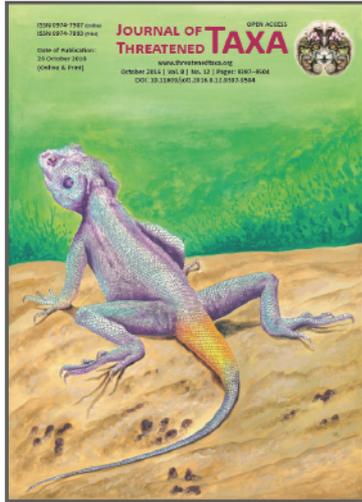


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IDENTIFYING ORCHID HOTSPOTS FOR BIODIVERSITY CONSERVATION IN LAOS: THE LIMESTONE KARST VEGETATION OF VANG VIENG DISTRICT, VIENTIANE PROVINCE

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Abstract: A project to study the phytodiversity of the Indo-Burma Biodiversity Hotspot (IBBH) was initiated by Kadoorie Farm and Botanic Garden, Hong Kong, in 2011, with the aim of surveying primary forest fragments and identifying conservation priorities within this expansive but highly threatened ecoregion. Vang Vieng District of Vientiane Province, northern Laos, was chosen as a focus for a pilot expedition, since it features an extensive karst landscape that has barely been explored. Together with officials from the Ministry of Science and Technology, Government of Lao PDR, surveys of three sites were conducted in April 2012, at the end of the dry northeast monsoon season. Emphasis was placed on Orchidaceae because it is among the most species-rich and commercially exploited flowering plant families in the region. A total of 179 specimens were collected, of which approximately 135 were unique taxa accounting for 29.6% of the orchids found in Laos and 5.8% of those found in IBBH as a whole, and equivalent to 0.27 species/hectare within the area surveyed, substantially higher than published figures for other limestone areas in the region, such as Cuc Phuong National Park in Vietnam (0.0055 species/hectare) and Perlis State in Peninsular Malaysia (0.0036 species/hectare). At least one is a species new to science, nine represent new distributional records for Laos and a further nine are new records for Vientiane Province. A list of the species encountered during the study is presented and the significance of the findings is discussed. Major threats to the natural environment in northern Laos are highlighted.

Keywords: Biodiversity survey, Indo-Burma Biodiversity Hotspot, Orchidaceae, threats.

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Author Contribution: PK, SG, GF & SB conducted field trips; PK, SG, GF & AS identified the plants; PK & SG wrote the manuscript; SG, GF & AS reviewed the manuscript.

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Royal Botanic Gardens
Kew



INTRODUCTION

The identification of biodiversity hotspots is necessary for landscape-level protection of fragile ecosystems (Myers et al. 2000), but this must be followed by comprehensive inventories of the species found within them for targeted action at the species- and habitat-level. In order to generate more detailed understanding of local floras within the Indo-Burma Biodiversity Hotspot, Kadoorie Farm and Botanic Garden, Hong Kong, commenced joint field surveys with the Ministry of Science and Technology of Laos People's Democratic Republic in 2011. The main aim of this initiative is to identify conservation priorities in Laos within the context of the highly threatened Indo-Burma Biodiversity Hotspot.

Indo-Burma Biodiversity Hotspot

The Indo-Burma Biodiversity Hotspot (henceforth, IBBH) covers an area of over 2.3 million km² including all of Cambodia, Laos and Vietnam, most of Thailand (excluding a small part of the southern tip) and Myanmar (excluding a small part in the very north), and parts of South China (Hainan Island, southern parts of Yunnan, Guangxi and Guangdong provinces, and Hong Kong and Macau Special Administrative Regions), northern Peninsular Malaysia, Bangladesh and northeast India (Mizoram, Manipur, Meghalaya, Nagaland and parts of Arunachal Pradesh, Assam, Tripura and the Andaman Islands) [demarcated on the basis of shapefiles for IBBH available at CEPF website (CEPF 2016)]. IBBH has the largest human population of all the world's biodiversity hotspots, currently with over 315 million people, and this figure is projected to climb, placing intense pressure on the region's biodiversity. Accordingly, it is considered one of the world's five most threatened ecoregions (Mittermeier et al. 2004; Tordoff et al. 2011): today, less than 5% of its natural vegetation remains intact (Mittermeier et al. 2004; Gale et al. 2013). Notwithstanding the region's ecological importance, only approximately 236,000km² (~10%) of this area is currently protected (Tordoff et al. 2012).

The hotspot spans several climatic zones and features a high diversity of landforms, notably limestone karst, which together have served to generate exceptional levels of endemism (Clements et al. 2006). In addition, Miocene sea-level fluctuations and the associated establishment of refugia have been highlighted in identifying Indochina (i.e., that part of IBBH comprising Cambodia, Laos and Vietnam) as a major evolutionary hotspot (de Bruyn et al. 2014).

About 10% of IBBH land area comprises limestone mountains (Clements et al. 2006; Go et al. 2009). The highly variable climatic and edaphic conditions and the inaccessibility of the physical terrain have been cited as key factors for the development of high diversity and endemism on these limestones formations (Kruckeberg & Rabinowitz 1985; Clements et al. 2006). The limestone vegetation of IBBH has received little research attention (Chin 1977; Liang & Mo 1982; Ye et al. 1994; Cen et al. 1999; Yu & Xue 1999; Yan et al. 2002; Go et al. 2005, 2009; Clements 2006; Lu & Chen 2007; Shui & Chen 2006; Qin et al. 2007; Liu et al. 2015; Wang 2011; Wang et al. 2016), but in adjacent Peninsular Malaysia 21% of the plant species occurring on karst were found to be endemic (Chin 1977) and nearly 60% of the flora of Sarawak occurs only on limestone (Yong et al. 2004). With respect to orchids, 15 out of 22 taxa of *Paphiopedilum* recorded from Vietnam are exclusively found on limestone (Averyanov et al. 2003) and a study in Perlis state, which lies at the southern margin of the IBBH in Peninsular Malaysia, revealed 102 species including 41 new records in the course of just two surveys (Go et al. 2005), and species richness rose further to 288 species in the course of subsequent surveys conducted over the following four years (Go et al. 2009). Overall, 700 of the 2,000 recorded species of orchids in Malaysia occur exclusively on limestone (Go et al. 2009).

Floristic studies in IBBH

The flora of IBBH represents a mixture of distinct temperate, tropical and subtropical zones spanning the Indian, Sino-Himalayan, Indochinese and Malesian (Sundaic) biogeographic elements (Schmid 1989). However, comprehensive understanding of the flora of the region, in the form of checklists and floras, is wanting. According to estimates, IBBH harbours from 15,000–25,000 species of plants with nearly 50% endemism among angiosperm and gymnosperm families (Davis et al. 1986; Campbell & Hammond 1989; Davis et al. 1995; van Dijk et al. 1999). Of these, the Orchidaceae is among the most species-rich and one of the most heavily exploited (Phelps & Webb 2015).

One of the first floristic works covering part of IBBH was *Flora Cochichinensis*, published by João de Loureiro in 1790, while a more comprehensive treatment came from Lecompte (1907–1942) in the series *Flore Generale de l'Indochine*, followed by 31 volumes of the *Flore du Cambodge, du Laos et du Vietnam*, edited by Aubréville & Leroy (1960–2004). Recent contributions to knowledge of the regional flora comes from

Averyanov & Averyanova (2003) and Averyanov (2008, 2010, 2011, 2013a, b) for Vietnam; Pedersen et al. (2014 and preceding 11 volumes) for Thailand; and the *Flora of China* series (efloras 2008) for South China. Orchid-specific monographs have also been published for countries or parts of countries of IBBH (e.g., Hynnieweta et al. 2000; Lucksom 2007; Misra 2007; Schuiteman & de Vogel 2004; Schuiteman et al. 2008; Chen et al. 2009; Barretto et al. 2011; Pedersen et al. 2011, 2014; Gale et al. 2014; Kurzweil & Lwin 2014; Tun 2014), of which Seidenfaden's papers on the Orchidaceae of Thailand (Seidenfaden 1975–2003) and Indochina (Seidenfaden 1993) are particularly far-reaching, given the size and ecological breadth of the family on the one hand, and the scope and detail of the information presented on the other. Taken together, these sources provide an estimate of 2,141 orchid species for the region, of which around 952 species (~44%) are considered endemic to IBBH (shown in Table 1 in relation to remaining forest cover and total protected area), with an average annual increase of 18 taxa through the discovery of new species (Govaerts et al. 2016). Despite the progress made in understanding orchid diversity of IBBH, significant information gaps persist. This is due primarily to challenging field conditions, the inaccessibility of the expansive core mountain areas which retain their primary forest cover, the dearth of trained field biologists and plant taxonomists in the region, difficulties in obtaining the necessary permits, and the lack of funding and resources allocated for building capacity in biodiversity science in the region.

Laos

Among the countries of IBBH, Laos holds a special significance because it contains the largest part of the Indochinese limestone belt (Rundel 1999), but stands out as the least surveyed in terms of herbarium collections (Newman et al. 2007; Table 2). A similar inference can be drawn from the fact that there are 217 endemic orchid species known from Vietnam (Averyanov & Averyanova 2003; Govaerts et al. 2016) and 141 known from Thailand (Nanakorn & Indharamusika 1999; Govaerts et al. 2016), but only 13 endemic species are recorded from Laos (Schuiteman et al. 2008; Govaerts et al. 2016), despite the fact that these countries share a common land border for the entirety of the latter's latitudinal extent. These numbers are therefore likely to change as more comprehensive field surveys are conducted.

