BirdLife International Vietnam Programme
in collaboration with the
Forest Inventory and Planning Institute

A Feasibility Study for the Establishment of Xuan Lien Nature Reserve, Thanh Hoa Province, Vietnam.

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A Feasibility Study for the Establishment of Xuan Lien Nature Reserve, Thanh Hoa Province,Vietnam

by

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This is a technical report for the project entitled:
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Cover Illustration: Thai woman harvesting rice in the buffer zone of Xuan Lien proposed nature reserve. Photo: J. C. Eames

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Conventions Used

Plant names, sequence and species limits follow Pham Hoang Ho (1991). Mammal names (common and scientific), sequence and species limits follow Corbet and Hill (1992), with scientific names given at first mention and in Appendix 2. Bird names (common and scientific), sequence and species limits follow Inskipp et al. (1996), with scientific names given at first mention and in Appendix 3. Herpetile names, sequence and species limits follow Nguyen Van Sang and Ho Thu Cuc (1996). Butterfly names, sequence and species limits follow Corbet et al. (1992), Pinratana (1977-1988) and other, more recently published, literature.

Diacritical marks are omitted from Vietnamese names due to typographical limitations and the restricted understanding of international readers.

Locality names follow the Department of Cartography 1:50,000 series maps (1978).

A globally threatened species is any species assigned a category of threat in the IUCN Red Lists of Threatened Animals and Plants (IUCN 1996 and 1997); the term excludes species listed as Near-threatened, Data Deficient or Insufficiently Known.

Indochina refers to the biogeographic region of Cambodia, Laos, Myanmar, Thailand and Vietnam.

The study area refers to Xuan Lien proposed nature reserve, Thuong Xuan district, Thanh Hoa province.

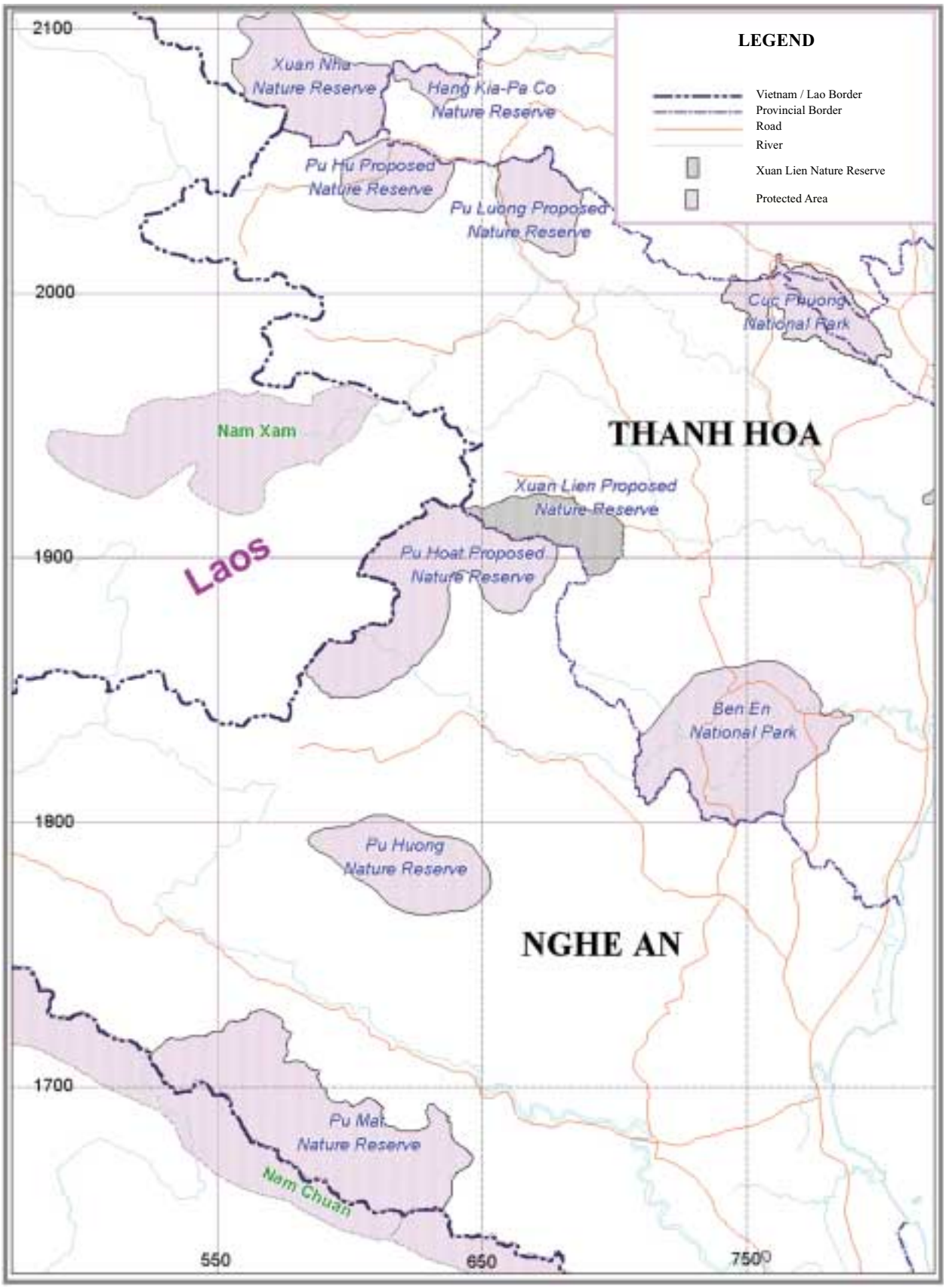
Abbreviations and Acronyms Used

EU	-	European Union
FIPI	-	Forest Inventory and Planning Institute, Hanoi
FPD	-	Forest Protection Department
FREC	-	Forest Resources and Environment Centre of FIPI
GNP	-	Gross National Product
IUCN	-	World Conservation Union
MARD	-	Ministry of Agriculture and Rural Development
MPI	-	Ministry of Planning and Investment

Disclaimer

This report does not contain any endorsement by the authors, BirdLife International, FIPI or the European Union, either implied or otherwise, of the proposal to establish the Cua Dat hydroelectric dam and reservoir.

Map 1: Location of Xuan Lien Proposed Nature Reserve



Map based on field survey in 1998
Grid: UTM, zone 48; units: metric

SCALE: 1:2,000,000

Produced by the Forest Resources and Environment Centre of FIPI

Executive Summary

This report is an expanded translation of a feasibility study for the establishment of Xuan Lien proposed nature reserve, Thanh Hoa province, originally published in Vietnamese in December 1998 by the Forest Inventory and Planning Institute (FIPI) in collaboration with BirdLife International. The objectives of the original report were to assess the biological and economic value of Xuan Lien, and the feasibility of establishing a nature reserve in the area. The objective of this report is to provide a higher level of detail for an international audience interested in Xuan Lien proposed nature reserve.

Within the framework of the European Union funded project entitled "Expanding the protected areas network in Vietnam for the 21st Century", a biodiversity and socio-economic survey of south-western Thuong Xuan district, Thanh Hoa Province was carried out in October and November 1998 by FIPI and BirdLife International. The results of the survey were used to produce a feasibility study for the establishment of Xuan Lien Nature Reserve

The survey revealed moderate levels of biodiversity relative to other protected areas in northern and central Vietnam. In total, 560 plant species, 38 species of mammals, 134 species of birds, 53 species of herpetiles and 143 species of butterflies were found. Several of these species are globally threatened, including six species of plant, 10 species of mammal, two species of bird and one species of herpetile. The survey was undertaken during the autumn when activity levels amongst birds and butterflies are depressed. This may have resulted in the species richness of these groups being under-recorded. Future surveys should be undertaken during the spring, which is the peak season for bird and butterfly activity.

Xuan Lien proposed nature reserve supports four plant species endemic to Vietnam (Cinnamomum balansae, Colona poilanei, Croton bonianus and Macaranga balansae), two bird species endemic to Vietnam and Laos (Red-vented Barbet Megalaima lagrandieri and Short-tailed Scimitar Babbler Jabouilleia danjoui) and one amphibian species endemic to Vietnam (Rana microlineata). Ten endemic species of butterflies were recorded, concentrated in two families: the Satyridae and Amathusiidae.

Large mammals recorded in the area included Tiger Panthera tigris, Gaur Bos gaurus, Asiatic Black Bear Ursus thibetanus and Sun Bear U. malayanus, although populations of many of these species are small and fragmented as a result of high hunting pressure. Furthermore, it is unlikely that Xuan Lien proposed nature reserve is large enough, by itself, to maintain viable populations of these species. However, Xuan Lien is contiguous with Pu Hoat proposed nature reserve in Nghe An province, with a shared boundary of 20 km and a combined protected area coverage of 90,841 ha.

One of the most significant results of the survey was the rediscovery of Roosevelt's Muntjac Muntiacus rooseveltorum. This was the first time this species has been recorded since its discovery in Laos 69 years previously, and also the first time that this species has been recorded in Vietnam. Furthermore, the survey revealed one recently discovered butterfly species (Ypthima sp. nov.), along with six new species for Vietnam.

As a result of the survey, two boundary options for Xuan Lien Nature Reserve were discussed at a workshop held in Thanh Hoa province in February 1999. Under option one, 16,500 ha would be included within the boundary of the nature reserve, whilst, under option two, 23,610 ha would be included, of which 18,522 ha would comprise forest of various types. Under neither of the options would the nature reserve contain any human settlement or permanent agricultural land. At the workshop, option two was decided upon.

The survey results indicate that, apart from the occurance of Roosevelt's Muntjac at this site, Xuan Lien

proposed nature reserve has low conservation importance relative to other sites in Thanh Hoa province and elsewhere in central Vietnam. Thanh Hoa Provincial People's Committee should allocate the limited resources available to them for protected area establishment and management on the basis of the global conservation importance of each site. Areas of forest supporting potentially viable populations of globally threatened primates, particularly areas supporting the Critically Endangered Delacour's Langur (Semnopithecus francoisi delacouri), such as Pu Luong proposed nature reserve and an area to the west of Cuc Phuong National Park, are higher priorities for conservation (F. Momberg verbally).

If the project to construct a hydroelectric dam at Cua Dat goes ahead, the resulting reservoir will inundate 1,716 ha within the proposed nature reserve. The decision on whether or not to proceed with the Cua Dat dam should only be taken after a thorough and professionally conducted Environmental Impact Assessment has been undertaken.

Tóm tắt dự án

Bản báo cáo nghiên cứu tính khả thi thành lập Khu bảo tồn Thiên nhiên Xuân Liên, tỉnh Thanh Hóa được Viện Điều tra quy hoạch rừng (FIPI) phối hợp với tổ chức BirdLife International tại Việt Nam cùng biên soạn bằng tiếng Việt vào tháng 12 năm 1998. Mục đích của bản báo cáo gốc nhằm đánh giá giá trị sinh học, kinh tế của khu vực Xuân Liên và tính khả thi thành lập khu Bảo tồn Thiên nhiên trong vùng. Mục đích của bản báo cáo này nhằm cung cấp những thông tin chi tiết cho các độc giả Quốc tế quan tâm đến khu Bảo tồn Thiên nhiên dự kiến Xuân Liên.

Trong khuôn khổ dự án được tài trợ của Cộng đồng châu Âu mang tên "Mở rộng hệ thống rừng đặc dụng ở Việt Nam cho thế kỷ 21", một đợt khảo sát đa dạng sinh học và dân sinh-kinh tế ở phía tây bắc huyện Trường Xuân, tỉnh Thanh Hóa đã được FIPI và tổ chức BirdLife International tiến hành vào tháng 10 và tháng 11 năm 1998. Kết quả của đợt khảo sát được sử dụng xây dựng báo cáo nghiên cứu khả thi khu Bảo tồn Thiên nhiên Xuân Liên.

Kết quả khảo sát này cho thấy mức trung bình của tính đa dạng sinh học của khu vực so sánh với các khu bảo vệ khác ở miền Bắc và miền Trung Việt Nam. Tổng số có 560 loài thực vật, 39 loài động vật, 134 loài chim, 53 loài ếch, nhái, bò sát, 143 loài bướm đã ghi nhận được.

Đã ghi nhận một số loài đang bị đe dọa mang tính toàn cầu, bao gồm có 6 loài thực vật, 10 loài thú, 2 loài chim và 1 loài bò sát. Tuy vậy đợt khảo sát được tiến hành trong mùa thu nên mức độ hoạt động của các loài chim và các loài bướm giảm xuống . Điều này dẫn đến số liệu về sự phong phú bị thiếu hụt .Các cuộc khảo sát trong tương lai cần được tiến hành giữa mùa xuân khi hoạt động của các loài bướm và chim đạt đỉnh điểm.

Tính đặc hữu của khu Bảo tồn Thiên nhiên Xuân Liên ở mức độ trung bình: 4 loài thực vật đặc hữu (Cinnamomum balansae, Colona poilanei, Croton bonianus, Macaranga balansae), hai loài chim đặc hữu (Megalaima lagrandieri, Jabouilleia danjoui) và một loài ếch nhái đặc hữu (Rana microlineata) đã được phát hiện.Mười loài bướm đặc hữu đã được ghi nhận, tập trung vào hai họ: Satyridae, Amthsiidae.

Các loài thú lớn được ghi nhận trong khu bao gồm Hổ Panthera tigris, loài bò Tót Bos gaurus, loài Gấu ngựa Ursus thibetanus và loài Gấu Chó U. malayanus, mặc dù quần thể của các loài này rất nhỏ và chia cắt do áp lực của săn bắt. Hơn nữa, khu Xuân Liên gần với khu Bảo tồn Thiên nhiên dự kiến Pù Hoạt thuộc tỉnh Nghệ An, có chung 20 km đường ranh giới và tổng diện tích của hai khu là 90,841 ha.

Một trong những kết quả quan trọng thu được từ đợt khảo sát là phát hiện loài Mang Roosevelt Muntiacus rooseveltorum. Loài này lần đầu tiên được phát hiện tại Lào cách đây 69 năm, như vậy đây là lần đầu tiên chúng được phát hiện ở Việt Nam. Phát hiện này có ý nghĩa to lớn đối với khoa học hơn nữa, kết quả khảo sát cũng đã ghi nhận một loài bướm vừa mới được phát hiện ở Việt Nam (Ypthima sp.nova), cùng với 6 loài ghi nhận mới cho Việt Nam.

Với kết quả khảo sát đã đề xuất hai phương án lựa chọn ranh giới cho khu Bảo tồn Thiên nhiên Xuân Liên. Hai phương án này đã được thảo luận tại cuộc hội thảo tháng 2 năm 1999 tại tỉnh Thanh Hóa. Diện tích ranh giới khu Bảo tồn Thiên nhiên theo lựa chọn 1 là 16.500 ha, theo lựa chọn 2 là 23.610 ha, bao gồm 18.522 ha rừng các loại. Cả hai giải pháp trong khu bảo tồn không có khu dân cư và đất nông nghiệp. Lựa chọn 2 đã được ưu tiên, lựa chọn và thông qua tại hội thảo này.

Kết quả khảo sát chỉ ra rằng, bên cạnh việc phát hiện loài Mang Roosevelt có ý nghĩa lớn

lao, khu Bảo tồn Thiên nhiên dự kiến Xuân Liên có giá trị bảo tồn ở cấp trung bình so với các khu vực khác của Thanh Hóa cũng như miền Trung Việt Nam. Ủy ban nhân dân tỉnh Thanh Hoá nên cân đối nguồn kinh phí hạn hẹp một cách hợp lý cho việc thành lập và quản lý các khu Bảo tồn trên cơ sở ưu tiên cho những khu có tầm quan trọng bảo tồn toàn cầu. Chẳng hạn khu Bảo tồn Thiên nhiên dự kiến Pù Luông và vùng ở phiá Tây của vườn quốc gia Cúc Phương là nơi cư trú của quần thể linh trưởng bị đe dọa toàn cầu, cụ thể đối với loài Voọc quần đùi bị đe dọa nghiệm trọng (Semnopithecus francoisi delacouri). Đây là những nơi giữ vị trí ưu tiên hàng đầu cho công tác bảo tồn (theo lời của Ông F. Momberg).

Nếu dự án xây dựng đập thủy điện Cửa Đạt được thực hiện, kết quả hồ chứa sẽ làm ngập 1717 ha thuộc khu Bảo tồn Thiên nhiên dự kiến. Việc quyết định thi công đập Cửa Đạt hay không cần phải dựa trên cơ sở quá trình Đánh giá Tác động Môi trường.

1. Introduction

1.1 Geography, Demographics, Economics and Environment

Geography. The Socialist Republic of Vietnam is a relatively narrow strip running north-south along the eastern coast of the Indochinese Peninsula. With a 3,000 km coastline, Vietnam extends from 23°37.5' to 8°00.5'N. It is approximately 525 km across at its widest point and 47 km across at its narrowest point. Vietnam's total land area is 331,689 km^2. Mountain ranges extend along Vietnam's border with the People's Republic of China in the north, and along the borders with the Lao People's Democratic Republic and the Kingdom of Cambodia in the west. The highest point is Mount Fan Si Pan in the far north at 3,143 m, although average mountain altitudes are around 1,000 m. Vietnam is topographically complex with the exception of the narrow, coastal lowlands of the central region and the southern Mekong Delta region.

Demographics. The population of Vietnam is approximately 77 million people (1998) with a growth rate of 2.3% (at this rate, the population will double in 32 years time). The country is comprised of 61 provinces with 570 urban centres. Eighty percent of the population live in rural areas. Two cities have over 1 million inhabitants: Ho Chi Minh City (formerly Saigon) and Hanoi, the capital. Literacy rates are high: 93% for males and 83% for females. Life expectancy is 62 years for males and 67 years for females (Pham Ngoc Dang 1998).

Economics. Vietnam is currently undergoing an economic transition towards a more open economy. Vietnam's annual per capita gross national product (GNP) is about US$250 (World Bank 1997). GNP has been growing rapidly for the past decade. Vietnam's leading exports in order of contribution to GNP are crude oil, coal, rice, coffee, textiles, marine products, shoes, tea, cashew nuts and rubber. It is the world's third largest rice exporter and the fifth largest coffee exporter.

Environment. Economic growth, infrastructure development, population growth, protracted wars, and the development of agriculture, forestry and fishing industries have resulted in over-exploitation of Vietnam's natural resources. The environment in Vietnam has largely been compromised; forest cover is estimated at less than 20% of the country's total land area (less than 10% primary forest) (Vo Quy 1998). Over the last two decades, there has been an average reduction of forest by 350,000 ha per year (Vo Quy 1998). Gross deforestation has been accompanied by degradation of arable land, soil erosion, destruction of water catchments, diminished groundwater sources, siltation and ecological degradation of coastal and submerged areas, and a loss of overall biodiversity within Vietnam.

1.2 Conservation

The Government of Vietnam recognised the necessity for conserving and rehabilitating the natural environment at the end of the 1970s. Its first priority was to provide areas for settling war veterans. The second priority was chemical detoxification and remediation for human resettlement of areas affected by chemical defoliants. The third priority was given to reforestation, establishing reserves and the conversion of forests into cultivated land (MOF 1991a). Only in the 1990s has the conservation emphasis moved towards protecting endangered habitats and species.

Vietnam's forests are divided into three categories (MOF 1991a,b):

(a) Production Forests. These are forested areas which can be allocated to any organisation or individual (with management requirements and harvesting regulations) for domestic commercial timber needs as stipulated in Vietnam's Forestry Law, Articles 28-34;

(b) Watershed Protection Forests. These forested areas can be allocated to forestry agencies, people's committees, or to the people directly, with the main purposes of watershed protection, soil erosion control and foreshore protection with special provisions as per Articles 35-37; and

(c) Special-use Forests. These are forested lands allocated for environment conservation, tourism, educational purposes, national defence, and other special uses. These lands can be allocated to organisations and agencies in the state forestry sector which are expected to generate revenues outside of the strict preservation areas and follow management procedures as per Articles 39-41. Special-use Forests are further subdivided into:

(i) *Cultural and Historical Sites* to preserve and maintain areas of national and cultural interest and importance;

(ii) *Nature Reserves* intended to preserve all representative forest types and to conserve biodiversity; and

(iii) *National Parks* to protect and conserve all major types of wildlife and habitat types found within of Vietnam.

Vietnam currently has proposals for 105 protected areas, comprising 976,000 ha or 3% of the total land area. Under Special-use Forest classification there are 10 national parks, 61 nature reserves, and 34 cultural of historical sites (Dang Huy Huynh 1998). Vietnam is actively gazetting new sites as part of its treaty obligations under the Convention on Biological Diversity. Under this treaty, Vietnam has agreed to increase its protected area system to 2,000,000 ha by the year 2000, thereby doubling its network of Special-use Forests.

