

FLORA OF NAM KADING NATIONAL PROTECTED AREA II: 30 NEW RECORDS OF ANGIOSPERMS FOR LAOS

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Thirty angiosperm species in 20 families, collected in Nam Kading National Protected Area, are recorded in Laos for the first time. Because the flora of Nam Kading is rich in endemic species, the area represents one of the core sites of plant biodiversity in Laos. To elucidate the plant diversity accurately, further intensive floristic surveys are required.

Keywords. Angiosperms, flora, Laos, new records.

Nam Kading National Protected Area, located in central Laos, is one of the most globally significant natural ecosystems of the Lao People's Democratic Republic (Hallam & Hedemark, 2013). The national park covers an area of c.169,000 ha, with an altitudinal gradient from 138 m in the lowlands to 1514 m at the summit of Mount Phou Pa (Hallam & Hedemark, 2013). The vegetation is diverse along this gradient, containing lowland evergreen forest, mixed deciduous forest, grasslands, wetlands and limestone karst (Strindberg *et al.*, 2007; Hallam & Hedemark, 2013). Whereas the vertebrate fauna, including at least 43 species of mammals, 234 species of birds and 21 species of reptiles, has been well documented in the area (IEWMP, 2006; WCS, no date), very limited studies of the flora (Electrowatt, 1995; Hwang *et al.*, 2015; Souladeh *et al.*, 2017) have been made as in the other areas in Laos (Rundel, 1999; Newman *et al.*, 2007a).

To elucidate the flora of Nam Kading National Protected Area, we carried out botanical inventories from 22 to 26 December 2016, and from 26 to 30 June 2017 (Fig. 1) under an agreement between the National University of Laos and Kyushu University, Japan, and collected 724 voucher specimens. The first period was in the dry season, and the second in the rainy season. Two field surveys were carried out to sample the maximum number of herbaceous species; in their sterile condition, such species might have been overlooked if a single survey had been carried out in one season.

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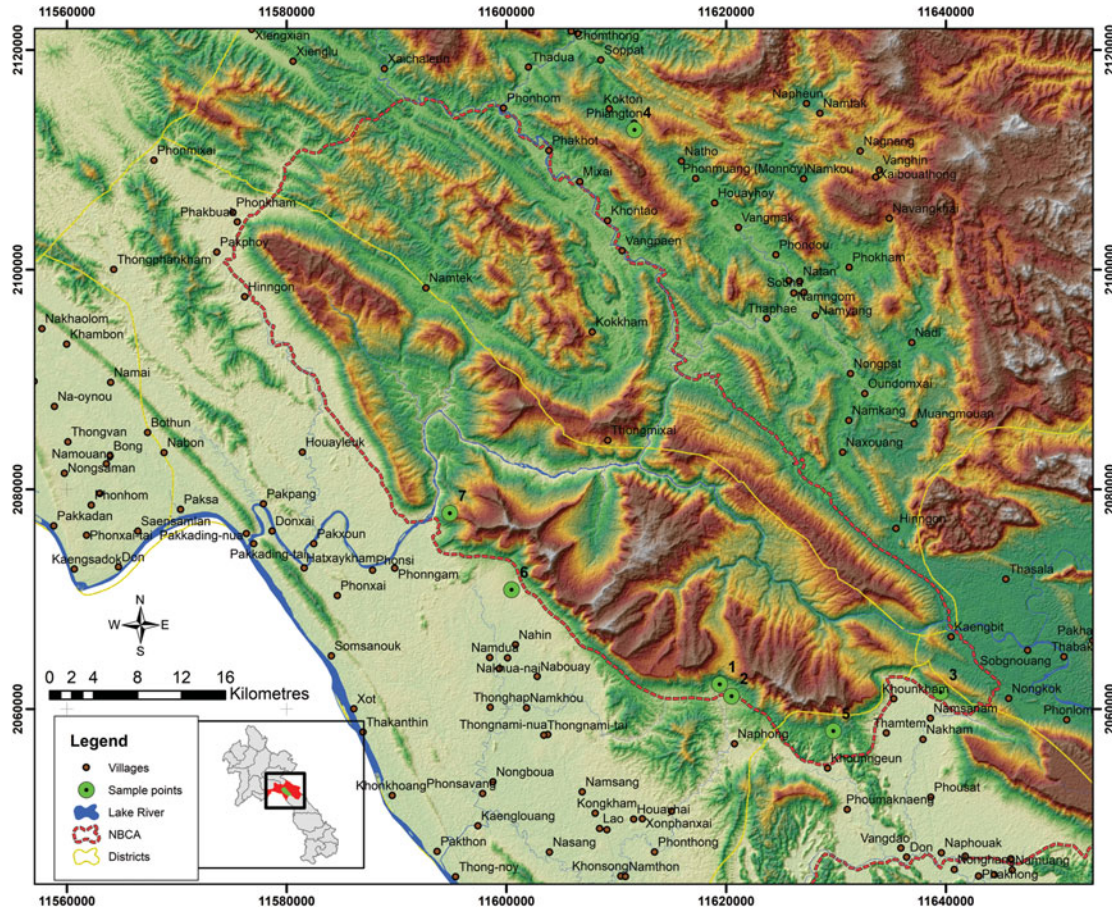


