Uses and conservation of plant diversity in Ben En National Park, Vietnam

Hoang, V.S.

USES AND CONSERVATION OF PLANT DIVERSITY IN BEN EN NATIONAL PARK VIETNAM

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USES AND CONSERVATION OF PLANT DIVERSITY IN BEN EN NATIONAL PARK VIETNAM

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NATIONAL HERBARIUM OF THE NETHERLANDS
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2009

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Chapter 1

GENERAL INTRODUCTION

TROPICAL FORESTS

This thesis concerns the interactions between plant diversity and plant uses by the local population in Ben En National Park, Vietnam. The study should be viewed against the background of global concerns about the current status and future sustainability of tropical forests.

Tropical forests are characterized by very high plant diversity; covering less than 10% of the total land areas; they possess more than 50% of all known plant species on earth (Wilson 1988; Mayaux et al. 2005). The international Convention on Biological Diversity signed in Rio de Janeiro in 1992 strongly emphasized the need for biodiversity conservation. From that global perspective, despite numerous efforts to conserve biodiversity, tropical forests have severely declined in the last 16 years and still continue to decline (Johnson 1993; Achard et al. 2002; Chien 2006; Butler & Laurance 2008; Putz et al. 2008). During the past decades, around 6 million ha of tropical forests have been lost (Achard et al. 2002). The main causes are agricultural expansion, over-harvesting of tropical hardwoods, development of plantations, mining operations, industry, urbanization, and road building (Geist & Lambin 2002; Chien 2006). Among tropical areas, South-East Asia has the highest relative rate of deforestation (Achard et al. 2002; Brook et al. 2006; Chien 2006). Tropical forests are important for global environmental ecosystem function (Fearnside 1997; Laurance 1999), they also provide subsistence needs and income for hundreds of millions of people worldwide (Iqbal 1993; Walter 2001), often the very poor (Ticktin 2004).

A successful biodiversity conservation strategy requires a good understanding of the relationships among natural resources and social conditions. This is particularly important for tropical countries, where the forests are very rich in biodiversity, but are being lost at an alarming rate (Whitmore 1997; Sodhi et al. 2004; Chien 2006).

FORESTS AND BIODIVERSITY IN VIETNAM

Vietnam is a country rich in biodiversity (Thin 1997). The country was ranked as the 16th most biologically diverse country in the world (WCMC 1992; Hoang et al. 2008 a). Forests covered around 43% of Vietnam before 1954 (Maurand 1943; Lung 2001). However, the forests of Vietnam were severely damaged by many causes, such as the war with the United States of America, overexploitation, shifting

cultivation, and agricultural expansion. As a result, the forest cover declined to an estimated 30% in 1985, and 28% in 1995 (Lung 2001; Hoang et al. 2008 a). In 1998, the 5 million ha Reforestation Program was launched by the Vietnamese government with a target to plant 5 million ha of forests by 2010, restoring the forest cover to 43% (Lung 2001). The program aims not only to reforest, but also to protect existing natural forests. In recent years the forest cover of Vietnam has gradually increased (Hung 2004; Lan et al. 2006; Hoang et al. 2008 a). However, the quality of the forests is still low as most of the forests are poor in timber volume and tree species diversity and density as a result of a long time of overexploitation (Dang 2001; Chien 2006). On the other hand, to protect the rich and threatened biodiversity, the Vietnamese government has established a system of protected areas (Tai 1995; VN 2003; Hoang et al. 2008 a): in 2006, Vietnam had 126 protected areas, with a total area of 2.54 million ha (Hoang et al. 2008 a).

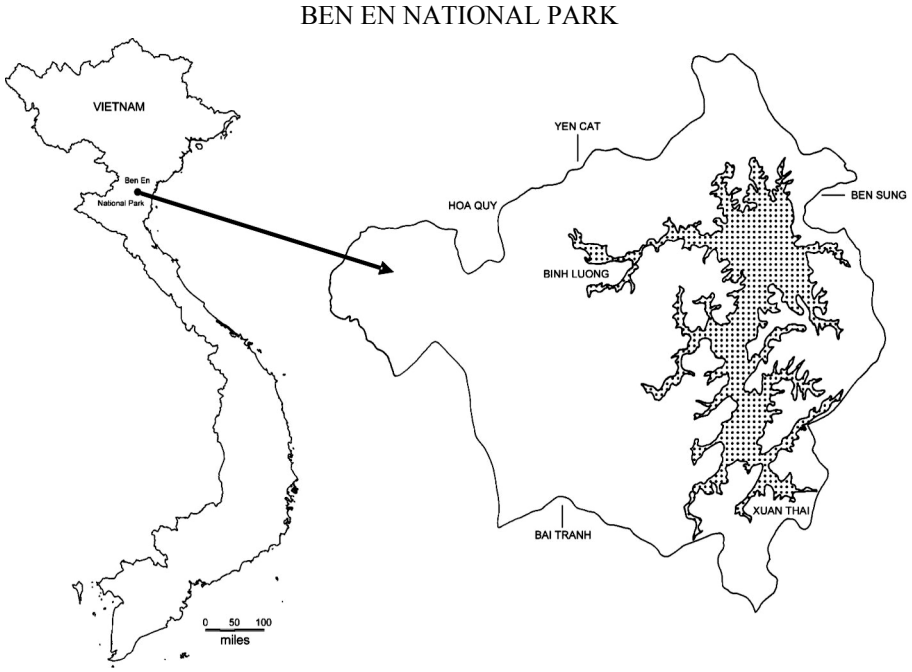

Fig. 1.1. Map of Ben En National Park in Vietnam (inset – lakes are dotted)

Our study focuses on Ben En National Park, one of the 30 National Parks in Vietnam (Forest Protection Department 2006). Ben En National Park is situated in Nhu Thanh and Nhu Xuan districts of the Thanh Hoa province in Vietnam 19° 30' to 19° 40' N by 105° 21' to 105° 35' E (Fig. 1.1). The Park was established in 1992 to conserve the rich, but seriously threatened biodiversity of the country. The Park is inhabited by 18,000 local people belonging to five ethnic groups. The majorities of the people who are living in the National Park belong to the Kinh, Thai, Muong and Tay ethnic groups; although there are also a small number of Tho people. Their life

still depends on forest resources, Non Timber Forest Products, as well as timber (Hoang et al. 2008 b & c). The vegetation of Ben En National Park has been strongly influenced by human exploitation (Khoi 1996; Hoang et al. 2008 a). The forests were commercially logged as late as 1992, and small-scale, illegal logging continues to this date (Tordoff et al. 2000; Hoang et al. 2008 a & c).

OBJECTIVES OF THIS STUDY

The aims of this thesis are:

- To inventory plant species diversity, their life forms and their conservation status, and the vegetation types in Ben En National Park.
- To survey medicinal and non-medicinal plant uses and the role of plant resources in the economy of the indigenous communities in Ben En National Park.
- To analyze the impact of human and environmental factors on plant diversity and composition in Ben En National Park.
- To use the resulting information and understanding to underpin recommendations for future management of Ben En National Park and other protected areas.

OUTLINE OF THE THESIS

Following a general introduction, **Chapter 2** focuses on the diversity of plant families, genera, species, life forms, conservation status, and the vegetation types recorded during a two years survey in Ben En National Park from 2005 to 2007. In addition we briefly review the status of forest biodiversity and causes of biodiversity loss in Vietnam.

Chapter 3 deals with the numerous medicinal plant species and their uses by local people in Ben En National Park, and analyzes the role of medicinal plants in the indigenous communities. In addition this chapter presents a comparison of the situation in Ben En National Park with other local communities depending on natural forest resources in and beyond Vietnam.

Chapter 4 addresses the great diversity of non medicinal useful plants in food, construction, firewood, household tools and related products, and other uses; and analyses the impact of local use on the conservation status of some of the utilized species.

Chapter 5 focuses on the impact of human and environmental factors (mainly soils) on plant diversity and forest structure in Ben En National Park, and gives some recommendations for developing a sustainable management of Ben En National Park based on the results of the analysis.

Chapter 2

PLANT BIODIVERSITY IN BEN EN NATIONAL PARK, VIETNAM

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Agricultural Publishing House, Hanoi, Vietnam. 2008

SUMMARY

The plant species diversity and vegetation types of Ben En National Park were studied to provide baseline information for conservation and sustainable use management within the Park. A total of 1389 vascular plant species are recorded in Ben En National Park belonging to 650 genera and 173 families. Together with earlier inventories this brings the total species number of vascular plants to about 1600. Three species found here are new to the flora of Vietnam (*Myristica yunnanensis* Y.H. Li - Myristicaceae, *Glyptopetalum sclerocarpum* (Kurz) M.A. Lawson - Celastraceae, and *Timonius arborea* Elmer - Rubiaceae); 7 families, 43 genera and 252 species are new records for the flora of Ben En National Park. Euphorbiaceae constitute the most diverse family with 113 species, while 47 families are represented only with one species. Phanerophytes are the dominant component (76% of all species), with chamaephytes (6%), hemicryptophytes (8.5%), cryptophytes (6%), and therophytes (4%) constituting minor proportions of the local flora.

Major parts of the forest in Ben En National Park have been impacted by man; before it became a National Park in 1992 the area was a timber concession, and use of wild and cultivated plant resources by local people in the Park continues to this day. Three man-made ecosystems are present on 29% of the surface area: 1) agricultural fields about 650 ha, 2) plantation forests about 110 ha, and 3) mixed bamboo and timber tree stands about 3800 ha. Two main vegetation types are recognized with heavily and slightly disturbed subtypes, depending on the intensity of plant use and illegal logging by the local population.

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1) Tropical evergreen limestone forest (subtypes: slightly disturbed, heavily disturbed, and shrubland on limestone).

2) Tropical evergreen lowland forest on other soils (mainly ferralitic, and in a small area on alluvial soil). Subtypes: slightly disturbed forest on ferralitic or alluvial soil, heavily disturbed forest on ferralitic soil, and shrubland vegetation outside the limestone hills.

A small area of virgin forest on limestone could not be described, because of its inaccessibility.

A total of 386 plant species are used by local people in Ben En National Park. The Park is of great importance for plant species conservation: a total of 29 plant species are listed in the red data list of IUCN (2006), and 42 species are listed in the Red Data Book of Vietnam (Ban 2007), which recognizes a total of 448 endangered species. In addition, 89 species were found to be endangered locally.

INTRODUCTION

Tropical rainforests are the most species-rich terrestrial ecosystems on earth, but these forests are rapidly disappearing as land is cleared for timber, agriculture, and other uses (Fimbel et al. 2001; Meijaard et al. 2005). Vietnam's forests contain a wealth of biodiversity (Thin 1997). The country was ranked as the 16th most biologically diverse country in the world (WCMC 1992). The forests of Vietnam have dramatically declined during the last 60 years (Chien 2006). Research on plant diversity in Vietnam has a long history, but there are relatively few detailed site studies. The botanical survey of Cuc Phuong National Park, the first National Park established in 1962, is perhaps the most complete (Thin 2000).

In this book, we briefly review the status of forest biodiversity and causes of biodiversity loss in Vietnam. Our study focuses on Ben En National Park, one of the 30 National Parks in Vietnam (Forest Protection Department 2006). The Ben En area was designated for the protection of fauna in 1979, and as a nature reserve in 1986, and National Park in 1992 to conserve the rich, but seriously threatened biodiversity of the country. The park is inhabited by 18,000 local people belonging to five ethnic groups. The vegetation of Ben En National Park has been strongly influenced by human exploitation (Khoi 1996; Hoang et al. 2008 c). The forests were commercially logged as late as 1992, and small-scale, illegal logging continues to this date (Tordoff et al. 2000; Hoang et al. 2008 c).

This study deals with the diversity of plant families, genera, species, life form, their conservation status, useful plants, and the vegetation types recorded during a two years survey in Ben En National Park from 2005 to 2007.

The status of forest and biodiversity in Vietnam

Before 1945, forests covered around 43% of Vietnam (Maurand 1943; Lung 2001). From 1954 to 1975, the forests of Vietnam were severely damaged by the long war with the United States of America. By 1976, the total area of forests had been

reduced to 11.2 million ha (33.8%), of which only 10% were primary forests (Lung 2001; Chien 2006). Since 1976, more forests have still been destroyed for many reasons, such as overexploitation, shifting cultivation, and agricultural extension. As a result, the forest cover declined to an estimated 30% in 1985, and 28% in 1995 (Lung 2001; Chien 2006). In 1998, the 5 million ha Reforestation Program was launched by the Vietnamese government with a target to plant 5 million ha of forests by 2010, restoring the forest cover to 43% (Lung 2001). The program aims not only to reforest, but also to protect existing natural forests. As a result, the forest cover of Vietnam has gradually increased. In 2003, the forested area of Vietnam was 36.1% (Hung 2004; Lan et al. 2006). However, the quality of forests is still low as most of the forests are poor in timber volume and tree species diversity and density as a result of a long time of overexploitation (Dang 2001; Chien 2006). According to Dang (2001) natural forests rich in timber resources cover only 1.4 million ha (13% of the total forest area) while poor and young plantations or naturally regenerating forests comprise around 6 million ha (55% of the total forest area).

There are many reasons for the rapid loss of forests in Vietnam, but the war played a major role (Quy 1985). More than 2 million ha of natural forests, of which 500,000 ha of closed upland forests and 30,000 ha of mangroves were completely destroyed (Westing 1971; Quy 1985; Hong 1988; Sam 2005); many large forest areas were heavily logged to support people and the war effort. Subsequently, to rebuild the country after the war, around 1.3-1.4 million m^3 of timber were exploited annually (Nhat 2001; Chien 2006). Overexploitation is also an important reason for the decrease in forest resources in Vietnam. As a developing country with 80% of the population being farmers living in the countryside and remote areas, the need for firewood is huge. Annually, 22 to 23 million tons of firewood are harvested (Dang 2001). In addition, illegal logging is a serious problem as it has annually destroyed around 30,000 ha of forests in the last few decades (GoVN 1994; Chien 2006). The population of Vietnam has increased quickly, and this has also a large impact on the forests. From the beginning of the last century until 2007, the population of Vietnam increased from about 15 million to 85 million (Chien 2006). Such a large population puts the forest under heavy pressure, not only through practices of shifting cultivation, but also by transforming forested land into arable land and urban areas (Sam 1996).

Plant biodiversity in Vietnam

Vietnam possesses a rich and diverse flora, with around 28% of its total species considered endemic (Thin 1997). However, many species formerly recorded as endemic species in Vietnam also occur in China, Laos, or Thailand (Hoang et al. 2004). Thin (1997) indicated that Vietnam has 11,373 plant species, belonging to 2524 genera, 378 families and 7 major plant groups (Table 2.1). A few years later Thin (2000) estimated the Vietnamese flora to number 12,000 species.

To protect the threatened biodiversity, the Vietnamese government has established a system of protected areas with the aim of conserving the main ecosystems present in Vietnam, as well as the threatened and endemic species of flora and fauna, and the valuable landscapes for culture, ecology and biodiversity (Tai 1995; VN 2003; Chien 2006). The first National Park, Cuc Phuong, was established in 1962 as an

important landmark for forest protection and conservation in Vietnam (Thu 2002). Since then, the National Park and nature reserve system of Vietnam has developed quickly. By the year 2006, Vietnam had 126 areas of special purpose forests with a total area of 2.54 million ha (Table 2. 2), occupying 7.7% of the total area of the country (Forest Protection Department 2006).

Table 2.1. Components of the flora of Vietnam (Thin 1997)

Taxa	Number of families	Number of genera	Number of species
Bryophyta	60	182	793
Psilotophyta	1	1	2
Lycopodiophyta	3	5	57
Equisetophyta	1	1	2
Polypodiophyta	25	137	669
Gymnospermae	8	23	63
Angiospermae	299	2.175	9.787
Total	378	2.524	11.373
Endemic (%)	0	3	27.7

Table 2.2. Protected forest areas in Vietnam (Forest Protection Department 2006)

Classification	Number	Area (ha)
National Parks	30	1157.56
Nature reserve areas	46	1082.98
Species/habitat management protected areas	11	85.85
Protected landscape or seascape areas	39	215.29
Total	126	2541.68

The 4 kinds of protected areas are defined below (Forest Techniques and Science Association of Vietnam (FTSA) 2001; Chien 2006).

National Park: An area on the mainland or in the sea that has not or only slightly been impacted by human activities. It contains rare, precious or endemic species or has popular landscapes at national or international levels. The objectives of establishing a National Park are to protect the ecosystem of threatened species, as they have important roles for the country and the world, and to provide facilities for scientific study and eco-tourism.

Nature Reserve: A large area having typical ecosystems or containing populations of valuable species that need conservation. Nature Reserves are to protect and maintain ecosystems and floral and faunal species in their natural conditions. They aim also to provide for scientific research and environmental management. However, in contrast to National Parks, eco-tourism is limited in nature reserves.

Species/Habitat management protected area: A forest area established to protect, maintain and favor particular threatened species and their environment.

Protected landscape or seascape area: A protected landscape or seascape established to protect famous natural landscapes or national cultural properties. It is also to protect the natural beauty of forests, caves, waterfalls, sand dunes, coral islands and volcanic craters.

The total protected area in Vietnam is about 8% of the country (Forest Protection Department 2006). This is low compared to the minimum of 10% recommended by IUCN (1997). Control of human activities in protected areas has proved difficult due to the large number of people relying on forest resources for a living (Quy 1985; Nhat 2001; Chien 2006). Local people continue to practice agriculture in the forests, also extract timber, collect firewood, medicinal plants and other forest products, hunt and fish (Hoang et al. 2008 b & c). Although this is allowed in the buffer zones of National Parks, it is not sufficient to provide a sustainable strategy of protection and conservation if the living standard of local people is not improved. Local people should be taught new methods of cultivation, sustainable harvesting and production or should be provided with other ways to improve their living conditions. Recently the Vietnamese government issued some policies and carried out many projects to help poor local people to improve their livelihoods (GoVN 2006).

Ben En National Park

Ben En National Park is situated in Nhu Thanh and Nhu Xuan districts of the Thanh Hoa province in Vietnam 19° 30’ to 19° 40’ N by 105° 21’ to 105° 35’ E (Fig. 2.1). Before its establishment in 1986, the park was a logging enterprise. At that time many of the timber trees were cut, resulting in the fact that big trees with a diameter at breast height of over one meter were rarely observed during our field work from 2005 to 2007. Ben En National Park was established in 1992. Since then all logging activities are illegal. The core zone of the National Park covers 15,800 ha, while the buffer zone covers around 12,000 ha. About 18,000 people live in the buffer and core zones of the National Park (Tordoff et al. 2000; Hoang et al. 2008 b & c). The majority of the people who are living in the National Park belong to the Kinh, Thai, Muong, and Tay ethnic groups; although there are also a small number of Tho people. Their life still depends on forest resources, Non Timber Forest Products, as well as timber trees (Hoang et al. 2008 c).

Several studies have been carried out on the plants of Ben En National Park. Frontier phase VN 9703 conducted the first large-scale, field-based survey of the biodiversity of Ben En National Park (Khoi 1996) and reported 593 vascular plant species. Another study by Frontier-Vietnam biodiversity survey between July and September 1997 recorded 737 vascular plant species (Tordoff et al. 2000). In 2000, scientists from the Sub-institute of Forest Inventory and Planning II, Nghe An extended the list to 1347 species (Anonymous 2000).

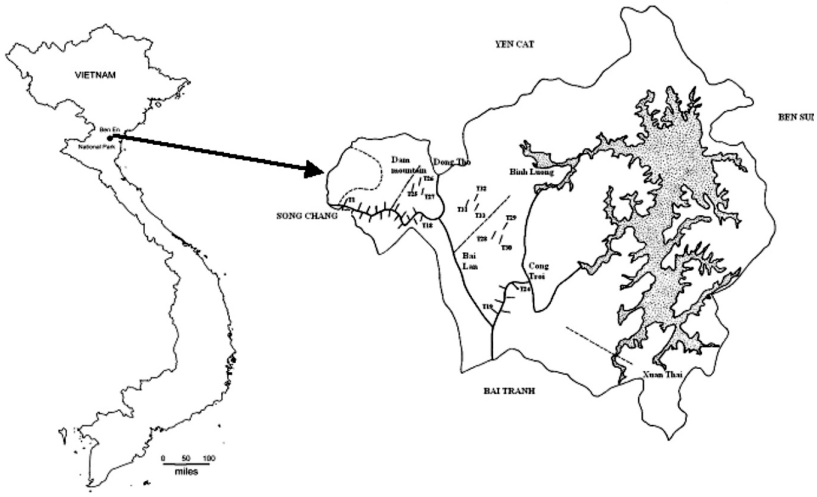

Fig. 2.1. Map of Ben En National Park in Vietnam
(inset with plot transects - lakes are dotted).

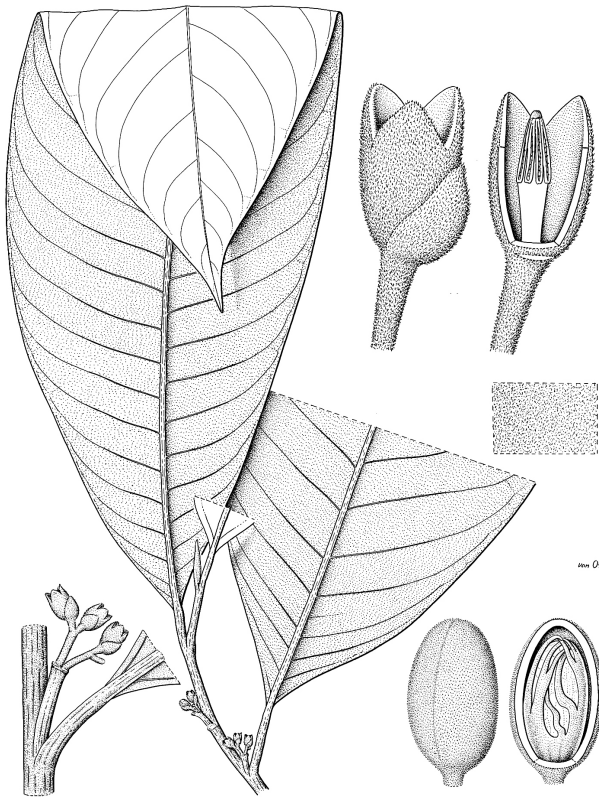

Fig. 2.2. *Myristica yunnanensis* Y.H. Li (Myristicaceae).
A new record for the flora of Vietnam.

METHODOLOGY

We used a plot design that would not only allow a comprehensive inventory of the plant species in Ben En National Park (Fig. 2.1), but that would also enable us to analyze the impact of human disturbance and exploitation (Hoang et al., in prep.). We established 41 transects, 200 m long and 2 m wide, at 250 m intervals at right angles to and along the old logging road from the Song Chang forest ranger station to Cong Troi. The total length of these transects combined is ca. 7.4 km. In each transect we noted all vascular plant species. We also established four 10 x 10 m plots at 50 m from the logging road and at 40 m forward intervals on each transect, resulting in ca. 147 plots for all transects combined (in some transects we were not able to establish four plots, because of steep, inaccessible limestone slopes). In the 147 plots (10 x 10 m) all trees with a dbh $\geq$ 5 cm were identified. All trees and treelets with a dbh < 5 cm, and h $\geq$ 1 m high were identified in 5 x 5 m subplots within each 10 x 10 m plot.

We also established six transects to cover the rest of the Park (Fig. 2.1). Transect 1 from Bai Tron to Song Chang via Bo Cung Mountain (about 5 km), transect 2 from Ben Cay Chanh to Cong Troi (4.5 km), transect 3 from Xuan Thai commune to Dong Tho Doc Dai (about 3.5 km), transect 4 from Rung Giong to Dam Mountain (about 4 km), transect 5 from Bai Lan to Bao Khe (about 4 km), and transect 6 from Nga Ba Dong Tho to Bao Cu (about 5 km). In each transect we noted all species and collected specimens of plants which could not be identified in the field. In all six transects we established 30 random plots of 10 x 10 m, and identified all species in the plots. Furthermore we also collected many plants outside the plots and transects, to make sure that our inventory was as representative as possible of the entire species richness of the local flora.

One voucher of each specimen was deposited at the herbarium of the Vietnam Forestry University, additional vouchers were sent to the National Herbarium of the Netherlands and other specialists for identification.

Useful plants in Ben En were determined by surveys and interviews with 135 randomly-selected households. Additionally special collecting trips were organized with indigenous experts: traditional doctors, village elders and other local people who knew about useful plants (Prance et al. 1987; PID & NES 1989; Ngai 2001; Hoang et al. 2008 b & c). The endangered species were defined based on the Red Data Book of Vietnam, Vol. 2 (Ban 2007), IUCN (2006), interviews with local people and forest rangers, and frequency of trees and stumps found during the field inventory (Hoang et al. 2008 b & c; Hoang et al. in prep.).

Life forms of plants in Ben En National Park were determined based on the classification of Raunkiaer (1934), modified according to Trung (1978) and Thin (1997):

1. Phanerophytes (Ph)
2. Chamaephytes (Ch)
3. Hemicryptophytes (Hm)
4. Cryptophytes (Cr)
5. Therophytes (Th)

In the group of Phanerophytes, the life-forms found in wet tropical areas are further divided by Raunkiaer (1934), and modified by Trung (1978) and Thin (1997).

1. Mega- and Meso-phanerophytes (MM)
2. Nan-phanerophytes (Na)
3. Lianas-phanerophytes (Lp)
4. Epiphytes-phanerophytes (Ep)
5. Hemi- and parasitic phanerophytes (Pp)
6. Succulent phanerophytes (Sp)

The vegetation types of Ben En National Park were classified according to UNESCO 1973; Trung 1978; Trung 1998; Vidal 2000; the United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) 2004, and Lan et al. 2006. Additionally the human disturbance levels of the vegetation were determined by noting the number of tree stumps and number of foot paths in the plots (Hoang et al. in prep.).

RESULTS

Floristic diversity in Ben En National Park

Diversity of taxa of Ben En National Park

A total of 1389 vascular plant species were recorded in Ben En National Park, belonging to 650 genera and 173 families. 117 species could be identified to genus level only. The list of plant species in Ben En is given in the Appendix 2.1. Their distribution over the major plant groups is shown in Table 2.3.

The ten families with the highest diversity of species (dominant families) in Ben En National Park (Table 2.4), although representing only 5.9% of the total number of families, include 560 species (40.3% of the total). The most species rich family is Euphorbiaceae with 113 species. In contrast to the ten dominant families, 47 families are represented by only a single species (Appendix 2.1). The number of species in Ben En National Park is about 13% of the total species number in Vietnam (Table 2.3).

Table 2.3. Major plant groups in Ben En National Park and Vietnam

Taxa	Number of families	Number of genera	Number of species in Ben En	Number of species in Vietnam
Psilotophyta	1	1	1	2
Lycopodiophyta	2	3	5	57
Equisetophyta	1	1	1	2
Polypodiophyta	22	41	77	644
Pinophyta	4	4	10	63
Magnoliophyta	141	599	1.295	9.812
Total	173	650	1.389	10.580

Table 2.4. Top 10 families ranked according to numbers of species

Scientific name	Species	% of total species
Euphorbiaceae	113	8.1
Fabaceae	97	7.0
Lauraceae	71	5.1
Rubiaceae	61	4.4
Poaceae	52	3.7
Asteraceae	45	3.2
Annonaceae	33	2.4
Moraceae	33	2.4
Rutaceae	28	2.0
Verbenaceae	27	1.9
Total	560	40.3

New records for the flora of Vietnam and Ben En National Park

Three species are new records for the flora of Vietnam: *Myristica yunnanensis* Y.H. Li (Myristicaceae) (Hoang 2008 a - Fig. 2.2), *Glyptopetalum sclerocarpum* (Kurz) M.A. Lawson, (Celastraceae) (Hoang 2008 b - Fig. 2.3), and *Timonius arborea* Elmer (Rubiaceae - Fig. 2.4). Seven families are newly recorded for the flora of Ben En National Park: Cyatheaceae, Betulaceae, Daphniphyllaceae, Ericaceae, Gesneriaceae, Lecythidaceae, and Woodsiaceae. Our study also found 43 new genera and 252 new species for the flora of Ben En National Park (see Appendix 2.1). A total of 210 species listed by Tordoff et al. (2000) and Anonymous (2000) was not found in our inventories or was treated as a taxonomic synonym of one species in our list (see the addendum of the Appendix 2.1).

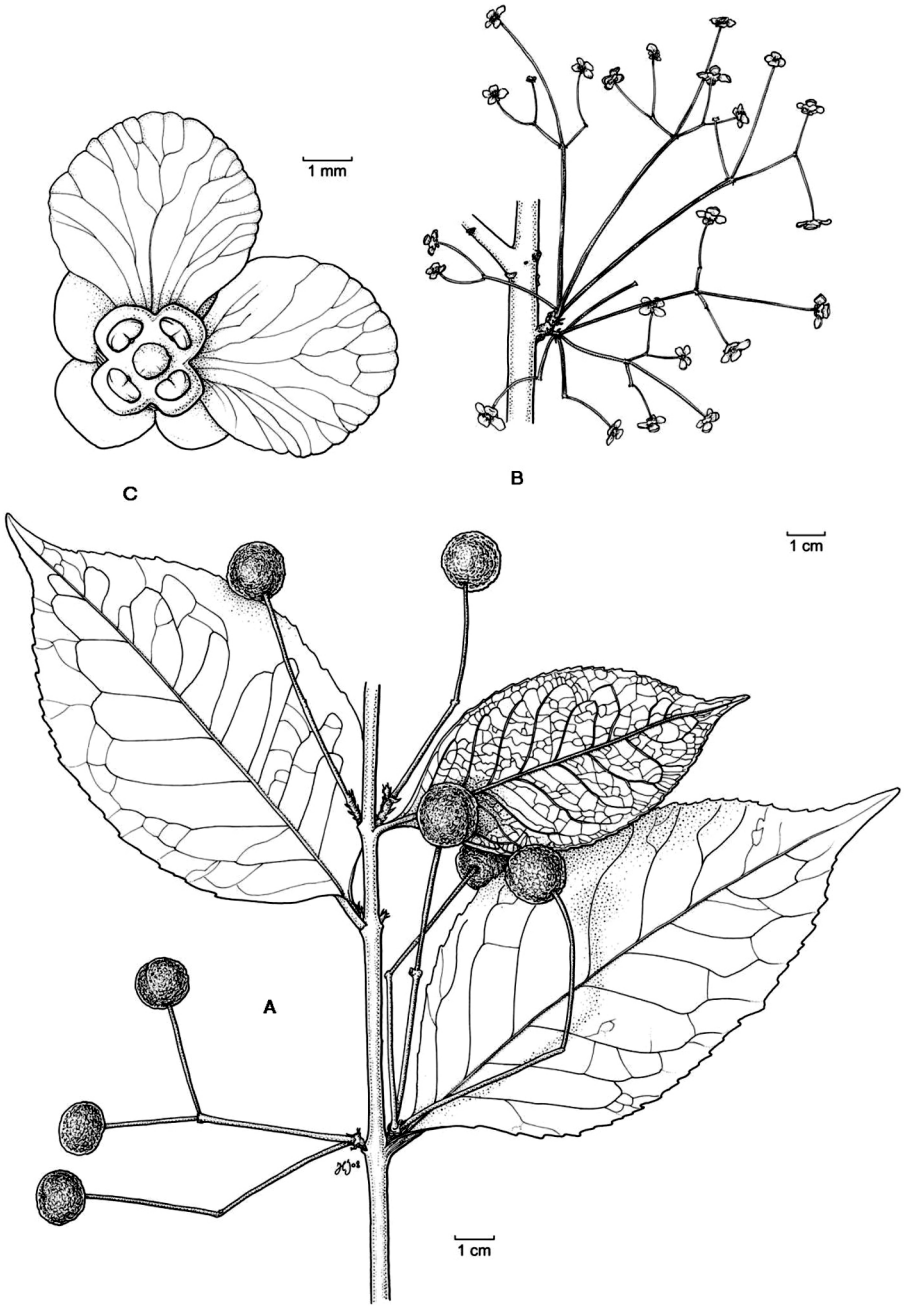

Fig. 2.3. *Glyptopetalum sclerocarpum* (Kurz) M.A Lawson (Celastraceae).
A new record for flora of Vietnam.

Diversity of life form

All species were classified by life form (Raunkiaer 1934; Trung 1978; Thin 1997). The existence of a variety of life forms reflects the typically tropical characteristics of the flora at the Ben En National Park. Phanerophytes are the most dominant life forms with about 76% of total plant species in the area (Table 2.5).

Table 2.5. Diversity of life forms in the flora of Ben En National Park

Life-forms	Number of species	% of total species
Phanerophytes	1054	75.9
Mega- / Meso-phanerophytes	575	41.4
Nano-phanerophytes	270	19.4
Lianas phanerophytes	169	12.2
Epiphytic phanerophytes	36	2.6
Hemi- and parasitic phanerophytes	2	0.1
Succulent phanerophytes	2	0.1
Chamaephytes	81	5.8
Hemicryptophytes	118	8.5
Cryptophytes	85	6.1
Therophytes	51	3.7
Total	1389	100%

Useful plant species

A total of 386 plant species are used by local people in Ben En National Park (Table 2.6) (Hoang et al. 2008 b & c), of which 52 species have more than one application. Medicinal plant species predominate among these useful plants with 230 species applied in 68 different diseases treatments (Hoang et al. 2008 b).

Table 2.6. Commodity groups of useful plants in Ben En National Park

Commodity group	Number of plant species	Percent/total (%)
Medicine	230	60
Food	142	37
Construction	40	10
Firewood	25	6
Household tools and related products	18	5
Other	16	4

Conservation status

A total of 29 plant species from Ben En National Park are listed in the Red Data list of IUCN (2006), and 42 species are listed in the Red Data Book of Vietnam (Ban 2007). However, based on our plot inventories (density of living trees and stumps) and interviews with forest rangers and local people as many as 89 species appear to be locally endangered (See species marked in Appendix 2.1).

Vegetation types in Ben En National Park

In Ben En National Park the highest peak is about 490 m, so all vegetation in the Park belongs to lowland forest types (UNESCO 1973; Trung 1978; Lan et al. 2006; UNEP-WCMC 2004). Among the natural vegetations of the Park there is a major dichotomy between the evergreen forests on limestone and those on other soil types. Each of these substrate-dependent forest types has a heavily disturbed and slightly disturbed subtype. The other four vegetation types are (almost) entirely anthropogenic: shrublands, agricultural fields, plantation forests and mixed bamboo and timber tree stands. In the following descriptions typical plant species are listed in declining order of their density (number of individuals per plot).

Tropical evergreen limestone forest

Slightly disturbed subtype

This forest type occurs in the limestone hills where local people hardly have access for cutting and transporting timber trees, e.g. on steep slopes with sharp edges that make the terrain dangerous. This forest type covers only about 90 ha. There are no stumps at all, and foot paths in this forest type are very rare. However, traces from collecting Non Timber Forest Products are present. This type can be found in Thung Sen, and a small area on Dam Mountain. The structure of this forest type includes four layers: The canopy layer is formed by trees over 15 m tall. Dominant species are *Actinodaphne obovata, Caryodaphnopsis tonkinensis, Aglaia spectabilis, Saraca dives, Pavieasia anamensis, Castanopsis tonkinensis, Aglaia silvestris, Aphanamixis grandiflora*. The subcanopy layer is characterised by small trees up to 15 m in height. Species occurring in this layer are shade tolerant species. Dominant species are *Callicarpa macrophylla, Acanthus ilicifolius, Acanthus leucostachyus, Callicarpa dichotoma, Diospyros montana, Miliusa balansae, Knema conferta, Melientha suavis, Lithocarpus pseudosundaicus, Antidesma hainanensis, Antidesma acidum, Baccaurea ramiflora, Antidesma montanum, Streblus macrophylla, Heritiera macrophylla, Streblus indicus, Sterculia lanceolata, Aidia pycnantha, Litsea mollifolia, Machilus bonii,* and *Phoebe macrocarpa.* The shrub layer includes only few species, like *Dracaena cambodiana, Dracaena cochinchinensis, Antidesma bunius, Streblus macrophylla, Miliusa balansae, Diospyros hirsuta, Litsea impressa, Cryptocarya lenticellata* and *Millettia boniana.* The herb layer is composed of a few

species of Balsaminaceae, Smilacaceae, Acanthaceae, Urticaceae, and Euphorbiaceae.

Heavily disturbed subtype

This forest type is the most common in the limestone hills where local people have easy access for cutting, transporting timber trees, e.g. near villages, or far from the forest ranger station. This forest type covers about 300 ha. Typical sites are Yen Ngua, along the old logging road, Ba Bai, Bo Cum mountain, and some small areas in the centre of the Park. Big trees are absent; stumps and foot paths are common (2 to 5 stumps, and more than one foot path in each 0.04 ha plot). The forest structure is simple with three layers: The canopy layer is composed mainly of *Callicarpa macrophylla, Callicarpa dichotoma, Acanthus ilicifolius Streblus macrophylla, Streblus indicus, Diospyros montana, Lagerstroemia calyculata, Pterospermum truncatolobatum, Pterospermum heterophyllum, Antidesma montanum, Acanthus leucostachyus, Diospyros hirsuta, Koilodepas longifolium, Hydnocarpus anthelmintica,* and *Machilus bonii.* The shrub layer is composed of few species, *Randia oxyodonta, Sterculia gracilipes, Streblus macrophylla, Antidesma bunius, Heritiera littoralis, Dracaena cambodiana, Dracaena cochinchinensis, Sterculia lanceolata, Acanthus leucostachyus, Diospyros hirsuta,* and *Aidia acuminatissima.* The herb layer is very simple with a few species of Acanthaceae, Balsaminaceae, Euphorbiaceae, and Smilacaceae.

Shrubland on limestone

This vegetation type is the result of heavy logging. It occurs along the old logging road, near villages, and is dominant in the buffer zone near Hai Van and Hai Long. This forest type covers a small area (about 40 ha). The shrubland is species-rich; dominant are *Dracaena cambodiana, Dracaena cochinchinensis, Memecylon edule, Ixora balansae, Melastoma sp., Randia pycnantha, Callicarpa arborea, Vitex trifolia, Acanthus ilicifolius, Desmos cochinchinensis, Uvaria micrantha, Alchornea tiliifolia, Psychotria montana, Aporosa microcalyx, Jasminum subtriplinerve, Helicteres angustifolia,* and species of Dryopteridaceae, Polypodiaceae, and Urticaceae.

Tropical evergreen lowland forest on other soils (mainly ferralitic and in a small area on alluvial soil)

Slightly disturbed subtype on ferralitic or alluvial soil

This forest type occurs in areas where it is difficult to transport the timber after harvesting, or where illegal logging meets with other obstacles, e.g. in steep valleys, on islands or in the vicinity of a station of the forest ranger. This forest type covers about 2140 ha. In the plots stumps are absent or at most one in each plot, foot paths are also rare (usually one in each plot). However, traces from collecting Non Timber

forest products are common. This forest type was found mainly in Thung Sen, Rung Giong, Thu Lon, Bai Lan, Khe Chuon, and some areas in the Bo Cum mountain. This forest type has four layers: The canopy layer is characterized by trees over 15 m tall: *Peltophorum tonkinensis, Erythrophleum fordii, Aglaia spectabilis, Saraca dives, Pavieasia annamensis, Aphanamixis grandiflora, Actinodaphne obovata, Phoebe paniculata, Dysoxylum caudiflorum, Pterospermum truncatolobatum, Lagerstroemia calyculata,* and *Machilus bonii.* The subcanopy layer is composed of small timber trees below 15 m in height. Dominant species are *Diospyros montana, Antidesma montanum, Diospyros hirsuta, Sterculia lanceolata, Aidia pycnantha, Litsea monopetala, Machilus chinensis, Phoebe macrocarpa, Koilodepas longifolium, Hydnocarpus anthelmintica, Syzygium wightianum,* and *Cryptocarya lenticellata.* The shrub layer is composed of many species, with as dominant ones *Antidesma bunius, Mallotus decipiens, Excoecaria cochinchinensis, Diospyros hirsuta, Miliusa balansae, Koilodepas longifolium, Litsea verticillata, Millettia boniana, Goniothalamus amuyon, Aidia oxyodonta,* and *Randia sp.* The herb layer is composed mainly of species of the families Zingiberaceae, Poaceae, Acanthaceae, Rutaceae, Rubiaceae, Euphorbiaceae, Asteraceae, and ferns.

Heavily disturbed subtype on ferralitic soil

This type of forest occurs in the lowland where local people have easy access to cut and transport timber trees, e.g. near villages, or the old logging road. This is the most extensive forest type in Ben En National Park (about 4100 ha). Stumps are common (usually 3 to 5 stumps per plot), and more than one foot path traverses each plot. There are three layers. The canopy layer is composed mainly of *Syzygium wightianum, Callicarpa dichotoma, Litsea balansae, Diospyros hirsuta, Beilschmiedia balansae, Koilodepas longifolium, Callicarpa dichotoma, Claoxylon indicum, Microcos paniculata, Ficus hispida, Alangium chinense, Machilus bonii, Pterospermum truncatolobatum, Mallotus paniculatus, Antidesma montanum, Cryptocarya chinensis, Ilex cymosa, Flacourtia balansae, Lithocarpus pseudosundaicus, Litsea rotundifolia, Machilus grandifolia, Dysoxylum caudiflorum, Mischocarpus pentapetalus, Canarium album, Canarium tramdenum,* and *Erythrophleum fordii.* The shrub layer is formed by many species, mainly treelets of the canopy layer. Dominant species are *Diospyros hirsuta, Goniothalamus amuyon, Litsea rotundifolia, Mallotus paniculatus, Macaranga auriculata, Excoecaria cochinchinensis, Miliusa balansae, Antidesma bunius, Cryptocarya sp., Machilus bonii, Dysoxylum caudiflorum, Millettia boniana,* and *Dalbergia lanceolaria.* The herb layer is composed mainly of species of the Zingi-beraceae, Poaceae, Annonaceae, Rubiaceae, Asteraceae, Acanthaceae, Euphorbiaceae, and ferns.

Shrubland vegetation outside the limestone hills

As in the limestone shrublands, this vegetation type is the result of heavy logging, shifting cultivation and other former agricultural activities in the Park. This

vegetation covers about 2950 ha. It occurs along the old logging road, near villages and in places inside the Park where agriculture used to be practiced before the Park was established in 1992. These shrublands occur around Xuan Thai, Duc Luong, Dong Tho, Bai Bong, and Nga Ba Dong Tho. Dominant species are *Breynia fleuryi, Wikstroemia indica, Melastoma candidum, Memecylon edule, Aporosa microcalyx, Rhodomyrtus tomentosa, Cleistanthus petelotii, Mallotus barbatus, Macaranga denticulata, Desmodium heterocarpon, Tephrosia indica, Senna tora, Cratoxylum polyanthum, Cratoxylum prunifolium, Antidesma scandens, Phyllanthus reticulatus, Smilax corbularia, Thysanolaena maxima, Saccharum spontaneum, Saccharum arundinaceum,* and *Imperata cylindrica.* This type of vegetation was also found around Muc Lake, where it is dominated by *Mimosa pigra.*

Plantation forest

Plantation forest scarcely occurs in the Park, it occurs in Trai Bo, Bai village, Roc Khoan, Dong Tho, and Xuan Binh (about 110 ha). The following species are planted: *Acacia auriculaeformis, Acacia mangium, Canarium tonkinensis, Cassia siamea, Eucalyptus camaldulensis, Hevea brasiliensis, Magnolia conifera,* and *Michelia mediocris*. The structure of this forest type is simple; it includes the tree layer and a ground layer with mainly weedy species belonging to Asteraceae, Poaceae, Amaranthaceae, Rubiaceae, Euphorbiaceae, Acanthaceae, and ferns.

Bamboo mixed with timber trees

This vegetation type is due to human activity. The growth of natural bamboo is stimulated by extraction of trees. This forest type covers a large area in Ben En National Park, about 3800 ha. It was found near Chang River, Bai Lan, Xuan Thai, Xuan Binh, and some areas in the centre of the Park. In some areas there are more timber trees than bamboos, but in other areas only few timber trees occur within the bamboo stands. The bamboos are dominated by *Schizostachyum funghomii*, and a few individuals of *Bambusa flexuosa, Indosasa sibataeoides,* and *Indosasa sinica.* Many timber tree species are mixed with the bamboo forest. The most important ones are *Pterospermum heterophyllum, Beilschmiedia balansae, Machilus bonii, Lagerstroemia calyculata, Endospermum chinense, Mallotus paniculatus, Aglaia spectabilis, Saraca dives, Phoebe paniculata,* and *Actinodaphne obovata*. The ground layer is formed by few species of Zingiberaceae, Asteraceae, Poaceae, Amaranthaceae, Rubiaceae, Euphorbiaceae, Acanthaceae, and ferns. Bamboo stands dominated by *Schizostachyum funghomii* have no herb layer at all.

Agricultural land

Agricultural land occurs on a small scale close to the villages in Ben En National Park, in total about 650 ha of home gardens and forest land that is allocated to individual households for protection and re-plantation (GoVN 1994). The land is used for growing sugar cane, cassava, beans, peanuts, vegetables and fruit trees such

as mango, banana, jack fruit, papaya, and orange. Paddy rice (*Oryza sativa*) is grown in irrigated fields along the Muc River and in some areas close to villages.

DISCUSSION

Floristic diversity in Ben En National Park

With 1389 vascular plant species recorded in Ben En National Park in this study the species number continues to increase from the 596 species found in the first inventory (Khoi 1996), via 737 species (Tordoff et al. 2000) and 1347 species (Anonymous 2000). From our list of taxa, 7 families, 43 genera and 252 species have never been recorded in any earlier studies; e.g., in Annonaceae we found 3 new genera and 13 new species for Ben En National Park, Euphorbiaceae has 2 new genera and 37 new species. Most of the newly recorded species are found in the forest, but some of them were found in home gardens of local people in the Park where the earlier studies might not have paid attention, such as *Punica granatum* (Lythraceae), and *Barringtonia acutangula* (Lecythidaceae).

The number of new families, genera and species found in the Park indicate that the flora of Ben En National Park is highly diverse. Moreover, 14 families, 32 genera and 210 species recorded in the earlier survey (Anonymous 2000; Tordoff et al. 2000), were not found during our inventory (Addendum of Appendix 2.1). For instance, 26 species of Orchidaceae were listed by Anonymous (2000), but we only found 16 species. This means that our inventory also may not be complete or that species numbers may be unreliable due to confused taxonomy or erroneous identifications. However, it also indicates that the number of plant species in Ben En National Park is not 1389 species, but could be about 1600 species. More research will probably yield more species records, especially in the undisturbed and poorly accessible areas.

The life forms of plant species in Ben En National Park are diverse. This study demonstrates the importance of Phanerophytes, which represent about 76% of the entire local flora. This is similar to Pu Mat National Park (74.1% phanerophytes; Thin & Nhan 2003), but seemingly different from Cuc Phuong National Park (Lan et al. 1996). However, in Cuc Phuong the percentage of Phanerophytes is lower (57.8%) than in Ben En, because Bryophytes were included in the survey and omitted from ours.

Vegetation types

The vegetation of Vietnam has been studied and classified from the beginning of the last century (Chevalier 1918). Earlier studies have yielded a range of partly overlapping vegetation classifications for Vietnam (Chien 2006; Lan et al. 2006). Trung 1998 recognized 14 vegetation types in Vietnam; Canh & Ly (2004) only 4 main types, Chien (2006) and Lan et al. (2006) each 8 types. Most authors use the

term “closed tropical forest” for primary forest. However, due to logging and other human disturbance most initially closed forests have evolved into a disturbed or open subtype, with two or even only one tree layer(s).

In Ben En National Park, the main forest types depend on whether the substrate is limestone or another type of soil. Within these two evergreen tropical lowland forest types we recognize two subtypes depending on whether disturbance levels were low (“slightly disturbed”) or severe (“heavily disturbed”), as quantified by the presence and frequency of tree stumps and footpaths in the plots. The different levels of disturbance have an impact on species numbers, and tree density, especially of the important timber tree species (Hoang et al. in prep.). In the less disturbed forests, the canopy has two tree layers and the heavily disturbed forest has only one. Some small areas located near Thung Sen, and on the Dam Mountain still have undisturbed limestone forest. However, we could not access these areas, because of the steep and sharp rocky slopes.

