

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

**A Feasibility Study for the Establishment of
Phong Dien (Thua Thien Hue Province)
and
Dakrong (Quang Tri Province)
Nature Reserves, Vietnam**

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A Feasibility Study for the Establishment of
Phong Dien (Thua Thien Hue Province)
and
Dakrong (Quang Tri Province)
Nature Reserves, Vietnam

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This is a technical report for the project entitled:
Expanding the Protected Areas Network in Vietnam for the 21st Century.

Hanoi, May 1999

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Cover Illustration: Edwards's Pheasant *Lophura edwardsi*
By R. David Digby from Hennache (1997)

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Conventions Used

Plant names (common and scientific), sequence and species limits follow Pham Hoang Ho (1991), with scientific names given at first mention and in Appendix 1. 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 and butterfly names (common and scientific), sequence and species limits follow Nguyen Van Sang and Ho Thu Cuc (1996) and Corbet *et al.* (1992), respectively, with scientific names given at first mention and in Appendices 4 and 5.

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 (1993).

A red-listed species is any species included in the IUCN Red Lists of Threatened Animals and Plants (IUCN 1996 and 1997) or in the Red Data Books of Vietnam (Anon. 1992 and 1996).

Endemic Bird Areas refer to locales supporting at least two restricted range species. A restricted range species is a bird species with a global range of less than 50,000 km².

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

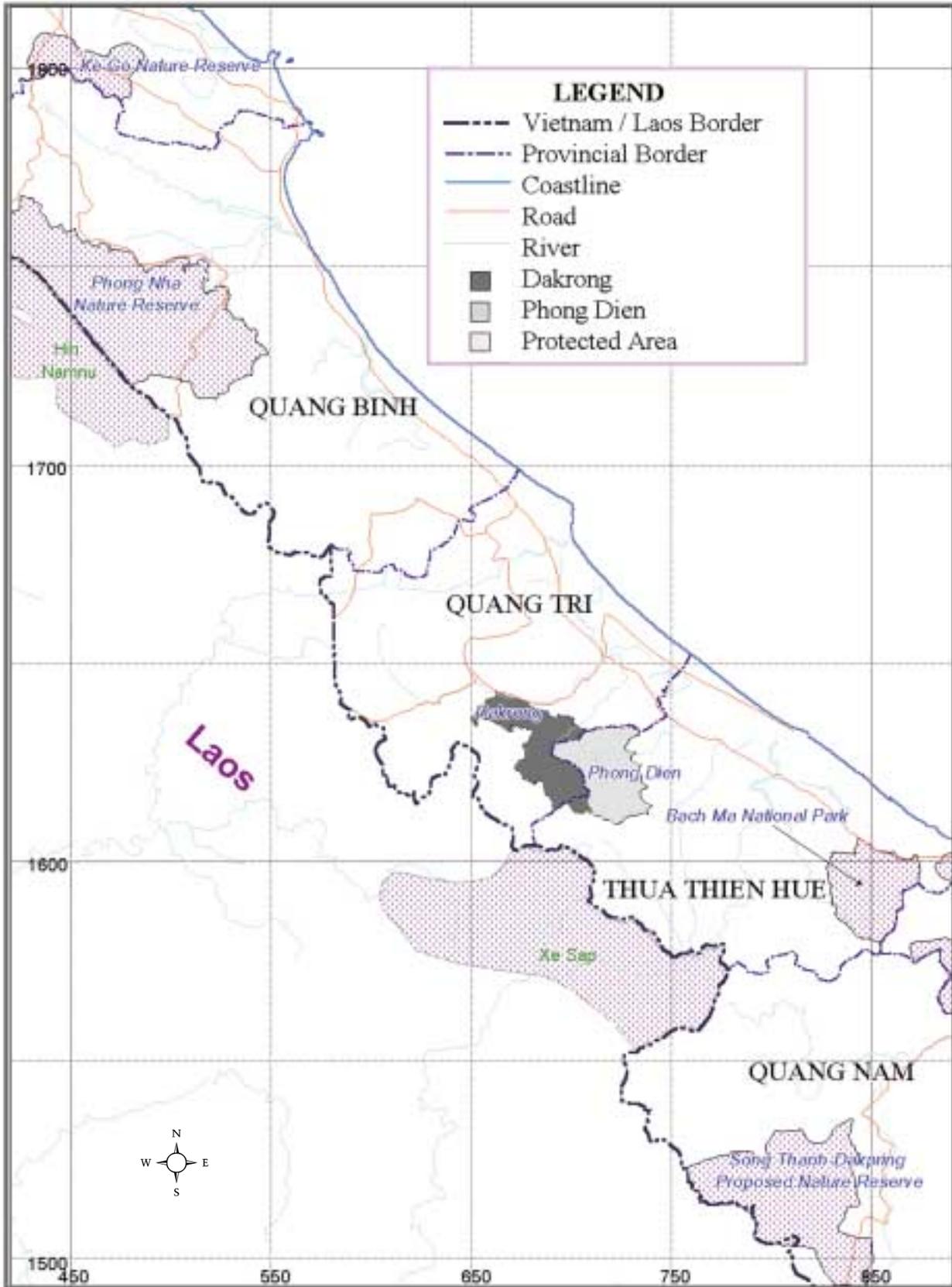
The Study Area refers to Phong Dien and Dakrong Watershed Protection Forests of Thua Thien Hue and Quang Tri Provinces, respectively.

