# DIVERSITY, DISTRIBUTION AND CONSERVATION OF RARE, ENDEMIC ORCHID SPECIES IN NAM NGUM UPSTREAM PROTECTION FOREST AREA OF XIENG KHOUANG PROVINCE, LAO PDR

**Nguyen Van Tu[1], Latdavan Bounyavet[2]**
[1]*Vietnam National University of Forestry*
[2]*Vocational Education Department Institute of Lao PDR*

**SUMMARY**

The Nam Ngum Upstream protection forest area (NUPA) is known as the repository of biodiversity. It supports 1,200 species of angiosperms. The orchidaceae is among the dominant family of angiospecies and a highly evolved family among the monocotyledon. The species of this family are facing tremendous pressure due to habitat degradation, overexploitation and changing environmental conditions. Therefore, while exploring the floristic diversity of NUPA, attempts were made to explore the orchid diversity, distribution patterns, nativity, endemism, threat categories, and local uses. Total 31 species of the orchids representing 10 genera were recorded between 250 - 1,500 m amsl. Of these, 31 species were native, 3 species endangered, and 2 species vulnerable. These species are represented in three forest types and are used for curing various diseases/ailments by the inhabitants of the buffer zone of NUPA. Due to habitat degradation, the populations of these species are decreasing fast. The overexploitation, habitat degradation and changing environmental conditions of these species has led to rapid population depletion. Therefore, appropriate strategy has been suggested for the conservation and management of these orchids.

**Keywords: Orchids, The Nam Ngum Upstream protection forest area, Xieng Khouang.**

## 1. INTRODUCTION

The Nam Ngum Upstream Protection Forest Area (NUPA) comprises of three districts in Xiengkhouang provinces. NUPA, as one of the mega hot spots of biological diversity, is a source of a great diversity of food, fuel, fodder, timber, dye and medicinal plants. NUPA is more than 110 km long and 50 to 60 km wide, with altitudes from 200 - 1,900 m. The vegetation comprises of tropical, temperate, alpine types (Sing Souphanha, 2017).

The NUPA supports about 1000 flowering plants, and family orchidaceae is one of the species in the families of angiosperms. Orchids are worldwide famous for their charming and long lasting flowers. They form a unique group of plants and represent a peak in the evolution of monocots. They are terrestrial (including lithophytes, epiphytes and saprophytes) in nature. The diversity of orchids decreases in the NUPA (Pascal Lovera, 2009).

In general, a large number of studies have been carried out on the orchids of Xiengkhouang provice. In particular in UNPA a very few studies are available on orchids. However, studies at UNPA for the exploration of orchids have not been carried out, which is most important for the conservation and management of orchids. Therefore, this paper attempts to: (i). Assess and identify the orchids' diversity; (ii). Assess the status and distribution patterns of native and endemic orchids; (iii). Assess orchids' diversity for threat categories, and (iv). Suggest strategy plans for the conservation of orchids' diversity.

## 2. RESEARCH METHODOLOGY

### 2.1. Study area

The study area is located in the north part of Laos and is characterized by highlands, mountain plain, imbedded in the Phoua mountain. The area is 250 to 1900 m above the sea level. The climate ranges from the subtropical – warm in summer and cold in winter, and marked by one wet season occurring from May to October. During this period, precipitation is 84% of the annual average rainfall of 1750 mm (see Figure 1).

