum*** Gagnep., *Bull. Soc. Bot. France* 53: 146 (1906); Newman et al., *Checkl. Vasc. Pl. Lao PDR* 362 (2007). – Type: Cambodia, Kampong Spoe, Samrong Tong, *J.B.L. Pierre* 5848 (holo P). **Fig. 32.**

Creeping herb, 1.5–2 m tall; *rhizome* c.0.5–1 cm diameter, deep, striate, glabrous; *stilt roots* absent; *interval between pseudostems* c.35 cm, scales lanceolate, 1.5–2 cm long, papery, glabrous, striate, soon rotting, apex acute. *Pseudostem* with > 15 leaves per pseudostem, gradually becoming smaller towards apex, c.1 cm diameter, glabrous, striate; *ligule* ovate, bilobed, 0.5–1 cm long, glabrous, coriaceous, thick at base, margin ciliate; *petiole* 0.5–1 cm long, canaliculate, glabrous; *blade* narrow, oblong, 30–40 × 3–5 cm, glabrous, base narrow, long attenuate, apex long caudate, primary veins prominent below, pale, secondary veins sunken. *Inflorescence* single, arising near base; *flowering part* ovoid-oblong, 3–4 × 2–3 cm; *peduncle* c.20 × 0.3–0.5 cm, striate, glabrous below, tomentose above; *scales* narrowly lanceolate at base, narrowly oblong above, 1–2.5 × 0.5–0.7 cm, thin, papery below, hard, coriaceous above, striate tomentose at base, apex acute or finely cucullate; *bracts* narrowly lanceolate to oblong, 1.5–2 × 0.4–0.6 cm, striate, coriaceous, subtending a single flower, outer surface pilose, tomentose at base, inner surface tomentose at base, apex obtuse, ciliate, margin ciliate; *bracteoles* tubular, 2-toothed, 1–1.2 × 0.4 cm, coriaceous, striate, apex acute, tomentose to pilose, bracteole tube twice as long as teeth. *Calyx* tubular, 2–3-toothed, 1–1.3 × 0.3 cm; calyx teeth very short, c.0.3 cm long, coriaceous, outer surface tomentose at base, apex acute, margin ciliate to pilose. *Corolla* 2–2.5 cm long, corolla tube 1–1.3 cm long, outer surface pilose, inner surface glabrous; lateral corolla lobes membranous, adaxially hairy, apex cucullate; central corolla lobe larger than lateral lobes, membranous, adaxially hairy, abaxially ciliate at margin, apex cucullate; *labellum* clawed, tomentose at base and along centre adaxially, apex lobed, as long as corolla lobes; *lateral staminodes* small, oblong, 0.2 cm long. *Filament* flat, 0.2 cm long, glabrous; *anther* oblong, 4 times as long as filament, glabrous; *anther crest* semi-lunar, finely lobed, 0.2–0.3 cm wide. *Stigma* flat, cup-shaped, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, tomentose at apex; *ovary* oblong, smooth, tomentose with long white hairs; *ovules*

globose. *Infructescence* peduncle 20–25 × 0.5 cm, glabrous at base, tomentose above; *fruiting part* ovoid, 6 × 4 cm, subtending > 10 fruits; *fruits* ovoid to globose, 1.5 × 1–1.2 cm, smooth, tomentose. *Seeds* globose, glabrous.

*Distribution.* Cambodia, Vietnam.

*Habitat and ecology.* Lowland forest.

*Proposed IUCN status.* DD. This is a poorly known taxon which has not been seen since 1870. Only four collections have been seen. Although there is still intact habitat at two of the recorded localities, there have been no specific searches for this species. It is therefore assessed as Data Deficient pending further information on its status.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** Samrong Tong, 7 iv 1870, *J.B.L. Pierre* 551 (P). **Siem Reab:** Angkor Wat, *C. Thorel* 2081 (K, NY, P [3]).

VIETNAM. **Ba Ria – Vung Tau:** iv 1866, *J.B.L. Pierre* 6672 (P).

This variety has not been collected recently. The description above is based heavily on *Pierre* 551 and 6672 (P) which are more complete than *Thorel's* collection. *Amomum tomrey* var. *stenophyllum* differs from *A. tomrey* var. *tomrey* by its narrow, oblong, glabrous leaves and narrow, oblong bracts.

**31. *Amomum tsaoko*** *Crevost & Lemarié*, *Cat. Prod. Indochine* 300 (1917); *Wu & Larsen*, *Fl. China* 24: 350 (2000). – Type: Vietnam, Lai Chau, Yao San, north of Phong Tho, 10 xii 1937, *E. Poilane* 26843 (neo P, designated here). **Figs 29, 32.**

Clump-forming herb, c.4 m tall, 3–10 pseudostems per clump; *rhizome* c.2–3(4) cm diameter, whitish then light brown; *stilt roots* absent; *interval between pseudostems* c.10 cm, scales broadly triangular, 1–2 cm long, brown, coriaceous, striate, glabrous, outer surface rough, apex acute to truncate. *Pseudostem* with c.30–40 leaves per pseudostem, gradually becoming smaller towards apex, c.1.5–2 cm diameter, reddish-green, slightly swollen at base, c.4 cm diameter, glabrous, outer surface striate; *ligule* ovate, 0.8–1.5 cm long, reddish-green, coriaceous, glabrous, apex emarginate to truncate, margin ciliate; *blade* sessile or long attenuate, oblong, 50–80 × 5–10 cm, upper surface rough, lower surface smooth, glabrous, apex long caudate, margin entire. *Inflorescence* arising near base or from base, c.3–5 inflorescences per shoot; *flowering part* broadly ellipsoid, 6–10 × 4–6 cm, c.6–8 flowers open at once; *peduncle* c.12 × 1 cm, reddish, glabrous; *scales* broadly triangular at base, 2 × 1 cm, to narrowly triangular above, 4–5 × 3–6 cm, red then dark brown, coriaceous at base, papery and soon rotting above, glabrous, outer surface finely striate, inner surface reticulate, apex emarginate or rounded with short spur; *bracts* narrowly triangular, 5–6 × 0.4–0.6 cm, dark brown, filiform, striate, papery, subtending a single flower, glabrous, apex acute, margin ciliate; *bracteole* tubular, 2-toothed, c.3–3.5 × 0.5–0.6 cm, reddish, coriaceous, finely striate, outer surface villous, bracteole tube c.2–2.5 cm long, teeth c.0.5–1 cm long, apex acute, membranous. *Calyx* tubular, 3-toothed, 2.5–3 × 0.5–0.6 cm, reddish-white,

coriaceous, outer surface villous; calyx tube c.2 cm long; teeth c.0.5–1 cm long, apex acute, margin ciliate. *Corolla* yellowish, c.5 cm long, corolla tube c.2.5 × 0.5 cm, coriaceous, outer surface with scattered, short hairs; lateral corolla lobes oblong, c.2 × 1 cm, adnate to labellum, membranous, glabrous; central corolla lobe oblong, 2–2.5 × 0.8–1 cm, membranous, glabrous, margin ciliate; *labellum* clawed, c.2.5–3 × 2.5–3 cm, yellow, with two thin, red stripes arising from base towards apex, glabrous, apex crisped or plicate, margin plicate, rounded, dentate; *lateral staminodes* absent. *Filament* flat, c.0.7 cm long, white, glabrous; *anther* oblong, c.1.4 cm long, whitish-yellow, glabrous; *anther crest* semi-lunar, c.1 × 0.6–0.7 cm, yellow, membranous, margin dentate, ciliate. *Stigma* cup-shaped, glabrous, apex ciliate; *style* hairy; *epigynous glands* oblong, c.0.3–0.4 cm long, apex truncate, glabrous; *pedicel* c.0.3 cm long, pinkish-white, villous; *ovary* c.0.3 × 0.3–0.4 cm, reddish-white, villous; *ovules* globose, c.12 per locule. *Infructescence* peduncle c.10–20 × 1 cm, reddish-brown, glabrous; *fruiting part* c.7–10 cm diameter, c.20 fruits per infructescence; *fruits* grouped at apex; *fruit* a red, juicy berry, ovoid-ellipsoid, c.1.5–2 cm diameter, dark reddish-violet, smooth, dotted, shiny. *Seeds* globose, c.0.3 cm diameter, aril white, c.10–12 per locule.

*Distribution.* China (Yunnan), Laos, Vietnam.

*Habitat and ecology.* Lowland to montane evergreen forest, in shade, at 1100–1800 m altitude.

*Proposed IUCN status.* NT. This species has a small extent of occurrence (7989 km<sup>2</sup>) and appears to be known only from four locations. The main threat is over-collection of the fruits which may affect the long-term genetic viability or reduce reproductive success perhaps leading to inbreeding problems between the wild and cultivated plants. At present there is no evidence for continuing decline in numbers of mature individuals, however, so the species is listed as Near Threatened since it almost qualifies for a listing under criterion B1ab.

*Specimens examined.* LAOS. **Phongsali:** Say Phou Thaleng Protected Area, 26 vi 2007, V. Lamxay & S. Phounsouang VL1138 (E, NLS); *ibid.*, 25 v 2008, V. Lamxay & M.F. Newman VL1317 (E, NLS); *ibid.*, 21 iv 2009, V. Lamxay VL1706 (NLS).

VIETNAM. **Lai Chau:** Phong Tho, 10 xii 1937, E. Poilane 26842 (P).

