PAPHIOPEDILUM CANHII IN LAOS PHOU PHACHAO MOUNTAIN – MOUNTAIN OF PAPHIOPEDILUM CANHII

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ROCKY LIMESTONE AREAS of mainland southeast Asia conceal the highest world diversity of strictly endemic *Paphiopedilum* species relatively well studied in China, Vietnam and Thailand. At least 22 slipper orchid species, with very limited distribution, were discovered here during the last two decades (Averyanov et al., 2003b; Averyanov, 2008; Cribb, 2008, 2011; Liu Zhongjian et al., 2009; Liu Xhong-Jian et al., 2009). Meanwhile, the central part of the Indochinese peninsula, and particularly the territory of Laos, contain the largest part of the Indochinese limestone belt (Rundel, 1999; Kiernan, 2009) which remains poorly known at present. These inaccessible areas, undoubtedly, are home for numerous unknown plant species, particularly for strictly endemic orchids. This habitat type is recognized in better studied neighbouring countries as being particularly rich in endemic plants (Shui, Chen, 2006), especially in orchids (Averyanov et al., 2003a). As a result, it is not surprising when each field exploration in previously unstudied rocky limestone massifs in Laos bring new and often exciting discoveries. One of such outstanding recent novelties in the flora of Laos is *Paphiopedilum canhii*.

Paphiopedilum canhii was first discovered in 2010 in north-western Vietnam being found in a locality allied to the Laotian border (Averyanov, 2010; Averyanov, Gruss, 2010). The plant attracted high interest in botanists and orchid lovers for their miniature habit and unusual appearance desirable for ornamental cultivation. Meanwhile, no other sites were found in Vietnam with this species up to now in spite of intense special investigation (Averyanov et al., 2011). At the same time, the very small population in north-western Vietnam was severely depleted due to commercial collecting and is now nearly extinct soon after its discovery. The detailed history of the discovery, exploitation, and extinction of *P. canhii* in Vietnam was presented in a series of publications (Averyanov et al., 2011a, b; 2013).

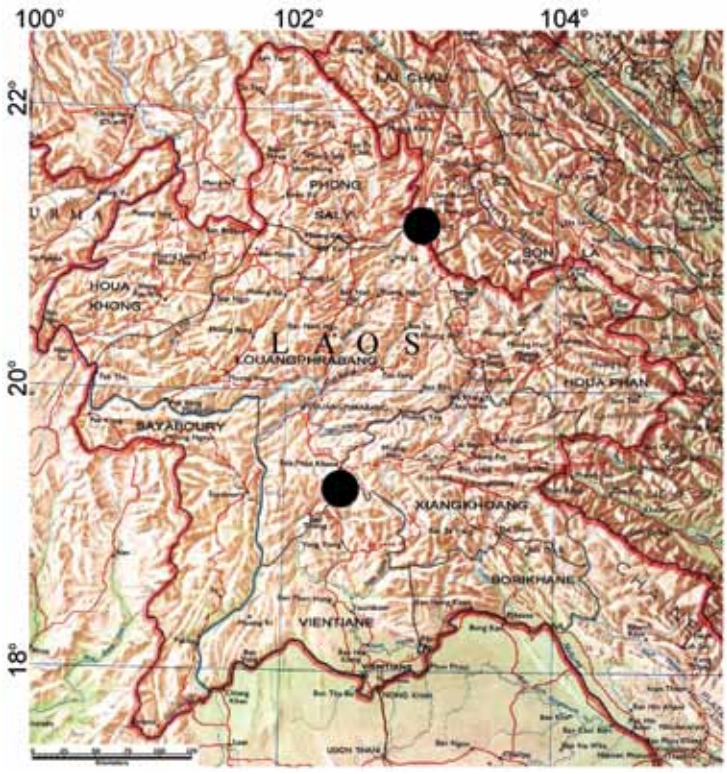

Fig. 1. Locations of discovered populations of *Paphiopedilum canhii* in northern Indochina.

At the same time, further studies of *Paphiopedilum canhii* revealed a very isolated taxonomical position of this species, hence some taxonomists and orchid enthusiasts proposed segregating it in a rank of a separate monotype section—*Paphiopedilum* subgen. *Paphiopedilum* sect. *Pygmaea* Aver. (Averyanov *et al*., 2011b), or even a separate subgenus—*Paphiopedilum* subgen. *Megastaminodum* Braem et O. Gruss (Braem, Gruss, 2011). Such segregation underlines once again the very high taxonomical level of plant endemism found in limestone rocky formations of Indochina and provides straight extrapolation for the possibility of exciting discoveries here in future.

