

DIVERSITY AND DISTRIBUTION OF ERICACEAE SPECIES IN MUONG LA NATURE RESERVE, SON LA PROVINCE

Pham Thanh Trang¹, Nguyen Thi Thu², Phung Thi Tuyen³,
Do Van Truong⁴, Ly Ta Chun⁵, Hoang Manh Quyen⁶

^{1,2,3,5,6}Vietnam National University of Forestry

⁴Vietnam National Museum of Nature, Vietnam Academy of Science and Technology

SUMMARY

This study provides diversity of species composition, phenology and distribution of the family Ericaceae in Muong La Nature Reserve (Muong La NR), Son La province. A total of 11 species belong to six genera consisting of *Rhododendron*, *Craibiodendron*, *Vaccinium*, *Lyonia*, *Monotropastrum*, and *Enkianthus* were recorded for the flora of Muong La NR. Most of Ericaceae species distribute in a mountain of ever green subtropical forest from 1,500 to more than 2,400 m above sea level where covered by foggy condition year-round. The flowering or fruiting periods of nine Ericaceae species were also observed in this study. The results indicated that three species have the flowering time from June to July (*Rhododendron maddenii* sub sp. *crissum* (Franch.) Cullen, *Lyonia villosa* var. *villosa* Ridley, and *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg) and six species had fruiting time from July to August (*Rhododendron tanastylum* var. *tanastylum* Ridley, *Rhododendron nuttallii* Booth, *Craibiodendron henryi* W. W. Sm., *Vaccinium dunalianum* Wight, *Enkianthus quinqueflorus* var. *serrulatus* Wilson, and *Monotropastrum humile* (D. Don) Hata.) The important information of species diversity, distribution and phenological characteristics of Ericaceae family in Muong La NR in this study will be a useful reference for further work.

Keywords: Distribution, Ericaceae, Muong La Nature Reserve, Rhododendron.

I. INTRODUCTION

The family Ericaceae, a large cosmopolitan family represented by 4,000 species in 125 genera which widely distributed in temperate and subarctic areas, and high elevations in tropical regions (Fang et al., 2007). Ericaceae species have been used in horticulture and medicine due to their colorful flowers and high antioxidant activities, respectively (Duy et al., 2015; Guendouze-Bouchefa et al., 2015). Of which, *Rhododendron* is the most species-rich genus with more than 1,000 species distributed in humid tropical and subtropical forest whereas *Arbutus*, *Calluna*, and *Erica* genera present the highest diversity under the Mediterranean climates (Yevhen et al., 2017; Guendouze-Bouchefa et al., 2015).

Ericaceae has been well-known from the neighboring countries as China and Thailand. The recent study recorded a total of 826 species and 22 genera, with 524 endemic species for the flora of China (Fang et al., 2007). In Vietnam, the number of species in Ericaceae was evaluated

about 81 species which distribute in high mountains with cool climate (Ban, 2000; Ho, 1999). Muong La Nature Reserve (Muong La NR) is located in Ngoc Chien, Nam Pam, and Hua Trai communes of Muong La district, Son La province. Its total area is 15,806.71 ha. Muong La NR plays an important role in keeping various species and genetics of evergreen forest in North-West of Vietnam. Additionally, this area possesses main roles in watershed delivery for several lakes that were contributed to hydroelectric plants. However, by over logging and natural disasters, the flora and fauna in this area are suffering from serious threats (Forest Protection Department of Son La Province, 2014). A large number of plant species in this area might be extincted in near future, especially Ericaceae species (Trang et al., 2017).

Muong La, a new Nature Reserve in Vietnam was established in June 2015 (People's Community of Son La province,

2015). The studies on flora in this area are very few and unsystematic. According to the report of Forest Protection Department of Son La Province in 2014, the number of 622 plant species, 130 families of five divisions in Muong La NR were evaluated. Therefore, to provide scientific information for sustainable management, conservation and utilization of Ericaceae, the study of distributions and phenological characteristics of species in Ericaceae was conducted.

II. RESEARCH METHODOLOGY

Secondary data collection

Desk study method was used in this research for carefully assessing secondary data of plant diversity from previous publications and reports of Muong La NR.

