



A New Subspecies and Two New Records of the Genus *Alpinia* from Lao PDR

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ABSTRACT

Alpinia Roxb. is the largest genus within the tribe Alpinieae, subfamily Alpinioideae, and family Zingiberaceae, with more than 250 species. A newly discovered subspecies of the rare Zingiberaceae plant *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi and Saensouk was recently identified in the Youd Ou District of Phongsali Province, Lao PDR. In addition, *Alpinia latilabris* Ridl. and *Alpinia nobilis* Ridl. are new discoveries previously unreported from Lao PDR. These plants have significant potential for usage as both food and traditional medicine. *Alpinia nobilis* Ridl. was collected from Ban Lane Toui Village, Youd Ou district, Phongsali Province, Lao PDR. *Alpinia latilabris* Ridl. was obtained from Pakkading District, Bolikhamxay Province, Lao PDR. The content includes a thorough description and scientific research on the ecological factors, timing of natural phenomena, geographical distribution, utilization, and visual evidence. This study aims to present a new subspecies and two new records of the genus *Alpinia* from Lao PDR.

Keywords: *Alpinia intermedia*, *Alpinia latilabris*, *Alpinia nobilis*, Lao PDR, new record, subspecies

Introduction

The Zingiberaceae family, commonly referred to as the family of ginger, has a vast variety of plants with flowers that can be discovered in tropical and subtropical regions across the globe, including the continent of Africa, the Americas, the Caribbean, and Asia as well.¹⁻⁶ The Zingiberales order comprises 1,900 species and 57 genera of the monocotyledon Zingiberaceae family. This family is distributed in the tropical regions spanning from Malaysia to India.^{5, 6, 7} The Zingiberaceae family exhibits the highest species diversity in Southeast Asia.^{4, 8, 9, 10, 11} The *Alpinia* Roxb. genus, belonging to the Alpinieae tribe, Alpinioideae subfamily, and Zingiberaceae family, is the largest genus with over 250 species.^{1, 12, 13, 14, 15, 16, 17} *Alpinia* species have been extensively utilized throughout history for many purposes such as food, ornamentation, medicine, ritual purposes and cosmetics.¹⁸ A total of 13 species of the *Alpinia* have been documented from "A Checklist of Vascular Plants of Lao PDR"^{16, 19} and "A Checklist of Plants in Lao PDR".^{16, 20} In 2018, during a plant exploring, the Queen Sirikit Botanic Garden Herbarium and Pha Tad Kae Botanical Garden discovered a species of *Alpinia* with pale yellow flowers in Phongsali Province. The specimens were unsuitable for identifying any species that is stated. Based on specimens and taxonomic literature obtained from Flora of China, it has been determined that this plant is closely affiliated with *Alpinia intermedia* Gagnep., a species characterized by white flowers. However, it distinguishes itself from this species by producing pale yellow blossoms.²¹

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This plant has a diverse range of variations in both its vegetative and floral structures. Therefore, the species *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi & Saensouk is acknowledged as a new subspecies and a rare species in the Zingiberaceae family in Lao PDR. Furthermore, while conducting a current research of the *Alpinia* genus, we have found two species belonging to the genus *Alpinia* in Lao PDR. The indigenous people utilized the growing produce flowers, immature pseudostem, and immature rhizomes of this particular plant for its edible and health purposes. The distinctive morphological characteristics of both species, together with the initial description of *Alpinia latilabris* Ridl. in J. Straits Branch Roy. Asiat. Soc. volume 32 page 168 published in 1899, and *Alpinia nobilis* Ridl. in J. Straits Branch Roy. Asiat. Soc. volume 32 page 169, published in 1899, are provided by POWO¹⁷ Lim^{22, 23}, Lý²⁴, Nguyễn²⁵, Tanaka *et al.*²⁶, and Saensouk and Saensouk²⁷ were also compared. Therefore, these *Alpinia* species matched and were accepted with *Alpinia latilabris* Ridl. and *Alpinia nobilis* Ridl. However, POWO¹⁷ reported the native distribution range of *Alpinia latilabris* Ridl. in Borneo, Malaya, Myanmar, and Vietnam, while recent work by Saensouk *et al.*²⁸ recorded *A. latilabris* as newly recorded in Thailand; *Alpinia nobilis* Ridl. in Peninsular Malaysia and southern Vietnam.¹ Subsequently, both species were newly recorded for Lao PDR. Therefore, this study aims to investigate new subspecies and recordings of the genus *Alpinia* in Lao PDR.