This idea proved true when we made our botanical explorations of orchid flora in the remote limestone areas of Laos completed during 2013. These activities were supported financially by the U.S.A. National Geographic Society, American Orchid Society, and Mohamed bin Zayed Species Conservation Fund. Beside *P. canhii*, 43 new orchid species belonging to 32 genera were discovered, eight of which (*Acanthophippium, Didymoplexiopsis, Eclecticus, Herpysma, Hetaeria, Lecanorchis, Neuwiedia* and *Trichosma* (now a synonym of *Eria* according to the *World Checklist of selected Plant Families*) are new for the flora of Laos. These discoveries listed below in Table 1 represent an important addition to the excellent, but still incomplete inventory of the Laotian orchid flora (Newman *et al*., 2007; Schuiteman *et al*., 2008).

Paphiopedilum canhii is undoubtedly the most exciting and surprising orchid discovery made during the expedition. This species, regarded earlier as a strictly Vietnamese endemic, was found in one of the largest rocky limestone massifs situated in the Kasi district of Vientiane Province of central Laos approximately 180 km to the SSW from the point of its first discovery on the territory of Vietnam (Fig. 1). It was found as a common inhabitant of the Phachao (Pha Tiao) mountain sys-

Table 1: Orchid species discovered during our field explorations in Laos

Acanthophippium striatum
Agrostophyllum callosum
Bulbophyllum apodum
B. psychoon
B. umbellatum
Cheirostylis griffithii
C. pusilla
C. spathulata
C. thailandica
Coelogyne virescens
Cymbidium eburneum
Dendrobium kontumense
Didymoplexiopsis khiriwongensis
Eclecticus chungii
Epigeneium chapaense
Eria calcarea
E. corneri (Syn. E. scabrilingus)
E. thao (Syn. Campanulorchis thao)
Flickingeria angustifolia
Gastrochilus calceolaris
G. pseudodistichus
Goodyera fumata
G. hispida
Herpysma longicaulis
Hetaeria affinis
Holcoglossum subulifolium
Lecanorchis vietnamica
Liparis balansae
L. pumila
Micropera poilanei
Nephelaphyllum tenuiflorum
Neuwiedia zollingeri
Oberonia cavaleriei
Otochilus pseudoporrectus
Paphiopedilum canhii
Papilionanthe biswasiana
Phalaenopsis wilsonii
Podochilus oxystophylloides
Sunipia rimannii
Thelasis khasiana
Thrixspermum sutepense
Trichosma simondii
T. suavis

tem which has the highest limestone peak in Indochina (1883 m/74134 feet). This massif, combining three main and a few smaller additional ridges, has a width about 2 km (1.2 miles) and runs from NE to SW for about 6 km (4 miles) with dominating elevations of 1400-1700 m a.s.l. (4593-5577 feet) (Fig. 2). Mother rocks of the mountain system are represented by highly metamorphosed marine sediments of Permian-Carboniferous age (Kiernan, 2009) elevated and deeply eroded during later ages. Presently, these limestone formations appear as highly eroded peneplain presented by numerous crowded column-, mesa-, or table-like rocky remnant mountains with very steep slopes and cliffs along their perimeter (Fig. 2-4). Deep caves, shady cliff shelves, and vertical karstic crevices are a very usual element of the landscape here (Fig. 3, 4). Solid, light gray to almost white, marble-like, crystalline limestone dominate in the rock mountain composition. Travertine deposits, like replaced dust-like lime, or impressive stalactites and stalagmites are observed regularly on shady cliffs and bluffs (Fig. 4d).

The *Paphiopedilum canhii* area, like everywhere in Laos, enjoys a tropical monsoon climate with two distinct seasons, the rainy season from the beginning of May to the end of September and the dry season from October through April. Average annual precipitation, determined by the nearest Luang Prabang climate station (situated at about75 km (47 miles) to the NNW from