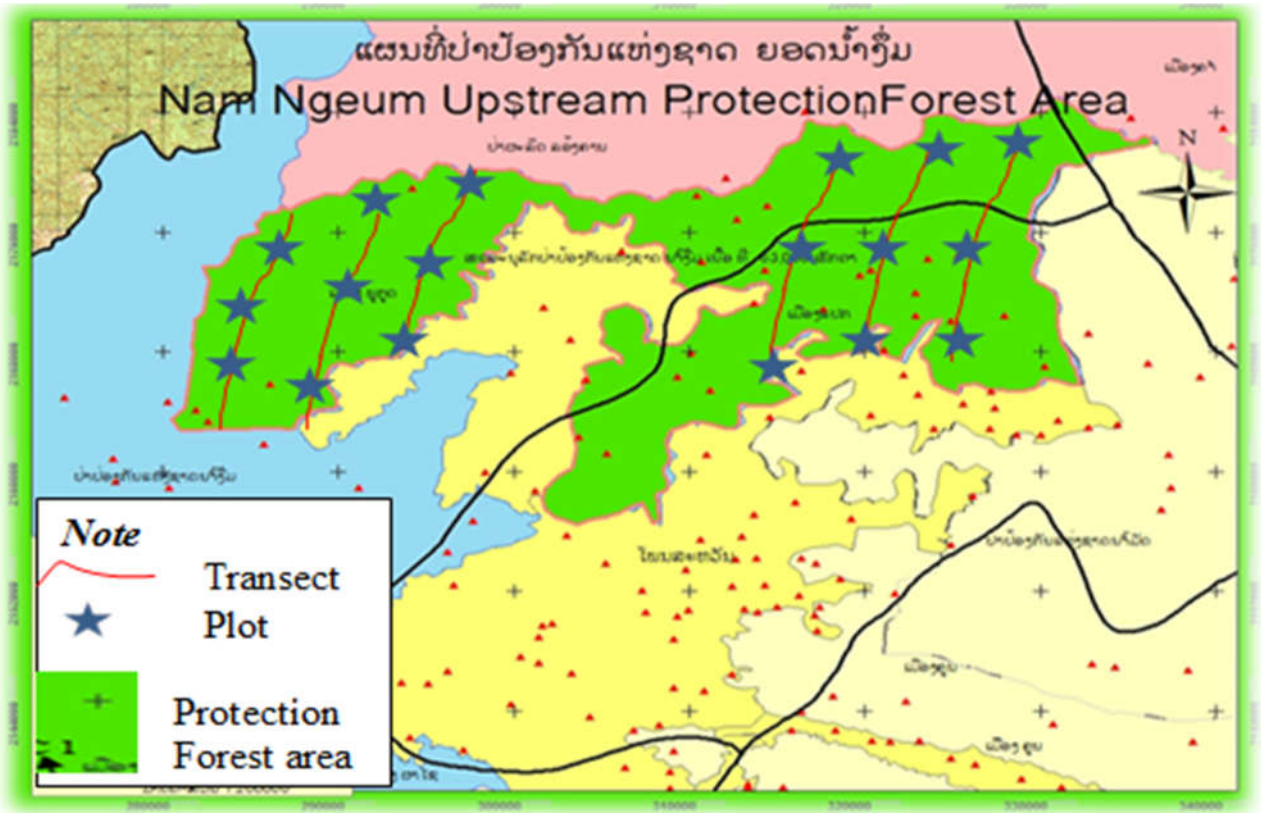


**Figure 1. The map of the visited sites**

## 2.2. Methods

**Surveys, sampling, identification and data analysis**

Preliminary distribution data of NUPA orchids were based on Bouakhaykhone, Svensuksa and Vichith Lamxay, 2005. *The Wild Orchids of Lao PDR*.

Secondary data collection. The extensive field surveys were conducted to explore the orchid diversity, distribution of the NUPA between 300 - 1,500 m during 2018 - 2019. It was conducted by lenght transects and 40 plots sized 25 x 40 m, depending on the slope. The rapid sampling of species was done and the samples of each species were collected for proper identification. For each species, information on habitat, altitudinal range, population size, local uses, etc. was collected. The species were identified with the help of a checklist flora of Lao PDR. Species were analyzed for nativity, endemism and rarity. Nativity of the species was identified. Endemism of the species was identified based on The Lao National Forestry Law (24 December 2007 N°6/NA); CITES (Convention on International trade of endangered species). Convention signed by Lao PDR the 01/March/2004 and According to the International Union for Conservation of Nature (IUCN). Information on the local uses of the species is based on the available literature and interviews of the inhabitants.