This species resembles *Amomum koenigii* and *A. tomrey* by its glabrous, shiny leaves and smooth fruits but is distinguished from them by its yellowish flower. The name *Amomum tsaoko* is frequently attributed to ‘Crevost & Lem.’ but Charles Lemaire, whose name is abbreviated Lem., died in 1871, long before publication of *A. tsaoko*. Crevost’s co-author was Charles Lemarié, about whom little is known. The protologue of *Amomum tsaoko* indicates that the species was described from very incomplete material. Leaves and flowers were unknown to the authors. It seems that their material consisted of a piece of rhizome with the base of a pseudostem and an infructescence attached to it. No trace of this material has been found so a neotype



has been chosen. The type locality is in, or near, Phong Tho district, Lao Cai Province in northern Vietnam: 'D'après la capitaine Durand, délégué à Phong-tho, du Résident de Lao-kay, cette plante est cultivée et occupe des champs entiers, aux altitudes de 1,000 à 1,500 mètres, sur les crêtes qui séparent la région annamite de Si-leu-lao du district chinois de Ma-khouei-tchang.'; the neotype is from the same district, which is now in Lai Chau Province and matches the description in the protologue.

**32. *Amomum uliginosum*** J.Koenig in Retz., *Observ. Bot.* 3: 56 (1783); Newman et al., *Checkl. Vasc. Pl. Lao PDR* 362 (2007). – *Cardamomum uliginosum* (J.Koenig) Kuntze, *Revis. Gen. Pl.* 2: 687 (1891). – Type: See notes below. **Figs 33, 34.**

*Amomum ovoideum* Pierre ex Gagnep., *Bull. Soc. Bot. France* 53: 140 (1906); Gagnepain, *Fl. Indo-Chine* 6: 115 (1908); Newman et al., *Checkl. Vasc. Pl. Lao PDR* 362 (2007). – Type: Cambodia, Kampong Spoe, Samrong Tong, 12 iv 1870, *J.B.L. Pierre* 542 (lecto P [barcode P00599417], designated here; isolecto E, K [3 sheets], NY [2 sheets], P [4 sheets]).

*Amomum robustum* K.Schum., *Pflanzenr.* IV, 46 (Heft 20): 253 (1904). – Type: Malaysia, Perak, Gunung Larut, *H. Kunstler* 1839 (lecto SING, designated here).

Creeping herb, c.3–3.5 m tall; *rhizome* 0.5–1 cm diameter, brown or white then green; *stilt roots* present; *interval between pseudostems* c.50–60 cm, scales tubular to ovate, 1.5–4 cm long, light brown, papery, striate, glabrous, outer surface rough, apex acute, margin ciliate. *Pseudostem* with c.40–45 leaves per pseudostem, becoming smaller towards apex, 1–2 cm diameter, swollen at base, glabrous, outer surface finely reticulate; *ligule* ovate, 1–1.5 cm long, green with red margin, coriaceous, glabrous, apex acute, margin ciliate; *petiole* very short, c.0.2–0.3 cm long, canalliculate, 0.5 cm diameter, glabrous, green or reddish-brown; *blade* oblong, 15–50 × 1.5–8 cm, shiny green above, light green below, glabrous, base attenuate, apex long caudate, cauda spiralling, c.2.5–5 cm long, primary veins prominent below, secondary veins sunken. *Inflorescences* arising c.5–10 cm from base, 1–3 inflorescences per pseudostem; *flowering part* ellipsoid, 3–5 × 2–3 cm, c.6–10 flowers open at once; *peduncle* 7 × 0.2–0.3 cm, whitish-brown, striate, tomentose; *scales* tubular at base, ovate to lanceolate above, 0.5–2.5 × 0.2–1 cm, light brown, hard, coriaceous, striate, outer surface pilose or tomentose, apex acute, margin ciliate; *bracts* boat-shaped to lanceolate, 2.3–3 × 0.8–1 cm, pinkish-brown then light brown, coriaceous, striate, hard, subtending a single flower, outer surface tomentose, rough, apex acute to cucullate; *bracteole* tubular, 3-toothed, 1.3–1.5 × 0.2–0.3 cm, pinkish-brown or light brown, membranous, outer surface tomentose, bracteole tube 1.5–2 cm long, teeth 0.3–0.5 and 0.7–1 cm long, apex acute to caudate. *Calyx* tubular, 3-toothed, 1.2–3 × 0.3 cm, whitish-pink or light brown, membranous, outer surface tomentose at base; calyx tube 1.2–2 cm long; teeth 0.3–0.6 and 0.6–1 cm long, apex acute to cucullate. *Corolla* 4–6 × 0.2 cm, whitish-pink, corolla tube 2–3 cm long, coriaceous,

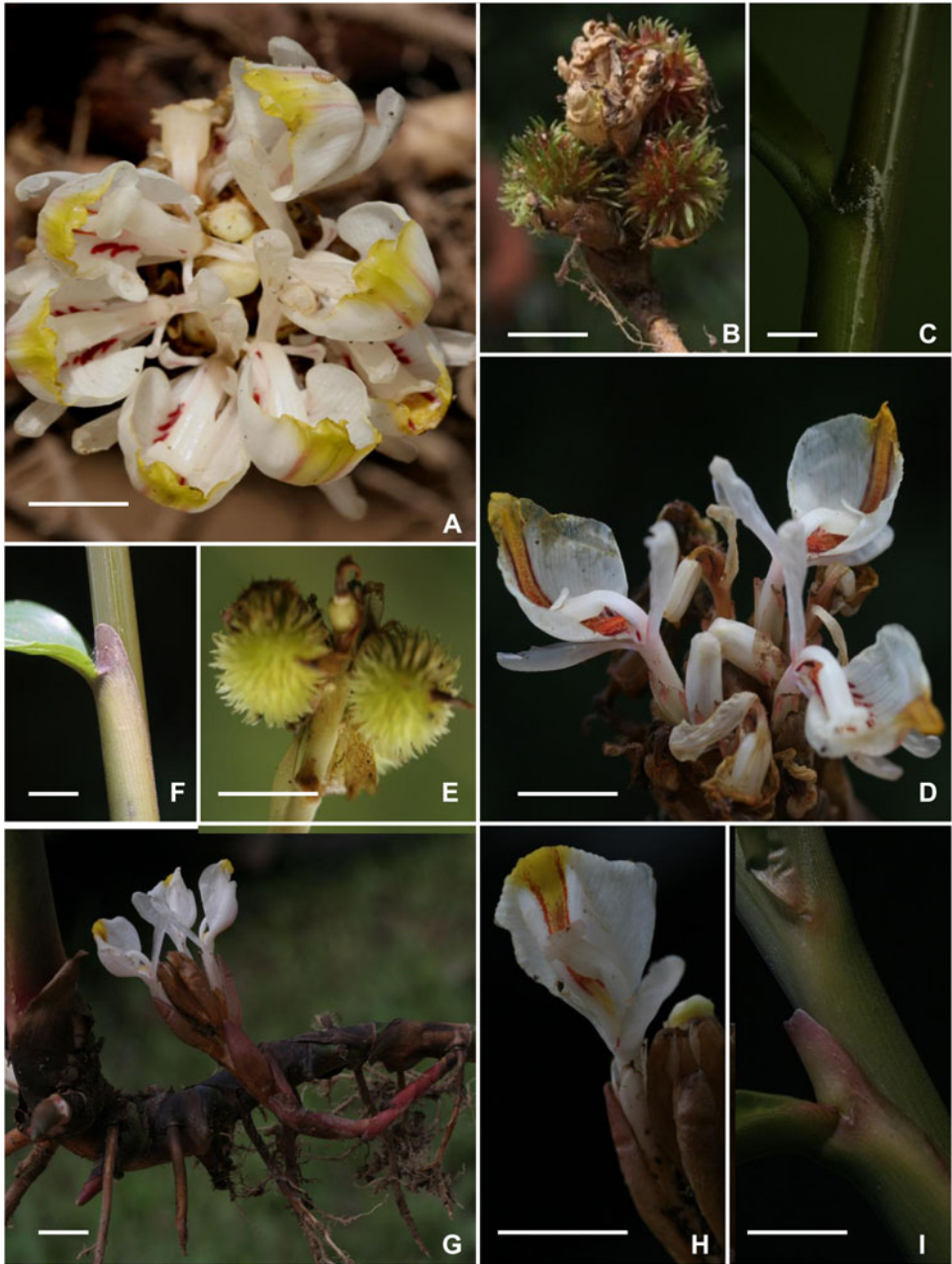


FIG. 33. A–C: *Amomum uliginosum*. A, inflorescence; B, infructescence; C, ligule. *Lamxay* VL1220. D–F: *Amomum villosum* var. *villosum*. D, inflorescence; E, infructescence; F, ligule. *Lamxay* VL1087. G–I: *Amomum villosum* var. *xanthioides*. G, part of rhizome with inflorescence; H, flower; I, ligule. *Lamxay* VL1153. Scale bar = 1 cm.

