

Retraction Notice

Title of retracted article: **Distribution of Vascular Plants along Altitudinal Gradients in Hoang Lien National Park, Vietnam**

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Journal: Open Journal of Forestry (OJF)
 Year: 2019
 Volume: 9
 Number: 4
 Pages (from - to): 407 - 418
 DOI (to PDF): <http://dx.doi.org/10.4236/ojf.2019.94023>
 Paper ID at SCIRP: 1620645
 Article page: <https://www.scirp.org/journal/paperinformation.aspx?paperid=96085>

Retraction date: 2020-04-08

Retraction initiative (multiple responses allowed; mark with X):

- ☐ All authors
X Some of the authors:
☐ Editor with hints from ☐ Journal owner (publisher)
☐ Institution:
☐ Reader:
☐ Other:

Date initiative is launched: 2020-04-03

Retraction type (multiple responses allowed):

- ☐ Unreliable findings
☐ Lab error ☐ Inconsistent data ☐ Analytical error ☐ Biased interpretation
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X were found to be overall invalid.

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- ☐ honest error
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History

Expression of Concern:

☒ yes, date: 2020-04-03☐ no

Correction:

☐ yes, date: yyyy-mm-dd☒ no**Comment:**

Free style text with summary of information from above and more details that can not be expressed by ticking boxes.

This article has been retracted to straighten the academic record. In making this decision the Editorial Board follows [COPE's Retraction Guidelines](#). Aim is to promote the circulation of scientific research by offering an ideal research publication platform with due consideration of internationally accepted standards on publication ethics. The Editorial Board would like to extend its sincere apologies for any inconvenience this retraction may have caused.

Editor guiding this retraction: Prof. Valeriy Perminov
(Editor-in-Chief)

Distribution of Vascular Plants along Altitudinal Gradients in Hoang Lien National Park, Vietnam

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How to cite this paper: Yen, M. T., Xing, S. P., Han, H. R., Cheng, X. Q., Thao, D. T., Hussain, S., & Shah, S. (2019). Distribution of Vascular Plants along Altitudinal Gradients in Hoang Lien National Park, Vietnam. *Open Journal of Forestry*, 9, 407-418. <https://doi.org/10.4236/ojf.2019.94023>

Received: July 8, 2019

Accepted: October 27, 2019

Published: October 30, 2019

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Abstract

The present study was conducted to examine the distributional characteristics of floral communities along the altitudinal gradients in Hoang Lien National Park (HLNP), located in Lao Cai province, Vietnam. We recorded the relatively abundant flora system with 3252 species (including 361 endemic species and 237 endangered species), belonging to 1126 genera, 230 families and 6 different phyla. Methodology of sampling, specimen collection and identification, statistical analysis are simultaneously used for investigating the complex changes of composition and richness of plant assemblages. The study results indicated the divisions in quantity and composition, especially differentiation of endemic and rare species in accordance with altitudinal gradients.

Keywords

Hoang Lien National Park, Altitudinal Gradients, Flora Diversity, Distribution, Endemic Plant, Rare Plant, Vascular Plant

1. Introduction

Vegetation cover is the flora layer of the earth and its various components (Schmithusen, 1976). In recent years, there has been a rapidly raising wave of interest in researching about the floral diversity to ecologists and biogeographers (Brown & Lomolino, 1998; Colwell & Lees, 2000; Rosenzweig, 1995). Vegetation

communities are identified by topography such as mountainous slopes, exposures, slopes and peaks (Austrheim, 2002; Gottfried, Pauli, Reiter, & Grabherr, 1999; Grytnes & Beaman, 2006; Grytnes & Vetaas, 2002; Ninot & Ferré, 2008). According to Bussmann & Sharon (2006), the vegetation cover has changes in structure, species composition, dominant species group, and density of plant communities along elevation belts. Evaluating the relative importance of the factors that might determine elevational richness patterns remains challenging (Krömer, Acebey, Kluge, & Kessler, 2013). Among the factors of geometric constraints, area and climate, altitude is one of the most important factors affecting species richness patterns in mountain ecosystems, because it has played an essential role in driving drastic changes in temperature, water availability as well as overall area (Beals, 1969; Bruun et al., 2006; Lee, Chun, Song, & Cho, 2012). The research results show that the correlation between species richness, plant communities with elevation, and changes of environmental factors by altitude is the cause of the diversity of habitats, abundance of plant communities and formation of vegetation belts.