Abbreviations and Acronyms Used

CITES	-	Convention on International Trade in Endangered Species
EBA	-	Endemic Bird Area
EU	-	European Union
FIPI	-	Forest Inventory and Planning Institute, Hanoi
GNP	-	Gross National Product
ICBP	-	International Council for Bird Preservation
IUCN	-	World Conservation Union
MARD	-	Ministry of Agriculture and Rural Development
MOF	-	Ministry of Forestry (now part of MARD)
NGO	-	Non-Governmental Organisation
WPF	-	Watershed Protection Forest
WWF	-	World Wide Fund for Nature



Map1: Location of Phong Dien and Dakrong Proposed Nature Reserves



Grid: UTM, zone 48
Horizontal Datum: India 1960

SCALE 1:2,000,000

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Executive Summary

In June and July 1998, BirdLife International worked in collaboration with the Forest Inventory and Planning Institute (Hanoi) to assess the feasibility of upgrading Phong Dien and Dakrong Watershed Protection Forests to Nature Reserve status. This feasibility study, funded by the European Union and BirdLife International, was part of the government's commitment to increase Vietnam's protected area coverage to 2 million hectares by the year 2000.

In 1992, BirdLife International conducted a world-wide survey which identified 221 centres of bird endemism. Bird endemism is believed to be a good indicator of an area's overall biodiversity. The Annamese Lowlands of central Vietnam is one of three Endemic Bird Areas (EBAs) in Vietnam.

Phong Dien and Dakrong Districts, of Thua Thien Hue and Quang Tri provinces, central Vietnam are located in the southern part the Annamese Lowlands EBA, and enclose the largest remaining area of evergreen and semi-evergreen lowland forest (below 1,000 m).

Lowland forest was once distributed throughout the coastal lowlands and foothills of central Vietnam. The forest area has been significantly reduced by human exploitation and the defoliation of vast tracts in Quang Tri and Thua Thien Hue provinces during the American-Vietnamese War. Only a small fraction of this once-extensive forest type now remains.

The best extant example of lowland forest within the Annamese Lowlands EBA is in northern Phong Dien district and southern Dakrong district. An effort at protection was made in 1993, when these areas were designated as Watershed Protection Forests (WPFs) but, in reality, this classification protects the forests from little more than commercial logging.

This study analysed the feasibility of upgrading these WPFs to two separate but contiguous nature reserves. The proposed Phong Dien Nature Reserve would cover 34,406 ha, and the proposed Dakrong Nature Reserve would cover 35,072 ha. Combined, they would constitute the largest protected area in the Annamese Lowlands EBA.

To better assess the value of conserving the area, a preliminary inventory of the area's flora and fauna was conducted. The inventory revealed that the proposed nature reserves are home to a number of endemic and threatened species. Two of the most recently discovered large mammal species in the world (Sao La and Giant Muntjac) both occur in the area. Edwards's Pheasant, thought to be extinct for 67 years, was rediscovered in the area; Phong Dien and Dakrong WPFs are believed to comprise the last remaining refuge of this critically endangered species.

Phong Dien and Dakrong WPFs Fauna and Flora

Group	Number of Species	% Red-listed
Mammals	43	53%
Birds	171	13%
Reptiles	38	42%
Amphibians	19	21%
Plants	597	3%

Listed in either the IUCN Red Lists (IUCN 1996 and 1997) or the Red Data Books of Vietnam (Anon. 1992 and 1996).

To further assess the merits of protecting the area, local butterfly species were identified. Butterflies have well-documented niche separation and consume a wide variety of species-specific food. Thus the number of butterfly species and their distribution is an indicator of habitat diversity. The high number of butterfly species found in the area further suggests that it supports diverse habitats.

Besides protecting the largest remnants of lowland forest in central Vietnam, a number of endangered species (especially Edwards's pheasant) and an area with high overall biodiversity, the proposed nature

reserves would aim to restrict the non-sustainable use of forest resources, improve flood and erosion control, establish buffer zones, and provide a number of jobs for local people. The nature reserves could also be linked to several other conservation areas by wildlife corridors. Moreover, the area compares favourably with other protected areas in Vietnam for both biodiversity and endemic species in need of conservation. In short, the conservation value of the area is high.

Creating viable nature reserves, however, will not be easy. While there are no people known to be living inside the area (as of July 1998), approximately 31,000 live in Phong Dien and Dakrong districts of which several thousand live near the proposed nature reserves' boundaries. Small-scale cutting of timber inside the area is widespread, and many of the locals use the forests for hunting and gathering. Slash-and-burn agriculture is still practised in the area, and there are six agricultural sites within the proposed protected area.

The study made several recommendations to address these problems including:

- reorienting the government's on-going agroforestry programme towards the establishment of silviculture areas (using native species) as buffer zones; and
- hiring, training and equipping a number of local people to act as guards for the nature reserves.

There are also problems with the boundaries of the proposed area itself. Several important conservation areas are not included. The proposed southern border, for example, bisects a large section of primary forest and, unless the entire forest is included, a valuable corridor to other protected areas (particularly Bach Ma National Park) will be lost. This study recommends that five such areas are included in the proposed nature reserves.

The overall recommended management objectives for the protected area are to:

- conserve the largest remnants of lowland forest in central Vietnam; and
- protect the area's populations of endangered and endemic species, especially Edwards's Pheasant.

Recommended next steps include:

- conducting assessments of the five areas recommended for inclusion in the protected areas;
- seeking funding and approval for the proposed Nature Reserves from the Ministry of Agriculture and Rural Development and the Ministry of Investment and Planning; and
- conducting more detailed socio-economic and forestry studies of the communities near the proposed protected areas.