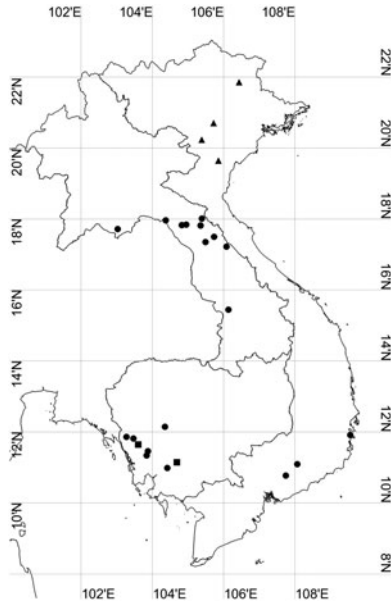


FIG. 34. Distribution of *Amomum uliginosum* J.Koenig (●), *Amomum verum* Blackw. (■) and *Amomum vespertilio* Gagnep. (▲) in Cambodia, Laos and Vietnam.

outer surface pilose at base, glabrous above; lateral corolla lobes  $1.5\text{--}2.5 \times 0.5\text{--}0.8$  cm, membranous, glabrous, apex cucullate; central corolla lobe  $1.5\text{--}2 \times 0.8\text{--}1$  cm, membranous, glabrous, apex cucullate; *labellum* clawed,  $2.3\text{--}3 \times 2\text{--}2.8$  cm, white with yellow central stripe edged by minute red dots, sometimes with yellow tip, coriaceous, glabrous, apex rounded with 2 small lobes, margin undulate; *lateral staminodes* oblong,  $0.5\text{--}0.7$  cm long, white, apex emarginate. *Filament* flat,  $0.5\text{--}0.7 \times 0.2$  cm, white, glabrous; *anther* oblong,  $0.5\text{--}0.7 \times 0.4$  cm, white, glabrous; *anther crest* trilobed, lateral lobes  $0.3 \times 0.2$  cm, rounded, central lobe  $0.4 \times 0.3$  cm, membranous, white, glabrous. *Stigma* rounded, glabrous, apex entire; *style* glabrous; *epigynous glands* 1 pair, oblong,  $0.3\text{--}0.5$  cm long, glabrous; *ovary*  $0.3\text{--}0.5$  cm diameter, bullate, long white hairs; *ovules* round, c.20–25 per locule. *Infructescence* peduncle c.  $9\text{--}10 \times 0.5$  cm, brown, tomentose; *fruiting part* with a few fruits,  $4\text{--}5 \times 3$  cm; *fruits* globose to ovoid,  $1.2\text{--}2 \times 1\text{--}1.5$  cm, greenish-red then dark reddish-brown, prickly with 1–3 branched prickles, glabrous or hairy, stalk very short, c.  $0.4$  cm long. *Seeds* globose,  $0.3$  cm diameter, glabrous, black, c. 10–25 per locule.

*Distribution.* Thailand, Cambodia, Laos, Vietnam, Malaysia, Indonesia (Sumatra).

*Habitat and ecology.* Lowland to mid-elevation evergreen forest, mixed deciduous forest, open forest, always along streams, often scattered in openings in forest, at 120–720 m altitude.

*Lao name and uses.* Mak naeng khieo (green fruit). This name is used equally for *Amomum villosum*. The fruits and seeds of *Amomum uliginosum* and *A. villosum* are the most important non-timber forest products in Laos, and are collected from the forest for sale and for medicinal purposes.

*Proposed IUCN status.* LC. This species has a very large extent of occurrence, is common and, although there are some threats across its range, these are not considered to be significant. It is therefore listed as Least Concern.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** Phnum Krapoëu, 17 vi 1930, *E. Poilane* 17649 (P); Kirirom, 29 v 2010, *M.F. Newman et al.* 2410 (E); Samrong Tong, 15 iv 1870, *J.B.L. Pierre* 542 (E, K, NY, P); *ibid.*, iv 1870, *J.B.L. Pierre* 542 (E, K, NY, P). **Koh Kong:** Thma Bang, 14 v 2010, *M.F. Newman et al.* 2246 (E); *ibid.*, 14 v 2010, *M.F. Newman et al.* 2265 (E); *ibid.*, 15 v 2010, *M.F. Newman et al.* 2267 (E); Veal Veng, road from Pramaoy to O Saom, 26 v 2010, *M.F. Newman et al.* 2393 (E); road from Pramaoy to Thmo Da, 27 v 2010, *M.F. Newman et al.* 2398 (E). **Pursat:** 27 vi 1930, *E. Poilane* 17789 (P).

LAOS. **Bolikhambxai:** Bane Na Heuang, 17 vii 2007, *V. Lamxay* VL1170 (E, NLS); Bane Nam Phao, 17 vi 2006, *V. Lamxay* VL1013 (E, NLS); *ibid.*, 24 viii 2009, *V. Lamxay* VL2070 (NLS); Bane Phone Xay, 13 v 2008, *V. Lamxay et al.* VL1247 (E, NLS); Phou Hai, 25 viii 2009, *V. Lamxay* VL2075 (NLS). **Khammouan:** Boualapha, 20 v 2006, *M.F. Newman et al.* LAO1208 (E); Bane Khoun Ngeun, 23 viii 2009, *V. Lamxay* VL2067 (NLS); *ibid.*, 18 vii 2007, *V. Lamxay* VL1179 (E, NLS); Bane Na Wa, 1 vii 2006, *V. Lamxay* VL1051 (NLS); Bane Oudomsouk, 19 vi 2006, *V. Lamxay* VL1021 (E, NLS); *ibid.*, 20 vi 2006, *V. Lamxay* VL1026 (NLS); *ibid.*, 20 vi 2006, *V. Lamxay* VL1027 (NLS); Phone Than, *O. Spire* 74 (P). **Salavan:** Bane Kham Toey, vii 2000, *Lee* 109 (E). **Vientiane Capital:** Xaythani, Bane Dan Xang, Houay Gngang Protected Forest, 18 vi 1999, *M.F. Newman* 863 (E); *ibid.*, 3 v 2008, *V. Lamxay et al.* VL1220 (E, NLS, P).

VIETNAM. **Dong Nai:** Tan Phu forest, Nga 3 Quan Y, 17 vi 2008, *H.D. Tran et al.* 39 (E). **Khanh Hoa:** Nha Trang, lower reaches of Song Cay, 18 vii 1921, *F. Evrard* 656 (P). **Lam Dong:** Deo Bao Loc, Dai Duc Me, 22 vi 2008, *H.D. Tran et al.* 68 (E). **Quang Nam-Da Nang:** Poste 6, 18 iii 1939, *E. Poilane* 29421 (P).

UNKNOWN. *F.J. Harmand* 635 (P).

This species is widely distributed in central Laos, southern Vietnam and Cambodia, southwards to Peninsular Malaysia and Sumatra, being found in many forest and soil types.

*Amomum uliginosum* is similar to *A. villosum* and to *A. longiligulare* which also have glabrous, shiny leaves, white flowers with a yellow central stripe on the labellum, a trilobed anther crest and prickly fruits, but it may be distinguished from *A. villosum* by the presence of lateral staminodes, and from *A. longiligulare* by its short, coriaceous ligule.

Gagnepain (1908, p. 115) treated this species as *Amomum ovoideum* but detailed study of all material determined to *A. ovoideum* and *A. uliginosum* from Thailand, Cambodia, Laos and Vietnam indicates that they represent a single species, for which *A. uliginosum* is the earlier name. Koenig collected *Amomum uliginosum* in Peninsular Thailand but his material has been lost. A neotypification will be carried out as part of a revision of *Amomum* for the Flora of Thailand (Kaewsri, in prep.).

The protologue of *Amomum ovoideum* cites specimens as follows: 'INDO-CHINE. – Cambodge, prov. de Samrong-tong, dans les monts Chereer et Tamire, avril-mai 1870, n° 542 [*Pierre*]. – Laos, prov. de Cammon, à Phon-thane, n° 74 [*Spire*]'. It has been noted before (Middleton & Regalado, 2005) that *Pierre* sometimes numbered his collections long after he had collected them and gave a single number to collections he thought belonged to one species. *Pierre* 542 is a case in point. Twenty-seven sheets have been seen; they were collected over a period of weeks from 17 March 1870 to sometime in May 1870 and the one collected in May 1870 is not from the same locality as the others. The greatest number of sheets was collected on 12 April 1870 and it is one of these that we select as lectotype. Collections made on other dates and the one collection made at Tamire in May 1870 remain syntypes.

**33. *Amomum verum*** Blackw., Herb. Blackwell., t. 371, 1757 [1754–1757]. – Type: Herb. Blackwell., t. 371, 1757 [1754–1757]. – Epitype: Cambodia, Koh Kong, v 1870, *J.B.L. Pierre* 629 (epi P P00599237, designated here; isoepi GH, K, P P032750). **Fig. 34.**

*Amomum krervanh* *Pierre* ex Gagnep., Bull. Soc. Bot. France 53: 138 (1906), nom. illeg.; Gagnepain, Fl. Indo-Chine 6: 111 (1908); Newman et al., Checkl. Vasc. Pl. Lao PDR 361 (2007). – Type: Cambodia, Koh Kong, v 1870, *J.B.L. Pierre* 629 (lecto P P00599237, designated here; isolecto GH, K, P P032750).