Laos is a landlocked country with an area of 236,800km², of which 14% is under statutory protection; 57.9% of the country's key biodiversity areas, including

10% of its 30,000km² of limestone, are covered by these protected areas (Day & Ulrich 2000; Tordoff et al. 2012). The topography is predominantly rugged with plateaus and plains interspersed across large, mostly contiguous mountain ranges. Timber is among the top foreign exchange earners for the country, and national statistics show that nearly US\$80 million of timber were exported from 2011 to 2012 (Land Issues Working Group 2012). Accordingly, Laos has suffered extensive deforestation due to logging as well as the establishment of forestry plantations, mining and construction of hydroelectric dams (Delang et al. 2013). In addition, significant forest loss has occurred as a result of fire and shifting agriculture (Légris & Blasco 1972; Rundel 1999). These factors have led to encroachment into protected areas (Corlett 2009). Primary forest close to villages in rural areas has consequently all but disappeared, and disturbance is apparent to varying extents even within remaining closed forest (Tordoff et al. 2011). The more inaccessible mountain ranges retain some intact primary forests, and it is expected that these still harbour noteworthy flora and fauna.

Plant collections from Laos

Only sporadic plant collection efforts have been made in Laos, with one of the earliest being made during the period 1866–1868 by Clovis Thorel, a French naval doctor and botanist (Gagnepain 1911, 1944; Newman et al. 2007). This was followed by the expeditions of Jules Harmand in 1870, Henri D'Orléans in 1892, Clément Dupuy in 1900 and Jean-Baptiste Couinillon in 1909 (Newman et al. 2007). Finet (1900) produced many articles based on the collections at the herbarium of the Muséum National d'Histoire Naturelle in Paris, including the descriptions of six orchids from Laos. In more recent times, one of the most significant works is the compilation of all vascular plant species recorded from Laos by Newman et al. (2007), which enumerates 4,850 species. There were no works specifically on the orchids of the country until those recently published by Schuiteman & de Vogel (2004), Svengsuksa & Lamxay (2005), Schuiteman et al. (2008), Averyanov (2013) and Schuiteman (2013). Schuiteman et al. (2008) estimated the orchid flora of Laos to comprise 831 species, based on a review of the literature, an assessment of herbarium specimens collected within the country and from surrounding countries, and on a limited number of field surveys. Schuiteman (2013) later reported a more modest 490 species, based more specifically on authenticated specimens collected within the country. Even so, Schuiteman et al. (2008) listed 236 orchids

Table 1. Comparison of orchid diversity, geographic area, protected area and forested area across IBBH.

	Southern China	Cambodia	India	Laos	Myanmar	Thailand	Vietnam
^a No. of orchid taxa	488	252	484	422	834	1264	1118
^a Orchid endemism in IBBH (Overall – 952 species, 15 varieties, 2 subspecies, 1 form)	66 species, 2 varieties	4 species, 1 form	25 species	13 species 1 variety	76 species	141 species, 3 varieties, 2 subspecies	217 species, 2 varieties
^a Total area (km ²)	333,095	181,035	115,712	236,800	676,578	513,120	332,698
Limestone area (km ²)	-	20,000	-	30,000	80,000	20,000	60,000
^a Protected Area (terrestrial) (%)	19	25.7	NA	16.6	6.3	20.1	6.2
^a Forest area 1990 (%)	16.7	73.3	21.5	70.5	60.0	38.3	28.8
^a Forest area 2012 (%)	22.6	55.7	23.1	67.6	47.7	37.2	45.4
Summary forest change, 1990–2012	+	-	+	-	-	-	+

Sources: ^a Govaerts et al. 2016; ^bcalculated by plotting IBBH map on ArcGIS; ^c IUCN & UNEP 2015, Tordoff et al. 2011; ^d Worldbank 2015.

Table 2. Floristic representation of different IBBH countries in different herbaria (from Newman et al. 2007)

Country	No. of herbarium specimens per 100sq.km.
Laos	3
Cambodia	4
Vietnam	14
Thailand	50

from Vientiane Province alone, indicating both that higher orchid diversity can be expected for the country as a whole, and that this province in particular could be a local hotspot for orchids. Given this, the objective of the present study was to conduct field surveys in the Vang Vieng region of Vientiane Province (Fig. 1a,b) as a first step towards a more authoritative understanding of local and national orchid diversity and conservation needs.

MATERIALS AND METHODS

Study Area

Vang Vieng lies 156km from Muang Phôn-Hông, the provincial capital of Vientiane Province (Fig. 1b). The district covers an area of 212.5km² with a total population in 2008 of 51,671 persons (Anonymous 2009). The area is surrounded by limestone karst mountains and other limestone formations. These ranges are covered with disturbed primary forest at their margins, but are still relatively well vegetated with intact forest towards their centre. The forest of this area is comparatively unexplored but is assumed to host important populations of animals and plants, including

orchids.

The climate of Vang Vieng is influenced by the warm, wet southwest monsoon from May–October, followed by the cooler, drier northeast monsoon from November to February. Annual mean temperature is approximately 24.4°C, ranging from a minimum of 12.5°C during January to a maximum of 33°C during April (Hijmans et al. 2005). Average monthly precipitation is highest during August and lowest during December, with mean annual rainfall being 2,986mm (Hijmans et al. 2005).

Most of the forested parts of Vang Vieng are found among the karst limestone and other limestone outcrops of the region. Though they are highly disturbed to the extent that they have been succeeded by secondary scrub forest in many places, some intact primary forests remain in more inaccessible parts. Detailed forest community analysis was not conducted during the present study due to time constraints.

Field surveys

Botanical surveys were conducted during the period 25–30 April 2012. Valid collection permits were obtained in advance from the Lao PDR Government. Forest trails familiar to local guides were followed where available, although off-trail sojourns were also made. An effort was made to cover limestone areas and other physically distinct formations. In particular, the forested parts of Tham Chang Cave (18°54'42.75"N & 102°26'32.01"E), Phone Ngueng Village (18°54'30.1392"N & 102°25'24.7224"E), Nam Pae Village (18°58'35.52"N & 102°18'56.84"E) and Phou Din Deng Village (18°57'45.97"N & 102°26'6.40"E) were surveyed (Fig. 1c). All orchids encountered were photographed in habitat, GPS coordinates were recorded, and representative voucher specimens were

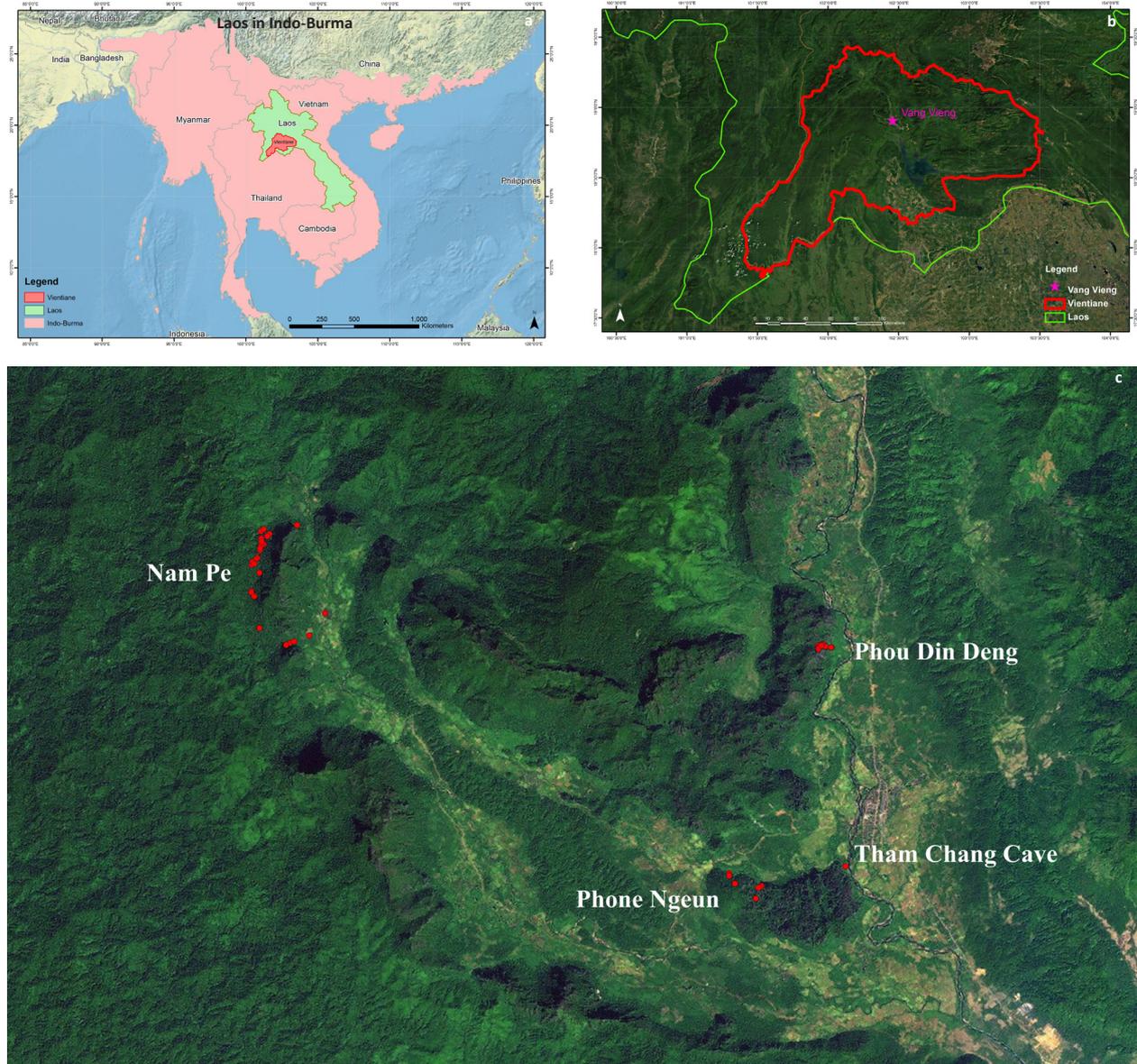


Figure 1. a - showing the Indo-Burma Biodiversity Hotspot and the location of Vientiane Province in Laos; b - satellite image showing the location of Vang Vieng District in Laos; c - satellite image showing the location of survey sites around Vang Vieng

collected.