Tóm Tắt Quá Trình Thực Hiện

Từ tháng 6 đến tháng 7 năm 1998, tổ chức BirdLife International phối hợp với Viện Điều tra Quy hoạch Rừng (Hà Nội) đánh giá tính khả thi để nâng cấp khu rừng phòng hộ Phong Điền, Đăkrông thành khu bảo tồn thiên nhiên. Cộng đồng Châu Âu và tổ chức BirdLife International đã tài trợ cho việc nghiên cứu tính khả thi và đây cũng là mục tiêu của Chính Phủ nhằm tăng diện tích các khu rừng đặc dụng ở Việt Nam lên tới 2 triệu ha vào năm 2000.

Năm 1992, tổ chức BirdLife International đã tiến hành khảo sát trên toàn thế giới và xác định được 221 trung tâm chim đặc hữu. “Chim đặc hữu” được coi là một chỉ thị tốt cho tính đa dạng sinh học toàn vùng. Vùng rừng núi thấp miền Trung là một trong 3 vùng chim đặc hữu ở Việt Nam.

Huyện Phong Điền và Đăkrông thuộc 2 tỉnh Thừa Thiên Huế, Quảng Trị nằm trong phần phía nam của vùng Chim đặc hữu Việt Nam và liền kề với khu vực rừng thường xanh, nửa rụng lá trên vùng núi thấp (độ cao < 1.000m).

Rừng núi thấp được phân bố trên toàn bộ khu vực đất ven biển của miền Trung Việt Nam. Diện tích rừng đã bị suy giảm đáng kể do sự khai tác và chất độc hóa học làm rụng lá trong suốt cuộc chiến tranh chống Mỹ. Ngày nay chỉ còn tồn tại một phần nhỏ của kiểu rừng này.

Tại phía bắc của huyện Phong Điền và nam huyện Đăkrông còn một dẫn chứng điển hình nhất cho khu vực chim đặc hữu ở vùng núi thấp Việt Nam. Năm 1993 khu vực này được quyết định trở thành khu rừng phòng hộ đầu nguồn, nhưng trên thực tế, việc khai thác gỗ cho mục đích thương mại vẫn thường xảy ra.

Trong đợt nghiên cứu này, chúng tôi đã phân tích tính khả thi để nâng cấp khu rừng phòng hộ đầu nguồn thành 2 khu bảo tồn thiên nhiên riêng biệt và liền kề nhau. Dự kiến khu bảo tồn thiên nhiên Phong Điền sẽ là 34,406 ha và khu bảo tồn thiên nhiên Đăkrông 35,027ha.

Kết hợp 2 khu này lại sẽ thành khu bảo tồn lớn nhất của loại hình rừng trên núi thấp. Công việc điều tra sơ bộ về động, thực vật đã được tiến hành để đánh giá giá trị của khu bảo tồn được tốt hơn. Qua đó cho thấy Khu bảo tồn thiên nhiên đề xuất là nơi cư ngụ của một số loài đặc hữu và đang có nguy cơ bị đe dọa. Hai trong số những loài thú lớn mới được phát hiện trên thế giới (Sao La và Mang Lớn) được tìm thấy ở đây. Gà lôi lam mào trắng đã được phát hiện lại ở khu vực này sau 67 năm vắng bóng. Rừng phòng hộ đầu nguồn Phong Điền, Đăkrông chắc chắn sẽ là nơi ẩn náu còn lại cuối cùng của những loài đang nguy cấp trên.

Động thực vật của Khu rừng phòng hộ đầu nguồn Phong Điền và Đăkrông

Nhóm	Số loài	% theo sách đỏ
Thú	43	56%
Chim	171	13%
Bò sát	38	42%
Lưỡng cư	19	21%
Thực vật	597	3%

Để đánh giá sâu hơn nữa giá trị của khu vực này, một số loài bướm bản địa đã được xác định. Bướm đã được ghi nhận là có sự phân cách về chỗ ở và tiêu thụ một diện rộng các



loại thức ăn đặc thù. Chính số lượng các loài bướm và sự phân bố của chúng là một chỉ thị cho tính đa dạng sinh cảnh. Với số lượng các loài bướm tìm được ở đây đã khẳng định thêm sự phong phú về sinh cảnh sống.

Bên cạnh việc bảo vệ phần còn lại rộng nhất của vùng rừng núi thấp Việt Nam, một số các loài đang có nguy cơ tuyệt chủng (đặc biệt Gà Lôi Lam Mào Trắng) và một vùng có tính đa dạng sinh học cao thì khu bảo tồn dự kiến còn nhắm tới việc hạn chế sử dụng không bền vững nguồn tài nguyên rừng, kiểm soát xói mòn, hạn chế lũ lụt, thiết lập vùng đệm và tạo việc làm cho người dân địa phương. Khu bảo tồn cũng nối với các khu bảo tồn thiên nhiên khác tạo ra những hành lang cho động vật hoang dã. Hơn thế nữa, khi so sánh với các vùng bảo vệ khác ở Việt Nam thì khu vực này cần bảo vệ cả tính đa dạng sinh học lẫn các loài đặc hữu. Tóm lại, giá trị bảo tồn ở đây rất cao.

Việc thành lập một khu bảo tồn thiên nhiên là có thể thực hiện được nhưng không phải dễ dàng. Cho đến tháng 7 năm 1998 thì không có dân sống bên trong khu vực đề xuất xây dựng khu bảo tồn. Dân số của 2 huyện Phong Điền và Đăkrông khoảng 31,000 người, trong số đó có vài nghìn người sống gần ranh rới khu bảo tồn. Vấn đề khai thác gỗ trên qui mô nhỏ đang lan rộng toàn khu vực, đồng thời việc săn bắn, đốt rừng làm nương rẫy vẫn đang diễn ra và có 6 điểm canh tác nông nghiệp tồn tại bên trong khu dự kiến.