Vietnam supports approximately 275 mammal species, 826 bird species, 260 reptile species, 82 amphibian species, 500 freshwater fish species, 2,000 marine fish species and 12,000 plant species (Dang Huy Huynh 1998, MacKinnon 1996).

1.3 Forest in Thanh Hoa Province

The natural vegetation of Thanh Hoa province is semi-evergreen rainforest in the lowlands in the east and centre of the province, with sub-montane dry evergreen forest in the mountains in the west (MacKinnon 1996). A thin belt of limestone forest runs across the north of the province, along the borders with Ninh Binh and Hoa Binh provinces.

In Thanh Hoa province, forest cover originally stretched from the coastal plains to the border with Laos. However, the coastal plains were almost entirely deforested prior to 1945 to make way for wet rice cultivation. Since then, there has been a gradual erosion of forest in the foothills and mountains in the centre and west of the province, as a result of shifting cultivation, commercial logging activities and resettlement of people from the lowlands. Between 1983 and 1995, 95,000 ha of forest was lost, at a rate of 8,000 ha per year (unpublished data from the Forest Inventory and Planning Institute (FIPI)). In the foothills, remaining forest areas are fragmented. However, large areas of continuous forest cover remain in the mountains close to the border with Laos.

The current and proposed system of Special-use Forests in Thanh Hoa province includes Ben En National Park, in the south-east of the province, which covers 16,634 ha. Three proposed nature reserves in the west of the province, Pu Luong, Pu Hu and Xuan Lien, cover a further 56,857 ha. Additionally, limestone

forest areas in the north of the province are protected by Cuc Phuong National Park, which extends across three provinces: Thanh Hoa, Ninh Binh and Hoa Binh (Map 1).

1.4 Xuan Lien proposed nature reserve

Forests in the west of Thanh Hoa and Nghe An provinces protect the watershed of the Chu River, the second largest river in Thanh Hoa province. These forests include Pu Hoat proposed nature reserve in Que Phong district, Nghe An province, and areas in south-west Thuong Xuan district, Thanh Hoa province. In 1996, the Asian Development Bank provided assistance to plan for the protection of the western catchment of the Chu River. In 1997, Thanh Hoa Provincial Forest Protection Department (FPD) submitted a proposal to the Ministry of Agriculture and Rural Development (MARD) to include the upstream area of the Chu River catchment in Thuong Xuan district, Thanh Hoa province in Vietnam's system of Special-use Forests as Xuan Lien Nature Reserve.

In October and November 1998, FIPI and the BirdLife International Vietnam Programme, in coordination with Thanh Hoa Provincial FPD, carried out a field survey of Xuan Lien proposed nature reserve as part of the EU-funded project "Expanding the Protected Areas Network in Vietnam for the 21st Century". Data on the biodiversity, population and economic conditions in the area were collected, and two potential boundaries for the proposed nature reserve were identified. The data was used to prepare this feasibility study.

This feasibility study is the initial step in the process to formally establish Xuan Lien Nature Reserve, Thanh Hoa province. This report is an English translation of the original feasibility study, which was published in Vietnamese in December 1998.

2. Site Features

2.1 Biogeography

According to the classification of MacKinnon (1996), Xuan Lien proposed nature reserve is located in sub-unit 10b (North Indochina) of the Indo-Chinese sub-region; and, according to the classification of Wikramanayake *et al.* (1997), the proposed nature reserve is situated within the Northern Indochina Subtropical Forests Ecoregion.

2.2 Location

Xuan Lien proposed nature reserve is located in Thuong Xuan district, Thanh Hoa province, and is bounded by the coordinates 19°52' to 20°02'N and 104°58' to 105°15'E (Map 1). The proposed nature reserve includes all or part of six communes: Bat Mot, Yen Nhan, Xuan Khao, Xuan Lien, Xuan My and Van Xuan.

The proposed nature reserve is bordered by the Cao River to the north, the provincial border with Nghe An to the south and west, and the Ta Leo and Bu Khong mountains and the confluence of the Cao and Chu Rivers to the east.

2.3 Topography

The proposed nature reserve is situated in a belt of mountains running from Sam Neua in Laos to Thuong Xuan and Nhu Xuan districts in Thanh Hoa province. These mountains contain many high peaks, such as Ta Leo (1,400 m), Bu Cho (1,563 m), Bu Hon Han (1,208 m), and an unnamed 1,605 m peak. The topography of the nature reserve is characterised by low mountains, dissected by deep, narrow valleys.

Two main topographic forms dominate the area:

(a) Medium High Mountains. Located at elevations of 800 to 1,600 m in the Cao and Nam Boo River basins, these mountains are dissected by deep, narrow valleys, sloping from west to east. Slopes are steep, averaging 35°. These areas cover a total of 4,289 ha or 18% of the study area.

(b) Low Mountains and Foothills These areas are located at elevations below 800 m and lie mainly in the east, in the Cao River basin, and in the south, near the border with Nghe An province. Slopes in these areas are generally shallower: on average 20 to 25° for the low mountain areas and 15 to 20° for foothill areas. The topography is less complex than in the higher areas. These areas cover a total of 19,321 ha, representing 82% of the study area.

Several other topographic types also occur in the study area, though they cover only small, scattered areas. Karsts occur at elevations below 800 m and may have extremely steep slopes (60 to 70°) with vertical cliffs in places. Access to these areas is often difficult. The topography of valleys in the study area varies: valley floors are narrow in upstream areas, becoming wider in the lower sections of the Cao, Kue and Chu Rivers. Many of these lower sections have relatively flat, fertile valleys.

2.4 Meteorology

The topography and geomorphology of the study area has affinities with the north-western regions of Vietnam. However, the climate is more similar to that of the lowlands and foothills of Thanh Hoa province.

Data from nearby meteorological stations in Bai Thuong, Nhu Xuan and Quy Chau districts are indicative of the climatic conditions in the study area (Table 1).

Table 1: Metereological Data from Three Weather Stations near Xuan Lien Proposed Nature Reserve

Meteorological Data	Bai Thuong	Nhu Xuan	Quy Chau
Latitude	19°54'N	19°38'N	19°33'N
Longitude	105°23'E	105°34'E	105°07'E
Altitude (m)	21	10	87
Period of measurements	1961 to 1995	1964 to 1995	1962 to 1995
Annual mean temperature (°C)	23.3	23.3	23.1
Absolute minimum temperature (°C)	2.6	3.1	0.6
Absolute maximum temperature (°C)	41.5	41.7	41.3
Total annual rainfall (mm)	1937.3	1790.4	1734.5
Maximum daily rainfall (mm)	314.8	376.7	290.1
Annual no. of rainy days	149	124	150
Annual humidity (% RH)	85	85	86
Evaporation (mm)	783	926	704

The coldest month is January and the hottest months are June and July. The highest rainfall occurs during the six months from May to October. Rainfall is heaviest in August and September, with occasional high intensity rain events of greater than 350 mm per day. Rainfall during the rainy season accounts for 90% of the total yearly rainfall. Heavy floods and erosion often occur in this period. The dry season occurs between November and April, with December to March being particularly dry. Annual mean humidity is 85% but may be as low as 16% in the dry season. Evaporation is highest during the dry season.

Frosts often occur in winter, particularly during January and February, and most often in valleys, high hills and mountains. They usually last for one or two days but may be as prolonged as 10 days.

Wind directions are generally, though not solely, seasonal: north-easterly in the dry season and south-easterly in rainy season. South-westerly and south-easterly winds may also occur in the dry season. In addition, hot, dry westerly winds, blowing from Laos to the centre of Vietnam often occur from May to August, affecting the valleys and low areas. Wind speeds can be strong, occasionally reaching force eight or nine.

The combination of heavy rainfall over a short period of time and strong winds can cause sudden flooding of rivers and streams, and necessitates the adoption of precautionary measures in the planning of conservation and development projects.

Climate is strongly influenced by topography and geomorphology. The average temperature in the foothills is 23°C, and in the mountains is 21°C. The minimum temperature in the mountains is 0.4°C. Rainfall averages between 1,700 and 2,000 mm. However, rainfall in the wetter areas averages between 2,000 and 2,500 mm and may be up to 3,000 mm in some years. Rainfall in drier areas averages 1,400 mm, but may

be as low as 1,060 mm in some years. The foothills have between 120 and 130 rainy days per year, while the mountains have 149 or 150. Evaporation is higher in the foothills (900 to 1,000 mm/year) than in the mountains (700 to 800 mm/year).

2.5 Hydrology

There are three main river systems in the nature reserve:

(a) Chu River Basin. The Chu River is the second largest river in Thanh Hoa province. The Chu River originates in Laos and flows through Nghe An province before passing through the proposed nature reserve. The Chu River is important for the transportation of goods and produce, water resources, hydro-electricity, irrigation, and drainage. The area of the Chu River watershed is 81,594 ha, excluding a section in Laos. The river bed is narrow, running through areas of high, sloping topography and has rapid currents. Table 2 summarises the hydrological features of the Chu River, measured at Bai Thuong Dam.

Table 2: Hydrological Features of the Chu River at Bai Thuong Dam

Hydrological Feature	Measurement
Average annual flow volume (m^3/yr)	4.57 x 10^9
Average flow rate (m^3/s)	145
Dry season flow rate (m^3/s)	23
Rainy season flow rate (m^3/s)	6,700
Maximum (rainy season) water level (m)	21.41
Minimum (dry season) water level (m)	15.80

(b) Cao River Basin. The Cao River (also known as the Khao River) is the largest tributary of the Chu River and has a catchment of 30,587 ha. The river originates in the mountains in Bat Mot commune, runs through Yen Nhan and Xuan Khao communes and meets the Chu River at Lang Thon village. The upstream reaches of the Cao River are very narrow and steep, with many waterfalls; Tieu waterfall in Bat Mot commune, for example, is more than 60 m high.

(c) Kue River Basin. The Kue River (also known as the Nam Bung) is also a large tributary of the Chu River. It drains the southern section of the study area. The river originates on the south-facing slopes of Ban Mua and Bu Hon Han mountains and flows through Bat Mot, and Xuan Lien communes before meeting the Chu River at the border between Thanh Hoa and Nghe An provinces.

In addition to the Cao and Kue Rivers, numerous smaller tributaries of the Chu River originate in the study area. These include the Hon Yen stream originating on the north-east-facing slopes of the Bu Cho and Ta Leo mountains in the east of the study area. In general, water courses in the study area are permanent and fringed by intact forest cover.

Surveys were undertaken at several sites to assess the hydrogeology of the region. Water was found at 1 to 2 m below the surface at most sites located in valleys. The lowest water-table was found to be 7 to 8 m below the surface. These results indicate that groundwater is abundant in the area. However, this is only a preliminary assessment of underground water resources due to the dearth of data on the groundwater characteristics of the region

2.6 Geomorphology

The geology of the area is varied and includes sedimentary material (flagstone, limestone, precipitated sand and pebbles, and clay flagstone), schist, spilite, aldezite, and other metamorphic rocks such as marble and mica. These deposits are either separated evenly or closely intertwined.

Generally, the mountains in central Vietnam, adjacent to the Laos border are formed from igneous material such as riolite and granite. They have sharp peaks and steep slopes compared to the surrounding mountains and hills, and were formed during the late Cretaceous period.

The central low hills and mountain areas are less than 800 m high, averaging 400 to 500 m. They are formed from a variety of undivided red sedimentary rocks of the Jurassic period, including clay schist, aerolites, pebbles and some limestone. In western Thanh Hoa province, and in this area in particular, mining of minerals has taken place in the past, including tin, gold, pyrite and antimony.

2.7 Soil

The main soil types found in the study area are:

(a) Feralite Humus Soil in Medium High Mountains (FH). This soil type covers 4,289 ha or 18% of the study area. It is formed in hot, humid conditions, on steep slopes, without stagnant water or agglomeration but with a high proportion of humus (the humus ratio in the surface layer is over 8 to 10%). The soil layer is thin, red-yellow in colour and contains a high proportion of stones. This soil type is distributed between 800 and 1,700 m on Bu Hon Han and Ban Mua mountains, and in mountains on the borders with Nghe An province and Laos.

(b) Feralite Soil in Lowlands (F): This soil type covers 19,321 ha or 82% of the study area. The colour of this typical feralite soil depends on the tectonic rock upon which it is based. It is found at elevations below 800 m and typically includes:

(i) *Yellow and Red Feralite Soil on Metamorphic Rock and Clay Schist in Lowlands* (Fs). The mechanical composition is heavy, and the soil layer is thick and contains few stones. It is distributed in Bat Mot, Xuan Le and Xuan My communes;

(ii) *Light Yellow Feralite Soil on Sandstone in Lowlands* (F9). The mechanical composition is light, and the soil layer is from thin to average and mixed with stones. It has a scattered distribution in Bat Mot, Yen Nhan, Xuan My, Van Xuan and Xuan Le communes; and

(iii) *Yellow and Red Feralite Soil on Magmatic Acidic Rock in Lowlands* (Fa). The mechanical composition has an incohesive structure. The soil layer is thin and mixed with stones. It is mainly distributed in Yen Nhan, Xuan Lien, Xuan Khao, Xuan My, Van Xuan and Xuan Le communes.

(c) River and Stream Alluvial Soil (P). This is a fertile soil, brown in colour, deeply layered, medium to light textured and porous. It is distributed along rivers and streams in the study area, most commonly in the lower basins of the Cao and Khue Rivers. This soil type covers less than 1% of the study area.

2.8 Flora Overview

Table 3: Floral Diversity of the Study Area

Taxon	Families	Genera	Species
Lycopodiophyta	2	2	3
Polypodiophyta	13	22	31
Pinophyta	5	6	6
Magnoliopsida	88	284	430
Liliopsida	16	67	90
Total	124	381	560

The field survey recorded 560 species of vascular plants in 381 genera and 124 families (Table 3). These species include 222 timber species, 31 ornamental species and 116 species with known medicinal uses (Appendix 1).

The flora of the proposed nature reserve is characterised by taxa indigenous to northern Vietnam and southern China, such as members of the Fagaceae and Lauraceae. In addition, there are two other major elements to the flora. The first is an Indo-Malayan element which includes members of the Dipterocarpaceae and Combretaceae together with a number of deciduous species such as *Lagerstroemia tomentosa* and *Tetrameles nudiflora*. The second is a temperate Sino-Himalayan element, characteristic of Yunnan and the Himalayan foothills; included in this element are several conifers and a number of broadleaf deciduous tree species.

Of the 124 plant families represented, 12 families contain 10 or more species. These are the Euphorbiaceae (with 33 species), Lauraceae (25), Poaceae (22), Rubiaceae (20), Orchidaceae (20), Moraceae (18), Fagaceae (14), Fabaceae (14), Caesalpiniaceae (11), Asteraceae (11), Meliaceae (11) and Arecaceae (10). However, the most abundant species in the study area belong to the Dipterocarpaceae, Fagaceae, Lauraceae, Magnoliaceae, Sapotaceae, Sapindaceae, Euphorbiaceae, Meliaceae, Hamamelidaceae, Cupressaceae and Poaceae. Stands of bamboo, comprising species such as *Neohouzeana dulloa* and *Dendrocalamus patellaris*, are found in areas where the forest has been very heavily disturbed. The tree flora of medium to high montane mixed coniferous and broadleaf evergreen forest is dominated by *Hopea mollissima* (Dipterocarpaceae); although conifers, including *Fokienia hodginsii*, are also present in smaller numbers. Conifers and broadleaf trees together form significant stands of mixed forest, at elevations above 1,200 m.

The conservation importance of several species is notable. Of the 560 species recorded during the field survey, four are endemic to Vietnam (*Cinnamomum balansae*, *Colona poilanei*, *Croton boniana* and *Macaranga balansae*) and six are listed as threatened in the IUCN Red List of Threatened Plants (IUCN 1997) (Table 4).

Table 4: Globally Threatened Plants Recorded in the Study Area

Species	Current Status as per IUCN 1997
Annamocarya sinensis	R
Calamus tonkinensis	R
Dalbergia tonkinensis	V
Fokienia hodginsii	R
Madhuca pasquieri	R
Parashorea chinensis	R

Notes: V = Vulnerable; R = Rare as per IUCN (1997).

2.9 Vegetation Types

The results from the field survey show that forest covers 78.5% of the total area, although a large proportion of this is bamboo forest with varying degrees of disturbance (Table 5 and Map 2).

Table 5: Existing Vegetation Types in the Study Area

Vegetation Type	Area (ha)	Percent
Primary Forest	1,762	7.5
Elfin Forest	481	2.0
Mixed Bamboo and Broadleaf Forest	2,245	9.5
Pure Bamboo Forest	8,691	36.8
Regenerating Forest	5,343	22.6
Scrub and Grassland	4,690	19.9
Agricultural Land	398	1.7
Total	23,610	100.0

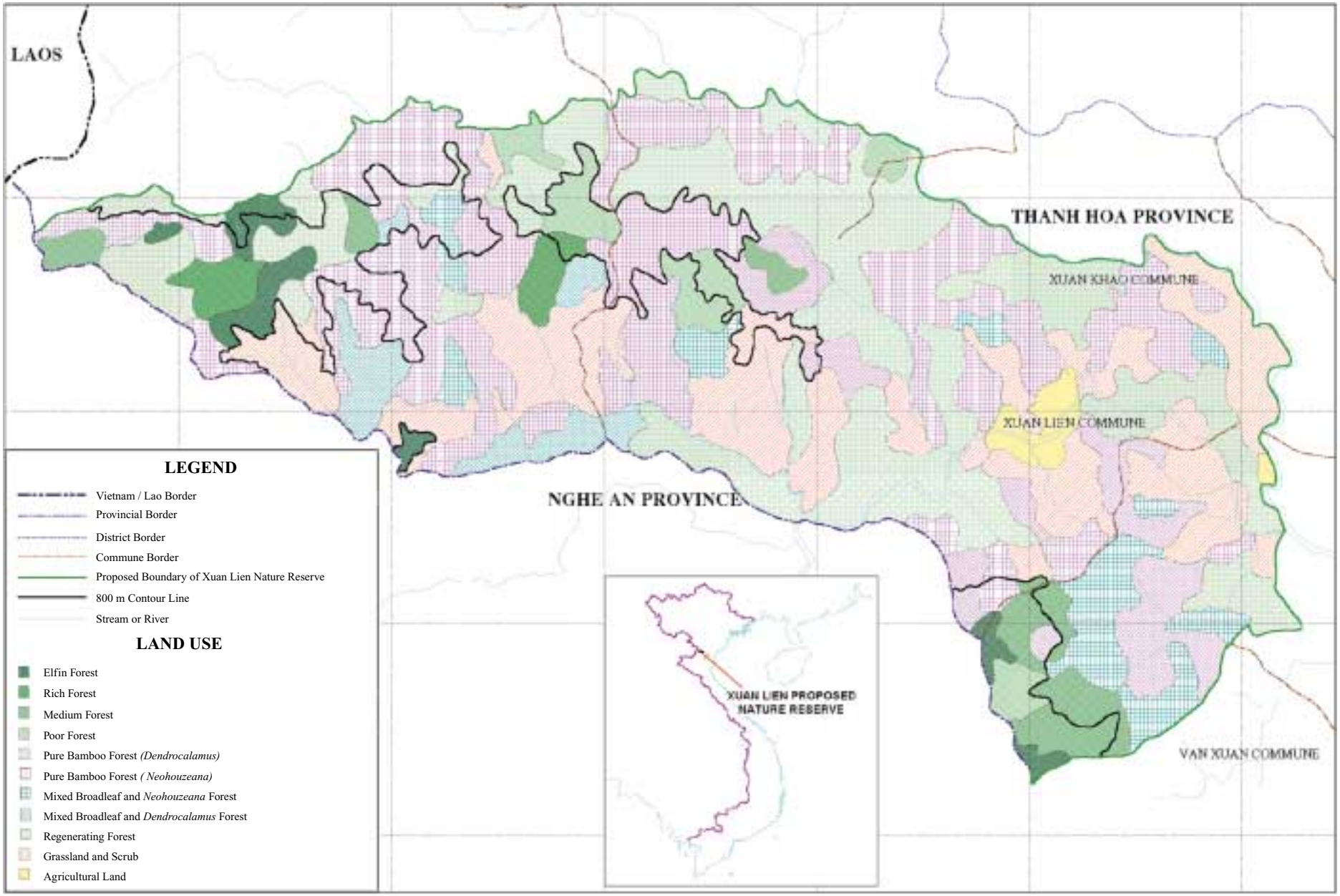
The classification of the main forest types in the study area

follows Thai Van Trung (1978). Based on this classification, the following forest types are found in Xuan Lien proposed nature reserve:

(a) medium to high montane mixed coniferous and broadleaf evergreen forest;
(b) low montane broadleaf evergreen forest; and
(c) secondary forest.