Clump-forming herb to 3–4 m tall; *rhizome* 0.5–2 cm diameter, glabrous; *stilt roots* c.0.2–0.3 cm diameter, tomentose; *interval between pseudostems* c.10 cm, scales coriaceous, glabrous, outer surface smooth, inner surface striate. *Pseudostem* with c.18 leaves per pseudostem, gradually becoming smaller towards apex, sometimes slightly swollen at base, c.1–2 cm diameter, striate, outer surface densely hairy at base and with long, stiff hairs at margins of leaf sheaths; *ligule* c.0.4–0.8 cm long, coriaceous, outer surface with long stiff hairs, apex truncate to emarginate, margin ciliate with long stiff hairs; *blade* sessile, oblong, 25–70 × 6–18 cm, glabrous, base long attenuate, apex long caudate, margin ciliate with stiff, long hairs towards apex, primary vein glabrous, prominent below, secondary veins sunken. *Inflorescences* arising from base, one to a few per pseudostem; *flowering part* oblong to ellipsoid, c.10 × 3–4 cm; *peduncle* c.4–26 × 0.3–0.6 cm, densely hairy; *scales* triangular to broadly lanceolate, 0.5 × 1 cm at base, 3–4 × 1–1.6 cm above, rotting into threads, papery, outer surface densely hairy, apex acute, margin ciliate; *bracts* narrowly triangular to ovate, 3–4 × 1–1.5 cm, striate, coriaceous, subtending only one flower, outer surface densely covered with long, stiff hairs, inner surface with pinnate venation, apex acute, margin ciliate; *bracteole* tubular, 2-toothed, c.2 × 0.3 cm, including calyx, membranous, striate, outer surface villous with dense, long hairs at base, bracteole tube c.1.5 cm long, teeth c.0.5 cm long, apex acute. *Flowers* not seen. *Infructescence* peduncle c.10–26 cm long; *fruiting part* oblong, 5–10 × 3–4 cm diameter, c.16–17 fruits per infructescence; *fruits* globose, finely ridged, c.1–1.2 cm

diameter, 3–4-lobed, pale brown, smooth, dense stiff hairs. *Seeds* triangular, 0.2–0.3 cm diameter, aril grey, c.8 per locule.

*Distribution.* Thailand, Cambodia, Indonesia (Sumatra).

*Habitat and ecology.* Lowland evergreen forest, c.300 m altitude.

*Proposed IUCN status.* DD. This is a species complex and although, as currently circumscribed, it has a very wide range and is common, it may be resolved into a number of more restricted-range species. Hence for now it has to be assessed as Data Deficient.

*Specimens examined.* CAMBODIA. **Kampong Spoe:** 21 vi 1930, *E. Poilane* 17738 (P). **Koh Kong:** 12 v 1870, *J.B.L. Pierre* 529 (GH); 25 v 1870, *J.B.L. Pierre* 529 (P); Mont Krevanh, 12 v 1900, *C. D'Alleizette* 7125 (L).

The protologue of *Amomum krervanh* lists *Amomum verum* Blackw. in synonymy but Blackwell's name has priority so *Amomum krervanh* is illegitimate (McNeill *et al.*, 2006, Art. 52). Since the name *Amomum krervanh* cannot be used for this species, then it must either be called *Amomum verum* or given a new name.

Blackwell's *A curious herbal* was published between 1737 and 1739 with re-issues in 1739, 1751 and 1782 (Blackwell, 1737). Another version of this work was published in Nuremberg as *Herbarium Blackwellianum* between 1747 and 1773. After 1749, the plates were published earlier than the accompanying descriptions. Plate 371, *Amomum verum*, appeared between 1754 and 1757 and is the first publication of the name after the starting date of 1 May 1753 (McNeill *et al.*, 2006, Art. 13.1a). As the plate is by Blackwell, the name can be attributed to her, even though the description, published later, may have been written by Trews, Böhmer or Bose (Stafleu & Cowan, 1976, entries 545 and 546).

Gagnepain (1906, p. 139) referred to 'Blackwell. *Herbarium Blackwellianum* (1760), IV, tab., 371'. The slightly later date of this reference can be explained by the fact that the date on the title page of the later volumes of *Herbarium Blackwellianum* was the date of publication of the last few pages of descriptions (Stafleu & Cowan, loc. cit.). As stated above, the plates had been published earlier.

Although Blackwell's name had priority, Gagnepain preferred to accept Pierre's name because Pierre 'a contribué plus que personne à faire connaître cette espèce intéressante et depuis si longtemps mal connue' (Gagnepain, 1906). This is in direct contradiction of the principle of priority in nomenclature (McNeill *et al.*, 2006, Prin. III).

Blackwell's plate is an illustration of an infructescence, showing the whole infructescence, a single fruit, the seed mass from within the fruit and some separated seeds. Without floral details or the provenance of the material Blackwell illustrated, it is difficult to say which species she drew. It might have been identical with *Amomum krervanh* or might have belonged to *Amomum compactum* Sol. ex Maton of Indonesia (J. Droop, pers. comm.). Nonetheless, given that Gagnepain has already associated *Amomum verum* with the Cambodian species, and that no contradictory

evidence is likely to arise, we shall assume that *A. verum* is the earliest legitimate name for this species and, by choosing Gagnepain's material of *A. krervanh* as epitype of *A. verum*, the application of this name will be fixed. As noted in the description above, good flowering material has yet to be collected in the Cardamom Mountains. Further collecting will be necessary in order to come to a final resolution of the taxonomy of this material.

Within Cambodia, Laos and Vietnam, this species has been found only in the Cardamom Mountains, Cambodia. Thorel's unnumbered collection at P (expedition of 1862–1866) was collected in Cochinchine which may be in modern-day Vietnam but there are no other collections of this species from Vietnam. *Amomum verum* closely resembles *Amomum testaceum* Ridl. by its narrowly triangular, striate, whitish bracts covered by stiff, long hairs, leaf sheaths and ligules ciliate with long, stiff hairs along the margin and hairy fruits lacking ridges, wings or spines, but it differs significantly by its bracteoles being longer than the calyx and its short peduncle. These two species are, therefore, maintained as distinct.

The protologue of *Amomum krervanh* cites a single collection, as follows: 'CAMBODGE. – Prov. de Tpong, dans les monts Krervanh ; en langue kmer : *Kreko-Krervanh*, 12 mai 1870, n° 629 [*Pierre*]'. We have found no material which exactly matches this information. Five sheets have been located, all collected by Pierre in the Cardamom Mountains, but each one differs in its way from the protologue.

Herbarium	Coll. no.	Coll. date	Altitude	Barcode no.
P	529	25 v 1870	100–300 m	P032749
GH	529	v 1870	100–300 m	
P	529	12 v 1870	100–300 m	P032750
P	629	v 1870	300 m	P00599237
K	629	v 1870		

Of these, we can exclude *Pierre* 529 (P, barcode P032749) because it bears a date which conflicts with that in the protologue. *Pierre* 529 (GH, P, barcode P032750) may be isolectotypes, assuming that the collection number 529 is a simple copying error for 629. The fact that the sheet at P, barcode P032750, bears the exact date of the protologue supports this assumption. *Pierre* 629 (P, barcode P00599237) is chosen as the lectotype because the only conflict with the protologue is that the date is given as May 1870, rather than 12 May 1870. *Pierre* 629 (K) may be an isolectotype though the determination on the label is *Amomum racemosum* Guibourt.

**34. *Amomum vesperilio*** Gagnep., Bull. Soc. Bot. France 49: 255 (1903); Gagnepain, Fl. Indo-Chine 6: 116 (1908). – Type: Vietnam, Hanoi, Mount Bavi, viii 1887, *B. Balansa* 4209 (lecto P [barcode P032738], designated here; isolecto K [barcode K000255057], P [barcodes P032736 & P032737]). **Fig. 34.**

Clump-forming herb, c.1 m tall; *stilt roots* absent; *interval between pseudostems* short, c.1–2 cm diameter, glabrous, scales soon rotting, glabrous. *Pseudostem* with > 10 leaves per pseudostem, c.1–1.3 cm diameter, glabrous, outer surface finely reticulate; *ligule* ovate, c.0.5–1.2 × 0.5–1 cm, swollen at base, coriaceous, glabrous, apex rounded; *petiole* short, canaliculate, c.1 × 0.5 cm, smooth, glabrous; *blade* oblong-elliptic, 40–60 × 8–13 cm, glabrous, base long attenuate, apex caudate, margin tomentose from middle to apex, primary vein prominent below, secondary veins sunken. *Inflorescences* arising from base; *flowering part* globose, c.3–5 × 5 cm, many flowers open at once; *peduncle* c.5 cm long, striate, hairy; *scales* broadly triangular, c.1 × 1 cm, to narrowly lanceolate c.4 × 1 cm, coriaceous, striate, outer surface hairy at base, apex acute; *bracts* narrowly lanceolate, c.4–5 × 1–1.2 cm, glabrous, subtending a single flower, coriaceous, striate, apex acute; *bracteole* open, boat-shaped, c.2–4 × 0.5 cm, membranous, striate, glabrous, apex acute. *Calyx* tubular, 2-toothed, c.2–4 × 0.5 cm, membranous, striate, glabrous. *Corolla tube* c.2–2.5 × 0.3 cm, glabrous; corolla lobes oblong, c.2–2.5 × 1 cm, membranous, glabrous, apex rounded; central lobe the same size and shape as lateral lobes; *labellum* clawed, c.2–2.5 × 2 cm, glabrous, obscurely trilobed at apex; *lateral staminodes* very small. *Filament* flat, glabrous, as long as anther; *anther* oblong, glabrous; *anther crest* semi-lunar, obscurely trilobed, c.1 cm wide, membranous, glabrous. *Stigma* cup-shaped, apex ciliate; *style* glabrous; *epigynous glands* oblong, c.0.4 cm long, glabrous; *ovary* c.0.3 cm long, villous with long white hairs. *Infructescence* peduncle c.3–5 × 1 cm, hairy; *fruiting part* c.5–6 × 1–2 cm, subtending many fruits; *fruits* c.4 × 1–1.5 cm, smooth, narrowly ovoid, glabrous, striate, acute, pericarp white outside, bright red inside. *Seeds* ovoid, c.0.3 cm diameter, glabrous, shining, black, aril white.

*Distribution.* Vietnam.

*Habitat and ecology.* Dry, evergreen forest, sometimes on very steep slopes, on hard, highly eroded, marble-like limestone, in rocky soil, at 284–450 m altitude.