Một số đề xuất nhằm giải quyết các vấn đề trên:

- Chính Phủ cần hướng tới các giải pháp nông lâm kết hợp, thành lập các vùng lâm nghiệp (sử dụng loài cây bản địa) như là vùng đệm.
- Tuyển dụng người dân địa phương huấn luyện, trang bị cho họ làm công tác bảo vệ.

Bản thân khu đề xuất cũng có những vấn đề về ranh giới. Một số vùng quan trọng cần được bảo vệ thì không được qui hoạch trong khu bảo tồn; ví dụ như biên giới phía nam của khu đề xuất lại chia cắt khu rừng nguyên sinh mà đây là hành lang có giá trị nối liền với các khu bảo tồn khác (đặc biệt là Vườn Quốc Gia Bạch Mã) sẽ bị mất đi. Chương trình nghiên cứu cũng gợi mở ra 4 vùng khác nằm trong khu đề xuất.

Các mục đích quản lý gợi mở cho vùng được bảo vệ nhằm:

- Bảo vệ một vùng rừng núi thấp lớn nhất hiện còn ở Việt Nam
- Bảo vệ quần thể các loài đặc hữu nguy cấp trong vùng, đặc biệt là Gà Lôi Lam Mào Trắng

Các bước tiếp theo bao gồm:

- Tiến hành đánh giá 5 vùng đã được nêu lên trong khu vực bảo vệ
- Tìm nguồn kinh phí và đề xuất lên Bộ Nông nghiệp và Phát triển nông thôn, Bộ Kế hoạch và Đầu tư.
- Tiến hành điều tra chi tiết dân sinh kinh tế, xã hội tại khu vực gần kề khu đề xuất bảo vệ.



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°0.5' 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 km². 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 caused an 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 forests 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 Forest.** 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 Forest (WPF)**. 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 Forest (Protected Area)**. 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 the country 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 establish 2,000,000 ha of protected areas by the year 2000, thereby doubling the 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 Lowland Forest in Central Vietnam

The natural vegetation of central Vietnam is tropical lowland evergreen and semi-evergreen rainforest below 1,000 m, with tropical montane rainforest above this altitude (Stattersfield *et al.* 1998). In central Vietnam, forests were originally distributed throughout the coastal lowlands and foothills. The coastal lowlands were almost completely deforested prior to 1945. Existing remnants are now confined to the foothills of central Vietnam, extending from Nghe An province to Thua Thien Hue province, and, apparently, into adjacent areas in central Laos (Stattersfield *et al.* 1998). Five of Vietnam's central provinces have lowland forest remnants: Nghe An; Thua Thien Hue; Quang Tri; Quang Binh; and Ha Tinh.

The forests in Phong Dien district, Thua Thien Hue province and Dakrong district, Quang Tri province represent some of the largest remaining tracts of lowland forest in central Vietnam.

Current Conservation Status. Lowland forests in central Vietnam are under-represented in the 'Special-Use Forest' system. Moreover, these forests are suffering from intensive deforestation and hunting pressure. Large areas of land adjacent to the remaining tracts of lowland forests are degraded, and are now undergoing regeneration and recovery from extensive chemical defoliation during the war.

Within the provinces in central Vietnam containing lowland forest, there are seven protected areas in which previous feasibility studies have been conducted. These 'Special-Use Forests' are located in the



following provinces:

- Nghe An (Pu Mat Nature Reserve and two proposed nature reserves at Pu Huong and Pu Hoat);
- Ha Tinh (Vu Quang and Ke Go Nature Reserves);
- Quang Binh (Phong Nha Nature Reserve); and
- Thua Thien Hue (Bach Ma National Park).

1.4 Global Conservation Significance

Initial surveys conducted by BirdLife International identified 221 centres of bird endemism worldwide, termed Endemic Bird Areas (EBAs) (ICBP 1992). Three EBAs were identified in Vietnam: Da Lat Plateau in the Western Highlands; the South Vietnamese Lowlands; and the Annamese Lowlands in central Vietnam (ICBP 1992, Stattersfield *et al.* 1998).

Bird endemism is believed to be a good indicator of overall biodiversity. Thus, areas found to be foci of endemic birds should be assessed by conservation planners for inclusion in protected-area systems, as such areas often provide the most comprehensive conservation coverage (Eames *et al.* 1994).

The lowland forests in central Vietnam were first surveyed because they are known to have suffered major habitat loss, and to support little-known and endangered species. Specialists from BirdLife and several Vietnamese institutions conducted surveys for known restricted-range and endemic bird species in 1988, 1991 and 1992 (Eames *et al.* 1989, 1992 and 1994, Lambert *et al.* 1994), and again in June and July 1998 (for this report).

Rediscovery of Edwards's Pheasant *Lophura edwardsi*. Of particular importance during these surveys was the search for Edwards's Pheasant. Initially described by Oustalet in 1896, Edwards's Pheasant had not been recorded since 1929 (Eve 1997). Unfortunately, field surveys in 1988, 1991, 1992 and 1994 failed to find Edwards's Pheasant. These field studies concluded that all the historical collecting sites for the pheasant had been deforested (Eames *et al.* 1992).

Following up on incidental sightings and descriptions by local hunters, a subsequent attempt to determine whether Edwards's Pheasant was still extant was made in Thua Thien Hue and Quang Nam-Da Nang provinces. In 1996, Edwards's Pheasant was rediscovered in Phong My commune of Thua Thien Hue province and in Huong Hoa commune of Quang Tri province (Eve 1997, Vo Quy 1997).