Field work

Participatory Rural Appraisal (PRA) surveys (Quoc, L. H et al., 1998): The PRA survey was conducted to explore the indigenous knowledge of local people about number of species in Ericaceae family, the local name, the abundance and distribution of them in the study area. Total of 30 interviewees including villagers (25 people) and forest rangers (five people) who deeply understand plant species in the forest of this area were involved in this study. The informants selected from each village are the most knowledgeable ones as suggested by respected elders and administrators who participated in the selection processes. The ages of the informants are between 20 and 60 years. The information collected from PRA surveys are important for the research to get the first understanding about tree species of this family before designing the field surveys. The combination of indigenous knowledge and scientific knowledge makes better classification and analysis of species diversity

in this family.

Forest inventory: The forest inventory is established to assess Ericaceae species diversity and status. The current vegetation maps were used to identify the distribution of all the vegetation types in this area and then decide the transect locations. Four transects (transect 1: from Hua Ke to Po Ke 2; transect 2: from Po Ke 2 to Ta Sua peak; transect 3: from Ta Sua peak to Hua Sang; and transect 4: from Hua Sang to Hua Ke) with total of 15 km were established around and from the base to the top of the hills so that samples of four vegetation types on different slopes and reliefs were collected (Figure 1). At each transect, a GPS reference was recorded for longitude, latitude and altitude, all plants of Ericaceae were listed and described and at least three samples were gathered. Collected samples from study site were immersed in ethanol 70% and then kept in plastic bags for 4 - 10 hours. Afterward, samples were natural dried or dried in an oven at 50°C for three days. Voucher specimens have been kept in herbarium of Center for Biodiversity and Sustainable Forest Management, Vietnam National University of Forestry. The samples were identified by comparing to standard specimens in herbariums of Vietnam National University of Forestry (VNUF), National Museum of Nature (VNMN), and Hanoi National University (HNU). Species identification was also based on the floral books including Flora of Vietnam (Ho, 1999), Flore générale de l'Indo-Chine (Lecomte, 1930), Flora of China (Fang, 2007). The data were compared to the information collected from PRA surveys about plant resources in the past and their trends, which were used to figure out the conservation status of the species in the study site.