## 3. RESULTS

### 3.1. Diversity

A total of 31 species of the orchids representing 10 genera were recorded in NUPA, These species were found across three notable forest types: lowland evergreen forest, evergreen forest over limestone, and uphill evergreen forest. Table 1 shows the list of these 31 orchidaceous species.

**Table 1. List of botanical orchids identified during study, including distribution**

| No. | Orchids botanical name (genera/species) | Lao names | Purpose | | Habitats | Micro - habitats: forest types | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | LEF | EFL | UEF |
| 1 | *Acampe papilliosa* Lindl | Chang saraphi noy | m | F | Epiphytic | x | x | x |
| 2 | *Aerides falcata* Lindl. | Koulap krapao poet | m | F | Epiphytic | x | x | x |
| 3 | *Aerides flabellata* Rolfe | Koulap Nok philap | m | F | Epiphytic | x | x | x |
| 4 | *Aerides multiflora* Roxb. | Koulab malai deng | m | f | Epiphytic | x | x | |
| 5 | *Aerides houliettana* Rchb.f. | Koulab leuang | | f | Epiphytic | x | x | |
| 6 | *Anoechtochylus lylei* Rolfe. | Nha bay lay | m | f | Terrestrial | x | x | |
| 7 | *Cleisostoma arietinum* Garay | Khao Phae | m | f | Epiphytic | x | x | x |
| 8 | *Cleisostoma fuerstenberganium* Krzl | Kang pla | m | f | Epiphytic | | x | x |
| 9 | *Coelogine trinervis* Lindl. | Ueang mak | | f | Epiphytic | x | | |
| 10 | *Dendrobium anosmum* Lindl. | Ueang say louang | m | f | Epiphytic | x | x | |
| 11 | *Dendrobium densiflorum* Lindl. | Ueang Mon Khai | m | f | Epiphytic | x | | x |
| 12 | *Dendrobium devonianum* Paxton. | Ueang sai pha kang | m | f | Epiphytic | | x | x |
| 13 | *Dendrobium dixanthum* Rchb.f. | Ueang Kham Pon | m | f | Epiphytic | x | x | x |
| 14 | *Dendrobium draconis* Rchb.f | Ueang Ngoen | | f | Epiphytic | x | x | x |
| 15 | *Dendrobium fimbriatum* Hook. | Ueang kham noi | | f | Epiphytic | x | x | x |
| 16 | *Dendrobium findlayanum* Rchb.f. | Ueang phuang yok | | f | Epiphytic | x | x | x |
| 17 | *Dendrobium friedericksianum Rchb.f* | Ueuang Lueang | m | f | Epiphytic | x | | |
| 18 | *Dendrobium gibsonii* Paxton. | Ueang Kham Ta | m | f | Epiphytic | x | x | x |
| 19 | *Dendrobium gratiosissimum* Rchb. f | Ueuang King dam | m | f | Epiphytic | x | x | x |
| 20 | *Dendrobium heterocarpum* Wall. | Ueang si tan | m | f | Epiphytic | x | x | x |
| 21 | *Dendrobium moschatum* Lindl. | Ueuang champa | m | f | Epiphytic | x | x | x |
| 22 | *Dendrobium nobile* Lindl. | Ueang Khao Kiu | m | f | Epiphytic | x | x | x |
| 23 | *Dendrobium primulinum* Lindl. | Ueang say nam | m | f | Epiphytic | x | x | x |
| 24 | *Dendrobium signatum* Rchb.f. | Ueang kham kiu | m | f | Epiphytic | x | x | x |
| 25 | *Dendrobium thyrsiflorum* Rchb.f. | Ueuang mawn khai | m | f | Epiphytic | x | x | x |
| 26 | *Eulophia spectabilis* Suresh. | Wan Hua Khru | | f | Epiphytic | x | x | |
| 27 | *Malaxis Sp* | Lin krabue | m | f | Terrestrial | x | | |
| 29 | *Pholidota articulata* Hook. | Ueuang To | m | f | Epiphytic | x | x | x |
| 31 | *Rhynchostylis gigantea* blum | Ueuang sangkha | | f | Epiphytic | x | x | x |