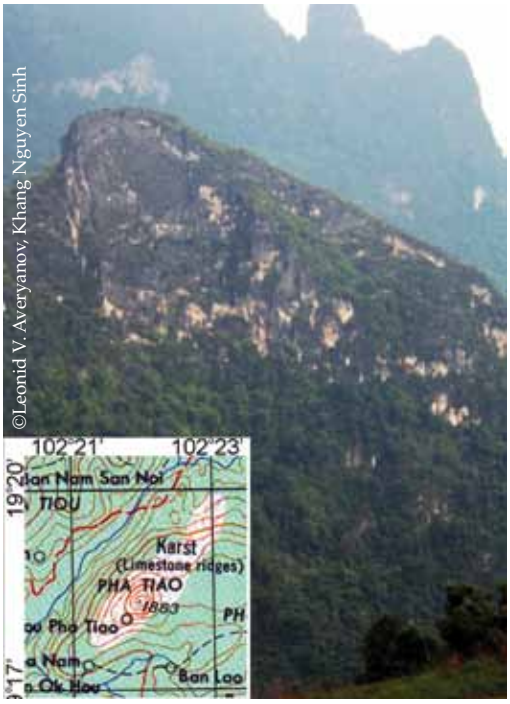

Fig. 2. Phou Phachao (Pha Tiao) Mountain in northern Laos (view from north-west) – highest limestone massif in Indochina (1883 m a.s.l.) with extremely rich local orchid flora provides home for outstanding Indochinese endemic – *Paphiopedilum canhii.*

Fig. 3. Distinctive picturesque rocky landscape of Phou Phachao mountain system on north-western slopes.

Fig. 4. Typical vegetation and habitats of *Paphiopedilum canhii* on highest part of slopes and on tops of Phou Phachao Mountain (**a-c:** primary semideciduous dry limestone forest and scrub on mountain summits; **d:** shady, north faced cliffs with mossy travertine deposits).

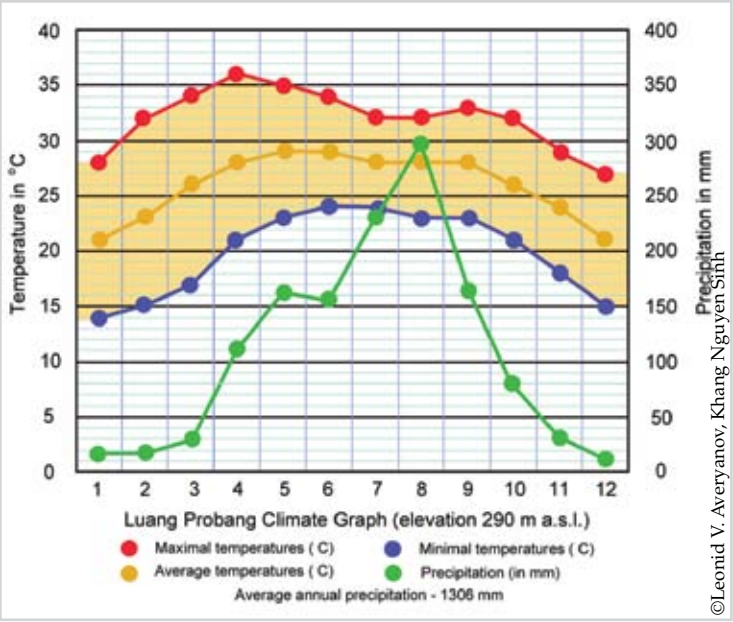

Fig. 5. Climate diagram based on data of Luang Prabang climate station situated at elevation 290 m a.s.l.