FIG. 1. Sites surveyed in the Nam Kading National Protected Area, Laos.

The identification of our collections resulted in the discovery of a new species of *Strobilanthes* Blume (Acanthaceae): *S. namkadingensis* Soulad. & Tagane (Souladeth *et al.*, 2017). Following the discovery of this new species, we here report 30 angiosperm species as new records in the flora of Laos.

Species records in Laos are based on the *Flore du Cambodge, du Laos et du Viêtname* (Aubréville *et al.*, 1960 to present) and *Flore Générale de l'Indochine* (Lecomte, 1907–1950), Newman *et al.* (2007a,b), Staples *et al.* (2014), Hwang *et al.* (2015), Souvannakhoumane & Suksathan (2015), Lim *et al.* (2016) and Zhu (2017), as well as the taxonomic literature on neighbouring countries, including the *Flora of Thailand* (Smitinand *et al.*, 1970 to present) and *Flora of China* (Wu *et al.*, 1989–2013).

Voucher specimens are deposited in the herbarium of the Faculty of Forest Science, National University of Laos (FOF), and the herbarium of the Museum of Kyushu University (FU). Partial sets of voucher specimens may be found in the Forest Herbarium, Thailand (BKF), the National Herbarium of Laos (HNL), Kyoto University Museum (KYO) and the National University of Taiwan (TAI).

SPECIES NEWLY RECORDED FOR LAOS

Thirty vascular plant species in 27 genera and 20 families are newly recorded in the flora of Laos (Table 1 and Figs 2, 3), among which six genera, *Pseuduvaria* Miq., *Thottea* Rottb., *Nyctocalos* Teijsm. & Binn., *Epiprinus* Griff., *Koiloclepa* Hassk. and *Hemiscolopia* Slooten are new at genus level.

Recently, Zhu (2017) assessed the floristic similarities of Laos and the surrounding countries, and concluded that the flora of Laos showed the highest similarity to the flora of Vietnam (92.13% at genus level and 61.19% at species level), followed by the flora of Myanmar (86.01% and 40.07%, respectively) and Thailand (77.84% and 42.47%, respectively). However, the similarity in our collection shows the reverse trend: only 14 species (47%) share their distribution range with Vietnam, 18 species (60%) with Myanmar and 25 species (83%) with Thailand, indicating that the plant diversity of Laos is a more intricate topic that needs to be examined very carefully.

The following five species have been known only from north-east Thailand: *Garcinia nuntasaenii* Ngerns. & Suddee (Clusiaceae), *Croton poomae* Esser (Euphorbiaceae), *Litsea phuwuaensis* Ngerns. (Lauraceae), *Argostemma siamense* Puff and *Rothmannia thailandica* Tirveng. (both Rubiaceae). Although these species show limited distribution in Thailand and are all threatened (Forest Herbarium, 2015; Ngernsaengsaruy & Suddee, 2017), they are abundant in the lowland evergreen forests of Nam Kading National Protected Area; the previously known localities in Thailand are considered to be at the edges of their distribution range.