Materials and Methods

Plant material and diversity study

The *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi and Saensouk and *Alpinia nobilis* Ridl. voucher specimens were collected in January–December 2018 during field trips to Ban Lane Toui Village, Youd Ou District, Phongsali Province, and Lao PDR. *Alpinia latilabris* Ridl. voucher specimens have been collected during field excursions in Pakkading District, Bolikhamxay Province, Lao PDR, between 2021 and 2023. The voucher specimens of the newly identified subspecies were kept at QBG (the herbarium of Queen Sirikit Botanic Gardens) in Mae Rim District, Chiang Mai Province, Thailand. The vouchers, specimens of new records, are maintained at the herbarium of Khon

Kaen University (KKU) in Muang District, Khon Kaen Province, Thailand. Additionally, the specimens were preserved in 70% ethyl alcohol. The field investigations involved collecting information on vernacular names, distribution, ecology, and phenology. In order to precisely identify the specimens, a comparison examination with the protologues of closely similar species was performed. The digital data and images sourced from aboard herbaria collections, including AAU, BKF, E, K, P, QBG, SING, and Mahasarakham University Herbarium were extensively employed in their identification. Furthermore, this research conducted a comprehensive analysis of the existing literature about *Alpinia*, with a specific emphasis on the morphological characteristics of each officially documented species within the *Alpinia* genus.

Conservation status study

The conservation status in the research area was assessed by examining the abundance of species. The assessment was derived from data collected during a field investigation in the research area.

The assessment of the conservation status based on worldwide criteria was analyzed using data from POWO¹⁷ and IUCN²⁹ criteria.^{30, 31}

Results and Discussion

Alpinia intermedia Gagnep. ssp. *aurea* Maknoi and Saensouk is a recently discovered subspecies. Furthermore, *Alpinia latilabris* Ridl. and *Alpinia nobilis* Ridl. were characterized as a novel finding in Lao PDR. Both newly discovered species of the *Alpinia* plant belong to the Zingiberaceae family, specifically, the Alpinioideae subfamily and the Alpinieae tribe. The discovery of this new subspecies (*Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi and Saensouk) and new recorded (*Alpinia nobilis* Ridl.) took place in Ban Lane Toui Village, Youd Uo District, Phongsali Province, Lao PDR. Additionally, a fresh specimen of *Alpinia latilabris* Ridl. was obtained in Pakkading District, Bolikhamxay Province, Lao PDR. This research provides a thorough description of its physical attributes, accompanied by graphic aids. In addition, this research includes the general name, biological characteristics, timing of biological events, usage, conservation status, and distribution map.

Taxonomic treatment

A new subspecies

The taxonomic classification of the new subspecies is presented below: *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi & Saensouk, ssp. nov. Type: Lao PDR, Phongsali Province [Ban Lane Toui, Youd Uo District, 6.07.2018, C. Maknoi, W. Khattiyot, N. Muangyen & P. Panyadee L13-222 & L13-223 (QBG!)] is shown Figures 1 & 2. The inflorescence morphology of this new subspecies closely resembles that of the typical ones, *Alpinia intermedia* Gagnep., except for its yellow flowers. In contrast, the blooms of the typical subspecies are shown as white blossoms (Figure 1).

