# STUDY ON EFFECTS OF ENVIRONMENTAL FACTORS TO PLANTS AT BA VI NATIONAL PARK

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## SUMMARY

The environmental factors (temperature, humidity, precipitation, soil type, elevation,...) have positive impact to the change of forest ecology in general and National Parks of Vietnam in particular. In the case of Ba Vi National Park, elevation is one of factors which have significant effects to plant diversity. This paper provides information about effect of elevation on plant diversity in Ba Vi National Park which has 3 types of natural forest and 2 types of artificial one. Plant composition is different among the elevation of Ba Vi National Park not only by number of plant species in general but also about high conservation value species. The number of plant species increased by elevation with the highest at 1000 m and the lowest at 400 m above sea level is 156 and 98 species, respectively. The number of plant families also increases by higher elevation. The result also showed that from 400 m up to 1000 m, the higher elevation the more plant biodiversity. The plant species similarity is the highest between 1000 m and 800 m with 40% species appear on both elevation and the lowest between 1000 m and 400 m with only 11% species distributed in both areas.

**Keywords: Ba Vi National Park, biodiversity index, elevation and plant.**

## I. INTRODUCTION

Vietnam is located in the tropical monsoon region with high biological diversity. However, the forest resources has been degraded due to many reasons. Human and environmental factors affects plant populations and can modify interactions among species within communities. Habitat loss, fragmentation, and degradation are currently the most important threats to biodiversity. Several interactions between environmental factors and plant diversity have been reported. For example, burnt forests, light levels are increased, while tree density is reduced. Therefore, identification of factors related to environment that affect biodiversity and forest vegetation structure is important because it might enable us to change to less destructive forest management types. Within diverse tropical forests there is also evidence that variation in environmental factors, such as soil nutrients, canopy openness, slope, and herb cover affect the distribution of tree species and forest composition. However, environmental factors can have a differential effect on plant diversity and forest composition. For example, soil factors and mean annual rainfall are more strongly related with floristic composition when compared with topography in lowland forests.

Ba Vi is a one of 31 national park in Vietnam. It is located in Luong Son, Ky Son (Hoa Binh), Ba Vi (Ha Tay) and about 60 kilometers far from Ha Noi. Ba Vi NTP was established in January 16$^{th}$ 1991 according to 17/CT decision of Prime Minister. At first, Ba Vi NTP was called "Ba Vi National forbidden

forest". Till December 18th 1991, the Prime Minister decided to change the name of the park in 407/CT decision. Then in May 12th 2003, he exposed 510/QD-TTg which is "Ba Vi NTP extension" with 4626 hectares of extended area. Until now, total area of NTP is 11097.5 hectares with highest peak more than 1200m above sea level. There are 3 types of natural forest which are distributed from 400m and above, 2 types of artificial forest are grown in the areas lower than 400m. The National park has high biodiversity and many threatened plant species but they have been affected by the environmental factors which included temperature, humidity, precipitation, soil type, elevation, etc,. that could change their characteristics (tree form, growth rate,...), distribution. Moreover, the variation in elevation is the precursor of the changes of environmental factors in Ba Vi. Additionally, climate change has affected remarkably to the plants there. Therefore, it is essential to study on effects of environmental factors in general, elevation in particular to plant diversity at Ba Vi National Park.

In this study we focus on the following questions: Can elevation influences on species composition and diversity and how elevation affect on plant diversity and composition in Ba Vi National Park?

The results of this study provide the information about plant diversity in Ba Vi and if possible, it can be the basic data which is useful for assessing the impacts of climate change on plant.

## II. METHODOLOGY

We established 12 plots 1000 $m^2$ (25 m x 40 m), 3 plots in each elevation 400 m, 600 m, 800 m and 1000 m above sea level.

In the plots (25 m x 40 m) all trees with a dbh $\geq$ 5 cm were identified and their diameter measured. All treelets with a dbh < 5 cm, and h $\geq$ 1 m high were identified and their diameter measured in 5 x 5 m subplots within each 25 x 40 m plot. In each transect we noted all species and collected specimens of plants which could not be identified in the field. One voucher of each specimen was deposited at the herbarium of the Vietnam Forestry University. The Red list species were identified based on the Red Data Book of Vietnam (Ban 2007; IUCN 2015).

