

Study on the distribution characteristics of the vegetation in high elevations in Hoang Lien National park of Vietnam

Nghiên cứu đặc điểm phân bố thảm thực vật theo đai cao tại Vườn quốc gia Hoàng Liên của Việt Nam.

Research article

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Hoang Lien National Park has a total area of 68569ha, located at an altitude of above sea 1000-3000m in the territory of the two provinces of Lai Chau and Lao Cai in Vietnam. It has a diversity of flora with 3252 species (including 775 endemic species and 236 endangered species), belonging to 1126 genera, 230 families and 6 different divisions. Due to the mountainous terrain, division diversity of Hoang Lien National Park's vegetation is thus clearly characterized by high elevations. We have studied the distribution characteristics of the vegetation by high elevations in Hoang Lien National Park of Vietnam by the general survey methodology, fieldwork, remote sensing digital image processing and analysis and inheriting the preceding research results. The study results indicated the divisions in quantity, vegetation composition, especially differentiation of endemic and rare species in accordance with high elevations. Study results were preliminary used to suggest some orientations for preserving plant diversity in high elevations of the terrain.

Vườn quốc gia Hoàng Liên có tổng diện tích 68569ha, nằm ở độ cao từ 1000-3000m so với mặt biển thuộc lãnh thổ hai tỉnh Lai Châu và Lào Cai của Việt Nam. Hệ thực vật của Vườn quốc gia Hoàng Liên rất phong phú với 3252 loài (trong đó có 775 loài đặc hữu và 236 loài quý hiếm), thuộc 1126 chi, 230 họ và 6 ngành khác nhau. Do địa hình núi cao, phân hóa đa dạng nên thảm thực vật của Vườn quốc gia Hoàng Liên có đặc trưng phân hóa theo đai cao rất rõ nét. Bằng các phương pháp điều tra tổng hợp, khảo sát thực địa, xử lý phân tích ảnh viễn thám và kế thừa các kết quả nghiên cứu đi trước nhóm tác giả đã tiến hành nghiên cứu đặc điểm phân bố thảm thực vật theo đai cao tại Vườn quốc gia Hoàng Liên của Việt Nam. Kết quả nghiên cứu chỉ rõ sự phân hoá về số lượng, thành phần hệ thực vật theo đai cao và phân hóa thành phần loài đặc hữu và quý hiếm theo đai cao. Bước đầu nghiên cứu đề xuất một vài định hướng bảo tồn đa dạng thực vật theo đai cao của địa hình.

Keywords: Hoang Lien National Park, vegetable, high elevations, divisions

1. Introduction

Hoang Lien National Park of Vietnam was established in 2002, located at an altitude of 1000-3000m above sea level on Hoang Lien mountain chain of Than Uyen, Phong Tho district of Lai Chau province and Sapa district of Lao Cai province. This is a center of diversity of plant species, under Plants Conservation Programme of the International Union for Conservation of Nature (IUCN).

The Hoang Lien National Park is recognized class A – the highest biodiversity value of Vietnam by the Global Environment Fund. It was also recognized as the ASEAN Heritage Park in 2006.

About the forest vegetation, there are over 3252 species of typical woody plants of which about 66 species are listed in the Vietnam's Red Book such as *Calocedrus macrolepis*, *Tsuga dumosa*, *Taxus wallichiana*, etc. There are 236 rare species of which some species are the main

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materials used to extract many precious medicines such as *Calocedrus macrolepis* distributing in karst Ban Ho (Sa Pa), *Taxus wallichiana* found in Sa Pà (Sa Pa), and species Hoang Lien- *Picea* distributing in the core area of national park. Besides, there are also hundreds of herbs such as *Althaea officinalis*, *Schefflera heptaphylla*, and *Nageia fleuryi*. In addition, it has been found that, antique *Ganoderma lucidum* and Sapa's *Schizostachyum aciculare* distributed mainly in the high mountains of China and Vietnam.

Due to the mountainous terrain and the diversity of division, Hoang Lien National Park's vegetations are thus characterized by high elevation divergence. In this article we refer to the distribution of characteristics of vegetations by high elevations in Hoang Lien National Park in Vietnam. The study results will provide a basis for rational use of natural resources, economic development and protection of the ecological environment in the study area.