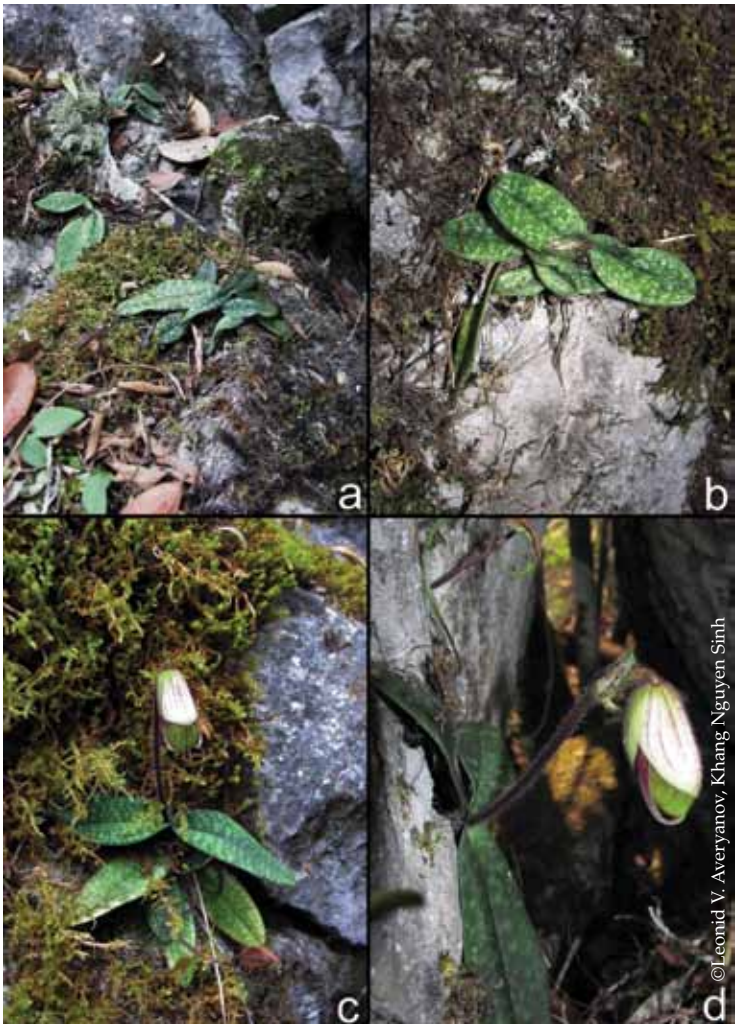

Fig. 6. Samples of *Paphiopedilum canhii* growing in native habitat on vertical shady mossy limestone cliffs of Phou Phachao Mountain.

Phachao Mountain) at elevation 290 m a.s.l. (950 feet), is 1306 mm (51 inches) with the maximum monthly rainfall in August about 300 mm/ 12 inches and minimal precipitation during December – February (less than 40 mm / 1.5 inches per month). The yearly average temperature in Luang Prabang is about 26°C (79°F), rising to a maximum of 36°C (97°F) in April and dropping to a minimum of 14°C (57°F) in January. Average monthly temperatures around the year lie between 21° and 29°C (Table 2, Fig. 5). Meanwhile, climate in the studied habitats of *P. canhii* near the top of Phachao Mountain at elevations of 1600-1880 m a.s.l. is different. Monthly temperatures here year round are at least 10°C lower, and during cold winter nights easily reach the freezing point. Monthly rain precipitations are much higher as well. Clouds, heavy fogs, and mists are typical on mountain tops anytime of the year and provide permanent high humidity favorable for orchid growth.

Primary broad-leaved evergreen or semi-deciduous seasonal forest represents climax type of intact vegetation in highland rocky limestone in central Laos including Phachao Mountain. On rocky mountain summits, forest may be rather open, particularly during the rainless season. However, it provides enough shade on north-faced slopes and in deep depressions between mountain peaks. On open rocky slopes of southern exposition, forest becomes short and sometime appears as a primary scrub only two-three m tall (Fig. 4). Highly endangered kinds of intact primary habitat observed here conceal outstandingly rich orchid flora having no analogs among other kinds of vegetation in the region. There easily may be 100-150 epiphytic, lithophytic or terrestrial orchid species on a fairly small square of primary forest or scrub on any mountain peak.

Paphiopedilum canhii typically grows as a genuine lithophyte on shady vertical cliffs or on narrow mossy shelves with plant roots densely adpressed to solid naked limestone having no soil level (Fig. 6, 8). It occurs mainly on vertical shady cliffs of north exposi-

Table 2: Month temperatures & precipitation in Luang Prabang at elevation 290 m.s.l.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Average maximal temperature	28°C	32°C	34°C	36°C	35°C	34°C	32°C	32°C	33°C	32°C	29°C	27°C
	82°F	90°F	93°F	97°F	95°F	93°F	90°F	90°F	91°F	90°F	84°F	81°F
Average temperature	21°C	23°C	26°C	28°C	29°C	29°C	28°C	28°C	28°C	26°C	24°C	21°C
	70°F	73°F	79°F	82°F	84°F	84°F	82°F	82°F	82°F	79°F	75°F	70°F
Average minimal temperature	14°C	15°C	17°C	21°C	23°C	24°C	24°C	23°C	23°C	21°C	18°C	15°C
	57°F	59°F	63°F	70°F	73°F	75°F	75°F	73°F	73°F	70°F	64°F	59°F
Average precipitation (in mm)	16	17	30	109	163	155	230	299	166	78	30	13

