

**MINISTRY OF EDUCATION & TRAINING
MINISTRY OF AGRICULTURE & RURAL DEVELOPMENT
VIET NAM NATIONAL UNIVERSITY OF FORESTRY**

DINH THI HOA

**PLANT DIVERSITY IN XUAN NHA NATURE
RESERVE, SON LA PROVINCE**

Major: Silviculture

Code: 62620205

DISSERTATION SUMMARY

Ha Noi – 2017

INTRODUCTION	2
CHAPTER 1: LITERATURE REVIEW	5
CHAPTER 2: CONTENTS AND METHODS	5
2.1. Research contents	5
2.2. Research methods	6
2.2.1. Document inheritance method:	6
2.2.2. Professional method	6
2.2.3. Field investigative methods.....	6
2.2.4. Data analysis.....	8
CHAPTER 3: RESULTS AND DISCUSSION	12
3.1. Diversity of vegetation types in Xuan Nha Nature Reserve ..	12
3.2. Floristics in Xuan Nha NR.....	13
3.2.1. Diversity of taxa of Xuan Nha NR	13
3.2.3. Diversity of useful plants	16
3.2.4. Diversity of life form.....	16
3.2.5. Diversity of phyto-geographical elements	17
3.3. Research on conservation value of plants in Xuan Nha NR ..	17
3.3.1. Diversity of threatened plants.....	17
3.3.2. Status of distribution of rare species in Xuan Nha.....	19
3.4. Research on conservation status and seed quality testing of Pinus cernua L. K. Phan ex Aver., Nguyen S. Nguyen & T. Nguyen.....	19
3.5. Proposing solutions to conserve plant resources in Xuan Nha Nature Reserve	19
3.5.1. The threats to plant resources in Xuan Nha NR.....	19
3.5.2. Proposing solutions to conserve plant resources in Xuan Nha.....	20
CONCLUSIONS AND RECOMMENDATIONS	22

INTRODUCTION

1. Problem statement

Xuan Nha Nature Reserve is one of the three nature reserves of Son La Province (Xuan Nha, Ta Xua, Sop Cop). Xuan Nha NR was established according to Decision No. 194 / CT of August 9, 1986 with the area of 16,316 hectares in the area of 4 communes of Tan Xuan, Xuan Nha, Chieng Xuan and Chieng Son.

With the diversity in terms of space, topography and climate, Xuan Nha NR has rich and diversified forest resources. Xuan Nha is known for a variety of rare plant species such as *Excentrodendron tonkinense*, *Markhamia stipulata*, *Chukrasia tabularis*,... Especially the presence of some high value Gymnospermae plants such as *Pinus kwangtungensis*, *Fokienia hodginsii*... In addition, currently Xuan Nha NR is facing many threats such as: most of the forest area is not intact, the people break the slash and burn cultivation in the nature reserve, the illegal logging and NTFPs, tourism activities develop spontaneously ... leading to many ecological systems are destroyed, many rare forest plants are facing high risk of extinction. .

The dissertation "*Plant diversity in Xuan Nha Natural Reserve, Son La Province*" was conducted to provide a more comprehensive and up-to-date look at the flora and vegetations in Xuan Nha. Particularly, conservation of threatened plant species in Xuan Nha NR. The dissertation also identified, analyzed to identify threats both from human activities and from nature to propose

effective solutions to manage and conserve plant resources in this area.

2. Objectives of the study

2.1. General objectives

Building scientific basis for conservation and ment of plant resources in Xuan Nha NR, Son La province.

2.2. Particular objectives

To determine the diversity of vegetation types, describing these types in Xuan Nha NR in Son La province.

Building a list of vascular plants in Xuan Nha NR. Evaluating the characteristics of the flora include the diversity of taxa, new species for Xuan Nha, rare species, useful plants, phyto-geography, life forms of the flora of Xuan Nha NR.

To determine the status of conservation in the wild and testing the seed quality of *Pinus cernua* L. K. Phan ex Aver., Nguyen S. Nguyen & T. Nguyen, Nguyen S. & T. Nguyen.

Identifying the threats to the plants and recommending for conservation and development of plant resources in Xuan Nha NR, Son La province.

3. Subjects and scope of study

Research subjects:

Flora and vegetations in Xuan Nha NR, Son La province.