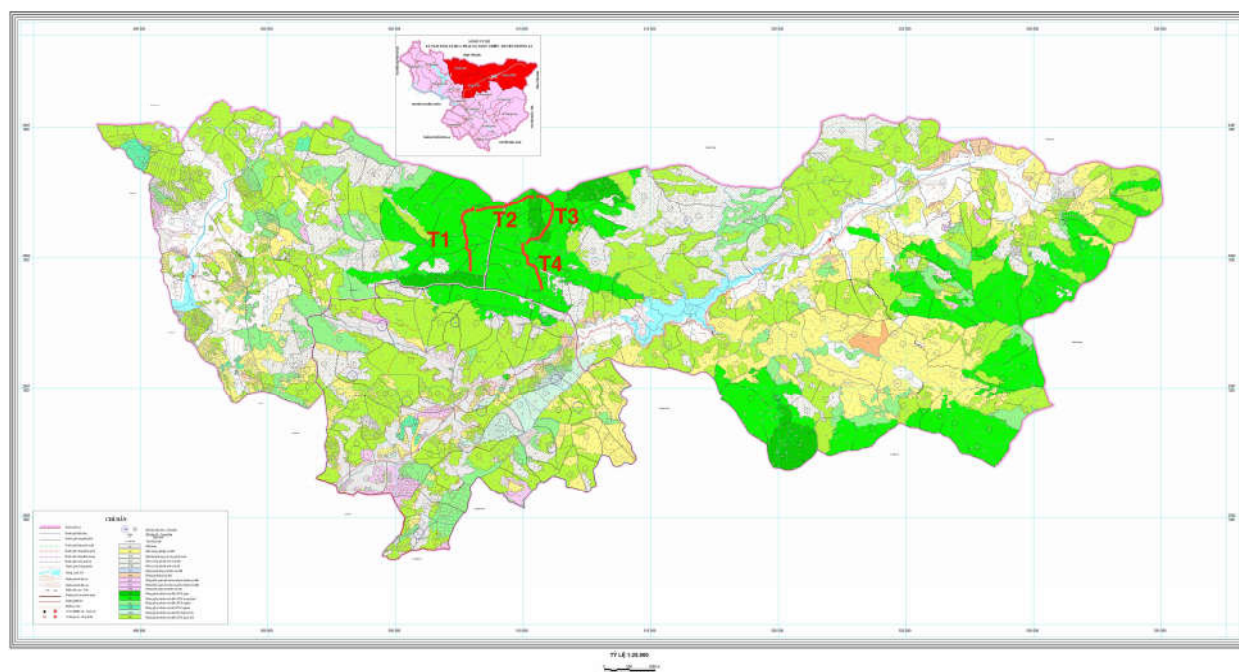


Figure 1. Study transects in Muong La NR

Transect 1: From Hua Ke (E00507811/N02391588) to Po Ke 2 (E00508000/N02390700);
 Transect 2: From Po Ke 2 (E00508000/N02390700) to Ta Sua peak (E00510469/N02398583);
 Transect 3: From Ta Sua peak (E00510469/N02398583) to Hua Sang (E00510214/N02392563);
 Transect 4: From Hua Sang (E00510214/N02392563) to Hua Ke (E00510571/N02390719).

III. RESULT AND DISCUSSIONS

3.1. Diversity of Ericaceae species in Muong La NR

Table 1. Diversity of Ericaceae species in Muong La NR

Name of species		Collection
Scientific names	Common names	numbers
<i>Craibiodendron henryi</i> W. W. Sm.	Cáp mộc bi đúp	ML02
<i>Vaccinium dunalianum</i> Wight	Việt quất lá có đuôi	ML05
<i>Rhododendron arborium</i> sub sp. <i>cinnamomum</i> (Lindl) Tagg	Đỗ quyên cây	ML32
<i>Rhododendron nuttallii</i> Booth	Đỗ quyên mộc lan	ML41
<i>Rhododendron tanastylum</i> var. <i>tanastylum</i> Ridley	Đỗ quyên vòi dài	ML42
<i>Rhododendron vialii</i> Delavay & Franch.	Hồng mã ngân hoa	ML47
<i>Lyonia villosa</i> var. <i>villosa</i> Ridley	Cà di lông	ML52
<i>Monotropastrum humile</i> (D. Don) Hata	Lan thủy tinh	ML62
<i>Rhododendron maddenii</i> sub sp. <i>crissum</i> (Franch.) Cullen	Đỗ quyên sa pa	ML69
<i>Rhododendron hainanense</i> Merr.	Đỗ quyên hải nam	ML76
<i>Enkianthus quinqueflorus</i> var. <i>serrulatus</i> Wilson	Trợ hoa lá có răng	ML82

Figure 2 and table 1 represent 11 species of Ericaceae in Muong La NR. The results indicate that those species of *Rhododendron* genus are dominant species recorded in the study areas whereas other genera are

investigated only one species. The information of 11 Ericaceae species in this research will provide a valuable information of Ericaceae for the flora of Muong La NR and Vietnam.

Table 2. Diversity of Ericaceae species

Genera	Muong La NR	Hoang Lien National Park ^a	Copia NR ^b	Xuan Nha NR ^c
<i>Agapetes</i>	0	2	0	0
<i>Craibiodendron</i>	1	0	1	1
<i>Enkianthus</i>	1	2	0	2
<i>Gaultheria</i>	0	4	0	0
<i>Leucothoe</i>	0	1	0	0
<i>Lyonia</i>	1 ^d	3	0	0
<i>Monotropastrum</i>	1 ^d	0	0	0
<i>Pieris</i>	0	1	0	0
<i>Rhododendron</i>	6	10	3	3
<i>Vaccinium</i>	1	15	0	2
Total	11	38	4	8

^a The result of biodiversity survey in Hoang Lien National Park, Lao Cai province, 2005.

^b The result of biodiversity survey in Copia NR, Son La province, 2002.

^c The result of biodiversity survey in Xuan Nha NR, Son La province, 2003.

^d Trang et al., 2017.

It can be seen in table 2, the number of Ericaceae species in Muong La NR is compared to that of different areas. Hoang Lien National Park is the most diversity area with 38 species, followed by Muong La NR, Xuan Nha NR, and Copia NR

with 11, 8, and 4 species, respectively. Although Muong La NR has the number of Ericaceae species lower than that of Hoang Lien NP, its numbers of species are still greater than that of the two Nature Reserves in Son La province.