Two species, *Celtis philippensis* Blanco (Cannabaceae) and *Argostemma lobbii* Hook.f. (Rubiaceae), were known to prefer limestone areas. In addition, a wild type of *Citrus hystrix* DC. (synonym, *Citrus macroptera* Montrouz.) (Rutaceae, specimen no. L1081), *Drypetes harmandii* Pierre ex Gagnep. (Putranjivaceae, L1064) and some species of Begoniaceae (*Begonia* spp., L961, L1091 and L1202) and

TABLE 1. Species newly recorded in the flora of Laos^a

Family	Species	Specimen number(s)	Distribution outside Laos
Annonaceae	<i>Pseuduvaria rugosa</i> (Blume) Merr.	L1055 (fr.)	India (Nicobar Islands), Indonesia (Java, Sumatra), Malaysia (Peninsula), Myanmar, Thailand
Apocynaceae	<i>Epigynum cochinchinensis</i> (Pierre) D.J.Middleton	L979 (fl.)	Myanmar, Thailand, Vietnam
Aristolochiaceae	<i>Thottea tomentosa</i> (Blume) Ding Hou	L269	Bangladesh, India, Indonesia, Malaysia (Peninsula), Myanmar, Philippines, Thailand, Vietnam
Bignoniaceae	<i>Nyctocalos brunfelsiiflorum</i> Teijsm. & Binn.	L1046 (fl.)	China (Yunnan), Indonesia, Malaysia, Myanmar, Thailand
Cannabaceae	<i>Celtis philippensis</i> Blanco	L1059	Australia, China, India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam; Africa, Pacific Islands
Celastraceae	<i>Glyptopetalum sclerocarpum</i> M.A.Lawson	L1061	Cambodia, China (Yunnan), India, Thailand, Vietnam
Clusiaceae	<i>Garcinia muntasaenii</i> Ngerns. & Suddee	L8 (male fl.), L431 (fl. & fr.), L1034	Thailand (NE)
Dichapetalaceae	<i>Dichapetalum gelonioides</i> (Roxb.) Engl.	L1062 (young fr.)	China, India, Indonesia, Malaysia, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam
Dipterocarpaceae	<i>Dipterocarpus grandiflorus</i> (Blanco) Blanco	L50 (fr.)	India (Andaman Islands), Myanmar, Thailand (Peninsula, NE)
Ebenaceae	<i>Diospyros pendula</i> Hasselt ex Hassk.	L67, L988 (fr.)	Cambodia, Indonesia (type), Myanmar, Malaysia (Peninsula, Borneo), Thailand (SE)
	<i>Diospyros pilosiuscula</i> G.Don	L209, L447, L1156 (fr.)	India, Malaysia (Peninsula), Myanmar, Thailand, Vietnam

TABLE 1. (Continued)

Family	Species	Specimen number(s)	Distribution outside Laos
Euphorbiaceae	<i>Croton poomae</i> Esser	L335, L972 (fr.)	Thailand (NE)
	<i>Epiprinus siletianus</i> (Baill.) Croizat	L290 (fr.)	China (Hainan, Yunnan), India, Myanmar, Thailand, Vietnam
	<i>Excoecaria oppositifolia</i> Griff.	L87, L1049 (fr.)	India (Assam), Myanmar, Thailand, Vietnam
	<i>Koilodepas longifolium</i> Hook.f.	L222	Indonesia (Sumatra), Malaysia, Thailand (Peninsula, SE)
	<i>Mallotus metcalfianus</i> Croizat	L1020 (fr.)	China (South), Vietnam
Fabaceae	<i>Trigonostemon albiflorus</i> Airy Shaw	L1092 (fl.)	China (Guangxi), Thailand (N, SE)
	<i>Millettia ichthyochtona</i> Drake	L225	China (Yunnan), Vietnam
Fagaceae	<i>Castanopsis clarkei</i> King ex Hook.f.	L29, L1021, L1048 (fr.)	China, India (NE), Myanmar (NE)
Lauraceae	<i>Dehaasia annamensis</i> Kosterm.	L40 (fr.), L1150	Vietnam
	<i>Litsea phuwuaensis</i> Ngerms.	L333, L1152 (female fl.)	Thailand (NE)
Moraceae	<i>Ficus montana</i> Burm.f.	L1206 (fr.)	India, Indonesia, Malaysia, Myanmar, Philippines, Papua New Guinea, Thailand
	Phyllanthaceae	<i>Phyllanthus elegans</i> Wall. ex Müll.Arg.	L1025 (male fl., female fl. & fr.)
Phyllanthaceae	<i>Phyllanthus microcarpus</i> (Benth.) Müll.Arg.	L1143 (fr.)	Cambodia, China (Hong Kong), Indonesia, Thailand
	Putranjivaceae	<i>Drypetes cambodica</i> Gagnep.	L76
Rubiaceae	<i>Argostemma lobbii</i> Hook.f.	L956 (fl.), L1203 (fl.)	Myanmar, Thailand
	<i>Argostemma siamense</i> Puff	L957 (fl.), L1200 (fl.)	Thailand (NE)
	<i>Rothmannia thailandica</i> Tirveng.	L3 (fl.), L224, L235, L446 (fl.), L451 (fr.), L1006 (fr.)	Thailand (NE)
	Rutaceae	<i>Zanthoxylum scandens</i> Blume	L1173 (fl. & fr.)
Salicaceae	<i>Hemiscolopia trimera</i> (Boerl.) Slooten	L177	Cambodia, Indonesia, Malaysia, Thailand (Peninsula), Vietnam