2. Research methodology

A combination of different research methods was used in the study including general survey, statistics, remote sensing image processing, and method of mapping and geographic information systems (GIS).

In particular, the methods of general survey and statistics were used in conjunction with the study and the analysis in room. The field survey method was applied to document and correct the study in room. The analysis data collected from botanical subjects, particularly subjects in the high mountain areas that where not able to conduct field surveys were carried out by the method of remote sensing image processing. Cartography and GIS were used as visual resources specifying the spatial differentiation of the study objects clearly.

3. Results and discussions

3.1 Ecological conditions arising vegetation by high elevations

3.1.1 Terrain

The study area belonging to Hoang Lien mountain chain is mainly located at altitude 1000 - 3000m. The highest peak is 3143m at Panxipang. The lowest place is 350m at Mong Sen valley. It is surrounded by the shale and limestone mountains (1500 - 2000m), and the high granite mountains (2200 - 2600m) in west and southeast.

The influences of terrains on vegetation showed changes in moisture and temperature. The altitude terrain facilitated the formation of vegetation belts. The wind is usually very strong in these areas that increase evapotranspiration, as well as limit the size growth of the tree.

3.1.2 Climate

Spatial divisions of climate make the diversity of vegetation types in the Hoang Lien national park. It is the tropical monsoon climate cool mountain region (15 - 200C) in the area under 1500m, average daily temperature within 7 - 90C, rainy summer – medium-length autumn, short dry season. The area has an elevation of 1600m is on a tropical monsoon climate mountains cold (<150C), small temperature range day (5 - 70C), rainy summer – long autumn and winter (8 months), short dry season (2 months). The climate's characteristics are closed broad-leaved forest (coniferous or mixed) with evergreen temperate, soil moisture on deep zonal thick, well drained.

3.1.3 Soils

The cover layer of soils has a division due to high elevations: 700 to 1500 m: group of mountain yellow-red loamy soil is popular, reducing temperature slows down the decomposition of dead plant products, producing sour crude organic matter, organic matter content from 4 to 10%. 1500 to 2800 m: The temperature is reduced with rainfall, steep slopes, strong erosion, thin weathering crust, organic matter promoting hydration to increase the mobility of iron oxide. Land was classified in humic Alitols. Above 2800 m: mainly raw humus peat soils on high mountain, thick soil, humus, year-round dry and cold climate, icy winter, soils are thus temperate clearly.

3.1.4. Human's activities

The height of the vegetation is less than 1500m above sea level in the area of the buffer zone of the national park exploited intensively by the people. Anthropogenic impacts mainly include deforestation for the purposes of timber, firewood, upland rice plantation. Humans have created stable communities with cultivated crops, garden fruit trees and convenient water. At the height of 1500m, the human impacts decline. The preservation areas are primary forest vegetation with mixed forests, temperate coniferous forest upland. The ecosystem at core zone of the national park is preserved intact.

3.2 Characteristics of vegetation division on high elevations

The natural vegetation of Hoang Lien National Park, under the rule of terrain elevations, was differentiated by number, rank taxon composition in high elevations, differentiation characteristics of plant families typically by high elevations and differentiation species of endemic and rare of by high elevations.

3.2.1 Features about the number and composition of the taxon level by high elevations

The study results reflect very clear change in the composition of the taxon level by high elevation terrain. According to terrain elevation, the number of branches, families, genera and species are decreasing.

Table 1. Changes in the composition of taxa according to high elevations in Hoang Lien National Park

No	High elevations(m)	Phylums		Families		Genera		Species	
		Number	%	Number	%	Number	%	Number	%
1	Below 1500	6	100.00	218	94.78	1027	91.21	2814	86.53
2	1500-2000	5	83.33	143	62.17	591	52.49	1067	32.81
3	2000-2800	4	66.67	91	39.57	193	17.14	398	12.24
4	Above 2800	3	50.00	43	18.69	77	6.84	116	3.57
Total		6	100.00	230	100.00	1126	100.00	3252	100.00

The composition of abundant taxon level is very rich at the height below 1500m. The number of phylums is 6 (including Psilotophyta, Lycopodiophyta, Equisetophyta, Polypodiophyta, Gymnospermae and Angiospermae, accounted for 100% of phyla in Hoang Lien national park; accounting for 94.78% of families; 91.21% of genera and 86.53% of species. Thus, conservation of plant diversity need special attention to elevations below 1500m, especially in the context of the elevations of the state natural vegetation is strongly affected by humans.