Forest type (a) broadly equates to sub-montane dry evergreen forest in the classification developed by MacKinnon and MacKinnon (1986) (and refined by MacKinnon in 1996); whilst forest type (b) broadly equates to tropical semi-evergreen rainforest.

Map 2: Land-use in Xuan Lien Proposed Nature Reserve



Map based on field survey in 1998
Grid: UTM, zone 48; units: metric

SCALE: 1:120,000

Produced by the Forest Resources and Environment Centre of FIPI

Medium to High Montane Mixed Coniferous and Broadleaf Evergreen Forest

This forest type is distributed between elevations of 800 and 1,605 m on Bu Cho, Ta Leo, Bu Hon Han and Ban Mua mountains. It occurs in areas with feralite soils, annual mean temperature of 20 to 22^{0}C, average humidity of 86% and annual rainfall of greater than 2,000 mm. The dry season in these areas lasts for less than three months, and they experience more than 150 rainy days each year.

This type of forest is generally undisturbed, although some small patches were cleared for hill rice cultivation in the past. Forest has since begun to regenerate in these areas. This forest type is dominated by tall broadleaf tree species. Many members of the Fagaceae are present, including *Castanopsis* spp., *Lithocarpus* spp. and *Quercus fleuryi*. Numerous species in the Lauraceae occur, many of which are widely distributed. The Dipterocarpaceae is represented by fewer species but these species are abundant in many areas. Coniferous species such as *Fokienia hodginsii*, *Podocarpus imbricatus* and *Cunninghamia konishii* are scattered throughout this forest type. Tables 6 and 7 show the tree composition of this forest type at two sample plots at different elevations.

Table 6: Composition of Mature Trees in Medium to High Montane Mixed Coniferous and Broadleaf Evergreen Forest at 1,200 m

Taxon	Density (%)	Basal Area (%)
Fagaceae	53	60
Lauraceae	11	10
Syzygium spp.	9	8
Fokienia hodginsii	9	12
Madhuca pasquieri	2	3
Other species	16	7

Many large trees in the Magnoliaceae occur in this forest type: *Michelia* spp., *Manglietia* spp. and *Tsoongiodendron odorum*. Specimens of *Madhuca pasquieri* can be found with diameters of 60 to 80 cm. In addition, the following families are also represented: Meliaceae (*Aglaia* spp.), Sapindaceae (*Mischocarpus* spp. and *Pometia pinnata*) and Ebenaceae (*Diospyros* spp).

In undisturbed forest areas, trees with a mean diameter of 25 cm are interspersed with larger trees with diameters of over 50 cm. These larger trees include *Madhuca pasquieri*, *Pometia pinnata*, *Michelia* spp., *Aglaia* spp. and members of the Fagaceae. These trees have a mean timber volume of 150 to 200 m^3/ha.

Table 7: Composition of Mature Trees in Medium to High Montane Mixed Coniferous and Broadleaf Evergreen Forest at 1,000 m

Taxon	Density (%)	Basal Area (%)
Hopea mollissima	69	80
Fagaceae	31	16
Eberhardia tonkinensis	2	1
Lauraceae	3	1
Other species	5	2

This forest type is stratified into four layers:

(a) Emergent Layer. This includes two valuable coniferous species (*Fokienia hodginsii* and *Cunninghamia konishii*). The trees have an average diameter of 70 to 80 cm and a height of 30 to 35 m, significantly higher than the forest canopy layer.

(b) Forest Canopy Layer. This is the dominant forest layer. A relatively even canopy, at a height of 20 to 22 m, is comprised predominantly of broadleaf tree species, such as *Quercus* spp., *Lithocarpus* spp., *Hopea mollissima*, *Diospyros* spp., *Michelia* spp. and *Madhuca pasquieri*.

(c) Understorey. The understorey comprises many members of the Euphorbiaceae, Annonaceae, Theaceae and Rubiaceae.

(d) Ground Layer. In addition to ferns, this layer includes species from the Araceae, Arecaceae and Marantaceae: *Alocasia macrorrhiza*, *Homalonema occulta*, *Calamus platyacanthus*, *Rhapis macrantha* and *Phrynium* spp.

Regeneration of this forest type is good with a seedling density of 6,000 to 7,000 stems/ha. The density of mature trees and saplings with a height of more than 3 m is 2,500 to 3,000 stems/ha. In addition, the composition of immature trees is very similar to that of mature trees, indicating that this is a climax community. Regeneration in forest gaps created by natural tree-fall usually involves *Ficus auriculata*, *Ormosia* spp., *Albizia chinensis*, *Sapium* spp. and *Trema orientalis.*

This forest type covers 4,289 hectares or 18% of the total area. Because this forest type has been subjected to minimal disturbance and is in a natural condition, it represents a good habitat for many animal species.

Subtype: a) Mixed Coniferous and Broadleaf Forest Containing *Fokienia hodginsii*
Two forest transects undertaken during the field survey identified areas of mixed forest of broadleaf and coniferous trees including *Fokienia hodginsii*. This forest subtype occurs at elevations above 1,000 m, on mountains such as Ta Leo, Bu Cho, Bu Hon Han and Ban Mua. *F. hodginsii* often grows on yellow, and yellow and red feralite soils with a thick humus layer, developed on igneous rocks such as riolite and granite.

F. hodginsii occurs as emergent trees above the forest canopy with other coniferous species such as *Cunninghamia konishii*, *Dacrycarpus imbricatus* and species in the Fagaceae, Ericaceae, Lauraceae families. The average density of regenerating *F. hodginsii* seedlings is about 50 to 60 stems/ha.

F. hodginsii generally occurs as mature trees with few immature specimens present, indicating a regeneration rate too low to maintain the species' current distribution. The density of mature trees is only 5 to 6 trees/ha. Due to the extremely high economic value of this species, illegal exploitation has occurred in the past and continues at present. Consequently, the protection and regeneration of *F. hodginsii* is urgently required to restore and conserve this forest subtype, and, beyond the nature reserve, to ensure the supply of highly valuable trees in the future.

Subtype: b) Elfin Forest
Elfin forest occurs at elevations greater than 1,400 m on exposed mountain ridges and summits, such as on Ta Leo, Bu Cho, Bu Hon Han and Ban Mua mountains. These areas are characterised by frequent cloud cover at high elevations, high humidity and strong winds. Soils are light yellow, thin, with few stones and with little humus. Trees are overgrown with epiphytes, including mosses, ferns and orchids. Tree size varies with slope angle, elevation and thickness of the soil layer but trees generally have a twisted form, a diameter of under 10 cm and a height of 5 to 6 m. Common tree species include *Rhododendron* spp., *Lithocarpus fissa*, *Rhodoleia championii*, and *Schefflera* spp.

Low Montane Broadleaf Evergreen Forest
This forest type covers 697 hectares and accounts for 3% of the total area. It occurs at elevations of less than 800 m, on yellow and red feralite soil, developed on granite, sandstone and clay schist. The soil layer is of average to high thickness, although erosion has occurred in several areas as a result of shifting cultivation practised by local people.

The vegetation in this forest type is generally complex and uneven due to the presence of many fast-growing, light-demanding trees from the Euphorbiaceae, Myrtaceae, Meliaceae, Moraceae, Mimosaceae, Ebenaceae, Lauraceae, Fagaceae and Elaeocarpaceae.
This forest type is stratified into three layers:

(a) Forest Canopy Layer. This is the ecologically dominant layer. It typically includes species from the following genera: *Engelhardtia*, *Garcinia*, *Endospermum*, *Peltophorum*, *Adenanthera*, *Gironniera*, *Elaeocarpus*, *Litsea* and *Beilschmiedia.* Mean tree diameter is 26 cm and tree

height varies from 20 to 25 m.

(b) Understorey. The understorey is shaded by the upper layer. It includes many species from the Euphorbiaceae, Tiliaceae, Rutaceae and Rubiaceae. Mean tree diameter is less than 20 cm and average tree height is 15 to 16 m.

(c) Ground Layer. The ground layer comprises ferns, *Calamus* spp., *Livistona chinensis*, *Plectocomia elongata* and *Alocasia macrorrhiza*.

In some stands of this forest type, larger trees are present, with diameters of around 80 cm and heights of 25 to 30 m. These species include *Ficus* spp. and *Dracontomelon duperreanum*; whilst *Shorea chinensis* also occurs in upstream areas.

Regeneration of this forest type is generally good, with the density of seedlings reaching up to 8,000 stems/ha, and the density of mature trees and saplings with a height of more than 3 m being about 2,200 stems/ha.

Secondary Forest Types

Subtype: a) Pure Bamboo Forest

Pure bamboo forest is concentrated at elevations below 800 m and is often distributed along the banks of rivers and streams or near villages. Pure bamboo forest develops on fallow agricultural land that has been left uncultivated for a period of time. The dominant species of bamboo are *Neohouzeana dulloa*, *Dendrocalamus patellaris* and *Bambusa* sp. Pure bamboo forest can be divided into two categories:

- Pure *Dendrocalamus* forest 1,565 ha (6.6%)
- Pure *Neohouzeana* forest 7,126 ha (30.2%)

N. dulloa has a diameter of about 5 cm, a height of 11 m, a mature stem density of 400 stems/ha and a density of young regenerating plants of 12,000 to 13,000 stems/ha. *D. patellaris* has a diameter of about 4 cm, a height of 12 to 18 m. *Bambusa* has a diameter 5 to 6 cm, a height of 12m. *Bambusa* is often dispersed on the fringes of pure bamboo forest.

Subtype: b) Mixed Bamboo and Broadleaf Evergreen Forest

In this forest subtype, the bamboos *D. patellaris* and *N. dulloa* are mixed with broadleaf trees, such as *Ormosia* spp., *Peltophorum dasyrrachis*, *Litsea* spp., *Michelia* spp., *Endospermum chinense*, *Grewia* spp., *Trema orientalis* and *Allospondias lakonensis*. In some areas of this forest subtype, broadleaf tree species with significant timber value occur, including *Chukrasia tabularis Mischocarpus* spp. and *Michelia* spp. Mixed bamboo and broadleaf evergreen forest can be divided into two categories:

- Mixed broadleaf and *Dendrocalamus* forest 720 ha (3.05%)
- Mixed broadleaf and *Neohouzeana* forest 1,525 ha (6.46%)

Due to the high density of bamboo, light penetration to the ground layer is low. Therefore, regeneration of tree species is generally poor: seedling density is usually less than 1,500 stems/ha. The ground layer is almost entirely devoid of grasses, lianas, palms and shrubs. Among the few species of herbaceous plants present are *Phrynium* spp., *Alocasia macrorrhiza* and *Zingiber zerumbet*, which are distributed along rivers and streams.

Subtype: c) Secondary Broadleaf Evergreen Forest

This forest subtype develops on abandoned agricultural land. The tree flora is comprised of fast-growing, light-demanding trees such as *Symplocos* spp., *Syzygium* spp., *Litsea* spp., *Cinnamomum* spp., *Macaranga*

spp., *Sapium* spp. and *Trema orientalis*.

This forest subtype often has only a single layer, with a canopy cover of around 80%. Both average tree diameter and tree height vary according to the stage of regeneration. In general, average tree diameter is below 10 cm and tree height is 6 to 7 m, although, in some places, tree height is only 3 m. No regeneration is occurring under the canopy layer. If left undisturbed, areas of secondary forest will eventually regenerate into low montane broadleaf evergreen forest.

Subtype: d) Grassland and Scrub
As a result of repeated clearance and cultivation of hill fields, many areas of grassland and scrub have developed. In general, the vegetation in these areas comprises grass and herbaceous plants, interspersed with shrubs. Common grass species include *Erianthus arundinaceus*, *Thysanolaena maxima* and *Imperata cylindrica*; herbaceous plants include *Cassia tora* and *Eupatorium odoratum*; whilst common shrubs include *Triumfetta pseudocana* and *Helicteres angustifolia*. There is no regeneration of trees in these areas. This vegetation subtype occurs around rivers, streams and villages with a total area of 4,690 ha (19.9% of the study area).

2.10 Mammals

Various methods were used to identify mammal species in the forest. These included direct observation, observation of tracks and interviews with local hunters. Thirty eight mammal species belonging to six orders and 16 families were recorded in the study area. Bats and small mammals were not studied during the field survey, however, studies of these groups would reveal a large number of additional species for the area.

Of the 38 mammal species recorded, 10 (26% of the total) are globally threatened (IUCN 1996) (Table 8). Of these species, nine are listed as Vulnerable and only one, Tiger *Panthera tigris*, is listed as Endangered. A further three species, Phayre's Leaf Monkey *Semnopithecus phayrei*, White-cheeked Gibbon *Hylobates leucogenys* and Sun Bear *Ursus malayanus*, are listed as Data Deficient but the continued survival of these species is almost certainly threatened.

Mammal Records
Roosevelt's Muntjac *Muntiacus rooseveltorum.* A skull of a male muntjak was collected from a specimen which had been burned. The specimen was caught by Mr Lang Van Hoa, on 8 November 1998, in forest in the upstream area of the Ken River (19^{0}59′N 104^{0}59′E). The maximum weight of this species is reported to be about 15 kg and the fur is dark brown. Information from local people suggests that this animal lives in closed evergreen forest and has a diet of leaves and fruits. During the study period, several more animals were trapped at elevations between 900 and 1,400 m. Preliminary analysis of the skull by Rob Timmins and Le Trong Trai identified the specimen as Roosevelt's Muntjac; however, further analysis is required to confirm this determination. This species was first collected at Muong Yo, Laos, in 1929, and is known only from the holotype which is kept at the Field Museum of Natural History (Osgood 1932). If confirmed, the record from Xuan Lien proposed nature reserve would be the first for 69 years and the first record of this species in Vietnam.

Gaur *Bos gaurus.* Information from local people indicates that there are 15 to 20 Gaur in an area of forest near the old Ban Liem hamlet, close to the border with Nghe An province, of which three were reported to have been killed by hunters in 1997. During the field survey, many old footprints were observed but only one new footprint was noted: in the high mountains between Bat Mot and Xuan Lien communes. In 1998, a number of local people observed a group of five Gaur in the upstream area of the Nam Pong River. It seems that the distribution of Gaur in the study area includes forest areas near Ban Vin, Luc and Duc villages, although the population is fragmented into small groups due to hunting.

Table 8: Globally Threatened Mammals Recorded in the Study Area

Species	Scientific Name	Current Status as per IUCN 1996
Primates:	Primates:	
Lorises	Loridae	
1. Lesser Slow Loris	*N. pygmaeus*	VU
Old-world monkeys	Cercopithecidae	
2. Assamese Macaque	*Macaca assamensis*	VU
3. Bear Macaque	*M. arctoides*	VU
Carnivores:	Carnivora:	
Dogs and Foxes	Canidae	
4. Indian Wild Dog or Dhole	*Cuon alpinus*	VU
Bears	Ursidae	
5. Asiatic Black Bear	*Ursus thibetanus*	VU
Cats	Felidae	
6. Clouded Leopard	*Pardofelis nebulosa*	VU
7. Tiger	*Panthera tigris*	EN
Even-toed Ungulates:	Artiodactyla:	
Cattle, Antelopes, Goats	Bovidae	
8. Gaur	*Bos gaurus*	VU
9. Southern Serow	*Naemorhedus sumatraensis*	VU
Rodents:	Rodentia:	
Old-world Porcupines	Hystricidae	
10. Malayan Porcupine	*Hystrix brachyura*	VU

Follows Corbet and Hill (1992). Notes: EN = Endangered; VU = Vulnerable as per IUCN (1996).

Tiger. During the field survey, no traces of Tiger were found. However, hunters reported two Tigers being shot in the Hon Yen and Hon Lech stream areas two years ago. During September and October 1998, a group of hunters observed Tiger footprints around traps set for smaller mammals.

Asiatic Black Bear *Ursus thibetanus.* Skins of Asiatic Black Bear and a captive animal were observed at Liem village in the upstream area of the Ken River. Information from local people indicates that a population is present in the study area. On 3 November 1998, a member of the survey team observed an Asiatic Black Bear on Bu Cho mountain (19°53’34"N 105°10’52"E, 1,563 m).

Sun Bear. Although no Sun Bear skins were observed, the presence of this species in the area was confirmed in interviews with hunters. Reportedly, Sun Bears account for only about 10% of the total number of bears trapped each year.

White-cheeked Gibbon. The call of White-cheeked Gibbon was heard in medium to high montane mixed coniferous and broadleaf evergreen forest in the Hon Lech stream and Ken River areas.

Assamese Macaque *Macaca assamensis.* Two Assamese Macaques were observed at border army station 505 and one at Ban Vin village. Macaque calls were heard many times during the field survey but the species could not be identified and could have been *M. mulatta, M. assamensis* or *M. arctoides.*

Rhesus Macaque *Macaca mulatta.* A specimen of a male Rhesus Macaque was obtained by hunters in the upstream area of the Ken River. According to local people, this species is widespread and common.

Southern Serow *Naemorhedus sumatraensis.* Tracks and droppings were observed during the field survey,

although only one specimen was obtained from local hunters. The species requires rocky, montane forest habitat, which is widespread in the area.

2.11 Birds

The field survey recorded 134 bird species belonging to 12 orders and 30 families in the study area. Of the 134 bird species recorded, two are listed as globally threatened (Collar *et al.* 1994) (Table 9).

Two endemic bird species were recorded during the field survey: Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Red-vented Barbet *Megalaima lagrandieri*, which are endemic to Vietnam and Laos.

Table 9: Endemic and Globally Threatened Bird Species Recorded in the Study Area

Species	Scientific Name	Endemic Species	Current Status as per Collar et al. 1994
	Megalaimidae		
1. Red-vented Barbet	*Megalaima lagrandieri*	EL	
	Sylviidae		
2. Short-tailed Scimitar Babbler	*Jabouilleia danjoui*	EL	VU
3. Short-tailed Parrotbill	*Paradoxornis davidianus*		VU

Follows Inskipp *et al.* (1996).

Notes: VU = Vulnerable as per Collar *et al.* (1994). EL = Endemic to Vietnam and Laos.

Bird Records

Great Hornbill *Buceros bicornis.* A group of three Great Hornbills was observed along the Ken River. The bill of a female Great Hornbill, caught in the upstream area of the Ken River, was seen in a hunter's house.

Brown Hornbill *Anorrhinus tickelli*. Foraging birds of this species were seen and heard at the foot of Ta Leo mountain (19°51'53"N 105°11'32''E). Many specimens of tail and wings were found in hunters' houses in Ban Vin village.

Habitat Distribution of Bird and Mammal Species

The composition of the bird and mammal communities varies according to habitat type:

(a) Pure Bamboo Forest. The diversity of both mammal and bird species in this habitat is low. The only common mammals are squirrels and other rodents. Common birds include White-headed Babbler *Gampsorhynchus rufulus*, Short-tailed Parrotbill *Paradoxornis davidianus*, Striped Tit-babbler *Macronous gularis* and several species of woodpecker (Picidae). Pale-headed Woodpecker *Gecinulus grantia* is one of the few bird species restricted to this habitat type.

(b) Mixed Bamboo and Broadleaf Evergreen Forest. Several civet species are found in this habitat, including Binturong *Arctictis binturong*, Masked Palm Civet *Paguma larvata* and Common Palm Civet *Paradoxurus hermapharoditus*. Common bird species include Brown Hornbill, Red-whiskered Bulbul *Pycnonotus jocosus*, Black-throated Laughingthrush *Garrulax chinensis*, Blue-winged Leafbird *Chloropsis cochinchinensis* and several species of woodpecker and drongo (*Dicrurus* spp.).

(c) Primary Forest. This habitat supports the greatest diversity of mammals and birds. Mammals found in this habitat type include Gaur, Asiatic Black Bear, Sun Bear, White-cheeked

Gibbon, Bear Macaque *Macaca arctoides*, Assamese Macaque, Tiger, Clouded Leopard *Pardofelis nebulosa*, Southern Serow and several species of muntjac. Bird species of conservation significance include Great Hornbill, Brown Hornbill and Blue-rumped Pitta *Pitta soror*. Several species of babbler (Garrulacinae and Timaliini) are restricted to forest at high elevations, including Grey Laughingthrush *Garrulax maesi*. This habitat supports approximately 80% of the bird and mammal species in the study area.