The *pseudostems* reaches 1-1.1 m tall. *Leaf sheaths* pubescent; ligule 6-6.5 × 4.5-5.5 mm, apex 2-lobed, pubescent; petioles 3.5-4 mm long, glabrous; leaf blade oblong to lanceolate, 28-42 × 8-13 cm, both surface glabrous, base attenuate, apex acuminate. *Inflorescence* paniculate, erect or pendent, 12-16 × 3-5 cm, subtended by long sheaths; peduncles 4.5-6 cm long, green, glabrous; rachis glabrous, bearing many cincinni; peduncles of cincinni glabrous, 4-6 mm long with 3-5 flowered on each cincinnus. *Bracts* oblong, 8-9 × 2-3 mm, apex rounded, glabrous. *Bracteoles* 1-3 × 2-2.5 mm, deciduous. *Flowers* light yellow, glabrous; pedicels 4-5 mm long, glabrous; calyx tubular, 3-5.5 mm long, glabrous, apex crenate; corolla-tube longer than calyx, glabrous, white; dorsal corolla lobe oblong, 4-5.5 × 2.1-2.2 mm, apex hooded, glabrous; lateral lobes oblong, 4.5-4.8 × 1.5-1.8 mm, apex hooded, glabrous; labellum ovate, 8-9 × 7-7.5 mm, apex 2-lobed and recurved or deflexed, yellow with 2 red stripes from base to apex; lateral staminodes subulate, to 2 mm long, bright red, apex recurved. *Stamen*: filaments slender, 6-7 mm long, curved towards labellum; anthers 3-3.5 × 2-2.5 mm, yellow with reddish at the top, slightly hairy; anther-crest wanting. *Ovary* 1-2 × 1-2 mm, glabrous, greenish; style slender; stigma cup-shaped, glabrous. *Epigynous glands* 2, flat, 5.5-6 mm long. *Mature fruits* capsule, bright

red in mature, globose, 6-9 mm in diam. *Seeds* 5-8, aril white. (Figure 1).

A vernacular name for this species is “Kha”. The ecology of this species revealed that the natural habitat is located at an approximate altitude of 1,200 meters within the Hill Evergreen Forest. However, this species exhibited a low occurrence in Lao PDR. The distribution of this species is in Lao PDR (Phongsali Province). Flowers bloom in July, while fruits mature in August. The specimens examined for this new subspecies were C. Maknoi, W. Khattiyot, N. Muangyen, and P. Panyadee L13-222 and L13-223 (QBG!) collected from Lao PDR, Phongsali Province, Youd Uo District, Ban Lane Toui (6 July 2018). This plant serves both as an auspicious ornamental decoration and a medicinal herb.

The conservation status found that the recently identified taxonomic group happened to appear in the year 2022. According to the existing evidence as well as following the standards provided by POWO¹⁷ and IUCN²⁹ criteria. Based on the limited information available regarding the geographical range of this species, we recommend classifying it as Data Deficient (DD). Although it is feasible to come across this species in Lao PDR, we acknowledge the importance of conserving it due to its limited occurrence in its natural habitats. Consequently, we propose categorizing the concerned species as a threatened species in order to give importance to its efforts to protect it, pending further research to gain an improved knowledge of its geographic spread and current situation. By implementing this preventative plan, the conservation of the newly identified species and its natural surroundings will be efficiently ensured.

Alpinia intermedia Gagnep. ssp. *aurea* Maknoi & Saensouk is classified as a subspecies of the typical *Alpinia intermedia* Gagnep. species. Due to the decrease or lack of the lateral staminode, it is classified within the genus *Alpinia*, tribe Alpinieae, subfamily Alpinioideae, and family Zingiberaceae. This new subspecies is characterized by its conspicuous yellow flowers, which differentiate it from the typical subspecies documented in the Flora of China by Wu and Larsen²¹, which possesses white flowers.