Species diversity was measured by using Shannon index and Simpson index.

The Simpson index was introduced in 1949 by Edward H. Simpson to measure the degree of concentration when individuals are classified into types:

$D = \sum (n/N)^2$

Which: D - Simpson index; n - the number of trees of an species; N - the number of all trees.

Shannon index is calculated by the formula below: $\sum_{i=1}^{s} Pi * \ln(Pi)$

Which: H - the Shannon index; Pi - the ratio of i species in the whole plot; S - number of trees in 1 plot.

Sorensen index of similarity in EstimateS 8.0 program was used to estimate sampling similarities for comparisons between sites from different elevations. Sorensen index is based on the number of shared and unique species in compared assemblages and is calculated as Sorensen index = 2c/(a + b), where c = number

of species occurring in both samples, a, b = total number of species in individual samples.

## III. RESULTS

### 3.1. Plant composition in Ba Vi National Park

***a. At elevation 400m***

The total of 98 species belong to 16 families were recorded in 3 plots. They were mainly *Liquidambar formosana, Ficus auriculata, Aporosa dioica, Bistrofia javanica, Litsea baviensis, ficus sp., Broussonetia papyrifera, acacia auliculiformis, Machilus odoratissima. Macaranga denticulata, Aphananthe aspera, Archidendron balansae, Schefflera heptaphylla, Machilus bonii, Caryodaphnopsis baviensis.*

At this elevation there are mostly small and medium trees, there are no big tree was recorded in this area. There were only 2 high conservation species found in this area is *Chukrasia tabularis* and *Podocarpus nerifolius.* However, it is only 2 small trees of *Chukrasia tabularis* and 1 single tree of *Podocarpus nerifolius.*

***b. At elevation 600m***

The total of 103 species belong to 16 families were recorded in 3 plots including *Chukrrasia tabularis, Sacara dives, Litsea monopetala, Archidendron balansae, Schefflera heptaphylla, Machilus bonii, Caryodaphnopsis baviensis, Wrightia annamensis, Macaranga denticulata, Pinus massoniana, Mallotus barbatus, Litsea cubeba, Michelia mediocris, Bistrofia javanica, Litsea baviensis.*

At this elevation, the forest was less impact of human than the forest at 400m. The forest quality good and we could easy to see the big tree in the plots. There were 8 high conservation species found in this area such as: *Madhuca pasquieri, Erythrophleum fordii, Chukrrasia tabularis .v.v*

***c. At elevation 800 m***

The total of 152 species belong to 19 families were recorded in this area. They were mainly *Castanopsis tonkinensis, Peltophorum tonkinensis, Michelia mediocris, Bistrofia javanica, Chukrasia tabularis, Litsea glutinosa, Machilus odoratissima, Sacara dives, Wrightia annamensis, Syzygium cumini, Elaeocarpus balansae, Archidendron balansae, Canarium album, Machilus bonii, Caryodaphnopsis baviensis, Wrightia annamensis, Maglietia conifera, Madhuca pasquieri etc.*

At this elevation, the forest also less impact of human. The forest quality were good with many big trees. There were 9 high conservation species found in this area such as: *Calocedrus macrolepis, Hopea chinensis, Chukrasia tabularis, Garcinia fagraeoides.*

***d. At elevation 1000 m***

The total of 156 species belong to 21 families were recorded in this area. They were mainly *Magnolia baviensis, Castanopsis tonkinensis, Eurya japonica, Castanopsis* sp., *Cryptocarya sp., Elaeocarpus balansae, Litsea baviensis, Syzygium balsamineum, Machilus* sp., *Aglaia perviridis, Castanopsis indica, Acer laeviegatum, Eberhardtia aurata, Peltophorum tonkinensis, Michelia balansea, Michelia mediocris, Lithocarpus corneus, Hopea chinensis, Pometia pinnata, Madhuca pasquieri, Chukrasia tabularis, Litsea*