*Purpose: m = Medicinal, f = Flora*

*Forest types: LEF = lowland evergreen forest, EFL = evergreen forest over limestone and UEF = uphill evergreen forest.*

Among the 31 recorded orchids in NUPA, 18 are the most widely occurring species in three forest types (Figure 2).

**Figure 2. Pictures of some botanical orchids in NUPA**

### 3.2. Distribution by altitudinal zone

A total of 31 species of the orchids were recorded between 250 - 1,500 m amsl. Of these, 5 species of orchids were recorded from < 500 m altitudinal zone, followed by the 501 - 1,000 m zone (16 spp), 1,001 - 1,500 m zone (12 spp) and > 1,500 m (4 spp.), respectively (Figure 3). The diversity of orchid increases with the increase in altitude 501 - 1,500, decrease in altitude > 1,500 m.

| Altitudinal zone *(m)* | Number of species | Species |
|---|---|---|
| > 1,500 | 4 | *Acampe papilliosa* Lindl; *Dendrobium moschatum* Lindl.; *Hygrochilus parishii* Pfitz; *Rhynchostylis gigantea* blum; |
| 1,001 -1,500 | 12 | *D. draconis* Rchb.f; *Eria tomentosa* Hook.f.; *D. thyrsiflorum* Rchb.f; *Dendrobium signatum* Rchb.f; *D. findlayanum* Rchb.f.; *Eria tomentosa* Hook.f.; *D. heterocarpum* Wall; *D. signatum* Rchb.f.; *D. primulinum* Lindl; *Aerides falcata* Lindl; *A. multiflora* Roxb; |
| 501 -1,000 | 16 | *A.houliettana* Rchb.f; *A.odorata* Lour; *A.chylus lylei* Rolfe; *D. devonianum* Paxton; *Coelogine trinervis* Lindl; *Cleisostoma arietinum* Garay; *Bulbophylum affine* Lindl; *Cleisostoma fuerstenberganium* Krzl; *D. heterocarpum* Wall; *D. devonianum* Paxton |
| 250 -500 | 5 | *Malaxis Sp*; *Pholidota articulata* Hook; *Dendrobium gibsonii* Paxton; *D. fimbriatum* Hook; *Aerides multiflora* Roxb |

**Figure 3. Altitudinal distribution of orchids in NUPA**

### 3.3. Threat categorization

Of the total species, 3 species have been identified as endangered and 2 species as vulnerable. According to the International Union for Conservation of Nature (IUCN) and Lao red book, 3 species have been categorized as Endangered. Table 2 shows the list of threat levels of these orchidaceous species.

**Table 2. List of these orchidaceous species threated in NUPA**

| No. | Species | IUCN 2019 | CITES | Lao red book | Lao National Forestry Law |
|---|---|---|---|---|---|
| 1 | *Anoechtochylus lylei* Rolfe. | NE | II | NE | II |
| 2 | *Dendrobium anosmum* Lindl. | NE | II | NE | II |
| 3 | *Dendrobium densiflorum* Lindl. | VU | II | VU | II |
| 4 | *Dendrobium nobile* Lindl. | VU | II | VU | II |
| 5 | *Dendrobium primulinum* Lindl. | NE | II | NE | II |

*NE: Endangered; VU: Vulnaeable*

*CITES and Lao National Forestry Law appendix II: (i). An export permits or re-export certificate issued by the MAF of the State of export or re-export is required; (ii). Export permit may be issued only if the specimen was legally tained and if the export is not detrimental to the survival of the species*

## 4. DISCUSSION AND SUGGESTION

### 4.1. Discussion

The NUPA of Xiengkhouang province supports relatively lower number of orchids compared to other provinces. Mostly epiphytic orchids are found in the NUPA except *Anoechtochylus lylei* Rolfe (Lao name. Nha bay lay) and *Malaxis Sp* (Lin krabue), which are terrestrial in nature.