All GPS points were mapped and a maximum convex polygon was drawn around each field location individually using ArcGIS to determine the scale of the overall survey area (because Tham Chang Cave and Phone Ngeung Village are directly adjacent to one another, they were considered a single site in making these calculations). Within this, the area actually walked and surveyed was estimated in ArcGIS by multiplying the total track length (for all three sites summed), as measured with a handheld GPS unit, by a nominal track width of 10m (i.e., 5m either side of the walked route). Most of the epiphytic orchids collected were obtained either from

the crowns of fallen trees or from branches of standing host trees within arm’s reach of ground level. We also scanned mature trees in the towns and villages to check for the presence of orchids and other epiphytes. Due to limited time, resources and the inaccessibility of the terrain, our surveys were limited to limestone hills close to villages.

Pressed voucher specimens were deposited at the National Herbarium of Laos (HNL). Living plants of certain species (mostly orchids) were transferred to the National Botanic Garden of Laos in Vientiane for ex situ conservation. DNA samples and spirit specimens of flowers were also made. All specimens (including

dissected parts where possible) were photographed. The taxonomic literature cited in the Introduction was used to identify the collections. Some sterile collections could not be identified to species level.

RESULTS

Total track length was 5.33km, giving an actually surveyed area of 0.053km² within an overall survey area of 4.71km². A total of 179 orchid specimens representing a total of 135 species were collected, but due to an absence of flowers only 81 (45.2%) of these could be accurately identified to species level. Even so, three of the five orchid subfamilies (Vanilloideae, Orchidoideae and Epidendroideae; Images 1 & 2) were confirmed, including one putative new species in the genus *Didymoplexiella* and nine new country records: *Cyrtosia nana* (Rolfe ex Downie) Garay, *Coelogyne suaveolens* (Lindl.) Hook.f., *Dendrobium linguella* Rchb.f., *D. macraei* Lindl., *Grosourdia muscosa* (Rolfe) Garay, *Hetaeria oblongifolia* Blume, *Phaius columnaris* C.Z. Tang & S.J. Cheng, *Pinalia spicata* (D. Don) S.C. Chen & J.J. Wood, and *Thelasis khasiana* Hook.f. Furthermore, a total of nine orchids were found to be new records for Vientiane Province: *Bulbophyllum helenae* (Kuntze) J.J. Sm., *B. odoratissimum* (Sm.) Lindl. ex Wall., *B. siamense* Rchb.f., *B. violaceolabellum* Seidenf., *Dendrobium aduncum* Lindl., *D. crepidatum* Lindl. & Paxton, *D. transparens* Wall. ex Lindl., *Mycaranthes pannea* (Lindl.) S.C. Chen & J.J. Wood and *Vandopsis lissochiloides* (Gaudich.) Pfitzer.

The list presented in Appendix I is a full enumeration of all orchid species encountered during the surveys. We provide the accepted name and full author citation for each species, followed by specimen(s) studied from the current survey, global distribution following Brummit (2007) and Govaerts et al. (2016), habitat, life form and notes, if any. Species are arranged in order of subfamily, followed by tribes and subtribes following the most recent taxonomy of the family (Chase et al. 2015). New records for Vientiane Province have been marked with a single asterisk (*) and new records for Laos have been marked with a double asterisk (**). GPS locations have been omitted to protect the listed species.

DISCUSSION

The main goal of this study was to conduct a reconnaissance survey of some limestone regions of Vang Vieng, Laos, with special emphasis on orchids.

Our collection of 135 species of orchids, including nine new species for Laos and nine new records for Vientiane Province equates to 0.27 species/hectare (using overall survey area) and accounts for 5.8% of the 2,141 species found in IBBH (Govaerts et al. 2016) and 29.6% of the 422 species recorded within Laos (Schuiteman et al. 2008; Govaerts et al. 2016). Given that epiphytic species were only recorded from fallen trees and branches at or close to head height, it is likely that a thorough survey of the forest canopy will add significantly to this observed species richness. This underscores the high orchid diversity of the region previously referred to by Schuiteman et al. (2008). We could find no comparable, geographically explicit studies focusing on other parts of Laos, but when compared with data published for selected nature reserves at similar latitudes in Vietnam, our figures further reinforce the significance of the limestone mountains of Vang Vieng as an orchid hotspot within IBBH: for example, Pu Mat National Park (18°59'00"N & 104°40'00"E), situated on the eastern flanks of the Annamite Mountains in northern central Vietnam, is considered one of 12 high priority sites for biodiversity conservation in Vietnam, but harbours only 73 orchid species in an area of 900km² (0.0008 species/hectare) (Cuong et al. 2008); similarly, Cuc Phuong National Park (20°19'00"N & 105°36'30"E), situated in the foothills of the northern Annamite Range, covers an area of 200km² and harbours 110 orchid species (0.0055 species/hectare) (Loc et al. 2013) and Xishuangbanna (22°00'N & 100°48'E) situated in southwest China, covers an area of 19,690km² and harbours 426 orchid species (0.00021 species/hectare) (Liu et al. 2015). The limestone mountains of Perlis state, Peninsular Malaysia, in the southernmost tip of IBBH, extend over an area of 821km² and harbour ca. 288 species (Go et al. 2009), equivalent to 0.0036 species/hectare. Despite its high orchid species richness, Vang Vieng was not included within any of the Key Biodiversity Areas (KBAs) marked by Tordoff et al. (2012). The limestone mountains of the wider region are regarded as centres of speciation and play an important role in the provisioning of traditional medicines and other economic plants upon which local people depend (Clements et al. 2006). The areas visited in our surveys are easily accessible to local people, and have suffered visible habitat degradation; we also noted a marked absence of wildlife, possibly as a result of intensive hunting and poaching. The prevalence of 'empty forest' syndrome (Redford 1992) in Laos has been documented elsewhere, as well as more generally throughout IBBH (Tordoff et al. 2011).

Compared to neighbouring countries that are better



Image 1. a - *Bulbophyllum violaceolabellum* Seidenf. (HNL-KFBG 0243); b - *Didymoplexiella* sp. nov. (ined.) (HNL-KFBG 0007); c - *Cymbidium bicolor* Lindl. (HNL-KFBG 0002); d - *Micropera pallida* (Roxb.) Lindl. (HNL-KFBG 0046); e - *Luisia* sp. (HNL-KFBG 0014); f - *Thelasis khasiana* Hook.f. (HNL-KFBG 0026); g - *Dendrobium albopurpureum* (Seidenf.) Schuit. & Peter B.Adams (HNL-KFBG 0208).



Image 2. a - *Trichoglottis dawsoniana* (Rchb.f.) Rchb.f. (HNL-KFBG 0038); b - *Epipogium roseum* (D.Don) Lindl. (HNL-KFBG 0083); c - *Luisia* sp. (HNL-KFBG 0213); d - *Dendrobium aphyllum* (Roxb.) C.E.C. Fisch. (HNL-KFBG 0001); e - *Sarcoglyphis smithiana* (Kerr) Seidenf. (HNL-KFBG 0017); f - *Panisea uniflora* Lindl. (HNL-KFBG 0016); g - *Cyrtosia nana* (Rolfe ex Downie) Garay (HNL-KFBG 0154).

surveyed (e.g., Thailand; Table 1), the total known orchid flora of Laos remains relatively poorly known and current levels of known diversity are lower than might be expected, given that the country spans similar climatic and physiographic zones. During the course of just three field days in Vang Vieng, we confirmed 135 orchid species, of which one was new to science and a further nine were new records for Laos. These findings suggest that the known orchid flora of Laos will continue to grow with increased survey effort. In terms of number of species collected per genus, *Dendrobium* and *Bulbophyllum* were the two largest genera encountered, both represented by more than 15 species. Both genera were found in all the habitats surveyed. This is not surprising, given that these genera are among the most species-rich in the IBBH as a whole. It is also known that these two genera (especially *Dendrobium*) are in high demand in the orchid trade, both for horticulture and Chinese Traditional Medicine (Lamxay 2009; Lovera 2009; Gale et al. 2013; Schuiteman 2013; Phelps & Webb 2015).

Of the new country records confirmed here, two were obligate myco-heterotrophic species (*Cyrtosia nana* and *Didymoplexiella* sp.). Typically, fully myco-heterotrophic orchids are highly habitat-specific due to their dependence on particular fungal species (Leake 1994, 2004; McCormick & Jacquemyn 2013). The ephemeral, inconspicuous growth habit of these plants also suggests that more new discoveries could be made if further, more detailed surveys are made at different times of the year, as these plants can be seen only when flowering (Maas et al. 1986). Indeed, mycotrophic species tend to be discovered later, as compared to leafy species with year-round emergent parts, as evidenced by sightings records in comparatively well surveyed areas such as Hong Kong (Hu et al. 2014).