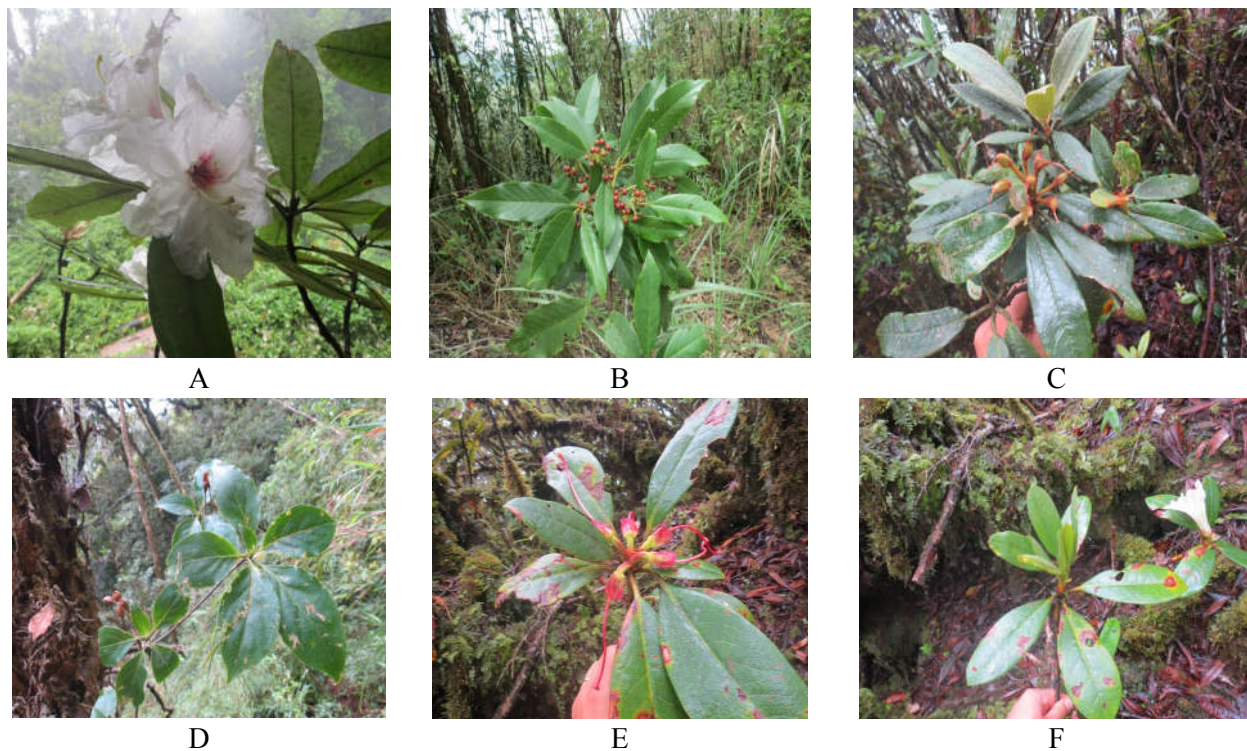


Figure 2. Identified species of Ericaceae in Muong La NR

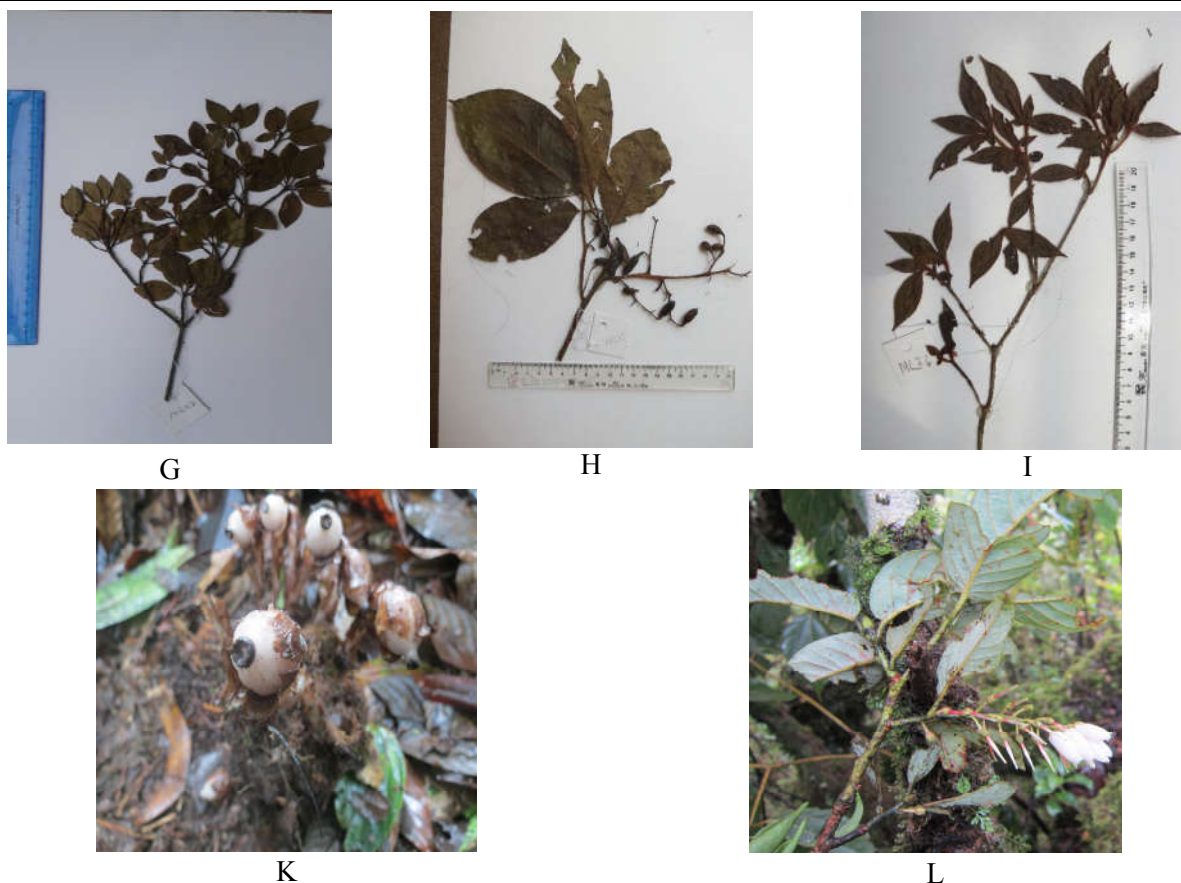


Figure 2. Identified species of Ericaceae in Muong La NR (cont.)

A: *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg.

B: *Vaccinium dunalianum* Wight.

C: *Rhododendron tanastylum* var. *tanastylum* Ridley.

D: *Enkianthus quinqueflorus* var. *serrulatus* Wilson.

E: *Rhododendron nuttallii* Booth.

F: *Rhododendron maddenii* subsp. *crassum* (Franch.) Cullen.

G: *Rhododendron vialii* Delavay & Franch.

H: *Craibiodendron henryi* W. W. Sm.

I: *Rhododendron hainanense* Merr.

K: *Monotropastrum humile* (D. Don) Hata.

L: *Lyonia villosa* var. *villosa* Ridley.

3.2. Phenological characteristics of Ericaceae species in Muong La NR

Results of flowering and fruiting periods of 11 species are indicated in table 3. The flowering time of only three species were recorded in from July consisting of *Rhododendron maddenii* subsp. *crassum* (Franch.) Cullen, *Lyonia villosa* var. *villosa* Ridley, and *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg, other species

were not observed their flowering time in July. Regarding the fruiting time, except five species consisting of *Rhododendron maddenii* subsp. *crassum* (Franch.) Cullen, *Lyonia villosa* var. *villosa* Ridley, *Rhododendron vialii* Delavay & Franch., *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg, and *Rhododendron hainanense* Merr., other species were found to have fruiting time in July. Ericaceae species had different

flowering and fruiting times (Ho, 2003). According to previous studies, nine species had flowering period from March to August, whereas two species bloomed from December to March (Ban, 2000; Chi, 2004; Ho, 1999) (Table 3). Particularly, the fruiting time of *Rhododendron tanastylum* var. *tanastylum*

Ridley and *Rhododendron nuttalii* Booth were recorded in July in this study which were different to observation of previous research from September to December (Ban, 2000; Chi, 2004; Ho, 1999). It can be explained because of the differences from soil and weather conditions among studied sites.