The occurrence of representative, natural, unique and socio-economically important orchids in the area indicates high conservation and socio-economic values and merits priority attention for conservation of these species. In NUPA and Xiengkhouang provice, the inhabitants are largely dependent on forests for grazing, fuel, fodder, timber, medicinal plants, wild edible plants, and for making agricultural

tools, etc. Due to continuous use of economically important species, their populations are depleting rapidly and the habitat degradation has increased many folds. Besides these, orchids are extensively used in the traditional medicine. *Anoechtochylus lylei* Rolfe is commercially exploited in the area. Due to a high commercial values of *Anoechtochylus lylei* Rolfe as a medicine, these species is facing tremendous pressure and has been identified as endangered. If overexploitation and habitat degradation continues, this species may become extinct in the area, because *Anoechtochylus lylei* is collected opportunistically by villagers throughout the year. They know it under the local name "Nha bai lai". This perennial species is harvested all year round. The whole plant including the rhizome is exploited. The yield is very low compared to the harvesting spending time, 4 to 5 days are required to collect 2 - 3 kg of raw material. The plant cannot be stored for more than few days and has to be sun-dried rapidly to prevent the rottenness of the plant. Collectors are not aware about the purpose/use of this orchid species. The other species are also exploited for curing various diseases and other purposes.

**4.2. Suggestion**

Study on habitat ecology, mass multiplication using convention and propagation methods, establishment and maintenance *ex-situ* and *in-situ* conditions, promotion of orchids, educational and awareness programmes on status, conservation and management of orchids, promotion of orchid species with high aesthetic value in floriculture, and involvement of inhabitants in the conservation management have been suggested.

As *Anoechtochylus* genus is not domesticated and shows the highest product value at each market level, the pressure on this natural resource is very high. Collection and trade are legally prohibited. In order to conserve the species and to find ways to explore its economic value, the following suggestions are given:

1. At the village level: Small-scale experiments should be initiated in order to test domestication methods. This should include detailed observations of the species' natural habitat and growth factors. Such experiments could also be supported by training on different cultivation techniques and the knowledge of relevant cultivation aspects such as habitat, diseases and other features.

2. At the district level: Illegal harvesting and trade violations need to be rigorously punished. This requires improved monitoring system and the relevant forestry and agriculture departments should conduct an inventorization at the district level to increase awareness of the micro habitat and the current occurrence of the species.

3. At national level: Research on habitat and biological characteristics should be initiated at different places in northern Laos. Collaboration with Chinese, Vietnamese and other Southeast Asian researchers should be sought. This should include the sharing of knowledge resulting from cultivation trials. In order to successfully conserve this species at national level, the government needs to seek alternative income sources at specific harvesting locations.

**5. CONCLUSION**

There are 31 species of orchids that are recorded for the first time in NUPA, of which 5 species are endangered, vulnerable to the Laos, based on the country's list of threatened species. Three species are considered endangered on the international level. None of these species have yet been assessed with regard to their conservation status. Their recorded NUPA distribution could be partially explained by the concept of PAICs or could be just remnants of scientific under-collection. The continuing anthropogenic pressures to Xiengkhouang's forests threaten the habitats of these orchid species and thus this updated list could be used as a baseline information for future conservation initiatives.

## Acknowledgements

The authors wish to thank Prof. Dr. Tran Ngoc Hai for orchidaceous species identified and the Protected Area Management Board for providing access and permit for fieldworks. Also, to Mr. Sing Souphanha for the assistance and companionship throughout the conduct of the research.