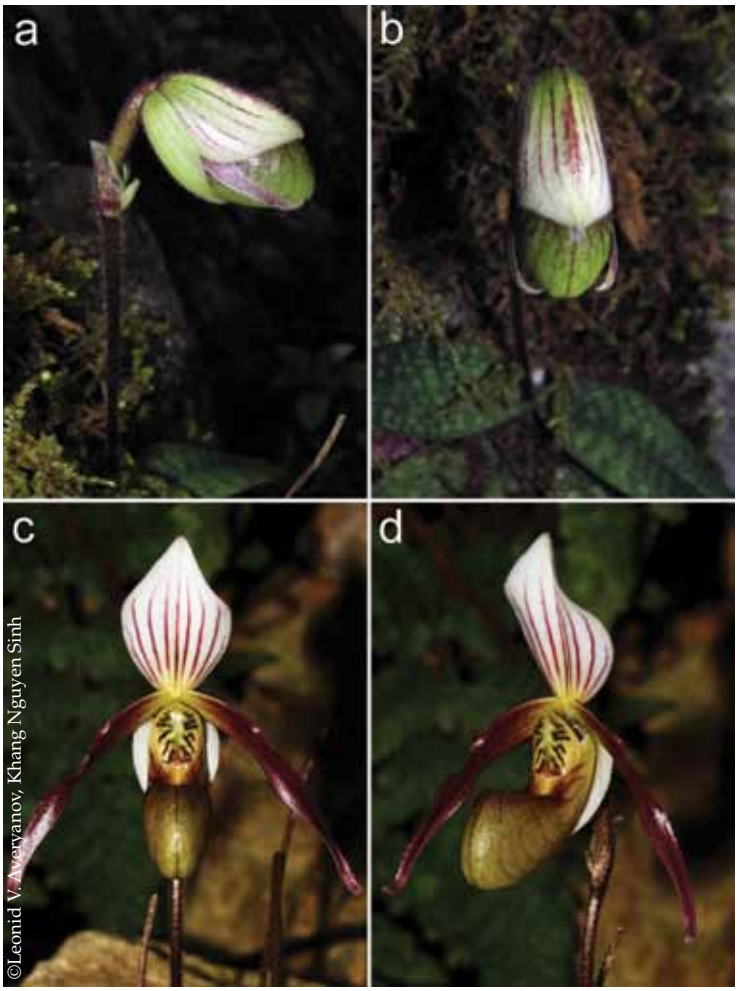

Fig. 7. Flower buds and typical flower of P*aphiopedilum canhii* in Laotian populations.

tion near mountain summits at elevations 1600-1800 m a.s.l. (5249- 5905 feet) under constant light shade of rather open primary forest. All observed plants certainly differ from Vietnamese samples with distinctly shorter, broader and much more rigid leaves making Laotian clones more compact and miniature (Fig. 6, 8). The flowers are a bit larger, but their shape, structure and coloration looks identical with plants found in Vietnam (Fig. 7). We observed frequent fruit formation in all discovered Laotian subpopulations in the spring of 2013 (Fig. 8) in contrast to a miserable number of developed capsules seen in species *locus classicus* in Vietnam (Averyanov et al., 2011a, b; 2013).

Habitats of *Paphiopedilum canhii* and associated plant communities on rocky limestone are very rich in other orchid species. Two other slipper orchids—*Paphiopedilum dianthum* and *P. concolor* regularly occur in the same habitats as common close neighbors (Fig. 9). At least 200 orchid species may be observed in and around habitats of *P. canhii* in Phachao Mountain. Many of them are ornamental plants widely collected for sale everywhere in easily accessible localities. Rich intact populations of such species may be still seen in the discovered area of *P. canhii*. Some ornamental orchid species common in the Phachao Mountain habitats are presented in Fig. 10 and 11.

There exists a valid reason for organization on the governmental level for a special protected area including the Phachao Mountain massif for protection and conservation of this excellent example of still intact primary rocky limestone vegetation with extremely rich and highly endemic flora. Without such actions, the most interesting species, particularly rare orchids, like *Paphiopedilum canhii* will be extinct in the area in the very near future as happened recently in Vietnam.✾

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Fig. 8. Fruiting samples of *Paphiopedilum canhii* in native Laotian habitats observed in March - April.

Fig. 9. *Paphiopedilum dianthum* and *P. concolor* – usual slipper orchids associates in Laotian habitats of *P. canhii.*

Fig. 10. Some ornamental orchids common in habitats of *Paphiopedilum canhii* in Laos (**a, b**: *Dendrobium cariniferum*; **c, d**: *D. findleyanum*; **e**: *D. wardianum*; **f**: *Cymbidium lowianum*; **g**: *Bulbophyllum orectopetalum*; **h**: *B. psychoon*; **i**:*Panisea uniflora*).

Fig. 11. Some miniature ornamental orchids associated with *Paphiopedilum canhii* in Laos (**a, b**: *Phalaenopsis wilsonii*; **c**: *Papilionanthe biswasiana*; **d, e**: *Eclecticus chungii*; **f**: *Sarcoglyphis mirabilis*; **g, h**: *Sunipia rimannii*; **i**: *Cheirostylis griffithii*).

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