*glutinosa, Machilus odoratissima, Sacara dives, Wrightia levis, Syzygium cumini, Dracotomelum dao, Canarium album, Machilus bonii, Caryodaphnopsis baviensis, Maglietia conifera etc.*

At this elevation, the forest also less impact of human. The forest quality were good with many big trees. There were 9 high conservation species found in this area such as: *Calocedrus macrolepis, Fokienia hodginsii*, *Madhuca pasquieri, Maglietia fordiana etc.*

**3.2. Diversity of plant resource with conservation values**

The vegetation of Ba Vi has 64 species were listed on red-data book of Vietnam (2007) with 2 *Critically Endangered species (CR)* which are *Chroesthes lanceolata, Cinnamomum parthenoxylon* and 15 *Endangered species (EN) Alniphyllum eberhardtii*, *Anoectochilus setaceus*, *Asarum balansae*, *Balanophora laxiflora*, *Calocedrus macrolepis*, *Curculigo orchioides*, *Dendrobium nobile*, *Diospyros mollis*, *Drynaria fortunei*, *Lithocarpus polystachyus*, *Madhuca pasquieri*, *Nervilia fordii*, *Paris polyphylla*, *Podophyllum tonkinense* và *Vatica subglabra.*

On the list of 32/2006/NĐ-CP Decree, there are 4 species on IA appendix : *Dalbergia tonkinensis*, *Anoectochilus lanceolatus*, *Anoectochilus roxburghii*, *Anoectochilus setaceus* and 23 species on IIA appendix: *Cephalotaxus manii*, *Calocedrus macrolepis*, *Cycas balansae*, *Cycas pectinata*, *Cycas revoluta*, *Asarum balansae*, *Asarum caudigerum*, *Asarum glabrum*, *Asarum maximum*, *Markhamia stipulata*, *Codonopsis javanica*, *Cinnamomum balansae*, *Cinnamomum parthenoxylon*, *Coscinium fenestratum*, *Fibraurea tinctoria*, *Stephania dielsiana*, *Stephania japonica*, *Stephania longa*, *Stephania pierrei*, *Stephania rotunda*, *Stephania sinica*, *Dendrobium nobile*, *Nervilia fordii*.

The Flora of Ba Vì national park has 49 species which were listed on IUCN standard (3/2012) with 25 species belonging to threatened species:

2 species are critical endangered (CR): *Amorphophallus interruptus* and *Hopea mollissima*.

6 species are endangered species (EN) : *Amentotaxus yunnanensis*, *Cinnamomum balansae*, *Dipterocarpus alatus*, *Erythrophleum fordii*, *Schefflera kontumensis*, *Zingiber monophyllum*.

17 species are vulnerable species (VU) including: *Aglaia perviridis*, *Amomum vespertilio*, *Bennettiodendron cordatum*, *Calocedrus macrolepis*, *Cycas pectinata*, *Dalbergia tonkinensis*, *Dipterocarpus retusus*, *Helicia grandifolia*, *Hopea odorata*, *Horsfieldia longiflora*, *Hydnocarpus annamensis*, *Hydnocarpus hainanensis*, *Knema pierrei*, *Knema tonkinensis*, *Madhuca pasquieri*, *Mouretia tonkinensis*, *Pinus merkusii*.

Moreover, there are 9 species which were listed on CITES: *Cyathea contaminans, Cyathea gigantea, Cyathea metteniana,*

*Cyathea podophylla, Cyathea salletti, Euphorbia antiquorum, Euphorbia milii, Euphorbia tirucalli, Cibotium barometz.*

### 3.3. Effect of elevation on plant diversity in Ba Vi National Park

The result showed that in Ba Vi National Park, the number of species increased with elevation. At the elevation 1000m, the number of species was the highest with 156 species and the lowest number of 98 species was at 400m. The number of families was also higher when the elevation increases (table 1).

