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

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## 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 ( $UI = U_s/N$ . 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). 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.

