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Article in *Phytotaxa* · February 2025

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Orophea phouphamarnensis (Annonaceae), a new species from limestone karst in central Laos

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Introduction

In Southeast Asia, approximately 408,000 km² is covered with limestone, most of which was originally fragmented in distribution (Clements *et al.* 2006). In Laos, the limestone area is about 30,000 km², covering ca. 12.6% of land in northern and central Laos. Khammouane Province, central Laos, is one of the core sites of limestone in the country where two main national protected areas, Phou Hin Poun National Protected Area and Hin Nam No National Park, are well known. In addition, the Nam Sanam-Phou Pha Marn Provincial Protected Area (hereafter PPA) covers an area of about 1,500 km², in which the Rock Viewpoint Phou Pha Marn covers a huge area of the PPA.

In these areas, a karst massif bordered by limestone walls rises to 500 m above sea level, the summits of which are inaccessible beneath a mantle of thick forest on chaotic surfaces with limestone pinnacles and deep fissures (Waltham & Middleton 2000). These habitats are widely recognized as unique centres of biodiversity and endemism, especially in Laos (Averyanov *et al.* 2019).

Annonaceae are a large pantropical angiosperm family of 108 genera and ca. 2,430 species (Chatrou *et al.* 2018) and important components in tropical and subtropical forests. *Orophea* Blume (1825: 18) with about 61 accepted species (POWO 2024) ranging from the Indian subcontinent through mainland Asia to Southeast Asian islands (Turner 2018) is characterized by the presence of dissimilar petal whorls (the inner one being clawed towards the base and generally connivent at anthesis), there is a reduction in number of stamens and carpels per flower and loosely arranged stamens with a minute connective prolongation not covering the thecae (Keßler 1988, Leonardía & Keßler 2001, Damthongdee *et al.* 2021, 2024). In *Orophea*, two subgenera are recognized namely, *Orophea* and *Sphaerocarpon* (Keßler 1988: 13, Leonardía & Keßler 2001, Damthongdee *et al.* 2021), differing mainly in venation of tertiary veins (generally percurrent in subg. *Orophea* vs. generally reticulate in subg. *Sphaerocarpon*), presence/absence of staminodes (presence or rarely absence vs. always absence), number of ovules per carpel (usually 6, rarely 1–3 vs. almost always 2 ovules per carpel, rarely up to 3–6 in species with inner petal tips that are recurved from bud to anthesis), and shape

of monocarps (ellipsoid-cylindrical to cylindrical monocarps vs. globose rarely oblongate monocarps). In Laos, four species of *Orophea*, all subg. *Sphaerocarpon*, are known: *O. harmandiana* Pierre (1881: t.44), *O. hirsuta* King (1892: 82), *O. laotica* Leonardia & Kessler (2001: 155), and *O. polycarpa* Candolle (1832: 215, Newman *et al.* 2007 & 2017 onwards).

During our field surveys in the limestone karst of the Rock Viewpoint Phou Pha Marn, a species of *Orophea* was collected. After further comparisons with related taxa based on the literature and herbarium specimens, it was found to be a species of subg. *Sphaerocarpon*, morphologically most similar to *O. laotica*, but differing from all previously known species in the genus. Here, we describe it as a new species.

Field surveys were conducted at Nam Sanam-Phou Pha Marn PPA in the Khounkham District of Khammouane Province in 2023. The morphological characters, ecological data, and locality were recorded. The voucher specimens were prepared and deposited in FOF, KAG, VNM, TNS and KYO, following Thiers (2016–continuously updated).

To confirm distribution records in Laos, we consulted various relevant taxonomic literature (Keßler 1988, Leonardia & Keßler 2001, Li & Michael 2011, Newman *et al.* 2007 & onward 2017, Chatrou *et al.* 2018, Damthongdee *et al.* 2021 & 2024), herbarium specimens housed at FOF, KAG, VNM and online herbarium specimen databases at Kew Data Portal (<https://data.kew.org>), Natural History Museum Data Portal (<https://data.nhm.ac.uk>), AAU Herbarium Database (<https://sciencemuseum.dk/herbariet>), and Catalogue des herbiers de Genève (<https://www.ville-ge.ch/musinfo/bd/cjb/chg/>). Morphological characters for description of the new species are based on the herbarium specimens collected in our field surveys.

Taxonomic treatment

Orophea phouphamarnensis D.Kong., Soulad. & Tagane, *sp. nov.* (Figs 1, 2)

TYPE:—LAOS. Khammouane Province, Khounkham District, Nam Sanam-Phou Pha Marn PPA, The Rock Viewpoint walking trail, in evergreen forest, 18.17626°N, 104.48905°E, 423 m elev., 17 March 2024, fl., Tagane *et al.* Z994 (holotype FOF0005504; isotypes KAG187403, KAG187404, VNM).

Orophea phouphamarnensis is most similar to *O. laotica* in leaf shape and size but distinguished by a number of morphological features, especially stamen and carpel numbers (Table 1).