Table 3. Flowering and fruiting time of species of Ericaceae

Species	Observations		References	
	Flower	Fruit	Flower	Flower
<i>Rhododendron tanastylum</i> var. <i>tanastylum</i> Ridley	-	July	March - July (Ban, 2000; Chi, 2004)	November (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Rhododendron nuttalii</i> Booth	-	July	June - August (Ho, 1999; Chi, 2004)	September - December (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Rhododendron maddenii</i> subsp. <i>crassum</i> (Franch.) Cullen	July	-	June - August (Ho, 1999; Ban, 2000; Chi, 2004)	November (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Rhododendron arborium</i> subsp. <i>cinnamomum</i> (Lindl) Tagg	June – July	-	June - August (Ho, 1999; Chi, 2004)	November (Ho, 1999; Chi, 2004)
<i>Rhododendron hainanense</i> Merr.	-	-	December - January (Chi, 2004)	September (Ban, 2000)
<i>Rhododendron vialii</i> Delavay & Franch.	-	-	April (Ho, 1999; Chi, 2004)	-
<i>Craibiodendron henryi</i> W.W.Sm.	-	July	June (Ban, 2000)	July - August (Ban, 2000)
<i>Vaccinium dunalianum</i> Wight.	-	July	April - December (Ho, 1999; Ban, 2000; Chi, 2004)	April - December (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Enkianthus quinqueflorus</i> var. <i>serrulatus</i> Wilson	-	July	February - March (Ho, 1999; Ban, 2000; Chi, 2004)	May - September (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Lyonia villosa</i> var. <i>villosa</i> Ridley	July	-	June - July (Ho, 1999; Ban, 2000; Chi, 2004)	August (Ho, 1999; Ban, 2000; Chi, 2004)
<i>Monotropastrum humile</i> (D. Don) Hata	-	July	March - May (Ho, 1999; Ban, 2000; Chi, 2004)	-

(-) Not observed.

3.3. Distribution of Ericaceae species in Muong La NR

The distributions of 11 species in Ericaceae are shown in table 4 and figure 3. The result indicated that, those species distribute from 1,500 to 2,400 m above sea level (asl). Of which, Ta Sua mountain, a protected area covered by primary forest status, is the most

suitable place for Ericaceae species growth. In Ta Sua, six species were investigated at 2,300 m asl. and three species were recorded from 1,500 - 2,000 m asl. It is found that Ta Sua has more diversity species than other places because this area might be less affected by humans than other places.

Table 4. Distribution of species in Ericaceae

Scientific names	Sample codes	Located points	Altitude (m)	Forest status
<i>Rhododendron</i> aff. <i>hainanense</i> Merr.	ML76	E00508879/N02393008	1629	Evergreen subtropical forest
<i>Rhododendron vialii</i> Delavay & Franch.	ML47	E00508879/N02393008	1629	Evergreen subtropical forest
<i>Vaccinium</i> aff. <i>dunalianum</i> Wight	ML05	E00510943/N02391429	1717	Evergreen subtropical forest
<i>Rhododendron arborium</i> subsp. <i>cinnamomum</i> (Lindl) Tagg	ML32	E00509094/N02394002	2328	Evergreen subtropical forest
<i>Rhododendron tanastylum</i> var. <i>tanastylum</i> Ridley	ML42	E00509444/N02394059	2433	Evergreen subtropical forest
<i>Rhododendron nuttallii</i> Booth	ML 41	E00509444/N02394060	2434	Evergreen subtropical forest
<i>Rhododendron maddenii</i> subsp. <i>crassum</i> (Franch.) Cullen	ML69	E00509444/N02394061	2435	Evergreen subtropical forest
<i>Enkianthus quinqueflorus</i> var. <i>serrulatus</i> Wilson	ML82	E00509444/N02394061	2435	Evergreen subtropical forest
<i>Craibiodendron henryi</i> W.W.Sm	ML02	E00509444/N02394061	2435	Evergreen subtropical forest
<i>Lyonia villosa</i> var. <i>villosa</i> Ridley	ML52	E00509444/N02394061	2435	Evergreen subtropical forest
<i>Monotropastrum humile</i> (D. Don) Hata	ML62	E00509094/N02394002	2328	Evergreen subtropical forest