In IBBH in general and Laos in particular, orchids are heavily threatened by illegal collection (Schuiteman et al. 2008; Schuiteman 2013; Vermeulen et al. 2014; Phelps & Webb 2015). Indeed, new species have been described from collections made directly from markets selling wild-collected plants. For example, *Dendrobium lamyaiiae* was described from plants found in trade in Laos (Lovera 2009; Schuiteman 2013) and *Bulbophyllum anodon* and *B. dasystachys* were described from plants found in trade in Thailand (Vermeulen et al. 2014). The description of the recently published Lao endemic *Paphiopedilum rungsuriyanum* O.Gruss, Rungruang, Chaisur, & Dionisio was similarly based on plants from North Laos that had made their way into Thailand (Gruß et al. 2014), even though the entire genus *Paphiopedilum*

is listed on CITES Appendix I. Wild orchids remain a source of income for local people who generally supply plants to itinerant traders from China, Thailand and Vietnam (Thomas et al. 2006; Lamxay 2009; Lovera 2009; Schuiteman 2013). The extraction of other wild-harvested plants (e.g., *Cycas* spp. and palms) in Laos has also been documented (Averyanov et al. 2003; Thomas et al. 2006). Averyanov et al. (2003) reported on international orchid dealers in Vietnam who encourage collection of wild orchids by local people.

Rural parts of Laos are now also being widely exploited for the establishment of agro-industrial plantations (mainly rubber and teak), hydroelectric power stations and mines (Phimmavong et al. 2010; Delang et al. 2013). Such activities impose severe pressure on the natural habitat of many native orchids, and have resulted in the extirpation of species including *Paphiopedilum malipoense* var. *hiepii* and *P. vietnamense* in neighbouring Vietnam (Averyanov et al. 2003). Although the Lao Government has stated its intention of restoring forests to 70% of national land area by 2020, the nature of these new forests requires close scrutiny given that natural forest cover declined from 70% in 1940 to 41% in 2002 (Phimmavong et al. 2010). For now, protection of remaining old growth forests on limestone, so-called 'islands within islands' (Clements et al. 2006), should be prioritised, as these contain a significant fraction of the biodiversity of Laos. Our results demonstrate that fragments of disturbed primary limestone vegetation still harbour exceptional orchid diversity, suggesting that significant conservation gains could be made by protecting even relatively small areas.

To safeguard both the biodiversity and natural resources of Laos, there is an immediate need to initiate landscape-scale conservation practices. The first step to achieving this is the synthesis of comprehensive inventories of species occurrence abundance and, ultimately, ecological requirements. In light of this, there is an immense need for multi-disciplinary scientific research to better understand the inter-dependency of species, such as the requirement of orchids for specific mycorrhizal fungi and pollinators. Information of this sort is central to conducting extinction risk assessments using Red List criteria (IUCN 2012), which in turn can act as indicators for the value and irreplaceability of diversity, and so help prioritise threatened sites (Howard et al. 1998; Burgess et al. 2002; Harris et al. 2005). It is hoped that the information presented here can assist in ensuring better protection of the unusually high plant diversity of the Vang Vieng area, ideally as part of the

KBA system proposed by Tordoff et al. (2012).

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Appendix 1. Enumeration of species

Subfamily: Vanilloideae

Tribe: Vanilleae

Cyrtosia Blume, *Bijdr. Fl. Ned. Ind.*: 396 (1825).

Cyrtosia nana (Rolfe ex Downie) Garay, *Bot. Mus. Leafl.* 30: 233 (1986). [Image 2g] **

Specimens studied: HNL-KFBG 0154 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 639m.

Global Distribution: Endemic to IBBH, distributed in northeastern India (Manipur), southern China (Guangxi and Guizhou), Laos, Thailand and Vietnam.

Life form: Terrestrial

Habitat: Myco-heterotrophic orchid near rotting tree trunk.

Note: This is a myco-heterotrophic orchid bearing bright yellow flowers and long, fleshy red fruits. Avian seed dispersal has recently been reported for this genus in Japan (Suetsugu et al. 2015). This is a new record for Laos.

Subfamily: Orchidoideae

Tribe: Cranichideae

Subtribe: Goodyerinae

Hetaeria Blume, *Bijdr. Fl. Ned. Ind.*: 409 (1825), nom. cons.

Hetaeria oblongifolia Blume, *Bijdr. Fl. Ned. Ind.*: 410 (1825). **

Specimens studied: HNL-KFBG 0008 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 280m.

Global Distribution: This is a widespread species distributed in India (Andaman & Nicobar Islands), Laos, Myanmar, Thailand, Vietnam, Taiwan to West Pacific and the Ryukyu Islands.

Life form: Terrestrial

Habitat: Terrestrial orchid growing in leaf litter in limestone crevices.

Note: This is a new record for Laos.

Subfamily: Epidendroideae

Tribe: Tropidieae

Corymborkis Thouars, *Nouv. Bull. Sci. Soc. Philom. Paris* 1: 318 (1809).

Corymborkis veratrifolia (Reinw.) Blume, *Coll. Orchid.*: 125 (1859).

Specimens studied: HNL-KFBG 0152 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 642m; HNL-KFBG 0192 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 554m.

Global distribution: This is a widespread orchid distributed in southern China (Guangxi and Yunnan), India (widespread in northeastern India, Andaman & Nicobar Islands), Sri Lanka, Cambodia, Laos, Myanmar, Thailand, Vietnam, Taiwan, Malesia, Papuasias, Australia, South-Central and Northwestern Pacific.

Life form: Terrestrial

Habitat: Terrestrial orchid up to 2–3 m tall in deep shade.

Corymborkis sp.

Specimens studied: HNL-KFBG 0055 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 269m.

Life form: Terrestrial

Habitat: Terrestrial orchid at the base of limestone cliff in humus pocket, under deep shade.

Tropidia Lindl., *Edwards's Bot. Reg.* 19: t. 1618 (1833).

Tropidia sp.

Specimens studied: HNL-KFBG 0112 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 327m.

Life form: Terrestrial

Habitat: Growing in secondary forest.

Tribe: Gastrodieae

Didymoplexiella Garay, *Arch. Jard. Bot. Rio de Janeiro* 13: 33 (1954).

Didymoplexiella sp. 1 [Image 1b]

Specimens studied: HNL-KFBG 0007 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 280m; HNL-KFBG 0282 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 353m.

Life form: Mycotrophic

Habitat: Myco-heterotrophic orchid. Growing in deep leaf litter on limestone.

Note: Stem brown, flowers white with orange and purple markings. Morphologically this species seems close to *Didymoplexiella siamensis* (Rolfe ex Downie) Seidenf. but differs in having a lip with much broader and longer side lobes and a flattened callus at the base. It is probable that it represents a species new to science. Further study is required.

Tribe: Nervilieae

Subtribe: Nerviliinae

Nervilia Comm. ex Gaudich., *Voy. Uranie*: 422 (1829), nom. cons.

Nervilia aff. *aragoana* Gaudich., *Voy. Uranie*: 422 (1829).

Specimens studied: HNL-KFBG 0203 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 375m.

Global distribution: Widespread from tropical and subtropical Asia, India (widespread in the mainland and Andaman Islands), China (Hubei, Sichuan, Xizang and Yunnan), Laos, Myanmar, Thailand, Vietnam, Taiwan to Pacific.

Life form: Terrestrial

Note: Fruiting stems up to 40 cm. Fruits 6 ridged, green. Stem green, leaves just emerging, tubers ca. 4 cm long.

Subtribe: Epipogiinae

Epipogium Borkh., *Tent. Disp. Pl. German.*: 139 (1792).

Epipogium roseum (D. Don) Lindl., *J. Proc. Linn. Soc., Bot.* 1: 177 (1857). [Image 2b]

Specimens studied: HNL-KFBG 0083 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 434m.

Other specimens from Laos: A.F.G.Kerr s.n. (K), 23.iv.1932; A.F.G.Kerr 984 (K, two specimens), 24.iv.1932; A.F.G.Kerr s.n. (K), 25.iv.1932.

Global distribution: Widespread from tropical Africa, tropical Asia to Southwest Pacific.

Life form: Terrestrial

Habitat: Myco-heterotrophic orchid in dense understorey vegetation. Total of four plants were seen.

Tribe: Arethuseae

Subtribe: Coelogyninae

Coelogyne Lindl., *Coll. Bot.*: t. 33 (1824).

Coelogyne suaveolens (Lindl.) Hook.f., *Fl. Brit. India* 5: 832 (1890). **

Specimens studied: HNL-KFBG 0044 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m; HNL-KFBG 0047 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m; HNL-KFBG 0216 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0259 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Global distribution: Northeastern India (Arunachal Pradesh), China (Yunnan), Myanmar and Thailand.

Life form: Epiphyte

Habitat: Encountered on exposed ridge in Phone Ngeung Village, found growing on mossy trunk in open forest and bearing white flowers in Phou Din Deng.

Note: This is new record for Laos.

Coelogyne sp. 1

Specimens studied: HNL-KFBG 0160 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 468m.

Life form: Epiphyte

Habitat: Epiphytic on large trees in rainforest on slopes of limestone outcrops.

Coelogyne sp. 2

Specimens studied: HNL-KFBG 0166 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Life form: Epiphyte

Habitat: Collected from a tall fallen tree.

Coelogyne sp. 3

Specimens studied: HNL-KFBG 0174 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

Coelogyne sp. 4

Specimens studied: HNL-KFBG 0230 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 531 m.; HNL-KFBG 0240 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng, Phou Din Deng Village, 531m.

Life form: Epiphyte

Habitat: Very abundant in the uppermost part of the limestone mountain. Epiphyte on trees and lithophyte on limestone rocks. Prefers open conditions.

Note: Peduncle flattened with terete rachis.

Coelogyne sp. 5

Specimens studied: HNL-KFBG 0260 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Life form: Epiphyte

Coelogyne sp. 6

Specimens studied: HNL-KFBG 0263 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 375m.

Life form: Epiphyte

Coelogyne sp. 7

Specimens studied: HNL-KFBG 0045 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m.

Life form: Epiphyte

Habitat: Found growing as epiphyte on trees on exposed limestone ridge.