**Table 1. Fluctuation number of plant species and families by elevation in Bavi National Park**

| Elevation (m) | Number of species | Number of families |
|---|---|---|
| 400 | 98 | 16 |
| 600 | 103 | 16 |
| 800 | 152 | 19 |
| 1000 | 156 | 21 |

The result showed that the Shannon Index different among elevation in Ba Vi National Park. Shannon Index increase at higher elevation. In contrast, the Simpson index decreases from low to higher attitude. It means that the higher elevation the more plant biodiversity (table 2).

**Table 2. Effect of elevation on plant biodiversity index**

| Elevation (m) | Shannon Index | Simpson index |
|---|---|---|
| 400 | 2,70 | 0,70 |
| 600 | 2,73 | 0,67 |
| 800 | 2,80 | 0,63 |
| 1000 | 3,00 | 0,52 |

Sorensen index showed that the species similarity between 1000 m and 800 m were the highest with 40% of species appear on both elevation and the lowest between 1000 m and 400 m that only 11% species distribution in both areas (table 3).

**Table 3. Sorensen index at different elevation in Ba Vi National Park**

| Altitude | 400 | 600 | 800 | 1000 |
|---|---|---|---|---|
| 400 | 1 | 0,24 | 0,18 | 0,12 |
| 600 | | 1 | 0,36 | 0,25 |
| 800 | | | 1 | 0,40 |
| 1000 | | | | 1 |

## IV. CONCLUSION

Plant compositions were different among the elevation of Ba Vi National Park not only by number of plant species in general but also about high conservation value species. The number of plant species increased by elevation

with highest at 1000 m above sea level is 156 and the lowest at 400 m with 98 species. The number of plant families also higher when the elevation increased in Ba Vi National park.

In Ba Vi National park, from 400 m up to 1000m the the higher elevation the more diverse of plant biodiversity.

The plant species similarity between 1000 m and 800m is the highest with 40% of species appear on both elevation and the lowest between 1000 m and 400 m that only 11% species distribution in both areas.

The scope of research was only the elevations lower than 1000 m. At the higher elevation, the result might not be the same

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# NGHIÊN CỨU VỀ ẢNH HƯỞNG CỦA CÁC NHÂN TỐ MÔI TRƯỜNG TỚI THỰC VẬT RỪNG TẠI VƯỜN QUỐC GIA BA VÌ

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## TÓM TẮT

Các nhân tố môi trường (nhiệt độ, độ ẩm, lượng mưa, loại đất, đai cao,...) có ảnh hưởng tích cực đến sự thay đổi của hệ sinh thái rừng nói chung và các vườn quốc gia của Việt Nam nói riêng. Với Vườn Quốc Gia Ba Vì thì đai cao là 1 những yếu tố môi trường có trong tầm ảnh hưởng lớn và rõ rệt nhất đến đa dạng sinh học thực vật. Bài báo trình bày kết quả nghiên cứu về ảnh hưởng của đai cao tới tính đa dạng sinh học thực vật tại vườn quốc gia Ba Vì, nơi có 2 loại rừng trồng và 3 loại rừng tự nhiên. Kết quả nghiên cứu cho thấy có sự khác nhau về thành phần loài thực vật giữa các đai cao. Số loài và số họ thực vật tăng theo đai cao từ 400 m đến 1000 m, cao nhất là 156 loài ở đai cao 1000 m và thấp nhất là 98 loài ở đai cao 400 m. Không chỉ khác nhau về số loài thực vật mà trên các đai cao thì số loài có giá trị bảo tồn và chỉ số đa dạng sinh học cũng cao hơn ở các đai thấp hơn. Thành phần loài giữa đai cao 800 m và 1000 m là có sự tương đồng cao nhất với 40% số loài xuất hiện trên cả 2 đai và thấp nhất giữa đai cao 1000 m và 400 m khi cho có 11% số loài cùng xuất hiện ở cả 2 khu vực này.

**Từ khóa: Chỉ số đa dạng sinh học, đai cao, thực vật, Vườn Quốc gia Ba Vì.**

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