Flora diversity in HLNP (Lao Cai province) is recognized class A—the highest biodiversity value of Vietnam by the Global Environment Fund. HLNP is a typical high mountain area; the only place has three elevations in Vietnam (Lap, 1976). There have been a large number of studies evaluating climate differentiation as well as ecological surveys and plant distribution investigations according to elevation belts (Gottfried et al., 1999; Kem & Dilger, 1994; Ly, Thu, Tue, Tan, & Quang, 1996; Pham, 1999–2001; Rahbek, 1997; Thin & Harder, 1996; Tsyganov, Milbau, & Beyens, 2013; Vo, 1970; Vu & Nguyen, 2005, 2007; Zhao, Li, & Chai, 2018). However, these previous studies have only been limited in collecting specimens, analyzing and classifying but are not systematic. Besides, many of the previous studies also researched in the specific survey areas as well as each altitude but did not mention the trend of the vegetation communities in HLNP.

The purpose of the present study was to provide specific information on plant distribution of characteristics of flora along altitudinal gradients in HLNP in Vietnam as a whole. The study results also aimed to provide basic materials for rational use of natural resources, economic development and protection of the ecological environment in and around the study area.

2. Materials and Methods

Experimental area

The study was conducted in HLNP, Lao Cai Province (22°07' - 22°23'N, 103°00' - 104°00'E) (Figure 1) from June, 2016 to December, 2018. The main types of terrain include high mountains, valleys, hillsides could be divided into two main forms: upper montane and lower montane terrain. HLNP is composed of rocks such as granite, amphibolite, filit, limestone, which is most commonly granite, in humid tropical and subtropical conditions. The annual average precipitation is relatively high, with 80% of rainfall from May to October. The annual average air temperature is from 15°C to 24°C, with the highest temperature of

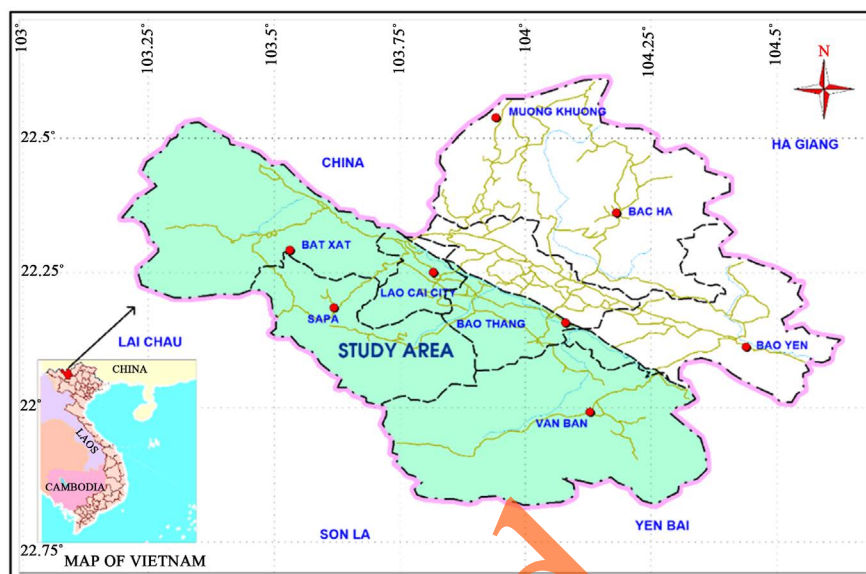


Figure 1. Map of surveyed area in Hoang Lien National Park.

39°C and the lowest of -3.2°C in altitude of above 1500 m. Sunshine duration during the growing season is 1400 - 1460 h.

Sampling

Field work was carried out from 15th June, 2016 to 20th December, 2018 in HLNP, Lao Cai Province, with the average period of 14 - 15 days/time. Five plots were established at altitudes of under 1700 m, 1700 - 2200 m, 2200 - 2800 m, and above 2800 m to sample a range of vegetable types. Plots were selected based on different topographical features such as habitat types, altitude, aspects, slope and different vegetation types. In total, 50 sampling quadrats were selected with area of 20×30 m and were considered to represent the general characteristics of each altitude. Each plot was sampled exhaustively and the area was kept constant, thus controlling both sampling effort and area in our measure of species richness per plot (Lomolino, 2001; Rahbek, 1997). Presence of all species was recorded in each plot and measured with criteria of species quantity/ha, species composition, dominant species, etc. for researching flora system diversity and comparison.