The rediscovery of Edwards's Pheasant, 67 years after its last documented sighting, significantly added to the conservation importance of these forests and provided the impetus for this survey. Edwards's Pheasant is one of three endemic *Lophura* pheasant species endemic to the Annamese Lowlands EBA. The only known population of Edwards's Pheasant is within the remnant forests in Dakrong and Phong Dien districts.

Recently Described of New Mammal Species. Lowland forests in central Vietnam are also significant for endemic mammals, particularly Sao La *Pseudoryx nghetinhensis*, which was discovered in 1992 (Vu Van Dung *et al.* 1993), and Giant Muntjac *Megamuntiacus vuquangensis*, which was discovered in 1994 (Do Tuoc *et al.* 1994). Both discoveries represent previously undescribed genera.

1.5 Environmental History of the Area

Interest in the fauna of central Vietnam (known as Annam under the French colonial administration) was piqued as early as 1923. Interest in the area stemmed from four pheasant skins sent to the Paris



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Natural History Museum which had been collected in Quang Tri province 27 years previously, in 1896, by a French missionary, Reverend Father Renauld (Eve 1997).

Delacour organised seven expeditions to French Indochina between 1923 and 1939, including trips to Quang Tri and Thua Thien Hue provinces, during which at least 64 specimens of Edwards's Pheasant were collected (Eve 1997). In 1925, Delacour officially requested that the colonial administration establish a 50,000 ha national park solely for the protection of Edwards's Pheasant (de Clermont *et al.* 1925 cited in Eve 1997).

The study area borders the demilitarised zone of the American-Vietnamese War. Intensive use of defoliants left vast areas near the 17th Parallel denuded of forest. Land mines and other unexploded ordinance are also legacies of the war.

Prior to 1993, the contiguous WPFs in Phong Dien and Dakrong districts were classified as 'Production Forests' and, as such, were the site of logging enterprises administered by the Provincial Forestry Departments. The value of preserving these areas as water catchments was recognised, and a proposal was submitted to the government for upgrading to WPF status in 1992. The two provincial governments managed, despite limited funds, to upgrade these two forests to WPF status in 1993.

1.6 Management Authority

The Ministry of Agriculture and Rural Development (MARD) has proposed to the government of Vietnam that these two WPFs now be upgraded to 'Special-Use Forests', in the form of two contiguous nature reserves. The agencies in charge of management and protection of these two WPFs are the Provincial Forest Protection Departments of Thua Thien Hue and Quang Tri provinces. In Vietnam, all forested and cultivated lands are possessions of the State.

Inclusion in Vietnam's network of 'Special-Use Forests' would necessitate transfer of management responsibility to the Forest Protection Department within MARD. Protection of all 'Special-Use Forests' and 'Protection Forests' is co-ordinated by this national-level department. All other areas are managed by province-level Forest Protection Departments (MOF 1991a). However, the management responsibility for and administration of nature reserves is undertaken, in most instances, at the provincial level.



2. Site Features

2.1 Biogeography

The proposed nature reserves are situated within the northern Vietnam coastal moist forests, the Annamite range moist forests, and Bolocars Kon Tum montane forests ecoregions (Wikramaratnayake *et al.* 1997).

The bio-unit of central Vietnam is characterised by high levels of distinctiveness and endemism (Stattersfield *et al.* 1998, Dang Huy Huynh 1998, MacKinnon 1996). This area is peculiar for its overlapping northern and southern faunas, as well as for high levels of endemism. The study area of Phong Dien and Dakrong WPFs is located at the southern limit of the Annamese Lowlands EBA.

2.2 Location

The proposed Phong Dien and Dakrong Nature Reserves are located within Thua Thien Hue and Quang Tri provinces, respectively. These adjacent proposed nature reserves are located approximately 40 km north-west of Hue city and 50 km south-east of Dong Ha town. The two are bordered by Hai Lang district to the north, the Dakrong River to the west, and A Luoi district to the south.

Phong Dien WPF. Phong Dien WPF includes three communes: Phong My, Phong Xuan and Phong Son: all located in Phong Dien district of western Thua Thien Hue province.

The current WPF is approximately 18 km west of National Highway 1. It lies within the water catchment basins of the My Chanh and O Lau Rivers. The WPF borders A Luoi district to the south and Quang Tri province to the west. The study area extends from 16°21'06" to 16°34'11" N, and from 107°01'28" to 107°17'30" E.

Dakrong WPF. Dakrong WPF is located in nine communes: Ba Long; Hai Phuc; Trieu Nguyen; Ta Long; Ta Rut; Dakrong; Mo O; Hong Thuy; and Huc Nghi; all located in Dakrong district of Quang Tri province.

The WPF is in the catchment basin of the Quang Tri and Thach Han (also known as Dakrong) Rivers. The WPF borders A Luoi district to the south, the Dakrong River to the west, Phong Dien district in Thua Thien Hue province to the east and Hai Lang district to the north. Dakrong WPF extends from 16°23'09" to 16°39'16" N, and from 107°10'33" to 107°57'14" E.

Access Roads. In Dakrong Proposed Nature Reserve, a secondary road runs parallel to the proposed nature reserve's north-western boundary, bisecting Ba Long and Ta Long communes. A second, unsurfaced, road follows the proposed nature reserve's western boundary.

Phong Dien Proposed Nature Reserve has no roads within its boundary. However, National Highway 1 does come within 1 km of the proposed nature reserve's eastern boundary.