Panisea (Lindl.) Lindl., Fol. Orchid. 5: 1 (1854), nom. cons.**Panisea uniflora (Lindl.) Lindl., Fol. Orchid. 5: 2 (1854).** [Image 2f]

Specimens studied: HNL-KFBG 0016 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m; HNL-KFBG 0195 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 375m.

Other specimens from Laos: A.F.G.Kerr 985 (K, two specimens), 25.iv.1932; A.F.G.Kerr 985 (P), 25.iv.2010, Wiengchan, Nam Yuak.

Global distribution: China (Yunnan), northeastern India, Nepal, Cambodia, Laos, Myanmar, Thailand, Vietnam and Malaysia.

Life form: Epiphyte and lithophyte

Habitat: Growing directly on limestone cliff surface in Phone Ngeung Village, locally relatively abundant. Also seen in Phou Din Deng as an epiphyte on trees on exposed limestone outcrops.

Pholidota Lindl., Exot. Fl. 2: t. 138 (1825).**Pholidota articulata Lindl., Gen. Sp. Orchid. Pl.: 38 (1830).**

Specimens studied: HNL-KFBG 0277 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m; HNL-KFBG 0188 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m; HNL-KFBG 0225 (HNL!), 30.iv.2012, Vientiane

Province, Vang Vieng District, Phou Din Deng Village, 272m; HNL-KFBG 0274 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Other specimens from Laos: A.D.Kerr s.n., 30189 (K, spirit); A.D.Kerr 4365 (K, spirit); C.J.Spore 524 (P, 2 specimens), 2010, Xieng Khouang; C.J.Spore 521 (P, two specimens), 2010, Xieng Khouang; J.E.Vidal 1627 (P, two specimens), iv.2011, Xieng Khouang, Phou Kabôs.

Global distribution: India (Uttarakhand, Himachal Pradesh and northeastern states), Nepal, Bhutan China (Guizhou, Sichuan, Xizang and Yunnan), Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Sulawesi and Sumatra.

Life form: Epiphyte

Habitat: Growing on slender branch in exposed location on limestone.

Thunia Rchb.f., Bot. Zeitung (Berlin) 10: 764 (1852).**Thunia sp.**

Specimens studied: HNL-KFBG 0066 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m.

Life form: Terrestrial

Tribe: Malaxideae**Subtribe: Dendrobiinae****Bulbophyllum Thouars, Hist. Orchid.: t. 3 (1822), nom. cons.****Bulbophyllum blepharistes Rchb.f., Flora 55: 278 (1872).**

Specimens studied: HNL-KFBG 0116 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Other specimens from Laos: E.Poilane 28649 (P), 27.xi.2004, Plateau des Boloven, 6 km au nord de la station agricole; J.E.Vidal 5624 (P), 29.x.2011, Vientiane, Phou Khao Khouay; J.E.Vidal 5625 (P), 29.x.2011, Phou Khao Khouay; C.Thorel s.n. (P, three specimens), Bassac.

Global distribution: Northeastern India, Cambodia, Laos, Myanmar, Thailand, Vietnam and Malaysia.

Life form: Epiphyte

Bulbophyllum helenae (Kuntze) J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 2, 8: 24 (1912). *

Specimens studied: HNL-KFBG 0226 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 272m.

Global distribution: India (Uttarakhand and northeastern states), Nepal, Bhutan, China (Yunnan), Myanmar and Thailand.

Life form: Epiphyte

Habitat: Large clump covering mossy branch ca. 5 m above ground, in semi-shade.

Note: This is a new record for Vientiane Province.

Bulbophyllum laxiflorum (Blume) Lindl., Gen. Sp. Orchid. Pl.: 57 (1830).

Specimens studied: HNL-KFBG 0049 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m; HNL-KFBG 0184 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m; HNL-KFBG 0245 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Global distribution: Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Malaysia, Philippines, Java, Sulawesi and Sumatra.

Life form: Epiphyte and lithophyte.

Habitat: Epiphyte on exposed limestone ridge in Phone Ngeung Village, and growing on mossy rocks and trees in moist mountain forest in Phou Din Deng.

Bulbophyllum lobbii subsp. siamense (Rchb.f.) Mangal, F.Velazquez & J.J.Verm., Bulbophyllum Borneo: 40 (2015). *

Specimens studied: HNL-KFBG 0258 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0268 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Global distribution: Northeastern India, Cambodia, Myanmar, Thailand, Borneo, Java, Lesser Sunda Islands, Malaysia, Philippines and Sumatra.

Life form: Epiphyte

Note: This is a new record for Vientiane Province.

***Bulbophyllum odoratissimum* (Sm.) Lindl. ex Wall., Numer. List: n.º 1987 (1828). ***

Specimens studied: HNL-KFBG 0235 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 539m.

Global distribution: India (Uttarakhand and northeastern states), Nepal, Bhutan, China (Hong Kong, Fujian, Guangdong, Guangxi, Sichuan, Xizang and Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Habitat: On top of mountain growing as epiphyte on dwarf trees, fully exposed. Rooting only at the base of the pseudobulb.

Note: This is a new record for Vientiane Province.

***Bulbophyllum thaiorum* J.J.Sm., Bull. Jard. Bot. Buitenzorg, sér. 2, 8: 28 (1912).**

Specimens studied: HNL-KFBG 0256 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Global distribution: China (Yunnan), Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Note: This was recorded for Laos without known locality in Schuiteman et al. (2008).

***Bulbophyllum violaceolabellum* Seidenf., Nordic J. Bot. 1: 210 (1981). [Image 2a] ***

Specimens studied: HNL-KFBG 0217 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0243 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0244 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Global distribution: Endemic to IBBH, distributed in China (Yunnan), Laos and Vietnam.

Life form: Epiphyte and lithophyte

Habitat: Flowering on moss covered branches or rocks in open forests on uppermost part of mountain.

Note: This is a new record for Vientiane Province.

***Bulbophyllum xylophyllum* C.S.P.Parish & Rchb.f., Trans. Linn. Soc. London 30: 151 (1874).**

Specimens studied: HNL-KFBG 0224 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 539m.

Global distribution: Southern India, Nepal, China (Guizhou), Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Habitat: Fully exposed on branch of small tree on top of mountain. Rooting along the rhizome.

Note: This was recorded for Laos without known locality in Schuiteman et al. (2008).

***Bulbophyllum* sp. 1 (aff. Section Racemosae)**

Specimens studied: HNL-KFBG 0011 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 280m.

Life form: Epiphyte

Habitat: Epiphyte on dead branch on very exposed ridge. Pseudobulb rugose. Leaf large, stiff, leathery.

***Bulbophyllum* sp. 2**

Specimens studied: HNL-KFBG 0033 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: On exposed limestone ridge.

***Bulbophyllum* sp. 3**

Specimens studied: HNL-KFBG 0034 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: Growing in full sun on exposed trunk on a ridge.

Note: Leaves and pseudobulbs dark purple-green.

***Bulbophyllum* sp. 4**

Specimens studied: HNL-KFBG 0071 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m.

Life form: Epiphyte

***Bulbophyllum* sp. 5**

Specimens studied: HNL-KFBG 0179 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Bulbophyllum* sp. 6**

Specimens studied: HNL-KFBG 0180 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Bulbophyllum* sp. 7 (Section Hirtula)**

Specimens studied: HNL-KFBG 0182 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Bulbophyllum* sp. 8**

Specimens studied: HNL-KFBG 0183 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Bulbophyllum* sp. 9**

Specimens studied: HNL-KFBG 0185 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Bulbophyllum* sp. 10**

Specimens studied: HNL-KFBG 0227 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 272m.

Life form: Epiphyte

Habitat: Growing on slender branch in exposed location.

***Bulbophyllum* sp. 11**

Specimens studied: HNL-KFBG 0233 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m.

Life form: Epiphyte

Habitat: Epiphyte on dwarf tree. Very succulent growing in full sun. Rooting only at the base of the pseudobulb.

***Bulbophyllum* sp. 12**

Specimens studied: HNL-KFBG 0239 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 531m.

Life form: Epiphyte

Habitat: Growing on top of mountain in bright conditions.

Note: Large clump covering mossy branch ca. 5 m above ground, in semi shade. Leaf underside purple.

***Bulbophyllum* sp. 13**

Specimens studied: HNL-KFBG 0242 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Life form: Epiphyte

Habitat: Wet mountain forest, growing on mossy rocks and trees.

***Bulbophyllum* sp. 14**

Specimens studied: HNL-KFBG 0248 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462 m.,

Life form: Epiphyte

***Bulbophyllum* sp. 15**

Specimens studied: HNL-KFBG 0255 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0264 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng, Phou Din Deng Village, 375m.

Life form: Epiphyte

***Bulbophyllum* sp. 16**

Specimens studied: HNL-KFBG 0257 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Life form: Epiphyte

Habitat: Growing on branches in disturbed primary forest.

***Bulbophyllum* sp. 17**

Specimens studied: HNL-KFBG 0275 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng, Phou Din Deng Village, 449m.

Life form: Epiphyte

Dendrobium* Sw., *Nova Acta Regiae Soc. Sci. Upsal.* 6: 82 (1799), nom. cons.**Dendrobium aduncum* Lindl., *Edwards's Bot. Reg.* 28(Misc.): 58 (1842). ***

Specimens studied: HNL-KFBG 0281 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m.

Global distribution: Endemic to IBBH, distributed in northeastern India, Bangladesh, China (Guangdong, Guangxi, Guizhou, Hainan, Hunan and Yunnan), Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Note: This is new record for Vientiane Province.

***Dendrobium albopurpureum* (Seidenf.) Schuit. & Peter B. Adams, *Muelleria* 29: 66 (2011).**

Specimens studied: HNL-KFBG 0208 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Other specimens from Laos: A.D.Kerr 872 (K, spirit).