Processing plant samples

We have identified scientific names and developed a list of vascular plants distribution along elevation belts in HLNP (Lao Cai province). In the procedure of preliminary classification, specimens were processed (pressing, chemical impregnating and drying), and based on special morphological characteristics, especially the reproductive organs and representing to the species. Processed samples were compared to the standard samples at the Botanical Museum then we continued analyzing samples, looking up classifications, referring materials as well as consulting experts to identify scientific names. Scientific names of species were also carefully checked and to ensure systematically, names of species were adjusted according to Brummitt's system in "Vascular Plant Families and Gene-

ra" (Brummitt, 1992). Endemic plants identification was referred to "Vietnamese flora" (Thin et al., 2000-2010), while rare plants followed to "List of Vietnamese plants" (Thin et al., 2001-2005) and "Authors of Plant Names" (Brummitt & Powell, 1992).

Preliminary description of types of flora cover was built by naming and describing types of flora patterns in HLNP based on UNESCO's vegetation classification framework (1973) which was applied to Vietnam by Phan Ke Loc (Loc, 1985). In order to achieve accurate analysis of species composition and identify dominant species in the vegetation cover structure, all of species in the standard quarters must be sampled.

Data analysis

The data obtained from the experiments described above were analyzed with SPSS Statistics with version 25 with analysis of descriptive statistics.

Evaluate the change of vegetation cover along elevation belts: in terms of changes in quantity and species composition, changes in vegetation status, distribution of specific species of elevation belts, correlations between belts, we calculated Sorensen's formula (1911, recorded by Thin, 2004) to compare the relationship between the belts by Primer version 6 software.

$$S = \frac{2c}{a+b}$$

where: S is the Sorensen index (value from 0 to 1); a is the number of species of community A; b is the number of species of the community B and c is the number of common species of two communities (A and B). The closer the value is to S , the closer the relationship of the two communities is. On the contrary, S has a value of nearly 0, indicating that the two communities do not have a close relationship.

3. Results

Entire vegetation cover

The result of the flora survey in and around HLNP explicitly revealed the distribution of a total of 3252 species, 1121 genera, 230 families of 6 vascular plants in HLNP (in Lao Cai province). Compared with the flora of Vietnam, it confirms that, undeterred by only accounting for 1.01% of the terrestrial area (3360.0539 km² compared to 331.212 km²), HLNP is currently preserving 31.6% of species, 50.13% of genera and 68.86% of the quantity of vascular plants in Vietnam on the whole. The distribution of taxon gradients of flora in HLNP is shown in Table 1.

At altitude of below 700 m, the belt affected the most by human, the research recorded 6 phyla (100%), 201 families (87.39%), 859 genera (76.63%) and 1985 species (61.04%).

Altitude of 700 - 1700 m is the richest and the most diverse flora belt with absolutely dominant composition of abundant taxon level. The quantity of phyla is 6 (including *Psilotophyta*, *Lycopodiophyta*, *Equisetophyta*, *Polypodiophyta*,

Table 1. Changes in taxon component along altitudinal gradients in Hoang Lien National Park.

No.	Altitude (m)	Phylum		Families		Genera		Species	
		Quantity	%	Quantity	%	Quantity	%	Quantity	%
1	<700 m	6	100	201	87.39	859	76.63	1985	61.04
2	700 - 1700 m	6	100	221	96.09	1024	91.35	2812	86.47
3	1700 - 2200 m	5	83.33	165	71.74	521	46.48	1115	34.29
4	2200 - 2800 m	3	50	89	38.69	203	18.11	360	11.07
5	>2800 m	3	50	43	18.69	79	7.05	122	3.75
	Total	6	100.00	230	100.00	1121	100.00	3252	100.00

Gymnospermae and *Angiospermae*, accounting for 100% of phyla in Hoang Lien Range), accounting for 96.09% of families; 91.35% of genera and 86.47% of species. The quantity of taxon level is descending at the height of 1700 m. At the elevation between 1700 - 2200 m, there are 5 phyla (83.33%), 165 families (71.74%), 521 genera and 1115 species (accounting for 46.48% and 34.29%). The plant distribution by altitude between 2200 - 2800 was confirmed: 89 families (38.69%), 203 genera (18.11%) and 360 species (11.07%). The number of families is reduced to the lowest with 43 families (18.69%) at altitude of above 2800 m, with 79 genera (7.05%) and 122 species (3.75%).