*Proposed IUCN status.* VU B1ab(iii). This species has an extent of occurrence of just under 8000 km<sup>2</sup>. It is known from four locations and may already have been lost from one of these. There is continuing decline in the extent and quality of habitat due to habitat clearance for expanding agriculture and mining activities.

*Specimens examined.* LAOS. **Louangphabang:** slopes of Phou Phung, 31 xii 1953, *J.E. Vidal* 2588 (P).

VIETNAM. **Bac Kan:** Na Ri district, An Tinh community, Na Duong village, Kim Hy NPA, 22 xi 2002, *D.K. Harder et al.* 7532 (MO). **Hoa Binh:** Mai Chau district, Van Mai municipality, highway 7, 15 km post, on trail to east, between two mountains, *D.K. Harder et al.* 8169 (MO). **Thanh Hoa:** i 1886, *B. Balansa* 311 (P).

This species resembles *Amomum dealbatum* in having many flowers open at once and large leaf blades, but may be distinguished by its smooth capsules. *Amomum vespertilio* lacks the silky white hairs on the lower leaf surface which are seen in *A. sericeum*.



There are three sheets of the type, *Balansa* 4209, at P but there is nothing on the labels to suggest that they should be regarded as a single duplicate mounted over more than one sheet. Thus, we regard them as duplicates and choose one as the lectotype.

*Vidal* 2588 (P) is the only record of *Amomum vespertilio* in Laos and is a mixed collection. The infructescence is this species but the leaves belong to a species of *Alpinia*. The local name on the label, 'kha khôm', also corresponds to a species of *Alpinia*. The collecting locality, Phou Phung, has not been visited by us and the presence of *Amomum vespertilio* in Laos must be regarded as doubtful until more complete material is collected.

**35. *Amomum villosum*** Lour., Fl. Cochinch. 4 (1790), nom. cons. prop. (Newman & Lamxay, 2011); Wu & Larsen, Fl. China 24: 353 (2000); Newman et al., Checkl. Vasc. Pl. Lao PDR 362 (2007). – *Zingiber villosum* (Lour.) Stokes, Bot. Mat. Med. 1: 63 (1812). – *Cardamomum villosum* (Lour.) Kuntze, Revis. Gen. Pl. 2: 687 (1891). – Type: Laos, Champasak Province, Pathoumphone District, Xepiane NPA, 14°47'13.1"N, 106°00'15.6"E, 210 m, 8 vi 2010, *V. Lamxay* VL2118 (E; iso NLS, P), typ. cons. prop. **Figs 33, 35.**

*Amomum echinosphaera* K.Schum., Bot. Jahrb. Syst. 27: 322 (1899); Gagnepain, Fl. Indo-Chine 6: 105 (1908). – Type: Vietnam, Hanoi, Mount Bavi, v 1887,

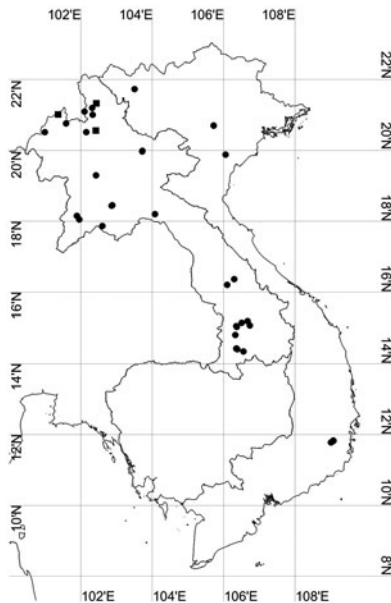


FIG. 35. Distribution of *Amomum villosum* Lour. (●) and *Amomum villosum* var. *xanthioides* (Wall. ex Baker) T.L.Wu & S.J.Chen (■) in Cambodia, Laos and Vietnam.

*B. Balansa* 4211 (lecto P [barcode P00599372], designated here; isolecto K [barcode K000255069], P [barcodes P00599373 & P00599374]).

**35a. *Amomum villosum* var. *villosum***

Creeping herb, c.2–3 m tall; *rhizome* scented, 0.4–1.5 cm diameter, white then brown or green; *stilt roots* absent; *interval between pseudostems* c.20–50 cm, scales tubular to ovate, 1–3 cm long, dark brown, smooth, coriaceous, striate, glabrous, apex acute to rounded, margin ciliate. *Pseudostem* with c.20–40 leaves per pseudostem becoming rapidly smaller towards apex, c.0.5–1.5 cm diameter, swollen at base, glabrous, outer surface striate; *ligule* 0.2–1 cm long, greenish-brown to dark brown, coriaceous, glabrous, apex emarginate to acute, margin ciliate; *petiole* very short, c.0.2–0.3 cm long or absent, canaliculate, swollen at base, glabrous; *blade* oblong to oblong-elliptic, 13–45 × 1–9 cm, shiny, glabrous, base attenuate, apex long caudate, primary veins prominent below, secondary veins sunken. *Inflorescences* arising near base, c.5–15 cm long, 1–3 per pseudostem; *flowering part* ovoid to ellipsoid, 3–4 × 1.5–3 cm, 1–2(–4) flowers open at once; *peduncle* 2–4 (rarely to 8) × 0.2–0.3 cm, striate, glabrous at base, tomentose above; *scales* tubular at base, ovate above, 1–3 × 0.5–1 cm, brownish then dark brown, coriaceous, striate, pilose to glabrous, apex acute, cucullate, mucronate, margin ciliate; *bracts* boat-shaped, 1.8–2.5 × 0.5–1.5 cm, light brown then darkening, coriaceous, striate, soon rotting, subtending a single flower, outer surface pilose, scabrous and tomentose at base, apex acute, margin papery; *bracteole* tubular, 2-toothed, 1.5–1.6 × 0.2 cm, whitish-brown, finely coriaceous then membranous, bracteole tube 0.7–0.8 cm long, teeth 0.5–0.7 cm long, apex acute. *Calyx* tubular, 3-toothed, 1.7–2.2 × 0.2 cm, whitish-pink then light brown, membranous, outer surface pilose, tomentose at base, apex cucullate; calyx tube 1.3–1.6 cm long; teeth 0.2–0.3 and 0.4–0.7 cm long. *Corolla* 4–5 cm long, whitish-pink, corolla tube 1.5–2.6 cm long, coriaceous, outer surface pilose, inner surface strigose above; lateral corolla lobes 2.2–2.5 × 0.5–0.7 cm, membranous, glabrous, apex cucullate; central corolla lobe 2.5 × 0.8–1 cm, membranous, glabrous, apex cucullate; *labellum* clawed, 2.3–2.5 × 2–2.3 cm, white with yellow central stripe and red lines from throat to tip, central lobe reflexed, dark yellow, apex rounded with 2 small lobes, coriaceous, glabrous, margin undulate; *lateral staminodes* absent, or very small, scale-like, c.0.1 cm long, white, glabrous. *Filament* flat, 0.5–0.7 × 0.2 cm, white, strigose at base on abaxial surface; *anther* oblong, 0.5–0.7 × 0.3 cm diameter, white, glabrous; *anther crest* trilobed, lateral lobes rounded, small, c.0.3 × 0.2 cm, central lobe 0.5 × 0.2 cm, membranous, glabrous, reflexed, white. *Stigma* rounded, glabrous, apex entire; *style* glabrous; *epigynous glands* oblong, 0.3–0.4 cm long, glabrous; *ovary* 0.4 cm diameter, bullate, tomentose with long white hairs; *ovules* globose, c.15 per locule. *Infructescence* peduncle 2–4 (rarely to 10) × 0.3 cm, brown, glabrous at base, tomentose above; *fruiting part* with few fruits, 2–6 × 3 cm; *fruits* on a very short pedicel, c.0.3 cm long, hairy, globose to ovoid, 0.5–1.5 cm diameter, prickly, green-red or pinkish-green or reddish-brown, prickles

flat at base, tomentose. *Seeds* angular to rounded, 0.2–0.3 cm diameter, brown then black, glabrous, aril light brown, c.15 per locule.

*Distribution.* China, Thailand, Laos, Vietnam.

*Habitat and ecology.* Lowland to montane evergreen forest, mixed deciduous forest, open forest, always scattered in openings in forest, at 122–1650 m altitude.

*Lao name and uses.* Mak naeng khieo (green fruit). The fruits and seeds of *Amomum villosum* and *A. uliginosum* are the most important non-timber forest product in Laos and are collected from the forest for sale as an ingredient in Chinese medicine, known as ‘sha ren’. *Amomum villosum* has been widely collected from the wild and also planted in southern Laos for 20–40 years.

*Proposed IUCN status.* LC. A widespread and common taxon with no significant threats. It is assessed as Least Concern.