Because of its land location and low elevation, mangroves, conifer forests and other high mountain vegetations do not occur in Ben En National Park.

Conservation of plant species

There are differences between the lists of plant species that occur in the Red Data book of Vietnam, Vol. 2 (Ban 2007), and in the Red List of IUCN (2006). The Red List of IUCN (2006) on the flora of Vietnam concentrates on tree species and there is not much information on herbs, shrubs and climbers. But not only tree species are endangered; many herbs, shrubs and climbers species are also threatened such as *Polygonum multiflorum* (Polygonaceae), a small climbing species. At the local level, more species were listed as threatened such as *Stephania longa* (Menispermaceae), *Cibotium barometz* (Dicksoniaceae), *Actinodaphne obovata,* and *Phoebe paniculata* (Lauraceae). They are perhaps not only threatened in Ben En, but also in other parts of Vietnam. *Chukrasia tabularis* is listed both in the Red List of IUCN 2006, and the Red Data Book of Vietnam (Ban 2007). This species is endangered in natural forests. However, *Chukrasia tabularis* (Meliaceae) is planted in plantation forests throughout Vietnam, and in and around Ben En National Park in particular, so that this species is not threatened here. Another species, *Alstonia scholaris* (Apocynaceae), is listed in the IUCN list of 2006, but this species is also common in plantations throughout the country. From our field surveys, it appeared that some species have become endangered by overcollecting of entire plants, such as *Morinda citrifolia*, *Morinda officinalis* (Rubiaceae), and *Smilax glabra* (Smilacaceae) (Hoang et al. 2008 b), or high intensity of illegal logging, and have become very rare in the field: *Garcinia fagraeoides* (Clusiaceae), *Markhamia stipulata* (Bignoniaceae) (Hoang et al. in prep.). Those species will soon be strongly threatened or extinct, at least locally, if no attempts are made to protect and replant them.

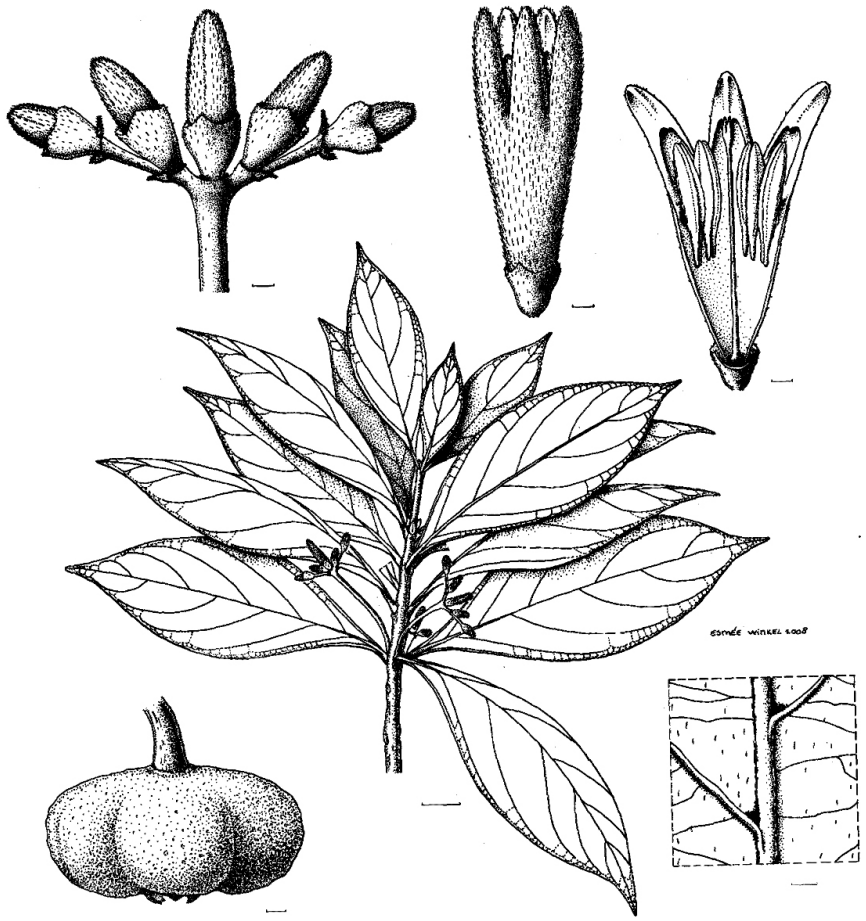

Fig. 2.4. *Timonius arborea* Elmer (Rubiaceae). A new record for flora of Vietnam.

CONCLUSION

Despite very heavy disturbance levels of the most common vegetation types in the Ben En National Park, the number of plant species is still high with an estimated number of 1600 vascular plant species. A large number of plant species provide important commodities for the local communities in Ben En National Park. Thus the plant diversity is still very big and worth conserving. Many species in the Park are threatened at the global, national and local level. Special measures are urgently needed to reverse the effects of disturbance by stopping illegal logging, and making the collection of useful plants more sustainable. In order to reduce the human pressures on the forest resources, more support is needed for local people living in the core zone of the Park, both financially and in acquiring plant cultivation skills. Additionally, a forest restoration program is needed to counteract the heavy anthropogenic disturbance in parts of the Park.

APPENDIX 2.1

List of the vascular plant species in Ben En National Park

Key: LF = life forms: Ph: Phanerophytes; MM: Mega- and Meso-phanerophytes; Na: Nano-phanerophytes; Lp: Lianas-phanerophytes; Ep: Epiphytes-phanerophytes; Pp: Hemi- and parasitic phanerophytes; Sp: Succulent phanerophytes; Ch: Chamaephytes; Hm: Hemicryptophytes; Cr: Cryptophytes; Th: Therophytes. - RDB = Red Data Book of Flora of Vietnam (2007). - RD-IUCN = Red list data of IUCN (2006). - RDBE = Red Data of Ben En National Park: CR: Critically endangered; EN: Endangered; V: Vulnerable; R: Rare; T: Threatened; NT: Near threatened; DD: Data deficient; LC, LR - Least concern. - NOTE = NFBE: New family to BENP; NGBE: New genus to BENP; NSBE: New species to BENP; NSVN: New species to Vietnam. - * Species was recorded in the plots.

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Psilotophyta	**Ngành Quyết lá thông**					
Psilotaceae	**Họ Quyết lá thông**					
Psilotum nudum (L.) Beauv.*	Quyết lá thông	Ch				
Lycopodiophyta	**Ngành Thông đất**					
Lycopodiaceae	**Họ Thông đất**					
Huperzia carinata (Desv.) Trevis.	Thông đất	Ch				
Lycopodiella cernua (L.) Pic.Serm.	Thông đất	Ch				
Selaginellaceae	**Họ Quyển bá**					
Selaginella argentea (Hook. ex Grev.) Spring*	Quyển bá	Ch				
Selaginella delicatula (Desv.) Alston	Quyển bá	Ch				
*Selaginella sp.**	Quyển bá	Ch				
Equisetophyta	**Ngành Cỏ quản bút**					
Equisetaceae	**Họ Mộc tặc**					
Equisetum diffusum D. Don*	Cỏ quản bút lan	Hm				
Polypodiophyta	**Ngành Dương xỉ**					
Adiantaceae	**Họ Tóc thần vệ nữ**					
Adiantum capillus-veneris L.*	Tóc thần vệ nữ	Hm				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Adiantum caudatum L.	Tóc thần vệ nữ	Hm				
Adiantum erylliae Hance*	Ráng	Ch				
Adiantum flabellulatum L.	Tóc thần	Hm				
Adiantum induratum Chr.*	Ráng nguyệt	Hm				
Adiantum stenochlamys Baker	Ráng nguyệt xỉ	Ch				
Cheilanthes sp.	Thần mô	Hm				
Cheilanthes tenuifolia (Burm. f.) Sw.	Thần mô	Hm				
Angiopteridaceae	**Họ Quan âm**					
Angiopteris evecta (Forst.) Hoffm.	Toà sen	Na				
Aspleniaceae	**Họ Tổ chim**					
Asplenium griffithianum Hook.*	Tổ điểu	Ep				NSBE
Asplenium nidus L.	Tổ điểu	Ep				
Asplenium normale D. Don*	Tổ điểu thường	Ep				
Asplenium obscurum Blume	Ráng	Hm				
Asplenium thunbergii Kuntze*	Tổ điểu	Hm				
Azollaceae	**Họ Bèo tai chuột**					
Azolla imbricata (Roxb.) Nakai	Bèo dâu	Cr				
Blechnaceae	**Họ Ráng lá dừa**					
Blechnum orientale L.*	Ráng lá dừa	Hm				
Stenochlaena palustris (Burm. f.) Bedd.	Chại	Lp				
Woodwardia cochinchinensis Ching	Ráng	Hm				NGBE
Cyatheaceae	**Họ Dương xỉ mộc**					NFBE
Cyathea contaminans (Hook.) Copel.*	Dương xỉ mộc	MM				NGBE
Davalliaceae	**Họ Vẩy lợp**					
Davallia denticulata (Burm.) Mett.	Ráng đà	Cr				
Davallia divaricata Blume*	Ráng đà hoa toả	Cr				
Davallia repens (L.f.) Kuhn	Quyết âm thạch	Ep				
Gymnogrammitis dareiformis (Hk.) Ching	Quyết mưa	Ep				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Rumohra sp.	Quyết	Ch				
Dennstaedtiaceae	**Họ Ráng đàn tiết**					
Lindsaea odorata Roxb.*	Quyết	Hm				
Microlepia trapeziformis (Roxb.) Kuhn	Quyết vảy	Hm				NSBE
Dicksoniaceae	**Họ Lông cu li**					
Cibotium barometz (L.) J. J. Sm.*	Lông cu li	Ch			T	
Dipteridaceae	**Họ Song dực**					
Dipteris chinensis (Kaulf.) Reinw.	Quyết quạt	Hm				
Dryopteridaceae	**Họ Dương xỉ thường**					
Cyrtomium sp.	Quán chúng	Cr				
Dryopteris subtriangularis (Hope.) C.Chr*	Dương xỉ	Hm				
Polystichopis chinensis (Rosenst.) Holttum	Quyết	Cr				
Tectaria decurrens (C. Presl) Copel.	Quyết ba chạc	Hm				
Tectaria devexa (Mett.) Copel.*	Ráng	Hm				
Tectaria pentagonalis (Bon) C. Chr.	Ráng	Cr				NSBE
*Tectaria sp.**	Quyết	Cr				
Tectaria vasta (Blume) Copel.	Ráng	Cr				
Gleicheniaceae	**Họ Guột**					
Dicranopteris linearis (Burm.) Underw.	Guột	Cr				
Hymenophyllaceae	**Họ Lá màng**					
Crepidomanes radicans (Sw.) Copel.	Quyết	Cr				
*Trichomanes sp.**	Quyết lông	Ep				
Lomariopsidaceae	**Họ Ráng sưu xỉ**					
Bolbitis heteroclita (Presl) Ching ex C.Chr.	Ráng bích xỉ	Hm				
Piperopteris sp.	Quyết nhung	Ch				
Marattiaceae	**Họ Quyết toà sen**					
Angiopteris confertinervia Ching	Toà sen	Na				NSBE
Angiopteris evecta (G.Forst.) Hoffm.	Quyết toà sen	Na				
Marsileaceae	**Họ Rau bợ**					

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Marsilea quadrifolia L.	Rau bợ	Th				
Polypodiaceae	**Họ Dương xỉ**					
Drynaria bonii H. Christ	Cốt toái bổ	Ep	V		DD	
Drynaria fortunei (Kuntze ex Mett.) J. Sm.	Cốt toái bổ	Ep	EN		R	NSBE
Drynaria lanceolata (L.) Farw.	Cốt toái bổ lưỡi mác	Ep				
Lemmaphyllum microphyllum C. Presl*	Quyết lá nhỏ	Ep				
Microsorum superficiale (Bedd.) Ching	Ráng	Ep				
Pyrrosia lanceolata (L.) Farw.	Thạch vĩ lưỡi mác	Ep				
Pyrrosia lingua (Thunb.) Farw.	Ráng	Ep				
Pteridaceae	**Họ Chân xỉ**					
Pteris ensiformis Burm. f.	Seo gà	Ep				
Pteris finotii C. Chr.*	Ráng chân xỉ	Ch				
Pteris grevilleana Wall.	Quyết đuôi gà	Hm				
Pteris longipes D. Don*	Seo gà dài	Cr				
Pteris multifida Poir.	Seo gà xẻ nhiều	Ch				
*Pteris sp.**	Chân xỉ	Hm				
Pteris vittata L.	Chân xỉ sọc	Hm				
Schizaeaceae	**Họ Bòng bong**					
Lygodium conforme C. Chr.*	Bòng bong lá to	Lp				
Lygodium digitatum C. Presl*	Bòng bong	Lp				
Lygodium flexuosum (L.) Sw.	Bòng bong	Lp				
Lygodium scandens (L.) Sw.	Bòng bong lá nhỏ	Lp				
*Lygodium sp.**	Bòng bong	Lp				
Thelypteridaceae	**Họ Ráng thu dực**					
Abacopteris rubra (Ching) Ching	Ráng	Hm				
Christella acuminata (Hout.) Holttum	Quyết lông	Hm				
Christella balansae (Ching) Holttum*	Ráng lông	Hm				
Macrothelypteris torresiana (Gaud.) Ching	Ráng	Cr				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Pneumatopteris truncatus (Poir.) Holttum	Quyết khí	Ch				
Pronephrium sp.	Ráng	Cr				
Vittariaceae	**Họ Ráng lưỡi beo**					
Antrophyum annamensis C. Chr. & Tardieu	Lưỡi beo	Ep				
Woodsiaceae	**Ráng gỗ nhỏ**					NFBE
Callipteris esculenta J. Sm.*	Rau dớn	Lp				NGBE
Diplazium esculentum (Retz.) Sw.	Rau rớn	Lp				NGBE
Pinophyta	**Ngành thông**					
Cycadaceae	**Họ Tuế**					
Cycas chevalieri Leandri	Nghèn	Na	LR		R	
Cycas immersa Craib	Tuế chim	Na			R	
Cycas pectinata Buch.-Ham.	Tuế lược	Na	V		R	NSBE
Cycas revoluta Thunb.	Vạn tuế	Na			R	
Gnetaceae	**Họ Gắm**					
Gnetum gnemon L.	Gắm	Lp				NSBE
Gnetum latifollium Blume	Gắm lá rộng	Lp				NSBE
Gnetum montanum Markgr.	Gắm núi	Lp				
Pinaceae	**Họ Thông**					
Pinus massoniana D. Don	Thông đuôi ngựa	MM				
Pinus merkusii Jungh. & de Vriese	Thông nhựa	MM				
Podocarpaceae	**Họ Kim giao**					
Nageia fleuryi (Hickel) de Laub.	Kim giao	MM			T	
Magnoliophyta	**Ngành Mộc lan**					
Magnoliopsida	**Lớp 2 lá mầm**					
Acanthaceae	**Họ Ô rô**					
Acanthus leucostachyus Wall.*	Ô rô núi	MM				
Acanthus ilicifolius L.*	Ô rô lá bé	MM				
Baphicacanthus cusia (Nees) Bremek.*	Chàm lá lớn	Na				NGBE
*Clinacanthus sp.**	Chàm	Na				
Justicia poilanei Benn.	Thanh táo	Na				NGBE

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Strobilanthes cystolithiger Lind.*	Chuỳ hoa	Na				
Strobilanthes multangulus Benoist	Chàm rừng	Na				
Rhinacanthus nasutus (L.) Kurz*	Bạch hạc	Na				NSBE
Thunbergia fragrans Roxb.	Cát đằng	Lp				
*Thunbergia sp.**	Bông xanh	Lp				
Aceraceae	**Họ Thích**					
Acer decandrum Merr.*	Thích lá nguyên	MM				
Acer laevigatum Wall.*	Thích	MM				NSBE
Alangiaceae	**Họ Thôi ba**					
Alangium barbatum (R. Br.) Baill.*	Thôi ba	MM				
Alangium chinense (Lour.) Rehd.*	Thôi ba	MM				
Alangium kurzii Craib*	Thôi ba lông	MM				
Amaranthaceae	**Họ Rau dền**					
Achyranthes aspera L.*	Cỏ xước	Ch				
Achyranthes bidentata Blume	Cỏ xước	Ch				
Alternanthera sessilis (L.) A.DC.	Rau diếp dại	Ch				
Amaranthus spinosus L.	Dền cơm	Th				
Amaranthus tricolor L.	Dền tía	Hm				
Amaranthus viridis L.	Đơn đỏ	Hm				
Celosia argentea L.	Mào gà	Ch				
Cyathula prostrata (L.) Blume	Đơn đỏ	Hm				NGBE
Deeringia polysperma (Roxb.) Miq.	Cúc bách nhật	Ch				NGBE
Anacardiaceae	**Họ Xoài**					
Buchanania arborescens Blume	Chay lớn	MM				
Buchanania lucida Blume	Chay	MM				
Dracontomelon dao (Blanco) Merr. & Rolfe*	Sấu	MM				
Mangifera indica L.	Xoài	MM				
Mangifera minutiflora Evrard	Xoài rừng	MM		V		
Mangifera reba Pierre	Quéo	MM				
Rhus chinensis Muell.	Muối	MM				
Rhus rhetsoides Craib*	Sơn rừng	MM				
Rhus succedanea L.*	Sơn ta	MM				
Spondias axillaris Roxb.	Xoan nhừ	MM				
Spondias lakoensis Pierre*	Dâu da xoan	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Annonaceae	**Họ Na**					
Alphonsea hainanensis Merr. & Chun*	Thau lĩnh hải nam	MM				
Alphonsea monogyna Merr. & Chun*	Thau lĩnh	MM				NSBE
Alphonsea squamosa Finet & Gagnep.*	Thau lĩnh trơn	MM				NSBE
Alphonsea tonkinensis A. DC.*	Thau lĩnh bắc bộ	MM				NSBE
Annona muricata L.	Mãng cầu xiêm	MM				
Annona squamosa L.	Na	MM				
Artabotrys hexapetalus (L.f.) Bhandari*	Dây công chúa	Lp				
Artabotrys intermedius Hassk.*	Móng rồng nhỏ	Lp				
Dasymaschalon macrocalyx Finet & Gagnep.	Dất mèo	Na				NGBE
Desmos chinensis Lour.	Dây công chúa	Lp				
Desmos cochinchinensis Lour.*	Hoa giẻ	Lp				
Desmos pedunculosus (A.DC.) Ban	Hoa giẻ	Lp				
Fissistigma latifolium (Dun.) Merr.*	Cách thư lông	Lp				NSBE
Fissistigma petelotii Merr.	Cách thư	Lp				
Fissistigma villosum (Ast) Merr.	Cách hoa có lông	Lp				NSBE
Friesodielsia fornicata (Roxb.) D. Das	Cườm chài	Lp				NGBE
Goniothalamus amuyon Merr.*	Giác đế	MM				
Goniothalamus macrocalyx Ban*	Giác đế lá lớn	MM	V	V	DD	
Miliusa balansae Finet & Gagnep.*	Màu cau	MM				
Miliusa horsfieldii (Benn.) Pierre*	Màu cau	MM				NSBE
*Miliusa sp.**	Màu cau	MM				
Miliusa velutina Hook.f. & Thomson*	Màu cau lông	MM				NSBE
Polyalthia cerasoides (Roxb.) Benth.*	Nhọc lá bé	MM				
Polyalthia jucunda Finet & Gagnep.*	Nhọc lá dài	MM				
Polyalthia laui Merr.*	Nhọc lá to	MM				
Polyalthia nemoralis DC.	Nhọc đen	MM				
Uvaria boniana Finet & Gagnep.	Dây dứt	Lp				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Uvaria macrophylla Roxb.	Dây dứt nhung	Lp				
Uvaria micrantha Hook.f. & Thomson	Dây dứt na	Lp				
Uvaria tonkinensis Finet & Gagnep.	Dây hoa dẻ	Lp				
Xylopia pierrei Hance	Dền trắng	MM	V	V	R	NSBE
Xylopia poilanei Ast*	Dền trắng	MM				NSBE
Xylopia vielana Pierre*	Dền	MM				
Apiaceae	**Họ Hoa tán**					
Anethum graveolens L.	Thì là	Th				
Centella asiatica (L.) Urb.	Rau má	Ch				
Coriandrum sativum L.	Rau mùi	Th				
Eryngium foetidum L.	Mùi tàu	Ch				
Hydrocotyle sibthorpioides Lamk.	Rau má to	Ch				
Apocynaceae	**Họ Trúc đào**					
Alstonia scholaris (L.) R. Br.	Sữa	MM		LR		
Alyxia balansae Pit.	Dây ngôn	Lp				
Beaumontia grandifolia Wall.	Dây cao su	Lp				
Catharanthus roseus L.	Dừa cạn	Na			T	NGBE
Holarrhena antidesenterica (L.) Wall.	Mộc	Na				
Holarrhena pubescens Wall.	Mộc hoa trắng	Na				NSBE
Kibatalia anceps (Dunn & R. Williams) Woodson	Dùi đôi	Lp				
Kibatalia laurifolia (Ridl.) Woodson	Thần linh	Na				
Kibatalia macrophylla (Pierre) Woodson*	Ớt sừng lá lớn	Na				NSBE
Kitabalia microphylla (Pit.) Woodson*	Ớt sừng	Na				
Melodinus brachyphyllus Merr.	Dây cao su	Lp				
Paravallaris macrophylla Pierre ex Hua*	Mức trâu	MM				NGBE
Plumeria rubra L.	Đại	MM				
Pottsia laxiflora Kuntze	Bốt hoa thưa	Lp				
Rauvolfia serpentina Baill.*	Ba gạc đỏ	Na	CR		R	NSBE
Rauvolfia verticillata Baill.*	Ba gạc	Na	V		T	NSBE
Strophanthus caudatus (Burm. f.) Kurz*	Sừng trâu	Na				NSBE
Strophanthus divaricatus Hook. & Arn.	Sừng dê	Na				
Tabernaemontana bovina Lour.	Lài trâu	Na				

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Tabernaemontana pallida Pierre ex Pit.	Ớt rừng lá nhỏ	Na				
Tabernaemontana sp.	Ớt rừng	Na				
Trachelospermum axillare Hook. f.	Lạc thạch	Lp				NGBE
Wrightia annamensis Eberh. & Dub.*	Lòng mức trung bộ	MM				
Wrightia laevis Hook. f.*	Thừng mức trơn	MM		LR		
Wrightia tomentosa Roem. & Schult.*	Mức lông	MM				
Aquifoliaceae	**Họ Bùi**					
Ilex cymosa Champ.*	Vỏ rụt	MM				
Ilex macrocarpa Oliv.	Bùi quả to	MM				NSBE
Ilex rotunda Thunb.*	Nhựa ruồi	MM				
Araliaceae	**Họ Nhân sâm**					
Acanthopanax aculeatum Seem.	Ngũ ra bì	Na				
Aralia armata Seem.	Đơn châu chấu	Na				
Aralia toranensis Ha*	Cuồng	Na				
Polyscias fruticosa Harms	Đinh lăng	Na				
Schefflera alpina Grushv. & Skvortsova	Chân chim	MM				
Schefflera octophylla Harms*	Chân chim 8 lá	MM				
Schefflera pauciflora R. Vig.*	Chân chim	MM				
Schefflera tonkinensis Hook.*	Chân chim	MM				
Trevesia burkii Boerl.	Đu đủ rừng	Na				
Trevesia sp.	Đu đủ rừng	Na				
Asclepiadaceae	**Họ Thiên lý**					
Cryptolepis buchananii Roem. & Schott.	Dây càng cua	Lp				
Dischidia acuminata Costantin	Dây hạt bí	Lp				
Dischidia balansae Costantin	Song ly	Lp				
Dischidia sp.	Tai chuột	Ep				
Gymnema tingens Spreng.	Rau mơ	Lp				NGBE
Hoya villosa Costantin	Hoa sao	Ep				
Streptocaulon griffithii Hook.f.	Hà thủ ô trắng	Ch				

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Telosma cordata Merr.	Hoa thiên lý	Lp				
Asteraceae	**Họ Cúc**					
Ageratum conyzoides L.	Cứt lợn	Hm				
Artemisia annua L.	Thanh cao hoa vàng	Hm				
Artemisia japonica Thunb.	Ngải cứu rừng	Hm				NSBE
Artemisia vulgaris L.	Ngải cứu	Hm				
Bidens bipinnata L.	Đơn buốt	Hm				
Bidens pilosa L.	Đơn buốt	Hm				
Blumea aromatica DC.	Đại bi xanh	Ch				NSBE
Blumea balsamifera DC.	Đại bi	Ch				
Blumea lacera (Roxb.) DC.	Cúc trời	Hm				
Blumea lanceolaria Druce	Xương sông	Ch				
Blumea megacephala C.T. Chang & C.H.Yu.	Đại bi	Na				NSBE
Conyza canadensis (L.) Cronquist	Cúc dại	Hm				
Crossostephium chinense Makino	Nguyệt bạch	Ch				
Dichrocephala integrifolia Kuntze	Cúc mắt cá	Hm				NGBE
Eclipta prostrata L.	Nhọ nồi	Hm				
Elephantopus mollis Kunth	Chân voi mềm	Ch				
Elephantopus scaber L.*	Cúc chỉ thiên	Hm				
Elephantopus spicatus Aubl.*	Cúc chỉ thiên lông	Hm				
Emilia sonchifolia (L.) DC.	Rau má lá rau muống	Hm				
Erechtites hieraciifolia (L.) Raf. & DC.	Rau tàu bay rừng	Hm				
Erigeron crispus Pourr.*	Cúc hôi	Ch				
Eupatorium odoratum L.*	Cỏ lào	Ch				
Gnaphalium polycaulon Pers.	Rau khúc	Th				NGBE
Grangea sp.	Rau dại	Th				
Gynura barbaraefolia Gagnep.	Kim thất cải	Hm				
Gynura crepidioides Benth.	Rau tàu bay	Ch				
Gynura japonica (Thunb.) Juel.	Cúc tam thất	Hm				

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Gynura procumbens (Lour.) Merr.	Kim thất	Lp				
Gynura pseudochina (L.) DC.	Bầu đất	Ch				
Gynura sp.	Kim thất	Hm				
Gynura sp.1	Bầu đất	Hm				
Lactuca indica L.	Bồ công anh	Hm				
Lactuca roborowskii Maxim.	Diếp dại	Th				
Mikania cordata (Burm.f.) B.L.Rob.	Cúc leo	Lp				
Pluchea indica Less.	Cúc tần	Hm				
Sigesbeckia orientalis L.	Cỏ dĩ	Hm				
Spilanthes paniculata Wall.	Cúc nút áo	Hm				NGBE
Synedrella nodiflora Gaertn.	Cúc bọ xít	Hm				
Tagetes erecta L.	Vạn thọ	Ch				
Vernonia andersonii C.B.Clarke	Rau ráu	Lp				
Vernonia arborea Buch-Ham.	Bông bạc	MM				
Vernonia cinerea (L.) Less.	Cúc tím	Hm				
Vernonia cumingiana Benth.	Bông bạc	MM				
Vernonia sp.	Bạch đầu	Na				
Xanthium strumarium L.	Ké đầu ngựa	Ch				
Balsaminaceae	**Họ Bóng nước**					
Impatiens pygmaea Hook. f.	Bóng nước	Ch				
Impatiens verrucifer Hook.f.	Phượng tiên	Ch				
Impatiens sp.	Phượng tiên	Ch				
Basellaceae	**Họ Mồng tơ**					
Basella rubra L.	Mồng tơi	Th				
Begoniaceae	**Họ Thu hải đường**					
Begonia aptera Blume	Thu hải đường	Ch				
Begonia balansae Gagnep.	Thu hải đường	Ch				
Begonia lecomtei Gagnep.	Thu hải đường	Ch				
Begonia pierrei Gagnep.	Thu hải đường	Ch				
Begonia tonkinensis Gagnep.	Thu hải đường bắc bộ	Ch				NSBE

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Begonia sp.	Hải đường	Ch				
Betulaceae	**Họ Cáng lò**					NFBE
Betula alnoides Buch.-Ham.	Cáng lò	MM				NGBE
Bignoniaceae	**Họ Núc nác**					
Dolichandrone serrulata Seem.	Quao	MM		LR	R	
Fernandoa brilletii (P.Dop) Steenis*	Đinh thối	MM				
Markhamia stipulata Seem. ex Schum.*	Đinh	MM	V		E	
Markhamia cauda-felina (Hance) Craib*	Kè đuôi dông	MM				
Oroxylum indicum (L.) Benth. ex Kurz*	Núc nác	MM				
Stereospermum colais (Buch.-Ham. ex Dillwyn) Mabb.	Quao núi	MM				NGBE
Bombacaceae	**Họ Gạo**					
Bombax ceiba L.	Bông gạo	MM				
Gossampinus malabarica Merr.	Gạo	MM				
Boraginaceae	**Họ Vòi voi**					
Heliotropium indicum L.	Vòi voi	Hm				
Brassicaceae	**Họ Cải**					
Brassica chinensis L.	Cải bẹ trắng	Th				
Brassica integrifolia West.	Cải ngọt	Th				
Brassica juncea (L.) Czern.	Cải canh	Th				
Raphanus sativus L.	Cải củ	Th				
Rorippa dubia Pers.	Cải dại	Th				
Buddlejaceae	**Họ Bọ chó**					
Buddleja asiatica Lour.	Bọ chó	Na				
Burseraceae	**Họ Trám**					
Canarium album Rausch.*	Trám trắng	MM				
Canarium bengalense Roxb.*	Trám 3 cạnh	MM				
Canarium littorale Blume*	Trám hồng	MM		LR		NSBE
Canarium tonkinensis L.*	Trám chim	MM				
Canarium tramdenum Chan Din Dai & Yakovlev*	Trám đen	MM	V		R	
Garuga pinnata Roxb.*	Trám mao	MM				
Cactaceae	**Họ Long cốt**					
Epiphyllum oxypetalum Haw.	Quỳnh	Ch				
Caesalpiniaceae	**Họ Vang**					

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Bauhinia championii Benth.	Móng bò	Lp				
Bauhinia coccinea DC.*	Quạch	Lp				NSBE
Bauhinia mastipoda Pierre ex Gagnep.	Móng bò hoa đỏ	Lp				NSBE
Bauhinia ornata Kurz	Móng bò leo	Lp				
*Bauhinia sp.**	Móng bò	Lp				
*Bauhinia sp.1**	Dây máu	Lp				
*Bauhinia sp.2**	Móng bò	Lp				
Bauhinia variegata L.	Ban	MM				NSBE
Caesalpinia bonduc (L.) Roxb.	Móc mèo núi	Lp				
Caesalpinia mimosoides Lam.	Muồng trinh nữ	Lp				
Caesalpinia minax Hance	Vuốt hùm	Lp				
Caesalpinia pubescens (Desf.) Hatt.	Muồng dây	Lp				NSBE
Caesalpinia sappan L.	Vang	MM			R	
Cassia hirsuta (L.) Irwin & Barneby	Muồng hôi	MM				
Cassia mimosoides L.	Muồng trinh nữ	Na				
Cassia sp.	Muồng	Na				
*Cassia sp.1**	Muồng	MM				
Delonix regia (Bojer) Rafin.	Phượng	MM				
Gleditsia australis Hemsl.*	Bồ kết	MM				
Erythrophleum fordii Oliv.*	Lim xanh	MM			T	
Peltophorum dasyrrachis (Miq.) Kurz*	Lim vàng	MM				
Peltophorum tonkinensis Pierre*	Lim xẹt	MM			V	
Sacara dives Pierre*	Vàng anh	MM				
Senna occidentalis (L.) Link	Cốt khí	Na				
Senna siamea Lam.*	Muồng đen	MM			R	
Senna tora (L.) Roxb.*	Thảo quyết minh	Ch				
Sindora tonkinensis A. Chev.	Gụ lau	MM	EN		E	
Tamarindus indica L.	Me	MM				NGBE
Capparaceae	**Họ Màn màn**					
Capparis tonkinensis Gagnep.	Cáp	Lp				NSBE
Cleome gynandra L.	Màn màn	Ch				

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Crateva magna (Lour.) DC.*	Cây bún	MM				
Crateva religiosa Forst. f.	Bún	MM				
Stixis scandens Lour.	Trứng cuốc	Lp				
Stixis sp.	Trứng cuốc	Lp				
Caprifoliaceae	**Họ Kim ngân**					
Lonicera japonica Thunb.	Kim ngân	Ch				
Lonicera macrantha (D. Don) Spreng.	Kim ngân hoa to	Ch				
Sambucus javanica Reinw. ex Blume*	Cơm cháy	MM				
Viburnum lutescens Blume	Vót vàng	Na				NSBE
Viburnum sambucinum Reinw.*	Vót cơm cháy	Na				
Caricaceae	**Họ Đu đủ**					
Carica papaya L.	Đu đủ	Na				
Celastraceae	**Họ Chân danh**					
Celastrus annamensis Tardieu*	Gối Trung bộ	Lp				NGBE
Celastrus paniculatus Willd.*	Dây sang máu	Lp				NGBE
Euonymus laxiflorus Champ.	Chân danh	Na				
Glyptopetalum sclerocarpum (Kurz) M.A. Lawson*	Xâm cánh Bến En	MM			R	NSVN
Salacia verrucosa Wight*	Cộc màu	Na				
Chenopodiaceae	**Họ Rau muối**					
Chenopodium ficifolium Smith	Rau muối	Th				
Chloranthaceae	**Họ Hoa sói**					
Chloranthus erectus (Benth. & Hook.f.) Verdc.	Sói rừng	Na				
Clusiaceae	**Họ Bứa**					
Calophyllum calaba L.	Cồng tía	MM				
Calophyllum inophyllum L.*	Mù u	MM		LR	R	NSBE
Calophyllum membranaceum Gardn. & Champ.	Cồng	MM				
Cratoxylum polyanthum Korth.*	Thành ngạnh	MM				
Cratoxylum prunifolium Kurz*	Đỏ ngọn	Na				
Cratoxylum sp.	Lành ngành	Na				
Garcinia cochinchinensis (Lour.) Choisy*	Bứa nam bộ	MM				

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Garcinia cowa Roxb.	Tai chua	MM				
Garcinia multiflora Champ. ex Benth.	Dọc	MM				
Garcinia fagraeoides A. Chev.*	Trai lý	MM			E	
Garcinia oblongifolia Champ. ex Benth.*	Bứa	MM				NSBE
Garcinia sp.	Bứa	MM				
Combretaceae	**Họ Bàng**					
Combretum catappa L.	Bàng	MM				
Quisqualis indica L.	Dây giun	Lp				
Terminalia alata Roxb.*	Chiêu liêu	MM				
Terminalia bellirica (Gaertn.) Roxb.	Choại	MM				
Terminalia myriocarpa Van Heurck & Müll.Arg.*	Chò xanh	MM				
Connaraceae	**Họ Dây khế**					
Cnestis palala Merr.	Dây khế	Lp				
Rourea minor Leenh.	Khế rừng	Lp				
Convolvulaceae	**Họ Bim bim**					
Argyreia acuta Lour.	Bạc thau	Ch				
Ipomoea aquatica Forssk.	Rau muống	Lp				
Ipomoea batatas (L.) Lam.	Khoai lang	Lp				
Ipomoea cymosa (Desr.) Roem. & Schult.	Dây lang rừng	Lp				
Ipomoea quamoclit L.	Tóc tiên	Th				
Merremia boisiana (Gagnep.) Ooststr.	Bìm bìm	Lp				NSBE
Merremia sp.	Bìm bìm	Lp				
Crassulaceae	**Họ Thuốc bỏng**					
Kalanchoe integra Kuntze	Thuốc bỏng	Sp				
Kalanchoe pinnata (Lam.) Pers.	Thuốc bỏng	Sp				
Cucurbitaceae	**Họ Bầu bí**					
Benincasa hispida (Thunb.) Cogn.	Bí xanh	Th				
Coccinia grandis (L.) Voigt	Mảnh bát	Lp				
Cucumis sativus L.	Dưa chuột	Lp				
Cucurbita maxima Lam.	Bí đỏ	Lp				
Gymnopetalum sp.	Dây loa	Lp				
Gymnopetalum sp.1	Dây loa	Lp				
Hodgsonia macrocarpa Cogn.	Đại hái	Lp				

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Lagenaria siceraria (Molina) Standl.	Bầu	Th				
Luffa cylindrica M. Roem.	Mướp	Th				
Momordica charantia L.	Mướp đắng	Th				
Momordica cochinchinensis (Lour.) Spreng.	Gấc	Th				
Solena heterophylla Lour.	Dây mảnh bát	Th				
Trichosanthes cucumeroides Maxim.*	Dưa núi	Lp				
Zehneria indica (Lour.) M. Keraudren-Aymonin*	Dưa chuột dại	Lp				
Cuscutaceae	**Họ Tơ hồng**					
Cuscuta chinensis Lam.	Tơ hồng	Pp				
Daphniphyllaceae	**Họ Giao phương**					NFBE
Daphniphyllum calycinum Benth.*	Giao phương	MM				NGBE
Datiscaceae	**Họ Đăng**					
Tetrameles nudiflora R.Br.	Đăng	MM				
Dilleniaceae	**Họ Sổ**					
Actinidia latifolia Merr.	Đào khỉ	MM				
Dillenia heterosepala Finet & Gagnep.*	Lọng bàng	MM				
Dillenia indica L.*	Sổ	MM				
Dillenia pentagyna Roxb.*	Sổ 5 nhuỵ	MM				
Saurauia dillenioides Gagnep.*	Nóng sổ	MM				
Saurauia roxburghii Wall.*	Nóng	MM				NSBE
Saurauia tristyla DC.*	Nóng	MM				
Tetracera indica Merr.*	Chạc chìu	Lp				NSBE
Tetracera scandens Merr.	Chạc chìu	Lp				
Dipterocarpaceae	**Họ Dầu**					
Dipterocarpus retusus Blume	Chò nâu	MM	V		R	
Hopea chinensis (Merr.) Hand.-Mazz.*	Sao hòn gai	MM		CR		
Hopea hainanensis Merr. & Chun*	Sao hải nam	MM	EN		R	
Hopea mollissima C.Y. Wu*	Táu mặt quỷ	MM	V	CR	T	
Hopea odorata Roxb.	Sao đen	MM			R	
Parashorea chinensis Wang Hsie*	Chò chỉ	MM		EN	T	
Vatica harmandiana Pierre*	Táu xanh	MM		EN	R	
Vatica odorata (Griff.) Symington*	Táu lá nhỏ	MM			R	
Vatica subglabra Merr.	Táu nước	MM	EN		E	

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Ebenaceae	**Họ Thị**					
Diospyros apiculata Hiern*	Nhọ nồi	MM				
Diospyros crumenata Thwaites*	Thị đá	MM				NSBE
Diospyros decandra Lour.	Thị	MM				
Diospyros eriantha Champ. ex Benth.*	Thị lông đỏ	MM				NSBE
Diospyros hirsuta L.f.*	Thị rừng lông	MM				
Diospyros kaki L.f.	Hồng	MM				NSBE
Diospyros montana Roxb.*	Thị rừng	MM				
Diospyros morrisiana Hance	Hồng rừng	MM				
Diospyros pilosula (A.DC.) Walll. ex Hiern	Thị lông vàng	MM				
Diospyros rubra C.F.Gaertn.*	Thị rừng	MM				NSBE
*Diospyros sp.**	Thị rừng	MM				
*Diospyros sp.1**	Thị rừng	MM				
Diospyros sylvatica Roxb.*	Thị rừng	MM				NSBE
Elaeagnaceae	**Họ Nhót**					
Elaeagnus bonii Lecomte	Nhót	Lp				
Elaeagnus tonkinensis Serv.	Nhót nhà	Lp				
Elaeocarpaceae	**Họ Côm**					
Elaeocarpus apiculatus Mast.	Côm vòng	MM		CR	DD	NSBE
Elaeocarpus dubius Aug. DC.*	Côm tầng	MM				
Elaeocarpus hainanensis Oliver*	Côm hải nam	MM				NSBE
Elaeocarpus petiolatus (Jack) Wall.*	Côm cuống dài	MM				
Elaeocarpus sylvestris Poir.*	Côm trâu	MM				
Elaeocarpus varunua Buch.-Ham.*	Côm xanh	MM				NSBE
Ericaceae	**Họ Đỗ quyên**					NFBE
Craibiodendron henryi W.W. Sm*	Hoa bọt	MM				NGBE
Craibiodendron stellatum W.W. Sm.*	Hoa bọt	MM				NGBE
Rhododendron microphyton Franch.	Đỗ quyên	Na				NGBE
Euphorbiaceae	**Họ Thầu dầu**					
Acalypha hispida Burm.f.	Tai tượng đỏ	Na				
Actephila excelsa (Dalzell) Müll.Arg.	Da gà	Na				

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Alchornea annamica Gagnep.	Đom đóm trung bộ	Na				
Alchornea rugosa (Lour.) Müll.Arg.*	Sói dai	Na				
Alchornea tiliifolia Müll.Arg.*	Đom đóm	Na				NSBE
Alchornea trewioides Müll.Arg	Đom đóm	Na				
Aleurites moluccana (L.) Willd.	Lai	MM				
Antidesma acidum Retz.*	Chòi mòi	MM				
Antidesma ambiguum Pax & K. Hoffm.	Chòi mòi	Na				NSBE
Antidesma bunius (L.) Spreng.*	Chòi mòi bun	MM				
Antidesma cochinchinense Gagnep.*	Chòi mòi	MM				NSBE
Antidesma fruticosum Müll.Arg.	Chòi mòi bụi	Na				NSBE
Antidesma fleuryi Gagnep.*	Chòi mòi	MM				NSBE
Antidesma hainanensis Merr.*	Chòi mòi hải nam	MM				NSBE
Antidesma microphyllum Hemsl.	Chòi mòi	Na				NSBE
Antidesma montanum Blume*	Chòi mòi núi	MM				NSBE
Antidesma scandens Lour.*	Chòi mòi đất	MM				NSBE
*Antidesma sp.**	Chòi mòi	MM				
*Antidesma sp.1**	Chòi mòi	Na				
*Antidesma sp.2**	Chòi mòi	MM				
Antidesma tonkinensis Gagnep.	Chòi mòi bắc bộ	MM				NSBE
Antidesma velutinum Tul.*	Chòi mòi lông	MM				NSBE
Antidesma yunnanense Pax & K. Hoffm.	Chòi mòi vân nam	MM				NSBE
Aporosa dioica Müll.Arg.	Thẩu tấu	MM				
Aporosa macrophylla Müll.Arg.	Thẩu tấu	MM				NSBE
Aporosa microcalyx Hassk.*	Thẩu tấu	MM				NSBE
Aporosa sp.	Thẩu tấu	Na				
Aporosa yunnanensis (Pax & K. Hoffm.) F.P. Metcalf*	Thẩu tấu vân nam	MM				NSBE
Baccaurea ramiflora Lour.*	Dâu đất	MM				
Balakata baccata (Roxb.) Esser	Sòi núi	MM				
Bischofia javanica Blume*	Nhội	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Breynia angustifolia Hook.f.	Bồ cu vẽ lá hẹp	Na				NSBE
Breynia fleuryi Beille	Bồ cu vẽ	Na				
Breynia fruticosa Hook.f.	Bồ cu vẽ	Na				
Breynia rostrata Merr.	Bồ cu vẽ	Na				NSBE
Bridelia balansae Tutcher*	Đỏm gai	MM				
Bridelia minutiflora Hook.f.	Đỏm lông	MM				
Bridelia ovata Decne.	Đỏm	MM				
Bridelia tomentosa Blume	Đỏm	MM				NSBE
Chaetocarpus castanocarpus Thwaites*	Dạ nâu	MM				
Claoxylon indicum Hassk.*	Lộc mại	MM				
Claoxylon longifolium Baill.*	Lộc mại lá dài	MM				NSBE
Cleidion spiciflorum Merr.*	Mỏ chim	MM				
Cleistanthus petelotii Merr. ex Croizat*	Cọc rào	Na		V	DD	NSBE
Cleistanthus tonkinensis Blume	Cọc rào	Na				
Cnesmone tonkinensis Gagnep.	Bọ nẹt	Lp				
Croton joufra Roxb.	Bả đậu	MM				
Croton oblongifolius Roxb.	Bả đậu lá thuôn	MM				NSBE
Croton sp.	Bả đậu	Na				
Croton thorelii Gagnep.*	Bả đậu	MM				NSBE
Croton tiglium L.*	Bả đậu	MM				
Deutzianthus tonkinensis Gagnep.*	Mọ	MM		LR	DD	NGBE
Endospermum chinense Benth.*	Vạng trứng	MM				
Euphorbia antiquorum L.	Xương rồng	Sp				
Euphorbia hirta L.	Cỏ sữa	Hm				
Euphorbia pulcherrima Willd. ex Klotzsch	Trạng nguyên	Na				
Euphorbia thymifolia L.	Cỏ sữa lá nhỏ	Hm				
Euphorbia tirucalli L.	Xương khô	Na				
Excoecaria cochinchinensis Lour.*	Đơn xanh	Na				
Excoecaria cochinchinensis Lour. var. *cochinchinensis*	Đơn xanh	Na				NSBE
Flueggea virosa (Willd.) Voigt	Bỏng nổ	Na				
Glochidion annamense Beille	Bọt ếch	Na				NSBE

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Glochidion assamicum Hook.f.	Sóc	Na				NSBE
Glochidion balansae Beille	Bọt ếch	Na				NSBE
Glochidion daltonii Kurz	Bọt ếch thuốc	Na				NSBE
Glochidion hirsutum Voigt	Sóc lông	Na				
Glochidion lanceolarium Voigt*	Bọt ếch	Na				NSBE
Glochidion lutescens Blume	Bọt ếch vàng	Na				
Glochidion pilosum (Lour.) Merr.	Bọt ếch	Na				NSBE
Glochidion sp.	Bọt ếch	Na				
Glochidion sp.1	Bọt ếch	Na				
Glochidion thoreli Beille*	Sóc	Na				
Glochidion velutinum Wight*	Bọt ếch	Na				
Homonoia riparia Lour.	Rù rì	Na				
Hura crepitans L.	Vông đồng	MM				
Jatropha curcas L.	Dầu mè	MM				
Koilodepas longifolium Hook.f.*	Khổng	MM				
Macaranga auriculata (Merr.) Airy Shaw*	Lá nến	MM				NSBE
Macaranga denticulata Müll.Arg.*	Lá nến	MM				
Macaranga indica Wight	Lá nến sáp	Na				
Macaranga kurzii Pax & K. Hoffm.	Lá nến	Na				NSBE
Macaranga trichocarpa Müll.Arg.	Lá nến lông sao	Na				
Mallotus apelta Müll.Arg	Bục trắng	Na				
Mallotus barbatus Müll.Arg.	Bùm bụp	Na				
Mallotus cuneatus Ridl.	Ruối rừng	MM				NSBE
Mallotus decipiens Müll.Arg.	Ba bét	Na				NSBE
Mallotus floribundus Müll.Arg.*	Ba soi	Na				
Mallotus metcalfianus Croizat	Ba bét đỏ	Na				
Mallotus microcarpus Pax & K. Hoffm.*	Ba soi	MM				NSBE
Mallotus paniculatus (Lam.) Müll.Arg.*	Ba soi	MM				
Mallotus philippensis (Lam.) Müll.Arg.	Cánh kiến	MM				
Manihot esculenta Crantz	Sắn	Na				
Phyllanthus amarus Schum. & Thoms.	Me vị đắng	Na				
Phyllanthus emblica L.*	Me rừng	MM				
Phyllanthus reticulatus Poir.*	Phèn đen	Na				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Phyllanthus sp.	Phèn đen	Na				
Phyllanthus urinaria L.	Chó đẻ	Na				
Ricinus communis L.	Thầu dầu	Na				
Sapium discolor Müll.Arg.*	Sòi tía	MM				
Sauropus androgynus Merr.*	Rau ngót	Na				
Sauropus garrettii Craib	Rau ngót la to	Na				
Sauropus racemosus Beille	Rau ngót	Na				
Sauropus rostratus Miq.*	Ngót dai	Na				NSBE
Sauropus sp.	Rau ngót dai	Na				
Sebastiania chamaelea (L.) Müll.Arg.	Cỏ kỳ nhông	Th				
Securinega virosa (Willd.) Baill.	Bỏng nổ	Na				
Strophioblachia fimbricalyx Boerl.	Mồng sa	Na				NSBE
Suregada cicerosperma (Gagnep.) Croizat*	Kẹn son	Na				NSBE
Suregada multiflora Baill.*	Mần mây	Na				
Suregada sp.	Háo duyên	Na				
Trigonostemon bonianus Gagnep.	Tam tầng	Na				NGBE
Trigonostemon rubescens Gagnep.*	Tam tầng	Na				NGBE
Vernicia montana Lour.*	Trẩu	MM				
Fabaceae	**Họ Đậu**					
Abrus pulchellus Wall.	Cam thảo	Lp				NSBE
Abrus precatorius L.	Cam thảo dây	Lp				
Bowringia callicarpa Champ. ex Benth.	Dây bánh nem	Lp				
Cajanus scarabaeoides (L.) Thouars	Đậu tương dại	Lp				
Crotalaria ferruginea Scheele	Lục lạc	Ch				
Crotalaria montana Roxb.	Lục lạc núi	Ch				
Crotalaria pallida Aiton	Lục lạc trắng xanh	Ch				
Dalbergia balansae Prain*	Trắc	MM		V	R	
Dalbergia boniana Gagnep.*	Trắc bon	MM		DD	DD	NSBE
Dalbergia lanceolaria Moon*	Sưa vẩy ốc	Na				
Dalbergia obovata E. Mey.*	Sưa lá bé	MM				NSBE
Dalbergia tonkinensis Prain	Trắc thối	MM		V	E	
Derris elliptica Benth.*	Dây mật	Lp				

