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Studies in Asian *Nervilia* (Nervilieae, Epidendroideae, Orchidaceae) VI: *N. mekongensis*, a new species from Thailand, Cambodia, Laos and Vietnam

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Abstract

A new species of the terrestrial orchid genus *Nervilia* is described and illustrated from material collected at several localities in the Greater Mekong region of Southeast Asia. The multi-flowered inflorescence bearing relatively large flowers with a pubescent lip, and the many-veined, cordate-reniform leaf blade that is held well above ground level, place *N. mekongensis* in section *Nervilia*. Despite being superficially similar to *N. aragoana*, a widespread species of tropical Asia and Australasia, it is most closely affiliated to *N. fordii*, a species known from southern China and Thailand. It is distinguished by its stout inflorescence and lip that is broadest midway along the hypochile and which has acute, forward-projecting side-lobes and a short, ovate mid-lobe. A conservation assessment plus taxonomic notes are provided.

Introduction

The full diversity of the Old World terrestrial orchid genus *Nervilia* Commerson ex Gaudichaud-Beaupré in Freycinet (1829: 421, t. 35) remains unknown. The World Checklist of Selected Plant Families lists 69 accepted names (Govaerts *et al.* 2015), but five new species have been added in the three years since it was last updated (Gale *et al.* 2013, 2014, 2015; Lin & Chang 2013; Lin 2014), and recent revisions for national floras have hinted at other undescribed or incompletely known taxa (e.g. Chen & Gale 2009; Gale & Watthana 2014). All of the five recently described species were collected in Asia, and all belong to a single section of the genus, section *Linervia* (Schlechter 1911: 400), which is characterised by a one-flowered inflorescence that elongates during fructescence (Pettersson 1991). Although molecular studies have uncovered significant genetic distance among previously confused species in the section (Gale *et al.* 2010, 2015; Eum *et al.* 2011), the authors of the new taxa emphasised the uniformity of gross morphology as a factor in obscuring their recognition. At least in section *Linervia*, therefore, species complexes and cryptic taxa have emerged as a recurrent challenge to a more complete understanding of the systematics of the genus.

The existence of species complexes in the two other sections of the genus, *Vinerlia* (containing two-flowered species) and *Nervilia* (containing many-flowered species), has been suggested by some authors (Seidenfaden 1978; Pettersson 1991; Gale & Watthana 2014) but not critically examined. In Asia and Australasia, section *Nervilia* is epitomised by *N. aragoana* Gaudichaud-Beaupré in Freycinet (1829: 422), a very widespread species that bears 4–16 flowers, each comprising similar, green tepals and a white lip that is marked with dark green or brownish-purple lines and which bears tall, white hairs primarily along the main veins on the disk. Considerable variation in the outline and colouration of the lip, as well as in the degree of pubescence on the disk, has led to proliferation of scientific names and confusion as to their correct application (Seidenfaden 1978). This has blurred species boundaries with other members of the section, several of which appear to have much more restricted distributions and consequently are considerably less well represented in herbaria. Detailed studies are needed, for example, to establish whether the name *N. concolor*

(Blume 1825: 417) Schlechter (1911: 404) should take precedence over *N. aragoana*, as suggested by some recent authors (e.g. Govaerts *et al.* 2015), or whether they should be maintained as separate entities.

In the course of ongoing revisionary studies of the genus in Asia, plants of uncertain identity were encountered across Indochina and Thailand that clearly belong to section *Nervilia* on account of their multi-flowered inflorescence and pubescent disk. Despite their wide geographic separation, the plants exhibited remarkable stability in floral and vegetative characters, indicating that they represent a single, well defined species (Fig. 1). Some collections of the species had been referred to *N. aragoana* in the course of surveys (e.g. Averyanov 2011) and by local botanists, but detailed observation quickly revealed this not to be the case: in addition to their striking bright green and magenta perianth, the prominent, triangular, forward-pointing side-lobes and short, ovate and densely villose mid-lobe of the lip were inconsistent with the typically rounded side-lobes and long, undulate and sparsely pubescent mid-lobe of the lip in *N. aragoana*. Closer inspection suggested greater affinity to *N. maculata* (C.S.P. Parish & Rchb.f. in Reichenbach 1874: 143) Schlechter (1911: 403), a species named from Southeast Myanmar, and *N. fordii* (Hance 1885: 247) Schlechter (1911: 403), a species named from Guangdong Province in southeast China, both of which remain poorly known.