Plant distribution by altitude

Altitude of below 700 m: Representatives of tree species are *Chestnut* family (*Fagaceae*), *Lauraceae*, *Vernicia montana*, *Triadica conchinchinensis*, *Schima wallichii*, *Alniphyllum* sp., *Alangium* sp., *Styrax tonkinensis*, *Litsea cubeba*, *Eurya* spp., etc. Besides, owing to human impact, at the elevation below 700 m, there is a common presence of pure bamboo or intercropping with other trees. Some typical bamboo species include: *Melocalamus compactiflorus*, *Bambusa multiplex*, *Dendrocalamus sericeus*, *Neohouzeana dulloa*, *Schizostachyum aciculare*, *Phyllostachys pubescens*, *Sinarundinaria griffithiana*, etc.

Altitude between 700 - 1700 m: *Castanopsis*, *Lipthocarpus* (*Chestnut-Fagaceae*), *Cinnamomum*, *Litsea-Lauraceae*, *Magnoliaceae*, *Sinarundinaria griffithica*, *Schima wallichii*, *Eurya* spp., *Amomum aromaticum*, *Clematis lechenaultiana*, *Osbeckia cinerea*, *Gaultheria* sp., *Hedychium coronarium*, *Oxyspora paniculata*, *Desmodium sequax*, etc. In which *Sinarundinaria griffithica* is quite typical and popular in Hoang Lien—Sapa area. And the type of *Livistona* sp. is a vegetation group under the dominant layer in Hoang Lien—Van Ban area. Species of common gymnosperms in this belt are *Podocarpus neriifolius*, *Podocarpus pilgeri*, *Fokienia hodginsii*, *Amentotaxus argotaenia* and *Taxus wallichianus*, *Dacrycarpus imbricatus*, etc. A number of tree species becoming gradually extinct, such as *Dipterocarpus retusus*, *Hopea mollissima*, and *Madhuca pasquieri* also appear with small quantity.

Altitude between 1700 - 2200 m: *Alcimandra cathcartii*, *Huodendron tibeti-*

cum, *Acer spp.*, *Ericaceae* families such as *Rhododendron tanastylum*, *R. arboreum*, *R. lyi*, *R. delavayi*, *R. klossii*, *Elaeocarpus spp.*, *Illicium spp.*, *Lauraceae*, *Fagaceae*, *Ternstroemia spp.*, *Fokienia hodginsii*, *Rhodoleia championii*, *Michelia spp.*, *Arthraxon hispidus*, *Sinarundinaria petelottii*, *Litsea spp.*, *Berberis spp.*, *Carex altrivaginata*, *Clematis montana*, *Symplocos sp.*, *Ilex sp.*, *Eurya sp.* and representatives of the *Rosaceae* families, etc. *Pteridium aquilinum*, *Arisaema erubescens*, *Schima wallichii*, *Amomum aromaticum*, *Oxyspora paniculata*, etc. also appear, in which *Schima wallichii*, *Amomum aromaticum*, *Oxyspora paniculata* are the most common species in secondary forests and grasslands at elevations below 2000 m. At an altitude of over 2000 m, the trunk has many forms of living plants, moss, ferns, some types of orchids, etc.

Altitude between 2200 - 2800 m: The typical species are *Acer spp.*, *Rhododendron tanastylum*, *R. arboreum*, *R. lyi*, *R. delavayi*, *R. klossii*, *Elaeocarpus spp.*, *Illicium spp.*, *Lauraceae*, *Fagaceae*, *Theaceae*, *Ternstroemia spp.*, *Fokienia hodginsii*, *Rhodoleia championii*, *Michelia spp.*, and representatives of *Rosaceae* families, etc. In all kinds of areas, *Pteridium aquilinum*, *Schima wallichii*, *Amomum aromaticum*, *Oxyspora paniculata*, *Arundinaria sp.*, etc. in which *Schima wallichii*, *Arundinaria sp.*, and *Oxyspora paniculata* are the most common species in secondary forests and grasslands.

Altitude of above 2800 m: Species being typical for this elevation belt belongs to the family of *Azaleas (Ericaceae)*, *Carex sp.*, *Rhodoleia championii*, *Illicium sp.*, *Sinarundinaria petelottii*, *Berberis spp.*, *Carex altrivaginata*, *Litsea spp.*, *Symplocos spp.*, *Ilex spp.*, *Eurya spp.*, representatives of *Rose families (Rosaceae)*, *Tsuga dumosa*, *Viburnum cordifolium*, etc. and bamboo species such as *Chimonobambusa fansipanensis*, *Bashania fansipanensis*, *Borinda fansipanensis*, etc.

Distribution of major plants

Rare plants

Hoang Lien National Park is also considered to be the center of rare plants such as *Fokienia hodginsii*, *Taxus chinensis*, *Coptis spp.*, *Berberis spp.*, *Mahonia japonica*, *Aristolochia spp.*, *Asarum spp.*, *Panax spp.* The plant system of Hoang Lien Range has 237 rare species (covering 7.26% of the total species), of which there are 163 species in the Vietnamese Red List, 85 species in the IUCN Red List (IUCN Red List of Threatened Species TM, 2014), 51 species under Decree 32 and 22 species in CITES.