^a Editor's note: Prosperi *et al.* (the preceding article in this issue of the *Edinburgh Journal of Botany*) independently report the occurrence in Khammouane Province of four species in this table, namely, *Pseuduvaria rugosa* (Blume) Merr., *Celtis philippensis* Blanco, *Dichapetalum gelonioides* (Roxb.) Engl. and *Diospyros pilosiuscula* G.Don.

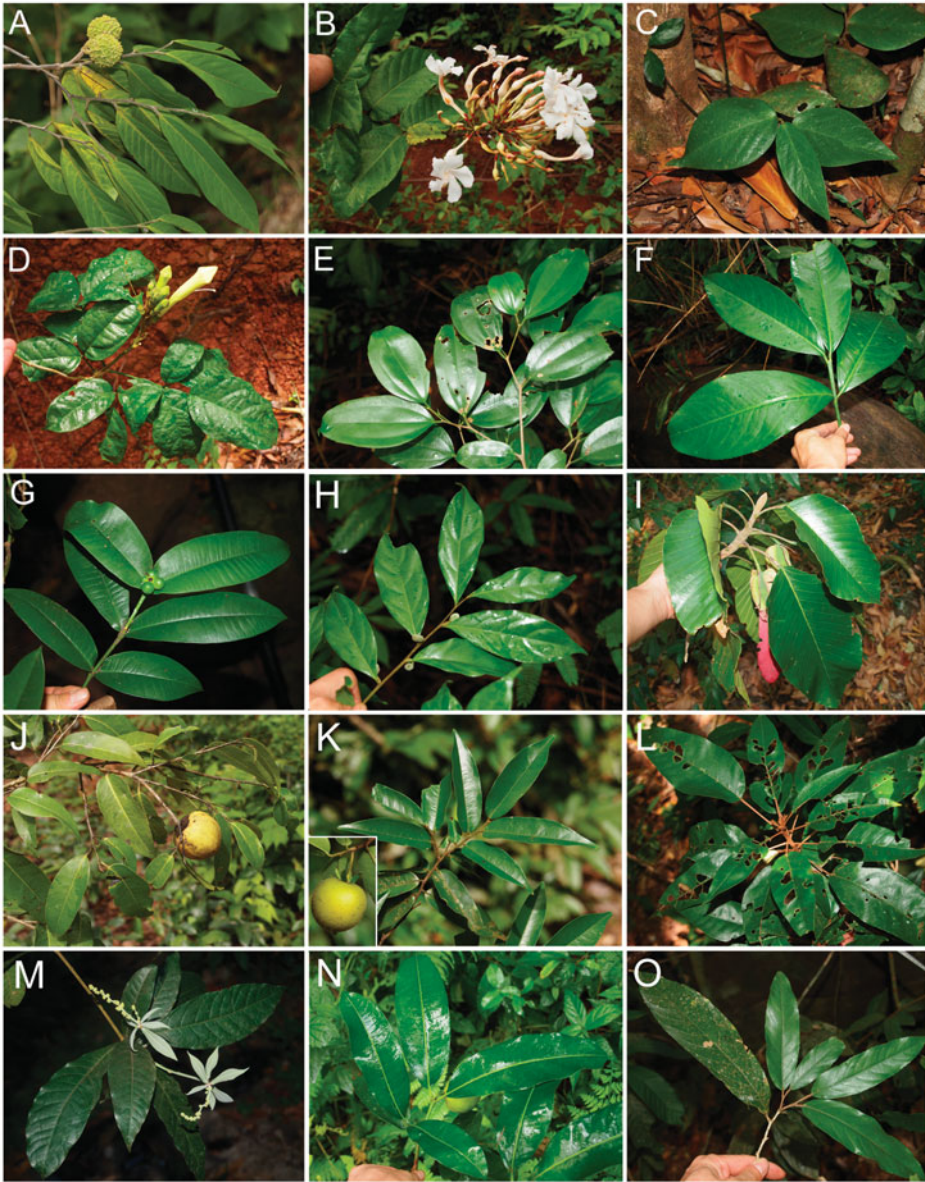


FIG. 2. A, *Pseuduvaria rugosa* (Blume) Merr.; B, *Epigynum cochinchinensis* (Pierre) D.J.Middleton; C, *Thottea tomentosa* (Blume) Ding Hou; D, *Nyctocalos brunfelsiiflorum* Teijsm. & Binn.; E, *Celtis philippensis* Blanco; F, *Glyptopetalum sclerocarpum* M.A.Lawson; G, *Garcinia nuntasaenii* Ngerns. & Suddee; H, *Dichapetalum gelonioides* (Roxb.) Engl.; I, *Dipterocarpus grandiflorus* (Blanco) Blanco; J, *Diospyros pendula* Hasselt ex Hassk.; K, *Diospyros pilosiuscula* G.Don; L, *Croton poomae* Esser; M, *Epiprinus siletianus* (Baill.) Croizat; N, *Excoecaria oppositifolia* Griff.; O, *Koilodepas longifolium* Hook.f.