Scope of study:

Xuan Nha Nature Reserve, Son La province.

The vascular plants in Xuan Nha NR, Son La province.

4. Significance of the dissertation*Scientific significance:*

Providing scientific database on the diversity of flora and vegetation in Xuan Nha NR, Son La Province.

Providing scientific information on *Pinus cernua* L. K. Phan ex Aver., Nguyen S. Nguyen & T. H. Nguyen.

Practical significance:

The results of the study are the scientific basis to propose the solution for conservation and development of plant resources in Xuan Nha NR, Son La province.

5. New contributions of the dissertation

- Evaluation of the diversity and characteristics of flora and vegetations in Xuan Nha NR with 11 types of natural vegetations cover in 3 climate areas and 2 types of humanrity vegetations.

- Built a list of vascular plants in Xuan Nha NR with 1068 species belonging to 487 generas and 159 families.

- Providing 02 new records of plant species for flora of Vietnam are *Ficus acamptophylla* (Miq.) Miq. - Moraceae and *Rhododendron pseudochrysanthum* Hayata - Ericaceae; Supplemented with 75 species, 37 genera and 18 families for the flora of Xuan Nha NR, Son La province.

- Evaluation of conservation status and testing of seed quality for *Pinus cernua* L. K. Phan ex Aver., Nguyen S. Nguyen & T. H. Nguyen.

6. The contents of the dissertation

The thesis consisting of 144 pages is structured in five main sections: Introduction; Chapter 1: Literature review, Chapter 2: Contents and methods, Chapter 3: Results and discussion, Chapter 4: Conclusion - recommendations. The thesis has 33 tables and 31 pictures. The thesis uses 123 references (105 Vietnamese documents and 18 foreign language documents).

CHAPTER 1

LITERATURE REVIEW

The dissertation refers to 123 references with 105 Vietnamese documents and 18 foreign language documents

CHAPTER 2

CONTENTS AND METHODS

2.1. Research contents

- Research on vegetation diversity in Xuan Nha NR, Son La province.
- Research on flora characteristics in Xuan Nha NR, Son La province.

- Research on conservation value of plants in Xuan Nha NR, Son La province.

- Research on the status of conservation and testing of seed quality for *Pinus cernua* L. K. Phan ex Aver., Nguyen S. Nguyen & T. Nguyen.

- To propose solutions for conservation of plant resources in Xuan Nha NR, Son La province.

2.2. Research methods

2.2.1. Document inheritance method:

Inheritance of data on natural, economic, social conditions and other documents related to the thesis.

2.2.2. Professional method

Used in plant classification

2.2.3. Field investigative methods

The dissertation applied the current plant diversity research methodology of national experts (Nguyen Nghia Thin, 1997, 2004, 2008; Hoang et al, 2009).

2.2.3.1. Investigative method on the transects

A total of 15 transects were conducted. In addition, there are also many short transects (<1km) to quickly survey some grasslands and shrubs and follow villagers in the exploitation of some non-timber forest products such as forest vegetables, medicinal plants, bamboo shoots ...

2.2.3.2. Investigative method in the sample plots

We established representative plots, typical for elevations and forest status, which is divided into 3 main groups according to Thai Van Trung (1978, 2000), including tropical belt (elevation <700m (10 plots), Sub-tropical belt (elevation 700-1600m arranged 25 plots); Temperate belt > 1600m (10 plots). A total of 45 plots were established. Specific information on the coordinates and altitudes of these plots is shown in Annex 10 and on the map (Figure 2.1).

The area of each plot is 2000 m² with a size of 40x50m was established. In each plot, five small plots were arranged in four corners and one central small plot (2x5m). Particularly in the difficult areas such as limestone mountains or where the compositions were quite similar species such as grassland, bamboo forest, plots area was smaller (500-1000 m²). In addition, we conducted to observe and describe in the survey book to serve for describing the structure of the vegetation types.

Data collected in the sample plots: In each plot: a survey of plant species in the timber. For the timber, determined the stem diameter from land surface at 1.3m (D1.3), the height under the branch (Hdc), the height of the top of tree (Hvn), crown diameter (Dt) for all the timbers which had D1.3 were bigger than 6cm and collected plant specimens.