Regarding rare species, 7 species out of 237 rare species (2.95%) developed in belts of above 1700 m without being present at elevations below 1700 m. All rare species grow in the belt above 2200 m are distributed in one of the altitudes below 2200 m and there are 22 rare species (9.28%) only distributed at the belt below 700 m.

Endemic plants

Concerning endemic species, 35 species out of 361 endemic species (9.70%) are distributed only at the height above 1700 m but not below 1700 m and 8 spe-

cies (2.22%) only distributed at belts above 2200 m without being present below 2200 m. All endemic species distributed in the belt above 2800 m are present in one of the belts below 2800 m and 46 species (12.74%) only extended at the altitude below 700 m (**Table 2**).

4. Discussion

With the aim of collecting the specific data of vegetation diversity in and around Hoang Lien National Park, investigations were conducted and documented positive results.

Compared to previous researches, we confirmed the additional number of 1228 species, 350 genera, 30 families comparing to 2024 species, 771 genera, 200 families of vascular plants recorded according to Thin N. N., & Thoi N. T., 1999; as well as contributed a new number of 820 species, 223 genera, 21 families comparing to 2432 species, 898 genera and 209 families following to Tri, N. Q., 2009 (Tri, 2009).

The survey of plant distribution along altitude gradient showed that the number of plant communities decreased when the altitude increased, except for the region between the belt of below 700 m and 700 - 1700 m (**Figure 2**). Almost previous studies have documented that the higher the height a.s.l, the lower the quantity and richness (Bai, Sang, & Axmacher, 2011; Wang, Long, Wang, Ding, & Wang, 2007), while there is also the report getting acceptance of the increase of species quantity in the middle belt and the trend of richness has yet to be exactly demonstrated (Yang et al., 2014).

Sorensen index indicated the level of relationship between 2 plant communities. In HLNP, Sorensen index is changed from 0.45 to 0.69 (**Table 3**). Common species quantity among elevation belts is an index to determine the degree of species differentiation among altitudes. Belts of below 700 m and 700 - 1700 m has the highest value of Sorensen index of 0.69 with the largest number of common species of 1674, which is possibly caused by similarities in environmental conditions. Elevations of 700 - 1700 m and 1700 - 2200 m follow with 0.52, and the third is belts of 2200 - 2800 m and above 2800 m of 0.49 and the last is belts

Table 2. Differentiation of endemic and rare species along altitudinal gradients in Hoang Lien National Park.

No.	Altitudinal gradients (m)	Endemic species		Rare species	
		Number	%	Number	%
1	<700 m	157	43.49	117	49.37
2	700 - 1700 m	280	77.56	208	87.76
3	1700 - 2200 m	106	29.36	100	42.19
4	2200 - 2800 m	34	9.42	28	11.81
5	>2800 m	10	2.77	6	2.53
	Total	361	100	237	100