The number of taxol level is descending at the height of 1500m. The number of Phylums is 5 at the height between 1500-2000m (accounting for 83.33%), the number of plant families is 143 (representing 62.17%), the number of genera and species are relatively 591 and 1067 (accounting for 52.49 and 32.81%). The number of components of taxol level is reduced. The number of families is 91 (accounting for 39.57%), the number of genera is 193 (representing 17.14%) and the number of species is 398 (representing 12, 24%). The number of families is reduced to 43 (representing 18.69%) above 2800m, the number of general is 77 (representing 6.84%) and the number of species is 116 (representing 3.57%).

3.2.2 Characteristics typical of plant families by high elevations

The lower elevation below 1500 m: The tropical plant species predominate. The typical plant families include Fagus, Alnus, Epilobium, Carex, Anaphalis, Galium, Polygala, Achillea, Potentilla, Viola, Dipsacus, Aster,

Polygonum. Characteristics of vegetation in this elevation are that human’s activities have destroyed most of the natural forest communities instead of human-interacted secondary vegetation with predominance of grassland, scrub and secondary bamboo.

The high elevation within 1500 - 2000m: Species of plants represent subtropical, temperate and tropical interlocking and interpenetration. In addition, there are many representatives of ferns. The typical plant families include Fagaceae, Betulaceae, Lauraceae, Hamamelidaceae, Styracaceae, Magnoliaceae, Theaceae, Araliaceae, Aceraceae, Pittosporaceae, Rubiaceae, Polygalaceae, Celastraceae, Lamiaceae, Liliaceae, Gesneriaceae, Acanthaceae, Myrsinaceae, Violaceae, Campanulaceae.

The high elevation within 2000 – 2800m: the representatives of families such as Ericaceae, Illiciaceae, Fagaceae, Cyperaceae, Rosaceae. Specially Tsuga yunnanensis (Pinaceae) and Abies , structured species, ferns, mosses and lichens.

The upper elevation above 2800m: mostly temperate vegetation of the high mountains dominated dwarf bamboo Arundinaria, many shrubs in Ericaceae family such as Rhododendron excelsa, chevalieri Rhododendron, Rhododendron triumphans, viscifolium Vaccinium, Vaccinium yersinii, Agapetes, Rosaceae, Illiciaceae. This type of carpet is under 0.5m on top of mountains or at 1-1.5 m at the ridges.

Table 2. Statistical table of the representatives of typical vegetation by high elevations in Hoang Lien National Park

No	High elevations	Plant factors	Typical plant families
1	Below 1500m	Tropical Plants	Acanthaceae, Amaranthaceae, Alangiaceae, Annonaceae, Anacardiaceae, Apocynaceae, Araceae, Araliaceae, Asclepiadaceae, Asteraceae, Boraginaceae, Buddlejaceae, Capparaceae, Chloranthaceae, Clethraceae, Convolvulaceae, Cornaceae, Dioscoreaceae, Elaeagnaceae, Euphorbiaceae, Fabaceae, Flacourtiaceae, Gnetaceae, Icacinaceae, Lauraceae, Loranthaceae, Malvaceae, Malpigiaceae, Moraceae, Melastomataceae, Myrsinaceae, Myrtaceae, Oleaceae, Onagraceae, Orchidaceae, Passifloraceae, Pittosporaceae, Poaceae, Polygonaceae, Proteaceae, Rhizophoraceae, Rosaceae, Rubiaceae, Rutaceae, Sapindaceae, Selaginellaceae, Simaroubaceae, Solanaceae, Staphyllaceae, Sterculiaceae, Symplocaceae, Verbenaceae, Zingiberaceae.
2	1500-2000m	Tropical and temperate plants	Fagaceae, Betulaceae, Lauraceae, Hamamelidaceae, Styracaceae, Magnoliaceae, Theaceae, Araliaceae, Aceraceae, Pittosporaceae, Rubiaceae, Polygalaceae, Celastraceae, Lamiaceae, Liliaceae, Gesneriaceae, Acanthaceae, Myrsinaceae, Violaceae, Campanulaceae.
3	2000-2800m	Temperate plant	Ericaceae, Illiciaceae, Fagaceae, Cyperaceae, Rosaceae, Poaceae, Crassulaceae, Theaceae, Berberidaceae, Saxifragaceae, Violaceae, Juncaceae, Araceae, Rubiaceae,