Exploitation of Mammals and Birds
Hunting and trapping of wildlife is common in the area of Ban Vin village, Bat Mot commune. Most families have guns for hunting. These are usually either 12 or 20 mm calibre, or occasionally home-made guns with one barrel of different diameters used to shoot large game or birds. Trapping of animals was very common in Ban Vin village until five years ago. Presently, there are eight groups involved in trapping. Each group consists of five to eight people and lays about 200 traps. Results of trapping by hunters of Ban Vin village between September and early November provided the following data: 14 Asiatic Black Bear, three Sun Bear, five Southern Serow and 11 Barking Deer *Muntiacus muntjak*. All trapped animal species, except bears, are used for food. Bears are sold to traders at a price of VND2 to 5 million per animal.

Illegal hunting threatens populations of large mammals and birds in the area. Unless effective management and protection measures are taken by the relevant authorities, the bird and mammal resources of the area will be depleted in the near future.

2.12 Herpetiles

Species Composition Fifty three species of reptiles and amphibians were recorded in the study area during the field survey. These include 34 species of reptile, in three orders and 14 families, and 19 species of amphibian, in one order and five families.

Recent research has shown the range of several species present in the nature reserve area is larger than previously thought. *Lygosoma quadrupes*, for example, was formerly considered to be restricted to Hanoi and Ca Mau but has now been observed at an elevation of 1,000 m on Bu Cho mountain, Xuan My commune.

The species composition of reptile and amphibian populations in the study area is similar to that in western areas of Nghe An province, Vu Quang Nature Reserve, and Cuc Phuong, Ben En and Ba Vi National Parks. In comparison to Tam Dao National Park, the reptile and amphibian communities in the study area are less diverse, with fewer orders, families and species.

At the national level, the herpetofauna of the study area includes 57.6% of the families known from Vietnam and 15.6% of the species. However, more detailed surveys covering a broader range of habitat types are likely to identify additional species in the area.

Threatened Species. The field survey recorded a single herpetile species, *Manouria impressa*, listed as globally threatened (IUCN 1996).

Endemism. During the field survey, one species of herpetile endemic to

Table 10: Endemic and Globally Threatened Herpetiles Recorded in the Study Area

Species	Endemic Species	Current Status as per IUCN 1996
Manouria impressa		VU
Rana microlineata	EV	

Follows Nguyen Van Sang and Ho Thu Cuc (1996).

Notes: VU = Vulnerable as per IUCN (1996); EV = Endemic to Vietnam.

Vietnam was recorded: *Rana microlineata*.

Distribution of Herpetiles. Herpetile species are distributed unevenly within the study area. Thirty six species (68% of the total) occur in medium to high montane mixed coniferous and broadleaf evergreen forest. These areas are less affected by human habitation. Twenty species were restricted to these areas and not found elsewhere (Table 11). At high elevations, close to mountain peaks, the number of species is noticeably lower. The number of species is also lower in inhabited areas, where 22 species were recorded (42% of the total); including 12 that were restricted to these areas (Table 11). Amphibians were concentrated near water, with 14 out of a total of 19 species being collected in or alongside forest streams.

Table 11: Herpetile Species with Restricted Habitat Distributions

Restricted to Montane Forest	Restricted to Inhabited Areas
Gekko gecko	*Hemidactylus frenatus*
Physignathus cocincinus	*Mabuya multifasciata*
Takydromus wolteri	*Amphiesma stolata*
Varanus salvator	*Ptyas korros*
Python molutus	*Elaphe radiata*
Ampiesma parallela	*Xenochrophis piscator*
Trimeresurus albolabris	*Enhydris plumbea*
Platysternum megacephalum	*Bufo melanostictus*
Cistoclemmys galbinifons	*Ooeidozyga lima*
Geoemyda spengleri	*Rana guentheri*
Manouria impressa	*R. rugulosa*
Palea steindachneri	*Rhacophorus leucomystax*
Leptobrachium hasselti	
Bufo galeatus	
Phynoglossus laevis	
Rana andersoni	
R. kuhlii	
R. microlineata	
R. ricketti	
R. sauteri	

2.13 Butterflies

Species Composition. A total of 143 butterfly species in nine families were recorded during the field survey (Appendix 5). Table 12 summarises the distribution and composition of the butterfly species recorded in the study area. Of the 143 species recorded, 68 were observed in grassland and scrub at elevations between 150 and 300 m; of these, species in the Hesperiidae were the most abundant, accounting for 34% of the total number. Fifty species were found in secondary forest habitats and 40 species were found along rivers and streams. Only 22 species were recorded in bamboo forest (at elevations of 300 to 400 m). Of these species, members of the Satyridae accounted for 36% and included *Lethe syrcis*, *L. mekara*, *Ethope noirei* and *Mycalesis zonata*. Sixteen species were found in undisturbed primary forest at an elevation of 1,200 m.

Most butterfly species recorded in the study area occur at low elevations. Many species found at moderate

Table 12: Distribution of Butterfly Species with respect to Habitat Type

Family	Number of Species	Habitat Type				
		H1	H2	H3	H4	H5
Papilionidae	15	9	0	7	7	0
Pieridae	9	4	0	3	7	1
Danaidae	8	6	2	1	4	2
Satyridae	22	6	8	16	0	2
Amathusiidae	6	1	1	3	1	2
Nymphalidae	28	12	3	7	15	2
Riodinidae	4	1	0	3	0	2
Lycaenidae	19	6	2	7	6	2
Hesperiidae	32	23	6	3	5	3
Total	143	68	22	50	45	16

Habitat Types: H1 = Grassland and scrub (150 to 300 m); H2 = Bamboo forest (300 to 400 m); H3 = Secondary forest (400 to 900 m); H4 = Streams and rivers (300 to 400 m); H5 = Primary forest (1,200 to 1,500 m)

elevations were also present in lower areas. These species included *Euploea mulciber*, *Faunis eumeus*, *Notocrypta feistamelii*, *Paralaxita dora*, *Yasoda tripunctata* and *Abisara neophron*. Some species were found only above 1,200 m: *Ragadia crisilda*, *Thaumantis diores*, *Bassarona iva* and *Parantica sita*. The distributions of most of the species recorded are restricted to the Indochinese peninsular and East Asia (Appendix 5). Eighty five species (59% of the total) have a distribution restricted to East Asia. Twenty eight species (20%) have a distribution restricted to the Indochina sub-region and the distribution of 14 species (10%) is restricted to northern Indochina. Eleven species have a distribution restricted to the tropical region of Indo-Australia.

Endemic Species. Ten species found in the study area are endemic to Vietnam. These species belong mainly to the Satyridae and Amathusiidae and include *Neorina patria*, *Lethe syrcis*, *L. naga*, *Mycalesis misenus* and *Enispe euthymius sychaeus*. *Celaenorrinhus vietnamicus* is a recently described species (Devyatkin 1997) endemic to Vietnam, which is also known from Pu Mat Nature Reserve and Cuc Phuong National Park

New Species. The field survey recorded a new species in the Satyridae, *Ypthima* sp. nov. (Monastyrskii in prep.). The first specimen of this species was collected at Pu Mat Nature Reserve with a later specimen collected at Ben En National Park. During the field survey, three specimens were observed, one of which was collected. This species occurs in bamboo forest or secondary forest habitats at low elevations (300 to 400 m).

New Distribution Records. The survey found six species which had not previously been recorded in either central Vietnam or Vietnam as a whole. *Jamides virgulatus* and *Celaenorrhinus inaequalis* represent new records for Vietnam. Four species in the Hesperiidae (*Iton semamora*, *Scobura phiditia*, *Matapa cresta* and *Halpe frontieri*) had not been recorded in central Vietnam previously, only in northern Vietnam (Evans 1949, Devyatkin and Monastyrskii in press).

In addition to these new records, *Unkana ambassa* was recorded during the field survey. This species was first recorded in Vietnam in 1998, and the specimen from Xuan Lien proposed nature reserve is only the second record. The species is yet to be described and is not included in inventories of the butterfly fauna of Vietnam.

Endangered Species. During the field survey, no nationally or globally threatened species of butterfly were recorded. However, *Rhinopalpa polynice* is a relatively rare species in Vietnam, with recent records from Ben En National Park and Pu Mat Nature Reserve. In Laos, Thailand and the Malay peninsular, this species is also considered rare.

2.14 Socio-Cultural Features

Xuan Lien proposed nature reserve includes all or part of six communes in Thuong Xuan district; an additional three communes are included in the buffer zone. The total population of the proposed nature reserve is 600 households, comprising 200 households in Xuan Lien commune and 400 households in Xuan My commune. The Thanh Hoa Provincial People's Committee propose to build a dam in Xuan My commune to supply water for irrigation and hydro-electricity. The water level of the resulting artificial lake will rise to 100 m above sea level, flooding approximately 7,000 ha, including approximately 1,716 ha within the proposed nature reserve. As a result of this, cultivated land will be inundated and residents will be forced to relocate to new areas under a programme organised by Thanh Hoa province. Consequently, the nature reserve will not include any human settlements in the future.

Demographics

The socio-economic survey was based upon population census data and statistics from the administration of each commune. According to 1997 data, there are 34,298 people in 5,849 households in Thuong Xuan district. The average household consists of six people in two or three generations. However, some households contain more than 10 people in three or four generations.

Population Density. The average population density in the area is 45 people/km^2. However, the population is unevenly distributed between and within the different communes. People are usually concentrated in or near the district town and along roads, while the population is very sparse in high mountainous areas. Specifically, the population density in the nine communes in the nature reserve and the buffer zone is:

- Less than 20 inhabitants/km^2 in Bat Mot and Xuan Lien communes.
- 20 to 40 inhabitants/km^2 in Yen Nhan, Xuan My and Xuan Le communes.
- 40 to 100 inhabitants/km^2 in Xuan Khao and Van Xuan communes.
- 100 to 150 inhabitants/km^2 in Luong Son and Xuan Cam communes.

Population Growth Rate. The population growth rate for the whole area is high (2.8%), compared to the average national growth rate (2.3%). The reasons for the high growth rate are low levels of education and lack of effective family planning, particularly in remote areas. Household surveys showed that each couple has, on average, four to five children, with some couples having up to 10 children.

Ethnic Composition. Although several different ethnic groups live in the area, the Thai form the overwhelming majority (99.8%) of the population. Other, smaller groups include the Kinh, Tay and H'mong, although some of these smaller groups can be considered to have effectively merged with the main group. Villages are usually located near water sources and fertile land, suitable for cultivation and animal husbandry.

Economic Activities

Agricultural Practices. In recent years, fixed cultivation has expanded, with a corresponding decrease in shifting cultivation. Agriculture has also diversified from rice production and now includes cultivation of subsidiary crops and short-rotation industrial crops. Total food production is 7,624 tonnes/year of which rice accounts for 5,115 tonnes/year. Crop production, in both absolute and per capita terms, is increasing each year due to investment in new technologies, fertiliser and irrigation. However, food production varies year by year due to the following reasons:

- Only one variety of rice is grown.
- Crop yield is dependent on climatic conditions because irrigation is not developed sufficiently and there are only low fertiliser inputs.
- Rice is mainly cultivated in hill fields and yields are very low (0.7 to 0.8 tonnes/ha/year).
- Agricultural pests regularly damage rice crops and, in some years, may completely destroy the crop, as occurred in Duc and Kheo villages, Bat Mot commune in 1998.

The area for production of subsidiary crops, such as maize, cassava and peanuts, varies from year to year. The yield for these crops varies between years but is generally low.

Although most households practice wet (paddy) rice cultivation, some households still practise shifting cultivation. Policies promoting fixed cultivation have been implemented since 1980. More recently, households living in mountainous areas, including parts of Bat Mot, Yen Nhan, Xuan Lien, Xuan Le and Xuan Khao communes, have been resettled to lower areas. Small-scale irrigation systems are required

for conversion to fixed cultivation but these systems are frequently damaged or destroyed by annual floods.

Forestry. Thuong Xuan forest enterprise is based in the district. Its functions are logging and establishment of plantations. At present, trees in existing plantations are too small to log and unavailable for production or trade. Fifty thousand hectares of forest land have been allocated by the forest enterprise to individual households.

There are large areas of barren land and areas affected by shifting agriculture suitable for forestry activities. However, limited understanding of forestry activities among local people has created difficulties in developing plantations, protecting forest and allocating forest land. Because of relatively low levels of education, local people engaged in forestry activities do not see the relevance of forestry policies. This issue should be considered when establishing a system of forest conservation and social forestry programmes in the area.

Infrastructure

Transport and Communication. The communication network in the area is poorly and unevenly developed. It is concentrated mainly in the eastern sections around the Cao and Chu Rivers. The area is accessible only in the dry season; during the rainy season, travel within the district is very difficult. The poor road system is a major constraint on economic development as it restricts the transport of goods. Very few main roads exist in the area, and the development of new roads and the repair and upgrading of existing roads have been very limited. The 70 km stretch of road between the district town and the border with Laos is in very poor condition and impassable during the rainy season when bridges and causeways are washed out. Many communes and villages are only accessible on foot along steep paths; most transportation of goods is along these trails.

Irrigation and Hydro-electricity. The district has many weirs and small-scale irrigation systems to service rice fields. These include dams on the Ruong, Hon, Poong, Keu and Tu streams. Many areas have potential for small-scale hydro-electricity generation. However, significant investment is required to develop such hydro-electricity stations. At present, households are supplied by small electric generators from China, Thailand and Singapore with capacities of 300, 500 or 1,000 W per generator. Electricity is mainly used for lighting and operating radios. The area can receive television and radio broadcasts.

Education. Statistical data from 1997 supplied by Thuong Xuan district indicated that the total number of pupils in the area is 7,956. These students are served by 20 primary schools (grades I and II) with 304 classes. These schools are staffed by 396 teachers, 20% of whom are female. Whilst infrastructure for schools has been improved, funding remains limited. However, most people are literate.

Health Care. District statistical data indicate that the district has nine health stations, 20 doctors and 23 nurses. On average, there is one member of health staff for every 2,000 people and there is one bed for every 1,000 people. Local health facilities are developing slowly: local health stations lack medical facilities and medicines. Patients with serious medical problems can only be treated at the district health station or at the hospital in Thanh Hoa city.

Several health programmes have been implemented in the area. These include programmes to improve child nutrition, prevent diseases in new-born babies, provide clean water to rural areas and promote family planning. However, these programmes have had limited success, particularly in remote areas where people still face many difficulties. To improve the health of the community, more consideration needs to be paid to the construction of health care facilities and the training of doctors and nurses to serve the local villagers. The cost of medicines should be subsidised and health care should be free to

3. Evaluation

3.1 Criteria for Evaluating the Proposed Nature Reserve

In order to evaluate the overall importance of a site, it is useful to compare the site against a set of criteria for assessing a protected area's conservation value. The study area satisfies some but not all of the criteria identified

Table 13: Conservation Criteria and Evaluation of Xuan Lien Proposed Nature Reserve

Conservation Criteria	Site Evaluation
Size: The area must be of a size and form sufficient to support ecological units or viable populations of flora and fauna. As a rule, conservation importance increases with protected-area size.	The study area covers 23,610 ha and may not be large enough to support viable populations of certain large mammal species unless forest corridors to adjacent protected areas supporting suitable habitat are maintained.
Richness and Diversity: Usually linked with the diversity of habitat types; ecological gradients or ecotones should be represented because they support transitional communities.	The study area has moderate levels of biodiversity relative to other protected areas in northern and central Vietnam. An altitudinal gradient exists between 50 and 1,600 m.
Naturalness: Assessment of the extent of primary habitats.	The natural vegetation of the study area has been heavily disturbed by human activities and only 10% of the original primary forest remains.
Rarity: The primary purpose of many protected areas is to protect rare and endangered species and habitats. Rarity may be a result of special habitat requirements, direct human pressure or indirect human influences.	The study area protects 19 globally threatened species. Four plant and five vertebrate species are endemic to Vietnam or to Vietnam and Laos. The study area supports only two bird species listed as globally threatened.
Uniqueness: Areas which exhibit particular natural processes or which are poorly represented in the national protection system.	Roosevelt's Muntjac is known globally only from the study area and one other site in Laos.
Typicalness: It is important to represent typical areas of common habitats and typical communities of a biome.	The study area contains representative examples of sub-montane dry evergreen forest and lowland semi-evergreen rainforest, the two most widespread natural habitat types in Vietnam.
Fragility: A measure of an area's susceptibility to change through either natural or man-made processes.	22% of the study area is covered by regenerating forest.
Position as an Ecological Unit: To establish the area's position in an ecological unit, it is important to determine how or whether an area is linked to other areas of natural or semi-natural habitats.	To the south, the study area is contiguous with Pu Hoat proposed nature reserve, forming a combined conservation area of 90,841 ha.
Economic Value: An area may protect a valuable water catchment or a higher level of biogeographic subdivision.	The study area protects the water catchment of the Chu River and the planned Cua Dat dam.
Conservation Opportunity: Socio-political climate is highly determinate in the success of any conservation area's future objectives and priorities.	The proposed nature reserve has good political support at the provincial level. Following the construction of Cua Dat dam, there will be no human settlements in the study area.

by Ratcliffe (1977) (Table 13) and should, therefore, be considered to be of low conservation value.

3.2 Evaluation of Biological Factors

Biodiversity

The initial field survey of Xuan Lien proposed nature reserve was relatively brief and took place during October and November when conditions are unfavourable for biodiversity surveys due to various factors, including the low number of butterflies, the difficulty in identifying plants that are not in flower and the difficulty in recording forest birds that are not singing. However, known levels of biodiversity, although not as high as for certain protected areas in northern and central Vietnam, are comparable to those of several nearby protected areas.

The study area is known to contain 560 species of vascular plants. The composition of the flora of Xuan Lien proposed nature reserve is likely to be distinct from that in certain nearby protected areas, such as Pu Hu proposed nature reserve, Ben En National Park and Ke Go Nature Reserve because, unlike these sites, Xuan Lien contains about 5,000 ha of forest at elevations between 800 and 1,600 m. In addition, comparison of the known plant species diversity of different protected areas shows that Xuan Lien proposed nature reserve is comparable to other protected areas in central Vietnam (Table 14).

Table 14: Comparison of Plant Diversity in Xuan Lien Proposed Nature Reserve with other Protected Areas in Central Vietnam (Ranked)

Protected Area	Area (ha)	Families	Genera	Species
1. Pu Hoat Proposed Nature Reserve	67,231	124	427	763
2. Ben En National Park	16,643	135	453	737
3. Pu Huong Nature Reserve	50,075	117	342	612
4. Phong Dien and Dakrong Proposed Nature Reserves	69,474	118	366	597
5. Ke Go Nature Reserve	24,801	117	367	567
6. Xuan Lien Proposed Nature Reserve	23,610	124	381	560
7. Pu Luong Proposed Nature Reserve	17,662	148	389	552
8. Pu Hu Proposed Nature Reserve	15,595	102	324	509
9. Bach Ma National Park	22,031	124	351	501
10. Vu Quang Nature Reserve	55,630	111	275	328

A total of 223 vertebrate species were recorded during the field survey, comprising 38 mammal, 131 bird and 53 herpetile species. Whilst the overall known vertebrate species diversity of Xuan Lien proposed nature reserve is lower than that of other nearby protected areas (Table 15), Xuan Lien supports a population of Roosevelt's Muntjac, which is not known from any other site in Vietnam.

Table 15: Comparison of Vertebrate Diversity of Xuan Lien Proposed Nature Reserve with other Protected Areas in Central Vietnam (Ranked)

Protected Area	Mammals	Birds	Reptiles	Amphibians	Total
1. Vu Quang Nature Reserve	95	254	37	25	411
2. Phong Nha Nature Reserve	65	269	51	22	407
3. Ke Go Nature Reserve	46	270	30	17	363
4. Ben En National Park	61	194	39	21	315
5. Cuc Phuong National Park	64	137	36	17	254
6. Phong Dien and Dakrong Proposed NRs	44	173	19	6	242
7. Xuan Lien Proposed Nature Reserve	38	131	34	19	222
8. Bach Ma National Park	55	158	—	—	213

At least in part, the low levels of known vertebrate species diversity reflect the small amount of survey effort expended in Xuan Lien relative to certain other protected areas, for instance Cuc Phuong National Park. For example, no research has yet been conducted into small mammals and bats, thus, the number of mammal species

has certainly been under-recorded. Therefore, it is not apparent at this stage whether or not low levels of known biodiversity reflect a lower underlying level of biodiversity. However, it is clear that, with further study, the known conservation value of the proposed nature reserve is likely to increase.