Nervilia maculata was described in 1874 as *Pogonia maculata* (Reichenbach 1874). Although the protologue states that the species is one- or two-flowered, details of the lip place it in section *Nervilia*; in revising the species of Africa, Pettersson (1991) has already established that flower number per se is not an accurate means of assigning sectional affiliation in *Nervilia*. Nevertheless, the few-flowered inflorescence of this species (Hooker 1890; Gale & Watthana 2014) is at odds with the four- or more-flowered inflorescence of our plants from Thailand and Indochina. Moreover, the scape of *N. maculata* is slender, its tepals are narrow (<3 mm wide), and its small leaf (<4 cm across) is marked with dark purple blotches. Although the band of dense, long hairs on the mid-lobe of the lip is similar to that in our unplaced plants, the broad, truncate side-lobes that emerge further back from the lip apex (Seidenfaden 1978) are incongruous. In addition, the lip of *N. maculata* is described in the protologue as green with dark green venation (Reichenbach 1874), a markedly different colouration compared to that of our collections.

Nervilia fordii, described as *Pogonia fordii* Hance in 1885, is known to have a three- to five-flowered inflorescence (Seidenfaden 1978; Chen & Gale 2009; Gale & Watthana 2014). The lip of this species, too, is densely villose in a central band that extends to the apex of the mid-lobe. However, the lip side-lobes are broadly triangular and project outwards, and the mid-lobe is oblong with a truncate apex, features which set it apart from our plants. The widest point of the lip of *N. fordii* is across the side-lobes, with the hypochile tapering sharply towards the base below them; in contrast, the lip in our unplaced plants broadens to its widest point midway along the hypochile, well below the side-lobes (Fig. 2E). The colouration of the lip of *N. fordii* also differs, being white with purple venation, and with the hairs on the disk being white. Although the ovary of *N. fordii* has a long, slender inflorescence at anthesis, in contrast to the short, stout inflorescence of our unplaced species. In addition, the leaf of *N. fordii* has dark blotches on the veins, similar to that of *N. maculata*.

A combination of several features therefore distinguishes the unplaced Thai and Indochinese plants from the most similar species in the region: the short, stout scape bearing four to eight flowers; the prominently winged ovary; the vivid green tepals and bright magenta lip; the small, triangular, forward-projecting side-lobes and short, ovate mid-lobe of the lip; and the dense, magenta pubescence on the disk. Given that more minor variation in lip colour, outline and indumentum has concealed wide genetic differentiation and distinct evolutionary histories in section *Linervia* (Gale *et al.* 2015), these clear differences seem to justify recognition at the species level.

Taxonomy

Nervilia mekongensis S.W.Gale, Schuit. & Suddee, sp. nov. (Figs. 1, 2).

- Type:—THAILAND. Nakhon Ratchasima Province: Chok Chai District, Thoong Aruan, c. 250 m, 16 June 2015, *T. Sando 01* (holotype BKF!, flower); 9 July 2015, *T. Sando 02* (paratype BKF!, leaf).
- Diagnosis: This new species is most closely affiliated to *N. fordii* (Hance) Schltr., but it differs in its short, stout inflorescence; the colouration of its flowers; the triangular, acute, forward-projecting side-lobes and short, ovate mid-lobe of the lip; the lip being broadest well below the side-lobes; and in the absence of dark purple blotches on the leaf.

Nervilia aragoana auct. non Gaudich., sensu Averyanov (2011: 89, fig. 49c-f & 50h-i), pro parte.



FIGURE 1. *Nervilia mekongensis.* A. Inflorescence emerging above ground. B and C. Flowering plant in habitat. D and E. Close-up of flower. F. Seed capsules. G. Plants in leaf emerging above ground. H. Large colony of plants in leaf. Photos A, C, D and F–H taken by T. Sando at the type locality in eastern Thailand, photo B taken by N. Karnsunthad in Mae Ping National Park, Lamphun Province, northern Thailand, and photo E taken by K. Souvannakhoummane in Luang Prabang Province, northern Laos.