No	High elevations	Plant factors	Typical plant families
4	Above 2800m	Temperate alpine plant	Polygonaceae, Ericaceae, Poaceae, Cyperaceae, Crassulaceae, Rosaceae, Theaceae, Berberidaceae, Saxifragaceae, Violaceae, Juncaceae, Liliaceae, Araceae, Rubiaceae, Balsaminaceae, Polygonaceae, Apiaceae

3.2.3. Change of characteristics in the composition of rare and endemic species by high elevations

Hoang Lien National Park is the most concentrated area of endemic plant species in Vietnam with 775 species, representing 25% of the total number of endemic species in Vietnam. However, these endemic species were unevenly distributed in high elevations. Most of them concentrated in the elevation of 1500m with 635 species, accounting for 81.94%. At the higher elevations, the number of endemic species was declining. There were 215 endemic species found in the elevation of 1500-2000m (representing 27.74%), 61 ones in the elevation of

2000-2800m (accounting for 7.87%) and 19 one in the upper elevation of 2800m (representing 2.45%).

Hoang Lien National Park is also considered to be the center of rare plants such as *Forkienia hodginsii*, *Taxus chinensis*, *Coptis spp.*, *Berberis spp.*, *Mahonia japonica*, *Aistolochia spp.*, *Asarum spp.*, *Panax spp.* The number of rare species changed in different high elevations and declined when elevations raised. At the elevations below 1500, there were 225 rare species found, accounting for 95.34%. At the elevation above 2800m, these values were only 6 species (2.54%) (Table 3).

Table 3. Differentiation of endemic and rare species in different high elevations in Hoang Lien National Park

No	Elevations (m)	Endemic species		Rare species	
		Number	%	Number	%
1	Below 1500	635	81.94	225	95.34
2	1500 - 2000	215	27.74	97	41.10
3	2000 - 2800	61	7.87	28	11.86
4	Above 2800	19	2.45	6	2.54
Total		775	100	236	100

3.3. Orientation and conservation of plant diversity by high elevations

Special attention needs to be paid at the lower elevation of 1500m where concentrated 86.53% of the total number of species, 95.34% of endemic species and 81.94% of rare species in comparison to the entire area of Hoang Lien National Park. This elevation was severely affected by mining activities and other uncontrolled destruction of human beings. There is only a small area in Than Uyen Sapa district maintaining relatively pristine swathes of 3 and 5-storey timbers. The forests are now mostly secondary forests, regenerating forests and production forests. It is therefore necessary to establish and protect strictly the plant diversity in key zones at the elevation < 1500m.

The elevations within 1500-2000m need to become a buffer zone to protect priority areas of plant diversity. It is vital to keep protecting vegetation and ecosystems of typical alpine landscapes for the development of sustainable tourism at the upper elevation of 2000m.

4. Conclusion

Hoang Lien National Park is one of the biodiversity centers of Vietnam. Vegetation is clearly differentiated by high elevations due to the mountainous terrain. There are four high elevations of typical plants including the lower elevations (below 1500m, 1500-2000m, 2000-2800m, and above 2800m). Each plant elevation has different characteristics of distribution, composition and number of taxo-

nomical level. The diversity of the number of families, species decline when the elevation gets higher. In particular, the lower elevation of 1500m concentrated 86.53% of the total number of species, 95.34% of rare and endemic species 81.94% of the entire area of Hoang Lien National Park. This is the elevation affected most by human being. Effective solutions must be therefore taken to protect the sustainable ecological environment.

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