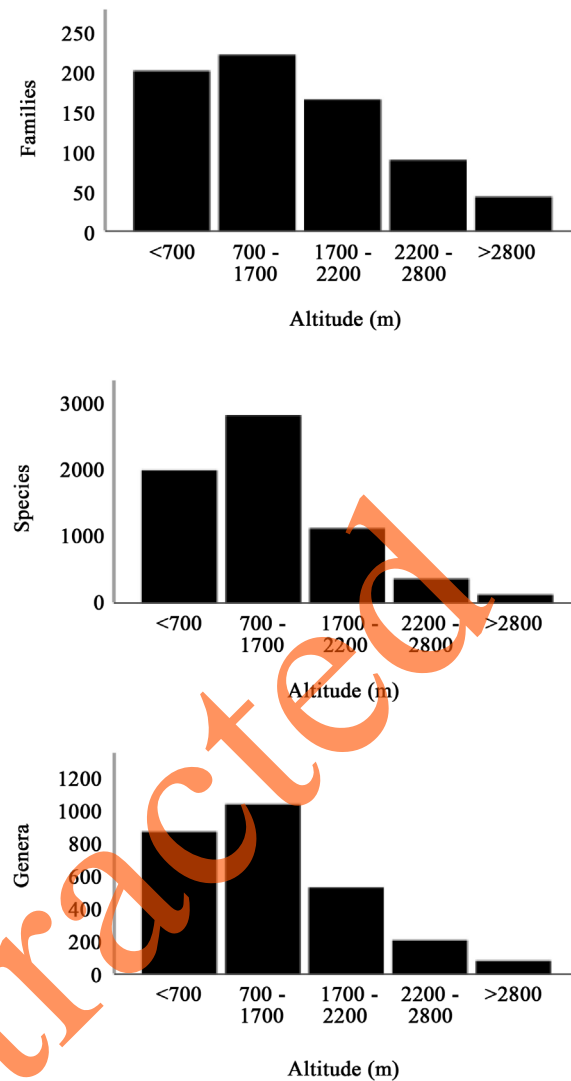


Figure 2. Number of species, genera and families along altitudinal gradients in Hoang Lien National Park.

Table 3. Sorensen index of flora richness between elevations in Hoang Lien National Park.

	<700 m	700 - 1700 m	1700 - 2200 m	2200 - 2800 m
		700 - 1700 m	1700 - 2200 m	2200 - 2800 m
Common species quantity	1674	1014	334	120
Sorensen index	0.69	0.52	0.45	0.49

of 1700 - 2200 m and 2200 - 2800 m with an equivalent value of 0.45. This reflects the close relationship of plant species composition between belts, especially lower elevations.

It was simultaneously confirmed the same result about the distribution of rare and endemic plants, similar to the total quantity of growing plants along evaluation belts (**Figure 3**). The greatest number of rare and endemic plants belonged

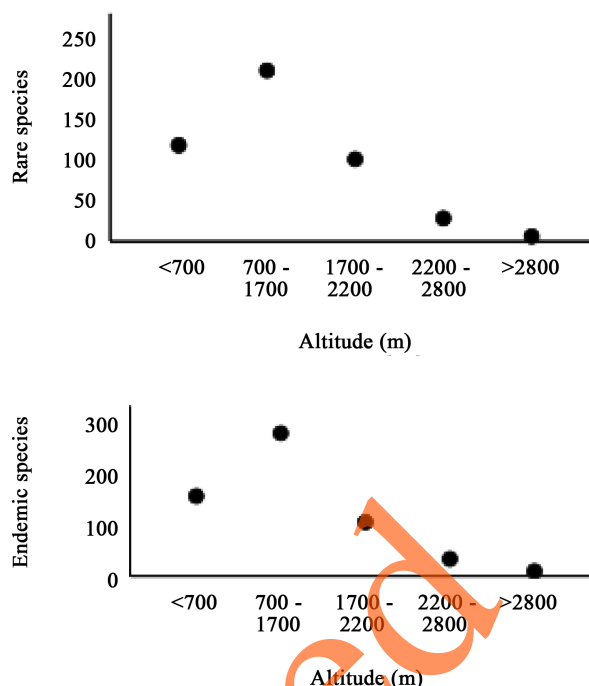


Figure 3. Distribution of rare and endemic species along altitude gradient in Hoang Lien National Park.

to the altitude of 700 - 1700 m, which could be reasoned of favorable climate factors, because environmental factors has directly attached to flora richness (Tsyganov et al., 2013; Zhao et al., 2018). This belt is also less affected by human activities than the height of below 700 m, leading to the greater abundance. With the higher altitudes, topology and slope as well as strict climate caused the limit of vegetation diversity. The concentration distribution of vascular plants as well as rare species, endemic species at elevations below 1700 m, especially from 700 - 1700 m shows the importance of this belt with protecting plant diversity, preserving plant resources in Hoang Lien Son area (Lao Cai province) and conserving biodiversity in Vietnam in general.

5. Conclusion

This study found the decrease of flora diversity with the upper elevations, except for the middle belt of 700 - 1700 m with the richest quantity in HLNP. Besides, the Sorensen reflected the close relationship of flora richness among altitudes. There are five altitudinal gradients of typical plants including the elevations of below 700 m, 700 - 1700 m, 1700 - 2200 m, 2200 - 2800 m, and above 2800 m. Each plant elevation has different characteristics of distribution, composition and number of taxon. Effective solutions must be therefore taken to protect the sustainable ecological environment. An enormous change in the composition of plant species, endemic species, and rare species by elevation belts requires a policy and strategy to conserve plant diversity, preserve typical ecosystems, and protect rare species suitable for each altitude.