Evergreen trees, 20 m tall, d.b.h. 63.3 cm. Young twigs 2.0 mm in diam., densely covered with yellowish brown hairs, old twigs dark grey to dark brown, glabrous, lenticellate. Terminal buds 0.6–1.9 cm long, densely covered with dark brown hairs. Leaves alternate; blades oblong-elliptic to oblong-ovate, 9.2–16.0 × 2.6–5.2 cm, sometimes slightly falcate, dark greyish brown, glabrous adaxially, reddish brown, covered with yellowish brown hairs on midrib and secondary veins abaxially, apex acuminate, acumen to 18 mm long, margin entire, base broadly cuneate to acute, midrib prominent except shallowly sunken or flat near the base adaxially, prominent abaxially, secondary veins 6–8 pairs, prominent abaxially, tertiary veins scalariform-reticulate, prominent abaxially; petioles 2.0–6.0 mm long, covered with yellowish brown hairs. Inflorescences axillary or on old stems behind leaves, up to 7-flowered, dark to yellowish brown hairy, sessile; bracts ovate-elliptic, ovate-triangular, 2.3–4.1 × 2.0–2.2 mm, glabrous adaxially, densely covered with dark brown hairs abaxially, margin ciliate, apex acute. Pedicel up to 2.0 mm long, densely covered with dark brown hairs, bracteoles narrowly triangular, 2.0 × 1.0 mm, margin ciliate, apex acute. Sepals 3, ovate-triangular, 1.0–1.2 × 1.0–1.2 mm, glabrous adaxially, dark brown hairy abaxially, margin ciliate, apex acute. Outer petals 3, ovate-triangular, 2.7–3.0 × 1.5–2.0 mm, glabrous adaxially, dark brown hairy abaxially, margin ciliate, apex acute. Inner petals 3, clawed, claw 3.0 mm long, lamina 2.0 mm long, tip protracted to 4.0 × 2.0 mm, broad, incurved, strongly recurved from bud to anthesis, warty, sparsely covered with hairs 4.0 × 2.0 mm. Nectary slits in paired. Stamens 12 in two whorls (6 + 6), 0.8 × 0.5 mm, anthers 0.5 mm long. Staminodes absent. Carpels 10–12, 0.5–0.8 mm long, 0.2–0.3 mm in diam., sparsely hairy, stigma globose, 0.2 mm in diam.; ovules 2 per ovary. Fruits not seen.

Distribution:—Laos, thus far known only from the type locality.

Habitat and Phenology:—Flowering in March in evergreen forest on limestone karst at 423 m elevation in forests dominated by *Hopea pierrei* Hance (Dipterocarpaceae), *Diospyros brandisiana* Kurz, *D. retrofracta* Bakh. (Ebenaceae), *Cleidion javanicum* Blume (Euphorbiaceae), *Litsea lancifolia* (Roxb. ex Nees) Fern.-Vill. (Lauraceae) and *Saraca declinata* (Jack) Miq. (Fabaceae).

Etymology:—Referring to the type locality, Phou Pha Marn.



FIGURE 1. *Orophea phouphamarnensis* (holotype, Tagane et al. Z994, FOF0005504).