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Derris trifolia Lour.	Dây cốc	Lp				NSBE
Desmodium caudatum DC.	Thóc lép	Hm				
Desmodium gyroides DC.	Tràng hạt	Hm				
Desmodium heterocarpon (L.) DC.	Thóc lép	Hm				
Desmodium heterophyllum (Willd.) DC.	Hàn the	Hm				
Desmodium laxum DC.	Tràng hạt	Hm				
Desmodium podocarpum DC.	Thóc lép	Hm				NSBE
Desmodium sp.	Hàn the	Hm				
*Desmodium sp.*1	Tràng hạt	Hm				
Desmodium styracifolium Merr.	Vẩy rồng	Hm				
Desmodium velutinum DC.	Tràng hạt	Hm				
Erythrina fusca Lour.*	Vông đồng	MM				NSBE
Erythrina variegata L.	Vông nem	MM				
Flemingia grahamiana Wight & Arn.	Tóp mỡ	Ch				
Glycine sp.	Dầu vân	Na				
Indigofera hisuta L.*	Chàm	Na				
Indigofera tinctoria L.	Chàm nhuộm	Na				
Lablab purpureus (L.) Sweet	Đậu ván	Lp				
Millettia boniana Gagnep.*	Thàn mát lá bé	MM				NSBE
Millettia ichthyotona Drake*	Thàn mát	MM				
Millettia pachyloba Drake	Thàn mát dây	Lp				NSBE
Mucuna interrupta Gagnep.	Mắc mèo	Lp				
Ormosia balansae Drake*	Ràng ràng mít	MM				
Ormosia fordiana Oliver*	Ràng ràng hom	MM				
Ormosia henryi Prain*	Ràng ràng lông	MM				NSBE
Ormosia microphylla Merr.	Ràng ràng lá nhỏ	MM				
Ormosia pinnata (Lour.) Merr.*	Ràng ràng xanh	MM				
Ormosia sp.	Ràng ràng	MM				
Ormosia tonkinensis Gagnep.	Ràng ràng bắc bộ	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Pachyrhizus erosus (Lour.) Merr.	Củ đậu	Ch				NSBE
Pueraria montana (Lour.) Merr.	Sắn dây rừng	Lp				
Pueraria phaseoloides Benth.	Sắn dây	Lp				
Sophora japonica L.	Hoa hoè	MM				
Spatholobus suberectus Dunn*	Huyết rồng lào	Lp				NGBE
Tephrosia candida DC.	Cốt khí	Na				
Uraria crinita Desv.	Đuôi chồn	Na				
Vigna radiata (L.) Wilczek	Đậu xanh	Th				
Vigna unguiculata (L.) Walp.	Đậu đen	Th				
Fagaceae	**Họ Dẻ**					
Castanopsis annamensis Hance	Dẻ	MM				
Castanopsis boisii Hickel & A. Camus*	Dẻ bắc giang	MM				NSBE
Castanopsis cerebrina (Hickel & A. Camus) Barnett*	Sồi phảng	MM				NSBE
Castanopsis hystrix DC.*	Dẻ đỏ	MM	V		R	NSBE
Castanopsis indica A.DC.*	Cà ổi ấn độ	MM				
Castanopsis lecomtei Hickel & A. Camus*	Dẻ gai	MM	V		R	NSBE
Castanopsis sp.	Dẻ	MM				
Castanopsis tonkinensis Seemen*	Cà ổi bắc bộ	MM				NSBE
Lithocarpus areca (Hickel & A. Camus) A. Camus	Sồi	MM				
Lithocarpus bacgiangensis (Hickel &. A. Camus) A. Camus	Sồi bắc giang	MM	V		R	
Lithocarpus cornea Rehder*	Sồi ghè	MM				
Lithocarpus dealbata Rehder*	Dẻ lá bạc	MM				NSBE
Lithocarpus ducampii (Hickel & A. Camus) A.Camus	Sồi	MM				
Lithocarpus elegans (Blume) Hatus. ex Soepadmo*	Sồi đỏ	MM			R	
Lithocarpus hemisphaericus (Drake) Barnett	Sồi bán cầu	MM				
Lithocarpus pseudosundaicus (Hickel & A. Camus) A. Camus*	Dẻ xanh	MM				
Lithocarpus sp.	Dẻ	MM				
*Lithocarpus sp.1**	Dẻ	MM				

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Quercus acutissima Carruth.	Dẻ	MM				NSBE
Quercus bambusifolia Hance ex Miq.	Dẻ lá tre	MM				NSBE
Quercus chrysocalyx Carruth.*	Dẻ cuống	MM	V		R	NSBE
Quercus platycalyx Hickel & A. Camus*	Giẻ cau	MM	V		R	
*Quercus sp.**	Sồi	MM				
Flacourtiaceae	**Họ Bồ quân**					
Casearia flexuosa Craib	Thủ đào	MM				
Casearia velutina Blume	Thủ đào lông	MM				
Flacourtia balansae Gagnep.*	Mùng quân	MM				
Flacourtia indica Merr.*	Mùng quân	MM				NSBE
Flacourtia jangomas Raeusch.*	Mùng quân trắng	MM				NSBE
Hydnocarpus anthelmintica Pierre*	Khổng trắng	MM				
Hydnocarpus hainanensis (Merr.) Sleumer	Nang trứng hải nam	MM		V		NSBE
Hydnocarpus kurzii Warb.*	Nang trứng	MM				
Hydnocarpus serrata Warb.*	Nang trứng	MM				
Hydnocarpus sp.	Nang trứng	MM				
Gesneriaceae	**Họ Thượng tiền**					NFBE
Beccarinda tonkinensis (Pellegr.) B.L. Burtt*	Thượng tiền	Ch				NGBE
Hamamelidaceae	**Họ Sau sau**					
Liquidambar formosana Hance*	Sau Sau	MM				
Mytilaria laosensis Lecomte	Sau sau lào	MM				
Symingtonia tonkinensis (Lecomte) Steenis	Chắp tay	MM			DD	
Hernandiaceae	**Họ Liên đằng**					
Illigera celebica Miq.	Liên đằng	Lp				
Hydrangeaceae	**Họ Thường sơn**					
Dichroa febrifuga Lour.*	Thường sơn	Na				
Dichroa hirsuta Gagnep.	Thường sơn lông	Na				
Icacinaceae	**Họ Thụ đào**					
Gomphandra hainanensis Merr.*	Bổ béo hải	Na				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	nam					
Gomphandra petelotii Merr.*	Bổ béo	Na				NSBE
Gomphandra tonkinensis Gagnep.*	Bổ béo bắc bộ	Na				
Nothapodytes sp.	Gian thiểu	Na				
Ixonanthaceae	**Họ Hà nu**					
Ixonanthes cochinchinensis Pierre*	Hà nu	MM				
Ixonanthes reticulata Jack	Hà nu	MM				NSBE
Juglandaceae	**Họ Hồ đào**					
Annamocarya sinensis (Dode) J.-F. Leroy*	Chò đãi	MM	EN	EN	E	
Engelhardtia chrysolepsis Hance*	Chẹo tía	MM				
Engelhardtia roxburghiana Wall.	Chẹo trắng	MM				
*Engelhardtia sp.**	Chẹo	MM				
Pterocarya tonkinensis Dode	Cơi	MM				
Lamiaceae	**Họ Hoa môi**					
Acrocephalus indicus Kuntze	Nhân trần	Th				
Anisomeles ovata R.Br.	Cứt lợn	Ch				
Elsholtzia blanda H. Keng	Kinh giới dại	Th				
Elsholtzia ciliata (Thunb. ex Murray) Hyl.	Kinh giới	Th				
Gomphostemma parviflorum Wall.	Hoa môi	Ch				NSBE
Hyptis rhomboidea M.Martens & Galeotti	Ké	Hm				
Hyptis suaveolens (L.) Poit.	Tía tô dại	Hm				
Leonurus sibiricus L.	Ích mẫu	Ch				
Leucas sp.	Tổ ong	Hm				
Mentha crispa L.	Húng	Hm				
Mosla cavaleriei H. Lév.	Hương nhu	Th				
Ocimum basilicum L.	Húng quế	Th				
Ocimum tenuiflorum L.	Hương nhu tía	Th				
Perilla frutescens (L.) Britton	Tía tô	Th				
Perilla ocymoides L.	Tía tô dại	Th				
Plectranthus amboinicus (Lour.) Spreng.	Húng chanh	Th				
Salvia miltiorhiza Bunge	Kinh giới dại	Th				NGBE
Lauraceae	**Họ Long**					

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	não					
Actinodaphne obovata (Nees) Blume*	Song xanh	MM			T	NSBE
Actinodaphne pedunculata Meisn.*	Bạc tán	MM				NSBE
Actinodaphne pilosa (Lour.) Merr.	Đầu mầu	MM				
Beilschmiedia balansae Lecomte*	Bạc tán xanh	MM				NSBE
Beilschmiedia ferruginea H. Liou*	Chắp xanh	MM				NSBE
Beilschmiedia fordii Dunn*	Chắp	MM				
Beilschmiedia pergamentacea C.K.Allen*	Chắp xanh	MM				
Beilschmiedia poilanei Liou*	Chắp	MM				
Beilschmiedia sp.	Bạc tán	MM				
Caryodaphnopsis tonkinensis (Lecomte) Airy Shaw	Cà lồ	MM				
Cassytha filiformis L.	Tơ xanh	Ep				
Cinnamomum balansae Lecomte	Vù hương	MM	V	EN	E	
Cinnamomum bejolghota (Buch.-Ham.) Sweet*	Quế lợn	MM				
Cinnamomum camphora (L.) Presl	Long não	MM				
Cinnamomum cassia Blume	Quế	MM				
Cinnamomum ilicioides A. Chev.*	Re gừng	MM				
Cinnamomum impressineurium Meissn.	Re gân lõm	MM				
Cinnamomum iners Reinw. ex Blume*	Re hương	MM				
Cinnamomum ovatum Lukman	Re rừng	MM				
Cinnamomum sp.	Re bắc bộ	MM				
Cryptocarya annamensis C.K. Allen*	Mò lông lá lớn	MM				NSBE
Cryptocarya chinensis Hemsl.*	Mò trung hoa	MM				NSBE
Cryptocarya concinna Hance	Mò quả vàng	MM				
Cryptocarya ferrea Blume*	Mò cứng	MM				
Cryptocarya hainanensis Merr.*	Mò hải nam	MM				NSBE
Cryptocarya impressa Miq.*	Mò quả lớn	MM				NSBE
Cryptocarya lenticellata Lecomte*	Nanh chuột	MM				
Cryptocarya maclurei Merr.*	Mò lá bạc	MM				NSBE
Cryptocarya metcalfiana C.K. Allen*	Mò hương	MM				NSBE
Cryptocarya obtusiflora Merr.	Mò lá tròn	MM				
*Cryptocarya sp.**	Mò	MM				
Endiandra hainanensis Merr. & Metc.	Vừ	MM	EN		R	

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Lindera aggregata (Sims) Kosterm.*	Ô đước	MM				NSBE
Lindera racemosa Lecomte*	Lòng trứng	MM				
Lindera tonkinensis Lecomte*	Lòng trứng bắc bộ	MM				NSBE
Litsea balansae Lecomte*	Bời lời	MM				
Litsea baviensis Lecomte	Bời lời ba vì	MM				
Litsea cubeba Pers.*	Màng tang	MM				
Litsea glutinosa (Lour.) C.B. Rob.*	Bời lời nhớt	MM				
Litsea griffithii Gamble	Bời lời	MM				
Litsea impressa Boerl.*	Bời lời	MM				NSBE
Litsea lancifolia Hook. f.	Bời lời lá mác	MM				
Litsea mollifolia Chun*	Bời lời lông	MM				NSBE
Litsea monopetala Pers.*	Bời bời lá tròn	MM				
Litsea pierrei Lecomte*	Bời lời lecom	MM				
Litsea rotundifolia Hemsl.*	Bời lời lá tròn	MM				
*Litsea sp.**	Bời lời	MM				
Litsea umbellata Merr.*	Bời lời	MM				
Litsea verticillata Hance*	Bời bời lá vòng	MM				
Litsea yunnanensis Yang & P.H. Hoang	Bời lời vân nam	MM				NSBE
Machilus bonii Lecomte*	Kháo vàng	MM				
Machilus chinensis Hemsl.*	Kháo trung hoa	MM				
Machilus grandifolia S.K. Lee & F.N. Wei*	Kháo lá lớn	MM				NSBE
Machilus hainanensis Merr.	Kháo hải nam	MM				
Machilus odoratissimus Nees*	Kháo thơm	MM				
Machilus platycarpa Chun*	Kháo cuống dài	MM				NSBE
Machilus sp.	Kháo	MM				
Machilus sp.1	Kháo	MM				
Machilus velutina Champ. ex Benth.*	Kháo lông	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Neocinnamomum lecomtei H. Liou	Re mới	MM				NSBE
Neolitsea angustifolia A. Chev.	Re mới	MM				
Neolitsea poilanei H. Liou*	Re mới lá to	MM				
Phoebe macrocarpa C.Y. Wu*	Kháo quả to	MM	V		R	
Phoebe paniculata Nees*	Kháo nước	MM			T	NSBE
Phoebe tavoyana Hook.f.	Kháo lá to	MM				
Phoebe sp.	Kháo	MM				
Leeaceae	**Họ Gối hạc**					
Leea indica Merr.	Gối hạc đen	Na				
Leea manillensis Walp.	Gối hạc	Na				
Leea rubra Blume	Gối hạc	Na				
Lecythicaceae	**Họ Lộc vừng**					NFBE
Barringtonia acutangula (L.) Gaertn.	Lộc vừng	MM				NGBE
Loganiaceae	**Họ Mã tiền**					
Gelsemium elegans Benth.	Lá ngón	Lp				
Strychnos angustifolia Benth.*	Mã tiền	MM				
Strychnos nitida G. Don	Mã tiền	Lp	EN		DD	
Strychnos umbellata Merr.*	Mã tiền dây	Lp	V		DD	
Loranthaceae	**Họ Tầm gửi**					
Dendrophthoe pentandra (L.) Miq.*	Tầm gửi	Ep				
Elytranthe albida Blume	Tầm gửi	Ep	V			
Scurrula ferruginea Danser	Tầm gửi sét	Ep				
Lythraceae	**Họ Bằng lăng**					
Lagerstroemia calyculata Kurz*	Bằng lăng	MM			R	
Lagerstroemia speciosa Pers.	Bằng lăng tím	MM				
Lagerstroemia tomentosa C. Presl	Săng lẻ	MM				
Punica granatum L.	Lựu	MM				NGBE
Magnoliaceae	**Họ Mộc lan**					
Magnolia coco DC.*	Hoa trứng gà	MM				
Magnolia fistulosa Dandy	Mộc lan rừng	MM				
Manglietia conifera Dandy	Mỡ	MM			R	
Manglietia fordiana Oliver*	Vàng tâm	MM	V		R	
Manglietia insignis Blume	Mỡ đá	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Michelia alba DC.	Ngọc lan	MM				NSBE
Michelia balansae Dandy*	Giổi bà	MM	V			
Michelia champaca L.	Ngọc lan hoa vàng	MM				
Michelia foveolata Merr.	Giổi nhung	MM				
Michelia mediocris Dandy*	Giổi xanh	MM			R	
Michelia tonkinensis A. Chev.*	Giổi bắc	MM			R	
Malvaceae	**Họ Bông**					
Abelmoschus moschatus Medik.	Bông vàng	Ch				
Abutilon indicum (L.) Sweet	Cối xay	Na				
Hibiscus grewiaefolius Hassk.	Bụt cò ke	Na				
Hibiscus rosa-sinensis L.	Dâm bụt	Na				
Hibiscus sp.	Bông	MM				
Kydia calycina Roxb.*	Ong bù	MM				
Sida acuta Burm.	Ké	Na				
Sida rhombifolia L.	Ké hoa vàng	Na				
Urena lobata L.	Ké hoa đào	Na				
Melastomataceae	**Họ Mua**					
Blastus cochinchinensis Lour.*	Mua rừng	Na				
Medinilla assamica (C.B. Clarke) C. Chen	Mua chua	Na				
Melastoma candidum D. Don*	Mua bà	Na				
Melastoma normale D. Don	Mua	Na				
Melastoma sanguineum Sims	Mua máu	Na				
Melastoma septemnervium Merr.*	Mua đồi	Na				
Melastoma sp.	Mua đồi	Na				
Memecylon edule Roxb.*	Sầm si	Na				
Memecylon fruticosum King	Sầm	Na				
Memecylon scutellatum A.Chev.*	Sầm núi	Na				NSBE
Osbeckia truncata D. Don ex Wight & Arn.	Mua tép	Na				
Meliaceae	**Họ Xoan**					
Aglaia edulis Gray*	Gội dịu	MM				
Aglaia odorata Lour.*	Ngâu	MM		LR		
Aglaia perviridis Hiern	Gội tẻ	MM		V		
Aglaia roxburghiana Miq.	Gội núi	MM				NSBE
Aglaia silvestris Merr.	Gội	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Aglaia spectabilis (Miq.) S.S. Jain & Bennet*	Gội nếp	MM	V	LR	T	
*Aglaia sp.**	Gội	MM				
Aglaia tomentosa Teijsm. & Binn.	Gội lông	MM		LR		NSBE
Aphanamixis grandiflora Blume*	Gội trắng	MM			T	
Azadirachta indica A. Juss.	Sầu đâu	MM				
Chisocheton chinensis Merr.*	Quếch tía	MM				
*Chisocheton sp.**	Quếch	MM				
Chisocheton thorelii Pierre	Quếch	MM				
Chukrasia tabularis A. Juss.	Lát hoa	MM	V	LR		
*Cipadessa sp.**	Cà muối	MM				
Dysoxylum acutangulum Miq.	Chua khét	MM				
Dysoxylum cauliflorum Hiern*	Đinh hương	MM	V		T	
Dysoxylum tonkinensis A. Chev.*	Chặt khế	MM				
Khaya senegalensis A. Juss.	Xà cừ	MM				
Melia azedarach L.	Xoan	MM				
Toona sureni Merr.*	Trương vân	MM			R	NGBE
Menispermaceae	**Họ Tiết dê**					
Anamirta cocculus Wight & Arn.	Nhai đằng	Lp				
Cissampelos pareira L.	Tiết dê	Lp			R	
Coscinium fenestratum Colebr.	Vằng đắng	Lp			E	NSBE
Fibraurea recisa Pierre*	Hoàng đằng	Lp			T	
Fibraurea tinctoria Lour.	Hoàng đằng	Lp				
Pericampylus glaucus Merr.*	Lõi tiền	Lp				
Pycnarrhena poilanei (Gagnep.) Forman	Phi đằng	Lp				NSBE
Stephania hernandiifolia (Willd.) Walp.	Cam thảo	Lp				
Stephania longa Lour.	Lõi tiền	Lp			R	
Stephania rotunda Lour.	Củ bình vôi	Lp			R	
Tinospora sp.	Dây cóc	Lp				
Tinospora tomentosa Miers	Dây đau xương	Lp				
Mimosaceae	**Họ Trinh nữ**					
Acacia auriculaeformis A. Cunn. ex Benth.	Keo lá tràm	MM				
Acacia confusa Merr.	Đài loan tương tư	MM				

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Acacia farnesiana (L.) Willd.	Keo ta	MM				
Acacia mangium Willd.	Keo tai tượng	MM				
Acacia pennata (L.) Willd.	Sống rắn	Lp				NSBE
Adenanthera microsperma Teijsm. & Binn.*	Muồng Ràng Ràng	MM				
Albizia corniculata (Lour.) Druce	Sống rắn	Na				
Albizia lucida Benth. *	Bản xe	MM			R	
Archidendron balansae (Oliver) I.C. Nielsen*	Phân mã lá lớn	MM				NSBE
Archidendron chevalieri(Kosterm.) I.C. Nielsen*	Phân mã	MM				
Archidendron clypearia (Jack) I.C. Nielsen*	Mán đỉa	MM				
Archidendron kerrii (Gagnep.) I.C. Nielsen	Mán đỉa	MM				NSBE
Archidendron lucidum (Benth.) I.C. Nielsen*	Mán đỉa trâu	MM				
Entada phaseoloides (L.) Merr.	Bằm bằm	Lp				
Leucaena leucocephala (Lam.) de Wit	Keo dậu	MM				
Mimosa diplotricha Wright	Trinh nữ	Lp				
Mimosa pigra L.	Mai Dương	Na				
Mimosa pudica L.	Trinh nữ thẹn	Ch				
Moraceae	**Họ Dâu tằm**					
Antiaris toxicaria Lesch.*	Sui	MM				
Artocarpus heterophyllus Lam.	Mít	MM				
Artocarpus styracifolius Pierre	Chay lá bồ đề	MM				
Artocarpus tonkinensis A. Chev.	Chay	MM				
Broussonetia papyrifera Vent.*	Dướng	MM				
Ficus annulata Blume*	Đa quả xanh	MM				
Ficus auriculata Lour.*	Vả	MM				
Ficus benjamina L.	Si	MM				
Ficus capillipes Gagnep.	Vú bò	Na				NSBE
Ficus curtipes Corner	Đa	MM				NSBE
Ficus fistulosa Reinw. ex Blume*	Ngoã	MM				
Ficus fulva Elmer	Ngoã lông	MM				
Ficus glaberrima Blume	Sung	MM				NSBE
Ficus heterophylla L. f.	Vú bò	Na				
Ficus hirta Vahl*	Ngái lông	MM				

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Ficus hispida L. f.*	Ngái	MM				
Ficus lacor Buch.-Ham.*	Đa	MM				
Ficus laevis Blume*	Sung lá bóng	MM				NSBE
Ficus macrophylla Roxb.*	Đa lá lớn	MM				
Ficus nervosa Roth*	Đa rừng	MM				
Ficus pumila L.*	Sộp	MM				
Ficus racemosa L.*	Sung	MM				
Ficus retusa L.	Đa	MM				NSBE
*Ficus sp.**	Đa	MM				
*Ficus sp.1**	Đa	MM				
Ficus vasculosa Wall.	Vỏ mãn	MM				
Maclura cochinchinensis (Lour.) Corner	Mỏ quạ	Lp				
Morus alba L.	Dâu tằm	Na				
Morus macroura Miq.	Dâu quả dài	MM				
Streblus asper Lour.	Ruối	MM				
Streblus indicus (Burm.) Corner*	Ruối ô rô	MM				
Streblus macrophylla Blume*	Mạy tèo	MM				
Teonongia tonkinensis Stapf*	Teo nồng	MM				
Myristicaceae	**Họ Máu chó**					
Horsfieldia amygdalina (Wall.) Warb.*	Săng máu	MM				
Knema conferta Warb.*	Máu chó lá nhỏ	MM				
Knema elegans Warb.	Máu chó	MM				
Knema pierrei Warb.*	Máu chó lá to	MM		V	R	NSBE
Knema tonkinensis (Warb.) W.J. de Wilde	Máu chó bắc bộ	MM				
Myristica fragrans Houtt.	Đậu khấu	MM				NGBE
Myristica yunnanensis Y.H. Li*	Đậu khấu Bến En	MM			R	NSVN
Myrsinaceae	**Họ Đơn nem**					
Ardisia crenata Sims.	Trọng đũa	MM				
Ardisia lecomtei Pit.*	Trọng đũa gỗ	MM				
Ardisia quinquegona Blume*	Trọng đũa	Na				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	tuyến					
Ardisia replicata Walker*	Trọng đũa núi	MM				NSBE
Ardisia rubescens Pit.	Cơm nguội	Na				NSBE
Ardisia silvestris Pit.	Lá khôi tím	Na	V		E	
Ardisia sp.	Trọng đũa	Na				
Ardisia yunnanensis Mez	Trọng đũa Vân Nam	Na				NSBE
Embelia acuminata Merr.	Chua ngút	Lp				
Embelia laeta Mez	Ngút trắng	Lp				
Embelia oblongifolia (Benth.) Hemsl.	Chua ngút lá dài	Lp				
Embelia ribes Burm.f.	Chua ngút	Lp				
Maesa balansae Mez	Đơn nem	Na				
Maesa indica Wall.	Đơn nem răng cưa	Na				
Maesa perlarius (Lour.) Merr.*	Đơn nem	Na				NSBE
Maesa sinensis A.DC.	Đơn nem	Na				
Maesa sp.	Đơn nem	Na				
Myrtaceae	**Họ Sim**					
Baeckea frutescens L.	Thanh hao	Na				NSBE
Cleistocalyx operculatus Merr. & L.M. Perry*	Trâm vối	MM				
Eucalyptus camaldulensis Dehnh.	Bạnh đàn trắng	MM				
Eucalyptus exserta F. Müll.	Bạnh đàn liễu	MM				
Psidium guajava L.	Ổi	MM				
Rhodomyrtus tomentosa Hassk.	Sim	Na				
Syzygium attopeuense (Gagnep.) Merr. & L.M. Perry	Rì rì	Na				
Syzygium brachiatum Miq.*	Trâm	MM				
Syzygium chanlos (Gagnep.) Merr. & L.M. Perry*	Trâm trắng	MM				
Syzygium chloranthum (Duthie) Merr. & L.M. Perry	Gioi dại	MM				
Syzygium hancei Merr. & L.M. Perry*	Trâm	MM				NSBE
Syzygium jambos (L.) Alston*	Gioi	MM				
Syzygium levinei (Merr.) Merr.*	Trâm núi	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Syzygium polyanthum Walp.*	Sắn thuyền	MM				
*Syzygium sp.**	Trâm thơm	MM				
*Syzygium sp.1**	Trâm	MM				
Syzygium tonkinense (Gagnep.) Merr. & L.M. Perry*	Trâm bắc bộ	MM				
Syzygium wightianum Wall.*	Trâm trắng	MM				
Syzygium zeylanicum (L.) DC.*	Trâm tía	MM				
Nyctaginaceae	**Họ Hoa giấy**					
Bougainvillea spectabilis Willd.	Hoa giấy	Lp				
Ochnaceae	**Họ Mai vàng**					
Ochna integerrima (Lour.) Merr.*	Mai vàng	MM				
Olacaceae	**Họ Rau bù khai**					
Erythropalum scandens Blume	Bù khai	Lp				
Oleaceae	**Họ Nhài**					
Jasminum longipetalum King & Gamble	Nhài lá ngắn	Na				
Jasminum nervosum Lour.*	Chè vằng	Lp				
Jasminum sambac (L.) Ait.	Nhài	Na				
Jasminum scandens Vahl	Lài leo	Lp				
Jasminum subtriplinerve Blume	Vằng	Lp				
Jasminum undulatum Willd.	Vằng lông	Lp				
Ligustrum indicum (Lour.) Merr.	Râm	Na				
Linociera sangda Gagnep.	Vằng	Na				NSBE
Osmanthus fragrans Lour.*	Nhài	Na				
Osmanthus matsumuranus Hayata*	Vỏ sạn lá dài	MM				
Osmanthus pendunculatus Gagnep.*	Vỏ sạn	MM				
Osmanthus sp.	Nhài rừng	MM				
Onagraceae	**Họ Rau mương**					
Ludwigia adscendens (L.) H. Hara	Rau dừa nước	Cr				
Ludwigia octovalvis (Jacq.) P.H. Raven	Rau mương	Cr				
Opiliaceae	**Họ Rau sắng**					
Cansjera rheedei J.F. Gmel.	Sắng	MM				NGBE

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Meliantha suavis Pierre*	Rau sắng	MM	V		R	
Oxalidaceae	**Họ Chua me**					
Averrhoa carambola L.*	Khế	MM				
Biophytum sensitivum (L.) DC.	Chua me đất	Ch				
Oxalis corniculata L.	Chua me	Ch				
Pandaceae	**Họ Chẩn**					
Microdesmis casearíaefolia Planch. ex Hook.*	Chẩn	MM				
Passifloraceae	**Họ Lạc tiên**					
Passiflora foetida L.	Lạc tiên	Lp				
Pentaphragmataceae	**Họ Rau tai voi**					
Pentaphragma sinense Hemsl. & E.H. Wilson	Rau tai voi	Hm				
Piperaceae	**Họ Hồ tiêu**					
Peperomia pellucida Kunth.	Rau càng cua	Th				
Piper betle L.	Trầu không	Lp				
Piper bonii C.DC.*	Tiêu lông	Lp				NSBE
Piper lolot C.DC.	Lá lốt	Hm				
Piper nigrum L.	Tiêu rừng	Ep				
Piper sp.	Tiêu rừng	Lp				
Plantaginaceae	**Họ Mã đề**					
Plantago asiatica L.	Mã đề	Hm				
Plantago major L.	Mã đề	Hm				
Polygalaceae	**Họ Viễn chí**					
Polygala tonkinensis Chodat	Viễn chí	Na				
Xanthophyllum sp.	Săng ớt	MM				
Polygonaceae	**Họ Rau răm**					
Persicaria hydropiper (L.) Spach	Nghể răm	Th				
Polygonum barbatum L.	Nghể râu	Hm				NSBE
Polygonum chinense L.	Mía giò	Lp				
Polygonum multiflorum Thunb.	Hà thủ ô	Lp	V		V	
Polygonum odoratum Lour.	Rau răm	Hm				
Polygonum orientale L.	Nghể	Hm				
Portulacaceae	**Họ Rau sam**					

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Portulaca grandiflora Hook.	Hoa mười giờ	Th				
Portulaca oleracea L.	Rau sam	Th				
Proteaceae	**Họ Quắn hoa**					
Helicia bullata Sleumer*	Mạ sưa răng cưa	MM				NSBE
Helicia cochinchinensis Lour.*	Cơm vàng	MM				
Helicia hainanensis Hayata	Mạ sưa hải nam	MM				
Helicia obovatifolia Merr. & Chun*	Mạ sưa	MM				NSBE
*Helicia sp.**	Mạ sưa	MM				
Helicia tonkinensis Lecomte*	Mạ sưa bắc bộ	MM				NSBE
Heliciopsis lobata (Merr.) Sleumer	Mạ sưa	MM				
Heliciopsis sp.	Mạ sưa rừng	MM				
Ranunculaceae	**Họ Mao cấn**					
Clematis buchaniana DC.	Dây ông lão	Lp				
Rhamnaceae	**Họ Táo ta**					
Berchemia lineata (L.) DC.	Dây sâm	Lp				
Gouania leptostachya DC.	Dây đòn gánh	Lp				
Ziziphus funiculosa Buch.-Ham. ex Wall.	Táo dại	Na				
Ziziphus mauritiana Lam.	Táo nhà	MM				
Ziziphus oenoplia (L.) Mill.	Táo dại	Na				
Rhizophoraceae	**Họ Đước**					
Carallia brachiata (Lour.) Merr.*	Trúc tiết	MM				
Carallia lucida Roxb.	Răng cá	MM				
Rosaceae	**Họ Hoa hồng**					
Duchesnea indica (Andrews) Focke	Dâu núi	Na				NGBE
Eriobotrya deflexa Nakai*	Tì bà	Na				NSBE
Eriobotrya japonica (Thunb.) Lindl.*	Tì bà	Na				NSBE
Persica vulgaris Mill.	Đào	MM				NGBE
Prunus arborea (Blume) Kalkman*	Xoan đào	MM				
Prunus armeniana L.	Mơ	MM				
Prunus fordiana Dunn*	Vỏ hôi	MM				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Prunus salicina Lindl.	Mận	MM				
Prunus sp.	Xoan đào rừng	MM				
Prunus zippeliana Miq.*	Da bò	MM				
Rhaphiolepis indica (L.) Lindl.	Bánh xe	MM				
Rosa chinensis Jacq.	Hoa hồng	Na				
Rubus alcaefolius Poir.	Mâm xôi	Lp				
Rubus cochinchinensis Tratt.	Ngấy	Lp				
Rubus leucanthus Hance	Mâm xôi	Lp				
Rubiaceae	**Họ Cà phê**					
Aidia acuminatissima (Merr.) Masam.*	Mãi táp lông	MM				NSBE
Aidia cochinchinensis Lour.*	Mãi táp	MM				NSBE
Aidia oxyodonta (Drake) Yamaz.*	Găng nhọn	MM				
Aidia pycnantha (Drake) Tirveng.*	Mãi táp	MM				
*Aidia sp.**	Mãi táp	Na				
Aidia spicata (Valeton) Tirveng.*	Mãi táp	MM				
Canthium dicoccum Merr.*	Xương cá	MM	V		R	
Canthium horridum Blume	Găng gai	Na				
*Canthium sp.**	Găng cơm	Na				
Catunaregam spinosa (Thunb.) Tirveng.	Găng trâu	Na				
Gardenia philastrei Pierre ex Pit.	Dành dành	Na				NSBE
*Gardenia sp.**	Dành dành	Na				
Hedyotis capitellata Wall.*	Dạ cẩm	Lp				
Hedyotis hispida Retz.	Dạ cẩm lông	Na				NSBE
Ixora balansae Pit.	Đơn núi	Na				NSBE
Ixora chinensis Lam.	Mẫu đơn	Na				
Ixora coccinea L.	Đơn đỏ	Na				
Ixora sp.	Mẫu đơn	Na				
Ixora sp.1	Mẫu đơn	Na				
Lasianthus calycinus Dunn	Chìa vôi	Na				
*Lasianthus sp.**	Chìa vôi	Na				
Morinda citrifolia L.	Mặt qui	Lp			R	
Morinda officinalis F.C. How	Ba kích	Lp			E	
Morinda tomentosa Heyne	Nhàu lông	Lp				NSBE
Morinda umbellata L.	Mặt qui	Lp				
Mussaenda cambodiana Pierre ex Pit.	Bướm bạc	MM				

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Mussaenda macrophylla Wall.	Bướm bạc lá to	MM				
Mussaenda pubescens W.T. Aiton	Bướm bạc lông	MM				
Mussaenda sp.	Bướm bạc	Na				
Neolamarckia cadamba (Roxb.) J. Bosser	Gáo	MM				
Neonauclea calycina Merr.	Vàng kiêng	MM				
Neonauclea purpurea (Roxb.) Merr.	Vàng kiêng	MM				
Neonauclea sessilifolia Merr.	Gáo vàng	MM				
Oldenlandia sp.*	Dạ cẩm	Ch				
Paederia foetida L.	Mơ	Lp				
Pavetta graciliflora Wall.	Xương gà	MM				
Psychotria fleuryi Pit.	Lấu	Na				NSBE
Psychotria montana Blume*	Lấu núi	Na				NSBE
Psychotria rubra Poit.	Lấu	Na				
*Psychotria sp.**	Lấu	Na				
*Psychotria sp.1**	Lấu	Na				
Randia acuminatissima Merr.*	Mãi táp	MM				
Randia eucodon K. Schum.*	Mãi táp	MM				NSBE
Randia macrophylla Pit.*	Mãi táp lá to	MM				
Randia oxyodonta Drake*	Găng	Na				NSBE
Randia pycnantha Drake*	Mãi táp	Na				NSBE
*Randia sp.**	Găng	Na				
Randia spinosa Loes.*	Mãi táp	MM				
Tarenna latifolia Pit.	Trèn lá to	Na				NGBE
Tarenna sp.	Trèn	Na				
Timonius arborea Elmer*	Găng Bến En	Na			R	NSVN
Uncaria homomalla Miq.	Vuốt đồng	Lp				
Uncaria macrophylla DC.	Câu đằng lá to	Lp				
Uncaria scandens Hutch.	Vuốt leo	Lp				
Uncaria sp.	Câu đằng	Lp				
Urophyllum sp.	Lá đuôi	MM				
Urophyllum streptophodium Wall.*	Lá đuôi	MM				
Urophyllum villosum Jack & Wall.	Lá đuôi lông	MM				NSBE

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Wendlandia glabrata DC.	Hoắc quang trắng	MM				NSBE
Wendlandia paniculata DC.*	Hoắc quang tía	MM				
Xanthophytum polyanthum Pit.	Hoàng cách	Na				
Rutaceae	**Họ Cam**					
Acronychia pedunculata Miq.*	Bưởi bung	MM				
Atalantia citroides Pierre ex Engl. & Prantl*	Chanh rừng	MM				NSBE
Atalantia sessiliflora Guillaumin	Tầm xoọng	Na				
Citrus aurantifolia Swingle	Chanh	Na				
Citrus grandis Osbeck	Bưởi	MM				
Citrus reticulata Blanco	Quít	Na				
Citrus sinensis Osbeck	Cam	MM				
Clausena dunniana H. Lev.*	Hồng bì dại	MM				NSBE
Clausena excavata Burm.f.*	Hồng bì dại	MM				
Clausena indica Oliver*	Mắc mật	MM				
Clausena lansium Skeels*	Hồng bì	MM				
Clausena laevis Drake*	Hồng bì	MM				
Euodia lepta (Spreng) Merr.	Ba chạc	Na				
Euodia meliaefolia Benth.*	Thôi chanh	MM				
Euodia sp.	Ba chạc	Na				
Glycosmis cochinchinensis Pierre	Cơm rượu	Na				
Glycosmis cyanocarpa Spreng.	Cơm rượu	Na				NSBE
Glycosmis parviflora (Sims) Little	Cơm rượu	MM				NSBE
Micromelum falcatum Tanaka*	Mắt trâu	MM				
Micromelum hirsutum Oliver*	Mắt trâu	MM				
Murraya alata Drake	Nguyệt quất	Na				
Murraya paniculata (L.) Jack*	Nguyệt quất	Na				NSBE
Zanthoxylum avicennae DC.	Sẻn	Na				
Zanthoxylum cucullatipetalum Guillaumin	Hoàng mộc	MM				NSBE
Zanthoxylum nitidum (Roxb.) DC.	Xuyên tiêu	MM				
Zanthoxylum rhetsoides Drake	Sẻn hôi	MM				
Zanthoxylum sp.	Sẻn	Na				
Sapindaceae	**Họ Bồ hòn**					
Allophylus cobbe (L.) Blume*	Ngoại mộc	MM				
Amesiodendron chinense (Merr.) Hu*	Trường sâng	MM		LR	T	

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Dimocarpus fumatus (Blume) Leenh.*	Nhãn rừng	MM				
Dimocarpus longan Lour.	Nhãn	MM				
Glenniea philippinensis (Radlk.) Leenh.	Chua khét	MM				
Litchi chinensis Sonn.	Vải	MM				
Mischocarpus pentapetalus Radlk.*	Trường kẹn	MM				
Nephelium cuspidatum Blume*	Vải guốc	MM				
Paviesia annamensis Pierre*	Trường mật	MM			T	
Pometia pinnata Forst.*	Sâng	MM			R	
Sapindus saponaria L.	Bồ hòn	MM				
Xerospermum noronhianum Blume*	Vải guốc	MM				
Sapotaceae	**Họ Hồng xiêm**					
Achras sapota L.	Hồng xiêm	MM				
Chrysophyllum cainito L.	Vú sữa	MM				
Donella lanceolata (Blume) Aubrév.	Sơn xã	MM				NSBE
Madhuca pasquieri H.J. Lam*	Sến mật	MM	EN	V	E	
Pouteria sapota (Jacq.) H.E. Moore & Stearn.	Trứng gà	MM				
Sinosideroxylon bonii Aubrév.*	Sến xanh	MM				
Sinosideroxylon racemosum (Dubard) Aubrév.*	Sến đất	MM				
Saururaceae	**Họ Diếp cá**					
Houttuynia cordata Thunb.	Diếp cá	Hm				
Scrophulariaceae	**Họ Hoa mõm chó**					
Lindernia ciliata Pennell	Mẫu thảo	Hm				
Scoparia dulcis L.	Cam thảo nam	Lp				
Torenia violacea (Azaola ex Blanco) Pennell	Tô liên	Hm				
Simaroubaceae	**Họ Thanh thất**					
Ailanthus triphysa (Dennst.) Alston*	Thanh thất	MM				
Eurycoma longifolia Jack*	Bách bệnh	MM				
Solanaceae	**Họ Cà**					
Capsicum annuum L.	Ớt	Na				
Datura metel L.	Cà độc dược	Na				
Physalis angulata L.	Tầm bót	Na				
Solanum album Lour.	Cà dại	Na				
Solanum indicum L.	Cà dại	Na				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	hoa tím					
Solanum torvum Sw.	Cà gai	Na				
Solanum undatum Poir.	Cà nhà	Na				
Sonneratiaceae	**Ho Bần**					
Duabanga grandiflora Walp.*	Phay	MM				
Staphyleaceae	**Họ Côi**					
Turpinia cochinchinensis (Lour.) Merr.	Khớp	MM				
Turpinia indochinensis Merr.*	Khớp đơn	MM				NSBE
Turpinia montana Kurz*	Khớp núi	MM				
Sterculiaceae	**Họ Trôm**					
Abroma angulosa Poir.	Tai mèo	MM				
Brownlowia tabularis Pierre*	Lò bo	MM				
Byttneria petiolata Cristobal	Quả gai lông	Lp				NSBE
Commersonia bartramia (L.) Merr.	Thung gai	MM				
Firmiana simplex W.F. Wight*	Ngô đồng	MM				
Helicteres angustifolia L.	Thâu kén đực	Na				
Helicteres hirsuta Lour.	Thâu kén bà	Na				
Heritiera littoralis Aiton	Vôi cui	MM				
Heritiera macrophylla Wall. ex Voigt*	Vôi cui lá lớn	MM				
Pterospermum angustifolium Tardieu*	Mang lá hẹp	MM				
Pterospermum heterophyllum Hance*	Mang xanh	MM				
Pterospermum jackianum Wall.*	Mang tía	MM				NSBE
Pterospermum lancaefolium Roxb.*	Mang lá mác	MM				NSBE
Pterospermum truncatolobatum Gagnep.*	Mang lá cụt	MM				
Sterculia gracilipes Pierre*	Sảng cuống nhỏ	MM				
Sterculia lanceolata Cav.*	Sảng nhung	MM				
Sterculia lissophylla Pierre	Sảng cuống dài	MM				
*Sterculia sp.**	Sảng	MM				
Styracaceae	**Họ Bồ đề**					
Alniphyllum fortunei Makino*	Bồ đề xanh	MM				NSBE
Styrax tonkinensis Craib ex Hartwich*	Bồ đề	MM				
Symplocaceae	**Họ Dung**					

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Symplocos atriolivacea Merr. & Chun ex H.L. Li	Dung đen	MM				NSBE
Symplocos cochinchinensis (Lour.) S. Moore.*	Dung nam	MM				
Symplocos cochinchinensis (Lour.) S. Moore. var. *cochinchinensis**	Dung nam	MM				NSBE
Symplocos glauca Koidz.*	Dung mỡ	MM				NSBE
Symplocos laurina Wall.*	Dung giấy	MM				
Symplocos racemosa Roxb.	Dung lông	MM				
Theaceae	**Họ Chè**					
Adinandra annamensis Gagnep.	Súm	MM				
Adinandra integerrima T. Anderson ex Dyer	Súm	MM				NSBE
Camellia amplexicaulis Cohen-Stuart*	Hải đường	MM				
Camellia caudata Wall.	Chè đuôi	MM				
Camellia chrysantha (Hu) Tuyama*	Chè đồi	MM				NSBE
Camellia sinensis Kuntze	Chè	MM				
Eurya acuminata DC.*	Súm	Na				
Eurya japonica Thunb.	Súm	Na				
Eurya tonkinensis Gagnep.*	Súm bắc bộ	Na				
Pyrenaria jonquieriana Pierre ex Laness.	Súm	MM				
Schima superba Gardn. & Champ.*	Vối thuốc	MM				
Schima wallichii Choisy*	Vối thuốc	MM				
Thymelaeaceae	**Họ Trầm**					
Aquilaria crassna Pierre ex Lecomte	Trầm hương	MM	EN	CR	E	
Wikstroemia indica (L.) C.A. Mey.	Niệt gió	Na				
Tiliaceae	**Họ Đay**					
Colona thorelii Burret	Bồ an	MM				
Grewia eriocarpa Juss.	Cò ke	MM				
Grewia hirsuta Vahl	Cò ke lông	MM				
Grewia paniculata Roxb.*	Cò ke	MM				
Triumfetta pseudocana Sprague & Craib	Ké lông	Na				
Ulmaceae	**Họ Du**					
Celtis sinensis Pers.*	Sếu	MM				
Gironniera cuspidata Kurz	Ngát	MM				
Gironniera mollissima Gagnep.	Ngát lông	MM				NSBE
Gironniera subaequalis Planch.*	Ngát vàng	MM				
Trema angustifolia Blume	Hu lá hẹp	Na				NSBE