Acknowledgements

We thank Mr. Han Hai Rong and Ms. Xiaoqin Cheng for supervising for this paper, thank Mr. Tuan and his students for invaluable help during the fieldwork and data analysis in this study. Thanks for support of forest rangers in Hoang Lien National Park, Hoang Lien—Van Ban Nature Reserve, local leaders and people of ethnic groups in Sapa, Bat Xat and Van Ban (Lao Cai province); support of Forest Protection Department, Forestry Sub-Department, Department of Statistics. Thanks are also due to Ms. Thao for her support and encouragement.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- Austrheim, G. (2002). Plant Heterogeneity Patterns in Semi-Natural Grasslands along an Elevational Gradient. *Plant Ecology*, 161, 193–205. <https://doi.org/10.1023/A:1020315718720>
- Bai, F., Sang, W., & Axmacher, J. C. (2011). Forest Vegetation Responses to Climate and Environmental Change: A Case Study from Changbai Mountain, NE China. *Forest Ecology and Management*, 262, 2052–2060. <https://doi.org/10.1016/j.foreco.2011.08.046>
- Beals, E. W. (1969). Vegetational Change along Altitudinal Gradients. *Science*, 165, 981–985. <https://doi.org/10.1126/science.165.3897.981>
- Brown, J. H., & Lomolino, M. V. (1998). *Biogeography* (2 ed.). Sunderland: Massachusetts Sinauer Associates, Inc. Publishers.
- Brummitt, R. K. (1992). *Vascular Plant Families and Genera*. Kew: Royal Botanic Gardens.
- Brummitt, R. K., & Powell, C. E. (1992). *Authors of Plant Names*. Kew: Royal Botanic Gardens.
- Bruun, H. H., Moen, J., Virtanen, R., Grytnes, J.-A., Oksanen, L., & Angerbjörn, A. (2006). Effects of Altitude and Topography on Species Richness of Vascular Plants, Bryophytes and Lichens in Alpine Communities. *Journal of Vegetation Science*, 17, 37–46. <https://doi.org/10.1111/j.1654-1103.2006.tb02421.x>
- Busmann, R. W., & Sharon, D. (2006). Traditional Medicinal Plant Use in Northern Peru: Tracking Two Thousand Years of Healing Culture. *Journal of Ethnobiology and Ethnomedicine*, 2, Article No. 47. <https://doi.org/10.1186/1746-4269-2-47>
- Colwell, R. K., & Lees, D. C. (2000). The Mid-Domain Effect: Geometric Constraints on the Geography of Species Richness. *Trends in Ecology and Evolution*, 15, 70–76. [https://doi.org/10.1016/S0169-5347\(99\)01767-X](https://doi.org/10.1016/S0169-5347(99)01767-X)
- Gottfried, M., Pauli, H., Reiter, K., & Grabherr, G. (1999). The Austrian Research Initiative: Global Change Effects at the Low-Temperature Limits of Plant Life. In *Global Change in the Mountains* (pp. 54–56). New York: Parthenon.
- Grytnes, J. A., & Beaman, J. H. (2006). Elevational Species Richness Patterns for Vascular Plants on Mount Kinabalu, Borneo. *Journal of Biogeography*, 33, 1838–1849. <https://doi.org/10.1111/j.1365-2699.2006.01554.x>
- Grytnes, J. A., & Vetaas, O. R. (2002). Species Richness and Altitude: A Comparison between Null Models and Interpolated Plant Species Richness along the Himalayan Altitude.