2.3 Topography

The topography of the study areas is largely low mountains at the southern end of the Annamite range, extending from north-west to south-east, and forming the boundary between Quang Tri and Thua Thien Hue provinces. The WPFs include the foothills and lower water catchment basins of several mountain summits: Coc Lepar (1,408 m), Ca Cut (1,405 m), Coc Muen (1,298 m) and Coc Ton Blai



(1,157 m). Two cave systems are also found within the area: the A Pong Cave (1,077 m); and the Che Cave (815 m).

The north-eastern sections of the area are predominantly low-lying hills and stream basins and are comparatively flat. The southern and western sections are more mountainous in the upstream or highest river catchments.

2.4 Hydrology

In this area of central Vietnam, the foothills extend to the coastline, and the coastal plain is compressed or non-existent. As a result of the coastal topography and extreme seasonality in rainfall, rivers in this region are often short and narrow, with small catchment basins. Predominant flow direction is east or north-east towards the sea.

The principal river systems in this area are the:

- (a) **O Lau and My Chanh River Systems.** Located to the south and south-east of the study area. These two short river catchment basins originate within the study area and are the tertiary watercourses protected by the designated WPFs;
- (b) **Bo River Basin.** This tertiary watercourse is located in the south-east of the proposed nature reserves. Primary and secondary streams, many originating within the WPFs, flow into the Bo River;
- (c) **Quang Tri and Thach Han River Basins.** Located in the north of the study area, the Quang Tri and Thach Han River systems are the tertiary waterways which receive western mountain catchments of the Annamite mountain range. The Quang Tri River emerges at the confluence of the eastern flow of the Thach Han River and the northern flow of the Dakrong River; and
- (d) **Dakrong River System.** Located along the proposed nature reserves' western border, the Dakrong River receives several smaller catchments originating in the WPFs. The Dakrong-Thach Han confluence in Huong Hoa commune is near the north-western boundary of the proposed nature reserves.

Many of the primary and secondary springs, rivulets, creeks and streams are ephemeral as a result of seasonal droughts, localised rainfall patterns and low retention in degraded upper water catchments.

There are large temporal variations in water flow from the WPFs. While the average annual flow rate from these areas is $70 \text{ m}^3/\text{km}^2/\text{s}$, the flow rate during the rainy season is $150 \text{ m}^3/\text{km}^2/\text{s}$ and during the dry season $25 \text{ m}^3/\text{km}^2/\text{s}$. As an example of typical variation in flow rates in the region, the O Lau River's average maximum and minimum flow rates are $440 \text{ m}^3/\text{km}^2/\text{s}$ and $2.5 \text{ m}^3/\text{km}^2/\text{s}$. Heavy rainfall can result in flash floods and extensive erosion.

2.5 Geomorphology

The study area is situated within the Viet-Lao Caledon enfolded syncline of central Vietnam. This syncline is confined between the lines of the Ma River fault to the north and the Tam Ky-Hiep Duc fault to the south. This syncline complex developed from the Cambrian Period to the beginning of the Devonian Period.



Most of the mountains are composed of granite which is common in the region. Lower mountains are composed of sedimentary rocks from the Ordovician-Silurian Age, including hyaline rock, stratified arenaceous rock, stratified sandstone, and argillaceous rock.

2.6 Pedology

In Phong Dien and Dakrong WPFs, the following soils are typical:

- (a) **Hills:** yellow feralite soils developed on sedimentary rocks;
- (b) **Lower Mountains and Hills:** red/yellow feralite soils developed on sedimentary rocks, with fine soil composition;
- (c) **Low Mountains:** yellow feralite soils developed on effusive acid rock;
- (d) **Mid-high Mountains:** yellow and red alpine humus and feralite soils developed on sedimentary rock, with rude soil composition, or yellow and red alpine humus developed on effusive acid rock; and
- (e) **Basins and River Washes:** river and stream alluvium.

2.7 Meteorology

Vietnam's central region is characterised by distinct tropical wet and dry seasons, variable winter and summer temperatures, and eastern tropical monsoons. The influence of the eastern monsoon in central Vietnam is experienced slightly later than in northern regions, with the typhoon season extending southward to central Vietnam during the months of September and October.

Temperature. The average annual temperature ranges from 22 to 24°C in the study area. Winters are cold and humid, due to north-easterly winds. In the highlands (over 400-500 m), average winter temperatures drop below 20°C and, during December and January, the average temperature can drop below 10°C.

In contrast, the summer westerly winds are hot and dry. Over a three to four month period (from May to August) the average temperature is over 25°C. The hottest months of the year are usually June and July with an average temperature of 29°C. Peak temperatures can reach 39-40°C.

Precipitation and Humidity. The Dakrong and Phong Dien areas experience high rainfall, averaging 2,500-3,000 mm per annum.

Cloud formations borne by north-easterly winds are often dispersed as they cross the Annamite Mountains, resulting in localised rainfall patterns. September and October have the highest rainfall and account for up to 45 % of the total annual rainfall. The dry season usually begins in February and ends in July.

Relative humidity for this region averages between 85 and 88 %. During the rainy season, relative humidity is commonly 90 %. Minimum relative humidity during the hottest months of the dry season can be below 30 %.

Meteorological data from four regional weather stations are indicative of the prevailing meteorological conditions within the proposed nature reserves (Table 1). Of particular relevance are the data from the Khe Sanh and A Luoi weather stations, which border the proposed protected areas.