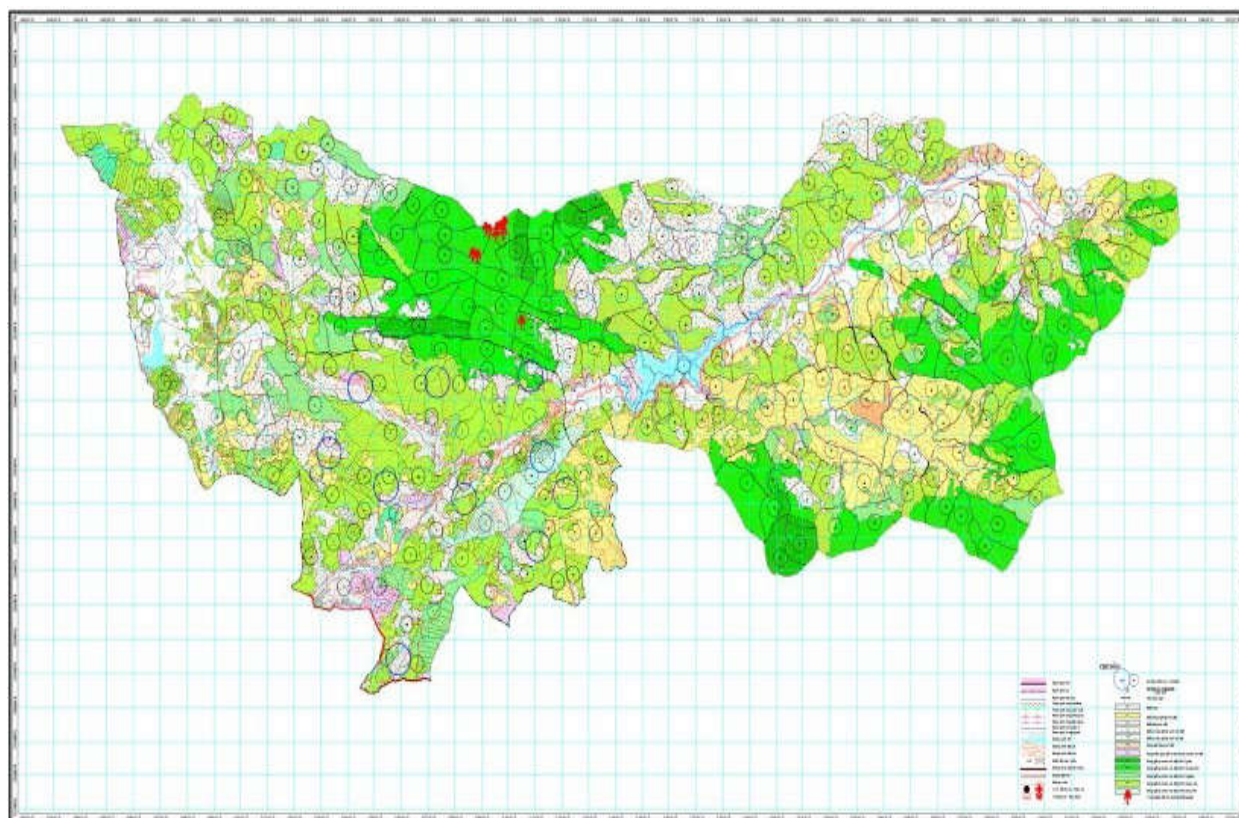


Figure 3. Distribution of family Ericaceae in Muong La NR

≡: Distributed areas of Ericaceae

IV. DISCUSSION

Four Ericaceae species were recorded in Copia NR (The result of biodiversity survey in Copia NR, Son La province, 2002). Besides, eight species investigated in Xuan Nha NR (The result of biodiversity survey in Xuan Nha NR, Son La province, 2003). In particular, Hoang Lien National Park in Lao Cai province with 29,509 ha is considered a extremely suitable place for growth and development of Ericaceae. There are 38 species of eight genera (*Agapetes*, *Enkianthus*, *Gaultheria*, *Leucothoe*, *Lyonia*, *Pieris*, *Rhododendron* and *Vaccinium*) were found (The result of biodiversity survey in Hoang Lien National Park, Lao Cai province, 2005). Based on the initial results obtained in this study, Muong La NR is thought to have more Ericaceae species than Copia and Xuan Nha but less than that of Hoang Lien NR. One important is that Muong La is a new NR in Vietnam. There are very few studies on Ericaceae species resulting in many Ericaceae species might be still unknown.