Xuan Lien proposed nature reserve contains 57% of the orders, 58% of the families and 16% of the species of herpetile known for Vietnam. The herpetile diversity of Xuan Lien proposed nature reserve is comparable to that of several other protected areas in northern and central Vietnam (Table 16). Only at Tam Dao National Park is the number of herpetile species significantly greater than at Xuan Lien. Once again, this probably reflects the greater amount of survey effort expended at Tam Dao.

Table 16: Comparison of Herpetile Diversity of Xuan Lien Proposed Nature Reserve with other Areas in Northern and Central Vietnam (Ranked)

Area	Area (ha)	Orders	Families	Species
1. Tam Dao National Park	19,000	6	21	103
2. Vu Quang Nature Reserve	55,630	4	19	62
3. Ba Vi National Park	7,000	4	16	62
4. Ben En National Park	16,643	4	20	60
5. Western Nghe An Province	—	4	19	56
6. Xuan Lien Proposed Nature Reserve	23,610	4	19	53
7. Cuc Phuong National Park	25,000	4	17	53

The autumn butterfly fauna in northern and central Vietnam is characteristically diverse. The species diversity of some families, such as the Pieridae, Papilionidae and Amathusiidae, varies between spring and autumn. For example, observations at Ba Be National Park have shown a similar number of species in spring (April) and autumn (November): 193 and 196, respectively. However, fluctuations in species diversity occurred within individual families. For example, 22 Papilionidae species were recorded in spring and only nine species were recorded in autumn. In contrast, more species of Nymphalidae were recorded in November (Monastyrskii *et al.* 1998). Therefore, when comparing butterfly communities at different sites, only data for the autumn period (September to November) was used. The degree of similarity of between sites was measured using Sorenson's Similarity Index (Magurran 1988). The index, C_S, is given by the formula:

$$C_S = \frac{2j}{(a + b)}$$

Where: j = The shared species of two areas
a = Number of species in area A
b = Number of species in area B

High values of C_S indicate a high degree of similarity between the assemblages at a pair of sites. Comparisons between different protected areas in northern and central Vietnam have been completed under each family and for all butterfly communities (Table 17).

Table 17: Sorenson's Similarity Index (CS) comparing Butterfly Species Composition in Xuan Lien Proposed Nature Reserve with those in other Protected Areas in Northern and Central Vietnam

Xuan Lien	Vu Quang	Pu Mat	Ben En	Cuc Phuong	Ba Be	Hoang Lien
All Species	0.544	0.500	0.484	0.463	0.439	0.264
Papilionidae	0.687	0.636	0.667	0.488	0.500	0.228
Pieridae	0.583	0.438	0.352	0.387	0.432	0.275
Danaidae	0.571	0.640	0.667	0.571	0.608	0.666
Nymphalidae	0.579	0.515	0.560	0.523	0.423	0.363
Satyridae	0.558	0.626	0.353	0.512	0.533	0.117
Amathusiidae	0.769	0.750	0.200	0.833	0.715	0.200
Riodinidae	0.800	0.545	0.400	0.600	0.444	0.545
Lycaenidae	0.509	0.358	0.235	0.343	0.400	0.250
Hesperiidae	0.286	0.353	0.400	0.395	0.319	0.038

Habitat

The proposed nature reserve encompasses 23,610 ha, of which 18,522 ha (78%) is covered by forest. Of this, however, only 2,243 ha is undisturbed primary forest, whilst 16,279 ha is secondary forest of various types, including bamboo forest. Studies of the vegetation cover of Xuan Lien proposed nature reserve show that most forest at low elevations has been altered by human activity and that most remaining primary forest is distributed at elevations greater than 700 m. Areas of undisturbed habitat are of critical importance for a range of species sensitive to habitat change, particularly large mammals, hornbills and pheasants.

Endangered Species

Of the 560 species of plant recorded in the study area, six species are globally threatened (IUCN 1997). This represents only 1% of the species recorded in the study area. Ten globally threatened mammal species (IUCN 1996) were recorded in the study area, representing 26% of the total number of species. Furthermore, a single herpetile species, *Manouria impressa*, is globally threatened (IUCN 1996) (Table 18).

Table 18: Number of Nationally and Globally Threatened Species in the Study Area

Group	Total No. of Species	Globally Threatened Species	% of Total Species Globally Threatened
Mammals	38	10	26
Birds	134	2	6
Herpetiles	53	1	28
Butterflies	143	0	0
Plants	560	6	4
Total	928	19	6

As per IUCN (1996 and 1997) and Collar *et al.* (1994).

Table 19: Distribution of Threatened and Near-threatened Bird Species in Protected Areas in Thanh Hoa and Nghe An Provinces

Species	Thanh Hoa Province					Nghe An Province		
	Xuan Lien	Cuc Phuong	Pu Luong	Pu Hu	Ben En	Pu Mat	Pu Hoat	Pu Huong
Vulnerable								
Chestnut-necklaced Partridge		*						
Red-collared Woodpecker		*						
Blyth's Kingfisher							*	*
Short-tailed Scimitar Babbler	*	*						*
Short-tailed Parrotbill	*					*		
Near-threatened								
Brown Hornbill	*	*	*	*	*	*	*	*
Yellow-vented Green Pigeon						*		
White-bellied Green Pigeon		*						
Grey-headed Fish Eagle					*			
Pied Falconet		*			*			
Blue-rumped Pitta	*	*	*		*		*	
Bar-bellied Pitta		*			*			
White-winged Magpie	*	*				*	*	*
Indochinese Green Magpie	*	*	*	*	*		*	
Green Cochoa	*							
Grey Laughingthrush	*							*
Rufous-throated Fulvetta	*	*						
Total	9	11	3	2	6	4	5	5

Out of the total of 134 species of birds recorded in the study area, two species, Short-tailed Parrotbill and Short-tailed Scimitar Babbler, are listed as globally threatened (Collar *et al.* 1994). No species listed as either globally Endangered or Critically Endangered were recorded in the study area, although this may be partially due to

limitations of the field survey.
The conservation value of the proposed nature reserve with respect to avifauna can be seen clearly by comparing the number of globally threatened and Near-threatened bird species in protected areas in Thanh Hoa and Nghe An provinces (Table 19). By this measure, Xuan Lien proposed nature reserve is second only to Cuc Phuong National Park which does not lie wholly within Thanh Hoa province and, as previously mentioned, has been studied in greater detail.

One reason why a larger number of globally threatened and Near-threatened species are known from Xuan Lien may be that it is the only site in Thanh Hoa province which contains evergreen forest above 800 m; Short-tailed Parrotbill, Green Cochoa *Cochoa viridis* and Grey Laughingthrush are all restricted to forest above c.600 m (King *et al.* 1975). Additionally, the number of threatened and Near-threatened species at Pu Hoat, Pu Luong and Pu Hu may be under-recorded due to limitations of previous surveys of these areas in terms of time and expertise.

Endemism
As mentioned previously, four endemic plant species (*Cinnamomum balansae*, *Colona poilanei*, *Croton boniana* and *Macaranga balansae*) were recorded in the study area. Animal species endemic to Vietnam or to Vietnam and Laos include two mammal species (Roosevelt's Muntjac and White-cheeked Gibbon), two bird species (Short-tailed Scimitar Babbler and Red-vented Barbet), one herpetile species (*Rana microlineata*) and 10 butterfly species.

3.3 Evaluation of Economic Factors

Watershed Protection
The forest cover of the study area plays an important role in protection of watershed areas, protection of water resources, prevention of soil erosion and, especially, provision of wildlife habitat. The forest cover of the proposed nature reserve protects the catchment of the Chu River, which will supply the proposed Cua Dat irrigation and hydro-electricity dam. Cua Dat dam will regulate the flow of water to hundreds of thousands of hectares of rice fields of Thanh Hoa province. The water level of the proposed artificial lake will rise to 100 m above sea level, and the inundated area will include areas of agricultural land in Xuan My and Xuan Lien communes; only small areas of forest within the proposed nature reserve will be inundated.

Soil Conservation
Most of the forest ecosystems in the region occur on steep hills and mountains where soil is readily eroded if the forest cover is disturbed. Moreover, irrigation and hydro-electricity projects depend upon preservation of forest cover in order to avoid soil erosion and resulting siltation. A long-term forest and biodiversity conservation strategy should be prepared for the nature reserve to ensure adequate protection of soil and forest cover.

Forestry Resources
Xuan Lien proposed nature reserve contains the valuable timber species *Fokienia hodginsii*. Areas of mixed coniferous and broadleaf evergreen forest containing this species only cover a small fraction of the area of the proposed nature reserve, often in remote, inaccessible locations, making the commercial exploitation of this species unprofitable. However, the high value of this species and low income levels of local people mean that selective logging of even the most remote areas is economically viable for local people. Therefore, specific conservation measures should be implemented to prevent over-exploitation of this globally threatened species (IUCN 1997).

Medicinal and Ornamental Plants
One hundred and sixteen plant species with known medicinal uses were recorded during the field survey. These species already have a high value to local people, either through personal use or trade, however, there is potential for developing commercial production of traditional plant-based medicines, either through sustainable exploitation of medicinal plants in the forest or through cultivation of selected species.

Tourism

Due to the inaccessibility of the area and the lack of infrastructure, there is currently little potential for the development of tourism in the area of whatever form. In the future, with improvements in infrastructure, most importantly roads, the area may have some potential for certain kinds of niche-tourism, such as ecotourism. However, the absence of significant, easily observable populations of large mammals render the area of little interest to ecotourists.

3.4 Evaluation of Socio-economic Factors

Population and Social Conditions

The socio-economic data collected during the field survey indicate that the upstream areas of the Cao and Chu Rivers have considerable potential for agriculture. Valleys in these areas are favourable for food crops, industrial trees, fruit trees and agroforestry.

The education level of the population remains low, with old customs and habits prevailing. Although wet rice cultivation is traditionally practised, some people still practice shifting cultivation which has significantly degraded forest areas, leading to a preponderance of secondary forest types such as bamboo forest. Illegal timber extraction continues to deplete the forest and cause soil erosion. Hunting and trapping of wildlife by local people has depleted populations of many animal species in the area and threatens to significantly reduce the biodiversity of the area.

The area has a surplus of labour due to slow economic development. Labour distribution is simple, with most workers involved in agriculture. The technical knowledge of the labour force is low, resulting in low agricultural productivity and periods of food shortage. The rural economy is centred on subsistence agriculture, as developments in agricultural and forestry technologies have taken place slowly.

Industrial facilities have not been developed and are unlikely to provide a boost to the economy in the foreseeable future because the population is scattered and production is small-scale. Trade in commodities and consumer goods takes place in the towns and lowland areas. In remote areas, supplies of essential goods do not meet local demand. State forest enterprises have existed for many years in the region. However, their capacity for promoting and supporting social forestry activities is yet to be fully assessed, and the rate of transfer of forestry technology remains low.

Infrastructure

Road transportation is very restricted due to the poor condition of roads and trails in the area. Roads are frequently made impassable in the rainy season by floods, landslides and fallen trees. Access to communes and villages is generally along trails which are only passable on foot.

Health care, education and information dissemination facilities have in general improved in the area. Every commune has a school and a clinic, however, materials and supplies for them are often inadequate, out-dated and inappropriate for local conditions.

4. Management Considerations

4.1 Physical Factors

Topography. The topography of the proposed nature reserve is deeply dissected by a number of stream and rivers, which flow into the Cao River in the north and into the Khue River in the south (both are tributaries of the Chu River). Such steep topography creates difficulties for constructing the infrastructure necessary for a protected area, such as guard stations, and for carrying out management activities, such as enforcement of forest rules and regulations. Adequate planning of both the location and type of infrastructure is required, and particular consideration should be given to the steep topography.

Climate. The area has a tropical monsoon climate, with rainfall concentrated in the three months from July to September and the highest rainfall during August. Floods often occur at these times, causing obstacles to the management and protection of the nature reserve. The dry season is from November to April, and accounts for only 10% of the total annual rainfall. During the dry season, the area is exposed to hot, dry winds blowing from Laos. During this period, there is an increased risk of forest fire, caused by slash-and-burn agricultural practices. Consequently, the nature reserve management must implement measures to prevent and control forest fires, particularly in forest areas below 700 m. These measures should include raising awareness about the dangers of fire and establishing fire-prevention teams in each commune.

4.2 Biological Factors

Management of Forest Patches. The majority of mammals and birds in the proposed nature reserve depend upon evergreen forest. The only significant undisturbed areas of this habitat type occur above 700 m. The first priority in establishing and managing the nature reserve should be to protect and conserve existing primary forest patches in order to provide a refuge for species dependent upon evergreen forest. These species include Tiger, Clouded Leopard, Asiatic Black Bear, Roosevelt's Muntjac, and White-cheeked Gibbon.

Further Research. Although populations of several threatened and endemic mammal and bird species have been found in the proposed nature reserve, these populations have not been studied in sufficient detail to understand their distribution and ecology. The biodiversity data outlined in this report are only initial results and a more detailed research programme is essential in order to provide data for effective conservation management. Such a programme should include detailed surveys of mammal, bird, reptile and amphibian populations, with particular attention given to Roosevelt's Muntjac and threatened species. Future biodiversity survey work should take place in the spring when conditions are most favourable.

4.3 Socio-cultural Factors

Hunting and Trapping. At present, there is insufficient information on the populations of nationally or globally threatened animal species to develop a long-term plan for their conservation. However, hunting and trapping of mammals and birds by villagers continues in Ban Vin village, and it will be necessary to take measures reduce and possibly eliminate the impact of these unlawful activities. These measures should include enforcement of regulations on the possession of firearms and patrols to check trap laying during the trapping season from September to March.

Logging and Forest Clearance. Forest areas above 700 m have steep slopes and soils prone to erosion if the vegetation cover is removed. Once soil erosion has taken place, regeneration of the natural vegetation is impeded. The nature reserve management must seek to control forest clearance at higher elevations, in order to protect the integrity of the forest. Furthermore, it will be necessary to control logging and forest clearance along the Chu and Khao Rivers by local people from Hon Yen and Ban Vin villages if the catchments of these important water sources are to be protected.

The conifers *Fokienia hodginsii* and *Cunninghamia konishii* have high economic value and, consequently, most

of the trees with diameters greater than 30 cm have already been illegally felled; only small trees remain. In addition, broadleaf tree species, such as *Michelia* spp., are also illegally felled. Illegal timber extraction has already seriously degraded the forest in the proposed nature reserve; unless it is controlled, the few remaining areas of undisturbed forest will also be lost.

The northern areas of the nature reserve are close to centres of population along the Cao River, and it is the activities of the inhabitants of this area that may be having the greatest impacts on the proposed nature reserve. Therefore, priority should be given to conservation activities in this area, such as establishing guard stations.

5. Management Recommendations

5.1 Management Objectives

The following management recommendations for Xuan Lien Nature Reserve are based upon an appraisal of the biodiversity of the study area and an analysis of constraints on conservation.

The general management objectives should be to:

(a) completely preserve the biodiversity value of the nature reserve; and

(b) develop projects in the nature reserve and buffer zone, in order to encourage high levels of interest and involvement in conservation amongst local people.

Specific objectives should include to:

(a) strictly protect existing areas of primary forest within the nature reserve;

(b) preserve populations of animal and plant species in the nature reserve together with their habitat, with particular attention to nationally and globally threatened species that are vulnerable to over-exploitation, such as *Fokienia hodginsii*, *Cunninghamia konishii*, Tiger, Clouded Leopard, Gaur, White-cheeked Gibbon, Great Hornbill and Brown Hornbill;

(c) protect the population of Roosevelt's Muntjac which is currently under intense hunting pressure;

(d) maintain the ecological value and hydrological functions of the Chu and Cao Rivers, and protect the catchment of Cua Dat dam;

(e) initiate and carry out a research and monitoring programme to ensure the long-term protection of the natural values of the nature reserve;

(f) support development of infrastructure and technology in the buffer area to facilitate socio-economic development with the aim of gradually reducing the dependence of local people on the natural resources of the nature reserve; and

(g) conduct a programme to raise awareness amongst the local community of the value of the nature reserve and to promote sustainable use of its resources.

5.2 Management Authority

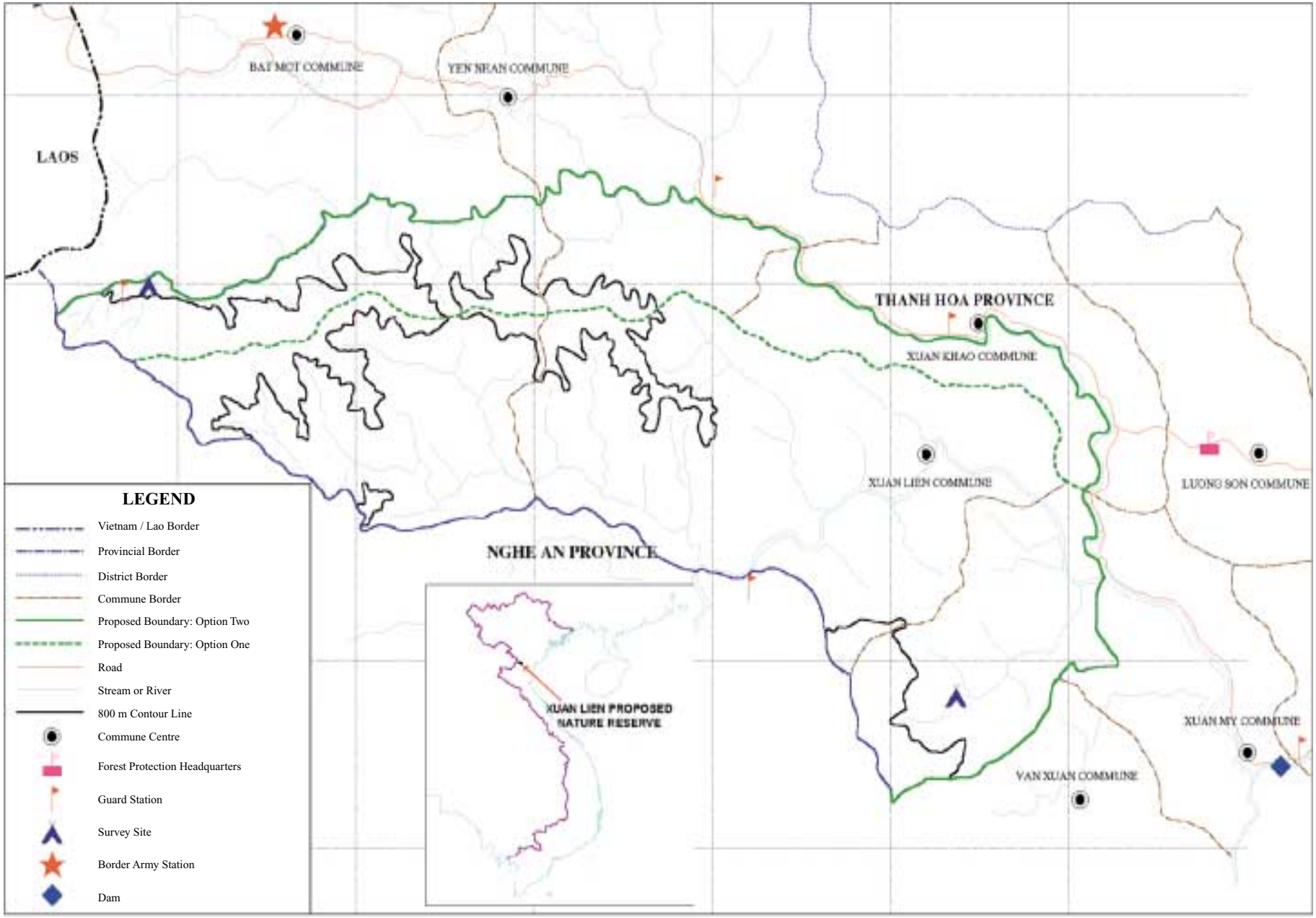
Inclusion of Xuan Lien Nature Reserve in Vietnam's network of Special-use Forests would necessitate transfer of management responsibility to the Forest Protection Department (FPD) within MARD, which coordinates protection of all Special-use Forests whilst all other areas are managed by provincial FPDs (MOF 1991a). However, the management responsibility for and administration of nature reserves is undertaken, in most instances, at the provincial level, and it is recommended that this should be the case for Xuan Lien Nature Reserve.