Global distribution: Endemic to IBBH, distributed in southern China (Yunnan), Laos, Thailand and Vietnam.

Life form: Epiphyte

Habitat: Epiphyte in upper part of mountains, primary forest with *Euphorbia* cf. *antiquorum* L. Flowers white.

***Dendrobium aphyllum* (Roxb.) C.E.C.Fisch. in J.S.Gamble, *Fl. Madras*: 1416 (1928). [Image 2d]**

Specimens studied: HNL-KFBG 0001 (HNL!), 25.iv.2012, Vientiane Province, Vang Vieng District, Tham Chang Cave; 238m; HNL-KFBG 0012 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 307m; HNL-KFBG 0056 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 277m; HNL-KFBG 0276 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Global distribution: India (widespread in Peninsular India and Andaman Islands), Nepal, Bhutan, China (Guangxi, Guizhou and Yunnan), Laos, Myanmar, Thailand, Vietnam and Malaysia.

Life form: Epiphyte

Habitat: Epiphytic on *Lagerstoemia speciosa* (L.) Pers. on flat banks of river near Tham Chang Cave. Relatively common in exposed locations along limestone ridges in Phone Ngueng.

***Dendrobium chrysotoxum* Lindl., *Edwards's Bot. Reg.* 33: t. 19 (1847).**

Specimens studied: HNL-KFBG 0175 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Other specimens from Laos: A.F.G.Kerr 957 (K), 03.iii.1932; M.Delacour s.n. (P), 2004, Napè; C.Thorel s.n. (P), 2011, Lakson; K.F.G.Kerr 957 (P), 03.iv.2011, Tatom, Chieng Kwang.

Global distribution: Northeastern India (Arunachal Pradesh), southern China (Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

***Dendrobium crepidatum* Lindl. & Paxton, *Paxton's Fl. Gard.* 1: 63 (1850). ***

Specimens studied: HNL-KFBG 0063 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m; HNL-KFBG 0238 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 499m.

Other specimens from Laos: A.F.G.Kerr 952 (K), 26.iii.1932; C.Thorel s.n. (P), 2011, Paktai; C.Thorel s.n. (P), 2011, PakTai; L.Pierre s.n. (P), iii.2011, Attopeu; A.F.G.Kerr 952 (P, two specimens), 26.iii.2011, Paksane, Veingchan.

Global distribution: India (widespread in Peninsular India), Nepal, Bhutan, southern China (Guizhou and Yunnan), Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Habit: Epiphyte on large trees in tall forest on rich soil in limestone depression.

Note: This is new record for Vientiane Province.

***Dendrobium farmeri* Paxton, *Paxton's Mag. Bot.* 15: 241 (1849).**

Specimens studied: HNL-KFBG 0088 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Global distribution: Northeastern India, Nepal, Bhutan, Laos, Myanmar, Thailand and Malaysia.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest.

***Dendrobium gratiosissimum* Rchb.f., *Bot. Zeitung (Berlin)* 23: 99 (1865).**

Specimens studied: HNL-KFBG 0187 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Global distribution: Endemic to IBBH, distributed in northeastern India, southern China (Yunnan), Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Dendrobium linguella* Rchb.f., *Gard. Chron., n.s.*, 18: 552 (1882). *

Specimens studied: HNL-KFBG 0232 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 531m; HNL-KFBG 0234 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 539m; HNL-KFBG 0278 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m.

Global distribution: Laos, Thailand, Vietnam, Borneo, Malaysia and Sumatra.

Life form: Epiphyte

Habitat: On the top of mountain, growing as epiphyte on dwarf trees, fully exposed.

Note: This is a new distribution record for Laos.

Dendrobium macraei* Lindl., *Gen. Sp. Orchid. Pl.*: 75 (1830). *

Specimens studied: HNL-KFBG 0162 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Other specimens from Laos: P.Tixier 16 (P), 2011, Vientiane; P.Tixier s.n., 17290 (P), Vientiane, Xiengkhouen.

Global distribution: Northeastern India, Sri Lanka, Laos, Myanmar and Vietnam.

Life form: Epiphyte

Habitat: Epiphyte on large trees, white flowers.

Note: This is a new distribution record for Laos.

***Dendrobium moschatum* (Buch.-Ham.) Sw., *Neues J. Bot.* 1: 94 (1805).**

Specimens studied: HNL-KFBG 0040 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m; HNL-KFBG 0041 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m; HNL-KFBG 0236 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 539m.

Global distribution: India (Jharkhand, Odisha, Chhattisgarh and Maharashtra), Nepal, southern China (Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte
Habitat: On exposed limestone ridge.

***Dendrobium salaccense* (Blume) Lindl., Gen. Sp. Orchid. Pl.: 86 (1830).**

Specimens studied: HNL-KFBG 0267 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Global distribution: Southern India (and Andaman Islands), Sri Lanka, China (Hainan, Xizang and Yunnan), Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Malaysia and Sumatra.

Life form: Epiphyte

Note: Local sources indicated that this species is intensively collected as a high priced medicinal *Dendrobium* used in Traditional Chinese Medicine.

***Dendrobium secundum* (Blume) Lindl. ex Wall., Numer. List: n.º 1996 (1828).**

Specimens studied: HNL-KFBG 0163 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Other specimens from Laos: F.J.Harmand 1091 (P, 3 specimens), iii.2011, Attopeu; C.J.Spire 1489 (P), 2011, Paklai, bords du Mékong; C.J.Spire 1749 bis (P), 2011, Na-luong; P.Tixier s.n. (P), 2011, Vientiane.

Global distribution: India (Andaman & Nicobar Islands), Bangladesh, Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Lesser Sunda Islands, Malaysia, Philippines, Sulawesi and Sumatra.

Life form: Epiphyte

Habitat: Collected from a fallen tree.

***Dendrobium senile* C.S.P.Parish & Rchb.f., Gard. Chron. 1865: 434 (1865).**

Specimens studied: HNL-KFBG 0186 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Other specimens from Laos: A.F.G.Kerr 960 (K!), 04.iv.1932.

Global distribution: Endemic to IBBH, distributed in Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

***Dendrobium transparens* Wall. ex Lindl., Gen. Sp. Orchid. Pl.: 79 (1830). ***

Specimens studied: HNL-KFBG 0165 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Global distribution: India (Uttarakhand, Jharkhand, Odisha and northeastern India), Nepal, Bhutan, Laos, and Myanmar.

Life form: Epiphyte

Habitat: Collected from a fallen tree.

Note: This is a new record for Vientiane Province.

***Dendrobium* sp. 1**

Specimens studied: HNL-KFBG 0156 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 627m.

Life form: Epiphyte

Habitat: Lithophyte growing on limestone. Old stem leafless, leaves shiny.

***Dendrobium* sp. 2**

Specimens studied: HNL-KFBG 0157 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 627m.

Life form: Epiphyte

Habitat: Lithophyte growing on limestone. Leaves greenish.

***Dendrobium* sp. 3**

Specimens studied: HNL-KFBG 0020 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: Collected from crown of a fallen tree.

***Dendrobium* sp. 4**

Specimens studied: HNL-KFBG 0021 (HNL!), 26.iv.2012, Vientiane

Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: Collected from crown of a fallen tree.

***Dendrobium* sp. 5**

Specimens studied: HNL-KFBG 0042 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 356m.

Life form: Epiphyte

Habitat: Found growing on exposed limestone ridge.

***Dendrobium* sp. 6**

Specimens studied: HNL-KFBG 0064 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m.

Life form: Epiphyte

***Dendrobium* sp. 7 (aff. *moschatum*)**

Specimens studied: HNL-KFBG 0065 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m.

Life form: Epiphyte

***Dendrobium* sp. 8**

Specimens studied: HNL-KFBG 0084 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 434m.

Life form: Epiphyte

Habitat: Large epiphyte in mature canopy tree. In fork at 10 m height.

***Dendrobium* sp. 9**

Specimens studied: HNL-KFBG 0085 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 434m.

Life form: Epiphyte

Habitat: Large epiphyte in mature canopy tree. In fork at 10 m height.

***Dendrobium* sp. 10**

Specimens studied: HNL-KFBG 0155 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 627m.

Life form: Epiphyte

***Dendrobium* sp. 11**

Specimens studied: HNL-KFBG 0164 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Life form: Epiphyte

Habitat: Collected from a fallen tree.

***Dendrobium* sp. 12**

Specimens studied: HNL-KFBG 0177 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Dendrobium* sp. 13**

Specimens studied: HNL-KFBG 0181 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 503m.

Life form: Epiphyte

***Dendrobium* sp. 14**

Specimens studied: HNL-KFBG 0210 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m.

Life form: Epiphyte

Habitat: Small epiphyte in dwarf forest on top of mountains. Very exposed. Long multiflowered inflorescence.

***Dendrobium* sp. 15 (Section *Crinifera*)**

Specimens studied: HNL-KFBG 0015 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 307m.

Life form: Epiphyte

Habitat: Epiphyte on limestone ridge.

***Dendrobium* sp. 16 (Section *Crinifera*)**

Specimens studied: HNL-KFBG 0019 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.
Life form: Epiphyte
Habitat: On limestone ridge.

Subtribe: Malaxidinae***Liparis* Rich., *De Orchid. Eur.*: 30 (1817), nom. cons.*****Liparis* sp. 1**

Specimens studied: HNL-KFBG 0043 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 355m.
Life form: Epiphyte
Habitat: Epiphyte on exposed ridge.

***Liparis* sp. 2**

Specimens studied: HNL-KFBG 0048 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 355m; HNL-KFBG 0198 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 375m; HNL-KFBG 0270 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.
Life form: Lithophyte
Habitat: On exposed limestone ridge in Phone Ngueng and epiphyte in semi-shade in Phou Din Deng.