Figure 1: *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi and Saensouk in Lao PDR and *Alpinia intermedia* Gagnep. the typical subspecies in Thailand. A. Inflorescence, B. Flower, C. Inflorescence, D. Cincinni with flowers

Two new records

Also, this study revealed two new records of *Alpinia latilabris* Ridl. and *Alpinia nobilis* Ridl., whose taxonomic description are reported in our findings.

Taxonomy of Alpinia latilabris Ridl. - new records for Lao PDR

The taxonomy of *Alpinia latilabris* Ridl. - new records for Lao PDR, are as shown in Inst. Bot. Buitenzorg 20:81. 1904. - *Alpinia sericea* Ridl., J. Linn. Soc., Bot. 42:163. 1914. - *Languas hookeriana* (Valeton) Merr., Univ. Calif. Publ. Bot. 15: 34. 1929. - *Languas sericea* (Ridl.) Merr., Univ. Calif. Publ. Bot. 15:35. 1929. - *Catimbium latilabre* (Ridl.) Holtum, Gard. Bull. Singapore 13(1):153. 1950, (Figure 2).

The *pseudostems* reaches 2.2-2.7 m tall. *Leaf sheaths* hairy near the base of ligule and petiole; ligule ovate, 1.1-1.3 × 1-1.1 cm, apex acute, hairy; blade lanceolate to oblong, 30-77 × 11-13 cm, base cuneate to attenuate, apex cauda sometimes spiral, 1.8-2.0 cm long, margin hairy, midrib or all of lower surface hairy; petiole 2.1-2.6 cm long, hairy. *Inflorescence* paniculate, semi-erect, 24-33 cm long; subtended by 2 long sheaths when immature; peduncle 11-16 cm long, densely hairy; rachis densely hairy, bearing 22-30 cincinni; *Bracts* absent; peduncle of cincinnus 1.3-1.4 cm long, dense covering of hairy with 2 flowers on cincinnus; *Bracteoles* 2.1-2.3 × 2.1-2.5 cm, white, pink at apex; pedicel 1.9-2.0 cm long, densely hairy. *Flowers* milky white; ovary ovoid, densely short hairy; style slender; stigma curved upwards, cup shaped, ciliate; epigynous glands 2, flat, 5.5-6 mm long; calyx tubular, 2.1-2.4 × 0.7-0.9 cm, apex trilobed, split on one side, glabrous except apices of lobes; floral tube shorter than calyx, 1.8-2.2 cm long, corolla lobes pinkish apices, oblong, 3.1-3.3 × 1.6-2.1 cm, dorsal corolla lobe longer than lateral lobes, margin hairy; lateral staminodes subulate, 2.5-8.5 × 2.2-3 mm; labellum yellow with purple to red stripes, broadly ovate and spatulate, 5-7 × 6-7 cm, apex trilobed; *Stamen*: filaments 21-22 × 4.5-5 mm, pink and slightly speckled; anther 11-13 × 3-4 mm, yellow; anther crest not extended at tip. *Ovary* 1.1-1.2 × 1.1-1.2 mm, glabrous, greenish; style slender; stigma cup shaped, glabrous. *Epigynous glands* 2, flat, 2.5-3.2 mm long. *Fruit* spherical, 1.7-2.1 cm in diam., orange to reddish when mature, slightly short hairy, ribbed, apex with persistent calyx. *Seeds* angled with white aril. (Figure 2)

The vernacular is named "Kha-Pa". It is a new record in Lao PDR. The ecology of this situation is fascinating. The vegetation in this area consists of dry evergreen forests, which are found at altitudes ranging from 50 to 500 meters. The species is distributed in Peninsular Malaysia, Sabah, Indonesia (Borneo), Burma, Thailand, Vietnam, and Lao PDR (central part: Pakkading District, Bolikhamxay Province). The phenology of the species is reported to flower in February–March and fruit in March–June. The specimen examined was studied in Lao PDR, Bolikhamxay Province, and Pakkading District (10 March 2021) (The specimen number Saensouk 101 is kept in KCU!). The local inhabitants utilized the juvenile flowers, immature pseudostems, and nascent rhizomes of this plant for both culinary and medicinal purposes. The conservation status of this particular species has been recorded in a restricted number of distinct regions in Lao PDR. As a result, it is recorded as a rare species. Therefore, *Alpinia latilabris* was last evaluated for inclusion in "The IUCN Red List of Threatened Species in 2018". *Alpinia latilabris* is categorized as "Least Concern" or "LC" according to the IUCN²⁹ criteria.^{30,31}