The fruiting time of two Ericaceae species (including: *Rhododendron tanastylum* var. *tanastylum* Ridley, *Rhododendron nuttallii* Booth) is from September to December (Ho, 1999; Ban, 2000; Chi, 2004). However, in this study, the fruiting time of those species is from July to August. Besides, three Ericaceae species (including *Rhododendron tanastylum* var. *tanastylum* Ridley; *Rhododendron nuttallii* Booth, and *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg) are distributed from 2,300 m to 2,500 m above sea level which compared to between 1,200 m to 3,000 m (Chi, 2004). Moreover, *Vaccinium* aff. *dunalianum*

Wight is located at elevation lower than 1,500 m (Chi, 2004), while this species is distributed at elevation higher than 1,700 m in this study site.

Furthermore, the information of indigenous knowledge about Ericaceae species illustrates that most of local people have good understanding of Ericaceae. However, their ability of plant identification is still limited. Local people can categorise what species belong to the Ericaceae based on the common characteristics of the family and they know well where those species distribute in study area. Information collected from PRA surveys played important role for the following forest inventory. Such information, though, is incompleting, it contributed significantly to our discovery of wide range new records of those species in Ericaceae in Muong La NR. Therefore, ethnobotany is an important component of any botanical study.

This study is the first time determination of the number of Ericaceae species in Muong La NR. The results provide information for the conservation activity of Ericaceae species in the future. For further work, seedling observation will be conducted with those species of Ericaceae in this study site.

V. CONCLUSION

In comparison with previous studies, this research reported the distributed areas of 11 species of Ericaceae in Muong La NR including *Rhododendron arborium* subsp. *cinnamomum* (Lindl) Tagg, *Vaccinium dunalianum* Wight, *Rhododendron tanastylum* var. *tanastylum* Ridley, *Enkianthus quinqueflorus* var. *serrulatus* Wilson,

Rhododendron nuttallii Booth, *Rhododendron maddenii* subsp. *crassum* (Franch.) Cullen, *Rhododendron vialii* Delavay & Franch., *Craibiodendron henryi* W.W.Sm., *Rhododendron hainanense* Merr., *Monotropastrum humile* (D. Don) Hata, and *Lyonia villosa* var. *villosa* Ridley. Those species distribute in the forest where the altitude at 1,500 - 2,400 m asl. The flowering and fruiting periods of nine species were reported in this study. Due to the diversity of species and beautiful flowers, Ericaceae species may be a promising source of horticulture.

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**NGHIÊN CỨU THÀNH PHẦN VÀ PHÂN BỐ CÁC LOÀI
TRONG HỌ ĐỔ QUYÊN (ERICACEAE)
TẠI KHU BẢO TỒN THIÊN NHIÊN MƯỜNG LA - SƠN LA**

**Phạm Thành Trang¹, Nguyễn Thị Thu², Phùng Thị Tuyền³,
Đỗ Văn Trường⁴, Lý Tà Chun⁵, Hoàng Mạnh Quyền⁶**

^{1,2,3,5,6}*Trường Đại học Lâm nghiệp*

⁴*Bảo tàng Thiên nhiên Quốc gia Việt Nam, Viện Khoa học và Công nghệ Việt Nam*

TÓM TẮT

Kết quả điều tra đã bổ sung cho hệ thực vật tại Khu bảo tồn thiên nhiên Mường La, Sơn La 11 loài thuộc 6 chi trong họ Đỗ quyên (Ericaceae). Chi *Rhododendron* có số lượng loài lớn nhất là 6 loài, các chi *Craibiodendron*, *Vaccinium*, *Lyonia*, *Monotropastrum*, *Enkianthus* chỉ xác định được 1 loài. Thời gian ra hoa và kết quả của các loài đã được điều tra và tổng hợp trong nghiên cứu này. Kết quả cho thấy, chủ yếu các loài có thời gian ra quả vào tháng 7. Kết quả điều tra cũng chỉ ra rằng các loài Đỗ quyên tại Khu bảo tồn thiên nhiên Mường La phân bố ở độ cao từ 1.500 m đến trên 2.400 m so với mực nước biển, nơi có khí hậu mát và quanh năm có sương mù. Các loài cây này mọc rải rác trong rừng kín thường xanh ẩm á nhiệt đới hoặc thành từng đám nhỏ trên núi cao. Kết quả điều tra đã bổ sung thông tin quan trọng về họ Đỗ quyên cho hệ thực vật tại Khu bảo tồn thiên nhiên Mường La. Đây là cơ sở ban đầu cho những nghiên cứu tiếp theo về Đỗ quyên.

Từ khóa: Đỗ quyên, Ericaceae, Khu bảo tồn thiên nhiên Mường La, phân bố.

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