## REFERENCES

1. Bouakhaykhone, Svensuksa and Vichith Lamxay, 2005. *Field Guide: The Wild Orchids of Lao PDR*. National University of Laos, Manthatoulath Printing, Vientiane, Lao PDR.

2. Food and Agriculture Organization (FAO), 2004. "*What is Agrobiodiversity*?" From the Building on Gender, Agrobiodiversity and Local Knowledge Training Manual.

3. Grejmans, Martin, Sounthone Ketphanh, Vichith Lamxay and Khamphone Sengdara, 2007, *Non Timber Forest Products in Lao PDR*: A Manual of 100 Commercial and Traditional products. Netherland Development Organization (SNV), Vientiane, Lao PDR.

4. IUCN 2019. *The IUCN red list of threatened species*. Version 2019-1. Last accessed on 23 May 2019.

5. Lao National Forestry Law, 24 December 2007 N°6/NA.

6.ORCHIS Project. 2009. "*Preliminary checklist of the Orchidaceae of Laos*".

7. Sing Souphanha, 2017, *Biodiversity assessment in Namngum upstream protection forest area of Xiengkhouang province, Lao PDR,* Manthatoulath Printing, Vientiane, Lao PDR.

# ĐA DẠNG, PHÂN BỐ VÀ BẢO TỒN MỘT SỐ LOÀI LAN QUÝ HIẾM, ĐẶC HỮU Ở KHU RỪNG PHÒNG HỘ THƯỢNG NGUỒN NẶM NGƯM, TỈNH XIÊNG KHOẢNG, CỘNG HÒA DÂN CHỦ NHÂN DÂN LÀO

**Nguyên Văn Tứ[1], Latdavan Bounyavet[2]**

*[1]Trường Đại học Lâm nghiệp*

*[2]Học viện Giáo dục và Phát triển nghề nghiệp Lào*

## TÓM TẮT

Khu rừng phòng hộ thượng nguồn Nặm Ngưm, tỉnh Xiêng Khoảng được biết đến là nơi rất đa dạng sinh học, hệ thực vật hạt kín có khoảng trên 1.200 loài. Họ lan (Orchidaceae) có số loài tương đối cao so cới các họ thực vật khác. Hoàn cảnh sống của các loài lan đang bị đe dọa bởi sự suy giảm sinh cảnh sống, bị khai thác quá mức, thiếu tính bền vững và do sự biến đổi khí hậu trong khu vực. Do đó, nghiên cứu đa dạng thực vật họ lan ở khu rừng phòng hộ đã được tiến hành để đánh giá sự đa dạng thành phần loài, phân bố trên các sinh cảnh và mức độ đe dọa của loài quý hiếm, đặc hữu. Kết quả nghiên cứu đã nghi nhận được tổng số 31 loài lan thuộc 10 chi khác nhau, các loài có phân bố theo độ cao từ 250 – 1.500 m so với mực nước biển. Trong tổng số 31 loài bản địa có 3 loài ở cấp nguy cấp, 2 loài sẽ nguy cấp. Loài lan được phân bố chủ yếu trên ba kiểu rừng, chúng được sử dụng làm thuốc, làm cảnh cho những người du cư trong vùng đệm khu rừng phòng hộ. Do khai thác quá mức và những tác động là giảm sinh cảnh sống dẫn đến số lượng của chúng bị suy giảm nhanh chóng, nhất là loài có giá trị, bài báo đã đề xuất giải pháp quản lý và bảo tồn bền vững cho loài lan quý hiến tại khu vực.

**Từ khóa: Họ Lan, rừng phòng hộ thượng nguồn Nặm Ngưm, Xiêng Khoảng.**

**Received : 13/8/2019**
**Revised : 16/9/2019**
**Accepted : 23/9/2019**