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Trema cannabina Lour.	Hu đen	Na				
Trema orientalis (L.) Blume	Hu đay	MM				
Trema politoria Blume	Hu đay lông	Na				
Urticaceae	**Họ Gai**					
Boehmeria clidemioides Miq.	Gai núi	Na				NSBE
Boehmeria nivea (L.) Gaudich.	Gai	Na				
Boehmeria tomentosa Wedd.*	Gai lông	Na				NSBE
Debregeasia squamata King ex Hook*	Gai rừng	Na				NGBE
Dendrocnide stimulans (L.f.) Chew	Lá han	MM				
Elatostema balansae Gagnep.	Cao hùng	Na				
*Elatostema sp.**	Cao hùng	Na				
Gonostegia hirta (Blume) Miq.	Bọ mắm lông	Na				
Laportea violacea Gagnep.	Han lá dài	MM				
Oreocnide integrifolia Miq.	Han lá nguyên	MM				
Oreocnide tonkinensis (Gagnep.) Merr. & Chun	Ná nang	Na				
Pellionia repens (Lour.) Merr.	Phu lệ bắc bộ	Th				
Pouzolzia sp.	Bọ mắm	Na				
Pouzolzia zeylanica (L.) Benn.	Bọ mắm	Na				
Verbenaceae	**Họ Cỏ roi ngựa**					
Callicarpa albida Blume	Tu hú	MM				
Callicarpa arborea Roxb.	Tu hú	MM				
Callicarpa cana L.	Nàng nàng	Na				
Callicarpa dichotoma Raeusch.*	Tu hú	Na				
Callicarpa longifolia Lam.	Tu hú lá dài	Na				NSBE
Callicarpa macrophylla Vahl*	Tu hú lá to	MM				NSBE
Clerodendrum chinense (Osb.) Mabb.	Mò trắng	Na				NSBE
Clerodendrum colebrookianum Walp.	Mò lông	Na				
Clerodendrum cyrtophyllum Turcz.	Mò núi	Na				
Clerodendrum fortunatum L.	Đắng cẩy	Na				
Clerodendrum fragrans Vent.	Mò thơm	Na				
Clerodendrum japonicum Sweet	Xích đồng nam	Na				
Clerodendrum paniculatum L.	Ngọc nữ	Na				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Clerodendrum sp.	Mò	Na				
Clerodendrum tonkinense Dop	Mò trắng	Na				NSBE
Gmelina annamensis Dop	Lõi thọ trung bộ	MM				
Gmelina arborea Roxb.*	Lõi thọ	MM				
Premna balansae Dop	Vọng cách	Na				NSBE
Premna cambodiana Dop	Vọng cách lá to	Na				
Premna chevalieri Dop	Vọng cách hoa vàng	Na				
Stachytarpheta jamaicensis (L.) J.Vahl	Cây đuôi chuột	Th				
Verbena officinalis L.	Cỏ roi ngựa	Ch				
Vitex leptobotrys Hallier f.	Đẻn	MM				
Vitex negundo L.	Đẻn lông	MM				
Vitex quinata Druce*	Đẻn 5 lá	MM				
Vitex trifolia L.*	Đẻn 3 lá	MM				
Violaceae	**Họ Hoa tím**					
Viola inconspicua Blume*	Hoa tím	MM				
Vitaceae	**Họ Nho**					
Ampelopsis heterophylla Blume	Nho dại	Lp				
Cayratia japonica (Thunb.) Gagnep.	Nho rừng	Lp				
Cayratia trifolia (L.) Domin	Dây hôi	Lp				
Cissus modeccoides Planch.	Chìa vôi	Lp				
Cissus trilobus (Lour.) Merr.	Nho rừng	Lp				
Parthenocissus heterophylla Merr.	Dây chìa vôi	Lp				
Tetrastigma planicaule Gagnep.	Dây thèm bép	Lp				
Tetrastigma sp.	Thèm bép	Lp				
Tetrastigma strumarum Gagnep.*	Dây quai bị	Lp				NSBE
Vitis vinifera L.	Nho	Lp				
Liliopsida	**Lớp 1 lá mầm**					
Acoraceae	**Họ Thạch xương bồ**					
Acorus gramineus Sol.	Thạch xương bồ	Cr				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Agavaceae	**Họ Huyết dụ**					
Cordyline terminalis (L.) Kunth	Huyết dụ	Na				
Alliaceae	**Họ Hành**					
Allium chinense G.Don	Kiệu	Cr				
Allium fistulosum L.	Hành	Cr				
Allium odorum L.	Hẹ	Cr				
Allium sativum L.	Tỏi	Cr				
Araceae	**Họ Ráy**					
Acorus gramineus Aiton	Thạnh xương bồ	Cr			R	
Aglaonema modestum Schott ex Engl.	Vạn niên thanh	Cr				
Alocasia macrorrhizos (L.) G. Don	Ráy	Cr				
Amorphophallus paeoniifolius (Dennst.) Nicolson	Khoai nưa	Cr				
Amorphophallus sp.	Nưa	Cr				
Colocasia esculenta (L.) Schott	Khoai sọ	Cr				
Colocasia gigantea (Blume) Hook. f.	Dọc mùng	Cr				
Colocasia macrorhiza (L.) G. Don*	Ráy	Lp				
Epipremnum giganteum Schott	Ráy leo	Lp				
Homalomena occulta Schott	Thiên niên kiện	Cr				
Pothos chinensis (Raf.) Merr.	Cơm lênh	Lp				
Pothos grandis Buch.	Cơm lênh lá lớn	Lp				
Pothos repens Druce	Chân rết	Ep				
Pothos sp.	Ráy leo	Ep				
Arecaceae	**Họ Cau**					
Areca catechu L.	Cau	MM				
Arenga pinnata Merr.*	Búng báng	Na				
Calamus balansaeanus Becc.*	Mây nước	Lp				NSBE
Calamus faberi Becc.	Mây thủ công	Lp				
Calamus platyacanthus Warb. ex Becc.*	Song mật	Lp	V		R	
Calamus salicifolius Becc.	Mây lá liễu	Lp				
Calamus sp.	Mây	Lp				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Calamus tenuis Roxb.	Mây đan	Lp				
Calamus tetradactylus Hance*	Mây mật	Lp			R	
Caryota mitis Lour.*	Đùng đình	Na				
Caryota urens L.*	Đùng đình	Na				
Cocos nucifera L.	Dừa	MM				
Daemonorops longispathus Becc.	Hèo	Na				
Licuala fatua Becc.*	Lụi	Na				
Livistona chinensis R.Br.	Cọ	MM				
Livistona saribus Merr. ex A. Chev.	Cọ	MM				
Rhapis excelsa Henry ex Rehder	Lụi cao	Na				
Rhapis humilis Blume	Lụi đỏ	Na				
*Rhapis sp.**	Lụi	Na				
Asparagaceae	**Họ Tóc Tiên**					
Asparagus cochinchinensis Merr.	Tóc tiên	Hm				
Bromeliaceae	**Họ Dứa**					
Ananas comosus (L.) Merr.	Dứa	Hm				
Cannaceae	**Họ Chuối hoa**					
Canna edulcis Ker Gawl.	Dong riềng	Cr				
Commelinaceae	**Họ Thài lài**					
Commelina communis L.	Thài lài	Hm				
Commelina diffusa Burm.f.	Rau trai	Hm				
Commelina paludosa Blume	Trai	Hm				
Dictyospermum montanum Wight	Trai núi	Na				
Floscopa scandens Lour.	Đầu rìu	Cr				
Pollia secundiflora (Blume) Bakh.f.	Lài	Cr				
Tradescantia zebrina Bosse	Thài lài tía	Hm				
Zebrina sp.	Thài lài	Cr				
Convallariaceae	**Họ Cao cẳng**					
Ophiopogon dracaenoides Hook.	Cao cẳng	Hm				
Ophiopogon latifolius L. Rodr.	Cao cẳng lá rộng	Hm				
Ophiopogon longifolius Decne.	Cao cẳng lá dài	Hm				
Ophiopogon reptans Hook.	Cao cẳng	Hm				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	lá hẹp					
Ophiopogon sp.	Cao cẳng	Hm				
Costaceae	**Họ Mía dò**					
Costus speciosus Sm.	Mía dò	Cr				
Costus tonkinensis Gagnep.	Mía dò bắc	Cr				NSBE
Cyperaceae	**Họ cói**					
Carex indica L.	Kiết ấn độ	Hm				
Carex sp.	Kiết	Hm				
Cyperus cephalotes Vahl	Kiết	Hm				
Cyperus diffusus Vahl	Lác	Hm				
Cyperus distans L.f.	Cói	Hm				
Cyperus exaltatus Retz	Cói cao	Hm				
Cyperus iria L.	Cú rận	Hm				
Cyperus pilosus Vahl	Cói lông	Hm				
Cyperus rotundus L.*	Cỏ gấu	Cr				
Cyperus sp.	Cói	Ch				
Cyperus trialatus (Boeckeler) J. Kern	Cói ba cánh	Ch				
Fimbristylis complanata (Retz.) Link	Năn	Hm				
Kyllinga monocephala Rottb.	Cỏ bạc đầu	Cr				
Kyllinga nemoralis (Forst.) Dandy ex Hutch. & Dalziel	Cỏ bạc đầu	Cr				
Scleria biflora Roxb.	Cỏ cuống	Hm				
Dioscoreaceae	**Họ Củ nâu**					
Dioscorea alata L.	Khoai ngot	Cr				
Dioscorea arachidna Prain & Burkill	Từ lông	Cr				
Dioscorea bulbifera L.	Củ dại	Cr				
Dioscorea cirrhosa Lour.	Củ nâu	Cr				
Dioscorea depauperata Prain & Burkill	Khoai mài	Lp				
Dioscorea glabra Roxb.	Củ từ	Lp				
Dioscorea persimilis Prain & Burkill	Củ mài	Cr				
Dracaenaceae	**Họ Bồng bồng**					
Dracaena cambodiana Pierre ex Gagnep.*	Huyết giác	Na				
Dracaena cochinchinensis Hort. ex Baker*	Huyết giác	Na				
Sansevieria hyacinthoides (L.) Druce	Lưỡi hổ	Na				
Hydrocharitaceae	**Họ Thuỷ**					

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	thảo					
Hydrilla verticillata (L.f.) Royle	Thuỷ thảo	Cr				
Hypoxidaceae	**Họ Sâm cau**					
Curculigo gracilis Wall.	Sâm cau	Cr				
Curculigo latifolia Dryand.	Sâm cau lá rộng	Cr				
Curculigo orchioides Gaertn.	Sâm cau	Cr				
Liliaceae	**Ho Loa ken**					
Dianella ensifolia (L.) DC.	Hoa Loa ken	Hm				NGBE
Lilium longiflorum Thunb.	Hoa huệ	Hm				
Iridaceae	**Họ Sâm đại hành**					
Belamcanda chinensis DC.	Rẻ quạt	Cr				
Eleutherine bulbosa Urb.	Sâm đại hành	Cr				NGBE
Marantaceae	**Họ Lá dong**					
Maranta arundinacea L.	Khoai dong	Cr				
Phrynium parviflorum Roxb.	Dong	Cr				
Phrynium placentarium Merr.	Lá dong	Cr				
Musaceae	**Họ Chuối**					
Musa acuminata Colla	Chuối rừng	Cr				
Musa balbisiana Colla	Chuối hột	Cr				
Musa basjoo Siebold	Chuối ngự	Cr				
Musa paradisiana L.	Chuối tiêu	Cr				
Orchidaceae	**Họ Phong lan**					
Aerides falcata Lindl. & Paxton	Giáng hương	Ep				
Anoectochilus roxburghii (Wall.) Lindl.	Kim tuyến	Cr	E		E	
Apotasia odorata Blume	Lan lá hẹp	Ch				
Appendicula sp.	An lan	Ep				
Bulbophyllum odoratissimum Lindl.*	Cầu diệp thơm	Ep				
Bulbophyllum sp.	Lan	Ep				
Calanthe herbacea Lindl.*	Địa lan	Hm				
Cymbidium lowianum Reichb.f.	Phong Lan	Ep				
Dendrobium aloideum La Llave & Lex.	Hoàng thảo	Ep				
*Dendrobium sp.**	Phong lan	Ep				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Eria pannea Lindl.	Nỉ lan	Ep				NSBE
Podochilus intermedius Aver.*	Lan leo	Pp				
Schoenorchis sp.	Phong lan	Ep				
Thrixspermum centipeda Lour.	Lan xương cá	Ep				
Thrixspermum sp.	Lan	Ep				
Pandanaceae	**Họ Dứa dại**					
Pandanus nanofrutex B.S. Stone	Dứa bụi	Na				
Pandanus tectorius Parkinson	Dứa gỗ	Na				
Pandanus tonkinensis B.S. Stone	Dứa	Na				NSBE
Phormiaceae	**Họ Hương bài**					
Dianella nemorosa Lam.	Hương bài	Th				
Poaceae	**Họ Lúa**					
Acroceras munroanum (Balansa) Henrard	Cỏ lá tre	Ch				
Arundinaria sat Balansa	Sặt	Na				
Axonopus compressus (Sw.) P. Beauv.	Cỏ lá gừng	Hm				NGBE
Bambusa blumeana Schult.f.	Tre gai	MM				
Bambusa flexuosa Munro	Hóp gai	MM				
Chloris barbata Sw.	Cỏ mật	Th				NGBE
Chrysopogon aciculatus (Retz.) Trin.	Cỏ may	Hm				
Coix lacryma-jobi L.	Ý dĩ	Th				
Cymbopogon caesius (Hook. & Arn.) Stapf	Sả hôi	Hm				NGBE
Cymbopogon citratus Stapf	Sả	Ch				
Cynodon dactylon (L.) Pers.	Cỏ gà	Hm				
Cyrtococcum patens A. Camus	Cỏ lá tre	Hm				
Dactyloctenium aegyptiacum Willd.	Cỏ chân vịt	Th				
Dendrocalamus asper Backer ex K. Heyne	Bương	MM				
Dendrocalamus barbatus Hsueh & D.Z. Li	Luồng	MM				
Dendrocalamus giganteus Munro	Mai	MM				
Digitaria adscendens (Kunth) Henrard	Cỏ chỉ	Ch				
Digitaria timorensis (Kunth) Balansa	Cỏ chân nhện	Ch				
Echinochloa crus-galli (L.) P. Beauv.	Cỏ lồng vực	Ch				
Eleusine indica (L.) Gaertn.	Cỏ mần trầu	Th				

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
Eriachne pallescens R.Br.	Cỏ chỉ	Hm				NGBE
Eriochloa procera (Retz.) C.E. Hubb.	Cỏ mật	Hm				
Imperata cylindrica L.P. Beauv.	Cỏ tranh	Cr				
Indosasa angustata McClure*	Vầu đắng	MM				
Indosasa sinica C.D. Chu & C.S. Chao*	Vầu ngọt	MM				
Isachne miliacea Roth.	Cỏ nghể	Ch				NGBE
Microstegium ciliatum A. Camus	Cỏ rác lông	Hm				
Microstegium vagans (Nees ex Steud.) A. Camus	Cỏ rác	Hm				
Miscanthus floridulus Warb. ex K. Schum. & Lauterb.	Lách	Hm				
Neyraudia reynaudina (Kunth) Keng ex Hitchcock	Sậy khô	Hm				
Oplismenus compositus (L.) P. Beauv.	Cỏ lá tre	Ch				
Oryza sativa L.	Lúa nước	Th				
Panicum amoenum Balansa	Cỏ gừng	Hm				
Panicum miliaceum L.	Kê	Th				
Panicum sarmentosum Roxb.	Cỏ giác	Ch				
Paspalum conjugatum Berg.	Cỏ giác	Ch				
Paspalum scrobiculatum L.	Cỏ đắng	Th				
Paspalum sp.	Cỏ giác	Ch				
Pennisetum sp.	Cỏ	Th				
Phacelurus sp.	Cỏ	Ch				
Phragmites karka (Retz.) Steud.	Sậy	Cr				
Pogonatherum crinitum Kunth	Cỏ lông lợn	Hm				
Saccharum arundinaceum Retz.	Lau	Ch				
Saccharum officinarum L.	Mía	Ch				
Saccharum spontaneum L.	Lách	Hm				
Schizostachyum funghomii McClure*	Nứa	MM				
Setaria palmifolia Stapf	Cỏ lá dừa	Cr				
Sinarundinaria griffithiana (Munro) C.S. Chao & Renvoize	Sặt gai	Ch				
Themeda caudata Hack.	Cỏ phao	Ch				
Thysanolaena maxima Kuntze	Chít	Hm				
Vetiveria sp.	Cỏ	Cr				
Zea mays L.	Ngô	Th				
Smilacaceae	**Họ Kim**					

SCIENTIFIC NAME	COMMON NAME	LF	RDB	RD-IUCN	RDBE	NOTE
	cang					
Heterosmilax chinensis Wang	Kim cang	Cr				NSBE
Heterosmilax gaudichaudiana A.DC.	Thổ phục linh	Lp				
Smilax bauhinioides Kunth	Kim cang lá tròn	Lp				
Smilax china L.	Khúc khắc trung hoa	Lp				
Smilax corbularia Kunth*	Kim cang bạc	Cr				
Smilax elegantissima Gagnep.	Kim cang	Cr	V		DD	
Smilax ferox Wall. ex Kunth	Cẩm cang gai	Cr				
Smilax glabra Roxb.	Thổ phục linh	Cr			T	
Smilax lanceifolia Roxb.*	Kim cang lá thuôn	Cr				
Smilax ovalifolia Roxb.	Kim cang lá to	Lp				
Smilax perfoliata Lour.*	Kim cang	Cr				
Smilax poilanei Gagnep.	Kim cang	Cr	CR		DD	
*Smilax sp.**	Kim cang núi	Lp				
Stemonaceae	**Họ Bách bộ**					
Stemona tuberosa Lour.	Bách bộ	Cr				
Tacaceae	**Họ Râu hùm**					
Tacca chantrieri André	Râu hùm	Cr				
Zingiberaceae	**Họ Gừng**					
Alpinia galanga Willd.	Riềng nếp	Cr				
Alpinia officinarum Hance	Riềng dai	Cr				
Alpinia sp.	Riềng rừng	Cr				
Alpinia zerumbet (Pers.) B.L. Burtt & R.M. Sm.	Riềng	Cr				
Amomum echinosphaera K. Schum.	Sa nhân	Cr				
Amomum villosum Lour.	Sa nhân	Cr				
Curcuma domestica Valeton	Nghệ	Cr				
Curcuma longa L.	Nghệ	Cr				

Curcuma zedoaria Rosc.	Nghệ đen	Cr
Zingiber eberhardtii Gagnep.	Gừng rừng	Cr
Zingiber officinale Rosc.	Gừng	Cr
Zingiber zerumbet (L.) Sm.	Gừng gió	Cr

Addendum: Species recorded for Ben En National Park by Anonymous (2000) and Tordoff et al. (2000), but not found in our 2005 - 2007 survey are listed below. Since no herbarium vouchers of the earlier surveys could be consulted, these additional species should be considered tentative. We have not checked the names for nomen-clatural precision or current taxonomic status.

LYCOPODIOPHYTA: Selaginellaceae *(Selaginella sp., S. sp1).*

POLYPODIOPHYTA: Adiantaceae (*Dryopteris concolor, Hemionitis arifolia, Onychium lucidum, Stenochlaena palustris, Syngramma alismifolia, Taenitis blechnoides*); Angiopteridaceae (*Angiopteris evecta*); Aspleniaceae (*Asplenium ensiforme*, *Diplazium christii, Diplazium esculentum*); Denstaedtiaceae (*Stenoloma chusanum*); Dryopteridaceae (*Tectaria polymorpha, T. subpedata, T. subtriphylla*); Gleicheniaceae (*Diplopterygium laevissimum*); Hymenophyllaceae (*Crepidomanes sp*.); Lindsaeaceae* (*Lindsaea ensifolia, L. orbiculata*); Marsileaceae (*Marsilea minuta*); Polypodiaceae (*Pyrrosia piloselloides*); Pteridaceae (*Pteris cadieri, Pteris deltodon, P. tripartita*); Salviniaceae (*Salvinia cucullata*); Schizaeaceae (*Lygodium microstachyum, L. polystachyum*); Sinopteridaceae (*Sinopteris sp.*); Vittariaceae (*Vittaria elongata*);

MAGNOLIOPHYTA - MAGNOLIOPSIDA: Acanthaceae *(Thunbergia grandiflora);* Annonaceae *(Uvaria purpurea);* Apocynaceae *(Rauvolfia cambodiana, R. indica, Winchia calophylla, Xylinabariopsis napeensis);* Asteraceae *(Centipeda minima, Gerbera jamesonii, Grangea maderaspatana, Tithonia diversifolia, Vernonia paludosa);* Begoniaceae *(Begonia balansaeana, B. rupicola);* Bignoniaceae *(Campsis grandifolia, Radermachera alata);* Boraginaceae *(Cordia myxa);* Cactaceae *(Opuntia ficus-indica);* Capparaceae (*Capparis grandis*); Caryophyllaceae* (*Drymaria cordata; Policarpon porostratum*); Celastraceae (*Euonymus aculeatus, E. mitratus, Salacia cochinchinensis*); Chenopodiaceae (*Chenopodium ambrosioides*); Chloranthaceae (*Chloranthus japonicus*); Clusiaceae (*Calophyllum dryobalanoides*); Connaraceae *(Agelaea trinervis; Connarus paniculatus, Rourea harmandiana*); Convolvulaceae (*Ipomoea bonii, I. heterifolia, I. involucrate, I. triloba, Merremia hederacea, M. vitifolia, Neuropeltis racemosa, Operculina turpethum*); Cornaceae* (*Cornus tonkinensis, Mastixia arborea*); Cucurbitaceae (*Actinostemma tenerum, Cucurbita pepo, Trichosanthes tricuspidata, Zehneria maysorensis*); Dilleniaceae (*Tetracera loureiroi*); Ebenaceae (*Diospyros bangoiensis, Diospyros susarticulata)*; Elaeocarpaceae (*Elaeocarpus stipularis*); Elatinaceae* (*Bergia ammannioides, Elatine ambigua*); Euphorbiaceae (*Acalypha siamensis, Cleistanthus myrianthus, Drypetes poilanei, Euphorbia ligularia, Glochidion zeylanicum, Macaranga tanarius, Mallotus mollissima, Pedilanthus tithymaloides, Phyllanthus clarkei, Sapium cochinchinensis, S. rotundifolium, S.*

sebiferum, Sumbaviopsis albicans, Trewia nudiflora, Vernicia fordii); Fabaceae (*Acacia megaladina, Aeschynomene indica, Arachis hypogaea, Butea monosperma, Cajanus cajan, Dalbergia, asamica, Desmodium styracifolium, D. zonatum, Mucuna bracteata, Neptunia oleracea, Saraca indica*); Fagaceae (*Lithocarpus finetii*); Flacourtiaceae (*Casearia menbranacea, Scolopia chinensis*); Hernandiaceae* (*Illigera parviflora, I. trifolia*); Gentianaceae* (*Crawfurdia sp.*); Lamiaceae (*Coleus scutellarioides, Pogostemon cablin*); Lardizabalaceae* (*Stautonia cavaleriana*); Lauraceae (*Beilschmiedia sphaerocarpa, Cinnamomum parthenoxylon, C. polyadelphum, Phoebe hainanensis*); Lythraceae (*Lagerstroemia floribunda, L. indica*); Malpighiaceae* (*Aspidopteryx henryi, A. tomentosa, Hiptage boniana, Malpighia coccigera*); Malvaceae (*Eriolaena candolei*); Melastomataceae (*Osbeckia thorelii, Phyllagathis setotheca, P. tonkinensis, Sonerilla rivularis, Vietsenia laxiflora)*; Meliaceae (*Aglaia duperreana, Heynea trijuga, Swietenia macrophylla*); Menispermaceae (*Tinospora cripa*); Molluginaceae* (*Mollugo pentaphylla*); Moraceae (*Ficus altissima, F. elastica, F. retusa, Malaisia scandens, Morus australis*): Myristicaceae (*Horsfieldia prainii, Knema corticosa*); Myrsinaceae (*Ardisia gigantifolia, A. stenophylla, A. verbascifolia*); Myrtaceae (*Decaspermum parviflorum, Syzygium samarangense, S. tsoongii*); Nyctaginaceae (*Boerhavia diffusa, Mirabilis jalapa*); Oleaceae (*Jasminum lanceolarium, Ligustrum sinense*); Onagraceae (*Ludwigia hyssopyfolia, L. parennis*); Passifloraceae (*Adenia chevalieri, Passiflora quadrangularis*); Pedaliaceae* (*Sesamum orientale*); Piperaceae (*Piper pierrei*); Polygonaceae (*Rumex wallichi*); Primulaceae* (*Lysimachia decurrens*); Ranunculaceae (*Naravelia laurifolia, N. siamensis, N. zeylanica*); Rosaceae (*Eriobotrya bengalensis, Rubus pavifolius*); Rubiaceae (*Coffea arabica, Gardenia lucida, Lasianthus kamputensis*); Rutaceae (*Atalantia buxifolia, A roxburghiana, Euodia triphylla, Micromelum minutum*); Sapindaceae (*Allophylus macrodontus, Arytera littoralis, Cardiospermum halicacabum, Nephelium melliferum*); Sapotaceae (*Planchonella annamensis, Sarcosperma kachinense*); Saururaceae (*Saururus sinensis*); Schisandraceae (*Kadsura coccinea*); Scrophulariaceae (*Angelonia goyazensis, A. aromatica, A. micrantha, Lindernia antipoda, L. pusilla, L. rueloides, L. tonkinensis, Microcarpaca minima, Torenia benthamiana*); Simaroubaceae (*Brucea javanica*); Solanaceae *(Solanum melongena, S. nigrum, S. virginiarum*); Sterculiaceae (*Muntingia calabura, Sterculia lissophyllla, S. tonkinensis*); Symplocaceae (*Symplocos adenophylla*); Theaceae (*Adinandra glischroloma*); Ulmaceae (*Gironniera yunnanensis*); Urticaceae (*Parietaria debilis, Procris frutescens*); Verbenaceae (*Premna chevalieri, P. serratifolia, Verbena hybrida*); Vitaceae (*Cissus javanica, C. quadrangulus*);

LILIOPSIDA: Acoraceae (*Acorus tatarinowi, A. verus*); Agavaceae* (*Agava americana, A. angustifolia*); Alismataceae* (*Alisma plantago*); Amaryllidaceae* (*Crinum asiaticum, C. giganteum*); Arecaceae (*Calamus poilanei*); Cannaceae (*Canna generalis*); Commelinaceae (*Zebrina pendula*); Cyperaceae *(Bulbostylis barbata, Cyperus compressus*); Dioscoreaceae (*Dioscorea esculenta*); Dracaenaceae (*Sansevieria cylindrica, S. trifasciata*); Eriocaulaceae* (*Eriocaulon bonii, E. miserum*); Flagellariaceae* (*Flagellaria indica*); Hemerocallidaceae (*Hemerocallis fulva*); Liliaceae (*Disporum calcaratum*); Orchidaceae (*Acriopsis javanica, Appendicula*

cornuta, Bulbophyllum insulsum, Calanthe angusta, Ceratostylis tonkinensis, Cleisostoma paniculatum, C. rostratum, Corymborchis veratrifolia, Cymbidium aloifolium, Dendrobium anceps, D. fimbriatum, D. lindleyi, D. manii, D. podagraris, D. tortile, Habenaria ciliolaris, Paphiopedium gratrixianum, P. villosum, Schoenorchis rosea, Spiranthes sinensis, Thrixspermum arachnites, Zeuxine bonii); Pontederiaceae (*Eichhornia crassipes, Monchoria elata, M. hastata*).

Chapter 3

TRADITIONAL MEDICINAL PLANTS IN BEN EN NATIONAL PARK, VIETNAM

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SUMMARY

This paper surveys the medicinal plants and their traditional use by local people in Ben En National Park, Vietnam. A total of 230 medicinal plant species (belonging to 200 genera and 84 families) is used by local people for treatment of 68 different diseases. These include species that are collected in the wild (65%) as well as species grown in home gardens. Leaves, stems and roots are most commonly used either fresh or dried or by decocting the dried parts in water. Women are mainly responsible for health care, they have a better knowledge of medicinal plants than men, and also collect them more than men at almost every age level. The indigenous knowledge of traditional medicinal plants may be rapidly lost because 43% of the young generation do not know or do not want to learn about medicinal plants, and the remainder knows little about them. Moreover, nowadays local people tend to use western medicine. Eighteen medicinal plant species are commercialized and contribute on average 11% to the income of the households. The majority of medicinal species are used by less than half of the households and 68% of the medicinal plant species have use indices lower than 0.25. Only 6 of the medicinal species of Ben En are listed in the Red data list of Vietnam, but locally 18 medicinal species are endangered because of over harvesting. A comparison of traditional uses of medicinal plants in Ben En National Park with traditional uses elsewhere in South-East Asia and the Indo-Pacific region shows that the same species may be used for widely different treatments by different ethnic groups. The conservation, sustainable use and economic potential of medicinal plants is discussed. We argue that their use, cultivation in home gardens, and marketing should be encouraged as an affordable alternative to expensive western medicine.

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Key words: Ben En National Park, traditional medicinal plants, disease treatment, conservation.

INTRODUCTION

Man is known to have utilized plants as a source of medicinal drugs for thousands of years. Medicinal plants are potential sources of new drugs and hold a great value for developing pharmaceutical products, phytomedicines, and dietary supplements (King et al. 1999).

An effective way to find new drugs is to follow the indigenous knowledge on medicinal plants (Spjut & Perdue 1976; Mendelsohn & Balick 1995; Swerdlow 2000). Using ethnobotany to identify promising plants could substantially reduce the costs for developing at least some pharmaceutical drugs (Mendelsohn 1997). About 80% of the world's population relies on traditional medicine (Farnsworth et al. 1985). Especially in remote areas in developing countries, medicinal plants may form the only available source of health care (Kasparek et al. 1996; Van Andel 2000).

Vietnam is no exception to this phenomenon. The better hospitals are all located in Hanoi, Ho Chi Minh City, and in other main cities. The health care situation in the research area of Ben En National Park is generally much less favourable. The few hospitals and health centres in the interior are often ill-equipped and suffer from lack of trained staff. Only few people can afford to travel to the hospital in the city when they need medical assistance, instead of seeking treatment in local health centres. Most local people do not have health insurance. The majority of the health problems of the local people in Ben En National Park are related to stomach ache, malaria, diarrhoea, wounds, and common colds.

Knowledge of medicinal plants, as once embedded in numerous indigenous cultures, is rapidly disappearing. Year by year, the total sum of human knowledge about the species, distribution, ecology, management, and extraction of medicinal plants is declining: the continuation of a process of loss of local cultural diversity that has been underway for centuries (Hamilton 2003). Although in many communities medicinal plants are the only available source for medical treatment, local indigenous remedies are less used now than before. In many tropical regions indigenous knowledge is at risk of extinction just as is biodiversity itself (Slikkerveer 1999, Van Andel 2000).

Ethnobotanical research can play a key role in the revitalization and revaluation of indigenous knowledge (Martin 1995). For Ben En National Park in particular very few ethnobotanical data exist. Some research has been conducted on biodiversity (Tordoff et al. 2000), and one study just listed plant or animal species, unfortunately without voucher specimens for scientific scrutiny (Anonymous 2000).

To analyse the role of medicinal plants in the indigenous communities in Ben En National Park, this study deals with the variety of medicinal plants and their uses recorded during a one year survey of non-timber forest products in that region.

The main research questions with regards to the use of medicinal plants were:

- Which plant species are being used for which disease?
- Which medicinal plant species are being commercialized in the research area?
- What is the present role of medicinal plants in the health care system of the indigenous communities?
- How does the situation in Ben En National Park compare with other local communities depending on natural forest resources in and beyond Vietnam?

We hope that the documentation of this medicinal plant knowledge contributes to the conservation of both cultural diversity and plant biodiversity in Vietnam in general and Ben En National Park in particular. By compiling and spreading this knowledge we hope to achieve those other ethnic groups in the region benefit from these local and cheap resources.

METHODOLOGY

Household surveys and interviews were carried out in 45 randomly selected households per village (out of a total of about 110-150 households per village). The standard interviews contained specific questions on age, gender, and ethnic background of the gatherers and main users of plant products. Additionally we used the 'walk-in-the-wood' method (Prance et al. 1987), to determine which products are harvested (and for what purpose) in the forests surrounding the villages. These trips were also used to collect voucher specimens for reliable identification of the harvested plants. Special collecting trips were organized with indigenous experts, e.g., traditional doctors, village elders and other local people who knew about medicinal plants. There are five traditional doctors (four females and one male) in the research area. Local names were also being noted during these surveys. Most information was confirmed by other informants. The information was also checked and compared with the 'Vietnam medicinal plants' (Loi 1995), 'Dictionary of medicinal plant of Vietnam' (Chi 1996), 'Plants of Vietnam' (Ho 2000), and the PROSEA (Plant Resources of South-East Asia) Handbooks on 'Medicinal and poisonous plants' (De Padua et al. 1999; Van Valkenburg & Bunyapraphatsara 2001; Lemmens & Bunyapraphatsara 2003).

Market inventories were used to determine the price of the forest products that are for sale. These surveys served as an independent way to determine which products are harvested from the surrounding forest, and to assess local uses of these forest products.

All plants that were considered by local people to have medicinal properties were collected and identified. These plants not only included wild species but also cultivated plants and wild plants that had been taken from the forest and planted in gardens or agricultural fields. Botanical specimens were collected of all useful plants. One voucher of each specimen was deposited at the herbarium of the

Vietnam Forestry University, additional vouchers were sent to the National Herbarium of the Netherlands and various specialists for identification.

The importance of medicinal plant species was identified using standard Participatory Rural Appraisal (PRA) techniques (PID & NES 1989; Ngai 2001) where local people were asked to rank a list of regularly used local medicinal plants. The importance of medicinal plants for health care was determined using two criteria: 1) proportion of local people using each listed species; and 2) frequency of use. The importance of medicinal plants species for income generation was determined by calculating the income from each listed species for the local population.

The database resulting from the ethnobotanical inventory was used to calculate a use index (UI) for each species by using the following equation:

$$UI = U_s/N$$

Where U_s is the number of households which mentioned a use for species s; N is the total of households that were interviewed in the research area. This Use Index is a modification from the Use Value (UV) introduced by Phillips & Gentry (1993) and recently used by De Lucena et al. (2007), which is calculated from the relative number of times a species is mentioned by various informants in ethnobotanical inventories.

The market demand, intensity of collection, and abundance in the wild were classified as follows:

Market demand

- High: easy to sell in large amounts.
- Medium: difficult to sell in large amounts.
- Low: only in very small supply on the market and sometimes left unsold because the demand was not stable.

Collection intensity

- High: local people collect the plants in large amounts because of high demand of the market and/or for personal use.
- Medium: the collected amount is not big because the demand is not high, plants are not abundant, or it is difficult to collect them in large amounts.
- Low: the demand of the market is low or is non-existent. People mainly collect for home consumption, but in small amounts.

Abundance in the wild

- High: the species is easy to find and abundant.
- Medium: the species is neither abundant nor rare.

- Low: the species is rare, and although local people can find it with special effort, the species will be endangered if collection continues.

STUDY AREA

Field work was conducted in Ben En National Park 19° 30' to 19° 40' N by 105° 21' to 105° 35' E, situated in the Nhu Thanh and Nhu Xuan districts of Thanh Hoa province, Vietnam (Fig. 1.1). The highest peak is about 490 m. The core zone of the National Park covers 15,800 ha, while the buffer zone covers around 12,000 ha. About 18,000 people live in the buffer and core zones of the National Park (Tordoff et al. 2000). The majority of the people living in the national park belong to the Kinh, Thai, Muong, and Tay ethnic groups; although there are also a small number of Tho people. The interviews were carried out in three villages: Xuan Thai, Binh Luong, and Hoa Quy. Additional information on medicinal plants was collected in the markets of Ben Sung and Yen Cat. The vegetation of the core zone is dominated by disturbed tropical evergreen rain forest, which has been affected by human activities, especially logging, which was legal until the park was established in 1992, but has continued illegally up to now.

RESULTS

Diversity of medicinal plants

A total of 230 medicinal plant species were used by local people in Ben En National Park belonging to 200 genera and 84 families. These species were involved in 313 different treatments and recipes. For most species only one recipe was mentioned; some have multiple medicinal applications. A complete list of species and their local medicinal uses is given in Appendix 3.1. The total number of vascular plant species in the Park is about 1390 (Hoang et al. 2008 a).

Most of the medicinal plant species in Ben En National Park are angiosperms, only 2 species belong to the gymnosperms and 9 species are ferns. Sixteen percent of all plant species in the Park are used by local people for medicinal purposes. The number of medicinal plant species used by local people in Ben En National Park is 7.2% of the total medicinal plant species in Vietnam (Chi 1996). Diversity of taxa is shown in Table 3.1.

Table 3.1. Diversity of taxa

	Number of medicinal species	Total number of plant species in Ben En	Percent of medicinal species / total species in Ben En (%)
Ferns	9	86	10
Gymnosperms	2	9	22
Angiosperms	219	1294	17
Total	230	1389	16

Among the 84 families, the top 10 families with the highest number of medicinal species in the area are listed in Table 3.2.

Table 3.2. The 10 families with the highest numbers of medicinal species

Name of Family	Number of genera	Number of species
Euphorbiaceae	9	11
Asteraceae	8	9
Moraceae	5	9
Fabaceae	8	8
Rubiaceae	7	8
Menispermaceae	6	8
Verbenaceae	4	8
Rutaceae	5	7
Araceae	6	6
Apocynaceae	6	6

From the 230 species of medicinal plants recorded in Ben En National Park 65% of the species were collected from the wild. These were all plants naturally occurring in different vegetation types (primary, secondary and logged over forests, shrubbery, along roads, along streams, and in agricultural fields). Twenty percent of the species were cultivated in home gardens or in fields or even along the village road. This practice helps to develop the medicinal plant resources, and also makes them more widely available, especially when derived from rare and endangered species. Fifteen percent of the species were both taken from the forest, and also grown in the home gardens and agricultural fields. This semi-domestication reduces the need to cover long distances in the forest to search for plants.

Diversity of life forms of medicinal plants

The analysis of the life forms of medicinal plants used by local people in Ben En National Park is shown in Fig. 3.1. Herbaceous medicinal plants used by local people usually grow on the forest floor, along forest edges and roads, in fields and villages. They are mainly Amaranthaceae, Araceae, Asteraceae, and Zingiberaceae. Next in order of importance are forest trees mainly belonging to Euphorbiaceae, Moraceae, Rubiaceae, and Rutaceae. The smallest groups are formed by lianas and shrubs belonging to mainly Araceae, Asclepiadaceae, Cucurbitaceae, Menispermaceae, and Smilacaceae. Shrubs growing in the forest or along streams mainly are Myrtaceae and Solanaceae.

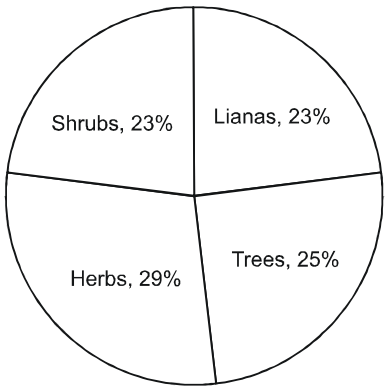


Fig. 3.1. Percentage of life forms of medicinal plants species used in Ben En National Park.

Diversity of plant parts used

In traditional medicine, different plant parts are used to treat different diseases: different components of one medicinal plant may have different effects. Some medicinal plant species have only one component that can be used, while for other species several components or the whole plant can be used. Of the identified medicinal plants in the research area, the whole plant is used of 14 species, whereas one species provides four useful components, 32 species provide three, 98 species provide two, and 85 species provide one component.

The diversity of parts used is indicated in Table 3.3. Leaves are most commonly used, either fresh or dried. Stems and roots are also common, either fresh or by decocting the dried root in water. Stems are usually chopped into small pieces and decocted in water. Often, different parts of the plants are combined to treat a disease.

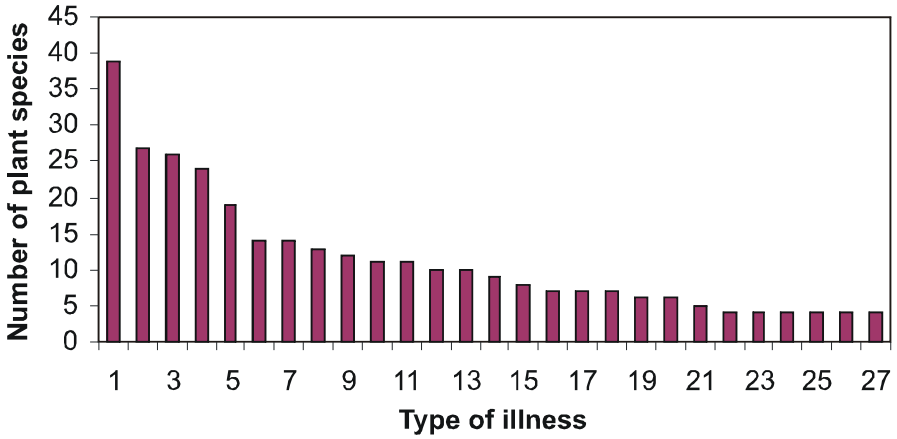
Table 3.3. Diverse parts of medicinal plants used by local people

Parts of plant	Number of species	Percent of total
Leaves	141	61
Root, rhizome	96	42
Stem	64	28
Bark	26	11
Fruit	19	8
Whole plant	14	6
Seed	9	4
Flower	9	4
Tuber	8	3
Bulb	3	1
Latex	2	1

Diseases treated with medicinal plants

The 230 medicinal plant species in Ben En National Park were used for treatment of 68 different diseases. For 20 of these diseases local people use only one medicinal plant for each disease. For example cancer was treated only with *Clausena lansium* (Rutaceae), mumps were exclusively treated with *Momordica cochinchinensis* (Cucurbitaceae), diabetes with *Aralia touranensis* (Araliaceae), aphasia with *Zanthoxylum avicennae* (Rutaceae), paralysis with *Alangium chinense* (Alangiaceae), and abscesses with *Hodgsonia macrocarpa* (Cucurbitaceae). For 12 of the 68 diseases local people used two plant species for treatment of each disease. For example, risk of miscarriage was treated with roots of *Boehmeria nivea* (Urticaceae) or with stems and leaves of *Artemisia vulgaris* (Asteraceae), and constipation was treated with leaves of *Cuscuta chinensis* (Cuscutaceae) or leaves of *Desmos cochinchinensis* (Annonaceae). For 5 diseases local people used three plant species for treatment of each disease. For example, impotence was treated with roots of *Morinda officinalis* (Rubiaceae), roots of *Morinda citrifolia* (Rubiaceae), or leaves and seeds of *Allium odorum* (Alliaceae).

The highest number of species was used to treat fairly common diseases, such as common colds, stomach ache, dysentery, weakness, itches, and diarrhoea (see Fig. 3.2).



1 Common colds, 2 Stomach ache, 3 Dysentery, 4 Weakness, 5 Itches, 6 Indigestion, 7 Diarrhoea, 8 Malaria, 9 Wounds, 10 Snake bite, 11 Fever, 12 Tooth ache, 13 Haemostatic, 14 Rheumatism, 15 Bone fractures, 16 Irregular menses, 17 High blood pressure, 18 Arthritis, 19 Sores, 20 Infection, 21 Urinating problems, 22 Sore throat, 23 Skin diseases, 24 Oedema, 25 Hemorrhage, 26 Detoxification, 27 Burns.

Fig. 3.2. Number of plant species used for different symptoms or illnesses in Ben En National Park.

Seven of the most common diseases in the research area are discussed below.

Wounds and cuts

Wounds and cuts can be caused by many agents, for instance spiny lianas, leaves of some grasses, and sharp limestone edges when people walk in the forest, and by knives, scissors, and other sharp utensils. Cuts soon become infected and may develop into deeper wounds and even skin sores. Common treatments include crushing or chewing leaves and covering cuts with them. Some plant species are commonly used for treatment of cuts and wounds, such as the leaves of *Piper betle* (Piperaceae) and leaves of *Microsorum superficiale* (Polypodiaceae), and leaves of *Eclipta prostrata* (Asteraceae).

Stomach ache

Stomach ache can be a symptom of many kinds of disease. Large numbers of medicinal plants are used against it, but only few species were said to cure the complaints completely. The Thai, Tho, and Muong ethnic groups are often quite knowledgeable on the collection and preparation of anti stomach ache plants and actively exchange recipes with other ethnic groups in the region to combat the symptoms. Medicinal plants which are used for the treatment of stomach ache are for example leaves of *Eupatorium odoratum* (Asteraceae), leaves of *Ardisia silvestris* (Myrsinaceae) or rhizomes of *Curcuma zedoaria* (Zingiberaceae).

Diarrhoea

Diarrhoea is associated with several diseases, mostly attributable to poor sanitary practices and infected drinking water. The local people in Ben En National Park prefer to drink rain water rather than boiled water. In the dry season, there is little choice, and water from Muc Lake (the lake inside the National Park) and streams is used. Many people get diarrhoea in this season. Barks, roots and leaves decoctions are specifically used to treat diarrhoea. *Celosia cristata* (Amaranthaceae) treatment was said to be effective against diarrhoea with blood, which indicates bacterial dysentery. Leaves of *Eupatorium odoratum* (Asteraceae), bark of *Melia azedarach* (Meliaceae), and bark of *Ficus auriculata* (Moraceae) are just three examples of plant species used against diarrhoea in general.

Snake bites

Naja naja, *Bugarus fasciatus*, and *Ptyas korros* are dangerous, poisonous snakes in Ben En National Park. When a person is bitten, the bite can be deadly within hours. The roots and leaves of *Gnetum montanum* (Gnetaceae), the leaves of *Phyllanthus urinaria* (Euphorbiaceae), and leaves and stems of *Gynura crepidioides* (Asteraceae) are considered to be the most effective medicinal plants to cure snake bites. The skin is sliced open, and some of the crushed or chewed plant parts are applied to the wound. This treatment must be applied as soon as possible after the bite.

Risk of miscarriage

Some medicinal plant species are used to prevent miscarriages. In the research area, pregnant women drink an extract from the leaves and stems of *Artemisia vulgaris* (Asteraceae), mixed with some salt or sugar. Another species said to be effective to prevent miscarriage is *Boehmeria nivea* (Urticaceae): boiled roots of this species are eaten during pregnancy. Muong and Tho ethnic groups claim that the older the roots, the better the effects.

Weakness

Weakness can be caused by insomnia, after giving birth or by excessive fatigue. A total of 24 plant species was used to treat weakness. Most remedies consist of a decoction of leaves and stems that is boiled and drunk as tea, such as a decoction of the stems of *Mucuna pruriens* (Fabaceae), decoction of leaves and stems of *Leonurus sibiricus* (Lamiaceae), or the whole plant of *Marsilea quadrifolia* (Marsileaceae) are used to treat insomnia. Some plants are specially used by women after childbirth, such as the leaves of *Artemisia vulgaris* (Asteraceae), roots and stems of *Jasminum subtriplinerve* (Oleaceae), or the roots of *Polygonum multiflorum* (Polygonaceae), and the stems of *Spatholobus suberectus* (Fabaceae). After sickness or exhaustion local people use the flowers of *Telosma cordata* (Asclepiadaceae), or a decoction of the roots and stems of *Fibraurea recisa* (Menispermaceae).

Common colds

A total of 39 plant species was used to treat common colds. Most remedies consisted of a decoction of leaves, which was boiled and drunk as tea, some plant species are drunk after grinding them together with sugar or salt and a little water. Some plants are specifically used to treat children's colds such as the leaves of *Allium odorum* (Alliaceae), and the leaves of *Ocimum tenuiflorum* (Lamiaceae). Some plant species could treat most kinds of colds, such as the leaves of *Blumea balsamifera* (Asteraceae), the bulbs of *Allium sativum* (Alliaceae), or leaves and roots of *Glycosmis pentaphylla* (Rutaceae). Pneumonia was clearly distinguished from the common colds and treated differently.

Collection and preparation of medicinal plants

Who is collecting medicinal plants?

From interviewing households and key informants, it emerged that women collect medicinal plants more than men at almost every age level, especially in the age classes of over 26 years old. This indicates that women are mainly responsible for health care. From the completed questionnaires it was also evident that women have a better knowledge of medicinal plants than men. Young people are rarely engaged in collecting medicinal plants (Table 3.4).

Knowledge of plants and preparation

Most of the people interviewed were familiar with the species used for the treatments of common ailments like cold/cough, fever, headache, indigestion, itches, and plant remedies were used on a regular basis. As in other rural communities (On 2003) common knowledge was learned from other community members, especially from elders and local healers who share knowledge of the mode of collection, and the preparation and administration of medicinal plants.

Table 3.4. Percentage of gender and age level of local people in Ben En National Park harvesting medicinal plants

Age	Gender	Percentage of individuals collecting medicinal plants (%)
> 50	Male	18
	Female	29
26 - 50	Male	17
	Female	27
16 - 25	Male	3
	Female	4
< 16	Male	1
	Female	1
Average % of Males		*39*
Average % of Females		*61*

Preparations of plants for medical use included decoction, paste, juice, chewing, and cooking or boiling (Table 3.5). The most common methods of the collection and preparation of medicinal plants are cutting the leaves, roots, stem or bark into small pieces and boiling them in water. For preparing a decoction, the plant parts are boiled until the liquid is reduced to about half or one third of the volume. Some decoctions are also used as steam baths. For pastes, plant parts are finely crushed or chewed, and then the resulting paste is applied to the affected part. For a juice, the plant part (mostly leaves and fruits) is extracted and drunk. For some remedies plant parts are chewed raw, then swallowed. Some plant materials can also be dried and stored for later use.