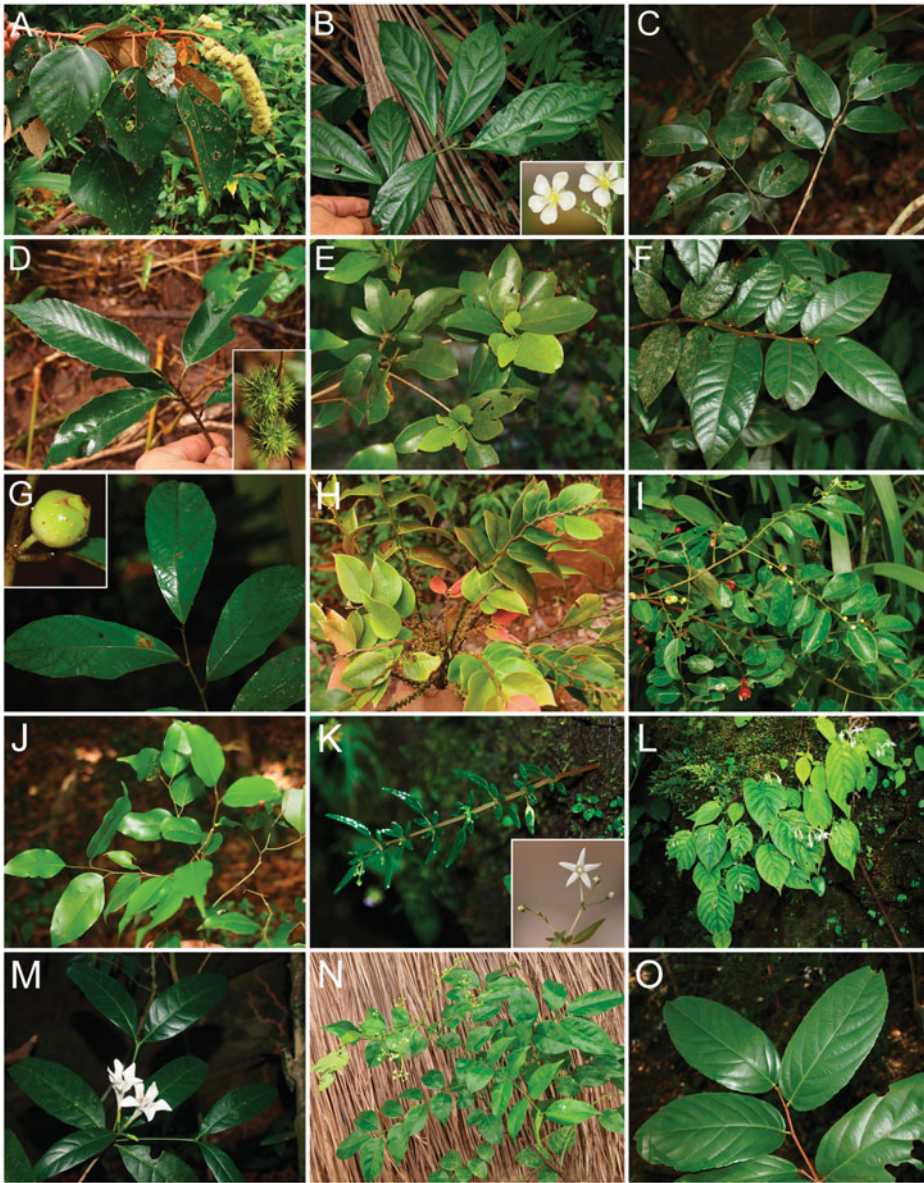


FIG. 3. A, *Mallotus metcalfianus* Croizat.; B, *Trigonostemon albiflorus* Airy Shaw.; C, *Millettia ichthyochtona* Drake; D, *Castanopsis clarkei* King ex Hook.f.; E, *Dehaasia annamensis* Kosterm.; F, *Litsea phuwuaensis* Ngerns.; G, *Ficus montana* Burm.f.; H, *Phyllanthus elegans* Wall. ex Müll.Arg.; I, *Phyllanthus microcarpus* (Benth.) Müll.Arg.; J, *Drypetes cambodica* Gagnep.; K, *Argostemma lobbii* Hook.f.; L, *Argostemma siamense* Puff; M, *Rothmannia thailandica* Tirveng.; N, *Zanthoxylum scandens* Blume; O, *Hemisclopa trimera* (Boerl.) Slooten.

Gesneriaceae (*Middletonia* sp., L973, and *Didymocarpus* sp., L1198) were collected from the limestone karst, among which an unidentified species of *Didymocarpus* may be an undescribed species (D. J. Middleton, Singapore Botanic Gardens, personal communication). Considering that we visited the edge of karsts only for a few hours, more species related to limestone habitat would be expected to be included in further intensive inventories.

Two species, *Pseuduvaria rugosa* (Blume) Merr. (Annonaceae) and *Dipterocarpus grandiflorus* (Blanco) Blanco (Dipterocarpaceae), are remotely isolated from the main distribution areas: India (Nicobar Islands), Indonesia (Java, Sumatra), Malaysia (Peninsula), Myanmar (S), Thailand (N, Peninsula, SE, SW) for the former (Su & Saunders, 2006), and Peninsular Thailand to Myanmar, extending to the Andaman Islands, for the latter (Smitinand *et al.*, 1980; Pooma *et al.*, 2017). We also collected an unidentified species of *Neo-uvaria* Airy Shaw (Annonaceae), which consists of 9–15 species (formally 7 species are accepted) (Chaowasku *et al.*, 2011), all known from the Malesian region (southern Thailand, Peninsular Malaysia, Borneo, Sumatra and the Philippines). It is notable that the flora of Nam Kading contains some Malesian elements.