Stout, glabrous, terrestrial herb up to 26 cm tall. Tuber whitish-beige, compressed globose, 18.4–27.0 mm long, 14.5-20.0 mm wide, 11.8-17.2 mm tall, 4-6-noded, bearing short wiry roots up to 1.1 cm long. Subterranean stem emerging from apical node of tuber, white flushed pink-purple above, up to 6.5 cm long, several-noded, with a small, papery sheathing cataphyll on the upper node(s), producing 2 or more segmented lateral runners 5.0-8.5 cm long in the leafing phase that each give rise to a daughter tuber at the apex. *Petiole-like stalk* erect, 8.5–16.8 cm long, 3.4–4.5 mm in diameter, purple-brown, with 1 brown membranous, tightly sheathing cataphyll 4.5–6.5 cm long at base. Leaf blade held well above ground level, broadly cordate-reniform, 6.2-9.3 cm long, 7.8-11.4 cm wide, strongly plicate and with the 21-27 veins alternately raised on the abaxial and adaxial surfaces, margin somewhat undulate, apex acute, deeply cordate at base, the basal lobes sometimes overlapping slightly, both surfaces light green and slightly iridescent. Inflorescence 7.0–18.5 cm tall, fleshy, elongating during fructescence, 1.8–3.6 mm in diameter, light green, bearing 2–3 membranous loosely sheathing cataphylls 1.8–3.2 cm long, 4–8-flowered; floral bracts reflexed, narrowly elliptic-lanceolate, 9.4-22.0 mm long, 1.6-2.5 mm wide, acute or acuminate, light green. Flowers laxly to subdensely spaced, resupinate, pendulous, 17.8-25.5 mm long, opening widely, faintly malodorous. Pedicel and ovary distinctly winged, 5.9–9.6 mm long, light green. Sepals and petals light green, obscurely keeled along mid-vein on outer surface, 4-5-veined, acute. Dorsal sepal narrowly oblanceolate, 11.9-16.9 mm long, 3.2-4.0 mm wide. Lateral sepals oblanceolate, asymmetric and slightly oblique, shallowly concave, 11.4-17.0 mm long, 3.3-4.6 mm wide. Petals elliptic to oblanceolate, slightly oblique, 10.8-14.5 mm long, 3.0-4.3 mm wide. Labellum broadly oblongovate, 9.5–11.2 mm long, 5.7–7.6 mm wide, 3-lobed near the apex, not spurred or saccate at base, with c. 9 bifurcating main veins either side of the mid-vein, lateral margins embracing the column, inner surface vivid magenta flushed white towards the base and with a narrow central white band, outer surface white; disk with a densely lanate, magenta band that runs along a low central ridge and broadens in the apical third to cover the entire surface of the mid-lobe; lateral lobes erect, triangular, c. 1 mm long and wide, projecting forwards, acute; mid-lobe ovate-triangular, 1.9–2.4 mm long, 1.6-3.2 mm wide, acute to subacute. Column clavate, straight, 6.2-7.4 mm long, 1.2-1.7 mm in diameter, swollen above the middle, glabrous, white flushed pale green at base; anther helmet-shaped, hinged at column apex, 1.5–1.7 mm long, the clinandrium deeply cucullate; pollinium mealy, c. 1.5 mm long; rostellum forming a thickened, protruding ridge at apex of stigma; stigma broadly shield-shaped, concave. Capsule fusiform, with 6 thick, pronounced ridges, 1.5–1.8 cm long, c. 0.8 cm in diameter.

Distribution:—We confirmed herbarium material of *Nervilia mekongensis* from eastern and northern Thailand, northern Laos, eastern Cambodia, and northern and southern Vietnam. Plants photographed by Naruemol Karnsunthad in Mae Ping National Park in Lamphun Province, northern Thailand, were also verified as belonging to this species (Fig. 1B).

Ecology:—At the type locality in eastern Thailand, *Nervilia mekongensis* grows in dry deciduous forest dominated by *Shorea siamensis*. In northern Thailand and Laos, it occurs in dry deciduous forest on limestone, and in Cambodia it is found in open deciduous forest, growing together with the terrestrial orchids *Eulophia spectabilis* (Dennst.) Suresh and *Geodorum siamense* Rolfe ex Downie. In Vietnam, it grows in open secondary scrub and grasslands at the edge of disturbed forest on eroded limestone ridges. It is known throughout an elevational range of 250–1,000 m.

Phenology:-Flowering April to June, in leaf from July until November.

Conservation status:-Based on the eight sightings (seven herbarium collections and one photo) confirmed in this study, we used GeoCAT (Bachman et al. 2011) to calculate an EOO of 742,378 km² and an AOO of 32 km², giving preliminary Red List assessments of LC and EN, respectively. Although the number of confirmed localities is presently limited to fewer than 10, it is plausible that the species is under-recorded given its brief flowering period and "non-orchid-like" leaf. It is also possible that plants of N. mekongensis have been misidentified as N. aragoana at other localities, especially if they have only been observed in leaf. Our observations indicate that only one of the known populations is currently under threat, with construction work encroaching into the type locality in eastern Thailand. We do not regard the species' distribution as "severely fragmented", with many Nervilia species having a similarly scattered occurrence. The habitat of N. mekongensis is generally threatened throughout the region, due to logging and establishment of exotic forestry plantations. However, N. mekongensis appears to be tolerant of moderate disturbance, and can establish in secondary woodland and grassland. Tubers of related members of Nervilia are heavily exploited in traditional Chinese medicine, and the spread of itinerant traders buying up wild plants in rural villages throughout Indochina for export to China poses a considerable threat to many purportedly medicinal orchids. On the strength of current knowledge, we estimate the global population of N. mekongensis to amount to more than 1,000 plants, although we are unable to judge the extent to which populations are made up of ramets belonging to just one or a few clones (see for example Gale *et al.* 2010) versus genetically distinct individuals all derived from seed. We therefore presently regard N. mekongensis as NT based on Red List Criterion B (geographic range; IUCN 2014), with the large EOO