Administration of medicines

Medical administrations include oral intake, application to external body parts, rubbing/massage, and inhalation (Table 3.6). Most of the species were administered orally, mainly as a decoction or extracted from plant parts. A high number of species were externally applied mostly to treat wounds, snake bites, bleeding and itches. Rubbing applied to treat back pain, muscle pain, and in only three remedies local

people applied inhalation, for instance of steam from *Eucalyptus camaldulensis* (Myrtaceae) and bamboo leaves in boiling water, to treat fever or cold.

Table 3.5. Preparation of medicinal plants

Preparation	Medical remedies (%)
Decoction	50
Paste	24
Juice	14
Chewing	6
Cooking/boiling	4
Powder	2

Table 3.6. Mode of administration of medical remedies

Mode	No. of remedies
Oral intake	199
External application	71
Rubbing/massage	14
Inhalation	3

Commercialization of medicinal plants

A total of 18 medicinal plant species in Ben En National Park are commercialized (Appendix 3.2); of these *Zingiber officinale* (Zingiberaceae) and *Allium sativum* (Alliaceae) are cultivated species. *Curcuma zedoaria* (Zingiberaceae) is both cultivated and wild. Three wild species in high market demand are *Morinda officinalis* (Rubiaceae), *Amomum villosum* (Zingiberaceae) and *Spatholobus suberectus* (Fabaceae).

Most of the species are sold to traders or in the market of the Nhu Thanh and the Nhu Xuan districts. Traders usually sell roots of *Morinda officinalis,* roots of *Polygonum multiflorum,* roots and stems of *Smilax glabra,* roots of *Gynura japonica* and stems and barks of *Abrus precatorius* to traditional medicine shops in big cities in Vietnam. *Spatholobus suberectus* and *Amomum villosum* are exported to China.

The demand of the market and the collection intensity of *Morinda officinalis* used as aphrodisiac are especially high. From our botanical field surveys (Hoang et al. in prep.) it appeared that this species has become endangered by overcollecting of the entire plant, and will soon be extinct, at least locally, if no attempts are made to get the plant into cultivation.

Importance of medicinal plant species for the local people in Ben En National Park

Importance for health care

The eight most important species for health care by local communities are listed in Table 3.7. Most of them are used to treat common diseases such as fever, colds, flu, weakness, and for treating women after childbirth.

Five species of these important medicinal plant species are already grown in home gardens, but the number of households planting them is still low (Table 3.7).

Table 3.7. The most important medicinal plants for local people in Ben En National Park

Latin name	Common name	Origin	Percentage of households cultivating the species
Asteraceae	**Họ Cúc**		
Artemisia vulgaris L.	Ngải cứu	Temperate Europe and Asia, wild, cultivated	21
Fabaceae	**Họ Đậu**		
Spatholobus suberectus Dunn	Huyết rồng Lào	Native, wild	0
Abrus precatorius L.	Cam thảo	India, wild	0
Lamiaceae	**Họ Hoa môi**		
Leonurus sibiricus L.	Ích mẫu	Siberia, China, wild, cultivated	12
Ocimum tenuiflorum L.	Hương nhu tia	Old World Tropics, wild, cultivated	15
Plantaginaceae	**Ho Mã đề**		
Plantago asiatica L.	Mã đề	Asia, wild, cultivated	11
Zingiberaceae	**Họ Gừng**		
Zingiber officinale Blume	Gừng	China, Asia cultivated	25
Amomum villosum Lour.	Sa nhân	China, wild	0

The use index of the medicinal plant species varies widely (Table 3.8, Appendix 3.1), from 0.01 to 1, indicating that 2 species are only used by 1% of all households (*Lonicera japonica* (Caprifoliaceae) and *Xylopia vielana* (Annonaceae)), while 4 species are used by all households, all of them are common and cultivated species (*Camellia sinensis* (Theaceae)*, Allium fistulosum, Allium sativum* (Alliaceae), and *Zingiber officinale* (Zingiberaceae)). The majority of species are used by less than half of the households, and 68% of the species have use indices lower than 0.25

(Table 3.8). On average, households use 25 medicinal plant species for disease treatment (Table 3.8).

Table 3.8. Use index of medicinal plants

Use index	Number of medicinal plant species
> 0.75	18
0.51 – 0.75	16
0.25 – 0.50	39
< 0.25	157

Importance for income generation

The monetary income value for local people was calculated for each listed species. A total of 18 medicinal plant species are commercialized in Ben En National Park, but the most important species for local income are *Amomum villosum* (Zingiberaceae) and *Spatholobus suberectus* (Fabaceae). The average income from *Amomum villosum* is US$ 11 per year per household; this is about 2.5% of the total income. *Spatholobus suberectus* yields about US$ 18 per year per household (4.3% of the total income). The other species do not generate much income, though *Morinda officinalis* (Rubiaceae) has a high price but it is very rare in the field and the amount collected by local people is small. Income of local people per household in Ben En National Park is shown in Table 3.9.

Table 3.9. Income of local people per household in Ben En National Park

Resource	Income in US$	Percentage (%)	Remark
Agriculture	150	36	Crops such as rice and corn
Livestock	100	24	Pigs, chickens, dogs, and cows
Non medicinal useful plants	50	12	Bamboo, rattan, resin, timber, firewood, etc.
Medicinal plants	45	11	See Appendix 3.2
Others	75	17	Employment, fishing, trading, etc.
Total	420	100	

Comparison with other regional studies on medicinal plants in Vietnam and in the region

To see whether medicinal plants in Ben En National Park had characteristics in common with those of other national parks in Vietnam, the results of this study were

compared with the medicinal plant uses recorded by other authors. Both wild and cultivated medicinal species were taken into account (Table 3.10).

The result of this study was also compared with the medicinal plant uses recorded in the PROSEA Handbooks on Medicinal and poisonous plants (De Padua et al. 1999; Van Valkenburg & Bunyapraphatsara 2001; Lemmens & Bunyapraphatsara 2003) and Van Reede tot Drakenstein's Hortus Malabaricus (1668–1692, Manilal 2003). Out of the total of 230 medicinal plant species in Ben En National Park 128 species are listed in the PROSEA Handbooks on Medicinal and poisonous plants and 41 species used by local people in Ben En National Park were also used in the 17th century in Southwest India according to Van Reede's Hortus Malabaricus (Manilal 2003). Differences and similarities in the medicinal use of these species will be considered in the discussion.

Table 3.10. Comparison of medicinal plants in Ben En National Park with other regions in Vietnam

Study	National Park	Ethnic groups	Size of population	Area (km^2)	No of Medicinal plant species
This study	Ben En	Kinh, Muong, Thai, Tay, Tho	18,000	15,800	230
Tran & Ziegler 2001	Banh Ma	Kinh, Ta ku, Van kieu, H Mong	65,000	22,031	432
On 2003	Ba Vi	Dao	46,547	6,768	503
Thin & Nhan 2003	Pu Mat	Kinh, Thai, Kho Mu, Dan Lai, Poong, H Mong, O Du, Tay	93,333	91,113	610
Chi 1996	Entire Vietnam	54 ethnic groups	85,000.000	330,000.000	3200

Public perception and awareness

In the research area many people are able to identify medicinal plants and give recipes, but the young members of the communities demonstrate little interest in learning the traditional ethnomedical lore. About 43% of young people in all households interviewed do not know about medicinal plants and 25% do not want to learn how to use traditional medicinal plants for disease treatment. Moreover, many local people tend to use synthetic medicine instead of medicinal plants. About 47% of the households interviewed prefer to use western medicine if they can afford it.

Most local people in Ben En National Park recognized that medicinal plants are important for the health care of communities, especially for poor people. They also agreed that medicinal plants in Ben En National Park would not be endangered if they are only harvested for local treatment of diseases and not for commercial purposes. About 82% are aware that such practices had caused a decline in the abundance of many species during the last few years, especially of the expensive, economically exploited species.

Conservation status

Three medicinal plant species from Ben En are listed in the Red data list of IUCN (2006). However, there are 6 medicinal plant species used by local communities in Ben En National Park that are listed in the Red Data Book of Vietnam Vol. 2 (Ban 2007) (Table 3.11). At the local level, 18 medicinal plant species appear to be endangered, rare, or threatened (Table 3.12).

Table 3.11. Medicinal plants in Ben En National Park listed in the red data book of Vietnam (Ban 2007), and Red list of threaten species of IUCN (2006).
E - Endangered; V - Vulnerable; T - Threatened; LR - Least concern; nl - not listed

Species	Family	Threat category in Red data book Vietnam	Threat category in Red list of IUCN 2006
Alstonia scholaris L.	Apocynaceae	nl	LR
Anoectochilus roxburghii (Wall.) Lindl.	Orchidaceae	E	nl
Ardisia silvestris Pit.	Myrsinaceae	V	nl
Caesalpinia sappan L.	Caesalpiniaceae	nl	LR
Cycas pectinata Buch.-Ham.	Cycadaceae	V	V
Drynaria fortunei (Mett.) J. Sm	Polypodiaceae	T	nl
Polygonum multiflorum Thunb.	Polygonaceae	V	nl
Rauvolfia verticillata (Lour.) Baill.	Apocynaceae	V	nl

DISCUSSION

The commercial potential of medicinal plants in Ben En National Park

The diversity of medicinal plants in Ben En National Park could have a much larger potential for the local people in the research area in particular and for Vietnam in general if the medicinal plants would be processed in a more sophisticated manner, e.g. in ready-to-use tonics and powders. On the other hand, the number of commercialized medicinal plant species in Ben En National Park (18 species) is lower than in other regions: for instance, 54 species in Ba Vi National Park (On 2003) are commercialized. Moreover, the prices of commercial medicinal plant species in Ben En are not stable. The two most important species to generate income

are *Amomum villosum* and especially *Spatholobus suberectus*. The revenues they generate still depend on the traders. It would be better if local communities organized the market system. Furthermore, local people should understand and establish sustainable harvesting methods, especially for the species of high value and importance for income generation. Last but not least, the commercially valuable medicinal plant species should be further studied and planted in home gardens.

Table 3.12. Medicinal plants considered as threatened species in Ben En National Park
E - Endangered, R - Rare, T - Threatened

Species	Family	Threat category
Acorus gramineus Sol.	Araceae	R
Anoectochilus roxburghii (Wall.) Lindl.	Orchidaceae	E
Ardisia silvestris Pit.	Myrsinaceae	E
Caesalpinia sappan L.	Caesalpiniaceae	R
Catharanthus roseus L.	Apocynaceae	T
Cibotium barometz (L.) J. Sm.	Dicksoniaceae	T
Cissampelos pareira L.	Menispermaceae	R
Coscinium fenestratum (Gaertn.) Colebr.	Menispermaceae	E
Cycas pectinata Buch.-Ham.	Cycadaceae	T
Drynaria fortunei (Mett.) J. Sm.	Polypodiaceae	R
Fibraurea recisa Pierre	Menispermaceae	T
Morinda citrifolia L.	Rubiaceae	R
Morinda officinalis Haw.	Rubiaceae	E
Polygonum multiflorum Thunb.	Polygonaceae	V
Rauvolfia verticillata (Lour.) Baill.	Apocynaceae	T
Smilax glabra Wall.	Smilacaceae	T
Stephania longa Lour.	Menispermaceae	R
Stephania rotunda Lour.	Menispermaceae	R

Loss of traditional knowledge

Traditional medicinal plant species are not only important for health care of local communities but also of some importance to generate income. However, the present knowledge on traditional healing practices is being lost rapidly. Only few of the local people younger than 25 year participate in collecting medicinal plants compared to those older than 50 (Table 3.4). Furthermore, many young members of the communities do not know about medicinal plants and show little interest in learning the traditional ethnomedical lore. Traditional knowledge of medicinal plants can get easily lost because many local people tend to use synthetic medicine

instead of medicinal plants. To protect and develop the valuable knowledge of traditional medicinal plants their use should be encouraged, especially among the younger generation.

Comparisons with other regional studies on medicinal plants in Vietnam and in the region

The general patterns of plant use recorded in Ben En National Park show overlap with other ethnomedicinal studies from other national parks. Many of the recipes and ideas about illnesses and healing in Ben En are similar to those in Ba Vi (On 2003) and Pu Mat (Thin & Nhan 2003). But the comparisons also show that the number of medicinal plant species used by local people in Ben En is smaller than in other national parks in Vietnam (Table 3.10). The reason may be that the population living in the core and buffer zone of Ben En is much smaller than in other parks. Moreover, this is the first study on medicinal plants in Ben En National Park, while the number of medicinal plants used by local people according to earlier research in other regions also was smaller than according to more recent results, e.g. 200 species found in Ba Vi National Park (On 2000) (now 503 species); 200 species found in Pu Mat National Park (On 2003) (now 610 species). So future research may show the number of medicinal plant species in Ben En to be higher than the 230 species recorded so far.

A total of 172 medicinal plant species in Ben En National Park (about 75%) are also used medicinally by local people in Pu Mat National Park (Thin & Nhan 2003). Out of these 172 species, 138 species show at least one disease treatment overlapping in use and application in the two parks. The ethnic minority groups in the two regions are quite similar; both regions have Kinh, Thai, and Tay groups, and this could account for similar traditional uses. In the remaining 34 species there are no similarities in the medicinal uses, for example *Glochidion velutinum* (Euphorbiaceae) is used in Pu Mat to treat oedema; in Ben En it is used to treat stomach ache and tooth ache.

The Dao ethnic group in Ba Vi National Park (On 2003) use 114 of the medicinal plant species (about 49%) recorded here as traditional medicinal plants in Ben En National Park. Out of these 114 medicinal species, 48 overlap in at least one disease treatment between the two parks. In the remaining 68 species there are no similarities in the medicinal uses. For example, *Rauvolfia verticillata* (Apocynaceae) is used in Ba Vi against diarrhoea; in Ben En it is used to treat sores and itches. *Gymnema inodorum* (Asclepiadaceae) in Ba Vi is used to treat rheumatism; in Ben En it is used to cure indigestion. This huge divergence in traditional use of medicinal plant species in two regions is hard to understand. It raises questions about the efficacy of traditional healing methods on the one hand and on the role of cultural divergence in health care, on the other.

In order to place these patterns in a broader perspective our results on the medicinal uses of plants in the Ben En National Park were also compared with two other detailed sources of information on traditional use of medicinal plants in Asia: Hortus Malabaricus and the three PROSEA handbook volumes on Medicinal and Poisonous Plants from South-East Asia.

The Hortus Malabaricus by Van Reede tot Drakenstein, consulted in the English translation (Manilal 2003), contains a detailed account of 690 species from the Malabar Coast in India (the modern state of Kerala) with information on their medicinal uses contributed and verified by local traditional healers and Brahmins (Heniger 1986). Although the floras of SW India and Vietnam are far apart and very different, 41 species out of the 230 medicinal species from Ben En National Park were also used medicinally in India in the 17th century and documented in the Hortus Malabaricus (the asterisked species in Appendix 3.1). A very precise comparison of the uses and (presumed) activity of the medicinal preparations is not possible because both Hortus Malabaricus and our own survey suffer from the fact that actual diseases are not properly identified in line with modern medical knowledge, but rather very general symptoms are listed that may be caused by many different diseases (such as stomach ache, head ache, fever, swellings, weakness, etc., cf. Appendix 3.1). Nevertheless, it is most striking that the same species were in most cases apparently used to treat entirely different symptoms by the 17th century inhabitants and doctors of Kerala when compared with the 21st century local healers in Ben En National Park. For instance, out of the 41 species only 9 show some overlap in their use and application between the two regions, usually concerning only general symptoms like headaches, fever or itches. In the remaining 32 species no similarities in the medicinal uses could be detected at all. To give just two examples: *Morinda citrifolia* (Rubiaceae) was used in India to treat gout; in Ben En National Park it is used as an aphrodisiac and to treat sores; *Phyllanthus reticulatus* was used in India as a mouth wash and to treat rheumatism and stomach ailments; in Ben En it is used to cure skin burns. This huge divergence in traditional use of these 41 species raises similar questions about the efficacy and reliability of traditional healing methods in general as signalled above. One might also question the reliability of the informants in both analyses.

A total of 128 medicinal species from Ben En (56% of the species) have also been reviewed in the PROSEA Handbooks on Medicinal and Poisonous Plants from South-East Asia (De Padua et al. 1999; Van Valkenburg & Bunyapraphatsara 2001; Lemmens & Bunyapraphatsara 2003). In the PROSEA Handbooks information on traditional and modern use of medicinal plants is comprehensively abstracted for the whole region from continental South-East Asia (including Vietnam and Thailand) to the Indo-Pacific (Malaysia, Indonesia, the Philippines, Papua New Guinea). Here the overlap with applications documented is much greater. This is not surprising because widespread medicinal species appear to have a very wide range of traditional uses, often highly divergent from country to country or region to region,

which increases the probability that a single traditional use communicated by the local people from Ben En is among the manifold uses documented for the whole of South-East Asia. PROSEA information thus also shows a fairly high overlap with ancient uses documented in Hortus Malabaricus. In over two thirds of the medicinal species from Ben En the local application agrees with one of the numerous applications recorded in the PROSEA Handbooks. Nevertheless, for 35 species the medicinal use reported by village elders, households and local doctors in Ben En appears to be 'new'. For instance *Achyranthes aspera* (Amaranthaceae) used to treat nervous debility in Ben En, is elsewhere used to treat wounds, abscesses and boils, rheumatism, stomach ache, menstruation pains, etc.; *Tetracera scandens* (Dilleniaceae) used to treat rheumatism in Ben En, has a very wide range of applications throughout South-East Asia, including the treatment of snake bites, coughs, burns and diarrhoea without any record for rheumatism (Van Valkenburg & Bunyaprapha tsara 2001). These and other divergences between our results from the field survey and interviews in Ben En and information documented in the literature suggest that both broad and narrow inventories of medicinal plants may still be very incomplete and that further critical study is needed.

APPENDIX 3.1

Medicinal plant species used by local people

Key: * species also treated in Hortus Malabaricus; + species also treated in PROSEA

Life-form W = Wood; S = Shrub; H = Herb; C = Liana: ***Wild/Cultivated:*** W = Wild; C = Cultivated

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
POLYPODIOPHYTA – FERNS	Ngành Dương xỉ						
Adiantaceae	**Họ Tóc thần vệ nữ**						
Adiantum caudatum L.	Tóc thần vệ nữ	H	0.10	W	Leaves, stem	Fever, coughs	Decoction of leaves and stems is drunk
Aspleniaceae	**Họ Tổ chim**						
Asplenium nidus L.	Tổ điểu	C	0.04	W	Leaves, tuber	Strained muscles	Plant parts are crushed and applied externally
Blechnaceae	**Họ Ráng lá dừa**						
Blechnum orientale L.	Guột lá dừa	H	0.18	W	Leaves, stem	Wounds, snake bite	Plant parts are chewed raw or crushed, then paste applied on the affected part
Dicksoniaceae	**Họ Lông cu li**						
Cibotium barometz (L.) J. Sm.+	Lông cu li	S	0.25	W	Root	Haemostatic	Hairs from stipe bases are taken and applied on the affected part
Marsileaceae	**Họ Rau bợ**						
Marsilea quadrifolia L.	Rau bợ	H	0.23	W	Whole plant	Insomnia	Plant parts are cooked and eaten
Polypodiaceae	**Họ Dương xỉ**						
Drynaria fortunei (Mett.) J. Sm.	Cốt toái bổ	H	0.17	W	Stem, leaves, root	Strained muscles, weakness	Decoction of plant parts is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Microsorum superficiale (Bedd.) Ching	Ráng	H	0.06	W	Leaves	Wounds	Leaves are chewed and paste applied on affected part
Schizaceae	**Họ Bòng bong**						
Lygodium conforme C.Chr.	Bòng bong lá to	C	0.08	W	Leaves, stem	Indigestion	Plant parts are decocted and the decoction is drunk
Lygodium scandens (L.) Sw.	Bòng bong lá nhỏ	C	0.05	W	Leaves	Rheumatism	Juice extracted from leaves are rubbed externally on affected part
PINOPHYTA–GYMNOSPERMS	Ngành Thông						
Cycadaceae	**Họ Tuế**						
Cycas pectinata Buch.-Ham.	Tuế Lược	W	0.05	W,C	Root	Tuberculosis	Roots juice is taken with warm water
Gnetaceae	**Họ Gắm**						
Gnetum montanum Markgr.	Gắm núi	C	0.16	W	Seed	Malaria	Seeds pounded is drunk with warm water
					Root, leaves	Snakebite	leaves are chewed raw or leaves and roots are crushed and paste applied on affected part
					Seed	Detoxification	Seeds are chewed raw and swallowed
MAGNOLIOPHYTA-ANGIOSPERMS	Ngành Ngọc Lan						
MAGNOLIOPSIDA –DICOTS	**Lớp 2 lá mầm**						
Acanthaceae	**Họ Ô rô**						
Rhinacanthus nasutus (L.) Kurz*	Bạch hạc	S	0.12	W	Leaves, stem	Herpes, itches, wounds	Plant parts are crushes and paste applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Strobilanthes cystolithigera Lind.	Chuỳ hoa	H	0.05	W	Leaves	Bone fractures	Leaves are crushed and paste applied on broken part
Alangiaceae	**Họ Thôi ba**						
Alangium chinense Lour.	Thôi ba	W	0.14	W	Leaves, root	Paralysis	Plant parts are crushed in water or root are soaked in wine and applied on, then rubbed by hand
Amaranthaceae	**Họ Dền**						
Achyranthes aspera L.* +	Cỏ xước	H	0.24	W	Flower	Nervous debility	Decoction of flowers is drunk
Amaranthus viridis L.	Đơn đỏ	H	0.26	W	Leaves, root	Snakebite, bee stings	Leaves and roots are crushed and paste applied on affected part
					Leaves	Fever	Leaves are decocted, then the decoction is drunk
Amaranthus spinosus L.+	Dền cơm	H	0.26	C	Root	Fever	Roots juice is drunk
Celosia cristata L.	Mào gà	H	0.26	C	Stem, leaves, root	Diarrhea with blood	Plant parts are decocted, then the decoction is drunk
Anacardiaceae	**Họ Điều**						
Spondias lakonensis Pierre	Dâu da xoan	W	0.51	W,C	Root	Weakness after childbirth	Roots decoction is given to mother after birth
Annonaceae	**Họ Na**						
Annona squamosa L.+	Na	W	0.15	C	Leaves	Sores	Leaves are crushed, then applied externally
Desmos cochinchinensis Lour.+	Hoa giẻ	C	0.04	W	Stem	Constipation	Small pieces of stem are decocted and the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Fissistigma villosum (Ast.) Merr.	Cánh hoa có lông	C	0.24	W	Leaves, stem	Stomach ache	Leaves and small pieces of stems are decocted then the decoction is drunk
Xylopia vielana Pierre	Dền	W	0.01	W	Bark, root	Malaria	Small pieces of barks and roots are decocted, then the decoction is drunk
Apiaceae	**Họ Hoa tán**						
Centella asiatica (L.) Urb. +	Rau má	H	0.68	W	Whole plant	Detoxification, urinating problems	Plant parts are chewed raw and swallowed
Apocynaceae	**Họ Trúc đào**						
Alstonia scholaris L.*	Sữa	W	0.11	W,C	Bark	Irregular menses	Small pieces of bark are decocted, then the decoction is drunk
Catharanthus roseus (L) G.Don+	Dừa cạn	H	0.08	W	Root, stem	High blood pressure	Leaves and stems are decocted, then the decoction is drunk
					Leaves	Irregular menses	Leaves are decocted, then the decoction is drunk
					Root, leaves	Dysentery	Leaves and roots are decocted then the decoction is drunk
Plumeria rubra L.	Đại	W	0.26	C	Leaves, flower	Diarrhea	Flowers and leaves juice is drunk with warm water
					Bark	Dysentery	Small pieces of barks are decocted, then the decoction is drunk
Rauvolfia verticillata (Lour.) Baill.+	Ba gạc	S	0.23	W	Leaves	Sores, itches	Leaves are crushed and paste applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Strophanthus caudatus (Burm. F.) Kurz +	Sừng Châu	C	0.04	W	Whole plant	High blood pressure	Plant parts are decocted, then the decoction is drunk
Wrightia annamensis Eberh. & Dub.	Mức trung bộ	S	0.06	W	Leaves	Dysentery	Leaves are decocted, then the decoction is drunk
Araliacea	**Họ Ngũ ra bì**						
Aralia armata (Wall. ex G. Don) Seem.	Đơn châu chấu	W	0.68	W	Root	Sore throat	Roots are chewed raw, then swallowed
Aralia touranensis Ha	Cuồng	C	0.32	W	Leaves	Rheumatism	Juice extracted from leaves are rubbed externally on affected part
					Root	Diabetes	Roots are decocted, then the decoction is drunk
Polyscias fruticosa Harms	Đinh lăng	H	0.82	C	Leaves, root	Weakness	Leaves are eaten as vegetable, roots are soaked in wine, then drunk
					Root	Indigestion	Roots are decocted, then the decoction is drunk
Schefflera octophylla (Lour.) Harms +	Chân chim 8 lá	W	0.84	W	Leaves, bark	Itches	Leaves and barks are crushed, then applied on the affected part
					Leaves	Urinating problems, weakness	Leaves are cooked, then eaten
Asclepiadaceae							
Gymnema inodorum Decne +	Rau mơ	C	0.46	C	Root	Indigestion	Roots are chewed raw and swallowed

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Streptocaulon griffithii Hook.f. +	Hà thủ ô	C	0.51	W	Root	Stomach ache	Roots are decocted, then the decoction is drunk
Telosma cordata (Burm.f.) Merr.	Hoa lý	C	0.19	C	Flower	Weakness	Flowers are cooked, then eaten
Asteraceae	**Họ Cúc**						
Artemisia vulgaris L.+	Ngải cứu	H	0.97	C	Leaves	Head ache	Juice extracted from leaves, then drunk
					Stem, leaves	Risk of miscarriage	Juice extracted from leaves and stems, mixed with salt or sugar then drunk
					Leaves	Weakness after childbirth	Leaves are cooked, then eaten
Blumea balsamifera (L.) DC.+	Đại bi	H	0.21	W	Leaves	Colds, flu, coughs	Leaves are decocted, then the decoction is drunk
					Stem	Stomach ache	Small pieces of stems are decocted, then the decoction is drunk
Eclipta erecta L.*+	Nhọ nồi	H	0.84	W	Root	Malaria	Roots are decocted, then the decoction is drunk
					Leaves	Haemostatic, wounds	Leaves are chewed raw or crushed, then paste applied on affected part
Elephantopus scaber L.*+	Cúc chỉ thiên	H	0.32	W	Root	Stomach ache	Roots are decocted, then the decoction is drunk
					Leaves	Dysentery	Leaves are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Emilia sonchifolia (L.) DC.	Rau má lá rau muống	H	0.11	W	Leaves, root	Dysentery	Leaves and roots are decocted, then the decoction is drunk
					Leaves	Colds, flu	Leaves are decocted, then the decoction is drunk
					Leaves	Sores	Leaves are crushed, then applied on affected part
Eupatorium odoratum L.	Cỏ lào	H	0.40	W	Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
					Leaves	Diarrhea	Leaves are decocted, then the decoction is drunk
Gynura crepidioides Benth. +	Rau tàu bay	H	0.57	W	Leaves, stem	Snakebite	Leaves and stems are crushed, then paste applied on affected part
					Leaves	Haemostatic	Leaves are chewed raw or crushed, then paste applied on affected part
Gynura japonica (Thunb.) Juel+	Cúc Tam Thất	H	0.26	W	Leaves, root	Infection	Leaves and roots are crushed, then paste applied on affected part
					Leaves	Haemostatic	Leaves are chewed raw or crushed, then paste applied on affected part
Xanthium strumarium L.+	Ké đầu ngựa	H	0.51	W	Stem, leaves, root	Dysentery	Plant parts are decocted, then the decoction is drunk
					Leaves	Itches	Leaves are chewed raw then applied on affected part
Bignoniaceae	**Họ Đinh**						

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Oroxylum indicum (L.) Vent.*+	Núc nác	W	0.09	W,C	Bark, fruit	Strained muscles	Barks and fruits are decocted, then the decoction is drunk
					Bark	Dysentery	Barks are decocted, then the decoction is drunk
Bombacaceae	**Họ Bông Gạo**						
Gossampinus malabarica (DC.) Merr.	Gạo	W	0.08	W,C	Leaves, bark	Bone fractures	Leaves and barks are crushed, then paste applied on broken part
					Leaves	Dysentery	Leaves are decocted, then the decoction is drunk
Caesalpiniaceae	**Họ Vang**						
Bauhinia viridescens Desv.	Móng bò	C	0.12	W	Root	Enteritis	Roots are decocted then the decoction is drunk
Caesalpinia digyna Rottler +	Móc mèo núi	S	0.35	W	Stem, seed	Fever, coughs	Small pieces of stems and seeds are decocted, then the decoction is drunk
					Stem	Weakness	Small pieces of stems are decocted, then the decoction is drunk
Caesalpinia sappan L.*+	Vang	W	0.37	W	Leaves, root	Diarrhea	Decoction of roots and leaves is mixed with honey, then drunk
					Leaves	Haemostatic	Leaves are chewed raw, then paste applied on affected part
Senna tora L.+	Thảo quyết minh	S	0.31	W	Flower	Anodyne	Flower is pounded, then given with warm water
					Seed	High blood pressure	Decoction of seeds is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Gleditsia australis Hemsl. +	Bồ kết	W	0.28	W,C	Fruit	Tooth ache	Juice extracted from fresh fruit, then applied on affected teeth
Tamarindus indica L.+	Me	W	0.21	W,C	Fruit	Indigestion	Fruit is decocted, then the decoction is drunk
					Fruit	Fever	Fruit is eaten
Caprifoliaceae	**Họ Kim ngân**						
Lonicera macrantha (D. Don) Spreng.	Kim ngân hoa to	C	0.04	W	Leaves	Dysentery	Leaves are chewed raw, then swallowed
Lonicera japonica Thunb.+	Kim ngân	H	0.01	W	Leaves	Allergies	Leaves are decocted, then the decoction is drunk
					Flower	Dysentery	Decoction of flower is drunk
Sambucus hookeri Rehder	Cơm cháy	W	0.02	W	Leaves, stem	Leprosy	Juice extracted from leaves and stem are applied on affected part
Caricaceae	**Họ Đu đủ**						
Carica papaya L.*+	Đu đủ	W	0.36	C	Root, leaves	Coughs	Roots and leaves are decocted, then the decoction is drunk
					Fruit	Urinating problems	Fruit are eaten
Clusiaceae	**Họ Bứa**						
Cratoxylum polyanthum Korth.	Thành ngạnh	W	0.25	W	Root	Tooth ache	Roots are soaked in strong wine and applied on the hurting teeth
Garcinia oblongifolia Champ. ex Benth.	Bứa	W	0.12	W	Bark	Stomach ache	Small pieces of barks are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Combretaceae	**Họ Bàng**						
Quisqualis indica L.+	Dây giun	W	0.20	W	Leaves	Itches	Leaves are crushed, then applied on affected part
					Stem	Tooth ache	Small pieces of stems are soaked in strong wine and applied on the hurting teeth
Connaraceae	**Họ Khế**						
Cnestis palala Merr.+	Dây khế	C	0.29	W	Leaves, bark	Wounds	Leaves and bark are crushed, then paste applied on affected part
Rourea minor (Gaertn.) Leenh.* +	Khế rừng	W	0.07	W	Leaves, bark	Dysentery	Leaves and bark are decocted, then the decoction is drunk
Convolvulaceae	**Họ Rau muống**						
Argyreia acuta Lour.	Bạc thau	C	0.09	W	Stem, leaves, root	Menorrhagia	Plant parts are decocted, then the decoction is drunk
Merremia boisiana (Gagnep.) Ooststr.	Bìm bịp	C	0.16	W	Leaves	Indigestion	Leaves are chewed raw, then swallowed
Crassulaceae	**Họ Thuốc bỏng**						
Kalanchoe pinnata (Lam.) Pers. +	Thuốc bỏng	H	0.87	W,C	Stem, leaves, root	Detoxification	Juice extracted from plant part, then drunk
					Leaves	Burns	Leaves are crushed, then paste applied on affected part
Cucurbitaceae	**Họ Bầu bí**						
Cucurbita maxima Lam.	Bí đỏ	C	0.23	C	Leaves, fruit	Head ache	Leaves and fruits are cooked, then eaten

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Hodgsonia macrocarpa (Blume) Cogn.+	Đại hái	C	0.05	W	Leaves	Abscesses	Leaves are crushed then paste applied on externally affected part
Momordica cochinchinensis (Lour.) Spreng.+	Gấc	C	0.34	C	Seed	Mumps	Seeds pounded mixed with honey, then paste applied on externally affected part
					Seed	Food poisoning	Seeds pounded is given with warm water
Trichosanthes cucumeroides (Ser.) Maxim.* +	Dưa núi	C	0.04	W	Leaves, stem	Fever	Plant parts are decocted, then the decoction is drunk
Cuscutaceae	**Họ Tơ hồng**						
Cuscuta chinensis Lam. +	Tơ hồng	C	0.04	W	Whole plant	Back pain	Plant parts are heated, then applied on the back
					Whole plant	Constipation	Plant parts are decocted, then the decoction is drunk
Dilleniaceae	**Họ Sổ**						
Tetracera scandens (L.) Merr.+	Chặc chìu	C	0.15	W	Root	Rheumatism	Juice extracted from roots is drunk
					Root, stem	Stomach ache	Small pieces of roots and stems are decocted, then the decoction is drunk
Ebenaceae	**Họ Thị**						
Diospyros decandra Lour.	Thị	W	0.07	C	Leaves, fruit	High blood pressure	Decoction of leaves and fruits is drunk
Elaeagnaceae	**Họ Nhót**						
Elaeagnus bonii Lecomte	Nhót	S	0.08	C	Stem	Dysentery	Decoction of small pieces of stems is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Euphorbiaceae	**Họ Thầu dầu**						
Baccaurea ramiflora Lour.	Dâu da đất	W	0.25	W,C	Leaves	Itches	Leaves are crushed, then applied on affected part
					Leaves, fruit	Indigestion	Fresh leaves and ripen fruits are eaten
Bischofia javanica Blume	Nhội	W	0.11	W	Bark, leaves	Burns	Plant parts are crushed, then paste applied on affected part
Breynia fleuryi Beille	Bổ cu vẽ	S	0.05	W	Root	Malaria	Roots are decocted, then the decoction is drunk
Euphorbia antiquorum L.*+	Xương rồng	H	0.29	W,C	Stem	Tooth ache	Juice extracted from stems, then applied on affected teeth
Euphorbia hirta L.+	Cỏ sữa	H	0.12	W	Whole plant	Malaria	Plants parts are decocted, then the decoction is drunk
					Whole plant	Dysentery	Plant parts are decocted, then the decoction is drunk
Glochidion velutinum Wight+	Bọt ếch	S	0.48	W	Leaves, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk
					Root	Tooth ache	Roots is soaked in wine, then applied on hurting teeth
Jatropha curcas L.+	Dầu mè	W	0.04	W	Seed	Head ache	Seeds oil is applied on forehead
					Leaves	Kidney failure	Leaves are decocted, then the decoction is drunk
Mallotus barbatus (Wall.) Muell. Arg.+	Bùm bụp	S	0.12	W	Leaves, root	Dysentery	Leaves and roots are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Leaves	Haemostatic	Leaves are crushed, then paste applied on affected part
Phyllanthus reticulatus Poir.*+	Phèn đen	S	0.27	W	Leaves	Burns	Leaves are crushed, then paste applied on affected part
Phyllanthus urinaria L.	Chó đẻ	S	0.52	W	Whole plant	Sores, itches	Plant parts are crushed, then applied on affected part
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Ricinus communis L.*	Thầu dầu	S	0.14	C	Stem, bark	Weakness	Small pieces of stems and barks are decocted, then the decoction is drunk
Fabaceae	**Họ Đậu**						
Abrus precatorius L.*+	Cam thảo	S	0.86	W	Whole plant	Coughs	Plant parts are decocted, then the decoction is drunk
					Bark, stem	Throat sores	Barks and stems are chewed raw, then swallowed
Bowringia callicarpa Champ. ex Benth.	Dây bánh nem	S	0.09	W	Leaves	Rheumatism	Leaves are crushed in water, then rubbed externally
Derris elliptica Benth.+	Dây mật	C	0.03	W	Root	Nervous debility	Roots are decocted, then the decoction is drunk
Desmodium caudatum (Murray) DC.	Thóc lép	H	0.04	W	Root	Oedema	Roots are decocted, then the decoction is drunk
Erythrina fusca Lour.+	Vông đồng	W	0.27	W,C	Bark, stem	Hemorrhage	Small pieces of stems and barks are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Bark	Tooth ache	Barks are soaked in wine, then use that wine applied on affected teeth
Mucuna pruriens (L.) DC.+	Mắc mèo	C	0.48	W	Stem	Weakness	Small pieces of stems are decocted, then the decoction is drunk
Pueraria phaseoloides (Roxb.) Benth.	Sắn dây	C	0.76	C	Tuber	Weakness	Powder made from tubers is drunk with water, or cooked, then eaten
Sophora japonica L. f.	Hoa hoè	W	0.27	W,C	Seed, flower	High blood pressure	Seeds and flowers are boiled, then drunk like tea
Spatholobus suberectus Dum.	Huyết rồng lào	C	0.95	W	Stem	Weakness after childbirth	Small pieces of stems are boiled in water, then drunk
Hydrangeaceae	**Họ Thường Sơn**						
Dichroa febrifuga Lour.	Thường sơn	S	0.07	W	Leaves, root, stem	Weakness after childbirth	Plant parts are decocted, then the decoction is drunk
Lamiaceae	**Họ Hoa môi**						
Hyptis suaveolens (L.) Poit.	Tía tô dại	H	0.17	W	Root	High blood pressure	Roots are decocted, then the decoction is drunk
Leonurus sibiricus L.+	ích mẫu	H	0.87	W,C	Leaves, stem	Weakness	Leaves and stems are decocted, then the decoction is drunk
					Leaves	Hemorrhage	Leaves are crushed in warm water and mixed with some salt, then drunk
Ocimum tenuiflorum L.	Hương nhu tía	H	0.78	W,C	Leaves	Head ache	Leaves are crushed, then applied on forehead

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Leaves	Flu	Leaves are decocted, then the decoction is drunk
					Leaves	Cold	Leaves are decocted, then the decoction is drunk (special to treat children's cold)
Lauraceae	**Họ Long nảo**						
Cassytha filiformis L.*+	Tơ xanh	C	0.04	W	Stem	Malaria	Decoction of small pieces of stems is drunk
Cinnamomum iners Reinw. ex Blume+	Re hương	W	0.21	W	Bark	Indigestion	Barks is chewed raw, then swallowed
					Bark	Stomach ache	Barks pounded and mixed with honey is given with cold water
Cinnamomum cassia Blume+	Quế	W	0.82	C	Bark	Indigestion	Barks is chewed raw, then swallowed
					Bark	Stomach ache	Barks pounded and mixed with honey is given with cold water
Litsea cubeba (Lour.) Pers.+	Màng tang	W	0.12	W	Leaves, stem	Nervous debility	Plant parts are decocted, then the decoction is drunk
Litsea glutinosa (Lour.) C.B. Rob.	Bời lời nhớt	W	0.04	W	Bark, root	Dysentery	Small roots and barks are decocted, then the decoction is drunk
					Root	Enteritis	Roots are decocted, then the decoction is drunk
Leeaceae	**Họ Gối hạc**						
Leea rubra Blume +	Gối hạc	S	0.07	W	Root	Arthritis	Small pieces of roots are soaked in wine, then wine is applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Root	Stomach ache	Roots are decocted, then the decoction is drunk
Lythraceae	**Họ Bằng lăng**						
Punica granatum L.+	Lựu	W	0.15	C	Leaves	Dysentery	Young leaves are chewed raw and swallowed
Malvaceae	**Họ Bông**						
Abutilon indicum (L.) Sweet *+	Cối xay	S	0.51	W	Leaves, fruit	Fever, flu	Plant parts are decocted, then the decoction is drunk
Hibiscus rosa-sinensis L.*+	Dâm bụt	S	0.15	W,C	Leaves, stem	Sores	Plant parts are decocted, then the decoction is drunk
Sida rhombifolia L.+	Ké hoa vàng	S	0.07	W	Root, stem	Malaria	Small pieces of roots and stems are decocted, then the decoction is drunk
Urena lobata L.*	Ké hoa đào	S	0.09	W	Root, stem	Malaria	Small pieces of roots and stem are decocted, then the decoction is drunk
Melastomataceae	**Họ Mua**						
Melastoma normale D. Don	Mua	S	0.19	W	Leaves, stem	Infection	Plant parts are crushed, then paste applied on affected part
Melastoma sanguineum Sims.	Mua bà	S	0.15	W	Young leaves	Fever	Young leaves are decocted, then the decoction is drunk
					Young leaves	Sore throat	Young leaves are chewed raw, then swallowed
Meliaceae	**Họ Xoan**						
Melia azedarach L.+	Xoan	W	0.21	C	Leaves, root	Stomach ache	Plant parts are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Inner bark	Diarrhea	Inner barks are decocted, then the decoction is drunk
Menispermaceae	**Họ Tiết dê**						
Cissampelos pareira L.+	Tiết dê	C	0.11	W	Leaves, stem, root	Rheumatism	Leaves, stems and roots are crushed, then paste applied on externally
Coscinium fenestratum (Gaertn.) Colebr. +	Vằng đắng	C	0.04	W	Root, stem	Fever	Decoction of roots and stems is drunk
					Root	Dysentery	Roots are decocted, then the decoction is drunk
					Leaves	Wounds	Plant parts are crushed, then paste applied on affected part
Fibraurea recisa Pierre	Hoàng đằng	C	0.12	W	Stem	Wounds	Plant parts are crushed, then paste applied on affected part
					Stem, root	Weakness	Small pieces of roots and stems are decocted, then the decoction is drunk
Pericampylus glaucus (Lam.) Merr.	Lõi tiền	C	0.12	W	Leaves, stem	Snakebite	Plant parts are crushed, then paste applied on affected part
Pycnarrhena poilanei (Gagnep.) Forman	Phi đằng	C	0.08	W	Leaves, root	Eye sores	Plant parts are decocted, then the decoction is drunk
Stephania japonica (Thunb.) Miers+	Cam thảo	C	0.35	W	Stem, root	Diarrhea	Plant parts are decocted, then the decoction is drunk
Stephania longa Lour.	Lõi tiền	C	0.16	W	Root	Stomach ache	Plant parts are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Stephania rotunda Lour.	Củ bình vôi	C	0.51	W	Tuber	Stomach ache	Tuber decocted, then the decoction is drunk
					Tuber	Cold	Tuber decocted, then the decoction is drunk
Mimosaceae	**Họ Trinh nữ**						
Acacia farnesiana (L.) Willd. +	Keo ta	W	0.03	C	Bark, stem	Wounds	Plant parts are crushed, then paste applied on affected part
Entada phaseoloides (L.) Merr.+	Bằm Bằm	C	0.05	W	Bark, flower, leaves	Itches	Plant parts are crushed, then applied on affected part
					Bark	Malaria	Decoction of barks is drunk
Leucaena leucocephala (Lam.) De Wit	Keo dậu	W	0.02	W,C	Seed	Hookworm	Seeds pounded, then drunk with warm water
Moraceae	**Họ Dâu tằm**						
Artocarpus tonkinensis A. Chev. ex Gagnep.	Chay	W	0.12	W,C	Bark	Tooth ache	Juice extracted from barks is dipped on affected teeth, or bark are soaked in wine, then use that wine to applied on affected teeth
Broussonetia papyrifera L.	Dướng	W	0.15	W	Leaves, root	Haemostatic	Plant parts are crushed, then paste applied on affected part
Ficus auriculata Lour.	Vả	W	0.18	W	Bark	Diarrhea	Barks are decocted, then the decoction is drunk
Ficus benjamina L. +	Si	W	0.14	W,C	Latex	Itches	Latex is paste applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Ficus heterophylla L.f.*	Vú bò	S	0.15	W	Root, stem	Weakness, icterus	Small pieces of roots and stems are decocted, then the decoction is drunk
					Latex	Itches	Latex is paste applied on affected part
Ficus hispida L.f.*+	Ngái	S	0.15	W	Bark, leaves	Diarrhea	Plant parts are decocted, then the decoction is drunk
Ficus racemosa L.*	Sung	W	0.22	W,C	Leaves, bark	Stomach ache, dysentery	Plant parts are decocted, then the decoction is drunk
Morus alba L.+	Dâu	W	0.26	W,C	Fruit	Weakness	Fruits are soaked in water with sugar, then eaten and drunk
Streblus asper Lour.*+	Duối	W	0.19	W,C	Root, leaves	Sunburn	Juice extracted from leaves and roots is applied on affected part
					Leaves	Flu	Leaves are boiled, then inhaled
Myrsinaceae	**Họ Đơn nem**						
Ardisia silvestris Pit.	Lá khôi	H	0.37	W	Fruit, leaves	Stomach ache	Plant parts are decocted, then the decoction is drunk
Embelia ribes Burm.f.*+	Chua ngút	C	0.19	W	Leaves, fruit	Hookworm	Leaves and fruits are chewed and swallowed
					Leaves, bark	Snakebite	Plant parts are crushed, then paste applied on affected part
Maesa balansae Mez	Đơn nem núi	S	0.10	W	Leaves	Hiccups	Leaves are chewed raw and swallowed
					Leaves	Hookworm	Juice from leaves mixed with sugar is drunk with warm water