The remaining 21 taxa either just extend to Laos or fill gaps in their distribution ranges. For example, *Epigynum cochinchinensis* (Pierre) D.J.Middleton (Apocynaceae), known from Myanmar, Thailand and Vietnam, and *Nyctocalos brunfelsiiflorum* Teijsm. & Binn. (Bignoniaceae), known from southern China (Yunnan), Thailand, Myanmar, Malaysia and Indonesia, were previously expected to occur in Laos and Cambodia by Middleton (2014) and Santisuk & Vidal (1985), respectively. Therefore, the distribution in Laos can be very valid. Recently, Dang *et al.* (2016) also reported *Nyctocalos brunfelsiiflorum* from northern Vietnam.

The flora of Nam Kading National Protected Area remains poorly known. More than half of our collections are still unidentified, mainly owing to the lack of flowers or fruits, and some of them seem to be new species. Further inventories, especially of higher elevation and limestone karst areas, are needed to document the total flora of the Nam Kading National Protected Area.

The forest in the lowland area has been recently cleared or partially logged for timber or firewood and often converted to plantations of cassava, pineapple and upland rice, even within the protected area. Also, a hydropower dam along the Nam Theun River is under construction. Further studies on the plant diversity of this area should be urged to develop better conservation planning of this protected area.

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