5.3 Proposed Boundary of Xuan Lien Nature Reserve

Option One

Beginning at Ta Leo peak (1,400 m) on the border with Nghe An province in the south-east of the nature reserve, the boundary runs between the watersheds of the Hon Yen and Hon Han streams until the confluence of the Chu and Cao Rivers. The boundary then continues north along the Cao River for 2.5 km, before heading west along the mountain ridge which incorporates the summits of Bu Pha Rang (580 m), Hon Han (655 m), Bu

Map 3: Proposed Boundary of Xuan Lien Nature Reserve



Map based on field survey in 1998
Grid: UTM, zone 48; units: metric

SCALE: 1:140,000

Produced by the Forest Resources and Environment Centre of FIPI

Hon Han (1,208 m) and Ban Mua (1,100 m) mountains and peaks at 315 m, 1,178 m, 1,397 m and 1,442 m, as far as the provincial border. The southern boundary follows the border between Thanh Hoa and Nghe An provinces for about 26 km (Map 3).

With this boundary, Xuan Lien Nature Reserve would have the following characteristics:

- A total area of about 16,500 ha, including 2,500 ha of evergreen forest.
- No human settlements in the nature reserve after the construction of Cua Dat dam.

However, under option one, an area of 7,100 ha south of the Cao River, including 2,000 ha of evergreen forest, would not be included in the nature reserve. Therefore, option two is proposed[1] .

Option Two

The southern and eastern boundary are the same as for option one. The northern boundary follows the Cao River and its tributary, the Ken River, from the border between Nghe An and Thanh Hoa provinces (19°59'N 104°57'E) to the confluence with the Chu River (Map 3).

With the boundary proposed under option two, the nature reserve would cover an area of 23,610 ha, an increase of 7,100 ha in comparison with option one. This increased area would enhance the conservation value of Xuan Lien Nature Reserve in the following ways:

- Expanded habitat for large mammal species with populations in the area south of the Ken and Cao Rivers, such as Gaur, Tiger, Asiatic Black Bear, Sun Bear and Roosevelt's Muntjac.
- Expanded habitat of several nationally and globally threatened bird species.
- More areas of forest in the watershed of Cua Dat dam are afforded Special-use Forest status.

Neither option for the boundary of Xuan Lien Nature Reserve includes areas to the north-west adjacent to the national border between Vietnam and Laos for to the following reasons:

- Local people in Bat Mot commune have settled the area north of the Ken River and are cultivating wet rice in the valleys and dry rice on the hills. This has led to exploitation or clearance of forest in this area.
- Nam Xam Nature Reserve in Laos is about 12 km from the international border with Vietnam. The forest in the intervening areas has been extensively cleared by settlers practising shifting cultivation. The isolated and degraded patches of forest which remain do not represent a viable habitat corridor between Xuan Lien and Nam Xam Nature Reserves.

Xuan Lien Nature Reserve will share a common boundary with Pu Hoat proposed nature reserve to the south in Nghe An province.

As a result of future emigration of people from Xuan My and Xuan Lien communes, following the construction of Cua Dat dam, there will be no human settlement or fixed cultivation within the nature reserve under either option. Option two will provide greater protection of forest habitat and the biodiversity dependent upon it, as well as increased watershed protection.

[1] Following the publication of the original Vietnamese version of this report, a workshop was held in Thanh Hoa province in February 1999 attended by representatives of FIPI, the provincial people's committee and the Provincial FPD to discuss the two options for the boundary at which option two was decided upon.

5.4 Management Areas

The core zone of Xuan Lien Nature Reserve should be divided into three areas, with each area having a different management regime: a Strict Protection Area, a Forest Rehabilitation Area and an Administration and Service Area. Additionally, there should be a buffer zone.

Strict Protection Area
The Strict Protection Area should be defined on the basis of the location of forest areas, which make up 78% of the nature reserve. This area should contain secondary forest types as well as primary forest. The areas to be included in the Strict Protection Area will be defined in detail in the investment plan for Xuan Lien Nature Reserve.

Function of the Strict Protection Area. The function of the Strict Protection Area is to completely protect all habitats represented in the nature reserve and the animal and plant species they support. Activities which over-exploit or degrade the forest should not be allowed. These activities include tree cutting, oil and resin exploitation, and hunting and trapping of animals. The management regime for the Strict Protection Area is shown in Table 20.

Table 20: Management Regime for the Strict Protection Area

Activity	Impacts	Management
Logging	Degradation and loss of forest, disruption of forest canopy, loss of plant and animal species	Strictly prohibited
Charcoal production	Degradation of forest, ecological disturbance, loss of habitat and species	Strictly prohibited
Resin tapping and oil distilling	Destruction of forest, disruption of canopy layer, wildlife disturbance	Strictly prohibited
Hunting with guns	Loss of mammal and bird species, wildlife disturbance	Strictly prohibited
Trapping mammals and birds with snares and traps	Loss of mammal and bird species, wildlife disturbance	Strictly prohibited
Trapping large mammals with explosives	Loss of mammal species, wildlife disturbance	Strictly prohibited
Fishing and frog catching	Impacts unclear, over-exploitation may lead to loss of species	Strictly prohibited
Livestock grazing	Disturbance to wildlife and ecology, prevention of natural regeneration	Strictly prohibited
Mining	Destruction of forest, pollution, loss of aquatic species	Strictly prohibited
Fire	Destruction of forest, prevention of natural regeneration	Strictly prohibited
Construction of roads, houses and other infrastructure	Creation of conditions for destruction of forest and over-exploitation of natural resources	Strictly prohibited
Orchid collection	Impacts unclear but can cause loss of plant species	Strictly prohibited
Medicinal plant collection	Impacts unclear but can cause loss of plant species	Limited
Rattan collection	Disturbance to the forest understorey, wildlife disturbance	Limited
Firewood collection Honey collection	Prevention of natural regeneration Impacts unclear, possible risk of fire	Limited to dead wood Permitted

Forest Rehabilitation Area
Most areas of scrub, grassland and agricultural land lie at low elevations. Large areas of these vegetation types will be inundated when Cua Dat dam is constructed. Consequently, the remaining areas of scrub and grassland in

the nature reserve will cover only 3,000 ha. Two options are proposed for these areas, either:

(a) these areas will be protected and allowed to regenerate naturally into forest. The advantage of this approach is that areas of scrub and grassland are scattered throughout the nature reserve, making active rehabilitation difficult; or

(b) these areas will be rehabilitated to forest habitat by planting indigenous tree species such as *Manglietia* spp., *Erythrophleum fordii*, *Chukrasia tabularis*, *Fokienia hodginsii* and *Cunninghamia konishii*.

Function of the Forest Rehabilitation Area. The purpose of the Forest Rehabilitation Area is to restore the natural vegetation of areas which have been cleared and prevented from regenerating naturally by the activities of humans. This will be achieved through either natural regeneration of the forest or planting of indigenous trees. Activities which prevent forest regeneration are not permitted. The management regime for the Forest Rehabilitation Area is shown in Table 21.

Table 21: Management Regime for the Forest Rehabilitation Area

Activity	Impacts	Management
Shifting cultivation	Destruction of ecosystem, reduction of habitat for wildlife species	Strictly prohibited
Hunting and trapping	Loss of animal species, decline in animal populations	Strictly prohibited
Mining	Destruction of forest, pollution, loss of aquatic species	Strictly prohibited
Construction of roads, houses and other infrastructure	Creation of conditions for destruction of forest and over-exploitation of natural resources	Strictly prohibited
Livestock grazing	Disturbance to wildlife and ecology, prevention of natural regeneration	Strictly prohibited
Fire	Destruction of forest, prevention of natural regeneration	Strictly prohibited
Planting of non-native tree species	Loss of habitat diversity and biodiversity	Generally prohibited
Exploitation of non-timber forest products	Over-exploitation may result in loss of species and habitat	Limited and regulated
Reforestation with indigenous tree species	Habitat expansion, maintenance of biodiversity,	Encouraged
Protection of natural regeneration	Forest rehabilitation and regeneration, habitat expansion	Encouraged

5.5 Buffer Zone

The core zone of Xuan Lien Nature Reserve will cover 23,610 ha, including the whole of Xuan Lien commune and parts of five other communes Bat Mot, Yen Nhan, Xuan Khao, Xuan My and Van Xuan. The remaining areas of these five communes, along with three other communes (Luong Son, Xuan Cam and Xuan Le) will form a buffer zone. The total area of the buffer zone will be 53,556 ha.

According to the plan for Cua Dat dam, all the inhabitants of Xuan Lien commune will be relocated, and this land will become part of Xuan Lien Nature Reserve. Socio-economic development projects for the buffer zone will be developed in the future, following and separate from the investment project for Xuan Lien Nature Reserve. Socio-economic development projects in the buffer zone will be managed by the local administration at commune, district and provincial level. Future conservation projects for the nature reserve will be integrated with community development projects for the buffer zone.

The buffer zone has the following advantages for development projects:

- The land is suitable for cultivating bamboo which can be sold to Thanh Hoa paper mill for use in paper production.
- Sugarcane can be planted to supply Lam Son sugar factory in Thanh Hoa province.
- The abundant labour force can be involved in forest protection and plantation activities as part of the nation-wide five-million-hectare forest planting programme.
- There is sufficient grazing land available to support an increased number of livestock.

5.6 Development of Xuan Lien Nature Reserve

Investment Plan
Establishment of the nature reserve will require the production of a 5 to 10 year investment plan. This investment plan should outline the infrastructure, manpower, management policy and investment capital required to ensure adequate protection of the natural resources of the nature reserve. This would include the staffing requirements for management, administration and forest protection. The plan should also outline the number and location of guard stations.

Capital Construction Programme
Headquarters. The proposed location of the nature reserve headquarters is to the east of the nature reserve in Luong Son commune, with coordinates 19°57'N 105°16'E (Map 3).

Guard Stations. Assuming that option two for the nature reserve's boundary is adopted, five guard stations will be required, positioned as follows:

(a) Cua Dat Guard Station. Located near Cua Dat dam with coordinates 19°53'N 105°17'E. Its task will be to patrol and protect the forest in the east of the nature reserve. The main patrol route will be along the Chu River.

(b) Xuan Lien Guard Station. Located on the border between Thanh Hoa and Nghe An provinces at the confluence of the Khue and Chu Rivers, with coordinates 19°55'N 105°08'E. Its task will be to patrol and check for forest clearance and hunting or trapping of animals in the area near the provincial border.

(c) Yen Nhan Guard Station. Located near Due hamlet, Yen Nhan commune, with coordinates 20°00'N 105°08'E. Its task will be to protect the forest on Bu Hon Han mountain and to monitor human activities in Yen Nhan and Bat Mot communes that affect the nature reserve.

(d) Xuan Khao Guard Station. Located on the Cao River with coordinates 19°58'N 105°12'E.

(e) Ban Vin Guard Station. Located in Ban Vin village, Bat Mot commune, with coordinates: 19°59'N 104°59'E. Its task will be to carry out forest management and protection of forest south of the Ken River. The main patrol routes will be between Ban Vin and Lang Liem villages, and between Ban Vin and Ban Can villages.

5.7 Future Plan for the Establishment of Xuan Lien Nature Reserve

1. This feasibility study will be discussed at a forthcoming workshop to be held in Thanh Hoa province, which will be attended by representatives of all organisations concerned in the establishment and management of the nature reserve. The purpose of this workshop will be to obtain feedback on and

ratify the contents of this feasibility study[2].

2. After being ratified by the provincial people's committee, this feasibility study will be submitted to the Ministry of Agriculture and Rural Development (MARD). Suggestions by senior experts regarding the development of the investment plan for Xuan Lien Nature Reserve will be solicited.

3. In 1999, the government and MARD will agree to fund the development of an investment plan for the nature reserve[3].

4. The amount of investment capital required for projects in the core zone and buffer zone of the nature reserve detailed in the investment plan will be estimated. The investment plan will then be submitted to MARD and the Ministry of Planning and Investment (MPI) for ratification.

5.8 Priority Actions

1. Establishment of Xuan Lien Nature Reserve as part of Vietnam's expanded system of Special-use Forests. This meets the commitment of the government to increase the protected area system of Vietnam to two million hectares by the year 2000.

2. Thanh Hoa Provincial FPD should submit a proposal to MARD, outlining the funds required to develop an investment plan for Xuan Lien Nature Reserve.

3. Thanh Hoa Provincial FPD should send official letters to the people's committees of Thuong Xuan district and the communes therein to inform them of provincial and ministerial policy decisions regarding the establishment of Xuan Lien Nature Reserve.

4. Thuong Xuan District FPD should step up control of illegal exploitation of natural resources in the area of the proposed nature reserve, particularly when these activities are taking place at unsustainable levels. The district FPD should also conduct education and awareness activities to increase understanding amongst local people of the importance of environment protection for agricultural development.

5. Further study of animal and plant populations, particularly in the upstream areas of the Ken and Khue Rivers, should be carried out. Special attention should be paid to identifying threatened and endemic bird species which were not found during the previous field survey. Further information should be collected on the distribution and ecology of Roosevelt's Muntjac and globally threatened mammals such as Tiger and Gaur.

6. A detailed socio-economic survey should be carried out in communities in the buffer zone of the nature reserve. The results of this survey will be a basis for developing a harmonious relationship between the nature reserve and the local community.

7. A thorough and professionally undertaken Environmental Impact Assessment should be undertaken prior to proceeding with the development of the Cua Dat dam.

[2] This workshop was held in February 1999 and the contents of the original Vietnamese version of this feasibility study were ratified.

[3] FIPI plan to write the investment plan for Xuan Lien Nature Reserve during the second half of 1999.

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Appendix 1: Flora Recorded in Xuan Lien Proposed Nature Reserve

Class, Family, Genus and Species	Notes
Lycopodiophyta	
Lycopodiaceae	
Lycopodiella cernua	M
Selaginellaceae	
Selaginella petelotii	
S. delicatula	
Polypodiophyta	
Angiopteridaceae	
Archangiopteris tonkinensis	
Angiopteris caudatiformis	
A. repandula	
Schizeaceae	
Lygodium conforme	
L. flexuosum	
L. japonicum	
Adiantaceae	
Adiantum capillus-veneris	M
Vittaria elongata	
Pteris ensiformis	
P. linearis	
Gleicheniaceae	
Dicranopteris dichotoma	
D. linearis	
Polypodiaceae	
Drynaria fortunei	M
Aglaomorpha coronans	
Pyrrosia lingua	M
Colysis bonii	
Cyatheaceae	
Cyathea contaminans	
C. gigantea	
Thyrsopteridaceae	
Cibotium barometz	M
Dennstaedtiaceae	
Pteridium aquilinum subsp. aquilinum	
Lindsaea ensifolia	
L. chienii	
Aspleniaceae	
Asplenium nidus	O
A. normale	
Diplazium esculentum	
Dryopteridaceae	
Tectaria decurrens	
T. leuzeana	
Davalliaceae	
Humata repens	
Davallia divarcata var. *orientalis*	
Blechnaceae	
Blechnum orientale	
Marsileaceae	
Marsilea quadrifolia	M
Pinophyta	
Gnetaceae	
Gnetum montanum	
Taxodiaceae	
Cunninghamia konishii	W
Cupressaceae	
Fokienia hodginsii	W,M,R
Podocarpaceae	
Dacrycarpus imbricatus	W
Podocarpus neriifolius	W
Amentotaxaceae	
Amentotaxus argotaenia	W
Magnoliophyta	
Magnoliopsida	
Magnoliaceae	
Manglietia conifera	W
M. hainanensis	W
M. fordiana	W
Michelia balansae	W
M. foveolata	W
M. hypolampra	W
Paramichelia baillonii	W
Tsoongiodendron odorum	W
Anonaceae	
Uvaria purpurea	
Desmos chinensis	
D. cochinchinensis	M,O
Dasymaschalon rostratum	
Polyalthia lauii	W
P. obtusa	W
Cyathocalyx annamensis	W
Alphonsea boniana	W
Mitrephora calcarea	W
Myristicaceae	
Knema conferta	W
K. globularia	W,M
Piperaceae	
Peperomia leptostachya	
Piper albispicum	
Illiciaceae	
Illicium parviflorum	
Ranunculaceae	
Clematis armandii	
C. buchaniana	
Menispermaceae	
Stephania japonica var. *discolor*	M
S. rotunda	M
Cissampelos pareira	M
Lauraceae	
Cinnamomum cassia	W,M
C. parthenoxylon	W
C. bejolghota	
(C. obtusifolium)	W
C. balansae	W,EV
Neocinnamomum lecomtei	
Litsea baviensis	W
L. cubeba	W,M
L. glutinosa	W,M
L. monopetala	W
L. robusta	W
L. verticillata	W
Neolitsea zeylanica	W
Lindera tonkinensis	W
Cryptocarya annamensis	W
C. lenticellata	W
C. metcalfiana	W
Beilshmiedia intermedia	W
B. percoriacea	W
Phoebe angustifolia var. *annamensis*	
P. tavoyana (P. cunneata)	W
Machilus bonii	W
M. macrophylla	W
Alseodaphne rhododendropsis	W
Caryodaphnopsis tonkinensis	W
Cassytha filiformis	M
Hernandiaceae	
Illigera parviflora	
Dilleniaceae	
Dillenia pentagyna	W
D. scabrella	W
D. turbinata	W,M
Tetracera scandens	M

Class, Family,	Notes
Actinidiaceae	
Saurauja tristyla	M
Theaceae	
Adinandra hainensis	
Eurya annamensis	
E. japonica	
Camellia dormoyana	
C. caudata	
Schima wallichii subsp. *noronhae*	W
Dipterocarpaceae	
Hopea mollisima	W
Parashorea chinensis	W,R
(Shorea chinensis)	
Vatica subglabra	W
Pentaphylaceae	
Pentaphylax euryoides	
(P. spicata)	W
Guttiferae	
Garcinia cochinchinensis	
(G. loureiri)	W
G. cowa	W
G. multiflora	W
G. oblongifolia	W
Cratoxylum cochinchinensis	W,M
C. formosum var. *prunifolium*	W,M
Elaeocarpaceae	
Elaeocarpus apiculatus	W
E. grandiflorus	W
E. griffithii (E. dubius,	
E. bachmaensis)	W
E. lanceifolius	W
E. limitanus	W
E. stipularis (E. thorelii,	
E. tomentosus)	W
Tiliaceae	
Grewia hirsuta	W
G. paniculata	M
Colona poilanei	W,EV
C. thorelii	W
Triumfetta pseudocana	
T. bartramia (T. rhomboidea)	M
Sterculiaceae	
Commersonia bartramia	
Helicteres angustifolia	
Pterospermum heterophyllum	W
P. lancaefolium	W
Reevesia thyrsoidea	W

Class, Family, Genus and Species	Notes
Sterculia lanceolata	W,M
Heritiera macrophylla	W
Bombaceae	
Bombax ceiba	W,M
Malvaceae	
Sida rhombifolia	M
Urena lobata	M
Kydia calycina	W
Flacourtiaceae	
Hydnocarpus annamensis	W
H. kurzii	W
Scolopia chinensis	W
Passifloraceae	
Passiflora foetida	M
Cucurbitaceae	
Solena heterophylla	
Gymnopetalum cochinchinensis	
Hodgsonia macrocarpa	M
Datiscaceae	
Tetrameles nudiflora	W,M
Begoniaceae	
Begonia boisiana	
B. macrostoma	
Capparaceae	
Capparis tonkinensis	
Crateva nurvala	M,O
Ericaceae	
Rhododendron nuttalii	O
R. cavaleriei	O
Vaccinium dunalianum	
Lyonia ovalifolia	
Sapotaceae	
Madhuca pasquieri	W,M,R
Eberhardtia tonkinensis	W
Sinosideroxylon racemosum	W
Sarcosperma kachinense	W
Ebenaceae	
Diospyros apiculata	
(D. eriantha var. *cocica)*	W
D. kerrii	W
D. pilosula	W
Styracaceae	
Styrax benjoin	W
S. tonkinensis	W,M
Alniphyllum fortunei	
Symplocaceae	
Symplocos adenophylla	W
S. cochinchinensis subsp. *laurina*	W

Class, Family,	Notes
S. paniculata (S. chinensis)	W
Myrsinaceae	
Maesa balansae	M
Embelia laeta	M
E. scandens	
Ardisia aciphylla	
A. maculosa	
A. ramondiaeformis	
A. silvestris	M
Amaranthaceae	
Cyathula prostrata	
Achyranthes aspera	M
Polygoniaceae	
Polygonum chinensis	
P. hydropiper	M
P. leptostachyum	
Rosaceae	
Eriobotrya bengalensis	W
Rhaphiolepis indica	W
Rubus cochinchinensis	M
R. parvifolius (R. triphyllus)	
R alceaefolius	M
Prunus arborea var. *montana*	W
Fabaceae	
Mimosoideae	
Entada phaseoloides	
(E. tonkinensis)	
Adenanthera pavonina	W
Albizia chinensis	W
A. odoratissima	W
A. lucidior	W
Archidendron clypearia	W
A. turgidum	W
A. bauchei	W
Caesalpiniodeae	
Peltophorum dasyrrachis var.	W
tonkinensis	
Caesalpinia sappan	M
C. mimosoides	
C. minax	M
Erythrophleum fordii	W
Cassia alata	M
C. hirsuta	
C. tora	M
Bauhinia touranensis	
B. godefroyi	
Saraca dives	W