2.2.3.3. Collection and treatment Method of specimens

Each species was collected 3 to 5 representative specimens for identification. Method of collecting and processing specimens base on Nguyen Nghia Thin (1997).

2.2.3.4. Participatory Rural Appraisal (PRA) Method

PRA method (Nguyen Ba Ngai et al., 2001). Interviewees include:

- + Forest rangers, government representatives on management, protection of resources, threats to plants in the area.

- + 90 households to interview about utility, the percentage of households using plants in the area.

2.2.4. Data analysis

2.2.3.1. Assessment methods of vegetations diversity

Applying the classification system of vegetations types based on Thai Van Trung (1978, 2000): Describe the structure of forest floors (wood floor - A: A1, A2, A3, Bush floor - B, Grass floor -C) and dominion species (based on Importance Value - IV%).

Building the map of vegetation types in Xuan Nha by using Mapinfo 11.5 software.

2.2.4.2. The method of building the plant checklist

Plant identification:

The botanical books in Viet Nam and other countries were used to identify the specimens. In addition, the specimens were also identified based on comparisons with specimens in herbaria in

Vietnam, China, France, the Netherlands and USA, many species were directly identified by plant taxonomists

Building the plant checklist:

Divisions in the plant list are arranged from low to high level of evolution. In each division, families and species are arranged according to alphabetical order. In this list, the major columns include scientific names, Vietnamese names, life forms, usages, phyto-geographic elements, new records (with the new species, genera and families for the flora of Xuan Nha or for the flora of Vietnam).

2.2.4.3. Flora diversity

Evaluation of the diversity of divisions and the classes.

Evaluation of the diversity of species, genera and families: The ten families, ten genera with the highest diversity of species (dominant families and genera), the mono species families, the mono species genera.

2.2.4.4. Evaluation of the new records

The new records for the flora of Xuan Nha are compared against the plant list of Xuan Nha (Le Nha Tran, 2012).

2.2.4.5. Plant life form diversity

Determining the life forms of species and the spectrum of biology based on the classification of Raunkiaer (1934) and Nguyen Nghia Thin (1997, 2008). The basis for classifying these groups is

shown in detail in Annex 7c. The life forms information of species are determined through specialized documents.

2.2.4.6. *Phyto-geography elements diversity*

Identification of phyto-geographic elements of species: These elements are determined according to Pocs Tamas (Nguyen Nghia Thin, 2004).

2.2.4.7. *Useful of plants species.*

The determination of useful plants in Xuan Nha was based mainly on the actual use of local people. These plants were divided into 5 end-use categories (Hoang et al, 2009): i) Timber; ii) Food; iii) Firewood; iv) Medicine; v) Others. The useful of plant species were determined through documents on plants and based on interviews with local people.

2.2.4.8. *Assessment threatened level of plant species*

To assess the number and status of rare and endemic species distributed in Xuan Nha, the dissertation used the classification according to the following documents: The Red Data Book of Vietnam - Part II - Plants (2007); The Decree No.32 /of the Vietnamese Government (2006); IUCN Red List of Threatened Plant Species (2016).

2.2.4.9. *Conservation of *Pinus cernua**

a. Investigation and assessment of the current situation in the wild

Interviewing with forest rangers and villagers for information on the locations where *Pinus cernua* is distributed. In addition, on the transects, we conducted plots to investigate the characteristics of the

forest where *Pinus cernua* distributed. In the area of research, we established 3 plots. Each plot area is 1000 m² (20x50m). Identifying some of the features of plot such as density, altitude, forest cover, ...

b. Seed quality testing method

The *Pinus cernua*'s cones were harvested in October 2014. Each tree took 5 kilograms of cones. Collecting cones at the head of the branch when the color was dark green, slightly brownish. After harvesting, composting in the sacks in 15 days, when the seeds started to turn brownish black, I selected them to test. The seeds were harvested from tree 1 to tree 4 were divided to 4 batches (marked batch 1 to batch 4, corresponding to tree 1 to tree 4).

*** *Seed quality testing:***

Using method of Nguyen Huu Vinh and Ngo Quang De (1998); Specialized standard (10TCN 322 - 2003) on testing plant seeds. Seed characteristics of *Pinus cernua* are: Seed purity (K%); Weight of seeds (A (g)); Germination rate (E%); Germination (T%); Germinated time (S (day)); Pragmatic value (G%).