Taxonomy of Alpinia nobilis Ridl. - new records for Lao PDR

The taxonomy of *Alpinia nobilis* Ridl. - new records for Lao PDR, are as shown in J. Straits Branch Roy. Asiat. Soc. 32 (1899) 169. Homotypic Synonyms: *Alpinia malaccensis* var. *nobilis* (Ridl.) I.M.Turner, Novon 6 (1996) 223 - Type: Ridley, H.N. [4617] (holotype K); Other cited specimens: Pahang, Kuala Tembeling, Ridley *s.n.*, 1891 (SING), Ginting Bidai, Ridley 7795; Corner SFN 32516 (Figure 3).

The *pseudostems* reaches 2.5-2.9 m tall. *Rhizome* thick, outside pale green turning brown with age, inside pale yellow, slightly aromatic. *Leafy shoots* of mature flowering individuals 4-5 m long, with 10-13 leaves, bladeless sheaths 4-6, 6-21 cm long, puberulent externally, glabrous internally; leaf sheath striated, deep green, puberulent; ligules entire, 0.2-0.3 cm long, leathery, yellowish to green with sparsely small purplish to red blotches, rusty villous, margin entire with ciliate; petiole 4-7 cm long, hairy; leaf blade oblong to lanceolate, lightly plicate, 68-

98 × 17-22 cm, leathery, adaxially deep green, glabrous, abaxially greenish, glabrous to puberulent, base attenuate, apex caudate. *Inflorescence* terminal raceme, erect, 25.5-27 cm long, bearing 37-52 cincinni, 1-flowered per cincinnus; peduncle 7.5-8 × 0.25-0.3 cm, greenish, densely hairy, with 2 sheath bracts, soon caducous; rachis 13-16 cm long, greenish, densely hairy; *Bracts* absent; *Bracteoles* open to base, shell-shaped, 0.35-0.4 × 0.55-0.6 cm, semi-translucent, white tinged red or not at the tip, glabrous, apex acute, margin entire with ciliate.



Figure 2: *Alpinia latilabris* Ridl. in Lao PDR. A. Inflorescence, B. Immature fruits, C. Mature fruit



Figure 3: *Alpinia nobilis* Ridl. in Lao PDR. A. Inflorescence, B. Immature fruits, C. Flowers

Flowers 5.5-6.5 cm long; pedicel 6-7.5 × 2.2-2.7 cm, greenish, hairy; calyx tubular, hairy, narrowed at the base, gradually dilate above, 21-23 × 11-12 cm at widest point, cream white, shiny, semi-translucent, apex 3- to 5-toothed, and split to 0.65-0.8 cm on one side, margin with ciliate; floral tube 0.13-0.15 cm, expanding progressively approaching the apex, light white, sparsely short white-hairy, glabrous at the base, turning red and hairy at apex; dorsal corolla lobe obovate to elliptic, 0.25-0.35 × 0.2-0.3 cm, white, inner wrapping margins, translucent, shiny, externally densely hairy, internally glabrous, margin with ciliate; lateral corolla lobes triangular, 0.25-0.3 × 0.15-0.18 cm, concave, white, shiny, partly translucent margins, cucullate at apex, densely hairy, margin with ciliate; labellum broadly ovate, 3-lobed, flattened in the apex half, 0.35-0.4 × 0.35-0.4 cm wide when stretched, base half yellow tinged orange to red blotch with yellow at margins, mid lobe yellowish with finely deep red stripes; slightly deflexed, apex oblong, shallowly 2-lobed, incision 0.65-0.7 cm long; lobes nearly equal, glabrous; lateral staminodes nearly absent, 0.4-0.55 cm long, deep red, at base of labellum. *Stamen* curved inwards; filament 0.2-0.3 × 0.45-0.5 cm, cream to white, hairy throughout; anther 0.2-0.3 × 0.4-0.5 mm, sparsely hairy on the base; light yellowish with red blotch; anther crests absent. *Style* 45-50 mm long, white, hairy at the apex; *Stigma* funnel-shaped, 1-2 mm in diam., white, sparsely hairy; ostiole ciliate. *Ovary* globose to elliptic, 0.26-0.28 × 0.26-0.28 cm, green, golden hairy, 3-locular, placentation axile. *Epigynous* 2, 0.35-0.40 × 2.2-2.5 cm wide, pale yellow, glabrous, apex truncate. *Fruit* capsular, indehiscent, globose, 2-2.5 × 2.8-3 cm, mid-green, densely hairy.