Class, Family,	Notes
Papilionideae	
Ormosia balansae	W
O. fordiana	W
O. pinnata	W
Bowringia calicarpa	
Dalbergia rimosa	
D. rimosa var. *tonkinensis*	W,V
D. hupeana var. *laccifera*	W
D. balansae	W
D. stipulaceae	W
Milletia ichthyotona	W
Desmodium caudatum	
Erythrina variegata	M
Pueraria montana	
Crotalaria medicaginea	
C. umbellata	
Eleagnaceae	
Eleagnus bonii	
E. conferta	
Proteaceae	
Helicia cochinchinensis	W
Heliciopsis lobata	W,M
Lecythidaceae	
Barringtonia acutangula	W,M
Sonneratiaceae	
Duabanga grandiflora	W
Lythraceae	
Lagerstroemia tomentosa	W
Myrtaceae	
Rhodomyrtus tomentosa	M
Syzygium bonii	W
S. finetii	
S. hancei	W
S. mekongensis	W
S. sterrophyllum	
Melastomataceae	
Melastoma septemnervium	
(M. candidum)	
M. normale	
Osbeckia nepalensis	
Blastus cochinchinensis	
Memecylon fruticosum	
Combretaceae	
Terminalia myriocarpa	W
Quisqualis indica	M
Rhizophoraceae	
Carallia lancaefolia	W

Class, Family, Genus and Species	Notes
Alangiaceae	
Alangium chinense	W
A. kurzii	W
Loranthaceae	
Helixanthera parasitica	
(Loranthus adpresus)	
Dendrophtoe pentandra	
(Loranthus pentandrus)	
Taxillus chinensis	
(Loranthus chinensis)	
Elythranthe albida	
Balanophoraceae	
Balanophora latisepala	
Celastraceae	
Glyptopetalum tonkinensis	
Euonymus acanthoxanthus	
E. pseudo-vagans	
Icacinaceae	
Gonocaryum lobbianum	W
Pandaceae	
Microdesmis casearifolia	W
Euphorbiaceae	
Phyllanthus emblica	W
P. reticulata	M
P. petelotii	
Glochidion hirsutum	
G. gamblei	
Breynia angustifolia	
B. fruticosa	M
Drypetes perreticulata	W
Aporusa dioica	
(A. microcalyx)	
Baccaurea ramiflora	
(B. sapida)	W
Antidesma yunnanensis	W
A. montanum	W
Bischofia javanica	W,M
Bridelia balansae	
B. minutiflora	W
Croton bonianus	EV
Claoxylon hainanensis	
Mallotus philippensis	W
M. barbatus	
M. apelta	M
M. paniculatus	
(M. cochinchinensis)	W
Alchornia tiliaefolia	W
Cleidion brevipetiolatum	W

Class, Family,	Notes
Macaranga denticulata	W
M. balansae	W,EV
Homonoia riparia	M
Aleurites moluccana	W
Vernicia fordii	W
Endospermum chinense	W
Sapium baccatum	W
S. discolor	W
S. rotundifolium	W
Oxalidaceae	
Averrhoa carambola	
Oxalis corniculata	M
Sapindaceae	
Nephelium chryseum	W
Xerospermum donnaiense	W
Pometia pinnata	W
Arytera littoralis	W
Mischocarpus fucescens	W
M. sundaicus	W
Paviesia annamensis	W
Staphyleaceae	
Turpinia montana	
Aceraceae	
Acer erythranthum	W
A. tonkinensis subsp. *tonkinensis*	W
Burseraceae	
Canarium album	W,M
C. bengalense	W
C. tonkinensis	W
Anacardiaceae	
Mangifera foetida	W
Allospondias lakonensis	W
Choerospondias axillaris	W,M
Dracontomelon duperreanum	W
Rhus javanica var. *roxburghii*	M
(R. chinensis)	
Toxicodendron rhetsoides	W
Simaroubaceae	
Brucea tonkinensis	
Ailanthus triphysa	W,M
Meliaceae	
Chukrasia tabularis	W
Melia azedarach	W
Dysoxylum binectariferum	W
D. hainanense var. *glaberrinum*	W
D. tonkinense	W
Chisocheton paniculatus	W
Aphanamixis polystachya	W

Class, Family,	Notes
Amoora dasyclada	W
Aglaia gigantea	W
A. roxburghiana	W
Heynia trijuga	W
Rutaceae	
Zanthoxylum armatum	
Z. avicenniae	M
Euodia lepta	
E. meliaefolia	
Acronychia pedunculata	M
Clausena dunniana	M
Luvunga sarmentosa	
Rhamnaceae	
Gouania leptostachya	M
Ventilago leiocarpa	M
Berchemia lineata	M
Leeaceae	
Leea rubra	M
Vitaceae	
Tetrastigma retinervium	
T. tonkinense	
Cissus rosea	
Cayratia trifolia	
C. japonica	M
Apiaceae	
Centella asiatica	M
Hydrocotyle sibthorpioides	M
Araliaceae	
Tupidanthus calyptratus	
Schefflera glomerulata	
S. leucantha	
S. brevipedicellata	
S. octophylla	W,M
Trevesia palmata	M
Diplopanax stachyanthus	W
Aralia armata	M
Heteropanax fragrans	
Platanaceae	
Platanus kurzii	W
Hamamelidaceae	
Symingtonia populnea	W
Mytilaria laosensis	W
Rhodoleia championii	W
Ulmaceae	
Gironniera subequalis	W
Celtis orientalis	W
Trema orientalis	W

Class, Family,	Notes
Salicaceae	
Salix tetrasperma var. *harmandii*	W
S. tetrasperma var. *nilagirica*	W
Moraceae	
Streblus asper	M
Broussonetia papyrifera	W,M
Malaisia scandens	
Artocarpus styracifolius	W
A. lakoocha	W
Antiaris toxicaria var. *toxicaria*	W,M
Ficus altissima	W
F. stricta	
F. racemosa	W
F. subpyriformis	
F. trivia (F. glandulifera)	W
F. fulva	
F. pumila	M
F. heterophylla var. *heterophylla*	M
F. auriculata	
F. hispida var. *hispida*	
F. cunia	
F. gibbosa	
Urticaceae	
Poikilospermum suaveolens	
Dendrocnide sinuata	
Pilea baviensis var. *serrata*	
P. peltata	
Elatostema balansae	
Pellionia macroceras	
Boehmeria holosericea	
Pouzolzia pentandra	
Debregeasia squamata var. *squamata*	
Juglandaceae	
Pterocarya stenoptera var. *tonkinensis*	W
Engelhardtia roxburghiana	W
E. spicata var. *spicata*	W
Annamocarya sinensis	W,R
Fagaceae	
Castanopsis annamensis	W
C. clarkei var. *pseudoindica*	W
C. ferox	W
C. indica	W
C. tonkinensis	W
Lithocarpus dussaudii	W
L. finetii	W
L. fissa	W

Class, Family,	Notes
L. laotica	W
L. paviei	W
L. tubulosus	W
Quercus bambusaefolia	W
Q. fleuryi	W
Q. petelotii	W
Betulaceae	
Betula alnoides	W
Loganiaceae	
Gelsemium elegans	
Strychnos wallichii	M
Apocynaceae	
Bousingonia mekongense	
Alstonia scholaris	W,M
Alyxia divaricata	
Tabernaemontana bovina	M
Wrightia macrocarpa	
W. pubescens subsp. *lanati*	W
Asclepidiaceae	
Cryptolepis buchananii	
Streptocaulon griffithii	M
Gymnema latifolia	
Hoya multiflora	
H. villosa	
Dischidia alboflava	
Solanaceae	
Solanum americanum	
S. torvum	M
Convolvulaceae	
Merremia scandens	
Ipomoea pes-tigridis	
I. bonii	
Boraginaceae	
Tournefortia sarmentosa	
Heliotropium indicum	M
Verbenaceae	
Callicarpa arborea	W
C. nudiflora	
Vitex quinata	W
V. trifolia	W
Gmelina arborea	W
Clerodendron cyrtophyllum	M
C. kaempferi	
Lamiaceae	
Ocimum gratissimum	M
Gomphostema lucidum	
Leonurus sibiricus	M

Class, Family,	Notes
Scrophulariaceae	
Paulownia fargesii	W
Lindernia ruellioides	
L. anagallis	
Acanthaceae	
Thunbergia coccinea	
Strobilanthes brunescens	
Justicia gendarussa	M
J. ventricosa	
Bignoniaceae	
Oroxylum indicum	M
Radermachera ignea	
Markhamia stipulata	W
Pentaphragmaceae	
Pentaphragma sinense	
Rubiaceae	
Hedyotis corymbosa	M
H. capitellata	M
H. auricularia	
Wendlandia glabrata	
W. paniculata	
Uncaria homomalla	
(U. tonkinensis)	
Neonauclea purpurea	W
(Nauclea purpurea)	
Neolamarckia cadamba	W
(Anthocephalus indicus)	
Haldina cordifolia	
(Nauclea cordifolia)	W
Mussaenda bonii	
M. dehiscens	
Aidia oxydonta	
(Randia oxydonta)	W
Randia acuminatissima	W
R. dasycarpa	
Gardenia sp.	
Canthium dicoccum var. *rostratum*	W,M
Ixora coccinea	O,M
Psychotria rubra	M
Lasianthus annamicus	
L. cyanocarpus var. *asperulatus*	
Caprifoliaceae	
Sambucus hookeri (S. javanica)	
Viburnum lutescens	
(V. colebrookeanum)	
Asteraceae	
Vernonia arborea var. *javanica*	W

Class, Family,	Notes
Ageratum conyzoides	M
Eupatorium odoratum	
Thespis tonkinensis	
Blumea balsamifera	M
Xanthium inaequilaterum	
(X. strumarium)	M
Sigesbeckia orientalis	M
Eclipta prostrata (E. alba)	M
Artemesia vulgaris	M
Crepis japonica	
Crassocephalum crepidioides	
Liliopsida	
Pandanaceae	
Pandanus humilis	
P. tonkinensis	
Araceae	
Pothos grandis	
P. repens	M
Epipremnum giganteum	O
Raphidophora decursiva	O
Homalomena occulta	
(H. aromatica)	M
Colocasia gigantea	
(C. indica)	
Alocasia macrorrhiza	M
Amorphophallus interruptus	
Commelinaceae	
Commelina diffusa	
Floscopa glabratus	
Pollia hasskarlii	
Arecaceae	
Rhapis macrantha	O
Livistona chinensis	O
Caryota rumphiana	O
C. urens	O
Arenga pinnata	O
Pinanga duperreana	O
Calamus platyacanthus	
C. tetradactylus	
C. tonkinensis	R
Plectocomia elongata	
Musaceae	
Musa acuminata	
M. aff. *coccinea*	O
Zingiberaceae	
Costus speciosus	M
C. tonkinensis	
Amomum villosum	M

Class, Family,	Notes
Alpinia chinensis	M
Catimbium bracteatum	
Zingiber zerumbet	M
Marantaceae	
Phrynium dispermum	
P. parviflorum	
Liliaceae	
Dianella nemorosa	
Smilacaceae	
Smilax glabra	M
S. ovalifolia	
Cyperaceae	
Fimbristylis complanata	
F. umbellaris	
Cyperus pilosus	M
C. rotundus	M
C. compressus	
Carex indica	
C. cryptostachys	
Poaceae	
Arundinaria sat	M
A. sp	
Indosasa aff. *crassiflora*	
Bambusa sp.	
Gigantochloa levis	
Dendrocalamus membranaceus	
D. patellaris	
Melocalamus sp.	
Neohouzeana dulloa	
Centhotheca lappacea	
Phragmites vallatoria	
Thysanolaena maxima	M
Eleusine indica	M
Dactyloctenium aegyptiacum	
Cynodon dactylon	
Pennisetum alopecuroides	
Imperata cylindrica	M
Saccharum spontaneum	M
Erianthus arundinaceus	
Chrysopogon aciculatus	M
Themeda gigantea	
Coix puellarium	
Agavaceae	
Dracaena loureiri	M
Taccaceae	
Tacca chantieri	
Stemonaceae	
Stemona tuberosa	M

Class, Family, Genus and Species	**Notes**
Dioscoreaceae	
Dioscorea persimilis	M
D. cirrhosa	M
Orchidaceae	
Paphiopedilum gratrixianum	O
Habenaria ciliolaris	
Anoectochilus roxburghii	
Arundina graminifolia	O
Oberonia ensiformis	O
Liparis elliptica	O
Dendrobium lindleyi	O
D. chrysotoxum	O
D. thyrsiflorum	O
D. anosmum	O
D. nobile	O
D. cretaceum	O
D. aloifolium	O
Eria muscicola	
E. globulifera	O
Bulbophyllum eberhardtii	
B. concinnum	O
Cymbidium dayanum	M,O
Aerides odorata	O
Renanthera coccinea	O

Follows Pham Hoang Ho (1991)

Notes: EV = Endemic to Vietnam;

M = Medicinal; W = Wood; O = Ornamental;

V = Vulnerable; R = Rare as per IUCN (1997).

Appendix 2: Mammals Recorded in Xuan Lien Proposed Nature Reserve

Common Name	Order, Family, Genus and Species	Record	IUCN 1996
Pangolins:	Pholidota:		
Pangolins	Manidae		
1. Chinese Pangolin	*Manis pentadactyla*	S	NT
2. Sunda Pangolin	*M. javanica*	S	NT
Treeshrews:	Scandentia:		
Treeshrews	Tupaiidae		
3. Northern Treeshrew	*Tupaia belangeri*	S,O	
Primates:	Primates:		
Lorises	Loridae		
4. Slow Loris	*Nycticebus coucang*	S	
5. Lesser Slow Loris	*N. pygmaeus*	S	VU
Old-world monkeys	Cercopithecidae		
6. Assamese Macaque	*Macaca assamensis*	S,O	VU
7. Rhesus Macaque	*M. mulatta*	S,O	NT
8. Bear Macaque	*M. arctoides*	S	VU
9. Phayre's Leaf Monkey	*Semnopithecus phayrei*	S,I	DD
Gibbons	Hylobatidae		
10.White-cheeked Gibbon	*Hylobates leucogenys*	H	DD
Carnivores:	Carnivora:		
Dogs and Foxes	Canidae		
11. Indian Wild Dog or Dhole	*Cuon alpinus*	I	VU
Bears	Ursidae		
12. Asiatic Black Bear	*Ursus thibetanus*	S,O	VU
13. Sun Bear	*U. malayanus*	S,I	DD
Weasels, etc.	Mustelidae		
14. Yellow-throated Marten	*Martes flavigula*	O	
15. Hog Badger	*Arctonyx collaris*	S	
16. Small-toothed Ferret-badger	*Melogale moschata*	S	
17. Otter	*Lutra* sp.	I	
Civets	Viverridae		
18. Large Indian Civet	*Viverra zibetha*	S	
19. Common Palm Civet	*Paradoxurus hermaphroditus*	S	
20. Masked Palm Civet	*Paguma larvata*	S	
21. Binturong	*Arctictis binturong*	S	
Mongooses	Herpestidae		
22. Crab-eating Mongoose	*Herpestes urva*	S	
Cats	Felidae		
23. Leopard Cat	*Prionailurus bengalensis*	I	
24. Golden Cat	*Catopuma temminckii*	I	NT
25. Clouded Leopard	*Pardofelis nebulosa*	I	VU
26. Tiger	*Panthera tigris*	I	EN
Even-toed ungulates:	Artiodactyla:		
Pigs	Suidae		
27. Wild Boar	*Sus scrofa*	S,T	

Common Name	Order, Family, Genus and Species	Record	IUCN 1996
Deer	Cervidae		
28. Sambar	*Cervus unicolor*	S,T	
29. Barking Deer	*Muntiacus muntjak*	S,T	
30. Roosevelt's Muntjac	*M. rooseveltorum*	S	
Cattle, antelopes, goats	Bovidae		
31. Gaur	*Bos gaurus*	T,I	VU
32. Southern Serow	*Naemorhedus sumatraensis*	S	VU
Rodents:	Rodentia:		
Non-flying squirrels	Sciuridae		
33. Black Giant Squirrel	*Ratufa bicolor*	O	
34. Pallas's Squirrel	*Callosciurus erythraeus*	O	
35. Cambodian Striped Squirrel	*Tamiops rodolphii*	O	
36. Red-cheeked Squirrel	*Dremomys rufigenis*	O	
Old-World Porcupines	Hystricidae		
37. Malayan Porcupine	*Hystrix brachyura*	S	VU
38. Asiatic Brush-tailed Porcupine	*Atherurus macrourus*	S	

Follows Corbet and Hill (1992).

Record: S = Specimen; O = Observed; T = Tracks; H = Heard; I = Interview.

Status: EN = Endangered; VU = Vulnerable; NT = Near-threatened; DD = Data Deficient as per IUCN (1996).

Appendix 3: Birds Recorded in Xuan Lien Proposed Nature Reserve

Common Name	Order, Family, Genus and Species	Endemic Species	Collar *et al*. 1994
	Galliformes		
	Phasianidae		
1. Bar-backed Partridge	*Arborophila brunneopectus*		
2. Red Junglefowl	*Gallus gallus*		
3. Silver Pheasant	*Lophura nycthemera*		
4. Grey Peacock Pheasant	*Polyplectron bicalcaratum*		
	Piciformes		
	Picidae		
5. Speckled Piculet	*Picumnus innominatus*		
6. White-browed Piculet	*Sasia ochracea*		
7. Grey-capped Pygmy Woodpecker	*Dendrocopus canicapillus*		
8. Greater Yellownape	*Picus flavinucha*		
9. Pale-headed Woodpecker	*Gecinulus grantia*		
10. Bay Woodpecker	*Blythipicus pyrrhotis*		
	Megalaimidae		
11. Red-vented Barbet	*Megalaima lagrandieri*	EL	
12. Green-eared Barbet	*M. faiostricta*		
13. Golden-throated Barbet	*M. franklinii*		
	Bucerotiformes		
	Bucerotidae		
14. Great Hornbill	*Buceros bicornis*		
15. Brown Hornbill	*Anorrhinus tickelli*		NT
	Trogoniformes		
	Trogonidae		
16. Red-headed Trogon	*Harpactes erythrocephalus*		
	Coraciiformes		
	Alcedinidae		
17. Common Kingfisher	*Alcedo atthis*		
	Halcyonidae		
18. White-throated Kingfisher	*Halcyon smyrnensis*		
	Cuculiformes		
	Cuculidae		
19. Large Hawk Cuckoo	*Hierococcyx sparverioides*		
20. Indian Cuckoo	*Cuculus micropterus*		
21. Drongo Cuckoo	*Surniculus lugubris*		
22. Asian Koel	*Eudynamys scolopacea*		
23. Green-billed Malkoha	*Phaenicophaeus tristis*		
	Centropodidae		
24. Greater Coucal	*Centropus sinensis*		
25. Lesser Coucal	*C. bengalensis*		
	Apodiformes		
	Apodidae		
26. Asian Palm Swift	*Cypsiurus balasiensis*		
27. Fork-tailed Swift	*Apus pacificus*		