CHAPTER 3

RESULTS AND DISCUSSION

3.1. Diversity of vegetation types in Xuan Nha Nature Reserve

According to the classification of vegetation of Thai Van Trung (1978, 2000), Xuan Nha Nature Reserve is divided to 3 elevation belts. Each belt is divided into several different following vegetation types:

- Vegetation types in the tropical belt (<700m):

- + Closed moist tropical evergreen broad-leaved forest
- + Secondary moist tropical evergreen forests after harvesting
- + Secondary moist bamboo tropical forest
- + Moist tropical scrubs
- + Moist tropical Grasslands

- Vegetation types in sub-tropical belt (700-1600m):

- + Closed moist sub-tropical evergreen broad-leaved forest
- + Closed moist sub-tropical evergreen broad-leaved mixed needle-leaved forest
- + Secondary moist sub-tropical evergreen forests after harvesting
- + Moist sub-tropical shrubs
- + Moist sub-tropical grasslands

- Vegetation type in the temperate belt (>1600m):

- + Closed evergreen temperate broad-leaved mixed needle-leaved forest.

- Plantation vegetation types:

+ Agricultural vegetation

+ Plantation forest (Acacia, bamboo, rubber forest)

Discussion: It can be seen that the types of vegetation in Xuan Nha NR are quite suitable and similar to the common vegetation types in many Natural Reserves, National Park in Viet Nam. Compared with some other studies in Xuan Nha earlier, some vegetation types such as Tropical sparse broad-leaved forests (Nguyen Van Huy, 2003) in the East of this Reserve, Sub-tropical broad-leaved mixed needle leaved forest at the top and rocky slopes, wetland scrubs and aquatic communities (Le Tran Chan, 2012) no longer appear in the Map of vegetation types in this research. Some new types have appeared in the area such as plantation forests (*Bambusa longissima* forest, *Hevea brasiliensis* forest) have been updated in the dissertation. Especially, the change in characteristics within the patterns of vegetation types, there is no type of primary or heavily disturbed forest which are in IV status in Xuan Nha as previously studied, or the 38 species are no longer present during the survey (floristics is better described in Section 3.2. and in Appendix 03). This shows the volatility of forest resources in Xuan Nha, which is an important basis for the management of forest resources in this area.

3.2. Floristics in Xuan Nha NR**3.2.1. Diversity of taxa of Xuan Nha NR****3.2.1.1. Diversity of taxa**

A total of 1068 vascular plant species were recorded in Xuan Nha, belonging to 159 families, 487 genera. More than 900 specimens were collected and deposited at Tay Bac University and Vietnam National University of Forestry. The list of plant species in Xuan Nha is given in the Appendix 01. Their distribution over the major plant groups is shown in Table 3.1.

Table 3.1. The vascular plant divisions in Xuan Nha

TT	Taxa	Family		Genera		Specie	
		Number	%	Number	%	Number	%
1	Lycopodiophyta	2	1,26	4	0,82	18	1,69
2	Equisetophyta	1	0,63	1	0,21	2	0,19
3	Polypodiophyta	18	11,32	37	7,60	119	11,14
4	Gymnospermae	6	3,77	12	2,46	17	1,59
5	Angiospermae	132	83,02	433	88,91	912	85,39
5.1	<i>Dicotyledonae</i>	108	67,92	360	73,92	801	75,00
5.2	<i>Monocotyledonae</i>	24	15,09	73	14,99	111	10,39
		159	100	487	100	1068	100

The result shows that Angiospermae has absolute advantage over other sectors, including number of families, number of genera and species with 132 families (83,02%), 433 genera (accounting for 88,91%) and 912 species (accounting for 85,39%). In this group, Dicotyledonae are dominant with 67,92% of families, 73,92% of genera and 75,00% of species.

Result of study provides 02 new records for the flora of Viet Nam are *Ficus acamptophylla* (Miq.) Miq., belonging to Moraceae and *Rhododendron pseudochrysanthum* Hayata, belonging to Ericaceae; My study also found 75 new species, 37 new genera and 18 new families for the flora of Xuan Nha NR, Son La province.