Table 1: Central Vietnam Meteorological Data

Meteorological Data	Weather Station			
	Khe Sanh	A Luoi	Quang Tri	Hue
Total annual rainfall (mm)	2,262.0	3,018.2	2,563.8	2,867.7
Highest average monthly rainfall (mm) and month of occurrence	469.6 September	732.0 October	620.5 October	795.6 October
Lowest average monthly rainfall (mm) and month of occurrence	17.3 February	16.4 February	66.2 April	47.1 March
Annual no. of rainy days	161.1	212.4	151.2	157.9
Annual mean temperature (°C)	22.4	21.5	25.0	25.2
Annual no. of sunny hours	—	1,736.3	1,885.7	1,893.6
Absolute high temperature (°C) and month of occurrence	38.2 July	38.1 July	42.0 July	41.3 July
Absolute low temperature (°C) and month of occurrence	7.7 December	4.0 December	9.8 January	8.8 January
Annual humidity (% RH)	87	86	85	84

Source: Department of Statistics (1998)

2.8 Flora Overview

Field surveys in the study area revealed 597 plant species within 366 genera and 118 families (Table 2). Out of these 597 species, there are 175 timber species, 159 known medicinal species and 41 common ornamental species (Appendix 1).

The flora of Phong Dien and Dakrong WPFs shows both high species richness and significant importance as a potential genetic, medicinal and ornamental resource.

Out of the total of 118 plant families, there are 18 families with over 10 species recorded. These are the Euphorbiaceae (with 54 species), Moraceae (27), Rubiaceae (21), Lauraceae (19), Poaceae (19), Asteraceae (15), Fabaceae (15), Cyperaceae (15), Arecaceae (14), Caesalpiniaceae (14), Verbenaceae (14), Orchidaceae (13), Araceae (13), Anacardiaceae (12), Annonaceae (11), Apocynaceae (11), Mimosaceae (11) and Myrtaceae (11).

The floristically dominant families are the Clusiaceae, Annonaceae, Euphorbiaceae, Caesalpiniaceae, Sapotaceae, Myrtaceae, Fagaceae, Lauraceae, Anacardiaceae, Sapindaceae and Moraceae.

Table 2: Plant Species Found in the Study Area

Taxon	Families	Genera	Species
Polypodiophyta	14	17	34
Lycopodiophyta	2	2	4
Pinophyta	2	5	5
Magnoliopsida	88	277	456
Liliopsida	12	65	98
Total	118	366	597

Table 3: Red-book-listed Flora and Current Status

Red-listed Plant Species	Current Status	
	IUCN	Vietnam
<i>Cibotium barometz</i>		R
<i>Dacrydium elatum</i>		K
<i>Nageia wallichiana</i>		V
<i>Cinnamomum parthenoxylon</i>		K
<i>Rhodoleia championii</i>		V
<i>Symplocos disepala</i>	R	
<i>Madhuca pasquieri</i>	R	K
<i>Ardisia silvestris</i>		V
<i>Aquilaria crassna</i>		E
<i>Sindora siamensis</i>		K
<i>S. tonkinensis</i>		V
<i>Gymnocladus angustifolius</i>	R	
<i>Chukrasia tabularis</i>		K
<i>Rauvolfia cambodiana</i>		T
<i>Dendrobium amabile</i>		R
<i>Calamus poilanei</i>	V	K

Notes: E = Endangered; V = Vulnerable; T = Threatened; R = Rare; K = Insufficiently Known as per IUCN (1997) and Anon. (1996).



Five endemic plant species were recorded which have high conservation significance: *Baccaurea silvestris*, *Breynia septata*, *Macaranga eberhardtii*, *Dendrobium amabile* and *Calamus poilanei*. Several unidentified specimens may represent new species records for Vietnam, in particular *Calophyllum* spp.

Of the 597 species recorded, 14 species are listed in the Red Data Book of Vietnam (Anon. 1996) and four species are listed in the IUCN Red List of Threatened Plants (IUCN 1997) (Table 3).

The high diversity within lowland forests in central Vietnam is largely a result of the nexus of four distinct floral biogeographic realms: there are elements of the north-Vietnam-south-China flora group, the Indo-Pacific or Sunda flora group, the Himalayan foothill flora group and the Indo-Malay/India-Burma flora complex.

Lowland forests in central Vietnam have predominant overlapping ranges for characteristic flora of both tropical Indo-Pacific/Sunda and subtropical/temperate China. For example, typical Indo-Pacific/Sunda tropical species, such as *Dipterocarpus kerrii*, are found alongside typical Sino-temperate species, such as *Nageia wallichiana* in the semi-evergreen forests. Other coniferous species, such as *Dacrydium imbricatum*, *Dacrydium elatum* and *Podocarpus neriifolius*, principally allied with the evergreen forests, add a further Sino-subtropical/temperate component.

Other components of the north-Vietnam-south-China flora group include the members of the Fagaceae and Lauraceae, whereas the orders Pinophyta and Lycopodiophyta are characteristic of the Himalayan foothill flora group. The eastern range of the Indo-Malay/Indian-Burma flora complex includes members of the Combretaceae, and species of *Lagerstroemia* and *Tetrameles*.

2.9 Vegetation Types

Although vegetation types were originally classified according to forestry criteria, such as tree size, forest cover, forest degradation and timber value, this classification scheme can also be used to indicate forest successional stages. The forestry scheme of ranking forests as 'Rich', 'Medium' and 'Poor' is implied as indicating primary, mature secondary, and immature secondary forest successional stages, respectively. Applying the forestry ranking scheme as representing early, mid- and late-succession stages was justified on the grounds that the species composition between these forests is highly similar. However, a discrepancy exists in that forests stunted by microclimates, poor soil percolation, hydrology or nutrient depauperate soils are included as immature secondary forest under this classification.