*Specimens examined.* LAOS. **Bolikhambxai:** 30 iv 1932, *A.F.G. Kerr* 21319 (K). **Champasak:** Ba Chiang Chaleunsouk, 15 ix 2006, *V. Lamxay* VL1116 (E, NLS); Pathoumphone, Bane Tha Hou, Xepiane NPA, 8 vi 2010, *V. Lamxay* VL2118 (E); Bane Khouang Sy, 27 viii 2009, *V. Lamxay* VL2080 (NLS); Bane Kiat Ngong, 24 vii 2007, *V. Lamxay* VL1184 (E, NLS); *ibid.*, 24 vii 2007, *V. Lamxay* VL1186 (NLS); Bane Kong Ta Youne, 26 viii 2009, *V. Lamxay* VL2079 (NLS); Bane Nong Hin, vi 2000, *V. Lamxay* 0088 (E); Bane Phone Thong, 7 vi 2000, *V. Lamxay* VL01 (E); Bane Tha Hou, 27 viii 2009, *V. Lamxay* VL2085 (NLS); Bane Thang Beng, 9 ix 2006, *V. Lamxay* VL1087 (E, NLS); Paksong, 26 ix 1928, *E. Poilane* 15731 (P). **Houaphan:** Bane Phonsong, Nam Et-Phou Loey NPA, 14 i 2010, *V. Lamxay* VL2096 (NLS); Bane Dan Cheng, 23 v 2008, *V. Lamxay* & *M.F. Newman* VL1308 (E, NLS). **Khammouan:** Bane Mak Feuang, 19 xii 2005, *E.C.S. Lundh* & *L.J. Ahnby* Ella19 (E) [as cf. *Amomum villosum* Lour.]. **Louangnamtha:** Bane Sop Y, 18 viii 2009, *V. Lamxay* VL2054 (NLS); Bane Xiang Kok, 28 iv 2007, *V. Lamxay* VL1120 (E, NLS). **Louangphabang:** Bane Tad Kacham, 21 viii 2009, *V. Lamxay* VL2064 (NLS); *ibid.*, 16 i 2010, *V. Lamxay* VL2109 (NLS). **Phongsali:** Bane Na Mak, 28 vi 2007, *V. Lamxay* & *S. Ounmixay* VL1146 (NLS); *ibid.*, 28 vi 2007, *V. Lamxay* VL1152 (E, NLS); Bane Pa Kha, 26 vi 2007, *V. Lamxay* VL1141 (E, NLS). **Salavan:** Lao Ngam, 14 ix 2006, *V. Lamxay* VL1105 (E, NLS, P); *ibid.*, 14 ix 2006, *V. Lamxay* & *S. Chanthavongsa* VL1107 (E, NLS, P); Bane Katanglavang, 13 ix 2006, *V. Lamxay* VL1101 (E, NLS). **Savannakhet:** Bane Houay Xay, 9 viii 2007, *V. Lamxay* VL1198 (E, NLS); Bane Na Thong, 7 viii 2007, *V. Lamxay* VL1193 (E, NLS). **Vientiane:** Bane Houay Mo, 17 i 2010, *V. Lamxay* VL2112 (NLS); Bane Mouang, 4 iv 2008, *V. Lamxay* VL1207 (NLS); Bane Tha Heua, 21 v 2008, *V. Lamxay* VL1294 (E, NLS). **Vientiane Capital:** Bane Phia Lat, 6 v 2008, *V. Lamxay* VL1228 (E, NLS, P). **Xaignabouli:** Bane Na Khagnang, 28 v 2008, *V. Lamxay* & *M.F. Newman* VL1325 (E, NLS, P); Paklai, 1866–1868, *C. Thorel* s.n. (P).

VIETNAM. **Hanoi:** road to Hoa Binh, 2 v 1941, *P.A. Pételot* 7585 (P); Ba Vi, vii 1887, *B. Balansa* 4213 (P) [as cf. *Amomum villosum* Lour.]. **Hoa binh:** Quy Duc, *P.A. Eberhardt* 4197 (P). **Lai Chau:** Muong Lai, 13 i 1938, *E. Poilane* P86 (P). **Lam Dong:** Lac Duong district, Da Chay municipality, vicinity of Klong Lanh village, 31 km NE of Dalat city, 3 v 1997, *L.V. Averyanov* VH4531 (MO); Da Chay municipality, 35 km NE of Dalat city, 4 v 1997, *L.V. Averyanov* VH4552 (MO); Bi Doup-Nui Ba N.P., 14 vi 2008, *S. Hul* & *N.S. Ly* 3596 (E) [as cf. *Amomum villosum* Lour.]; *ibid.*, 13 vi 2008, *S. Hul* & *N.S. Ly* 3598 (E) [as cf. *Amomum villosum* Lour.]. **Ninh Binh:** Cuc Phuong National Park, 16 v 1999, *N.M. Cuong* 141 (GH, MO).

This taxon is very close to *Amomum uliginosum* and to *A. longiligulare* by its glabrous, shiny leaves, short, glabrous ligules, recurved labellum with two small lobes at the tip, and prickly fruits. It differs from *Amomum uliginosum* by its finely coriaceous to papery bracts which are dark brown and soon rot, and in lacking lateral staminodes; and from *A. longiligulare* by its short ligules and lack of lateral staminodes.

A proposal to conserve the name *Amomum villosum* with a conserved type has been published separately (Newman & Lamxay, 2011). There are three sheets of *Balansa* 4211, the type of *Amomum echinosphaera*, at P. There is nothing to indicate that they are a single duplicate mounted over several sheets so one of them, with a leaf and an inflorescence, is chosen as the lectotype.

**35b. *Amomum villosum* var. *xanthioides*** (Wall. ex Baker) T.L.Wu & S.J.Chen, Acta Phytotax. Sin. 16(3): 38 (1978); Wu & Larsen, Fl. China 24: 353 (2000). – *Amomum xanthioides* Wall. ex Baker, Fl. Brit. India 6: 239 (1892); Newman et al., Checkl. Vasc. Pl. Lao PDR 362 (2007). – *Cardamomum xanthioides* (Wall. ex Baker) Kuntze, Revis. Gen. Pl. 2: 687 (1891). – Type: Burma, Tenasserim Division, Tavoy, 12 viii 1877, *W. Gomez* in Wallich 6557 (holo K-W; iso BM, BR). **Figs 33, 35.**

Creeping herb c.2.5 m tall; *rhizome* subterranean, c.1–1.5 cm diameter, white then brown and green; *stilt roots* absent; *interval between pseudostems* c.20–50 cm long, scales spiral, ovate, 1–1.5 cm long, apex rounded, glabrous, papery. *Pseudostem* with c.30–40 leaves per pseudostem, becoming smaller towards apex, slightly swollen at base, c.1–1.5 cm diameter, glabrous, finely reticulate; *ligule* entire, ovate, 1 cm long, coriaceous, glabrous, margin ciliate; *leaves* with agreeable smell; *petiole* short, canaliculate, c.0.2–0.3 cm long, glabrous, swollen at base; *blade* oblong to oblong-elliptic, 15–40 × 2–8 cm, shiny, glabrous, lower surface light green, base attenuate, apex acuminate to long caudate. *Inflorescences* arising near base; *flowering part* ovoid, c.4–6 cm diameter; *peduncle* c.6–7 cm long, tomentose, internodes c.3 cm long; *scales* spiral, ovate to lanceolate, c.3.5 × 1 cm, brown to dark brown, cucullate, mucronate, striate, pilose, margin ciliate; *bracts* boat-shaped, coriaceous then papery, 1.5–2 × 0.5–1 cm, light brown then dark brown, outer surface tomentose at base, pilose above, inner tomentose at base, apex cucullate, margin papery; *bracteole* tubular, 2-toothed, c.1.5–2 cm long, teeth c.0.8–1 cm long, whitish-brown, outer surface tomentose at base, then pilose, finely coriaceous or membranous. *Calyx* tubular with 2 unequal teeth, c.1.5–2 cm long; calyx tube c.1–1.5 cm long; longer tooth c.0.3–0.5 cm, shorter tooth c.0.2–0.3 cm, pink to light brown, outer surface pilose. *Corolla* white, corolla tube as long as corolla lobes, c.1.5–2 cm long, coriaceous, outer pilose, inner strigose; corolla lobes membranous, glabrous; *labellum* clawed, 2–3 × 1.5–2 cm, white except yellow central stripe on labellum, glabrous, apex with 2 short lobes; *lateral staminodes* very small, subulate or scale-like, c.0.1 cm long, white, glabrous. *Filament* flat, c.0.5–0.7 cm long, white, glabrous; *anther* white, 0.5–0.7 cm long; *anther crest* 0.3 cm long, trilobed, lateral lobes spreading, c.0.2 cm,

central lobe c.0.3 cm, reflexed, membranous, glabrous. *Stigma* ovoid to globose, glabrous; *epigynous glands* 0.4 × 0.2 cm, glabrous; *ovary* globose, c.0.4 cm diameter, tomentose with white hairs; *ovules* ovoid to globose, c.8–12 per locule, glabrous. *Infructescence* peduncle to 6–7 cm long; *fruiting part* with many fruits; *fruits* on a pedicel 0.3 cm long, globose, c.1 cm diameter, prickly, hairy, brown when mature, calyx persistent. *Seeds* angular, brown then black, glabrous, c.10 per locule.

*Distribution.* China, Burma, cultivated in Laos.

*Habitat and ecology.* Montane forest, in shade, at 705–1051 m altitude.

*Lao name and uses.* Mak naeng kouang toung (from Guangdong). *Amomum villosum* var. *xanthioides* was introduced to northern Laos in 1997 from China. It is cultivated for its fruits which fetch a high price.

*Proposed IUCN status.* DD. This taxon appears to have a very wide range and is common but it is impossible to distinguish the wild population from the naturalised/cultivated population so, for now, it has to be assessed as Data Deficient.

*Specimens examined.* LAOS. **Oudomxai:** Bane Tad Mouane, 27 v 2000, *Somsak* 60 (E). **Phongsali:** Bountai, 28 vi 2007, *V. Lamxay* & *S. Oummixay* VL1153 (E, NLS); Bane Chane Tane, v 2006, *V. Lamxay* PPS06 (E).