3.2.1.2. Diversity index of taxa

Family index varies from 2,0 to 9,0. The genera index is lower when it ranges from 1,4 to 4,5, and the number of genera per family varies from 1,0 to 3,3. This shows the degree of diversity in the number of genera, families and taxa in Xuan Nha. In general, the flora of this area has about 6.7 species per family. The genera index is 2,2 corresponding to the average of each genera of has more than two species; The genera index is 3,1, or each family has average 3,1 genera.

3.2.1.3. Diversity of families

The ten families with the highest diversity of species (dominant families) in Xuan Nha although representing only 6,29% of the total number of families, include 343 species, accounting for 32,12% of the total species. In Xuan Nha, the most diverse families are mostly species rich families of the flora of Viet Nam. Euphorbiaceae (61 species), accounting for 5,71%, Rubiaceae (49 species), accounting for 4,59% and other families such as Poaceae, Asteraceae, Rosaceae... has 24 to 35 species.

3.2.1.4. Diversity of genera

A total of 487 genera in Xuan Nha NR with the number of species in each genera ranging from one species (Trema, Ormosia, Abroma ...) to 18 species (Rubus).

In addition to assessing the diversity of the rich species families and rich species genera, the identification of mono species families and genera are very important in conservation. Because this group is prone to extinct because there is only one representative in the flora. In Xuan Nha NR, 263 genera are represented by only single species, accounting for 54% of the total number of genera. Meanwhile, the number of mono species family are also up to 34 families, accounting for 21.38% of the total families.

3.2.3. Diversity of useful plants

The result of study shows that of the total of 1068 plant species of Xuan Nha NR, there are 686 species belonging to different useful groups (accounting for 64,23% of total species of flora). There are many species for many uses (from 2 to 4 different uses). Wood species predominate among these useful plants with 394 species, accounting for 36,89%. Wood species are most commonly used by households such as *Fokienia hodginsii*, *Excentrodendron tonkinense*, *Michelia*,.... The group of medicinal plants has 337 species, accounting for 31,55% of the number of total species.

3.2.4. Diversity of life form

The dissertation has established the Spectrum of Biology (SB) for the flora of Xuan Nha NR as follows:

$$SB = 78,84Ph + 6,74Ch + 6,37Hm + 5,24Cr + 2,81Th$$

3.2.5. Diversity of phyto-geographical elements

The flora of Xuan Nha reflects the typically tropical characteristics with 74,44% of the species belonging to the tropical elements and only 3,75% of the species belong of temperate elements. In the tropical elements group, asian tropical species are the most dominant with 65,64%, the rate of ancient tropical species is 5,62%, and the rate of interdisciplinary tropical species is only 3,18%. The rate of endemic species in Xuan Nha NR (13,20%) is equivalent to this of the flora of Vietnam (11,49% - according to Thai Van Trung, 1978).

3.3. Research on conservation value of plants in Xuan Nha NR

3.3.1. Diversity of threatened plants

A total of 65 species belong to 39 families are rare plants which have high conservation value and need to be conserved at the international and Viet Nam levels as follows:

Table 3.13. The rare species at the international and Viet Nam levels

No	Symbol	Classification	Number	Species % relative to rare species	Species % relative to total species
<i>I. According to the IUCN Red List (2016)</i>			28	43,08	2,62
1	CR	Critically endangered	3	4,62	0,28
2	EN	Endangered	6	9,23	0,56
3	VU	Vulnerable	6	9,23	0,56
4	NT	Near threatened	4	6,15	0,37
5	LC/LR	Least concern	8	12,31	0,75
6	DD	Data deficient	1	1,54	0,09
<i>II. According to Red data book of Viet Nam (2007)</i>			55	84,62	5,15
1	CR	Critically endangered	1	1,54	0,09
2	EN	Endangered	17	26,15	1,59
3	VU	Vulnerable	36	55,38	3,37
4	LR	Least concern	1	1,54	0,09
<i>III. According to the Decree No. 32 /2006 of Vietnamese government</i>			15	23,08	1,40
1	IA	Prohibition of exploitation and use	3	4,62	0,28
2	IIA	Limit on exploitation and use	12	18,46	1,12

3.3.2. Status of distribution of rare species in Xuan Nha

With three belts in Xuan Nha, the tropical belt (<700m) has the least number of rare species with a total of 22 species, accounting for 33,85%; The subtropical belt with the elevation of 1000-1700m has 63 species, accounting for 96,92%, temperate belt with altitude > 1700m has only 8 species, accounting for 15,38%.