The vernacular is named "Kha-Pa". It is a new record in Lao PDR. The ecology of this situation is fascinating. *Alpinia nobilis* grows in partially shaded and humid environments found at the edges of lowland evergreen woods. It is typically found within the hillsides, around pathways or stream valleys, wet soil on granite at 500-600 meters above sea level. The species is distributed in Lao PDR (Phongsali Province). It is reported that the blooming time typically occurs from late March to May, while fruiting begins in April and is expected to last until the fall.

The specimen examined was studied in Lao PDR, Phongsali Province, Youd Uo District, Ban Lane Toui (20 March 2021) (The specimen number C. Maknoi, Saensouk Lao PDR 105 is kept in Maharakham University Herbarium)

Taxonomically, *Alpinia nobilis* closely resembles *A. latilabris* in terms of its general appearance and arrangement of flowers, but it does not possess the anther crest found in the latter species. It is often mistaken for *A. malaccensis* (Burm.f.) Roscoe due to its erect inflorescences, which produce white with a yellow-crimson labellum surrounded by white shell-shaped bracteoles. However, there are several differences: (i) the ligule is covered with fine hairs, whereas it is smooth in *A. malaccensis*, (ii) the bracteoles and calyx are hairy throughout, whereas they are mostly smooth with some hairiness at the top and bottom in *A. malaccensis*, (iii) the leaf blades are broadly oblong-lanceolate, whereas they are linear-lanceolate in *A. malaccensis*, (iv) the inflorescence is more densely packed with flowers, (v) the corolla lobes are densely covered in yellow silky hairs, whereas they are smooth in *A. malaccensis*. The villagers used the young flowers, underdeveloped pseudostems, and early rhizomes of this specific plant for both food and therapeutic purposes.

The species is frequently seen in open regions of lowland evergreen forests among the foothills of Central Lao PDR. In order to accurately determine the population size, our team, and other research groups require several years to carry out more excursions to collect a greater number of specimens. Therefore, the conservation status of this particular species is currently Data Deficient (DD) according to the IUCN²⁹ criteria and as a rare species according to POWO.^{17, 30, 31}

Conclusion

Alpinia intermedia Gagnep. ssp. *aurea* Maknoi and Saensouk was recently found in the Youd Ou District of Phongsali Province, Lao PDR as a new subspecies. Moreover, *Alpinia latilabris* Ridl. and *Alpinia nobilis* Ridl., with wonderful food and traditional medicine potential, were recorded as new records from Lao PDR. The indigenous

population employed the young flowers, underdeveloped pseudostems, and early rhizomes of all three plant species for both food and therapeutic uses. The conservation status of all three species was categorized as Data Deficient (DD) for *Alpinia intermedia* Gagnep. ssp. *aurea* Maknoi and Saensouk and *Alpinia nobilis* Ridl., while *Alpinia latilabris* Ridl. was classified as Least Concern (LC). Additionally, all three species were recorded as rare.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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