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Maesa sinensis A. DC.	Đơn nem	S	0.12	W	Leaves, stem	Oedema	Plant parts are decocted, then the decoction is drunk
Myrtaceae	**Họ Sim**						
Baeckea frutescens L.	Thanh hao	S	0.14	W,C	Leaves	Infection	Leaves crushed then paste applied on affected part
					Leaves, stem	Irregular menses	Plant parts are decocted, then the decoction is drunk
Eucalyptus camaldulensis Dehnh.+	Bạnh đàn trắng	W	0.51	C	Leaves	Colds, flu	Leaves are boiled with leaves of bamboo, then steam is inhaled
Eucalyptus exserta F.Muell.	Bạnh đàn	W	0.52	C	Leaves	Colds, flu, head ache	Leaves are boiled with leaves of bamboo, then steam is inhaled
					Root	Rheumatism	Roots are crushed in water, then applied on affected part
Psidium guajava L.*+	ổi	W	0.27	C	Leaves	Diarrhea, dysentery	Young leaves are chewed raw, then swallowed
Rhodomyrtus tomentosa (Aiton) Hassk.+	Sim	S	0.11	W	Stem, root	Diarrhea	Decoction of stems and roots is drunk
					Root	Itches	Juice extracted from roots is applied on affected part
Oleaceae	**Họ Hoa nhài**						
Jasminum scandens Vahl	Lài leo	C	0.04	W	Root, stem, leaves	Back pain	Plant parts are steamed, then paste applied on the back
Jasminum subtriplinerve A.DC.+	Vằng	C	0.11	W	Leaves, root	Itches	Leaves and roots crushed, then applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Root, stem	Weakness after childbirth	Plant parts are decocted, then the decoction is drunk
Oxalidaceae	**Họ Chua me**						
Oxalis corniculata L.+	Chua me đất	H	0.10	W	Stem, leaves, root	Malaria	Plant parts are decocted, then the decoction is drunk
Passifloraceae	**Họ Lạc tiên**						
Passiflora foetida L.	Lạc tiên	C	0.07	W	Root, leaves, stem	Heart weakness, anodyne	Plant parts are decocted, then the decoction is drunk
Piperaceae	**Họ Tiêu**						
Piper betle L.*+	Trầu không	C	0.53	C	Leaves	Wounds, itches	Leaves are crushed, then paste applied on affected part
Piper lolot C.DC.+	Lá lốt	H	0.32	C	Leaves	Tooth ache	Juice from leaves, then applied on the hurting teeth
Plantaginaceae	**Họ Mã đề**						
Plantago asiatica L.+	Mã đề	H	0.79	W,C	Leaves, stem	Kidney failure	Plant parts are decocted, then the decoction is drunk
					Leaves	Urinating problems, cough	Leaves are decocted then the decoction is drunk
Polygonaceae	**Họ Rau răm**						
Polygonum chinensis L. * +	Mía giò	H	0.16	W	Leaves, stem	Dysentery	Leaves and stems are chewed raw and swallowed
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Polygonum multiflorum Thunb. +	Hà thủ ô đỏ	H	0.21	W	Root	Weakness after childbirth	Small pieces of roots are decocted, then the decoction is drunk
Polygonum odoratum Lour.	Rau răm	H	0.08	C	Leaves	Malaria	Leaves are decocted, then the decoction is drunk
Portulacaceae	**Họ Rau sam**						
Portulaca oleracea L.*+	Rau sam	H	0.68	W	Stem, leaves	Weakness	Plant parts are cooked, then eaten
Rhamnaceae	**Họ Táo**						
Ziziphus mauritiana Lam.*+	Táo nhà	W	0.46	C	Leaves, root	Rheumatism	Juice extracted from leaves and roots is applied externally
					Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
					Leaves	Swellings	Leaves are crushed with salt, then paste applied on affected part
Ziziphus oenoplia (L.) Mill.+	Táo dại	W	0.04	W	Leaves, root, stem	Menorrhagia	Plant parts are decocted, then the decoction is drunk
Rosaceae	**Họ Hoa Hồng**						
Duchesnea indica (Andr.) Focke	Dâu núi	H	0.05	W	Leaves, root, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk
Persica vulgaris Mill.	Đào	S	0.09	W,C	Flower, stem	Irregular menses	Plant parts are decocted, then the decoction is drunk
Rosa chinensis Jacq.	Hoa hồng	S	0.18	C	Flower, stem	Hemorrhage	Small pieces of stems and flowers are decocted, then the decoction is drunk
Rubus cochinchinensis Tratt.	Ngấy	S	0.15	W	Leaves, fruit	Oedema, icterus	Fruits are eaten, or juice from leaves and fruit is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Leaves	Indigestion	Leaves are decocted, then the decoction is drunk
Rubiaceae	**Họ Cà Phê**						
Canthium horridum Blume+	Găng gai	S	0.25	W	Root	Dyspnea	Decoction of roots is drunk
					Leaves	Wounds	Leaves are crushed, then paste applied on affected part
Hedyotis capitellata Wall. ex G.Don+	Dạ cẩm	S	0.13	W	Leaves, root, stem	Bone fractures	Plant parts are crushed, then paste applied on affected part
Morinda citrifolia L.*+	Mặt quỉ	S	0.08	W	Whole plant	Sores	Plant parts are decocted, then the decoction is drunk
					Root	Aphrodisiacs	Roots are soaked in wine, then drunk, the longer the better
Morinda officinalis Haw.+	Ba Kích	C	0.24	W	Root, stem	High blood pressure	Plant parts are decocted, then the decoction is drunk
					Root	Aphrodisiacs	Roots are soaked in wine, then drunk, the longer soaking the better.
Mussaenda cambodiana Pierre ex Pit.	Bướm bạc	C	0.04	W	Leaves, root	Arthritis	Decoction of roots and leaves is drunk
Neolamarckia cadamba (Roxb.) Bosser*	Gáo	W	0.12	W,C	Leaves	Itches	Leaves are crushed, then applied on affected part
Paederia foetida L.+	Mơ	C	0.81	C	Leaves	Dysentery, diarrhea	Leaves are chewed raw and swallowed, or cooked with chicken egg, then eaten
Psychotria rubra (Lour.) Poit.	Lấu	S	0.56	W	Leaves, root	Kidney failure	Decoction of roots and leaves is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Rutaceae	**Họ Cam**						
Clausena excavate Burm.f.+	Hồng bì dại	W	0.09	W	Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
Clausena lansium (Lour.) Skeels+	Quất hồng bì	W	0.10	W,C	Leaves, fruit	Cancer	Plant parts are decocted, then the decoction is drunk
Euodia lepta (Spreng.) Merr. +	Ba gạc	S	0.21	W	Leaves	Measles	Leaves are heated, then paste applied on affected part
					Leaves	Itches	Leaves are crushed, then applied on affected part
Glycosmis pentaphylla Spreng.	Cơm rượu	S	0.17	W	Leaves, root	Colds, flu, coughs	Juice extracted from leaves and roots is drunk with warm water
					Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
Micromelum hirsutum Oliv.	Mắt trâu	W	0.09	W	Leaves	Itches, skin diseases	Leaves are crushed, then applied on affected part
Zanthoxylum avicennae (Lamk) DC.+	Xẻn	W	0.06	W	Root, leaves	Aphasia	Decoction of roots and leaves is drunk
Zanthoxylum nitidum (Lamk.) DC.	Xuyên tiêu	W	0.10	W	Leaves, bark	Itches	Leaves and barks are crushed, then applied on affected part
Simaroubaceae	**Họ Thanh Thất**						
Eurycoma longifolia W. Jack	Bách bệnh	S	0.19	W	Leaves, bark, root	Diarrhea	Plant parts are decocted, then the decoction is drunk
					Leaves	Infection	Leaves are crushed, then paste applied on affected part

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Solanaceae	**Họ Cà**						
Capsicum annuum L.*	ớt	S	0.08	C	Root, fruit	Malaria	Plant parts are decocted, then the decoction is drunk
Daruta metel L.*+	Cà độc dược	S	0.12	W	Leaves	Swellings	Leaves are crushed, then paste applied on affected part
Solanum indicum L.	Cà dại hoa tím	S	0.22	W	Leaves, root	Tooth ache	Juice extracted from roots and leaves, then paste applied on affected teeth
					Root	Vomiting	Juice extracted from roots is drunk with warm water
Solanum torvum Sw.+	Cà dại	S	0.13	W	Root	Tooth ache	Juice extracted from roots, then paste on affected teeth
Sterculiaceae	**Họ Chòm**						
Helicteres angustifolia L.	Thầu kén đực	S	0.20	W	Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Sterculia lanceolata Cav.	Sảng nhung	W	0.12	W	Leaves, bark	Snakebite	Leaves and barks are crushed, then paste applied on affected part
Styracaceae	**Họ Bồ Đề**						
Styrax tonkinensis (Pierre) Craib+	Bồ đề	W	0.02	W	Leaves	Pneumonia	Decoction of leaves is drunk
Theaceae	**Họ Chè**						
Camellia sinensis (L.) Kuntze+	Chè	S	1	C	Leaves	Indigestion	Tea make from fresh leaves is drunk
Ulmaceae	**Họ Du**						
Trema orientalis (L.) Blume*	Hu Đay	W	0.12	W	Leaves	Vomiting	Leaves are chewed raw with salt and swallowed

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Leaves, bark	Diarrhea	Decoction of leaves and barks is drunk
Urticaceae	**Họ Gai**						
Boehmeria nivea (L.) Gaudich.+	Gai	S	0.48	C	Root	Risk of miscarriage	Roots are boiled, then eaten
Pouzolzia zeylanica (L.) Benn.*+	Bọ mắn	S	0.15	W	Leaves	Infection	Leaves are crushed, then paste applied on affected part
Verbenaceae	**Họ Tếch**						
Clerodendrum cyrtophyllum Turcz.	Đắng cẩy	S	0.08	W	Leaves	Itches	Leaves are crushed, then applied on affected part
Clerodendrum fragrans Vent.+	Ngọc nữ	S	0.29	W	Root, Leaves	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
					Root	Rheumatism	Juice extracted from roots is rubbed externally
					Root	Irregular menses	Roots are decocted, then the decoction is drunk
Clerodendrum japonicum (Thunb.) Sweet+	Xích đồng nam	S	0.34	W	Root	Metritis, leucorrhoea, Irregular menses	Roots are decocted, then the decoction is drunk
					Root	Irregular menses	Decoction of roots is drunk
Clerodendrum paniculatum L.+	Mò trắng	S	0.10	W	Leaves, root	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
Stachytarpheta jamaicensis (L.) Vahl +	Cây đuôi chuột	H	0.06	W	Whole plant	Arthritis	Plants parts are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
					Leaves	Cold	Decoction of leaves is drunk
					Leaves	Skin diseases	Leaves are crushed, then applied on affected part
Verbena officinalis L.+	Cỏ roi ngựa	H	0.24	W	Leaves	Itches	Leaves are crushed, then applied on affected part
					Root, stem	Dysentery	Roots and stems are decocted, then the decoction is drunk
Vitex quinata (Lour.) F. N. Williams +	Đẻn	W	0.09	W	Fruit, leaves	Fever	Decoction of fruits and leaves is drunk
					Fruit	Indigestion	Fruits are eaten
Vitex trifolia L.*+	Đẻn 3 lá	W	0.07	W	Leaves	Arthritis	Decoction of leaves is drunk
Vitaceae	**Họ Nho**						
Cayratia japonica (Thunb.) Gagnep.	Nho rừng	C	0.12	C	Leaves	Bone fractures	Leaves are crushed, then paste applied on affected part
Cissus modeccoides Planch.	Chìa vôi	C	0.07	W	Root, stem	Arthritis	Decoction of leaves and stems is drunk
Tetrastigma strumarium Gagnep.	Dây quai bị	C	0.08	W	Leaves	Bone fractures	Leaves are crushed, then paste applied on affected part
					Leaves, root	Arthritis	Decoction of leaves and roots is drunk
LILIOPSIDA –MONOCOTS	Lớp 1 lá mầm						
Agavaceae	**Họ Huyết dụ**						
Cordyline terminalis Kunth	Huyết dụ	H	0.45	W,C	Root, leaves	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
Alliaceae	**Họ Hành**						

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Allium fistulosum L.+	Hành	H	1	C	Leaves, stem, Bulb	Flu, cold	Plant parts are cooked with rice, then eaten (onion soup)
Allium odorum L.+	Hẹ	H	0.61	C	Leaves	Cold	Juice extracted from leaves, then mixed with sugar is drunk (special to treat children's colds)
					Leaves, seed	Aphrodisiacs	Juice extracted from leaves is drunk or seed soaked in wine is drunk (the longer soaked the better effect)
Allium sativum L.+	Tỏi	H	1	C	Bulb	Dysentery, coughs, flu	Fresh bulbs are eaten
Araceae	**Họ Ráy**						
Acorus gramineus Aiton et Soland	Thạnh xương bồ	H	0.24	W	Leaves, stem	Stomach ache	Leaves and stems are decocted, then the decoction is drunk
Aglaonema modestum Schott	Vạn niên thanh	H	0.17	W,C	Leaves, tuber	Bone fractures	Leaves and tubers are crushed, then paste applied on affected part
Alocasia macrorrhizos (L.) G. Don+	Ráy	H	0.14	W,C	Stem, leaves	Wounds, burns	Leaves and stems are crushed, then paste applied on affected part
Amorphophallus paeoniifolius (Dennst.) Nicol.*+	Khoai nưa	H	0.09	W,C	Leaves	Detoxification	Leaves are cooked, then eaten
Homalomena occulta (Lour.) Schott	Thiên niên kiện	H	0.22	W,C	Tuber	Weakness, oughs	Decoction from tubers is drunk
Pothos repens (Lour.) Druce	Chân rết	H	0.09	W	Whole plant	Food poisoning	Plant parts are decocted, then the decoction is drunk
Arecaceae	**Họ Cau dừa**						

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Areca catechu L.+	Cau	W	0.09	C	Root, fruit	Dysentery, diarrhea	Plant parts are decocted, then the decoction is drunk
Caryota mitis Lour.	Đùng đình	W	0.12	W	Root	Stomach ache	Small pieces of roots are decocted, then the decoction is drunk
Asparagaceae	**Họ Tóc Tiên**						
Asparagus cochinchinensis (Lour.) Merr.+	Tóc tiên	H	0.16	W,C	Root	Tuberculosis	Decoction of roots is drunk
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Commelinaceae	**Họ Thài Lài**						
Commelina communis L. +	Thài lài	H	0.21	W,C	Stem, leaves	Dysentery	Plant parts are decocted, then the decoction is drunk
Cyperaceae	**Họ Cói**						
Cyperus rotundus L.+	Cỏ gấu	H	0.09	W	Tuber	Diarrhea	Tubers are decocted, then the decoction is drunk
Kyllinga monocephala Rottb.*+	Cỏ bạc đầu	H	0.21	W	Stem, leaves	Flu, fever	Plant parts are steamed, then paste applied on forehead
					Leaves, stem	Skin diseases	Plant parts are crushed, then applied externally on affected part
Dioscoreaceae	**Họ Củ mài**						
Dioscorea glabra Roxb.	Củ từ	C	0.06	W,C	Tuber	Dysentery	Decoction from tubers is drunk
Dioscorea pyrsimilis Prain & Burkill+	Củ mài	C	0.13	W	Tuber	Fever	Tubers are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Hypoxidaceae	**Họ Sâm Cau**						
Curculigo orchioides Gaertn.*+	Sâm cau	H	0.15	W	Leaves, root, stem	Rheumatism	Decoction of plant parts is drunk
Iridaceae	**Họ Sâm Đại Hành**						
Eleutherine bulbosa (Mill.) Gagnep.	Sâm đại hành	H	0.16	W	Bulb	Weakness, Indigestion	Bulbs are decocted, then the decoction is drunk
Orchidaceae	**Họ Phong Lan**						
Anoectochilus roxburghii (Wall.) Lindl.	Kim Tuyến	H	0.03	W	Whole plant	Weakness	Plant parts are decocted, then the decoction is drunk
Pandanaceae	**Họ Dứa**						
Pandanus tectorius Parkinson+	Dứa gỗ	S	0.06	W	Leaves, root, stem	Hemorrhage	Plant parts are decocted, then the decoction is drunk
Pandanus tonkinensis Mart. ex Stone	Dứa	S	0.05	W	Fruit	Sunburn	Juice extracted from fruits is rubbed externally
					Root	Oedema	Roots are decocted, then the decoction is drunk
Phormiaceae	**Họ Hương bài**						
Dianella ensifolia (L.) DC.+	Hương bài	H	0.30	W	Root	Wounds, infection	Roots are crushed, then paste applied on affected part
Poaceae	**Họ Cỏ**						
Chrysopogon aciculatus (Retz.) Trin.*	Cỏ may	H	0.09	W	Leaves, root, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Cymbopogon citratus (DC.) Stapf.+	Sả	H	0.08	C	Whole plant	Bone fractures	Plant parts are crushed, then paste applied on affected part
Eleusine indica (L.) Gaertn.	Cỏ Mần trầu	H	0.15	W	Leaves	Flu	Leaves are decocted, then the decoction is drunk
					Root	Urinating problems	Fresh roots are chewed and swallowed
Smilacaceae	**Họ Cầm Cang**						
Smilax corbularia Kunth+	Kim cang bạc	C	0.09	W	Leaves, root, stem	Indigestion	Plant parts are decocted, then the decoction is drunk
Smilax glabra Wall. +	Thổ phục linh	C	0.12	W	Root, stem	Arthritis	Plant parts are decocted, then the decoction is drunk
					Root, stem	Skin diseases	Juice are extracted from roots and stems is rubbed externally
					Root, stem	Bone fractures	Plant parts are crushed, then paste applied on affected part
Zingiberaceae	**Họ Gừng**						
Amomum villosum Lour.+	Sa nhân	H	0.36	W	Seed	Stomach ache	Seeds pounded is mixed with honey, then drunk with cold water
					Seed	Malaria	Seeds pounded is given with warm water
Curcuma domestica Valeton = *C. longa* L. +	Nghệ	H	0.77	C	Rhizome	Throat sores	Fresh pieces of rhizomes are chewed and swallowed
					Rhizome	Stomach ache	Small pieces of rhizomes are cooked with honey, then eaten

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Zingiber officinale Blume*+	Gừng	H	1	C	Rhizome	Weakness	Small pieces of rhizomes are soaked in wine, then drunk
					Rhizome	Indigestion, flu	Juice extracted from rhizomes is given with warm water
Curcuma zedoaria (Berg.) Roscoe+	Nghệ đen	H	0.48	C	Rhizome	Stomach ache	Small pieces of rhizomes are cooked with honey, then eaten

APPENDIX 3.2
Commercial medicinal plant species

Scientific name	Common name	Abundance in the wild	Intensity of collection	The price in US$ (1$ = 16,000 Vietnamese dong)	Market demand
POLYPODIOPHYTA-FERNS	Ngành Dương xỉ				
Dicksoniaceae	**Họ Lông cu li**				
Cibotium barometz (L.) J. Sm.	Lông cu li	Low	Medium	0.32/dried kg root	Medium
MAGNOLIOPHYTA-ANGIOSPERMS	Ngành Ngọc Lan				
MAGNOLIOPSIDA–DICOTS	Lớp 2 lá mầm				
Araliaceae	**Họ Ngũ ra bì**				
Schefflera octophylla (Lour.) Harms	Chân chim 8 lá	High	Medium	0.07/kg fresh leaves	Medium
Asclepiadaceae	**Họ Hà thủ ô**				
Streptocaulon griffithii Hook.f.	Hà thủ ô	Medium	Medium	Not stable	Medium
Asteraceae	**Họ Cúc**				
Gynura japonica (Thunb.) Juel.	Cúc Tam Thất	Medium	Medium	Not stable	Medium
Fabaceae	**Họ Đậu**				
Abrus precatorius L.	Cam thảo	Medium	Medium	Not stable	Medium
Spatholobus suberectus Dum.	Huyết rồng lào	High	High	0.06/kg dried stem	High
Lauraceae	**Họ Long nảo**				
Cinnamomun cassia Blume	Quế	Low	Low	0.7/ kg dried bark	Medium
Myrsinaceae	**Họ Đơn nem**				
Ardisia silvestris Pit.	Lá khôi	Low	Low	0.1/kg fresh leaves	Medium

Scientific name	Common name	Abundance in the wild	Intensity of collection	The price in US$ (1$ = 16,000 Vietnamese dong)	Market demand
Polygonaceae	**Họ Rau râm**				
Polygonum multiflorum Thunb.	Hà thủ ô đỏ	Low	Medium	0.6/kg fresh tuber	Medium
Rubiaceae	**Họ Cà Phê**				
Morinda officinalis Haw.	Ba Kích	Low	High	2.5/kg fresh tuber	High
Mussaenda cambodiana Pierre ex Pit.	Bướm bạc	Medium	Medium	Not stable	Low
LILIOPSIDA-MONOCOTS	Lớp 1 lá mầm				
Alliaceae	**Họ Hành**				
Allium sativum L.	Tỏi	Cultivated		0.07/4 tubers	High
Araceae	**Họ Ráy**				
Acorus gramineus Soland	Thạnh xương bồ	Medium	Medium	1.9/kg dried stem	Low
Homalomena occulta (Lour.) Schott	Thiên niên kiện	Medium	Medium	0.32/kg dried stem	Medium
Smilacaceae	**Họ Cầm Cang**				
Smilax glabra Wall. ex Roxb.	Thổ phục linh	Medium	Medium	Not stable	Medium
Zingiberaceae	**Họ Gừng**				
Amomum villosum Lour.	Sa nhân	High	High	0.6/kg dried seed	High
Curcuma zedoaria (Berg.) Roscoe	Nghệ đen	Low in wild, but cultivated	Medium	0.95/kg fresh rhizome	High
Zingiber officinale Blume	Gừng	Cultivated		0.7/kg fresh rhizome	High

Chapter 4

USES AND CONSERVATION OF PLANT SPECIES IN A NATIONAL PARK A CASE STUDY OF BEN EN, VIETNAM

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ABSTRACT

This paper surveys the use of wild and cultivated plants by local people in Ben En National Park, Vietnam, and analyzes its impact on the conservation status of some of the utilized species. A total of 208 species used for a range of non-medicinal purposes are listed (see Hoang et al. 2008 b) for 230 medicinal plants used in the Park. Most species are used for food. The use of plants contributes very significantly to the livelihood of local people in the Park, but the current use patterns are not sustainable and would lead to local extinction of rare and endangered species if no additional conservation measures are introduced. Men are collecting non-medicinal plants more often than women. A total of 38 useful plant species are commercialized, and contribute 12% of the average income of individual households. Bamboo shoots of *Schizostachyum funghomii* (Poaceae) are the most important for income generation. The monetary equivalent of non-commercialized useful plants probably far exceeds the value of the traded plant products. Plant use is independent of the ethnicity of the different populations living in the Park. Larger households make use of a greater variety of useful plant species than small families. Abundant species in the forest have a higher use index (UI) than less common species. Out of the 208 useful species, as many as 27 were found to be endangered locally, many more than the 11 or 8 endangered species included in national or global red lists. Currently, useful plants, especially important timber trees are more abundant in the less disturbed parts of the Park, far away from the villages,

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indicating the pressures of illegal logging and harvesting near villages on the ecosystems.

Key words: Useful plants, Ben En National Park, food plants, construction, firewood, household tools, conservation, Use Index.

INTRODUCTION

Ben En National Park is one of 30 National Parks in Vietnam, established in 1992 to conserve the rich, but seriously threatened biodiversity of the country. The Ben En area was designated for the protection of fauna in 1979, and as a nature reserve in 1986, although commercial logging operations continued until 1992. The Park is inhabited by 4000 local people belonging to five ethnic groups. Although initially all uses of wild natural resources were forbidden in the National Parks, current policies in Vietnam seek to find an optimal and realistic balance between conservation and sustainable use of natural resources, also within the boundaries of the National Parks. Apart from very preliminary species surveys (Anonymous 2000; Todoff et al. 2000), very little is known of both the plant biodiversity and ethnobotany of Ben En. The current study of native and cultivated plant use in the Park forms part of a larger study including traditional medicinal plant use (Hoang et al. 2008 b) and detailed botanical plot studies analysing the effect of selective harvesting of NTFP and of illegal logging on the plant species diversity within the Park (Hoang et al. 2008 c; Hoang et al. 2008 in prep.). This knowledge is crucial for the development of a sound management policy that is both aimed at nature conservation and improving the livelihood of the local communities within the Park.

The commercial extraction of useful plants as a conservation strategy is based on the argument that forest conservation must be able to offer economic incentives to local rural people in order to counter the threat of destructive land uses such as logging, shifting cultivation, and cattle ranching (Amacher 2002; Nepstad & Schwartzman 1992; Panayotou & Ashton 1992). However, the growing commercial trade of natural products, in particular medicinal plants and woodcrafts, has resulted in increasing exploitation of wild plant populations (Lange 1998) and this has generated concern about threats for local extinction (Cunningham 2001; Clay 1997; Tiwari 2000).

Specific research questions of the present study are: 1) which plant species are used for which purpose; 2) which species are commercialized; 3) what is their relative importance for the local communities based on a use index and on monetary revenues from commercialised species; 4) what is the impact of local people on these useful plants in the wild; and 5) how do factors such as ethnicity, size of each household, and species density in the park affect plant use?

The answers to these questions can hopefully serve to model management strategies in other National Parks in Vietnam and elsewhere and contribute to the conservation of both cultural and plant diversity.

METHODOLOGY

Ethnobotanical inventory

Household surveys and interviews were carried out in 45 randomly-selected households per village (out of a total of about 110 – 150 households per village) during a 6 months field survey held from October 2005 to March 2006 by the senior author and 4 students. The standard interviews contained specific questions on age, gender and ethnic background of the gatherers and main users of plant products. Additionally we used the 'walk-in-the-wood' method (Prance et al. 1987), to determine which products are harvested (and for what purpose) in the forests surrounding the villages. These trips were also used to collect voucher specimens for reliable identification of the harvested plants. Special collecting trips were organized with local experts, for instance people usually collecting useful plants, or locals with a detailed knowledge of plants. Furthermore several companies making furniture in and around the research area were visited to determine which timber species were used and from which sources they came. Local names were noted during these surveys as recommended by Martin (1995). Most information was double-checked with different informants and with manuals such as the Flora of Vietnam (Ho 2000), the manual on Non timber forest products in Vietnam (Hung 2007), and the PROSEA Handbooks (1989 – 2003). Market inventories were used to determine the price of the forest products. These served as an independent way to determine which products are harvested from the surrounding forest. We also assessed local uses of these forest products.

All plants that were considered by local people to have useful properties were collected and identified. These plants not only included wild species, but also cultivated plants and wild plants that had been taken from the forest and planted in gardens or agricultural fields. One herbarium voucher of each specimen was deposited in the herbarium of the Vietnam Forestry University, additional vouchers were sent to the National Herbarium of the Netherlands (L) and specialists elsewhere for identification.

The importance of useful plant species was identified using standard Participatory Rural Appraisal (PRA) techniques (PID & NES 1989; Ngai 2001), where local people were asked to rank a list of regularly used plants. We also quantified the relative use of species by calculating a Use Index (UI) based on the proportion of households utilizing a given species (see below).

The relative importance of timber species was assessed using three criteria: (1) ranking of species from a given list by forest rangers of Ben En National Park, who were asked how often certain illegally harvested species were confiscated from local people both inside and outside the Park, (2) proportion of listed species harvested by local people, and (3) frequency of tree stumps found during the field inventory. Stumps were identified by leaves, and fruits or flowers left in the forest when the timber trees had been felled very recently or from sucker shoots when the trees had been felled a long time ago. Bark characters were also used to identify the stumps. Additionally, local informants with expertise in tree (and stump) identification assisted us.

The market demand, intensity of collection and abundance in the wild were classified as low, medium or high (based on the interviews with local people, and by using PRA techniques).

Plants were divided into five end-use categories, largely following Prance et al. (1987):

a. Food: Any plant or plant part (fruits, seeds, leaves, bark, flowers, or latex) used for human consumption.
b. Construction: All roundwood and sawn boards used for house frames, furniture, canoes and bridges.
c. Household tools and related products: All plants or plant parts used for house equipment, handicrafts, tools, poisons, shampoo, candles.
d. Medicine (see Hoang et al. 2008 b).
e. Firewood: All plants that are used for firewood, including charcoal.
f. Others: Plants used as ornamentals, wrapping material, or pulp and paper.

Plants with multiple uses fall in more than one category.

Plot inventory

For a detailed analysis of plant biodiversity patterns in the Park (Hoang et al. 2008 a), and to study the impact of local people on collecting useful plants in the wild (this study) we established 41 transects, 200 m long, at 250 m intervals at right angles to and along the old logging road from Song Chang forest ranger station to Cong troi. The total length of these transects combined is ca. 7.4 km. We also established four 10 x 10 m plots at 50 m from the logging road and at 40 m forward intervals on each transect, resulting in ca. 147 plots for all transects combined (in some transects we were not able to establish four plots, because of steep, inaccessible limestone slopes). In each plot of 10 x 10 m, all trees with a dbh $\geq$ 5 cm were identified. In this study we combined four plots in each transect into one larger plot (we use the word 0.04 ha plot for these combined plots). We also established six transects to cover the rest part of the Park, with a total length of about 26 km. In each transect we noted all species and collected specimens of plants which could not be identified in the field. In all six transects we established 30 random plots of 10 x 10 m, and identified all species in the plots. Furthermore we also collected many plants outside the plots and transects, to make sure that our inventory was as representative as possible of the entire species richness of the local flora.

Data analysis

The database resulting from the ethnobotanical inventory was used to calculate a use index (UI) for each species by using the following equation:

$$UI = Us/N$$

Where Us is the number of households which mentioned a use for species s; N is the total of households that were interviewed in the research area. This Use Index is a modification from the Use Value (UV) introduced by Phillips & Gentry (1993) and recently used by De Lucena et al. (2007), which is calculated from the relative number of times a species is mentioned by various informants in ethnobotanical inventories.

Simple regression analysis (SPSS 16.0) was used to examine whether the number of stumps, and distances from villages to plots relate to number of useful plants and number of important timber trees; the relation between Use Index and number of useful plant species and number of important timber trees in plots; and the number of people in each household and number of useful plant species used by their households. Additionally, we used One Way ANOVA analysis to test if the number of useful plant species used is different among ethnic groups.

RESEARCH AREA

Field work was conducted in Ben En National Park, situated in Nhu Thanh and Nhu Xuan districts of the Thanh Hoa province in Vietnam, 19° 40' N by 105° 21' to 105° 35' E (Fig. 1.1). Before its establishment in 1986, the Park was a logging enterprise, resulting in the fact that big trees with a diameter at breast height of over one meter were rarely observed during our field work. Ben En National Park was established as a protected area in 1986 and as a National Park in 1992. Since then all logging activities are illegal. The core zone of the National Park covers 15,800 ha, while the buffer zone covers around 12,000 ha. About 18,000 people live in the buffer and core zones of the National Park (Tordoff et al. 2000). The majority of the people living in the National Park belong to the Kinh, Thai, Muong and Tay ethnic groups; although there are also a small number of Tho people. All ethnic groups have their own languages, but all can communicate in the national King (Viet) language. Most households in the research area have their own home garden, varying in size from 100 to 2,000 sq.m implying that 26% of the total land in the buffer zone is thus managed by local people. This includes 2620 ha (8.4%) of secondary forest and poor forest lands, 2256 ha (7.3%) of bare land or land with some small trees and shrubs, 443 ha (1.4%), of plantation forest and 2554 ha (8.2%) of agricultural land. There are plans to allocate more land to local households in the future. In some areas, land is being planted with sugar cane, cassava, in other areas reforestation is taking place with *Eucalyptus camaldulensis*, (Myrtaceae), *Acacia mangium*, *A. auriculiformis* (Mimosaceae), *Hevea brasiliensis* (Euphorbiaceae), and fruit trees.

The interviews were carried out in three villages: Xuan Thai, Binh Luong and Hoa Quy. Additional information on useful plants was collected in the Ben Sung, Yen Cat, and Xuan Thai markets and from several companies making furniture in and around the Park. There are nine vegetation types in Ben En National Park (Hoang et al. 2008 a): the vegetation of the core zone is dominated by tropical evergreen forest, which has been disturbed by human activities, principally by logging.

RESULTS

Diversity of useful plant species

A total of 208 plant species were found to be used by local people in Ben En National Park (excluding medicinal plant species which are surveyed elsewhere, see Hoang et al. 2008 b). These species belong to 130 genera and 64 families. A complete list of useful, non-medicinal plant species is given in Appendix 4.1.

From the 208 useful species, 59% are collected exclusively from the wild (primary, secondary and logged-over forest); 31% of the species are cultivated in home gardens or in fields and mostly used as vegetables or for their fruits, e.g. *Mangifera indica* (Anacardiaceae), *Artemisia vulgaris* (Asteraceae), *Diospyros kaki* (Ebenaceae); another 10% of the species are taken from the forest and planted in home gardens, e.g., *Garcinia cowa*, *Garcinia multiflora* (Clusiaceae), and *Dracontomelon dao* (Anacardiaceae).

Plant parts used

In Appendix 4.1 the different plant parts used of each species are indicated. Stems of trees, shrubs and lianas are most commonly used, for construction, firewood or handicrafts. Fruits and leaves are also commonly used; mostly for food. 22 species are used by local people as whole plants, mostly for ornamental purposes, e.g. *Euphorbia pulcherrima* (Euphorbiaceae), *Acanthopanax trifoliatus* (Araliaceae); some small plants are used as vegetables such as *Centella asiatica* (Apiaceae). Local people use seeds, resin, branches or bark. For instance, seeds of *Michelia tonkin*ensis, *Michelia mediocris* (Magnoliaceae) are used as spice for food; resin of *Canarium album* and *Canarium tramdenum* (Burseraceae) is used for making candles. Bark of *Artocarpus tonkinensis* (Moraceae) is chewed together with leaves of *Piper betle* (Piperaceae) and fruits of *Areca catechu* (Arecaceae) - this is a traditional custom in Vietnam.

Diversity of commodity groups

Table 4.1 shows the distribution of useful plants in the five end-use categories. The different commodity groups are discussed below.

Table 4.1. Commodity groups of useful plants in Ben En National Park

Commodity group	Number of plant species	Percent/total (%)
Food	142	68
Construction	40	19
Firewood	25	12
Household tools and related products	18	9
Other	16	8

Food

Food (fruits and vegetables) is the most important end-use category. Sixty wild species are collected from the forest, e.g. leaves of *Meliantha suavis* (Opiliaceae), *Maesa balansae* (Myrsinaceae), *Vernonia solaniflora* (Asteraceae), *Callipteris esculenta* (Athyriaceae), *Erythropalum scandens* (Olacaceae), *Schefflera octophylla* (Araliaceae), fruits of *Baccaurea ramiflora* (Euphorbiaceae), and tubers of *Dioscorea persimilis* (Dioscoreaceae). A total of 64 wild species have already been introduced in home gardens or agricultural fields such as *Polyscias fruticosa* (Araliaceae), *Telosma cordatum* (Asclepiadaceae), *Dracontomelon dao, Spondias lakoensis* (Anacardiaceae). All households interviewed collect bamboo shoots of *Schizostachyum funghomii* (Poaceae) for food; 32% of the households collect these shoots also for trading, both fresh and dried in local markets, and sell them to traders from Yen Cat, Ben Sung and Bai Tranh, three neighboring towns at 8–20 km distance from Ben En.

Construction

Although Ben En was established as a National Park in 1992, illegal logging is still taking place by people inside and outside the Park. A total of 40 species are used by local people for construction and furniture, e.g. *Erythrophleum fordii* (Caesalpiniaceae), *Paviesia annamensis* (Sapindaceae), *Vatica odorata* (Dipterocarpaceae), *Actinodaphne obovata* (Lauraceae), *Dysoxylum cauliflorum* (Meliaceae). Some rattan and bamboo species such as *Dendrocalamus barbatus* and *Bambusa blumeana* (Poaceae) are used for construction of animal cages (pigs, cows, buffaloes, chickens), and some households still use leaves of the palm *Livistona chinensis* for thatching. The 15 most important local timber species, according to the interviews with forest rangers and local people, and according to their stump frequency in the research plots (Hoang et al. 2008 a; Hoang et al. in prep.) are listed in Table 4.2.

Firewood

All households in the research area still depend on firewood for their cooking, also for heating and other energy sources; 25 species were recorded for firewood use; most of them are collected from the forest, and the forest land that belongs to the individual families. Small trees or branches are used that can easily be chopped into small pieces and quickly lit, from species such as *Xylopia pierrei* (Annonaceae), *Cratoxylum polyanthum* (Clusiaceae), *Melastoma normale*, or *Melastoma septemnervium* (Melastomataceae). Some cultivated species are also used such as *Acacia auriculaeformis*, *Acacia mangium* (Mimosaceae), *Eucalyptus camaldulensis* (Myrtaceae), *Pinus massoniana,* and *Pinus merkusii* (Pinaceae). Local people also make charcoal by burning the stumps and branches of *Erythrophleum fordii* (Caesalpiniaceae) that have already been cut for their timber.

Table 4.2. Important timber trees in Ben En National Park and their use index (UI)

Scientific name	Family	Use Index (UI)
Actinodaphne obovata Blume	Lauraceae	0.65
Aglaia spectabilis (Miq.) S.S. Jain & Bennet	Meliaceae	0.56
Amesiodendron chinense (Merr.) Hu	Sapindaceae	0.56
Aphanamixis grandifolia Blume	Meliaceae	0.53
Dysoxylum cauliflorum Hiern	Meliaceae	0.78
Erythrophleum fordii Oliv.	Caesalpiniaceae	0.99
Garcinia fagraeoides A. Chev.	Clusiaceae	0.52
Lagerstroemia calyculata Kurz	Lythraceae	0.81
Michelia mediocris Dandy	Magnoliaceae	0.84
Parashorea chinensis Wang Hsie	Dipterocarpaceae	0.81
Pavieasia annamensis Pierre	Sapindaceae	0.85
Peltophorum tonkinensis Pierre	Caesalpiniaceae	0.54
Phoebe paniculata Nees	Lauraceae	0.66
Vatica harmandiana Pierre	Dipterocarpaceae	0.54
Vatica odorata (Griff.) Symington	Dipterocarpaceae	0.50

Household tools and related products

A total of 18 species are used for household tools and related products, e.g. *Dendrocalamus barbatus, Bambusa blumeana,* and *Schizostachyum funghomii* (Poaceae) to make baskets; *Calamus balansaeanus, Calamus faberi,* and *Calamus tetradactylus* (Arecaceae) for handicrafts, e.g. cane chairs and tables, pillows, boxes; and *Baeckea frutescens* (Myrtaceae) for making brooms.

Other uses

Only 11 species are used as ornamental plants in the research area: e.g. *Camellia amplexicaulis* (Theaceae)*, Acanthopanax trifoliatus* (Araliaceae), *Cycas revoluta* (Cycadaceae)*, Barringtonia acutangula* (Lecythidaceae) and several orchid species.

Leaves of *Phrynium placentarium* (Marantaceae) are used for wrapping rice cake. Twelve species are collected for paper making, e.g. *Acacia auriculaeformis, Acacia mangium* (Mimosaceae), and *Schizostachyum funghomii* (Poaceae), and sold to a pulp mill in Lam Son, 15 km away from the Park. *Pterocarya tonkinensis* (Juglandaceae) is used to stupefy fish: leaves are crushed and immersed in streams and ponds as a mild fish poison that immobilises the fishes but does not affect their edibility after the fish is caught in this way.

Commercialization of useful plants

A total of 38 of the 208 useful species in the Park are commercialized. Most of these species are sold to traders or in the local markets. The commercial plant species are listed in Appendix 4.2. Of these, 14 are cultivated in home gardens, mostly as fruit trees and vegetables, e.g. *Musa paradisiaca* (Musaceae), *Citrus maxima, Citrus sinensis* (Rutaceae), *Psidium guajava* (Myrtaceae), *Ocimum basilicum* (Lamiaceae), *Luffa cylindrica* and *Lagenaria siceraria* (Cucurbitaceae). The remaining 24 commercial species are collected from the forest for a variety of end-uses such as resin for candle manufacturing from *Canarium album* and *Canarium tramdenum* (Burseraceae) or leaves and shoots as vegetables, e.g., from *Meliantha suavis* (Opiliaceae) and *Schizostachyum funghomii* (Poaceae). Illegal logging of 15 timber species (Table 4.2) for domestic use and trade is still ongoing. The most important species is *Erythrophleum fordii* (Caesalpiniaceae). The timber is sold to traders or furniture manufacturers.

Only 24 families collect firewood for trade, but the income from it is low. Eight families produce charcoal for trading at a price of about 6 US$ /100 kg.

The income of each commercialized plant species is shown in Appendix 4.2.

Income of local people per household in Ben En National Park is shown in Table 4.3.

Table 4.3. Annual income per household in Ben En National Park

Resource	Income in US$	Percentage (%)	Remarks
Agriculture	150	36	Crops such as rice and corn
Livestock	100	24	Pigs, chickens, dogs, and cows
Non-medicinal useful plants	50	12	See Appendix 4.2
Medicinal plants	45	11	See Hoang et al. 2008 a
Others	75	17	Employment, fishing, trading, etc.
Total	420	100	

Who is collecting useful plants?

From interviewing households and key informants, it emerged that men collect useful plants more often than women at almost every age level, especially in the age classes from 20 to 50 (Table 4.4). This is in contrast to medicinal plants which are chiefly collected by women (Hoang et al. 2008 b). Moreover, activities such as cutting timber, harvesting firewood, collecting honey and making charcoal are almost all carried out by men. Young people participate more actively in collecting non-medicinal useful plants than medicinal ones (Hoang et al. 2008 b). However, people younger than 25 years are less active in collecting both non-medicinal useful and medicinal plants than older people. The older people in the research area have a better knowledge of useful plants, and many young people in the research area are employed outside the Park (Hoang et al. 2008 b).

Table 4.4. Gender and age classes of local people harvesting useful plants in Ben En National Park

Age	Gender	Percentage of individuals harvesting useful plants (%)
> 50	Male	15
	Female	8
26 - 50	Male	34
	Female	23
16 - 25	Male	8
	Female	7
< 16	Male	3
	Female	2
Average % of Males		*60*
Average % of Females		*40*

Importance of useful plants for the local communities

Firewood is considered to be the most important by local people, irrespective of which species is used. All households in the study area use firewood as the main fuel to cook food for people and pigs (pigs are also an important source of income – see Table 4.3), and for heating. In fact, the prices of the alternative fuels like electricity, gas and kerosene are too high and cannot be afforded by the local people while firewood is freely available. Additional to firewood, the bamboo shoots of *Schizostachyum funghomii* (Poaceae) are also very important because they are not only collected for local consumption, but also for generating cash. The average income from this species was 13 US$ / per year / per household in 2005. *Erythrophleum fordii* (Caesalpiniaceae) is the most important timber species, not only for timber, but also for charcoal.

The use index of species varies widely (Appendix 4.1), from 0.01 to 1, indicating that some species are only used by 1% of all households (e.g. the orchid *Dendrobium aloideum* used by only two households for ornamental purposes), while others are used by virtually all households (e.g. onion, ginger, garlic, and sweet potato). Most species with an UI higher than 0.75 are cultivated food plants, but some timber trees also have a high use value such as *Erythrophleum fordii* (Caesalpiniaceae) (0.99), *Pavieasia annamensis* (Sapindaceae) (0.85), *Michelia mediocris* (Magnoliaceae) (0.84), and *Parashorea chinensis* (Dipterocarpaceae) (0.81). The vast majority of species are however used by less than half of the households, and 37% of the useful species have use indices lower than 0.25.

Conservation status

A total of 8 plant species used by local people from Ben En National Park are listed in the Red Data List of IUCN (2006), and 11 species are listed in the Red Data Book of Vietnam (Ban 2007) (Table 4.5).

Table 4.5. Useful plants in Ben En National Park listed in the Red list of IUCN 2006, the Red Data Book of Vietnam (Ban 2007), and considered as threatened species in Ben En National Park on the basis of this study.
E - endangered, CR - critically endangered, V - vulnerable, R - rare, T - threatened, K - insufficiently known, LR - least concern, nl - not listed.

Species	Family	Threat category in Red book of Vietnam	Threat category in Red list of IUCN 2006	Threat category in Ben En (this study)
Actinodaphne obovata Blume	Lauraceae	nl	nl	T
Aglaia spectabilis (Miq.) S.S. Jain & Bennet	Meliaceae	V	nl	T
Alstonia scholaris (L.) R. Br.	Apocynaceae	nl	LR	nl
Amesiodendron chinense (Merr.) Hu	Sapindaceae	nl	LR	T
Aphanamixis grandifolia Blume	Meliaceae	nl	nl	T
Caesalpinia sappan L.	Caesalpiniaceae	nl	nl	R
Calamus platyacanthus Warb. ex Becc	Arecaceae	V	nl	R
Calamus tetradactylus Hance	Arecaceae	nl	nl	R
Canarium tramdenum Chan Dinh Dai & Yakovlev	Burseraceae	V	nl	R
Chukrasia tabularis A. Juss.	Meliaceae	V	LR	nl
Cycas chevalieri Leandri	Cycadaceae	LR	CR	R
Cycas revoluta Thunb.	Cycadaceae	nl	nl	R
Dysoxylum cauliflorum Hiern	Meliaceae	V	nl	T
Erythrophleum fordii Oliv.	Caesalpiniaceae	nl	E	T
Garcinia fagraeoides A. Chev.	Clusiaceae	V	nl	E
Hopea odorata Roxb.	Dipterocarpaceae	nl	nl	R
Hopea chinensis (Merr.) Hand.-Mazz.	Dipterocarpaceae	nl	CR	R
Lagerstroemia calyculata Kurz	Lythraceae	nl	nl	R
Manglietia fordiana Oliv.	Magnoliaceae	V	nl	R
Markhamia stipulata (Wall.) Seem. ex Schum.	Bignoniaceae	V	nl	E
Meliantha suavis Pierre	Opiliaceae	V	nl	R
Michelia mediocris Dandy	Magnoliaceae	nl	nl	R
Parashorea chinensis (Wang Hsie) H. Zhu	Dipterocarpaceae	nl	E	T
Pavieasia anamensis Pierre	Sapindaceae	nl	nl	T

Species	Family	Threat category in Red book of Vietnam	Threat category in Red list of IUCN 2006	Threat category in Ben En (this study)
Peltophorum tonkinensis Pierre	Caesalpiniaceae	nl	nl	V
Phoebe paniculata Nees	Lauraceae	nl	nl	T
Vatica odorata (Griff.) Symington	Dipterocarpaceae	nl	nl	R
Vatica harmandiana Pierre	Dipterocarpaceae	nl	E	R
Vatica subglabra Merr.	Dipterocarpaceae	E	nl	E

Based on our plot inventories (density of living trees and stumps) and interviews with forest rangers and local people a total of 27 species appears to be endangered, vulnerable, rare, or threatened in the Park (Table 4.5). For instance, *Cycas revoluta,* and *Cycas chevalieri* (Cycadaceae) are rare in Ben En and local people also collect these species for ornamental purposes, although the pressure of collecting is low and the market demand is not high. All the used timber tree species are illegally exploited by local people in Ben En, and trespassers are often caught by the forest ranger of the Park. *Actinodaphne obovata, Phoebe paniculata* (Lauraceae), and *Erythrophleum fordii* (Caesalpiniaceae), are not difficult to find in the forest, but the intensity of harvesting these species by local people is high, and recent stumps were often seen during the field inventory. Additional species that are often confiscated by the forest ranger are *Garcinia fagraeoides* (Clusiaceae) and *Markhamia stipulata* (Bignoniaceae). These species are in high demand but rare in the forest, and thus locally endangered.

Impact of local people on useful plants

Of all useful species in the Park, 54 were recorded in the plot inventories (see Appendix 4.1). These species were further analysed for impact of local use on their occurrence and density in the plots. Most of these species are used for construction and firewood. Useful plants in general and important timber trees in particular are more abundant in remote (and less disturbed) plots than close to the villages (data not shown). Not surprisingly the density of useful plant species, especially of important timber trees is negatively correlated with the number of stumps found in each plot (Figs. 4.1 and 4.2).

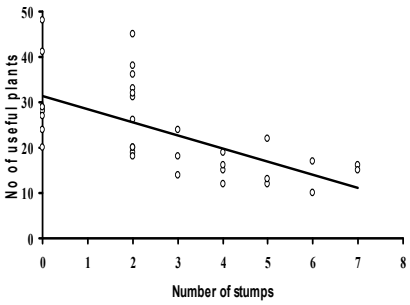

Fig. 4.1. Relation between the number of useful plants and number of stumps per 0.04 ha plot;
$y = 30.72 – 2.84\ x$; $R^2 = 0.45$

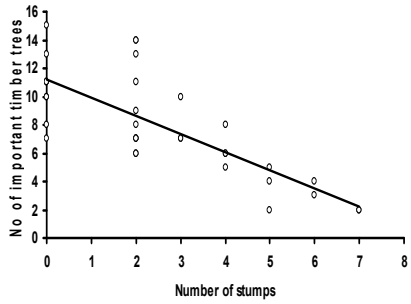

Fig. 4.2. Relation between the number of important timber trees and number of stumps per 0.04 ha plot;
$y = 11.34 – 1.29\ x$; $R^2 = 0.60$

Relation of use index, tree density, and number of people in each household

There is a strong correlation between number of people in each household and number of useful plant species used by each household in the Park (Fig. 4.3). There are also weak but significant correlations between use index and the density of useful plants (Fig. 4.4).