3.4. Research on conservation status and seed quality testing of *Pinus cernua* L. K. Phan ex Aver., Nguyen S. Nguyen & T. Nguyen.

Four mature individuals of *Pinus cernua* have recorded with an average diameter of 45,75 cm, 27m in height. These trees grow well and have sparse canopies. They distribute on limestone where the slope is high (from 25⁰ to 30⁰), at the altitude around of 1000m above sea level. No regenerated seedling found. Given the number and status of this species in Xuan Nha, it is proposed to be at the CR (Critically endangered) level in the IUCN Red List. The results of seed quality testing of *Pinus cernua* show that the seed purity is 90,46%, the germination rate is 96,25%, the pragmatic value is 87,07%. These are the base on conservation and development for this rare species.

3.5. Proposing solutions to conserve plant resources in Xuan Nha Nature Reserve

3.5.1. The threats to plant resources in Xuan Nha NR

The dissertation has identified seven threats from humans including: Illegal logging; Exploitation of firewood; Exploitation of non-timber forest products (medicinal plants, plants for food); Deforestation for shifting cultivation; Cattle grazing; Forest fire, Spontaneous tourism activities. Only one threat from nature was the frost phenomenon that led the mass death of plants in Xuan Nha.

3.5.2. Proposing solutions to conserve plant resources in Xuan Nha

3.5.2.1. The technical, scientific and technological solutions

a. In-situ conservation

The in-situ conservation needs to be done in the core zone to protect the habitat and populations, individuals rare species in this area.

b. Ex-situ conservation

In regular afforestation at the Xuan Nha NR, seedling orchards can be planted for sowing indigenous species, building botanical garden, herbarium, building models of sustainable afforestation and forest management.

c. Promoting and well performing scientific researchs, programs and projects

Attracting and creating good conditions for scientists and scientific research organizations to investigate, study and evaluate plant resources in this region.

3.5.2.2. Social and economic solutions

a. Land use planning

Planning should be well done in the buffer zone where communities live and cultivate.

b. Applying science and technology in cultivation and animal husbandry

Along with the promotion of scientific research in this area, selection of good results from programs and projects to apply the scientific and technological advances in cultivation and animal husbandry to improve productivity, increase agriculture value for local people.

c. Development of NTFPs and sub-occupations: Developing the species as raw materials such as bamboo and rattan, plant species for food, medicinal plants. In addition to NTFPs development, sub-occupations also need to be promoted in households.

d. Solving social issues: such as population and family planning, awareness, backward customs, trafficking and using drug, etc.

3.5.2.3. Institutional solutions, capacity building for law enforcement and management

Especially, such as building up the staff structure to ensure quantity and quality, improving the quality of education, cooperating in scientific research, equipping the soft skills, actively propagandizing,...

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The vegetation types in Xuan Nha NR is diverse with 11 natural vegetation types in three climate belts and two human vegetation types. Vegetation types in the tropical belt (<700m) include: Closed moist tropical evergreen broad-leaved forest, Secondary moist tropical evergreen forests after harvesting, Secondary moist tropical bamboo forest, Moist tropical scrubs, Moist tropical Grasslands. Vegetation types in sub-tropical belt (700-1600m) include: Closed moist sub-tropical evergreen broad-leaved forest, Closed moist sub-tropical evergreen broad-leaved mixed needle-leaved forest, Secondary moist sub-tropical evergreen forests after harvesting, Moist sub-tropical shrubs, Moist sub-tropical grasslands. Vegetation type in the temperate belt (>1600m) has only Closed evergreen temperate broad-leaved mixed needle-leaved forest. Plantation vegetation types include Agricultural vegetations and Plantation forest. There are different in number of plant species and characteristics of the structure in vegetation types in the research area.

The flora of Xuan Nha NR is diverse with a total of 1068 vascular plant species belonging to 487 genera, 159 families and 5 taxa. The research was added 75 new records, 37 genera, 18 families compared to the 2012 declaration for the flora of Xuan Nha.