This variety resembles *Amomum villosum* var. *villosum* by its loosely spreading habit, pseudostem swollen at the base, glabrous, shiny leaves, lanceolate to narrowly oblong bracts, generally white flowers except for a yellow stripe on the labellum, trilobed anther crest with two small lateral lobes, and its prickly fruit. It may be distinguished from *Amomum villosum* var. *villosum* by its peduncle internodes c.3 cm long, peduncle scales c.3.5 cm long, and globose, brown mature fruits. The peduncle, at 6–7 cm long, usually distinguishes it from *Amomum villosum* var. *villosum*.

#### EXCLUDED SPECIES

A number of species treated in *Amomum* by Loureiro (1790), Schumann (1904) and Gagnepain (1908), or reported by Newman *et al.* (2007), are now known to belong in other genera:

*Amomum cardamomum* L. = ***Elettaria cardamomum*** (L.) Maton

*Amomum galanga* Lour. = ***Alpinia galanga*** (L.) Willd.

*Amomum globosum* Lour. = ***Alpinia globosa*** (Lour.) Horan.

*Amomum harmandii* Gagnep. = ***Etlingera harmandii*** (Gagnep.) R.M.Sm.

*Amomum hirsutum* Lour. = ***Alpinia hirsuta*** (Lour.) Horan.

*Amomum hirticalyx* K.Schum. = ***Etlingera* sp.**

*Amomum laoticum* Gagnep. = ***Etlingera* sp.**

*Amomum littorale* J.Koenig = ***Etlingera littoralis*** (J.Koenig) Giseke

- Amomum medium* Lour. = **Alpinia galanga** (L.) Willd.  
*Amomum monophyllum* Gagnep. = **Elettariopsis monophylla** (Gagnep.) Loes.  
*Amomum montanum* J.Koenig = **Zingiber montanum** (J.Koenig) Link ex A.Dietr.  
*Amomum pavieanum* Gagnep. = **Etlingera pavieana** (Gagnep.) R.M.Sm.  
*Amomum repens* Sonn. = **Elettaria cardamomum** (L.) Maton  
*Amomum trilobum* Gagnep. = **Elettariopsis triloba** (Gagnep.) Loes.  
*Amomum unifolium* Gagnep. = **Elettariopsis unifolia** (Gagnep.) M.F.Newman  
*Amomum zedoaria* Christm. = **Curcuma zedoaria** (Christm.) Roscoe  
*Amomum zerumbet* L. = **Zingiber zerumbet** (L.) Sm.  
*Amomum zingiber* L. = **Zingiber officinale** Roscoe

#### UNCERTAIN SPECIES

*Amomum aromaticum* Roxb. was reported from Laos by Newman *et al.* (2007). This report came from the literature but the species has not been found in Cambodia, Laos or Vietnam during this study.

*Amomum lacteum* Ridl., J. Nat. Hist. Soc. Siam 4: 122 (1921), was based on *C.B. Kloss* s.n., collected at Dran, Lam Dong Province, Vietnam at 3000–4000 feet. Turner (2000) was unable to locate this collection. We, too, have failed to find it.

#### DOUBTFUL SPECIMEN

*Poilane* 25071 (P), collected 11 xii 1935 at Pakha (Bac Ha), Lao Cai Province, Vietnam, was determined as *Amomum lappaceum* Ridl. by K. Larsen in 1993. We have not been able to see this specimen to verify the determination but we have found no other collections of *A. lappaceum* in Cambodia, Laos or Vietnam.

#### ACKNOWLEDGEMENTS

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#### INDEX OF EXSICCATAE FOR CAMBODIA, LAOS AND VIETNAM

- Averyanov, L.V.* VH1835 (16), VH4531 (35a), VH4552 (35a).  
*Balansa, B.* 311 (34), 4205 (4), 4209 (34), 4211 (35a), 4212 (17), 4213 (35a); *Bansok, R.* 69 (23);  
*Bon, H-F.* 2687 (10); *Boualy* 87 (25), 88 (14).  
*Chevalier, A.J.B.* 40401 (7); *Contest-Lacour* 89 (25); *Cuong, N.M.* 141 (35a).  
*D'Alleizette, C.* 7125 (33).  
*Eberhardt, P.A.* 4197 (35a); *Evrard, F.* 656 (32).  
*Fleury s.n.* (4), 32143 (4), 32344 (4).  
*Harder, D.K. et al.* 4144 (15), 7532 (34), 8169 (34); *Harmand, F.J.* 635 (32); *Hul, S.* 3567 (24);  
*Hul, S. & Ly, N.S.* 3584 (26), 3596 (35a), 3598 (35a).  
*Kanstrup, J.* 221 (9), 222 (20), 223 (23); *Kerr, A.F.G.* 21315 (7), 21317 (23), 21319 (35a).



*Lamxay V. et al.* VL1130 (17), VL1131 (22), VL1171 (6), VL1172 (17), VL1173 (17), VL1174 (22), VL1214 (16), VL1215 (28), VL1218 (16), VL1220 (32), VL1221 (25), VL1222 (5), VL1223 (25), VL1241 (16), VL1243 (5), VL1247 (32), VL1250 (27), VL1252 (30a), VL1253 (3), VL1255 (29), VL1260 (29), VL1263 (16), VL1266 (29), VL1283 (25), VL1290 (1), VL1291 (2), VL1293 (1), VL1303 (22), VL2069 (25); *Lamxay, V.* VL01 (35a), 02 (14), PPS06 (35b), PPS07 (28), PPS08 (16), PPS09 (16), 0088 (35a), VL1001 (5), VL1002 (16), VL1003 (23), VL1012 (7), VL1013 (32), VL1015 (5), VL1016 (25), VL1017 (25), VL1018 (23), VL1021 (32), VL1022 (23), VL1023 (25), VL1026 (32), VL1027 (32), VL1028 (23), VL1032 (25), VL1046 (16), VL1047 (23), VL1050 (16), VL1051 (32), VL1084 (9), VL1085 (14), VL1086 (25), VL1087 (35a), VL1090 (25), VL1100 (30a), VL1101 (35a), VL1102 (14), VL1105 (35a), VL1106 (9), VL1108 (25), VL1114 (30a), VL1115 (14), VL1116 (35a), VL1117 (23), VL1118 (16), VL1119 (7), VL1120 (35a), VL1123 (16), VL1124 (28), VL1125 (28), VL1128 (28), VL1134 (7), VL1139 (13), VL1140 (28), VL1141 (35a), VL1144 (16), VL1145 (28), VL1149 (16), VL1152 (35a), VL1154 (19), VL1159 (25), VL1166 (13), VL1170 (32), VL1176 (23), VL1177 (16), VL1178 (11), VL1179 (32), VL1180 (7), VL1184 (35a), VL1185 (9), VL1186 (35a), VL1187 (30a), VL1193 (35a), VL1194 (25), VL1195 (5), VL1196 (30a), VL1197 (14), VL1198 (35a), VL1207 (35a), VL1208 (16), VL1213 (25), VL1228 (35a), VL1229 (25), VL1230 (5), VL1232 (13), VL1233 (25), VL1242 (25), VL1244 (23), VL1249 (23), VL1265 (16), VL1278 (25), VL1286 (11), VL1294 (35a), VL1314 (13), VL1324 (25), VL1706 (31), VL1708 (7), VL1709 (27), VL1710 (7), VL1711 (23), VL1712 (11), VL1713 (1), VL1714 (2), VL1715 (5), VL1716 (23), VL1717 (22), VL1718 (17), VL1719 (6), VL1721 (13), VL1722 (11), VL1723 (2), VL1724 (6), VL1726 (2), VL1730 (25), VL1732 (23), VL1733 (14), VL1746 (16), VL1790 (21), VL1876 (13), VL1877 (23), VL1878 (5), VL1879 (17), VL1880 (21), VL2016 (26), VL2030 (17), VL2050 (7), VL2051 (7), VL2052 (7), VL2053 (12), VL2054 (35a), VL2055 (16), VL2056 (13), VL2057 (12), VL2058 (28), VL2059 (16), VL2060 (28), VL2061 (7), VL2062 (13), VL2063 (26), VL2064 (35a), VL2065 (1), VL2066 (2), VL2067 (32), VL2068 (11), VL2070 (32), VL2071 (5), VL2072 (23), VL2073 (17), VL2074 (22), VL2075 (32), VL2076 (16), VL2077 (14), VL2078 (13), VL2079 (35a), VL2080 (35a), VL2081 (14), VL2082 (30a), VL2083 (14), VL2084 (14), VL2085 (35a), VL2086 (25), VL2087 (9), VL2091 (16), VL2092 (7), VL2094 (7), VL2095 (13), VL2096 (35a), VL2097 (26), VL2107 (7), VL2108 (26), VL2109 (35a), VL2110 (16), VL2111 (16), VL2112 (35a), VL2114 (5), VL2115 (25), VL2116 (25), VL2117 (21), VL2118 (35a), VL2119 (6), VL2120 (11), VL2121 (11), VL2122 (2), VL2207 (11), VL2220 (27); *Lamxay, V. & Bounlop* VL1089 (5), VL1188 (21), VL1189 (3), VL1190 (16), VL1191 (21), VL1192 (29); *Lamxay, V. & Chanthavongsa, S.* VL1107 (35a); *Lamxay, V. & Khounsirivong, K.* VL1165 (7), VL1167 (12); *Lamxay, V. & Newman, M.F.* VL1248 (7), VL1264 (21), VL1277 (9), VL1282 (5), VL1289 (7), VL1296 (13), VL1300 (18), VL1302 (13), VL1304 (8), VL1306 (8), VL1308 (35a), VL1312 (26), VL1315 (8), VL1317 (31), VL1318 (12), VL1321 (12), VL1322 (18), VL1323 (13), VL1325 (35a), VL1326 (13); *Lamxay, V. & Oummixay, S.* VL1146 (35a), VL1147 (28), VL1151 (7), VL1153 (35b); *Lamxay, V. & Phaphouampheng, P.* VL1121 (26), VL1122 (19), VL1126 (12), VL1129 (7), VL1155 (26), VL1156 (7), VL1157 (12); *Lamxay, V. & Phommachak, S.* VL1168 (7); *Lamxay, V. & Phoumsimouang, S.* VL1137 (12), VL1138 (31), VL1142 (7), VL1143 (12); *Lamxay, V. & Vongsombath, C.* VL1245 (16), VL1246 (16); *Lee* 106 (5), 109 (32); *Long, C. et al.* CL133 (20); *Lundh, E.C.S. & Ahnby, L.J.* Ella1 (16), Ella2 (5), Ella3 (25), Ella4 (23), Ella5 (16), Ella6 (25), Ella7 (25), Ella9 (35a), Ella30 (23), Ella35 (16); *Ly, N.S.* 305 (24), 306 (24).