***Liparis* sp. 3**

Specimens studied: HNL-KFBG 0076 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 327m.
Life form: Epiphyte
Habitat: Secondary forest. Large clumps in tree fork at 6 m height.

***Liparis* sp. 4**

Specimens studied: HNL-KFBG 0077 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 327m.
Life form: Epiphyte
Habitat: Secondary forest. Large clumps in tree fork at 6 m height.

***Liparis* sp. 5**

Specimens studied: HNL-KFBG 0222 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.
Life form: Epiphyte
Habitat: Growing on mossy branches in open forest in uppermost part of mountain.

***Liparis* sp. 6**

Specimens studied: HNL-KFBG 0229 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 271m.
Life form: Epiphyte
Habitat: Epiphyte on branch of sparse forest. Exposed location.

***Liparis* sp. 7**

Specimens studied: HNL-KFBG 0261 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.
Life form: Terrestrial

***Liparis* sp. 8**

Specimens studied: HNL-KFBG 0265 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 405m.
Life form: Terrestrial

***Liparis* sp. 9**

Specimens studied: HNL-KFBG 0271 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.
Life form: Terrestrial

***Liparis* sp. 10**

Specimens studied: HNL-KFBG 0272 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.
Life form: Terrestrial

Oberonia* Lindl., *Gen. Sp. Orchid. Pl.*: 15 (1830).**Oberonia* sp.**

Specimens studied: HNL-KFBG 0228 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 271m.
Life form: Epiphyte
Habitat: On slender rotting branch fallen from open canopy.

Tribe: Cymbidieae**Subtribe: Cymbidiinae*****Cymbidium* Sw., *Nova Acta Regiae Soc. Sci. Upsal.* 6: 70 (1799).*****Cymbidium bicolor* Lindl., *Gen. Sp. Orchid. Pl.*: 164 (1833). [Image 1c]**

Specimens studied: HNL-KFBG 0002 (HNL!), 25.iv.2012, Vientiane Province, Vang Vieng District, Tham Chang Cave; 238m.
Global distribution: Southern India, Sri Lanka, Borneo, Malaysia, Philippines, Java, Sulawesi and Sumatra.
Life form: Epiphyte
Habitat: Epiphytic on *Lagerstoemia speciosa* near pond beside cave.

Note: There is lot of confusion about the identity of this species and the name has often been used for another widespread species, *Cymbidium aloifolium* (L.) Sw., but *C. bicolor* can be differentiated on the basis of its usually narrower leaves along with narrower petals and sepals, and a lip midlobe which is not striped.

Tribe: Collabieae***Acanthophippium* Blume, *Bijdr. Fl. Ned. Ind.*: 353 (1825).*****Acanthophippium* sp.**

Specimens studied: HNL-KFBG 0059 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 390m.
Life form: Epiphyte
Habitat: Terrestrial orchid forming large clumps. Growing in thick humus at the base of limestone cliff.

Calanthe* R.Br., *Bot. Reg.* 7: t. 573 (1821), nom. cons.**Calanthe* sp. 1**

Specimens studied: HNL-KFBG 0075 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 328m.
Life form: Terrestrial
Habitat: Locally abundant in secondary forest at the base of limestone outcrop.

***Calanthe* sp. 2**

Specimens studied: HNL-KFBG 0193 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 542m.
Life form: Terrestrial

Phaius* Lour., *Fl. Cochinch.*: 529 (1790).**Phaius* cf. *columnaris* C.Z.Tang & S.J.Cheng, *Bull. Bot. Res., Harbin* 5 (2): 141 (1985). ****

Specimens studied: HNL-KFBG 0009 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 280m.
Global distribution: Southern China (Guizhou, Guangdong and Yunnan) and Laos.

Life form: Terrestrial
Habitat: Terrestrial orchid forming large clusters on dry stream banks, elongated stem up to 1.5 m long.

Note: Previously believed to be endemic to China. This is a new distribution record for Laos.

Tribe: Podochileae***Appendicula* Blume, *Bijdr. Fl. Ned. Ind.*: 297 (1825).*****Appendicula* sp.**

Specimens studied: HNL-KFBG 0221 (HNL!), 30.iv.2012, Vientiane

Province, Vang Vieng District, Phou Din Deng, 462m; HNL-KFBG 0246 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m; HNL-KFBG 0269 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.
Life form: Lithophyte

***Eria* Lindl., Bot. Reg. 11: t. 904 (1825), nom. cons.**

***Eria javanica* (Sw.) Blume, Rumphia 2: 23 (1836).**

Specimens studied: HNL-KFBG 0013 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 306m; HNL-KFBG 0170 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 463m.

Other specimens from Laos: *A.D.Kerr 2055* (K, spirit).

Global distribution: India (Sikkim), southern China (Yunnan), Laos, Myanmar, Thailand, Taiwan, Borneo, Java, Lesser Sunda Islands, Malaysia, Maluku, Philippines, Sulawesi, Sumatra and New Guinea.

Life form: Epiphyte

Habitat: Epiphyte in exposed location on ridge.

***Eria lasiopetala* (Willd.) Ormerod, Opera Bot. 124: 22 (1995).**

Specimens studied: HNL-KFBG 0061 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m; HNL-KFBG 0089 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Other specimens from Laos: P.Tixier s.n. (P), Vientiane.

Global distribution: India (Uttarakhand, Himachal Pradesh and northeastern India), Nepal, Bhutan, Bangladesh, China (Hong Kong and Hainan), Cambodia, Laos, Myanmar and Thailand.

Life form: Epiphyte

***Eria* sp. 1**

Specimens studied: HNL-KFBG 0018 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: Bulbs flat, on exposed ridge.

***Eria* sp. 2**

Specimens studied: HNL-KFBG 0057 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 277m.

Life form: Epiphyte

Habitat: Growing in disturbed secondary forest.

***Eria* sp. 3**

Specimens studied: HNL-KFBG 0090 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest. Pseudobulbs compressed, angled.

***Eria* sp. 4**

Specimens studied: HNL-KFBG 0092 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest.

***Eria* sp. 5**

Specimens studied: HNL-KFBG 0117 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 327m.

Life form: Epiphyte

Habitat: Tree in secondary forest outside village.

***Eria* sp. 6**

Specimens studied: HNL-KFBG 0168 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 463m.

Life form: Epiphyte

Habitat: Leaf-dropping species.

***Eria* sp. 7**

Specimens studied: HNL-KFBG 0169 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 463m.

Life form: Epiphyte

***Eria* sp. 8**

Specimens studied: HNL-KFBG 0173 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 502m.

Life form: Epiphyte

***Eria* sp. 9**

Specimens studied: HNL-KFBG 0262 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 462m.

Life form: Epiphyte

***Eria* sp. (cf. *dendrolirium*)**

Specimens studied: HNL-KFBG 0205 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 449m.

Life form: Epiphyte

Habitat: Epiphyte on trees throughout the upper part of mountains.

***Mycaranthes* Blume, Bijdr. Fl. Ned. Ind.: 352 (1825).**

***Mycaranthes pannea* (Lindl.) S.C.Chen & J.J.Wood, Fl. China 25: 348 (2009). ***

Specimens studied: HNL-KFBG 0176 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 502m.

Global distribution: Northeastern India, China (Guangxi, Guizhou, Hainan, Xizang and Yunnan), Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Malaysia and Sumatra.

Life form: Epiphyte

Note: This is a new distribution record for Vientiane Province. It is actually misplaced in *Mycaranthes* (Ng et al., pers. comm.), but is retained here until the proper generic placement has been published.

***Pinalia* Lindl., Orchid. Scelet.: 21 (1826).**

Pinalia spicata* (D.Don) S.C.Chen & J.J.Wood, Fl. China 25: 354 (2009). *

Specimens studied: HNL-KFBG 0178 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 502m.

Global distribution: India (Uttarakhand and northeastern India), Nepal, Bhutan, China (Xizang and Yunnan), Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Note: This is a new country record for Laos.

***Thelasis* Blume, Bijdr. Fl. Ned. Ind.: 385 (1825).**

Thelasis khasiana* Hook.f., Fl. Brit. India 6: 87 (1890). [Image 1f] *

Specimens studied: HNL-KFBG 0026 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Global distribution: Endemic to IBBH, distributed in northeastern India, southern China (Yunnan), Laos, Thailand and Vietnam.

Life form: Epiphyte

Habitat: On crown of large fallen tree. With flowers and fruits.

Note: Only *Thelasis pygmaea* (Griff.) Blume has been reported from Laos previously. This could be a new distribution record for Laos.

Tribe: Vandaeae

Subtribe: Aeridinae

***Acampe* Lindl., Fol. Orchid. 4: 1 (1853).**

***Acampe ochracea* (Lindl.) Hochr., Bull. New York Bot. Gard. 6: 270 (1910).**

Specimens studied: HNL-KFBG 0219 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 498m.

Global distribution: India (northeastern and Peninsular India),

Sri Lanka, Bangladesh, southern China (Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Habitat: Growing directly on limestone pinnacle, under sparse canopy.

***Aerides* Lour., Fl. Cochinch.: 525 (1790).**

***Aerides falcata* Lindl. & Paxton, Paxton's Fl. Gard. 2: 142 (1851).**

Specimens studied: HNL-KFBG 0190 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 502m; HNL-KFBG 0250 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 518m.

***Aerides* sp. 1**

Specimens studied: HNL-KFBG 0054 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 390m; HNL-KFBG 0062 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 384m.

Life form: Epiphyte

Habitat: Epiphyte on base of trunk. Limestone forest with sharp pinnacles taller than canopy, exposed ridge with *Euphorbia cf. antiquorum* L.