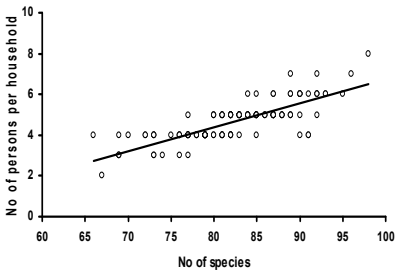

Fig. 4.3. Relation between number of persons in each household and number of useful plant species used;
$y = 0.12\ x – 5.02$; $R^2 = 0.64$

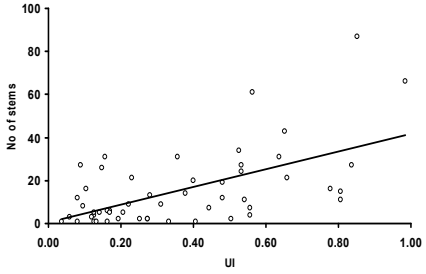

Fig. 4.4. Relation between number of stems per 0.04 ha plot and UI of 54 useful plant species;
$y = 42.22\ x + 0.56$; $R^2 = 0.34$

DISCUSSION

Conservation of useful plant species in Ben En National Park

Local people, living in and around the Park, still depend on natural resources. Dependence on these resources is highest in those communities living inside the core zone of the National Park. The remoteness of these communities makes it difficult for people to bring building materials or other plant commodities from outside the Park to their village. As a result 27 useful plant species in Ben En National

Park appear in danger of being lost locally; 16 of these are not recorded in the Red Book of Vietnam (Ban 2007). They are perhaps not only threatened in Ben En, but also in other parts of Vietnam, because the information on endangered species was - and still is - very incomplete. *Chukrasia tabularis* is listed both in the Red List of IUCN 2006, and the Red Book of Vietnam (Ban 2007); this species is endangered in nature, and it is rare in the natural forest. However, *Chukrasia tabularis* is planted widely in plantation forests in Vietnam, especially in and around Ben En National Park. Therefore we did not list this species in the list of threatened species in Ben En. Another species, *Alstonia scholaris* (Apocynaceae), listed by IUCN list (2006) is very common in plantations throughout the whole country. In contrast, *Garcinia fagraeoides* (Clusiaceae) is not on the IUCN list, but locally this species is endangered, because of the high intensity of illegal logging and its rarity in the field inventories. *Markhamia stipulata* (Bignoniaceae) was an important timber tree for local people 5 - 10 years ago. However, this species has become endangered in Ben En: only a single tree with a diameter over 5 cm was found during the field inventory.

Recently illegal logging has decreased because of the strict protection by forest rangers (Hien 2006; 2007). Local people also obtain land to plant trees. However, some illegal logging is still carried out in the Dong Tho, Song Chang, Duc Luong and Bai Tranh areas. In order to reduce the impact of local people on forest resources and to improve their living conditions, the Vietnamese Government issued Decree 02/CP in 1994, making it possible to allocate forest land to individual households for protection and re-plantation, and that policy still applies in the whole country. In some buffer zones of national parks, land is being planted with sugar cane, cassava, in others reforestation is taking place with *Eucalyptus camaldulensis*, *Acacia mangium*, *Acacia auriculiformis* and various fruit trees. This could reduce the pressure from local people on the Park in general, and in the core zone in particular. Additionally local people should be encouraged to cultivate plant species in home gardens, using modern techniques that would increase the yield of commonly used and commercialized species.

Impact of local people on useful plants

Our analysis of the occurrence and densities of useful plants in the plots (only 54 species out of the 208) has shown a significant and negative impact of harvesting and illegal logging near villages. It must be feared that – without appropriate measures - plant resources will in future also become depleted in more remote areas. A more detailed assessment of the impact of local people on plant species diversity and species densities throughout the Park is currently in preparation (Hoang et al. in prep.).

Some factors affecting plant use

We found no differences between the different ethnic groups and plant use (data not shown), but instead a significant relationship between the size of households and the number of species used per household. According to Phillips & Gentry (1993); Johns et al. (1990) and De Lucena et al. (2007) traditional plant use is strongly influenced

by factors such as abundance in the forest, and plant size and conspicuousness of individual species. Our analysis of the Use Index (UI) and other indicators of plant uses such as species ranking by informants and commercial value to some extent confirm this: in the plots species with a high UI are indeed more common than species with a low UI (Fig. 4.4), and all very useful commercial timber trees (both by species ranking and high UI, Table 4.1) are indeed big and conspicuous. There are however major exceptions to these trends: several important timber tree species with high UI are of very infrequent occurrence in all plots, e.g. *Vatica odorata* (UI = 0.50)*, Parashorea chinensis* (0.81), *Amesiodendron chinense* (0.56), and *Garcinia fagraeoides* (0.52) (Hoang et al. in prep.). Also, several species with very high UI are inconspicuous and small plants in the forest, e.g. *Artemisia vulgaris* (0.52), *Hydrocotyle sibthorpioides* (0.67), *Bauhinia coccinea* (0.69), and *Perilla frutescens* (0.57) (cf. Appendix 4.1). For many cultivated plant species there is an interesting discrepancy between the calculated UI and the relatively low ranking given in the PRA questionnaires (results not shown), suggesting that local people take many cultivated species "for granted" in their response to our interviews using PRA techniques.

The Use Index spectrum for non-medicinal useful plants is quite different from that of medicinal plants (Hoang et al. 2008 b): for medicinal plant species the vast majority (68%) has low UI values (< 0.25), and only 8% have high values > 0.75 (for the non-medicinal plants these values are 32% and 16% respectively). This indicates that traditional medicinal use of wild plant species is less common than the use of non-medicinal plants, perhaps because in many households the knowledge of or confidence in the therapeutic efficacy of a certain species is low, while non-medicinal uses are much more straightforward.

Valuation of traditional plant use

The contribution of non-medicinal and medicinal plants collected in the wild or grown in home gardens to income generation was calculated to amount to 23% or 95 US$ per household per annum (Table 4.3). These figures are only rough approximations since they are based on interviews of local people and market inventories, each with their own sources of error and imprecision. Nevertheless the total economic value of traditional plant use far exceeds this monetary component for the people of Ben En National Park, since it offers important commodities such as vegetables, fruits, condiments, fuel, construction materials, medicines, etc., "free of monetary charge", but in return for fairly light collecting and plant cultivation efforts. It would be interesting to calculate the monetary equivalents for all these free commodities, but our data unfortunately do not allow this. Conversely, the costs of overexploitation and ecological degradation should also be modeled: an even more difficult exercise, beyond the scope of this study.

APPENDIX 4.1

Plant species used by local people in Ben En National Park

Key: *Wild/Cultivated:* W: Wild; C: Cultivated

*: Species are also used for medicinal plant purposes (Hoang et al. 2008 b)

+: Species recorded in plots

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Ferns					
Gleicheniaceae	**Họ Guột**				
Dicranopteris linearis (Burm.) Underw.	Guột	0.28	W	Whole plant	Firewood
Marsileaceae	**Họ Rau Bợ**				
Marsilea quadrifolia L.*	Rau bợ	0.14	W	Leaves	Food
Woodsiaceae	**Ráng gỗ nhỏ**				
Diplazium esculentum (Retz.) Sw.	Rau rớn	0.30	W	Leaves	Food
Gymnosperms	**Ngành Thông**				
Cycadaceae	**Họ Tuế**				
Cycas chevalieri Leandri	Nghèn	0.12	W	Whole plant	Ornamental
Cycas revoluta Thunb.	Vạn tuế	0.08	W	Whole plant	Ornamental
Gnetaceae	**Họ Dây gắm**				
Gnetum gnemon L.	Gắm	0.29	W	Fruit	Food
Pinaceae	**Họ Thông**				
Pinus massoniana D. Don	Thông đuôi ngựa	0.33	W,C	Branch, stem	Construction, firewood
Pinus merkusii Jungh. & de Vriese	Thông nhựa	0.36	W,C	Branch, stem	Construction, firewood

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Angiosperms	**Ngành Ngọc Lan**				
Dicotyledons	**Lop Ngọc Lan**				
Amaranthaceae	**Họ Rau Dền**				
Alternanthera sessilis (L.) A. DC.	Rau diếp dại	0.24	W	Leaves	Food
Amaranthus spinosus L.	Dền cơm	0.26	C	Leaves	Food
Amaranthus tricolor L.	Dền tía	0.08	C	Leaves	Food
Anacardiaceae	**Họ Xoài**				
Dracontomelon dao (Blanco) Merr. & Rolfe	Sấu	0.19	W,C	Fruit, leaves, stem	Food, construction
Mangifera indica L.	Xoài	0.43	C	Fruit	Food
Mangifera reba Pierre	Quéo	0.06	W,C	Fruit	Food
Spondias axillaris Roxb.	Xoan nhừ	0.08	W	Fruit	Food
Spondias lakoensis Pierre * +	Dâu da xoan	0.25	W,C	Fruit	Food
Annonaceae	**Họ Na**				
Annona squamosa L. *	Na	0.16	C	Fruit	Food
Xylopia vielana Hance * +	Dền	0.91	W	Stem	Firewood
Apiaceae	**Họ Hoa Tán**				
Anethum graveolens L.	Thì là	0.27	C	Leaves, stem	Food
Centella asiatica (L.) Urb. *	Rau má	0.30	W	Whole plant	Food
Coriandrum sativum L.	Rau mùi	0.32	C	Leaves, stem	Food
Eryngium foetidum Thunb.	Mùi tàu	0.31	C	Leaves, stem	Food
Hydrocotyle sibthorpioides Lamk.	Rau má	0.67	W	Whole plant	Food

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Apocynaceae	**Họ Trúc Đào**				
Alstonia scholaris (L.) R. Br. *	Sữa	0.04	W	Whole plant	Ornamental
Holarrhena antidysentirica Wall.	Mộc hoa trắng	0.04	W	Whole plant	Ornamental
Aquifoliaceae	**Họ Nhựa ruồi**				
Ilex macrocarpa Oliv.	Bùi quả to	0.07	W	Leaves	Drink
Ilex rotunda Thunb. +	Nhựa ruồi	0.08	W	Leaves	Drink
Araliaceae	**Họ Ngũ ra bì**				
Acanthopanax aculeatum Seem.	Ngũ ra bì	0.07	W	Whole plant	Ornamental
Polyscias fruticosa Harms	Đinh lăng	0.42	C	Leaves	Food
Schefflera alpina Grushv. & Skvorts.	Chân chim	0.30	W	Leaves	Food
Schefflera octophylla Harms *+	Chân chim 8 lá	0.48	W	Leaves	Food
Asclepiadaceae	**Họ Thiên lý**				
Telosma cordata Merr.*	Thiên lý	0.26	C	Flower	Food
Asteraceae	**Họ Cúc**				
Artemisia japonica Thunb.	Ngãi cứu rừng	0.16	W	Leaves	Food
Artemisia vulgaris L. *	Ngãi cứu	0.52	C	Leaves	Food
Gynura crepidioides Benth *	Rau tàu bay	0.21	W	Leaves	Food
Lactuca indica L.	Bồ công anh	0.36	W	Leaves	Food
Vernonia andersonii C. B. Clarke	Dây rau ráu	0.22	W	Leaves	Food
Basellaceae	**Họ Mồng tơi**				
Basella alba L.	Mồng tơi	0.70	C	Leaves	Food

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Bignoniaceae	**Họ Đinh**				
Markhamia stipulata Seem. ex Schum. +	Đinh	0.41	W	Stem	Construction
Oroxylum indicum (L.) Benth. ex Kurz* +	Núc nác	0.13	W	Fruit	Food
Brassicaceae	**Họ Cải**				
Brassica chinensis L.	Cải bẹ trắng	0.91	C	Leaves	Food
Brassica integrifolia West.	Cải ngot	0.73	C	Leaves	Food
Brassica juncea (L.) Czern.	Cải canh	0.74	C	Leaves	Food
Raphanus sativus L.	Cải củ	0.70	C	Leaves, tuber	Food
Burseraceae	**Họ Trám**				
Canarium album Rauesch.+	Trám trắng	0.53	W	Resin, fruit	Candles, food
Canarium tonkinensis L.+	Trám chim	0.27	W	Resin, fruit	Candles, food
Canarium tramdenum Chan Dinh Dai & Yakovlev+	Trám đen	0.53	W	Resin	Candles
Caesalpiniaceae	**Họ Vang**				
Bauhinia coccinea DC.	Quạch	0.69	W	Stem	Drink
Bauhinia variegata L.	Ban	0.04	W,C	Whole plant	Ornamental
Caesalpinia sappan L. *	Vang	0.07	W	Stem, branch	Drink
Erythroploeum fordii Oliv.+	Lim xanh	0.99	W	Stem	Construction
Gleditsia australis Hemsl. ex Forb. & Hemsl.+	Bồ kết	0.25	W	Fruit	Shampoo
Peltophorum tonkinensis Pierre+	Lim xẹt	0.54	W	Stem	Construction
Tamarindus indica L.	Me	0.20	W	Fruit	Food
Caricaceae	**Họ Đu đủ**				

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Carica papaya L. *	Đu đủ	0.40	C	Fruit	Food
Clusiaceae	**Họ Măng cụt**				
Cratoxylum polyanthum Korth. *	Thành ngạnh	0.18	W	Whole plant	Firewood
Garcinia cowa Roxb.	Tai chua	0.16	W,C	Fruit, leaves	Food
Garcinia fagraeoides A. Chev.+	Trai lý	0.52	W	Stem	Construction
Garcinia multiflora Champ. ex Benth.	Dọc	0.22	W,C	Fruit, leaves	Food
Garcinia oblongifolia Champ. ex Benth. *+	Bứa	0.23	W	Fruit, leaves	Food
Convolvulaceae	**Họ Bìm bịp**				
Ipomoea aquatica Foir.	Rau muống	0.99	C	Leaves, stem	Food
Ipomoea batatas (L.) Lam	Khoai lang	0.99	C	Tuber, leaves	Food
Cucurbitaceae	**Họ Bầu bí**				
Benincasa hispida (Thunb.) Cogn.	Bí xanh	0.27	C	Fruit	Food
Cucurbita maxima Lam.*	Bí đỏ	0.30	C	Fruit	Food
Lagenaria siceraria (Molina) Standley	Bầu	0.26	C	Fruit, leaves	Food
Luffa aegyptiaca M. Roem.	Mướp	0.88	C	Fruit	Food
Momordica charantia L.	Mướp đắng	0.20	C	Fruit	Food
Momordica cochinchinensis (Lour.) Spreng. *	Gấc	0.42	C	Fruit	Food
Dilleniaceae	**Họ Sổ**				
Dillenia heterosepala Finet & Gagnep.	Lọng bàng	0.10	W	Fruit, stem	Food, firewood
Dillenia indica L.+	Sổ	0.10	W	Fruit, stem	Food, firewood
Dipterocarpaceae	**Họ Dầu**				

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Hopea odorata Roxb.	Sao đen	0.56	W	Stem	Construction
Hopea chinensis (Merr.) Hand.-Mazz.+	Sao	0.39	W	Stem	Construction
Parashorea chinensis Wang Hsie +	Chò chỉ	0.81	W	Stem	Construction
Vatica harmandiana Pierre+	Táu nước	0.54	W	Stem	Construction
Vatica odorata (Griff.) Symington+	Táu mật	0.50	W	Stem	Construction
Vatica subglabra Merr.	Táu xanh	0.20	W	Stem	Construction
Ebenaceae	**Họ Thị**				
Diospyros decandra Lour. *	Thị	0.42	C	Fruit	Food
Diospyros kaki L.f.	Hồng	0.33	C	Fruit	Food
Elaeagnaceae	**Họ Nhót**				
Elaeagnus bonii Lecomte *	Nhót	0.18	W	Fruit	Food
Elaeagnus tonkinensis Serv.	Nhót nhà	0.33	C	Fruit	Food
Euphorbiaceae	**Họ Thầu Dầu**				
Baccaurea ramiflora Lour. *+	Dâu da đất	0.44	W	Fruit	Food
Bischofia javanica Blume *+	Nhội	0.21	W	Leaves	Food
Breynia fleuryi Beille *	Bồ cu vẽ	0.05	W	Leaves	Food
Euphorbia hirta L. *	Cỏ sữa	0.10	W	Whole plant	Drink
Euphorbia pulcherrima Willd ex Klotzsch	Trạng nguyên	0.06	W,C	Whole plant	Ornamental
Macaranga denticulata Mull. Arg.+	Lá nến	0.10	W	Stem	Firewood
Mallotus paniculatus (Lam.) Mull. Arg.+	Ba soi	0.38	W	Stem	Firewood
Manihot esculenta Crantz	Sắn	0.80	C	Tuber	Food

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Phyllanthus emblica L.	Me rừng	0.19	W	Fruit	Food
Sauropus androgynus Merr.	Rau ngót	0.39	C	Stem	Food
Vernicia montana Lour.+	Trẩu	0.17	W,C	Fruit	Oil, firewood
Fabaceae	**Họ Đậu**				
Lablab purpureus (L.) Sweet	Đậu ván	0.29	C	Fruit	Food
Pachyrhizus erosus (Lour.) Merr.	Củ đậu	0.19	C	Tuber	Food
Pueraria phaseoloides Benth.*	Sắn dây	0.33	C	Tuber	Food
Sophora japonica L. *	Hoè	0.21	W,C	Flower, fruit	Drink
Tephrosia candida DC.	Cốt khí	0.16	W,C	Whole plant	Firewood
Vigna radiata (L.) Wilczek.	Đậu xanh	0.42	C	Fruit	Food
Vigna unguiculata (L.) Walp.	Đậu đen	0.45	C	Fruit	Food
Fagaceae	**Họ Dẻ**				
Castanopsis boisii Hickel & Camus+	Dẻ ăn quả	0.14	W	Fruit, stem	Food, construction
Castanopsis indica A. DC.+	Cà ổi	0.13	W	Stem	Firewood, construction
Lithocarpus pseudosundaicus (Hick. & A. Camus) A. Camus+	Sồi xanh	0.17	W	Stem	Construction
Quercus platycacalyx Hick. & A. Camus+	Dẻ cau	0.12	W	Stem	Construction
Flacourtiaceae	**Họ Mồng quân**				
Flacourtia balansae Gagnep.+	Mồng quân	0.09	W	Fruit	Food
Hamamelidaceae	**Họ Sau sau**				
Liquidambar formosana Hance	Sau sau	0.26	W	Leaves, resin	Food, candle

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Juglandaceae	**Họ Hồ đào**				
Engelhardtia chrysolepis Hance+	Chẹo tía	0.22	W	Stem	Firewood
Pterocarya tonkinensis Dode	Cơi	0.13	W	Leaves	Fishing
Lamiaceae	**Họ Hoa môi**				
Acrocephalus indicus Kuntze	Nhân trần	0.41	W	Stem, leaves	Drink
Mentha crispa L.	Húng	0.53	C	Leaves	Food
Ocimum basilicum L.	Húng quế	0.42	C	Leaves	Food
Perilla frutescens Britton	Tía tô	0.57	C	Leaves	Food
Lauraceae	**Họ Long não**				
Actinodaphne obovata Blume+	Song xanh	0.65	W	Stem	Construction
Beilschmiedia poilanei H. Liou+	Chắp	0.04	W	Stem	Construction
Beilschmiedia ferruginea H. Liou+	Chắp xanh	0.16	W	Stem	Construction
Cinnamomun cassia Blume *	Quế	0.50	W,C	Bark	Spice
Litsea cubeba Pers. *	Màng tang	0.38	W	Leaves, fruit	Spice
Machilus bonii Lecomte+	Kháo vàng	0.40	W	Stem	Construction
Phoebe paniculata Nees+	Kháo nước	0.66	W	Stem	Construction
Lecythidaceae	**Lộc vừng**				
Barringtonia acutangula (L.) Gaertn.	Lộc vừng	0.04	W, C	Whole plant	Ornamental
Lythraceae	**Họ Sang lẻ**				
Lagerstroemia calyculata Kurz+	Sang lẻ	0.81	W	Stem	Construction
Magnoliaceae	**Họ Ngọc Lan**				

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Manglietia conifera Dandy	Mỡ	0.32	W,C	Stem	Construction
Manglietia fordiana Oliver+	Vàng tâm	0.29	W,C	Stem	Construction
Michelia mediocris Dandy+	Giổi xanh	0.84	W	Seed, stem	Spice, construction
Michelia tonkinensis A. Chev.+	Giổi bắc bộ	0.24	W	Seed, stem	Spice, construction
Melastomataceae	**Họ Mua**				
Melastoma normale D. Don *	Mua	0.12	W	Stem, fruit	Firewood, Food
Melastoma septemnervium Merr.	Mua đối	0.28	W	Stem, fruit	Firewood, Food
Meliaceae	**Họ Xoan**				
Aglaia spectabilis (Miq.) S.S. Jain & Bennet+	Gội nếp	0.56	W	Stem	Construction
Aphanamixis grandifolia Blume+	Gội trắng	0.53	W	Stem	Construction
Chukrasia tabularis A. Juss.	Lát hoa	0.52	W,C	Stem	Construction
Dysoxylum cauliflorum Hiern+	Đinh hương	0.78	W	Stem	Construction
Melia azedarach L. *	Xoan ta	0.61	C	Stem	Construction
Mimosaceae	**Họ Trinh nữ**				
Acacia auriculaeformis A. Cunn. ex Benth.	Keo lá tràm	0.90	C	Stem	Construction, paper, firewood
Acacia mangium Willd.	Keo Tai tượng	0.87	C	Stem	Construction, paper, firewood
Moraceae	**Họ Dâu tằm**				
Antiaris toxicaria Lesch.+	Sui	0.31	W	Bark, stem	Twine, firewood
Artocarpus heterophyllus Lam.	Mít	0.65	C	Fruit, stem	Food, Firewood
Artocarpus tonkinensis A. Chev. *	Chay	0.16	W,C	Fruit, bark	Food, chewing betel
Broussonetia papyrifera Vent. *	Dướng	0.07	W	Leaves, stem	Firewood, twine

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Ficus auriculata Lour. *+	Vả	0.23	W	Fruit, stem	Food, firewood
Morus alba L.	Dâu tằm	0.22	C	Fruit	Food
Myrsinaceae	**Họ Đơn nem**				
Embelia laeta Mez	Ngút trắng	0.19	W	Leaves	Food
Embelia oblongifolia (Benth.) Hemsl.	Chua ngút lá dài	0.10	W	Leaves	Food
Maesa balansae Mez	Đơn nem	0.11	W	Leaves	Food
Myrtaceae	**Họ Sim**				
Baeckea frutescens L.	Thanh Hao	0.09	W	Whole plant	Brooms, firewood
Cleistocalyx operculatus Merr. & L.M. Perry	Trâm vối	0.19	W	Leaves	Drink
Eucalyptus camaldulensis Dehnh.*	Bạnh đàn trắng	0.58	C	Stem	Construction, firewood, paper
Psidium guajava L. *	ổi	0.68	C	Fruit	Food
Rhodomyrtus tomentosa Hassk. *	Sim	0.38	W	Fruit	Food
Syzygium polyanthum Walp.+	Sắn thuyền	0.28	W	Leaves	Food
Olacaceae	**Họ Bù Khai**				
Erythropalum scandens Blume	Bù Khai	0.37	W	Leaves	Food
Opiliaceae	**Họ Rau sắng**				
Meliantha suavis Pierre+	Rau sắng	0.58	W	Leaves	Food
Oxalidaceae	**Họ Chua me**				
Oxalis corniculata L. *	Chua me	0.25	W	Whole plant	Food
Piperaceae	**Hồ tiêu**				
Piper betle L.*	Trầu không	0.53	C	Leaves	Chewing betel

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Piper lolot C. DC. *	Lá lốt	0.96	W, C	Leaves	Food
Rhamnaceae	**Họ Táo**				
Ziziphus mauritiana Lam. *	Táo nhà	0.92	C	Fruit	Food
Ziziphus oenoplia (L.) Mill.	Táo rừng	0.42	W	Fruit	Food
Rosaceae	**Họ Hoa Hồng**				
Rubus alcaefolius Poir.	Mân xôi	0.60	W	Fruit	Food
Rubus cochinchinensis Tratt. *	Ngấy	0.36	W	Fruit	Food
Rutaceae	**Họ Cam**				
Acronychia pedunculata Miq.	Bưởi bung	0.53	W	Fruit	Food
Clausena dunniana H.Lev. +	Hồng bì rừng	0.36	W	Fruit	Food
Clausena indica Oliver+	Mắc mật	0.33	W	Fruit	Food
Clausena lansium Skeels *+	Hồng bì	0.19	C	Fruit	Food
Citrus aurantifolia Swingle	Chanh	0.95	C	Fruit, leaves	Food
Citrus maxima Osbeck	Bưởi	0.81	C	Fruit	Food
Citrus sinensis Osbeck	Cam	0.79	C	Fruit	Food
Sapindaceae	**Họ Bồ hòn**				
Amesiodendron chinense (Merr.) Hu+	Trường Sâng	0.56	W	Stem	Construction
Dimocarpus longan Lour.	Nhãn	0.96	C	Fruit	Food
Litchi chinensis Sonn.	Vải	0.95	C	Fruit	Food
Mischocarpus pentapetalus Radlk.+	Trường kẹn	0.15	W	Stem	Construction
Pavieasia annamensis Pierre+	Trường mật	0.85	W	Stem	Construction

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Sapotaceae	**Họ Hồng xiêm**				
Achras sapota L.	Hồng xiêm	0.19	C	Fruit	Food
Chrysophyllum cainito L.	Vú sữa	0.20	C	Fruit	Food
Pouteria sapota (Jacq.) H. E. Moore & Stearn	Trứng gà	0.50	C	Fruit	Food
Theaceae	**Họ Chè**				
Camellia amplexicaulis Cohen-Stuart+	Hải đường	0.23	W	Whole plant	Ornamental
Camellia sinensis Kuntze *	Chè	0.94	C	Leaves	Drink
Tiliaceae	**Họ Đay**				
Microcos paniculata L.+	Cò ke	0.16	W	Stem	Firewood
Ulmaceae	**Họ Du**				
Trema orientalis (L.) Blume *	Hu đay	0.22	W	Stem	Firewood
Monocotyledons	**Lớp Hành**				
Alliaceae	**Họ Hành**				
Allium fistulosum L. *	Hành	0.99	C	Whole plant	Spice, food
Allium sativum L. *	Tỏi	1.00	C	Whole plant	Spice, food
Arecaceae	**Họ Cau Dừa**				
Areca catechu L. *	Cau	0.56	C	Fruit, stem	Chewing betel, firewood
Calamus balansaeanus Becc.	Mây nước	0.36	W	Stem	Handicrafts
Calamus faberi Becc.	Mây thủ công	0.19	W	Stem	Handicrafts
Calamus platyacanthus Warb. ex Becc.	Song mật	0.36	W	Stem	Handicrafts
Calamus tetradactylus Hance	Mây mật	0.79	W	Stem	Handicrafts

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Caryota mitis Lour. *	Đùng đình	0.21	W	Stem	Handicrafts, food
Cocos nucifera L.	Dừa	0.67	C	Fruit, stem	Food, firewood
Daemonorops longispathus Becc.	Hèo	0.38	W	Stem	Handicrafts
Livistona chinensis (Jacq.) R. Br. & Mart.	Cọ	0.35	C	Leaves, fruit	Oil, roofs
Costaceae	**Họ Mía dò**				
Costus speciosus (Koenig) Smith	Mía dò	0.36	W	Stem	Food
Dioscoreaceae	**Họ Củ nâu**				
Dioscorea cirrhosa Lour. *	Củ nâu	0.34	W	Tuber	Food
Dioscorea persimilis Prain & Burk. *	Củ mài	0.19	W	Tuber	Food, to plaster board
Marantaceae	**Họ Lá Dong**				
Phrynium placentarium (Lour.) Merr.	Lá dong	0.95	W	Leaves	Wrapping cakes
Musaceae	**Họ Chuối**				
Musa acuminata Colla	Chuối rừng	0.21	W	Fruit, flower bud, stem	Food
Musa balbisiana Colla	Chuối hột	0.39	C	Fruit, flower bud, stem	Food
Musa basjoo Sieb.	Chuối ngự	0.97	C	Fruit, flower bud, stem	Food
Musa paradisiaca L.	Chuối tiêu	0.94	C	Fruit, flower bud, stem	Food
Orchidaceae	**Họ Phong lan**				

Scientific name	Common name	Use index	Wild/ Cultivated	Part utilized	Use
Cymbidium lowianum Reichb.f.	Phong lan	0.06	W	Whole plant	Ornamental
Dendrobium aloideum La Llave & Lex.	Hoàng thảo	0.01	W	Whole plant	Ornamental
Phormiaceae	**Họ Hương bài**				
Dianella nemorosa Lam. *	Hương bài	0.04	W	Whole plant	Incense
Poaceae	**Họ Cỏ**				
Arundinaria sat Balansa	Sặt	0.50	W	Stem	Firewood
Bambusa blumeana Schult. f.	Tre gai	0.41	C	Stem, shoot	Construction, food, tools
Cymbopogon citratus Stapf*	Sả	0.51	C	Tuber	Food
Dendrocalamus barbatus Hsueh & D.Z.Li	Luồng	0.78	C	Stem, shoot	Paper, construction, food, tools
Indosasa angustata McClure	Vầu đắng	0.37	W	Stem, shoot	Food, construction
Indosasa sinica C.D. Chu & C.S.Chao	Vầu ngọt	0.33	W	Stem, shoot	Food, construction
Panicum miliaceum L.	Kê	0.36	C	Seed	Food
Saccharum officinarum L.	Mía	0.96	C	Stem	Food
Schizostachyum funghomii McClure	Nứa	0.99	W	Stem, shoot	Making paper, food, tools
Zingiberaceae	**Họ Gừng**				
Curcuma longa L. *	Nghệ	0.97	C	Tuber, leaves	Spice, food
Curcuma zedoaria Rosc.*	Nghệ đen	0.39	W,C	Tuber	Spice, food
Zingiber officinale Rosc. *	Gừng	0.99	C	Tuber	Spice, food

APPENDIX 4.2

Commercial useful plant species in Ben En National Park

Scientific name	Abundance in the wild or cultivated	Intensity of collection	Price in US$	Income/ household/ year in US$	Market demand
Anacardiaceae					
Dracontomelon dao (Blanco) Merr. & Rolfe	Cultivated		Not stable	0.5	Medium
Mangifera indica L.	Cultivated		0.07/2fruits	0.6	Medium
Spondias lakoensis Pierre	Cultivated		Not stable	0.1	Medium
Annonaceae					
Annona squamosa L.	Cultivated		0.07/3 fruits	0.6	Medium
Araliaceae					
Schefflera alpina Grushv. & Skvorts.	High	Medium	Not stable	0.2	Medium
Schefflera octophylla Harms	High	Medium	0.28/kg	1	Medium
Burseraceae					
Canarium album Rauesch.	Medium	High	0.07/kg fruit 1.3/kg resin	2.9	Medium High
Canarium tonkinensis L.	Medium	High	1.3/kg resin	1.2	High
Canarium tramdenum Chan Dinh Dai & Yakovlev	Medium	High	1.3/kg resin	1.1	High
Caesalpiniaceae					
Gleditsia australis Hemsl. ex Forb. & Hemsl.	Low	Medium	0.07/4 fruits	0.2	Medium
Tamarindus indica L.	Low	High	0.07/6 fruits	0.2	Medium
Clusiaceae					
Garcinia cowa Roxb.	Low	Medium	0.07/5 fruits	0.5	Medium

Scientific name	Abundance in the wild or cultivated	Intensity of collection	Price in US$	Income/ household/ year in US$	Market demand
Garcinia multiflora Champ. ex Benth.	Medium	Medium	0.07/4 fruits	0.8	Medium
Ebenaceae					
Diospyros decandra Lour.	Cultivated		0.07/6 fruits	0.8	Medium
Diospyros kaki L.f.	Cultivated		0.07/6 fruits	1.0	Medium
Euphorbiaceae					
Vernicia montana Lour.	Medium	High	0.17/kg fruit	0.2	Medium
Lamiaceae					
Acrocephalus indicus Kuntze	Medium	Medium	Not stable	0.2	Medium
Moraceae					
Artocarpus tonkinensis A. Chev.	Medium	High	Not stable	0.2	Medium
Artocarpus heterophyllus Lam.	Cultivated		0.28/fruit	0.6	Medium
Myrtaceae					
Baeckea frutescens L.	Medium	Medium	Not stable	0.3	Medium
Psidium guajava L.	Cultivated		0.07/4 fruits	1.0	Medium
Olacaceae					
Erythropalum scandens Blume	High	Medium	Not stable	0.2	Low
Opiliaceae					
Meliantha suavis Pierre	High	Medium	0.14/kg	0.5	Medium
Rutaceae					
Citrus aurantifolia Swingle	Cultivated		0.07/5 fruits	0.5	Medium

Scientific name	Abundance in the wild or cultivated	Intensity of collection	Price in US$	Income/ household/ year in US$	Market demand
Citrus maxima Osbeck	Cultivated		0.14/ fruits	0.6	Medium
Citrus sinensis Osbeck	Cultivated		0.07/3 fruits	0.8	Medium
Sapotaceae					
Achras sapota L.	Cultivated		0.07/5 fruits	0.5	Medium
Chrysophyllum cainito L.	Cultivated		0.07/5 fruits	0.7	Medium
Pouteria sapota (Jacq.) H. E. Moore & Stearn.	Cultivated		0.07/5fruits	0.8	Medium
Liliopsida					
Arecaceae					
Calamus balansaeanus Becc.	Low	Medium	0.17/kg	1.0	Medium
Calamus faberi Becc.	Low	Medium	0.17/kg	1.2	Medium
Calamus tetradactylus Hance	Low	Medium	0.17/kg	2.6	Medium
Dioscoreaceae					
Dioscorea cirrhosa Lour.	High	Low	Not stable	0.3	Low
Dioscorea persimilis Prain & Burk.	High	Low	Not stable	0.4	Low
Marantaceae					
Phrynium placentarium (Lour.) Merr.	High	Medium	0.28/100 leaves	2.7	Medium
Poaceae					
Indosasa sibata C.D.Chu & C.S.Chao	Medium	High	0.2/fresh kg (Bamboo shoot)	2.0	High
Indosasa sibataeooides McClure	Medium	High	0.2/fresh kg (Bamboo shoot)	1.8	High
Schizostachyum funghomii McClure	High	High	1.1/dried, 0.17 fresh kg (Bamboo shoot) 0.0014/trees	13	High

Chapter 5

HUMAN AND ENVIRONMENTAL INFLUENCE ON PLANT DIVERSITY IN BEN EN NATIONAL PARK, VIETNAM

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ABSTRACT

In order to understand the influence of human disturbance and the physical environment on plant biodiversity in Ben En National Park, Vietnam, we analyzed species composition and density in forest plots with diverse soils and varying degrees of human disturbance. Soil factors significantly influenced tree species composition, although they only explained 5.7% of the observed data variance. Human factors (disturbance) were second most important in explaining species composition and density, accounting for 4.4% of variance. Changes in species composition related to human disturbance varied mostly independently of soils. The species composition of slightly and heavily disturbed forest differed significantly, with species of low conservation value being most common in heavily disturbed forest, while endangered species and important timber trees were most common in least disturbed forest. Density of treelets was higher in limestone forest than in non limestone forest. Timber trees and useful plants were more abundant in the less disturbed plots, which were located far away from villages and roads. Basal area in less disturbed forest was also larger than in heavily disturbed forest, indicating that the pressures of illegal logging and harvesting are closely connected to travel distances to nearest villages. Limiting the accessibility to forest resources should therefore be a priority in forest conservation as a first step to safeguard the park's rich biodiversity and stocks of useful plants.

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***Key words*:** Biodiversity conservation, disturbance, human impact, plant diversity, soils.

INTRODUCTION

Human disturbance affects plant populations and can modify interactions among species within communities (Huston 1994; Acharya 1999). Habitat loss, fragmentation, and degradation are currently the most important threats to biodiversity (Primack 1993). However, human activities are highly variable in their influence on biodiversity (Putz et al. 2000). For example, numerous studies have shown that logged-over forests retain much of their original biodiversity despite the severe damage that logging can inflict on the forest ecosystem (Whitmore & Sayer 1992; Cannon et al. 1998; Meijaard et al. 2005).

Several interactions between human disturbance, environmental factors and plant diversity have been reported. For example, in logged or burnt forests, light levels are increased, while tree density is reduced (Cannon et al. 1998; Uuttera et al. 2000; Eichhorn & Slik 2006). The increased light levels usually result in the occurrence of many woody pioneers and herbaceous species, which in some cases, i.e. logged forests, positively influence diversity indices although the "quality" of the biodiversity is negatively affected (Fredericksen & Mostacedo 2000; Pinard et al. 2000; Eichhorn & Slik 2006). Therefore, identification of factors related to human disturbance that affect biodiversity and forest vegetation structure is important because it might enable us to change to less destructive forest management types (Pickett 1995).

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 (Duivenvoorden 1995; Potts et al. 2002). However, environmental factors can have a differential effect on plant diversity and forest composition (Potts et al. 2002). For example, soil factors and mean annual rainfall are more strongly related with floristic composition when compared with topography in lowland forests (Baillie et al. 1987; Potts et al. 2002; Slik et al. 2003; Eichhorn & Slik 2006).

Ben En National Park is one of 30 National Parks in Vietnam. It was established in 1992 to conserve the rich, but seriously threatened biodiversity of the country. The Park is inhabited by 18,000 local people belonging to five ethnic groups: Kinh, Muong, Thai, Tay, and Tho, who continue to exert a strong influence on the natural environment. Illegal logging and harvesting of Non Timber Forest Products (NTFP) by both local people and people from outside the National Park continues (Tordoff et al. 2000; Hoang et al. 2008 a). The park has strongly contrasting soil types and one of the challenges is therefore to disentangle effects of soils and human disturbance on species composition.

In this study we focus on the following questions: Can human influences on species composition be separated from environmental factors, and if so, how do both affect

plant diversity and composition in Ben En National Park? Answers to these questions will be relevant for developing a sustainable management plan for Ben En and other National Parks in Vietnam.

RESEARCH AREA

Ben En National Park is situated in the Nhu Thanh and Nhu Xuan districts of the Thanh Hoa province in Vietnam (19° 30' - 19° 40' N; 105° 21' - 105° 35' E (Fig. 5.1)). The Park is situated in a region of low hills surrounding an artificial lake. Altitude ranges from 20 to 497 m, with most areas being below 200 m. The lake is 50 m above sea level and covers 2,281 ha. Small areas of limestone are also present (Tordoff et al. 2000). Soils in Ben En National Park are mainly ferralitic, while a small area around Lake Muc has alluvial soils (Anonymous 2000).

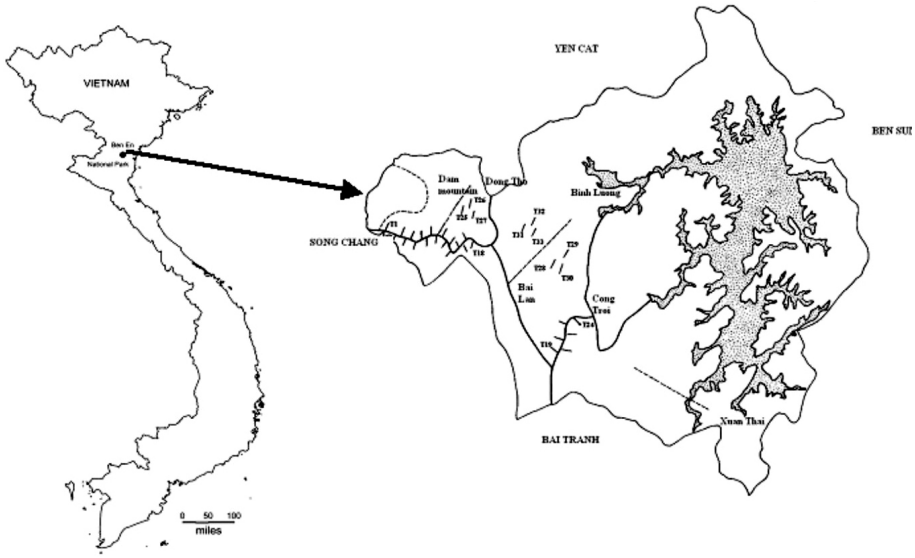

Fig. 5.1. Map of Ben En National Park in Vietnam
(inset – lakes are in grey; line transects are drawn in).

The core zone of the National Park covers 15,800 ha, while the buffer zone covers ca. 12,000 ha. The Ben En area was designated for the protection of fauna in 1979, changed to a Nature Reserve status in 1986, and to National Park status in 1992. Major parts of the forest in Ben En National Park have been impacted by man (Khoi 1996; Hoang et al. 2008 a). The forests were commercially logged as late as 1992, and small-scale, illegal logging continues to this date (Tordoff et al. 2000; Hoang et al. 2008 a & c). Ben En National Park is estimated to have a total species number of vascular plants of ca. 1600 (Hoang et al. 2008 a). In a previous study 1389 vascular plant species were recorded, belonging to 650 genera and 173 families (Hoang et al. 2008 a).

METHODOLOGY

Plot inventory

For this study we established transects and plots in forest areas along the old logging road as well as in the forest interior (Fig. 5.1). No agricultural lands and shrublands were included. In total we established 33 transects, each 200 m long. Twenty-four of these transects were placed at 250 m intervals at right angles along the old logging road from the Song Chang forest ranger station to Cong Troi, while nine transects were established in the slightly disturbed forest interior (Fig. 5.1). The total length of these transects combined was ca. 7.4 km. Along each transect we established four 10 x 10 m plots at 40 m intervals, starting 50 m from the old logging road. This resulted in 132 plots for all 33 transects combined. In the 132 plots (10 x 10 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 10 x 10 m plot. The data collected in each transect (four plots) were combined to so-called 0.04 ha plots to get a large enough sample size for subsequent statistical analyses.

In each 10 x 10 plot, we measured the percentage herb cover, canopy openness, slope, GPS-coordinates, noted the number of stumps, number of footpaths, and presence of limestone (Hoang et al. 2008 a). The distances used in this paper represent the shortest average distance (measured along the logging road and forest trails) to the four nearest villages. Inhabitants from 4 of these villages (Binh Luong, Xuan Binh, Hoa Quy, Xuan Quy) (Fig. 5.1) illegally log timber and harvest non timber forest products in the research area.

Light availability in the10 x 10 m plots was determined with the use of hemispherical photographs taken at 1.5 m height in a north-south direction in the centre of each plot. Canopy openness was then calculated using WINPHOT (Ter Steege 1996). Plot slopes were measured with a clinometer (Brunton Clino Master). Percentage herb cover was estimated in each 10 x 10 m plot. Canopy openness, slope and herb cover values of the plots were calculated by averaging the values of the four plots.

Soil samples were collected between 0 and 30 cm depth from a single location in the centre of each plot by using an auger with a diameter of 3 cm. Soils were analyzed at the Vietnam Forestry University, Vietnam following the Chin methods (Chin 2000; Le 2001). Total Ca, Mg, N, C, pH and exchangeable NH4 were determined. To analyze the relation between soil factors and plant diversity, soil data of the four plots in each transect were averaged.

Vouchers were collected of all plant species in the plots. One voucher of each specimen was deposited in the herbarium of the Vietnam Forestry University (VFU),

additional vouchers were sent to the National Herbarium of the Netherlands (L) and to various specialists for identification.

Data analysis

A total of 245 tree species (dbh ≥ 5 cm), and 251 species of treelets (dbh < 5 cm, and h ≥ 1 m high, including juvenile stages of 146 of the 245 tree species) were recorded in the plots. For each plot the density of trees, treelets, tree basal area, and Fisher's-Alpha were calculated (Fisher et al. 1943; Taylor et al. 1976). The usefulness of the plant species and importance of timber trees in Ben En National Park was determined by using standard Participatory Rural Appraisal (PRA) techniques (PID & NES 1989; Ngai 2001), and Use Index (UI) (Hoang et al. b & c). A total of 54 useful plant species and 15 important timber trees were found within the plots (Hoang et al. 2008 c).

The Red list species in Ben En National Park were identified based on the Red Data Book of Vietnam (Ban 2007), IUCN (2006), and frequency of trees and stumps found during the field inventory (Hoang et al. 2008 a, b & c).

A Canonical Correspondence Analysis (CCA) was used to see which variables best explained the differences in species composition, be it environmental or human (Ter Braak 1986; McCune & Mefford 1999). CCA is a constrained ordination technique, where the ordination axes represent a relationship between species and environmental data (Press & Wilson 1978). This analysis was done with PCORD 5, using the abundance matrix of tree species in the plots, in order to determine how environmental and human variables were related to differences in tree species composition between the plots. If certain CCA axes are significantly related to human or environmental factors, they can be used as proxy for disturbance or environmental gradients.

The CCA analysis was also used to determine species that were significantly affected by human impact and environmental variables (indicator species). Simple regression analysis (SPSS 16) was used to determine whether a species was significantly correlated with a CCA axis. Only species with more than 5 stems were used in the correlation analysis. Simple regression analysis was also used to examine whether and how the human and environmental variables were related to plot data for trees, treelets, useful plants and important timber trees. One way ANOVA analysis was used to test whether the density of trees, useful plants, important timber trees, and endangered species were different between slightly and heavily disturbed forest. The slightly and heavily disturbed forests were distinguished by their physiognomy (number of vegetation layers, presence of big trees) and the frequency of stumps and foot paths found in the plots (Hoang et al. 2008 a). In the slightly disturbed forest there were no or very few stumps and foot paths. In heavily disturbed forest stumps and foot paths were common (2 to 5 stumps and more than 1 foot path in each 0.04 ha plot) (Hoang et al. 2008 a).

RESULTS

Influence of human and environmental variables on tree composition in Ben En National Park

The first CCA axis explained 5.7% of data variance and was mainly determined by soil variables (Fig. 5.2). The second CCA axis explained 4.4% of data variance and was mainly determined by human impact variables. Tree species composition in the plots was therefore more strongly correlated with soil factors than with human disturbance. Especially Ca, Mg, pH and NH4 were important correlates. Human impact variables were almost exclusively correlated with CCA axis 2; these were mostly independent of soil variables. Since the distance to villages, number of stumps, and number of footpaths were strongly correlated with CCA axis 2, we used this axis as our human impact proxy for the remainder of our forest disturbance analyses. The slightly disturbed and heavily disturbed forest types are clearly recognizable along this axis in Fig. 5.2.

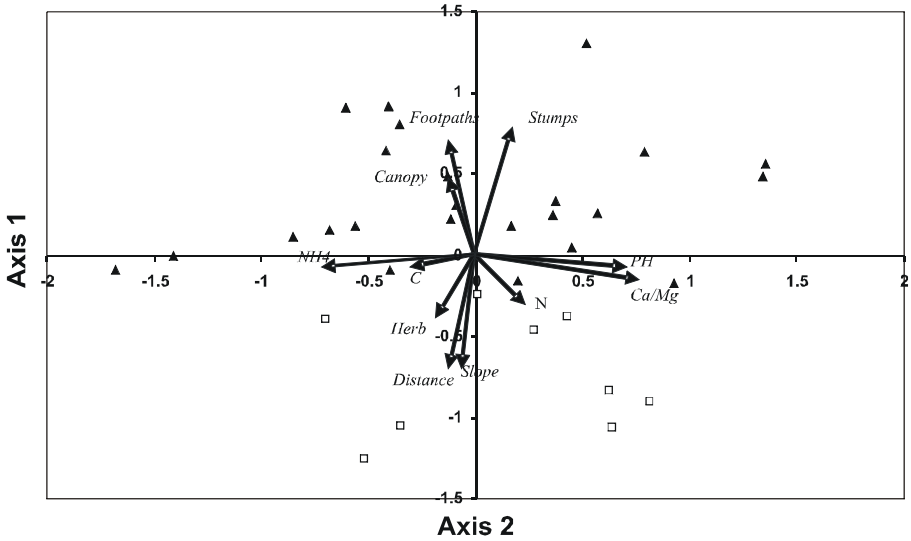

Fig. 5.2. Canonical Correspondence Analysis (CCA) showing the plots and environmental variables. The first axis explains 5.7% of the variance present in the data; the second axis explains 4.4% of the data variance. The slightly disturbed (white squares) and heavily disturbed (black triangles) forest types are well separated along axis 2.

Since soil factors, especially Ca, Mg, pH and NH4 were strongly correlated with species composition along CCA axis 1 in the Park we used this axis as environmental axis. There were nine species with a strong and significant correlation with axis 1 (Table 5.1); of these, four species were positive indicators for limestone forest, while five species were indicators for forest on acidic, and non limestone soils (Table 5.1).