*Newman M.F. et al.* LAO1207 (11), LAO1208 (32), LAO1298 (23), LAO1302 (2), LAO1547 (23), 2246 (32), 2265 (32), 2266 (30a), 2267 (32), 2273 (23), 2289 (20), 2363 (25), 2393 (32), 2394 (9), 2397 (26), 2398 (32), 2410 (32), 2414 (5); *Newman, M.F.* 863 (32), 864 (25), 866 (35a), 867 (16), 870 (16).

*Pételot, P.A.* 7585 (35a); *Phan, K.L. et al.* CBL1498 (18), 1671 (13), CBL2031 (18); *Phuong, D.L. s.n.* (17); *Pierre, J.B.L.* 529 (33), 542 (32), 542bis (5), 551 (30a, 30b), 554 (25), 591 (20),

625 (23), 629 (33), 630 (9), 5847 (30a), 5848 (30b), 6672 (30b); *Poilane, E.* s.n. (20), P86 (35a), 7227 (4), 11160 (23), 13692 (3), 15731 (35a), 16056 (14), 17343 (30a), 17649 (32), 17738 (33), 17789 (32), 18326 (5), 18471 (14), 21292 (9), 22772 (25), 25070 (18), 25270 (17), 26242 (16), 26280 (7), 26842 (31), 26843 (31), 27557 (23), 29421 (32), 32294 (3), 35517 (13); *Poilane, E. & Müller, R.* 29 (28).

*Schmid, M.* s.n. (16), s.n. (25), VN1647 (16); *Soejarto, D.D.* 10925 (17); *Somsak* 60 (35b), 61 (16); *Spire, O.* 74 (5), 4074 (5).

*Thorel, C.* s.n. (33), s.n. (35a), 2081 (30b); *Tran, H.D. et al.* 14 (25), 28 (25), 30 (30a), 38 (14), 39 (32), 60 (17), 66 (29), 67 (23), 68 (32); *Tran, H.D.* 171 (13).

*Vidal, J.E.* 2588 (34).

## INDEX

In the following index, accepted taxa are given in roman, synonyms in italic and new taxa in bold. A number after a name refers to the number of the taxon in the text above, (gen) = found in generic section, (exc) = found in excluded species, (int) = found in introduction, and (unc) = found in uncertain species.

*Alpinia galanga* (L.) Willd. (exc)  
*Alpinia globosa* (Lour.) Horan. (exc)  
*Alpinia hirsuta* (Lour.) Horan. (exc)  
*Amomum* Jack (gen)  
*Amomum aromaticum* Roxb. (gen)  
*Amomum biflorum* Jack (int)  
***Amomum calcaratum*** Lamxay & M.F.Newman (1)  
***Amomum calcicolum*** Lamxay & M.F.Newman (2)  
***Amomum celsum*** Lamxay & M.F.Newman (3)  
***Amomum chevalieri*** Gagnep. ex Lamxay (4)  
*Amomum chinense* Chun (5)  
***Amomum chryseum*** Lamxay & M.F.Newman (6)  
*Amomum corynostachyum* Wall. (13)  
*Amomum dealbatum* Roxb. (7)  
*Amomum dealbatum* var. *sericeum* (Roxb.) Baker (26)  
*Amomum echinatum* Thwaites (8)  
*Amomum echinocarpum* Alston (8)  
*Amomum echinosphaera* K.Schum. (35)  
*Amomum elephantorum* Pierre ex Gagnep. (9)  
*Amomum gagnepainii* T.L.Wu, K.Larsen & Turland (10)  
*Amomum galanga* Lour. (exc)  
***Amomum glabrifolium*** Lamxay & M.F.Newman (11)  
*Amomum glabrum* S.Q.Tong (12)  
*Amomum globosum* Lour. (exc)  
*Amomum harmandii* Gagnep. (exc)  
*Amomum hirsutum* Lour. (exc)  
*Amomum hirticalyx* K.Schum. (exc)  
*Amomum koenigii* J.F.Gmel. (13)  
*Amomum krevanh* Pierre ex Gagnep. (33)  
*Amomum lacteum* Ridl. (unc)  
*Amomum laoticum* Gagnep. (exc)

- Amomum longiligulare* T.L.Wu (14)  
*Amomum longipetiolatum* Merr. (15)  
*Amomum medium* Lour. (exc)  
*Amomum microcarpum* C.F.Liang & D.Fang (16)  
*Amomum monophyllum* Gagnep. (exc)  
*Amomum muricarpum* Elmer (17)  
*Amomum odontocarpum* D.Fang (18)  
*Amomum ovoideum* Pierre ex Gagnep. (32)  
*Amomum pavieanum* Gagnep. (exc)  
*Amomum petaloideum* (S.Q.Tong) T.L.Wu (19)  
*Amomum pierreanum* Gagnep. (20)  
**Amomum plicatum** Lamxay & M.F.Newman (21)  
**Amomum prionocarpum** Lamxay & M.F.Newman (22)  
*Amomum repens* Sonn. (exc)  
*Amomum repoeense* Pierre ex Gagnep. (23)  
*Amomum robustum* K.Schum. (32)  
**Amomum rubidum** Lamxay & N.S.Lý (24)  
*Amomum schmidtii* (K.Schum.) Gagnep. (25)  
*Amomum sericeum* Roxb. (26)  
**Amomum stephanocoleum** Lamxay & M.F.Newman (27)  
*Amomum subcapitatum* Y.M.Xia (28)  
*Amomum subulatum* Roxb. (gen)  
**Amomum tenellum** Lamxay & M.F.Newman (29)  
*Amomum thyrsoideum* Gagnep. (10)  
*Amomum tomrey* Gagnep. (30)  
*Amomum tomrey* var. *stenophyllum* Gagnep. (30b)  
*Amomum trilobum* Gagnep. (exc)  
*Amomum tsaoko* Crevost & Lemarié (31)  
*Amomum uliginosum* J.Koenig (32)  
*Amomum unifolium* Gagnep. (exc)  
*Amomum utriculosum* (Ridl.) Holttum (gen)  
*Amomum verum* Blackw. (33)  
*Amomum vespertilio* Gagnep. (34)  
*Amomum villosum* Lour. (35)  
*Amomum villosum* var. *xanthioides* (Wall. ex Baker) T.L.Wu & S.J.Chen (35b)  
*Amomum xanthioides* Wall. ex Baker (35b)  
*Amomum zerumbet* L. (exc)  
*Amomum zingiber* L. (exc)  
*Cardamomum* Kuntze (gen)  
*Cardamomum corynostachyum* (Wall.) Kuntze (13)  
*Cardamomum dealbatum* (Roxb.) Kuntze (7)  
*Cardamomum koenigii* (J.F.Gmel.) Kuntze (13)  
*Cardamomum sericeum* (Roxb.) Kuntze (26)  
*Cardamomum uliginosum* (J.Koenig) Kuntze (32)  
*Cardamomum villosum* (Lour.) Kuntze (35)  
*Cardamomum xanthioides* (Wall. ex Baker) Kuntze (35b)  
*Conamomum* Ridl. (gen)  
*Conamomum utriculosum* Ridl. (gen)  
*Curcuma longa* L. (int)  
*Cyphostigma schmidtii* (K.Schum.) K.Schum. (25)

*Elettaria cardamomum* (L.) Maton (exc, int)  
*Elettariopsis longipetiolata* (Merr.) D.Fang (15)  
*Elettariopsis monophylla* (Gagnep.) Loes. (exc)  
*Elettariopsis schmidtii* K.Schum. (25)  
*Elettariopsis triloba* (Gagnep.) Loes. (exc)  
*Elettariopsis unifolia* (Gagnep.) M.F.Newman (exc)  
*Etlingera harmandii* (Gagnep.) R.M.Sm. (exc)  
*Etlingera pavieana* (Gagnep.) R.M.Sm. (exc)  
*Geocallis* Horan. (gen)  
*Geocallis fasciculata* Horan. (gen)  
*Meistera* Giseke (gen)  
*Paludana* Giseke (gen)  
*Paramomum* S.Q.Tong (gen)  
*Paramomum petaloideum* S.Q.Tong (19)  
*Wurfbainia* Giseke (gen)  
*Zingiber corynostachyum* (Wall.) Steud. (13)  
*Zingiber officinale* Roscoe (exc, int)  
*Zingiber villosum* (Lour.) Stokes (35)  
*Zingiber zerumbet* (L.) Sm. (exc)