***Aerides* sp. 3**

Specimens studied: HNL-KFBG 0247 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.

***Aerides* sp. 4**

Specimens studied: HNL-KFBG 0249 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 268m.

Habitat: On large tree in secondary vegetation.

***Aerides* sp. 5**

Specimens studied: HNL-KFBG 0252 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 430m.

***Aerides* sp. 6**

Specimens studied: HNL-KFBG 0253 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 518m.

***Gastrochilus* D.Don, Prodr. Fl. Nepal.: 32 (1825).**

***Gastrochilus* sp.**

Specimens studied: HNL-KFBG 0052 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 269m.

Life form: Epiphyte

***Grosourdyia* Rchb.f., Bot. Zeitung (Berlin) 22: 297 (1864).**

Grosourdyia muscosa* (Rolfe) Garay, Bot. Mus. Leafl. 23: 181 (1972). *

Specimens studied: HNL-KFBG 0027 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Global distribution: India (Andaman Islands), Laos, Thailand and Malaysia.

Life form: Epiphyte

Habitat: On crown of large fallen tree.

Note: This is a new country record for Laos.

***Luisia* Gaudich., Voy. Uranie: 426 (1829).**

***Luisia* sp. 1 [Image 1e]**

Specimens studied: HNL-KFBG 0014 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 306m.

Life form: Epiphyte

Habitat: Epiphyte on ridge over valley. Flowers red.

***Luisia* sp. 2 [Image 2c]**

Specimens studied: HNL-KFBG 0213 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 536m.

Life form: Epiphyte

Habitat: Fully exposed on dwarf trees in limestone forest.

***Luisia* sp. 3**

Specimens studied: HNL-KFBG 0237 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 539m; HNL-KFBG 0241 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 530m.

Life form: Epiphyte

Habitat: Very exposed on small trees, growing upright.

***Micropera* Lindl., Edwards's Bot. Reg. 18: t. 1522 (1832).**

***Micropera pallida* (Roxb.) Lindl., Edwards's Bot. Reg. 18: t. 1522 (1832). [Image 1d]**

Specimens studied: HNL-KFBG 0003 (HNL!), 25.iv.2012, Vientiane Province, Vang Vieng District, Tham Chang Cave; 237m; HNL-KFBG 0046 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 355m.

Global distribution: Northeastern India, Bangladesh, Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Malaysia, Sumatra.

Life form: Epiphyte

Habitat: Epiphytic on *Lagerstroemia speciosa* (L.) Pers. Flowers pale yellow and white.

***Pomatocalpa* Breda, Kuhl & Hasselt, Gen. Sp. Orchid. Asclep.: t. 15 (1827).**

***Pomatocalpa* sp.**

Specimens studied: HNL-KFBG 0211 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 530m.

Life form: Epiphyte

Habitat: Small epiphytic in dwarf forest on top of mountains. Very exposed. Long multi-flowered inflorescence.

***Pteroceras* Hasselt ex Hassk., Flora 25 (2 Beibl.): 6 (1842).**

***Pteroceras* sp. 1**

Specimens studied: HNL-KFBG 0025 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m.

Life form: Epiphyte

Habitat: On crown of large fallen tree. In fruit.

***Pteroceras* sp. 2**

Specimens studied: HNL-KFBG 0206 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 448m.

Life form: Epiphyte

Habitat: Epiphyte on trees throughout the upper part of the mountains. In forests with *Euphorbia cf. antiquorum*.

***Renanthera* Lour., Fl. Cochinch.: 521 (1790).**

***Renanthera coccinea* Lour., Fl. Cochinch.: 521 (1790).**

Specimens studied: HNL-KFBG 0251 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 361m.

Other specimens from Laos: A.F.G.Kerr 954 (P), 01.iv.2011, Tatom, Chieng Kwang; C.J.Spore 1187 (P), 2011, Cahn trap, chaîne annamite; C.J.Spore 477 (P), 2011, Bal ho, prov. de Cammon.

Global distribution: Southern China (Guangxi, Hainan and Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Life form: Epiphyte

Habitat: Climbing in large clumps in fragments of primary vegetation on the lower part of mountain.

Robiquetia* Gaudich., Voy. Uranie: 426 (1829).**Robiquetia spathulata* (Blume) J.J.Sm., Natuurk. Tijdschr. Ned.-Indië 72: 114 (1912).**

Specimens studied: HNL-KFBG 0091 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m; HNL-KFBG 0191 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 354m.

Other specimens from Laos: A.D.Kerr 1243 (K, spirit, not seen), 25.ix.1967.

Global distribution: Northeastern India, Bangladesh, southern China (Hainan), Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Malaysia, Moluccas, Philippines, Sulawesi and Sumatra.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest.

Sarcoglyphis* Garay, Bot. Mus. Leaf. 23: 200 (1972).**Sarcoglyphis smithiana* (Kerr) Seidenf., Opera Bot. 114: 383 (1992). [Image 2e]**

Specimens studied: HNL-KFBG 0017 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m; HNL-KFBG 0022 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m; HNL-KFBG 0023 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m; HNL-KFBG 0024 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 339m; HNL-KFBG 0050 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 268m; HNL-KFBG 0053 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 268m; HNL-KFBG 0172 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 464m.

Global distribution: Endemic to IBBH, distributed in China (Yunnan), Laos, Thailand and Vietnam.

Life form: Twig epiphyte

Habitat: On crown of large fallen tree. Flowers white and pink, with curved spur.

Schoenorchis* Reinw. ex Blume, Bijdr. Fl. Ned. Ind.: 361 (1825).**Schoenorchis* sp.**

Specimens studied: HNL-KFBG 0087 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 434m.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest. Leaves terete.

Smitinandia* Holttum, Gard. Bull. Singapore 25: 105 (1969).**Smitinandia micrantha* (Lindl.) Holttum, Gard. Bull. Singapore 25: 106 (1969).**

Specimens studied: HNL-KFBG 0158 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 627m; HNL-KFBG 0171 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 463m; HNL-KFBG 0189 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 502m.

Other specimens from Laos: A.F.G.Kerr 958 (P), 03.iv.2010, Tatom, Chiang Kwang.

Global distribution: India (Jharkhand, Uttarakhand, Odisha, Chhatisgarh and northeastern India), Nepal, Bangladesh, southern China (Yunnan), Cambodia, Laos, Myanmar, Thailand, Vietnam, Borneo and Malaysia.

Life form: Epiphyte

Thrixspermum* Lour., Fl. Cochinch.: 519 (1790).**Thrixspermum* sp. 1**

Specimens studied: HNL-KFBG 0051 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 268m.

Life form: Epiphyte

Habitat: Twig epiphyte. Flowers yellow-white.

***Thrixspermum* sp. 2**

Specimens studied: HNL-KFBG 0093 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Life form: Epiphyte

Habitat: Pendulous epiphyte on fallen branch in primary hillside forest.

Trichoglottis* Blume, Bijdr. Fl. Ned. Ind.: 359 (1825).**Trichoglottis dawsoniana* (Rchb.f.) Rchb.f., Gard. Chron. 1872: 699 (1872). [Image 2a]**

Specimens studied: HNL-KFBG 0038 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 355m; HNL-KFBG 0218 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 495m.

Other specimens from Laos: P. Tixier s.n., P003361649 (P), 2008, Sayabury.

Global distribution: Endemic to IBBH, distributed in southern China (Yunnan), Laos, Myanmar and Thailand.

Life form: Epiphyte

Habitat: Epiphyte in sparse, stunted forest on exposed ridge. Rachis flat, flowers yellow and brown in Phone Ngeung Village, and epiphyte on tall tree at least 6m above ground in Phone Din Deng.

***Trichoglottis orchidea* (J.Koenig) Garay, Bot. Mus. Leaf. 23: 209 (1972).**

Specimens studied: HNL-KFBG 0070 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 268m.

Other specimens from Laos: E.Poilane 20761 (P), 16.iv.2011, Luang Prabhang.

Global distribution: India (Andaman & Nicobar Islands), Cambodia, Laos, Thailand, Java and Malaysia.

Life form: Epiphyte

***Trichoglottis seidenfadenii* Aver., Bot. Zhurn. (Moscow & Leningrad) 73: 429 (1988).**

Specimens studied: HNL-KFBG 0039 (HNL!), 26.iv.2012, Vientiane Province, Vang Vieng District, Phone Ngeung Village, 355m.

Global distribution: Endemic to IBBH, distributed in Laos, Thailand and Vietnam.

Life form: Epiphyte

Habitat: Epiphyte in sparse, stunted forest on exposed ridge.

***Trichoglottis* sp.**

Specimens studied: HNL-KFBG 0094 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 461m.

Life form: Epiphyte

Habitat: Flowers yellow and brownish-orange.

Vandopsis* Pfitzer in H.G.A.Engler & K.A.E.Prantl (eds.), Nat. Pflanzenfam. 2(6): 211 (1889).**Vandopsis lissochiloides* (Gaudich.) Pfitzer in H.G.A.Engler & K.A.E. Prantl (eds.), Nat. Pflanzenfam. 2(6): 210 (1889). ***

Specimens studied: HNL-KFBG 0161 (HNL!), 28.iv.2012, Vientiane Province, Vang Vieng District, Nam Pae Village, 463m.

Other specimens from Laos: A.D.Kerr s.n. (K, spirit).

Global distribution: Laos, Thailand, Lesser Sunda Islands, Moluccas, Philippines, Sulawesi and New Guinea.

Life form: Epiphyte

Habitat: Epiphyte on large trees.

Note: This is new distribution record for Vientiane Province.

***Vandopsis* sp.**

Specimens studied: HNL-KFBG 0254 (HNL!), 30.iv.2012, Vientiane Province, Vang Vieng District, Phou Din Deng Village, 375m.



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