set against the limited number of localities known for the species, the observed decline in number of individuals and habitat quality at one site, the loss of natural forest throughout its range, and the projected impact of harvesting for the medicinal plant trade; we expect that AOO will rise with more detailed surveys and closer examination of populations in the region.



FIGURE 2. *Nervilia mekongensis.* A. Flowering plant. B. Vegetative plant with immature leaf and developing lateral runners. C. Fully expanded leaf from above. D. Front view of flower at full anthesis. E. Labellum. F. Dorsal sepal. G. Lateral sepal. H. Petal. I. Ventral view of column. Drawn by Orathai Kerdkaew from *T. Sando 01* (parts A and D–I) and *T. Sando 02* (parts B and C).

Etymology:—Named for the Mekong River, which flows through all four range countries and supports the enormous biodiversity of the region.

Vernacular name:—Thai: ว่านแผ่นดินเย็นแม่โขง (Wan phaen din yen mekong).

Specimens examined:—CAMBODIA. Mondulkiri Province, c. 13 km northeast of Saen Monourom, 600 m, 9 May 2015, *Schuiteman, Ryan, Nay & Att 15-17* (K!, also living plant *Kew cult. 2015-1132*). LAOS. Luang Prabang Province, Chomphet District, Chan Tai Village, 300 m, 8 April 2014, *Souvannakhoummane KS581* (Pad Tad Ke Botanical Garden Herbarium!). THAILAND. Nakhon Ratchasima Province, Chok Chai District, Thoong Aruan, c. 250 m, 16 June 2015, *T. Sando 01* (BKF!); 9 July 2015, *T. Sando 02* (BKF!); Chiang Mai Province, Chiang Dao District, Muang Na, c. 600 m, 27 April 2014, *Watthana, La-ongsri & Sriton 4338* (QBG!). VIETNAM. Vung Tau Province, Con Dao Islands, Bay Canh Island, 30 April 1993, *Averyanov & Kudryavtzeva s.n.* (LE!); Ha Giang Province, Quan Ba District, Can Ty Municipality, in the vicinity of Sin Suoi Ho Village, 900–1,000 m, 11 May 2002, *Averyanov, Loc & Vinh HAL1580* (LE!, HN!); Ninh Binh Province, Cuc Phuong National Park, 4 April 2004, *Hiep s.n.* (LE!).

Taxonomic notes:—Minor morphological variation in details of the perianth and leaf have concealed cryptic species in the genus *Nervilia*, and this appears to be the case with *N. mekongensis*. Careful examination of the flower in particular is required to confirm the diagnostic characters described here because, in leaf, the species is practically indistinguishable from certain other members of section *Nervilia*, including *N. aragoana*. In light of this, the recognition of *N. mekongensis* necessitates reappraisal of existing herbarium material from the region which may have been misidentified. As for all members of the genus, however, obtaining a complete collection is challenging because the flowering phase is brief and the leaf only emerges once the inflorescence has faded. This growth habit will undoubtedly continue to confound accurate determination of species in the genus. As part of the present study, we examined a specimen at the HK herbarium (HK27665) comprising leaves that almost certainly belong to the type collection of *N. fordii* that have been mounted with an inflorescence of the unrelated *Mischobulbum cordifolium* (Hook.f.) Schltr. This sort of error, not uncommon in preserved material of *Nervilia*, underscores the difficulties that remain in tackling taxonomic confusion in the genus.

Although Pettersson (1991) used the elongating fruiting scape as the defining synapomorphy of section *Linervia*, we observed this feature in *N. mekongensis* during the present study; it has not previously been noted for a member of section *Nervilia*. Whether or not this trait also occurs in *N. fordii* and *N. maculata*, to which *N. mekongensis* otherwise seems closely affiliated, can only be confirmed as and when authentic fresh material comes to light. We advocate the application of molecular approaches, which have proved useful in unraveling complex species relationships in other sections of the genus (Gale *et al.* 2015), for further clarification of species boundaries in section *Nervilia*.

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