Common Name	Order, Family, Genus and Species	Endemic Species	Collar *et al*. 1994
	Strigiformes		
	Strigidae		
28. Mountain Scops Owl	*Otus spilocephalus*		
29. Collared Scops Owl	*O. bakkamoena*		
30. Brown Wood Owl	*Strix leptogrammica*		
31. Collared Owlet	*Glaucidium brodiei*		
	Columbiformes		
	Columbidae		
32. Oriental Turtle Dove	*Streptopelia orientalis*		
33. Spotted Dove	*S. chinensis*		
34. Red Collared Dove	*S. tranquebarica*		
35. Emerald Dove	*Chalcophaps indica*		
36. Thick-billed Green Pigeon	*Treron curvirostra*		
37. Mountain Imperial Pigeon	*Ducula badia*		
	Gruiformes		
	Rallidae		
38. White-breasted Waterhen	*Amaurornis phoenicurus*		
	Ciconiiformes		
	Accipitridae		
39. Crested Serpent Eagle	*Spilornis cheela*		
40. Crested Goshawk	*Accipiter trivirgatus*		
41. Black Eagle	*Ictinaetus malayensis*		
42. Mountain Hawk Eagle	*Spizaetus nipalensis*		
	Ardeidae		
43. Little Egret	*Egretta garzetta*		
44. Little Heron	*Butorides striatus*		
45. Chinese Pond Heron	*Ardeola bacchus*		
46. Cinnamon Bittern	*Ixobrychus cinnamomeus*		
	Passeriformes		
	Pittidae		
47. Blue-rumped Pitta	*Pitta soror*		NT
48. Rusty-naped Pitta	*P. oatesi*		
	Eurylaimidae		
49. Long-tailed Broadbill	*Psarisomus dalhousiae*		
	Irenidae		
50. Asian Fairy Bluebird	*Irena puella*		
51. Blue-winged Leafbird	*Chloropsis cochinchinensis*		
	Laniidae		
52. Long-tailed Shrike	*Lanius schach*		
	Corvidae		
53. White-winged Magpie	*Urocissa whiteheadi*		NT
54. Indochinese Green Magpie	*Cissa hypoleuca*		NT
55. Grey Treepie	*Dendrocitta formosae*		
56. Racket-tailed Treepie	*Crypsirina temia*		
57. Ratchet-tailed Treepie	*Temnurus temnurus*		
58. Large-billed Crow	*Corvus macrorhynchos*		
59. Ashy Woodswallow	*Artamus fuscus*		
60. Large Cuckooshrike	*Coracina macei*		
61. Pied Triller	*Lalage nigra*		

Common Name	Order, Family, Genus and Species	Endemic Species	Collar *et al*. 1994
62. Long-tailed Minivet	*Pericrocotus ethologus*		
63. Scarlet Minivet	*P. flammeus*		
64. White-throated Fantail	*Rhipidura albicollis*		
65. Black Drongo	*Dicrurus macrocercus*		
66. Ashy Drongo	*D. leucophaeus*		
67. Crow-billed Drongo	*D. annectans*		
68. Bronzed Drongo	*D. aeneus*		
69. Greater Racket-tailed Drongo	*D. paradiseus*		
70. Black-naped Monarch	*Hypothymis azurea*		
71. Asian Paradise-flycatcher	*Terpsiphone paradisi*		
72. Common Iora	*Aegithina tiphia*		
73. Great Iora	*A. lafresnayei*		
74. Large Woodshrike	*Tephrodornis gularis*		
	Muscicapidae		
75. Blue Whistling Thrush	*Myophonus caeruleus*		
76. Siberian Thrush	*Zoothera sibirica*		
77. Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*		
78. Oriental Magpie Robin	*Copsychus saularis*		
79. Plumbeous Water Redstart	*Rhyacornis fuliginosus*		
80. Slaty-backed Forktail	*Enicurus schistaceus*		
81. Green Cochoa	*Cochoa viridis*		NT
	Sturnidae		
82. Black-collared Starling	*Sturnus nigricollis*		
83. White-vented Myna	*Acridotheres cinereus*		
84. Crested Myna	*A. cristatellus*		
85. Hill Myna	*Gracula religiosa*		
	Sittidae		
86. Chestnut-bellied Nuthach	*Sitta castanea*		
	Paridae		
87. Sultan Tit	*Melanochlora sultanea*		
	Hirundonidae		
88. Red-rumped Swallow	*Hirundo daurica*		
	Pycnonotidae		
89. Black-crested Bulbul	*Pycnonotus melanicterus*		
90. Red-whiskered Bulbul	*P. jocosus*		
91. Ochraceus Bulbul	*Alophoixus ochraceus*		
92. Ashy Bulbul	*Hemixos flavala*		
93. Black Bulbul	*Hypsipetes leucocephalus*		
	Zosteropidae		
94. Oriental White-eye	*Zosterops palpebrosus*		
	Sylviidae		
95. Grey-bellied Tesia	*Tesia cyaniventer*		
96. Asian Stubtail	*Urosphena squameiceps*		
97. Common Tailorbird	*Orthotomus sutorius*		
98. Dark-necked Tailorbird	*O. atrogularis*		
99. Greenish Warbler	*Phylloscopus trochiloides*		
100. Rufous-faced Warbler	*Abroscopus albogularis*		
101. Yellow-bellied Warbler	*A. superciliaris*		
102. White-crested Laughingthrush	*Garrulax leucolophus*		

Common Name	Order, Family, Genus and Species	Endemic Species	Collar *et al.* 1994
103. Lesser Necklaced Laughingthrush	*G. monileger*		
104. Grey Laughingthrush	*G. maesi*		NT
105. Black-throated Laughingthrush	*G. chinensis*		
106. Buff-breasted Babbler	*Pellorneum tickelli*		
107. Spot-throated Babbler	*P. albiventre*		
108. Scaly-crowned Babbler	*Malacopteron cinereum*		
109. Large Scimitar Babbler	*Pomatorhinus hypoleucos*		
110. Streak-breasted Scimitar Babbler	*P. ruficollis*		
111. Short-tailed Scimitar Babbler	*Jabouillea danjoui*	EL	VU
112. Streaked Wren Babbler	*Napothera brevicaudata*		
113. Eyebrowed Wren Babbler	*N. epilepidota*		
114. Rufous-capped Babbler	*Stachyris ruficeps*		
115. Golden Babbler	*S. chrysaea*		
116. Spot-necked Babbler	*S. striolata*		
117. Striped Tit Babbler	*Macronous gularis*		
118. White-browned Shrike Babbler	*Pteruthius flaviscapis*		
119. White-hooded Babbler	*Gampsorhynchus rufulus*		
120. Rufous-throated Fulvetta	*Alcippe rufogularis*		NT
121. Mountain Fulvetta	*A. peracencis*		
122. White-bellied Yuhina	*Yuhina zantholeuca*		
123. Short-tailed Parrotbill	*Paradoxornis davidianus*		VU
	Nectariniidae		
124. Thick-billed Flowerpecker	*Dicaeum agile*		
125. Plain Flowerpecker	*D. concolor*		
126. Purple-naped Sunbird	*Hypogramma hypogrammicum*		
127. Fork-tailed Sunbird	*Aethopyga christinae*		
128. Crimson Sunbird	*A. siparaja*		
129. Streaked Spiderhunter	*Arachnothera magna*		
	Passeridae		
130. Eurasian Tree Sparrow	*Passer montanus*		
131. Forest Wagtail	*Dendronathus indicus*		
132. White Wagtail	*Motacilla alba*		
133. Yellow Wagtail	*M. flava*		
134. White-rumped Munia	*Lonchura striata*		

Follows Inskipp *et al.* (1996).
Status: VU = Vulnerable; NT = Near-threatened as per Collar *et al.* (1994); EL = Endemic to Vietnam and Laos.

Appendix 4: Herpetiles Recorded in Xuan Lien Proposed Nature Reserve

No.	Class, Order, Family Genus and Species	Xuan My Commune	Bat Mot Commune	Endemic Species	IUCN 1996
	Reptilia				
	Squamata:				
	Gekkonidae				
1	*Gekko gecko*	O	I		
2	*Hemidactylus frenatus*	O	O		
	Agamidae				
3	*Calotes emma*	S			
4	*Physignathus cocincinus*	O			
	Scincidae				
5	*Eumeces* sp.		O		
6	*Lygosoma quadrupes*	S			
7	*Mabuya multifasciata*		S		
8	*M. macularia*	S			
	Lacertidae				
9	*Takydromus sexlineatus*	O			
10	*T. wolteri*	S			
	Varanidae				
11	*Varanus salvator*	O			
	Xenopeltidae				
12	*Xenopeltis unicolor*	I	I		
	Boidae				
13	*Python molutus*	I	I		NT
	Colubridae				
14	*Amphiesma stolata*	O			
15	*A. parallela*	S			
16	*Elaphe radiata*	I	I		
17	*Ptyas korros*	I	O		
18	*P. mucosus*		I		
19	*Rhabdopsis subminiatus*	O	O		
20	*Xenochrophis piscator*	O	O		
21	*Ahaetulla prasina*		S		
22	*Enhydris plumbea*				
	Elapidae				
23	*Bungarus fasciatus*	I	I		
24	*B. multicinctus*	I	I		
25	*Naja naja*	I	I		
26	*Ophiophagus hannah*	I	I		
	Viperidae				
27	*Trimeresurus albolabris*	I	I		
	Testudinata:				
	Platysternidae				
28	*Platysternum megacephalum*		I		DD
	Emydidae				
29	*Cistoclemmys galbinifrons*	I			NT

No.	Class, Order, Family Genus and Species	Xuan My Commune	Bat Mot Commune	Endemic Species	IUCN 1996
30	*Pyxidea mouhoti*	I	I		
31	*Geoemyda spengleri*	O			
	Testudinidae				
32	*Manouria impressa*		O		VU
	Trionychidae				
33	*Palea steindachneri*	I			NT
34	*Pelodiscus sinensis*	I			
	Amphibia				
	Anura:				
	Pelobatidae				
1	*Leptobrachium hasselti*	O			
2	*Megophrys minor* (?)	S			
	Bufonidae				
3	*Bufo galeatus*		I		
4	*B. melanostictus*	O	O		
	Ranidae				
5	*Ooeidozyga lima*		O		
6	*Phrynoglossus laevis*	O			
7	*Rana andersoni*	S	I		
8	*R. guentheri*	I	I		
9	*R. kuhlii*	S	I		
10	*R. limnocharis*	O	O		
11	*R. maosonensis*	S			
12	*R. microlineata*	S	I	EV	
13	*R. ricketti*	S			
14	*R. rugulosa*	I	I		
15	*R. sauteri*				
16	*R.* sp.	S			
	Rhacophoridae				
17	*Rhacophorus leucomystax*	S	O		
	Microhylidae				
18	*Kaloula pulchra*	O			
19	*Microhyla butleri*	S			

Follows Nguyen Van Sang and Ho Thu Cuc (1996).

Notes: VU = Vulnerable; NT = Near-threatened; DD = Data Deficient as per IUCN (1996).

EV = Endemic to Vietnam.

Data Source: S = Specimen; O = Observed; I = Interview

Appendix 5: Butterflies Recorded in Xuan Lien Proposed Nature Reserve

No.	Family, Genus and Species	Range	S1	S2	S3	S4	S5
	Papilionidae						
1.	*Troides aeacus* Feld.	2				r	
2.	*Parides aidoneus* Ddl.	2			r		
3.	*Chilasa clytia* L.	3	r				
4.	*Papilio demoleus* L.	4	c				
5.	*P. helenus* L.	4			f		
6.	*P. alcmenor* Westw.	2				r	
7.	*P. polytes* L.	3	c				
8.	*P. protenor* Cram.	2			r	r	
9.	*P. memnon* L.	3	f				
10.	*P. paris* L.	3	f				
11.	*Graphium chironides* Honr.	3				r	
12.	*G. sarpedon* L.	4	c		f		
13.	*G. agamemnon* L.	4	f		r	r	
14.	*Lamproptera curius* F.	3	c		f	r	
15.	*L. meges* Zinken	3	c		f	r	
	Pieridae						
16.	*Delias acalis* Godart	2				r	
17.	*Prioneris thestylis* Dbl.	2				f	
18.	*Talbotia naganum* Moore	1				f	
19.	*Cepora nadina* Lucas	3				r	
20.	*Appias lyncida* Cram.	3				c	
21.	*Hebomoia glaucippe* L.	3	f		f	f	
22.	*Eurema blanda* Boisd.	3	c		f		f
23.	*E. andersoni* Moore	3	r		r		
24.	*E. ada* Dist. & Preyer	3	r			r	
	Danaidae						
25.	*Danaus genutia* Cram.	4	f			f	
26.	*Tirumala septentrionis* Butl.	4	f			r	
27.	*Parantica aglea* Stoll.	2	c			f	
28.	*P. sita* Koll.	2					r
29.	*Ideopsis vulgaris* Butl.	3				f	
30.	*Euploea core* Cram.	3	f	f			
31.	*E. mulciber* Cram.	3	f				r
32.	*E. radamanthus* F.	3	f	r			
	Satyridae						
33.	*Melanitis leda* L.	5	f	f	f		
34.	*Elymnias casiphone* Fruhst.	3			r		
35.	*E. patna* Westw.	3			r		
36.	*Lethe mekara* Moore	3		f			
37.	*L. europa* F.	3	f				
38.	*L. naga* Doherty	3			r		
39.	*L. syrcis* Hew.	1		c	f		
40.	*Neorina patria* Leech	1			r		
41.	*Ethope noirei* Janet	1		c	f		
42.	*Mycalesis inopia* Fruhst.	1	r				

No.	Family, Genus and Species	Range	S1	S2	S3	S4	S5
43.	*M. perseoides* Moore	3		r	r		
44.	*M. misenus* de Nicev.	1			r		
45.	*M. adamsoni* Watson.	2			r		
46.	*M. deficiens* Fruhst.	2			r		
47.	*M. zonata* Matsumura	2	c	c	c		
48.	*M. anaxias* Hew.	3		c	c		r
49.	*Erites falcipennis* W.-M. & de Nicev.	2			r		
50.	*Coelites nothis* Westw.	2			r		
51.	*Ragadia crisilda* Hew.	2					f
52.	*Ypthima imitans* Elw. & Edw.	1	c				
53.	*Y. baldus* F.	3	c				
54.	*Y.* sp. nov.	1		r	r		
	Amathusiidae						
55.	*Faunis canens* Hubn.	2			f		
56.	*F. eumeus* Drury	2		f	c		c
57.	*Stichophthalma fruhstorferi* Rob.	1				?	
58.	*Thaumantis diores* Dbl.	1					r
59.	*Enispe euthymius sychaeus* Brooks	1			r		
60.	*Discophora sondaica* Boisduv.	3	f				
	Nymphalidae						
61.	*Cethosia cyane* Drury	2		r	r	r	
62.	*Cupha erymanthis* Drury	4				r	
63.	*Vagrans egista* Cram.	4				r	
64.	*Cirrochroa tyche* Feld.	3	r				
65.	*Vindula erota* F.	3				f	
66.	*Vanessa indica* Herbst.	5	r				
67.	*Junonia atlites* L.	3	c			f	
68.	*J. almana* L.	3	c			f	
69.	*Rhinopalpa polynice* Cram.	3				r	
70.	*Hypolimnas bolina* L.	4	f	r			
71.	*Cyrestis thyodamus* Boisd.	3				f	
72.	*Chersonesia risa* Dbl.	3			r	r	
73.	*Neptis clinia* Moore	3	f	r			
74.	*N. nata* Moore (?)	3			r		
75.	*N. hylas* L.	4	f				
76.	*Pantoporia aurelia* Staudinger	3			r		
77.	*P. hordonia* Stoll.	3	r				
78.	*Athyma cama* Moore	3				r	
79.	*A. selenophora* Koll.	3				f	
80.	*Parthenos sylvia* Cram.	4	f				
81.	*Tanaecia julii* Lesson	3	f		c		r
82.	*T. lepidea* Butl.	3	f		r		
83.	*Bassarona iva ?* Moore	2			r		r
84.	*Eulacera osteria* Westw.	3	f				
85.	*Charaxes aristogiton* Feld.	2				r	
86.	*C. bernardus* F.	3				c	
87.	*Polyura athamas* Drury	3				f	
88.	*P. jalisus* Feld.	3				r	
	Riodinidae						
89.	*Zemeros flegyas* Cram.	3	c				

No.	Family, Genus and Species	Range	S1	S2	S3	S4	S5
90.	*Abisara neophron* Hew.	2			r		f
91.	*Paralaxita dora* Fruhst.	1			r		c
92.	*Stiboges nymphidia* Butl.	3			r		
	Lycaenidae						
93.	*Miletus* sp.	?		r		r	
94.	*Megisba malaya* Horsf.	2	f				
95.	*Celatoxia marginata* de Nicev.	3	r				
96.	*Udara dilecta* Moore	3				f	
97.	*Jamides alecto* Feld.	3			f		
98.	*J. virgulatus* Druce	3			r		
99.	*Nacaduba kurava* Moore	3				f	
100.	*Prosotas pia* Toxipeus	3				f	
101.	*Pithecops corvus* Fruhst.	3			r		r
102.	*Arhopala ammonides* Doherty	2			r		
103.	*A.* sp. 1	3?			r		
104.	*A.* sp. 2	3?			r		
105.	*Spindasis syama* Horsf.	3	c				
106.	*S. lohita* Horsf.	3				f	
107.	*Yasoda tripunctata* Hew.	2			f		f
108.	*Rapala pheretima* Hew.	3		r			
109.	*Zeltus amasa* Hew.	3	f				
110.	*Hypolycaena erylus* Godart	3	f			f	
111.	*Curetis bulis* Westw.	3	r				
	Hesperiidae						
112.	*Hasora badra* Moore	3				f	
113.	*Badamia exclamationis* F.	3	r				
114.	*Celaenorrhinus inaequalis* Elw. & Edw.	2	r				
115.	*C. vietnamicus* Dev.	1	f	f			
116.	*Tagiades gana* Moore	3					r
117.	*T. menaka* Moore	3					r
118.	*Mooreana trichoneura* Feld.	3		r	r		
119.	*Astictopterus jama* Feld.	3	r	r			
120.	*Sebastonyma dolopia* Hew.	2				r	
121.	*Suada swerga* de Nicev.	3	f				
122.	*Halpe zola* Evans	3	f			f	
123.	*H. nephele* Leech (cf. *frontieri*)	1	r				
124.	*Iambrix salsala* Moore	3	c	r			
125.	*Ancistroides nigrita* Latreille	3	r				
126.	*Koruthaialos rubecula hector* Wts.	3	r	r			
127.	*K. sindu* Feld.	3	r	r			
128.	*Notocrypta curvifascia* Feld.	3			f		
129.	*N. feistamelii* Boisd.	3	f				f
130.	*N. paralysos* W.-M. & de Nicev.	3	f				
131.	*Matapa cresta* Evans	3	r				
132.	*M. druna* Moore	3	r				
133.	*Scobura cephala* Hew.	2	r				
134.	*S. phiditia* Hew.	2	f				
135.	*S. woolletti* Riley	3	f				
136.	*Erionota thrax* L.	3				r	
137.	*Unkana ambassa* Moore	2				r	

No.	Family, Genus and Species	Range	S1	S2	S3	S4	S5
138.	*Cephrenas acalle oceanica*	3	f				
139.	*Telicota* sp. 1	?	?				
140.	*T.* sp. 2	?			?		
141.	*Parnara ganga* Evans	3	r				
142.	*Baoris farri* Moore	3	f				
143.	*Iton semamora* Moore	3	f				

Global Range: 1 - East Himalayas (Nepal, Assam, Sikkim, N Burma, Yunnan, SW China, N Indochina);
2 - Indochina to India;
3 - Oriental region;
4 - Indo-Australian tropics;
5 - Cosmopolitan.

Study Sites: S1 - Grassland and scrub 150 to 300 m a.s.l.;
S2 - Pure bamboo forest 300 to 400 m a.s.l.;
S3 - Regenerating forest 400 to 900 m a.s.l.;
S4 - Rivers and streams 300 to 400 m a.s.l.;
S5 - Primary forest 1,200 to 1,500 m a.s.l.

Species occurrence is divided into three categories:
r - rare (single or two specimens encountered);
u - frequent (~10 specimens seen);
c - common (up to 20 specimens seen).

BirdLife International is a global conservation federation with a worldwide network of Partner organizations, Representatives and committed individuals.

BirdLife International seeks to conserve all bird species on earth and their habitats and, through this, it works for the world's biological diversity. It recognizes that the problems affecting birds, their habitats and our global environment are linked inseparably with social, economic and cultural factors and that these can only be resolved if human societies function in an ecologically sustainable manner and if the needs, welfare and aspirations of people form a part of all conservation action.

Birds provide BirdLife International with a uniquely valuable focus: they are sensitive indicators of biological richness and environmental trends and fulfil many key ecological functions; they contribute greatly to our understanding of natural processes; they are an important economic resource; and they have inspired and delighted people of many cultures for centuries, which makes them excellent ambassadors for the promotion of conservation awareness and international collaboration.

BirdLife International pursues a programme of:

* scientific research and analysis to identify and monitor worldwide the most threatened bird species and the most critical sites for the conservation of bird diversity;

* advocacy and policy development to promote the conservation of birds and biodiversity through sustainability in the use of all natural resources;

* field action and country conservation programmes, ranging from community-based land-use and management projects to species recovery programmes benefiting both wildlife and people;

* network and capacity building to expand and strengthen the global partnership of conservation organizations and to promote worldwide interest in the conservation of birds and the wider environment.

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