Two new records for the flora of Viet Nam are *Ficus acamptophylla* (Miq.) Miq. (Moraceae) and *Rhododendron pseudochrysanthum* Hayata (Ericaceae).

The flora of Xuan Nha represents the typically tropical characteristics with 74,44% of the species belonging to the tropical elements, 13,20% belonging to endemic and only 3,75% of the species belong to the temperate elements.

The study result shows that of the total of 1068 plant species in Xuan Nha NR, there are 686 species belonging to different useful groups (accounting for 64,23% of total species of the flora). Plants for wood are predominate with 36,89%.

The flora of Xuan Nha has high conservation value with 65 threatened species belonging to 39 families at global and Viet Nam levels. 28 species are listed in the red data list of IUCN (2016), 55 species are listed in the red data book of Viet Nam (2007), and 15 species are listed in the Decree No. 32 /2006 of Vietnamese government. These species are mostly small in number and have not been studied much, so they must be urgent conserved.

Investigation on distribution of *Pinus cernua* L. K. Phan ex Aver., K. S. Nguyen & T. H. Nguyen in Xuan Nha natural reserve showed that at attitude of 940-1010m above of sea level only 4 mature individuals were found in IIIA status. No generated seedling occurred. So this species must be at the CR (Critically endangered) level in the IUCN Red List. The results of seed quality testing of

Pinus cernua showed that the seed purity is 90,46%, the germination rate is 96,25%, the pragmatic value is 87,07%. These are the base on conservation and development for this rare species.

The dissertation has identified seven threats from humans to plant resources in Xuan Nha (Illegal logging, exploitation of firewood; exploitation of NTFPs, deforestation for shifting cultivation, forest fire, cattle grazing, and spontaneous tourism activities. Only one threat from nature that caused the mass death of plants. From there, 3 groups of solutions have been proposed: technical, scientific and technological solutions; socio-economic solutions and solutions for institutional strengthening, management capacity and law enforcement.

Recommedations

Continueing research on biodiversity as well as plants. Specially, research on conservation, development of rare species, endemic species which are lack of data in Xuan Nha.

Researching and developping some models of potential NTFPs such as bamboo, medicinal plants ... for economic development.

Investing in building livelihoods for households in Xuan Nha NR to reduce the pressure of community impact on the plant resources.

Promoting research and protecting resource for heavily-exploited species that are at risk or extinction, such as valuable trees and rare medicinal plants in this area.

LIST OF PUBLISHED PAPERS AND BOOK

1. Dinh Thi Hoa, Nguyen Luong Thien, Hoang Van Sam (2014), “Diversity and conservation status of Gymnosperm in Xuan Nha nature reserve, Son La province”, *Science and technology journal of agriculture & rural development*, 15/2014 (246), page 109-115.
2. Dinh Thi Hoa, Hoang Van Sam, Nguyen Hung Chien (2016), “The diversity of high conservation value plant species in Xuan Nha nature reserve, Son La province”, *Forestry science and technology journal of Viet Nam national university of forestry*, 2/2016 (281), page 124-130.
3. Dinh Thi Hoa, Hoang Van Sam (2016), “Floristics in Xuan Nha nature reserve, Son La province”, *Forestry science and technology journal of Viet Nam national university of forestry*, 2/2016 (16), page 66-71.
4. Dinh Thi Hoa, Phan Thi Thanh Huyen, Nguyen Thi Bich Ngoc, Hoang Van Sam (2016), “Distribution and seed characteristics of *Pinus cernua* L.K. Phan ex Aver., K.S. Nguyen & T.H. Nguyen in Son La”, *Forestry science and technology journal of Viet Nam national university of forestry*, 6/2016, page 136-143.
5. Dinh Thi Hoa, Phan Thi Thanh Huyen, Pham Quang Thang, Doan Thi Thuy Linh, Nguyen Tien Dung (2016), *Atlas of specific plant species for the Northwest of Viet Nam*, Agricultural Publishing House, Ha Noi.
6. Hoang Van Sam, Dinh Thi Hoa (2017), “Two new records - *Ficus acamptophylla* (Miq.) Miq. and *Rhododendron pseudochrysanthum* Hayata for the flora of Viet Nam”, *Science and technology journal of agriculture & rural development*, 12/2017.