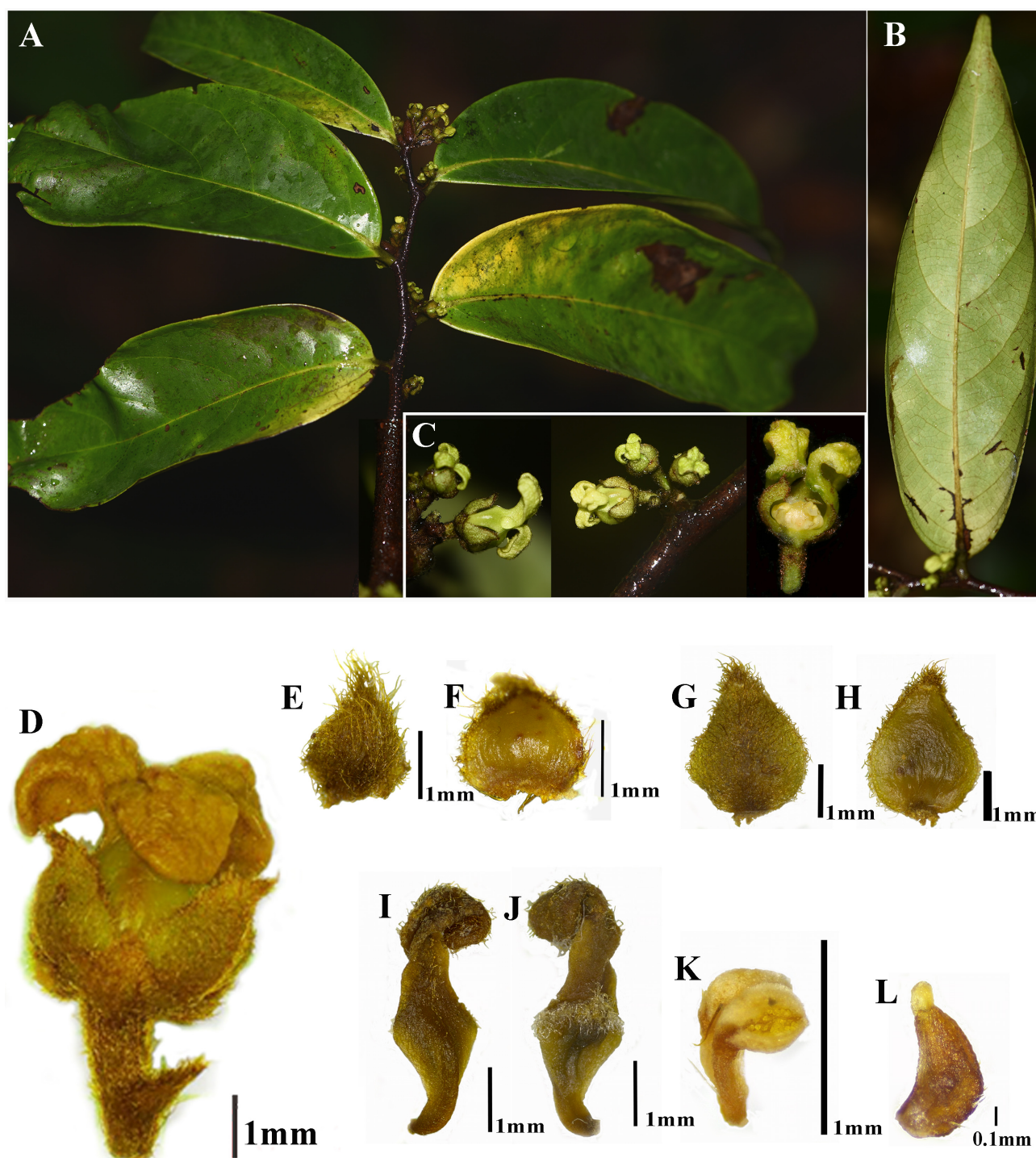


FIGURE 2. *Orophea phouphamarnensis*. A. Flowering branch. B. Lower leaf surface. C. Inflorescence, top view and side view. D. Flower. E, F. Sepal (abaxial and adaxial). G, H. Outer petal (abaxial and adaxial). I, J. Inner petals (abaxial and adaxial). K. Stamen, L. Pistil. Photos A–C, K. Souvannakhommane and D–J, L by D. Kongxaisavath of *Tagane et al.* Z994 (FOF).

Vernacular name:—*Pha marn Inthy* (ຜາມ່ານອິນທິ; Lao), proposed here. *Pha marn* refers to an area, and *Inthy* refers to Inthy Deuansavanh, who established walking trails on the limestone karst that enabled access to the core area of Phou Pha Marn.

Preliminary conservation assessment:—Likely data deficient (DD; IUCN 2024). Currently *Orophea phouphamarnensis* is known only from a single locality. We confirmed a single flowering individual along the Rock Viewpoint walking trail. Since we could not find any additional specimens at the herbarium and online database as far as we surveyed, the species is considered to be narrowly endemic to the area of limestone karst in the Phou Pha Marn

and adjacent areas. Further information on distribution and number of individuals/populations is needed to accurately assess the status and conserve this species.

Notes:—*Orophea phouphamarnensis* is closely related to *O. laotica*, endemic to Laos and shares many characteristics. However, it is clearly distinguished from *O. laotica* (Table 1). Stamen and carpel numbers are known to be reliable and informative characters for the classification of *Orophea* (Leonardia & Keßler 2001), and indeed the two species are different in these.

TABLE 1. Morphological comparison between *Orophea phouphamarnensis* and *O. laotica* (Leonardia & Keßler 2001).

Characteristics	<i>O. phouphamarnensis</i>	<i>O. laotica</i>
Height (m)	20	8
Peduncle (mm)	sessile	1.0
Length of pedicels (mm)	up to 2.0	8.0
Sepal (mm)	1.0–1.2 × 1.0–1.2	3.0 × 2.0
Outer petal (mm)	2.7–3.0 × 1.5–2.0	5.0 × 3.5
Length of inner petals claw (mm)	3.0	2.5
Size of the tips (mm)	2.0	15–18 × 4.0
Number of stamens	12 (6+6)	9 (6+3)
Carpels (mm)	10–12, 0.5–0.8 × 0.2–0.3 in diam.	15, ca. 1 × 0.5 in diam.
Ovules per carpel	2	2 or 3

Acknowledgments

Authors thank the manager and staff of The Rock Viewpoint Phou Pha Marn for permitting our botanical inventories in the area. This study was supported by Nagao Natural Environment Foundation, Japan.

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