- tudinal Gradient, Nepal. *The American Naturalist*, 159, 294-304.
<https://doi.org/10.1086/338542>
- IUCN Red List of Threatened Species TM (2014). In (Vol. 2). *IUCN Species Survival Commission: International Union for the Conservation of Nature and Nature Resources*.
- Kem, L. M. C., & Dilger, M. (1994). *Program of Researching Forests in Vietnam, Hoang Lien Conservation*.
- Krömer, T., Acebey, A., Kluge, J., & Kessler, M. (2013). Effects of Altitude and Climate in Determining Elevational Plant Species Richness Patterns: A Case Study from Los Tuxtlas, Mexico. *Flora—Morphology, Distribution, Functional Ecology of Plants*, 208, 197-210. <https://doi.org/10.1016/j.flora.2013.03.003>
- Lap, V. T. (1976). *Geographic Landscape of Northern Vietnam*. Hanoi: Science and Technology Publisher.
- Lee, C. B., Chun, J. H., Song, H. K., & Cho, H. J. (2012). Altitudinal Patterns of Plant Species Richness on the Baekdudaegan Mountains, South Korea: Mid-Domain Effect, Area, Climate, and Rapoport's Rule. *Ecological Research*, 28, 67-79.
<https://doi.org/10.1007/s11284-012-1001-1>
- Loc, P. K. (1985). *Applying UNESCO's Vegetation Classification Framework to Vegetation Cover in Vietnam*. Publisher of Hanoi.
- Lomolino, M. V. (2001). Elevation Gradients of Species-Density: Historical and Prospective Views. *Global Ecology and Biogeography*, 10, 3-13.
<https://doi.org/10.1046/j.1466-822x.2001.00229.x>
- Ly, T. D., Thu, D. H., Tue, H. V., Tan, L. D., & Quang, T. M. (1996). Vegetation and Flora in the Upper Mountains of Hoang Lien National Park. *Forestry Journal*, 4, 7-9.
- Ninot, J. M., & Ferré, A. (2008). Plant Diversity across Five Vegetation Belts in the Pyrenees (Catalonia, Spain). *Collectanea Botanica (Barcelona)*, 27, 65-74.
<https://doi.org/10.3989/collectbot.2008.v27.5>
- Pham, H. H. (1999-2001). *An Illustration of Flora of Vietnam* (Vol. 1, 2, 3). Ho Chi Minh City: Youth Publisher.
- Rahbek, C. (1997). The Relationship among Area, Elevation, and Regional Species Richness in Neotropical Birds. *The American Naturalist*, 149, 875-902.
<https://doi.org/10.1086/286028>
- Rosenzweig, M. L. (1995). *Species Diversity in Space and Time*. Cambridge: Cambridge University Publisher. <https://doi.org/10.1017/CBO9780511623387>
- Schmithusen, J. (1976). *General Geography of Vegetation*.
- Thin, N. N. (2004). *Tropical Forest Ecosystems*. Publisher of Hanoi National University.
- Thin, N. N., & Harder, D. K. (1996). Diversity of the Flora of Fan Si Pan, the Highest Mountain in Vietnam. *Annals of the Missouri Botanical Garden*, 83, 404.
<https://doi.org/10.2307/2399869>
- Thin, N. N., Loc, P. K., & Ha, L. T. (2000-2010). *Vietnamese Plants*. Hanoi: Institute of Ecology and Biological Resources, Hanoi Science and Technology Publisher.
- Thin, N. N., Loc, P. K., & Ha, L. T. (2001-2005). *List of Vietnamese Plants*. Hanoi: Hanoi National University, Vietnam Academy of Science and Technology, Hanoi Agriculture Publisher.
- Tri, N. Q. (2009). *Plant Diversity and Transformation of Plants by Elevation in Hoang Lien National Park, Lao Cai Province*. Forestry Doctoral Thesis, Hanoi: Forestry University.

- Tsyganov, A. N., Milbau, A., & Beyens, L. (2013). Environmental Factors Influencing Soil Testate Amoebae in Herbaceous and Shrubby Vegetation along an Altitudinal Gradient in Subarctic Tundra (Abisko, Sweden). *European Journal of Protistology*, 49, 238-248. <https://doi.org/10.1016/j.ejop.2012.08.004>
- Vo, V. C. (1970). *The Vegetation and Flora in Sa Pa-Fanxifang*. Hanoi: Science and Technology Publisher.
- Vu, A. T., & Nguyen, N. T. (2005). *Assessing the Relationship between Flora of Hoang Lien National Park and Some Other Flora Systems of Vietnam* (pp. 276-279). Hanoi: Science and Technology Press.
- Vu, A. T., & Nguyen, N. T. (2007). The Diversity of Flora in the Elevation Belt above 1600 m of Hoang Lien National Park, Lao Cai Province. *Journal of Biology*, 27, 27-30.
- Wang, C. T., Long, R. J., Wang, Q. J., Ding, L. M., & Wang, M. P. (2007). Effects of Altitude on Plant-Species Diversity and Productivity in an Alpine Meadow, Qinghai-Tibetan Plateau. *Australian Journal of Botany*, 55, 110. <https://doi.org/10.1071/BT04070>
- Yang, J. C., Hwang, H. S., Lee, H. J., Jung, S. Y., Ji, S. J., Oh, S. H., & Lee, Y. M. (2014). Distribution of Vascular Plants along the Altitudinal Gradient of Gyeongjisan (Mt.) in Korea. *Journal of Asia-Pacific Biodiversity*, 7, e40-e71. <https://doi.org/10.1016/j.japb.2014.03.008>
- Zhao, P. Y., Li, C., & Chai, B. F. (2018). Environmental Filters Drive the Assembly of the Soil Fungal Community in the *Larix Principis-Rupprechtii* Forests of the Guandi Mountains. *Chinese Journal of Environmental Science*, 39, 3876-3884.

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