Table 5.1. Soil type indicator species in Ben En National Park

Name of species	Axis 1	Number of stems per 0.04 ha	Correlation coefficient (r)	P Value
Limestone indicators				
Callicarpa macrophylla (Verb)	1.894	6	0.95	0.025
Garcinia fagraeoides (Clus)	1.369	5	0.98	0.026
Vatica odorata (Dipt)	1.079	5	0.93	0.012
Callicarpa dichotoma (Verb)	1.032	8	0.87	0.027
Acidic soil and non limestone indicators				
Schefflera octophylla (Aral)	-2.374	10	-0.85	0.034
Syzygium wightianum (Myrt)	-1.755	23	-0.74	0.002
Canarium tramdenum (Burs)	-1.571	30	-0.75	0.001
Erythrophleum fordii (Caes)	-1.292	59	-0.55	0.005
Randia pycnantha (Rub)	-1.239	8	-0.92	0.015

Six species had a strong and significant correlation with CCA disturbance axis 2; two of these indicated heavily disturbed forest, while four species were indicators of slightly disturbed forest (Table 5.2).

Table 5.2. Indicator species for forest disturbance in Ben En National Park

Name of species	Axis 2	Number of stems per 0.04 ha	Correlation coefficient (r)	P Value
Disturbance indicators				
Claoxylon indicum (Euph)	1.523	6	0.97	0.026
Microcos paniculata (Til)	1.259	16	0.89	0.012
Indicators of low disturbance forest				
Diospyros montana (Eben)	-2.235	5	-0.98	0.046
Meliantha suavis (Opil)	-1.364	11	-0.74	0.029
Heritiera macrophylla (Sterc)	-1.253	7	-0.88	0.023
Actinodaphne obovata (Laur)	-1.190	43	-0.59	0.007

Human impact on plant diversity in Ben En National Park

The density of trees, useful plants, and tree basal area were negatively correlated with human impact (Fig. 5.3 a-d). However, there were no significant correlations between disturbance factors and Fisher's alpha diversity indices of trees and treelets,

density of treelets, and number of treelet species in our plots (data not shown). The number of stumps found in each plot abruptly declined over 6 km away from the villages (Fig. 5.4). Although Fig. 5.4 shows total absence of stumps in these distant plots, we did find occasional stumps outside the plots in these remote areas.

The CCA analysis showed that soil factors had a strong correlation with plant composition in Ben En National Park (Fig. 5.2). Our analysis also showed that there was no significant correlation between soil factors, density of trees (including important timber tree species), useful plants and tree basal area in the 0.04 ha plots. However, soil factors had a strong correlation with treelet stem density, with highest treelet density in limestone forests (Fig. 5.5).

Soil variables also showed a very weak but significant correlation with Fisher's alpha index for tree species.

Canopy openness was not significantly correlated with treelet density. However, there was a weak but significant correlation with basal area, and tree density (Fig. 5.6 & 5.7).

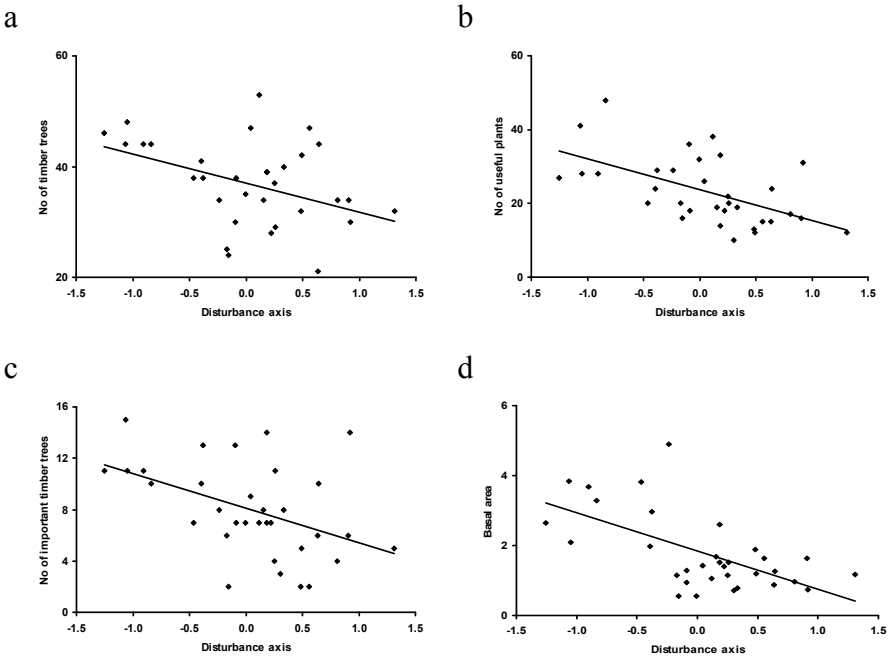

Fig. 5.3. Relation between disturbance CCA axis II and (a) tree density in the 0.04 ha plots; $R^2 = 0.16$; $P < 0.05$; (b) density of useful plants in the 0.04 ha plots; $R^2 = 0.31$; $P < 0.001$; (c) density of important timber trees in the 0.04 ha plots; $R^2 = 0.21$; $P < 0.01$; (d) tree basal area in the 0.04 ha plots; $R^2 = 0.38$; $P < 0.001$ (disturbance increases from left to right).

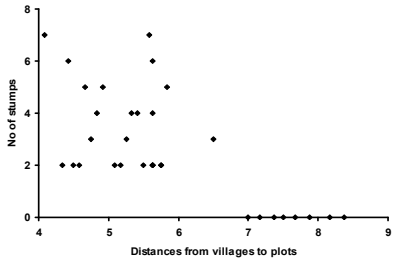

Fig. 5.4. Relation between the number of stumps per 0.04 ha plot and distance from villages to plots.

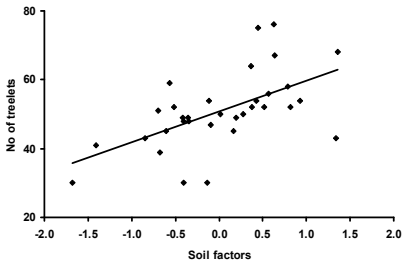

Fig. 5.5. Relation between soil CCA axis 1 and treelet density in the 0.04 ha plots: $R^2 = 0.33$; $P < 0.001$ (left to right indicates decreasing soil acidity and increasing occurrence of limestone).

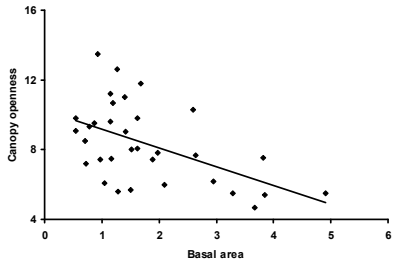

Fig. 5.6. Relation between canopy openness and tree basal area in the 0.04 ha plots: $R^2 = 0.27$; $P < 0.001$.

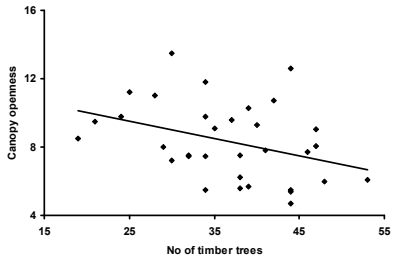

Fig. 5.7. Relation between canopy openness and tree density in the 0.04 ha plots: $R^2 = 0.13$; $P < 0.001$.

DISCUSSION

Human and environmental impact on plant diversity and composition in Ben En National Park

Our CCA analyses showed that soil is the most important factor for forest composition in Ben En National Park, even more important than the influence of human disturbance (Fig. 5.2). This is doubtlessly because Ben En National Park has strongly contrasting soil types: limestone on the one hand and ferralitic/alluvial soils of varying acidity on the other. The special characteristics of limestone floras in terms of species composition and forest structure have been well documented for several regions in Southeast Asia (Whitmore 1984; Vidal 2000; Lan et al. 2006). Soil factors, especially Ca and Mg are also important factors for forest composition

in Ben En National Park, which corresponds to findings in forests of North Borneo (Davies et al. 2005; Potts et al. 2002).

The two axes in the CCA only explain 10.1% of data variance. The low percentage of explanation of human and environmental factors on forest composition in Ben En National Park might be due to the fact that the inventory did not include very heavily disturbed shrublands, and bamboo forest. When those areas would have been included the explanatory power of the disturbance CCA axis would doubtlessly have been much higher. Low percentages of explanation of forest composition gradients by environmental parameters are not uncommon in tropical forests. For instance in an Amazonian forest, environmental factors (drainage, flooding, humus forms, and soil nutrient status) only explained 6.2 % of data variance by the first two canonical axes (Duivenvoorden 1995). In addition, plots that we surveyed were relatively small (0.04 ha) and, since many tropical tree species are rare, most species were only represented by a few individuals. This means that our analysis includes much random statistical noise since it is impossible to determine habitat preference for species with four or fewer individuals.

While the impact of human disturbance on the species composition in the forest appears to be limited (Fig. 5.2), its impact on tree density and basal area is considerable (Fig. 5.3). We observed a 13.4% decline in density of all trees (both timber trees and treelets), 16.7% in timber trees, 30% in useful plants, 30.8% in endangered species, and 36.4% in important timber trees. This is comparable to selectively logged forests elsewhere in the tropics, where basal area and density of trees are much reduced (Kao & Iida 2006). It must therefore be feared that without appropriate measures plant resources will become depleted in the future, also in the areas further away from villages, if illegal harvesting continues. Despite the large impact of disturbance on tree densities and basal area, human disturbance had no significant correlation with Fisher's alpha for tree species. This is an indication that the human disturbance seems not to affect relative species abundances much in the forests of Ben En National Park. Comparable findings were reported by Slik et al. (2002) in forests of Kalimantan where Fisher's alpha index in selectively logged forest did not differ significantly from undisturbed forest and even increased over time, even though tree density was strongly reduced by logging.

Two out of the four indicator species for low disturbance forest are listed in the Red List of Ben En National Park: *Actinodaphne obovata* (Lauraceae) and *Melientha suavis* (Opiliaceae) (Table 5.2; Hoang et al. 2008 a). In addition to that, *Actinodaphne obovata* (Lauraceae) is an important timber tree species. In contrast, none of the species indicating disturbance is listed in the Red Data Book of Vietnam and the Red List species in Ben En National Park, and none of them are important timber trees. Indeed, the number of Red List species in the Park has a significant negative correlation with the disturbance CCA axis (Fig. 5.8), emphasizing the conservation value of slightly disturbed forests in the area.

Soil factors were not significantly correlated with tree density, number of species and Fisher's alpha index in Ben En National Park. However, the density of treelets is higher on limestone soils than on other soil types (Fig. 5.5). This conforms to results from tropical forests in Sarawak and New Guinea, where the number of shrubs and treelets was also found to be higher on limestone (Whitmore 1984; Chapman & Wang 2002). This is apparently caused by a deficiency in certain plant nutrients, and poor water retention of limestone substrates (Whitmore 1984).

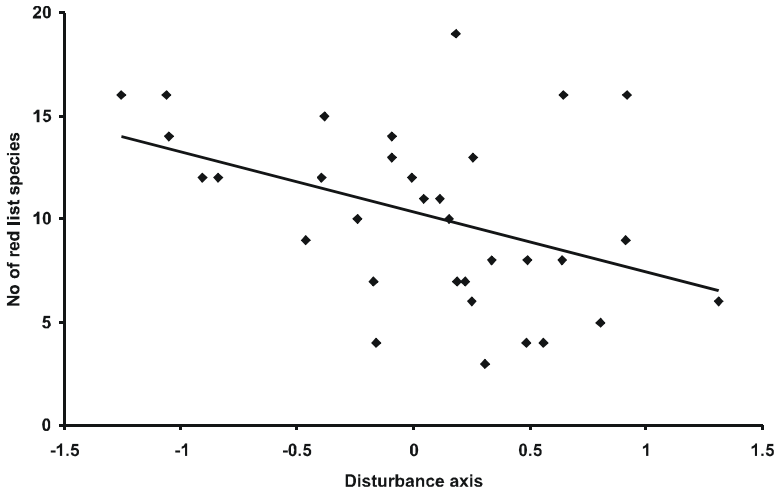

Fig. 5.8. Relation between disturbance CCA axis and density of Red list species in the 0.04 ha plots; $R^2 = 0.18$; $P < 0.05$.

CONCLUSION

Soil types and human disturbance have a significant effect on forest composition in Ben En National Park. Human disturbance had a strong negative impact on forest structure, leading to lowered densities of timber trees, useful plants, especially important timber trees, and Red list species. Disturbance levels decreased with distance to villages, indicating that the pressures of illegal logging and harvesting are closely connected to accessibility and transport costs. Prevention of forest conversion is urgently needed, by strict law enforcement within the Park to protect the important timber trees and endangered species before they become locally extinct. Reforestation and ecosystem restoration in the heavily disturbed forests and shrublands should be the next steps.

Chapter 6

SUMMARY AND RECOMMENDATIONS

This study concerns the plant species diversity of Ben En National Park in Vietnam - its history and current status, the uses of many local plant species still being made by the indigenous population, and the impact thereof on the conservation status of the flora. Ben En National Park was established in 1992 in a former timber concession. With a core zone covering 15,800 ha and a buffer zone of 12,000 ha, it constitutes one of the 30 National Parks in Vietnam.

The botanical inventory was carried out from 2005 - 2007 and consisted of general collecting throughout the core zone of the park and complete inventories of all woody plants in 147 10 x 10 m plots in slightly and heavily disturbed forests along transects that would allow to study the effects of accessibility by local people and of contrasting soil types on species composition and forest structure. Soil samples from all the plots were chemically analyzed. Information on plant use was obtained by completing extensive questionnaires for 135 households in three villages in the park, from village elders and forest rangers, and from recording all traces of plant collecting (such as stumps resulting from illegal logging) in the 147 plots.

Floristic diversity (Chapter 2) - Based on our own and earlier inventories in Ben En National Park, the total species number of vascular plant species is about 1600. In our survey 1389 vascular plant species were recorded, belonging to 650 genera and 173 families. Three species are new to the flora of Vietnam: *Myristica yunnanensis* Y.H. Li (Myristicaceae), *Glyptopetalum sclerocarpum* (Kurz) M.A Lawson, (Celastraceae), and *Timonius arborea* Elmer (Rubiaceae). Seven families, 43 genera and 252 species are new records for the flora of Ben En National Park. Euphorbiaceae constitute the most diverse family with 113 species, while 47 families are represented with one species only. As for the life form of plant species in Ben En, phanerophytes are the dominant component (76% of all species), with chamaephytes (6%), hemicryptophytes (8.5%), cryptophytes (6%) and therophytes (4%) constituting minor proportions of the local flora.

Vegetation types (Chapter 2) - Major parts of the forest in Ben En National Park have been impacted by man. The forests were commercially logged as late as 1992, and small-scale, illegal logging continues to this date. Three man-made ecosystems are present on 29% of the surface area of the core zone: 1) agricultural fields, about 650 ha; 2) plantation forests, about 110 ha; 3) mixed bamboo and timber tree stands, about 3800 ha. Two main natural vegetation types are recognized with heavily and slightly disturbed subtypes, depending on the intensity of plant use and illegal

logging by the local population (truly undisturbed, virgin forest is limited to a small inaccessible limestone area in the Park, and could not be included in this study). 1) Tropical evergreen limestone forest (subtypes: slightly disturbed, heavily disturbed, and shrubland on limestone). 2) Tropical evergreen lowland forest on other soils (mainly ferralitic, and in a small area on alluvial soil). Subtypes: slightly disturbed forest on ferralitic or alluvial soil, heavily disturbed forest on ferralitic soil, and shrubland vegetation outside the limestone hills.

Conservation status (Chapter 2) - A total of 29 plant species occurring in Ben En National Park are listed in the red data list of IUCN (2006), and 42 species are listed in the Red Data Book of Vietnam (2007), which recognizes a total of 448 endangered species. However, on the basis of our plot inventories and interviews with local people and forest rangers, 89 species (including 45 useful plants) were found to be endangered locally.

Useful plant species (Chapters 3 and 4) - A total of 386 plant species are used by local people in Ben En National Park, 52 of these species have more than one application. Medicinal plant species predominate among these useful plants with 230 species, belonging to 200 genera and 84 families, altogether used for the treatment of 68 different diseases (Chapter 3). These include species that are collected in the wild (65%) as well as species grown in home gardens. Leaves, stems and roots are most commonly used either fresh or dried or by decocting the dried parts in water. Women are mainly responsible for health care; they have better knowledge of medicinal plants than men, and also collect them more than men at almost every age level. The indigenous knowledge of traditional medicinal plants may be rapidly lost because 43% of the young generation do not know or do not want to learn about medicinal plants, and the remainder knows little about them. Moreover, local people increasingly tend to use western medicine. The majority of medicinal species are used by less than half of the households, and 68 % of the medicinal plant species are used by less than 25% of the households. A comparison of traditional uses of medicinal plants in Ben En National Park with traditional uses elsewhere in Southeast Asia and the Indo-Pacific region shows that the same species may be used for widely different treatments by different ethnic groups.

A total of 208 plant species are used for non-medicinal purposes (Chapter 4). Most species are used for food. In contrast with medicinal plants, men are collecting non-medicinal plants more often than women. A total of 56 useful plant species are commercialized and contribute 23% of the average income of individual households. Bamboo shoots of *Schizostachyum funghomii* (Poaceae), chipped stems of *Spatholobus suberectus* (Fabaceae), and seeds of *Amomum villosum* (Zingiberaceae) are the most important for income generation. The monetary equivalent of non-commercialized useful plants probably far exceeds the value of the traded plant products. Plant use is independent of the ethnicity of the different populations living in the Park. Larger households make use of a greater variety of useful plant species than small families. Abundant species in the forest have a higher use index (UI) than less common species (UI = Us/N. Where Us is the number of households which mentioned a use for species s; N is the total of households that were interviewed in

the research area). The current use patterns are not sustainable and would lead to local extinction of rare and endangered species if no additional conservation measures are introduced.

Human and environmental influences on plant diversity (Chapter 5) - Human disturbance had a strong negative impact on forest structure, leading to lowered densities of trees (especially important timber tree species) and useful plants, even though species diversity was not greatly altered. Soil factors significantly influence tree species composition although mineral composition of the soil only explains 5.7% of the observed data variance. Human factors (disturbance factors) are the second most important in explaining forest structure and species composition, accounting for 4.4% of data variance. Changes in species composition related to human disturbance varied independently of soils. The species composition of slightly and heavily disturbed forest differed significantly. Density of small trees was higher in limestone forest than in non limestone forest.

Timber trees and useful plant species, especially important timber trees, are more abundant in the less disturbed plots which were located far away from villages and roads. The number of endangered species is also more abundant in the less disturbed forest plots compared to heavily disturbed forest. Basal area in less disturbed forest was larger than in heavily disturbed forest. The pressures of illegal logging and harvesting are closely connected to travel distances to the nearest villages.

Recommendations and future outlook

Despite the fact that many forest areas in Ben En National Park have been and still are disturbed by local people, the plant diversity is still very high and worth conserving. Special measures are urgently needed to reverse the effects of disturbance by stopping illegal harvesting. In order to reduce the human pressures on the forest resources, and to conserve both plant biodiversity and traditional knowledge of local people on sustainable plant uses, more support is needed for local people living in the core zone of the Park, both financially and in teaching plant cultivation skills. More research is needed on the conservation status of endangered and utilised species in relation to the collecting activities of the inhabitants of the Park. Special research on the impact of local people on each individual endangered species is also needed, in order to prepare action plans for conservation and recovery of those species. Local people, especially of the young generation, should be encouraged to learn and use traditional medicinal plants for disease treatment to prevent that traditional knowledge of medicinal plants in the research area will disappear soon. Additionally, a forest restoration program is needed to counteract the heavy anthropogenic disturbance in large parts of the Park. Both the typical tree species and endangered herbaceous plants in the Park should be used for enrichment planting in the heavily disturbed forests and shrublands. Additionally, human pressure on the (semi-) natural forest ecosystem should be alleviated by allowing the plantation of valuable indigenous timber tree species in mixed stands with an undergrowth of multipurpose species in homegardens and shrublands near the villages, for future sustainable harvesting.

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SAMENVATTING EN AANBEVELINGEN

Dit proefschrift handelt over de diversiteit aan plantensoorten in het Ben En National Park in Vietnam. De volgende thema's komen aan bod: de voorgeschiedenis van het park, de huidige stand van zaken, het traditioneel gebruik van tal van inheemse en geïntroduceerde plantensoorten door de plaatselijke bevolking, de invloed daarvan op de zeldzaamheid, en de mogelijke bedreiging van de lokale flora. Voordat het Ben En National Park in 1992 tot beschermd gebied werd uitgeroepen, was het nog een kapconcessie. Met een zogenaamde "kernzone" van 15,800 ha, omgeven door een "bufferzone" van 12,000 ha vormt het één van de 30 nationale parken van Vietnam.

In het kader van dit onderzoek werd tussen 2005 en 2007 de botanische soortenrijkdom geïnventariseerd. In de gehele kernzone werden zoveel mogelijk soorten verzameld. Daarnaast werden in 147 proefvlakken van 10 x 10 m alle houtige planten geregistreerd. Deze "plots" werden zodanig langs transecten aangelegd dat ze een vergelijking mogelijk maakten tussen de soortenrijkdom en vegetatiestructuur in sterk en weinig door de lokale bevolking verstoorde bossen op verschillende bodemtypes. In alle plots werden bodemmonsters genomen voor chemische analyse. Informatie over het gebruik van planten werd ingewonnen door van 135 huishoudens uit de drie dorpen in het park uitgebreide enquêtes af te nemen en vragenlijsten in te vullen. Daarnaast werden dorpsoudsten en boswachters uitgebreid geïnterviewd, en werden sporen van het inzamelen van nuttige planten (zoals voorkomen en frequentie van boomstronken en voetpaden) in de 147 plots geregistreerd.

Diversiteit van de flora (Hoofdstuk 2) - Op grond van onze eigen inventarisatie en die van eerdere studies in Ben En National Park komen er in totaal ongeveer 1600 soorten vaatplanten voor. Daarmee is de soortenrijkdom van dit betrekkelijk kleine park vrijwel gelijk aan die van heel Nederland! Onze eigen verzamelingen brachten 1389 soorten aan het licht, behorend tot 650 geslachten en 173 families. Drie soorten bleken nieuw te zijn voor de flora van Vietnam: *Myristica yunnanensis* Y.H. Li (Myristicaceae), *Glyptopetalum sclerocarpum* (Kurz) M.A Lawson, (Celastraceae) en *Timonius arborea* Elmer (Rubiaceae). Zeven plantenfamilies, 43 geslachten en 252 soorten bleken tot nu toe nog niet bekend in het park. De wolfsmelkachtigen (Euphorbiaceae) vormen de meest diverse familie met 113 soorten. Daartegenover staan 47 plantenfamilies die slechts door één soort vertegenwoordigd zijn. Fanerofyten vormen de meest dominante component van de flora (76% van alle soorten). Chamaefyten (6%), hemicryptofyten (8.5%), cryptofyten (6%) en therofyten (4%) zijn elk veel minder prominent aanwezig in de lokale flora.

Vegetatietypes (Hoofdstuk 2) - Overgrote delen van het bos zijn door de mens aangetast. Commerciële houtkap vond plaats tot 1992. Illegale houtkap, zei het op kleinere schaal, vindt nog steeds plaats. Drie door de mens gecreëerde ecosystemen beslaan niet minder dan 29% van het opervlak van de kernzone: 1) akkerbouw-

velden, ca. 650 ha; 2) aangeplant bos, ca. 110 ha; 3) gemengde bamboe en houtopstanden (ca. 3800 ha). Twee natuurlijke hoofdtypes kunnen worden onderscheiden in de vegetatie, elk met drie (zeer) zwaar of slechts gering door de mens aangetaste varianten, afhankelijk van de intensiteit van het verzamelen van wilde planten en illegale houtkap door de lokale bevolking. Geheel onaangetast, zogenaamd maagdelijk bos, komt in het hele park slechts in een klein ontoegankelijk kalkrotsgebied voor en kon helaas niet in ons onderzoek worden betrokken. De wel onderzochte vegetatietypes zijn: 1) Tropisch immergroen laagland bos op kalkformaties (met drie subtypes: licht aangetast bos, zwaar aangetast bos, en struikvegetaties op kalksteen); 2) Tropisch immergroen laagland bos op andersoortige bodems (veelal ferralitisch, op een klein gebied alluviaal) met als subtypes: licht aangetast bos, zwaar aangetast bos en struikvegetaties buiten de kalksteenheuvels.

Natuurbeschermingsaspecten (Hoofdstuk 2) - De IUCN Rode Lijst van bedreigde plantensoorten (2006) telt 29 soorten die ook in Ben En National Park voorkomen; de Rode Lijst van Vietnam (2007) telt er niet minder dan 42 (op een totaal van 448 bedreigde soorten in Vietnam). Op grond van onze plotgegevens en interviews met de lokale bevolking en parkwachters zijn niet minder dan 89 soorten met lokale uitsterving bedreigd. Hiervan worden wel 45 soorten door de lokale bevolking voor diverse doeleinden gebruikt, wat hun bedreigde status verder verslechtert.

Nuttige planten (Hoofdstukken 3 & 4) - In totaal worden 386 plantensoorten gebruikt door de lokale bevolking van Ben En National Park. Hiervan hebben 52 soorten meer dan één soort toepassing. Medicinaal gebruik kon worden vastgesteld voor 230 soorten behorend tot 200 geslachten en 84 families. Deze soorten worden gebruikt bij de behandeling van 64 verschillende klachten of ziektebeelden (hoofdstuk 3). Van de medicinale planten wordt 65% der soorten verzameld in het wild; de rest wordt in zg. home gardens in en rond de dorpen gekweekt. Bladeren, stengels & takken en wortels worden zowel vers als gedroogd (of, na droging, met water verwerkt tot een infuus) gebruikt. De gezondheidszorg berust voornamelijk bij de vrouwen: zij hebben een betere kennis van de medicinale planten dan mannen, en zijn binnen alle leeftijdsklassen meer betrokken bij het verzamelen ervan in het wild. De lokale kennis van traditionele geneeskrachtige planten dreigt snel verloren te gaan, want 43% van de jongere generatie bleek geen kennis over medicinale planten te hebben en/of wenst zich die kennis ook niet eigen te maken. Ook bij de overige 57% van de jonge geïnterviewden was deze kennis gering. Daarnaast neemt de plaatselijke bevolking in toenemende mate haar toevlucht tot moderne westerse geneesmiddelen. Het overgrote deel van de 230 medicinale planten wordt door minder dan de helft van de huishoudens gebruikt, en 145 soorten worden zelfs door minder dan een kwart van de gezinnen gebruikt. Uit een vergelijking van het traditioneel gebruik van medicinale planten in Ben En met het gebruik elders in Zuidoost-Azië en het Indo-Pacifische gebied bleek dat dezelfde plantensoorten vaak voor totaal verschillende behandelingen en ziektes werden aangewend door de verschillende bevolkingsgroepen.

Een totaal van 208 plantensoorten vindt in het park toepassing voor niet-medicinale doeleinden (hoofdstuk 4). Het gaat hierbij vooral om voedselplanten, maar ook toepassingen in constructie, brandhout, en diverse huishoudelijke artikelen spelen een belangrijke rol. In tegenstelling tot wat bij de medicinale planten het geval was, zijn het vooral mannen die zich bezighouden met het verzamelen van deze niet-medicinale planten(delen). Niet minder dan 56 nuttige plantensoorten in het park worden verhandeld en dragen ca. 23% bij van het gemiddelde inkomen van de individuele huishoudens. Bamboescheuten van *Schizostachyum funghomii* (Poaceae), stamfragmenten van *Spatholobus suberectus* (Fabaceae), en zaden van *Amomum villosum* (Zingiberaceae) zijn de drie belangrijkste producten voor aanvulling van de inkomsten van de lokale bevolking. Het monetaire equivalent van de niet-verhandelde maar direct door de huishoudens gebruikte nuttige planten is waarschijnlijk veel hoger dan de waarde van de verhandelde planten, maar kon in ons onderzoek niet berekend worden. De benutting van planten bleek onafhankelijk van de etniciteit van de verschillende bevolkingsgroepen die in het park wonen. Grotere gezinnen bleken wel gebruik te maken van een grotere diversiteit aan plantensoorten dan kleinere gezinnen. Zeer algemeen voorkomende soorten in het bos hadden ook een grotere gebruiksindex (UI) dan zeldzamere soorten (UI = Us/N; waarbij Us = het aantal huishoudens dat het gebruik van een bepaalde soort s noemde; N = het totaal aantal geïnterviewde huishoudens). Het huidige gebruikspatroon van wilde planten is niet duurzaam en kan leiden tot plaatselijk uitsterven van enkele zeldzame en bedreigde soorten. Om dit te voorkomen zijn aanvullende beschermingsmaatregelen noodzakelijk.

De invloed van de mens en omgevingsfactoren op de floristische diversiteit (Hoofdstuk 5) - Menselijke verstoring heeft een grote negatieve invloed op de structuur van het bos, vooral op de frequentie van voorkomen van bepaalde boomsoorten, in het bijzonder de belangrijke houtleveranciers, en andere nuttige plantensoorten. De soortenrijkdom zelf is nog niet sterk aangetast. Bodemfactoren zijn van grote invloed op de soortensamenstelling van het bos, hoewel de minerale samenstelling van de bodem in de plots slechts 5.7% van de variatie in de floristische diversiteit verklaart. Menselijke verstoringfactoren verklaren op hun beurt 4.4% van de variatie in soortensamenstelling. Veranderingen in de soortensamenstelling door menselijke verstoring bleken onafhankelijk van bodemfactoren. De soortensamenstelling van licht verstoord en zwaar verstoord bos was significant verschillend. De frequentie van kleine bomen was hoger op de kalkrijke bodems dan op de ferralitische en alluviale bodems. Grote bomen en nuttige plantensoorten, vooral de commerciële houtsoorten, komen in hogere frequentie voor in de slechts licht verstoorde bosplots, die op grotere afstand van de dorpen en de wegen (hoofdweg door het park) lagen dan de sterk verstoorde plots. Het aantal bedreigde plantensoorten was ook hoger in de slechts licht verstoorde plots. Het basale stamoppervlak van de bomen was het grootst in de minst verstoorde plots. De schade door illegale houtkap vertoont een negatieve correlatie tot de afstand van de dorpen.

Aanbevelingen en vooruitblik

Ondanks het feit dat een groot deel van het bosareaal van het Ben En National Park in het verleden sterk beïnvloed is door commerciële houtkap en nog steeds te lijden heeft van illegale houtkap door de lokale bevolking, is de diversiteit aan plantensoorten nog steeds erg hoog en zéér de moeite van het beschermen waard. Er is een urgente behoefte aan extra maatregelen om de gevolgen van verstoring van de natuurlijke ecosystemen door de mens een halt toe te roepen en natuurlijk herstel een kans te geven. Het stoppen van de illegale houtkap is hierbij een eerste prioriteit. De menselijke druk op de natuurlijke hulpbronnen uit het bos kan ook verkleind worden door meer steun te bieden aan de lokale bewoners van de kernzone van het park, zowel financieel als in de vorm van educatie op het gebied van het zelf kweken van nuttige, met name medicinale planten. Hierdoor zou een bijdrage worden geleverd aan behoud van plantendiversiteit en zg. bioculturele diversiteit (nl. de kennis van de traditionele geneeskunde). Er is verder onderzoek nodig naar de verbanden tussen het verzamelen van nuttige planten door de lokale bevolking in het park en hun zeldzaamheid en bedreiging. Hierbij zou voor iedere met lokaal uitsterven bedreigde soort een actieplan moeten worden opgesteld voor het herstel ervan in het park. De plaatselijke bevolking, vooral de jonge generatie, zou ook gestimuleerd moeten worden om hun kennis over traditionele geneeskrachtige planten in ere te herstellen, ter voorkoming van verlies van dit biocultureel erfgoed in de regio. Daarnaast wordt gepleit voor een programma ter herstel van de verstoorde bosecosystemen in een groot deel van het park. Zowel de voor het gebied kenmerkende boomsoorten als de bedreigde kruidachtige plantensoorten zouden gebruikt moeten worden voor zg. verrijkingsaanplantingen in verstoord bos en in de anthropogene struikvegetaties. Bovendien zou de menselijke druk op het natuurlijke bosecosysteem verlaagd moeten worden door toe te staan de lokale bevolking op een beperkt areaal rond de dorpen gemengd bos te laten aanplanten met waardevolle inheemse boomsoorten, met een ondergroei van nuttige soorten van struiken en kruidachtige planten, voor toekomstig duurzaam (deels traditioneel) gebruik.

TÓM TẮT

Luận án này là kết quả nghiên cứu về sử dụng và bảo tồn đa dạng Thực vật ở Vườn quốc gia Bến En, Việt Nam - một trong 30 vườn quốc gia của Việt Nam. Trong đó tập trung vào nghiên cứu đa dạng loài, thảm thực vật, giá trị sử dụng, tình trạng bảo tồn, vai trò của tài nguyên Thực vật tới cuộc sống người dân, cũng như những tác động của người dân và một số nhân tố môi trường đến hệ Thực vật. Dựa vào những kết quả nghiên cứu, chúng tôi đưa ra những kiến nghị nhằm quản lý tốt hơn vườn quốc gia Bến En nói riêng cũng như các vườn quốc gia và khu bảo tồn thiên nhiên khác tại Việt Nam hay trong khu vực và trên thế giới.

Đa dạng sinh học Thực vật tại Việt Nam (Chương 2)

Việt Nam là nước giàu về đa dạng sinh học (Thin 1997). Đa dạng sinh học của Việt Nam đứng thứ 16 trên thế giới (WCMC 1992). Tuy nhiên diện tích rừng ở Việt Nam đã bị suy giảm nhiều trong 6 thập kỷ qua (Chien 2006). Hệ Thực vật Việt Nam rất đa dạng và phong phú, với ghi nhận lên tới 11.373 loài, thuộc 224 chi, 378 họ và 7 ngành, trong đó khoảng 28% số loài đặc hữu (Thin 1997). Nhằm bảo vệ nguồn tài nguyên rừng giàu tính đa dạng nhưng đang bị đe dọa, Chính phủ Việt Nam đã thành lập hệ thống rừng đặc dụng trên cả nước (Tai 1995; Chien 2006). Đến nay 126 khu rừng đặc dụng trên cả nước đã được thành lập, với tổng diện tích 2.54 triệu ha, chiếm 7.7% diện tích của cả nước.

Đa dạng sinh học Thực vật tại Vườn quốc gia Bến En (Chương 2)

Hệ Thực vật vườn quốc gia Bến En bao gồm 6 ngành với tổng số 1389 loài Thực vật có mạch thuộc 650 chi, 173 họ. Cùng với những nghiên cứu trước đây tại Vườn Bến En thì tổng số loài Thực vật có mạch có thể lên tới khoảng 1600 loài.

Nghiên cứu này đã bổ sung 3 loài mới cho hệ Thực vật Việt Nam đó là: Đậu khấu Bến En - *Myristica yunnanensis* Y.H.Li (Myristicaceae) (Hoang 2008 a), Xâm cánh Bến En - *Glyptopetalum sclerocarpum* (Kurz) M.A. Lawson, (Celastraceae) (Hoang 2008 b), và Găng Bến En *Timonius arborea* Elmer (Rubiaceae). Nghiên cứu cũng bổ sung 7 họ Thực vật, 43 chi và 252 loài Thực vật mới cho hệ Thực vật vườn quốc gia Bến En (Chương 2). Họ đa dạng nhất là họ Thầu dầu (Euphorbiaceae) với 113 loài. Bên cạnh đó có tới 47 họ Thực vật chỉ có duy nhất 1 loài đại diện. Dạng sống của hệ Thực vật vườn Quốc gia Bến En với ưu thế thuộc về cây có chồi trên mặt đất (Phanerophytes) với 76% tổng số loài, tiếp đến là cây có chồi nửa ẩn (hemicryptophytes) 8.5 %, cây có chồi sát mặt đất (chamaephytes) 6%, cây có chồi ẩn (cryptophytes) 6% và cuối cùng là cây có chồi một năm (therophytes) 4%.

Thảm Thực vật vườn quốc gia Bến En (Chương 2)

Trước khi được thành lập năm 1992 thì vườn Quốc gia Bến En thuộc Lâm trường Như Xuân, nên nhiều diện tích rừng ở đây đã bị tác động bởi con người (Khoi 1996;

Tordoff et al. 2000). Hiện nay, tình trạng khai thác gỗ trái phép vẫn còn xảy ra (Tordoff et al. 2000).

Thảm thực vật tại Vườn quốc gia Bến En được chia làm 2 kiểu rừng chính là: Rừng nhiệt đới thường xanh trên núi đá vôi và rừng nhiệt đới thường xanh trên núi đất. Mỗi trạng thái rừng được chia ra 3 loại phụ tùy theo mức độ tác động của người dân địa phương đó là: Rừng ít bị tác động, rừng bị tác động nhiều và trảng cây bụi. Bên cạnh đó tại vườn quốc gia Bến En còn có một số diện tích nhỏ rừng nguyên sinh chưa bị tác động ở những địa điểm nguy hiểm khó tiếp cận. Ngoài ra còn có khoảng 650 ha đất nông nghiệp, 110 ha rừng trồng và 3.800 ha rừng tre nứa hỗn giao với cây gỗ.

Giá trị bảo tồn tài nguyên Thực vật (Chương 2)

Tài nguyên Thực vật vườn quốc gia Bến En không chỉ đa dạng về thành phần loài, dạng sống và thảm thực vật mà còn có giá trị bảo tồn cao. Nghiên cứu đã đưa ra tổng số 29 loài tại vườn quốc gia Bến En có tên trong danh lục đỏ IUCN năm 2006, 42 loài có tên trong sách đỏ Việt Nam năm 2007. Bên cạnh đó, dựa vào kết quả điều tra thực địa, kết quả phỏng vấn người dân địa phương và kiểm lâm trong vườn, chúng tôi đưa ra 89 loài đang bị đe dọa trong phạm vi của vườn (chúng tôi gọi những loài này là Danh lục đỏ Bến En).

Đa dạng về giá trị sử dụng Thực vật Vườn quốc gia Bến En (Chương 3 & 4)

Qua điều tra và phỏng vấn 135 hộ gia đình trong khu vực nghiên cứu, chúng tôi xác đinh được 386 loài Thực vật được sử dụng bởi người dân địa phương, trong đó có 52 loài là cây đa tác dụng.

Nhóm thực vật có giá trị làm thuốc chiếm ưu thế với 230 loài thuộc 200 chi, 84 họ và được sử dụng để điều trị 68 bệnh khác nhau cho người dân địa phương khu vực vườn quốc gia Bến En (Chương 3). Với 56% tổng số loài được người dân sử dụng làm thuốc thu hái từ rừng tự nhiên. Lá, thân và rễ là các bộ phận chính của cây được người dân sử dụng để chữa bệnh. Về giới tính, phụ nữ có kiến thức tốt về cây thuốc hơn là nam giới và họ cũng tham gia thu hái cây thuốc từ rừng nhiều hơn nam ở mọi lứa tuổi. Qua điều tra chúng tôi cũng nhận ra rằng kiến thức bản địa của người dân về sử dụng thực vật làm thuốc đang bị suy giảm và có thể mất đi trong tương lai, bởi 43% số người trẻ được phỏng vấn không biết, hoặc không muốn học hỏi về chuyên môn này. Hơn nữa người dân nơi đây đang có xu hướng thích sử dụng thuốc tây để chữa bệnh (chương 3).

Số hộ gia đình sử dụng nhiều loài cây thuốc trong khu vực nghiên cứu để chữa bệnh không nhiều, trung bình một hộ gia đình sử dụng 25 loài cây thuốc. Trong khi đó khoảng 68% số loài được sử dụng bởi dưới 25% hộ gia đình. Khi so sánh giá trị sử dụng cây thuốc ở Bến En với một số nước khu vực Đông Nam Á và châu Á, chúng tôi nhận thấy rằng cùng một loài cây nhưng ở những địa điểm khác nhau, truyền

thống văn hóa và dân tộc khác nhau thì người dân có thể sử dụng để chữa các bệnh khác nhau (chương 3).

Bên cạnh 230 loài được người dân sử dụng làm thuốc, 208 loài được người dân sử dụng vào các mục đích khác (ngoài giá trị làm thuốc) (Chương 4) , trong đó có 52 loài là cây đa tác dụng (Chương 3 & 4). Phần lớn các loài được sử dụng làm thức ăn. Trái ngược với nhóm thực vật có giá trị làm thuốc, trong nhóm này đàn ông tham gia thu hái nhiều hơn phụ nữ ở hầu hết mọi lứa tuổi.

Tài nguyên Thực vật không chỉ quan trọng đối với cuộc sống sinh hoạt hàng ngày của người dân địa phương mà nó còn góp phần quan trọng nâng cao thu nhập của các hộ gia đình. Qua điều tra, chúng tôi thống kê được tổng số 56 loài với giá trị thương mại trong khu vực nghiên cứu và đóng góp 23% tổng thu nhập trung bình của các hộ gia đình. *Schizostachyum funghomii* (Poaceae), *Spatholobus suberectus* (Fabaceae), và *Amomum villosum* (Zingiberaceae) là những loài quan trọng đối với thu nhập cho người dân. Giá trị kinh tế của tài nguyên Thực vật có thế còn cao hơn nhiều so với thu nhập mà người dân có được do bán các sản phẩm này, bởi những đóng góp hàng ngày vào cuộc sống của người dân chưa được tính tới.

Kiến thức bản địa trong việc sử dụng tài nguyên Thực vật giữa các dân tộc trong khu vực nghiên cứu là cơ bản giống nhau, bởi các dân tộc sống cùng nhau trong bản/thôn. Tuy nhiên những hộ có đông thành viên thì sử dụng nhiều loài hơn những gia đình có ít người. Qua nhiên cứu chúng tôi phát hiện ra những loài còn phong phú trong tự nhiên thì có chỉ số sử dụng (UI) cao hơn những loài có ít số lượng cá thể. Rất tiếc việc sử dụng tài nguyên Thực vật tại vườn Quốc gia Bến En hiện nay là không bền vững. Những loài quý hiếm, bị đe dọa và có giá trị kinh tế cao có nguy cơ bị tuyệt chủng nếu không có những biện pháp bảo tồn kịp thời.

Tác động của con người và môi trường tới đa dạng thực vật (Chương 5)

Con người và môi trường có ảnh hưởng không lớn tới thành phần loài tại vườn Quốc gia Bến En. Tuy nhiên, ảnh hưởng của người dân địa phương có tác động tiêu cực tới mật độ cây trong rừng, đặc biệt là các loài cây gỗ quan trọng, cây có giá trị sử dụng và những loài trong Danh lục đỏ, cho dù chỉ số đa dạng sinh học không thay đổi. Sự tác động của con người và các nhân tố môi trường (chủ yếu là đất) lên cấu trúc rừng và thành phần loài thực vật là độc lập nhau. Các nhân tố môi trường phản ánh 5.7% cấu trúc và thành phần loài thực vật, trong khi những tác động của con người phản ánh 4.4%.

Nghiên cứu kết luận rằng thành phần loài và cấu trúc rừng ở khu vực ít bị tác đông có sự khác biệt rõ rệt với những nơi bị tác động nhiều. Ngoài ra nghiên cứu còn chỉ ra rằng mật độ cây gỗ nhỏ ở rừng núi đá vôi cao hơn trên núi đất.

Mật độ cây gỗ, cây có giá trị sử dụng, đặc biệt là cây gỗ quan trọng càng cao hơn ở những khu vực càng xa khu dân cư và đường khai thác cũ. Bên cạnh đó số loài trong

Danh lục đỏ và trữ lượng gỗ cũng cao hơn ở rừng ít bị tác động so với rừng bị tác động mạnh. Đồng thời nghiên cứu cũng khẳng định rằng áp lực của người dân địa phương lên tài nguyên thực vật càng lớn ở những diện tích gần khu vực dân cư.

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Mặc dù nhiều diện tích rừng ở vườn Quốc gia Bến En bị tác động bởi con người. Tuy nhiên tài nguyên Thực vật ở đây còn rất phong phú và đáng được quan tâm bảo tồn. Vì vậy việc cần thiết phải làm để bảo tồn tài nguyên thực vật là hạn chế tối đa việc khai thác gỗ trái phép.

Để giảm áp lực của người dân địa phương lên tài nguyên rừng và bảo tồn đa dạng sinh học cũng như kiến thức bản địa của người dân địa phương, đồng thời sử dụng bền vững tài nguyên thực vật thì cần thiết phải hỗ trợ người dân địa phương cả về tài chính cũng như hướng dẫn họ về kỹ thuật để gây trồng những loài cây hữu ích, đặc biệt là có giá trị kinh tế cao trong đất vườn và đất được giao sử dụng lâu năm của họ.

Bên cạnh đó cũng cần có những nghiên cứu sâu hơn về mối tương quan giữa người dân địa phương tới những loài bị đe dọa và những loài hữu ích trong khu vực vườn Quốc gia Bến En. Đồng thời người dân địa phương, đặc biệt là những người trẻ tuổi cần được khuyến khích sử dụng cây thuốc để chữa bệnh, nếu không kiến thức bản địa quý giá đó sẽ bị mai một và mất hẳn trong thời gian tới (chương 3).

Cuối cùng một chương trình làm giàu rừng là cần thiết cho những khu vực bị tác động mạnh, trảng cây bụi và khu vực vùng đệm. Trong chương trình này nên trồng những loài cây gỗ đặc trưng của vườn Bến En, những loài cây đa tác dụng và những loài đang bị đe dọa.

CURRICULUM VITAE

Hoang Van Sam was born on November 4th 1977 in Thanh Hoa province, Vietnam. In 1995 he enrolled at the Vietnam Forestry University, Hanoi. During this study he specialized in forest resources management. He graduated from the university with a BSc in 1999. In the same year, he started to work in the Forest Plant Department of the Faculty of Forest Resources and Environmental Management of this university as an assistant lecturer, and became a lecturer one year later. He teaches both theory and practice of taxonomy and Vietnamese plant families for students of Silviculture and Forest Resources and Environmental Management. He has carried out field work in many National Parks and Nature reserves in Vietnam. In 2002 he attended a training course on Plant taxonomy for young scientists from ASEAN countries in Bogor, Indonesia. Following this course, he was selected to follow an MSc program on Plant Biodiversity and Natural Products at the National Herbarium of the Netherlands, Leiden University. One of his MSc research projects on timber trees of Vietnam was carried out at the Musée Nationale d´Histoire Naturelle in Paris, France. He obtained his MSc at Leiden University in August 2004. After graduation he resumed his work at the Vietnam Forestry University. In May 2005 he was admitted as a PhD student at the National Herbarium of the Netherlands, Leiden University and embarked on the project of this thesis: "Uses and Conservation of Plant Biodiversity in Ben En National Park, Vietnam" under the supervision of Prof. Pieter Baas and Dr. Paul J.A. Keßler.

Hoang Van Sam has participated in and gave presentations at several international conferences related to his subject, such as the meetings on "Important Plant Areas and Standardization of Habitat Classification for ASEAN", in Kota Kinabalu, Malaysia in 2004; "Managing forests for poverty reduction" in Ho Chi Minh City, Vietnam in 2006; the "14th International conference of parties CITES", in Den Haag, the Netherlands in 2007; "Important timber trees and international trade" in Kuala Lumpur, Malaysia in 2007; the "VIIth Flora Malesiana Symposium" in Leiden, the Netherlands in 2007; "Biodiversity and Climate Change" in Aarhus, Denmark in 2008, and the first Symposium of the Flora of Laos, Cambodia and Vietnam in Phnom Penh, Cambodia in 2008.

During his study in Leiden University he gave lectures for MSc students in the courses on Ethnobotanical Knowledge Systems and Tropical Plant Families of South East Asia.

He published the following papers, some of which form part of this PhD thesis:

Hoang, S.V. & P.C. van Welzen. 2004. Revision of *Annesijoa, Elateriospermum* and the introduced species of *Hevea* in Malesia (Euphorbiaceae), Blumea 49: 425 - 440.

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