Table 4: Existing Vegetation Types in the Study Area (Ranked)

Vegetation Type	Area (ha)	Percent
Immature Secondary (Poor)	18,998	27.35
Patch (Degraded Forest)	13,690	19.70
Primary (Rich)	12,560	18.08
Mature Secondary (Medium)	8,473	12.20
Scrub (Bushland)	5,983	8.61
Regenerating (Incl. Silviculture)	5,417	7.80
Grasslands	3,740	5.38
Others	616	0.88
Total	69,478	100.00

Forest cover has been considerably reduced, degraded and fragmented throughout most of the WPFs by a combination of logging, shifting cultivation, collection of non-timber forest products and aerial spraying of defoliants. However, not only are the fragments of primary forest relatively large (Table 4) but they are contiguous with most remaining areas of mature secondary forest ([map2](#)).

Primary and Mature Secondary Forest (Rich and Medium Forest)

These two types of lowland forest make up 30 % of the total area of the proposed nature reserves. These



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forests are distributed mainly along the border between Thua Thien Hue and Quang Tri provinces. Disturbance is minimal, the forest structure is dense and largely intact with a very species-rich floral composition.

The structure of primary and mature secondary lowland forest in this EBA generally includes two to three forest stories or layers, as well as a shrub layer and ground cover. Characteristics for each layer are:

- (a) **Emergent Layer.** This is a forest story comprised of emergent tree species >30 m and including *Dracontomelum duperreanum*, *Tétrameles nudiflora*, *Aglaia gigantea* and *Dacrydium elatum*;
- (b) **Closed or Partially-closed Canopy.** This is a complex and continuous forest vegetation layer with foliage between 20 and 30 m and containing the highest species diversity and density. The most common species present belong to the Fagaceae (including *Castanopsis* spp, *Lithocarpus* spp and *Quercus* spp); other species include *Cinnamomum* spp, *Michelia mediocris*, *Rhodoleia championii*, *Calophyllum* spp, *Dacryodes dungii*, *Polyalthia nemoralis*, *Erythrophleum fordii*, *Sindora tonkinensis*, *S. siamensis*, *Madhuca pasquieri* and *Heritiera cochinchinensis*.
- (c) **Open Understory, Shade-tolerant Forest.** This foliage layer is patchy, with common shade-loving plants from the Myrtaceae, Euphorbiaceae, Annonaceae, Ulmaceae, Myristicaceae, Elaeocarpaceae, Ebenaceae, Lauraceae, Rubiaceae, Lecythydaceae, Myrsinaceae and Arecaceae. Immature specimens of tree species common in the canopy layer are well represented in this layer, such as the palm, *Licuala bracteata*.
- (d) **Shrub Layer.** This consists mainly of species in the Myrsinaceae and immature specimens of species represented in both the canopy and open under-story forest layers; and
- (e) **Ground Cover.** This is a sparse vegetation layer, comprised predominantly of grasses (Poaceae) and ferns (Polypodiaceae), as well as some members of the Acanthaceae.

Data from primary and mature secondary forest plots (40 x 40 m) show:

- Average tree height: 15 m
- Average tree diameter (dbh): 24 cm
- Number of trees/ha: 620
- Cross sectional area of timber: 28-30 m²
- Volume of timber: 210-225 m³/ha
- Canopy cover: 50-70 %

Immature Secondary Forest (Poor Forest)

This forest type makes up 27 % of the proposed nature reserves' land area. It is distributed mainly along rivers and streams, and near National Highway 1: all easily accessible and exploitable areas. These forests have been seriously degraded and the forest cover is not contiguous. Canopy cover is only about 10 to 40 % and there is no clear division into forest layers.

Some trees of economic value such as *Erythrophleum* spp., *Sindora siamensis*, *S. tonkinensis*, *Madhuca pasquieri*, *Heritiera cochinchinensis* and *Nageia wallichiana* are now rare; those remaining have broken or diseased timbers. Even trees with low economic value, such as *Polyalthia nemoralis* and *Calophyllum* spp, have been removed. Typical tree species now are *Dacryodes dungii*, *Gironniera subaequalis*, *Sindora circumcissimum*, *Teinostachyum dullooa* and other fast-growing pioneer species.



The shrub layer is comprised of *Licuala bracteata* and immature trees of various species. Despite the disturbed nature of this forest type, regeneration is good, with density of regenerating trees as high as 700-800 trees/ha. The potential for seral succession still appears to be high once further disturbance is halted.

Data from immature secondary forest plots (40 x 40 m) show:

- Average tree height: 13.7 m
- Average tree diameter (dbh): 26.1 cm
- Number of trees/ha: 300
- Cross sectional area of timber: 16 m²
- Volume of timber: 107 m³/ha
- Canopy cover: 10-40 %

Regenerating Forest (Secondary and Cultivated Land Regrowth)

There are two types of forests under regeneration, comprising about 8 % of the study area:

- (a) **Heavily Disturbed, Immature Secondary Growth Interspersed with Remnant Mature Trees.** This type is common and more botanically diverse. It is more similar to mature secondary growth forests in both forest structure and species composition than the following forest type; and
- (b) **Pioneer Communities on Fallow Areas Previously under Shifting Cultivation.** The flora is depauperate and represented by fast-growing pioneer tree species, such as *Macaranga andersonii*, *M. denticulata*, *Trema orientalis*, *Litsea cubeba* and other desiccation-tolerant species.

For both of these regenerating forest types, the forest structure is generally composed of only one forest vegetation layer and includes a stunted shrub layer. However, these two forest types have a high canopy cover (60 %), and seral succession is possible but unlikely.

Data collected in the regenerating forest plots (40 x 40 m) show:

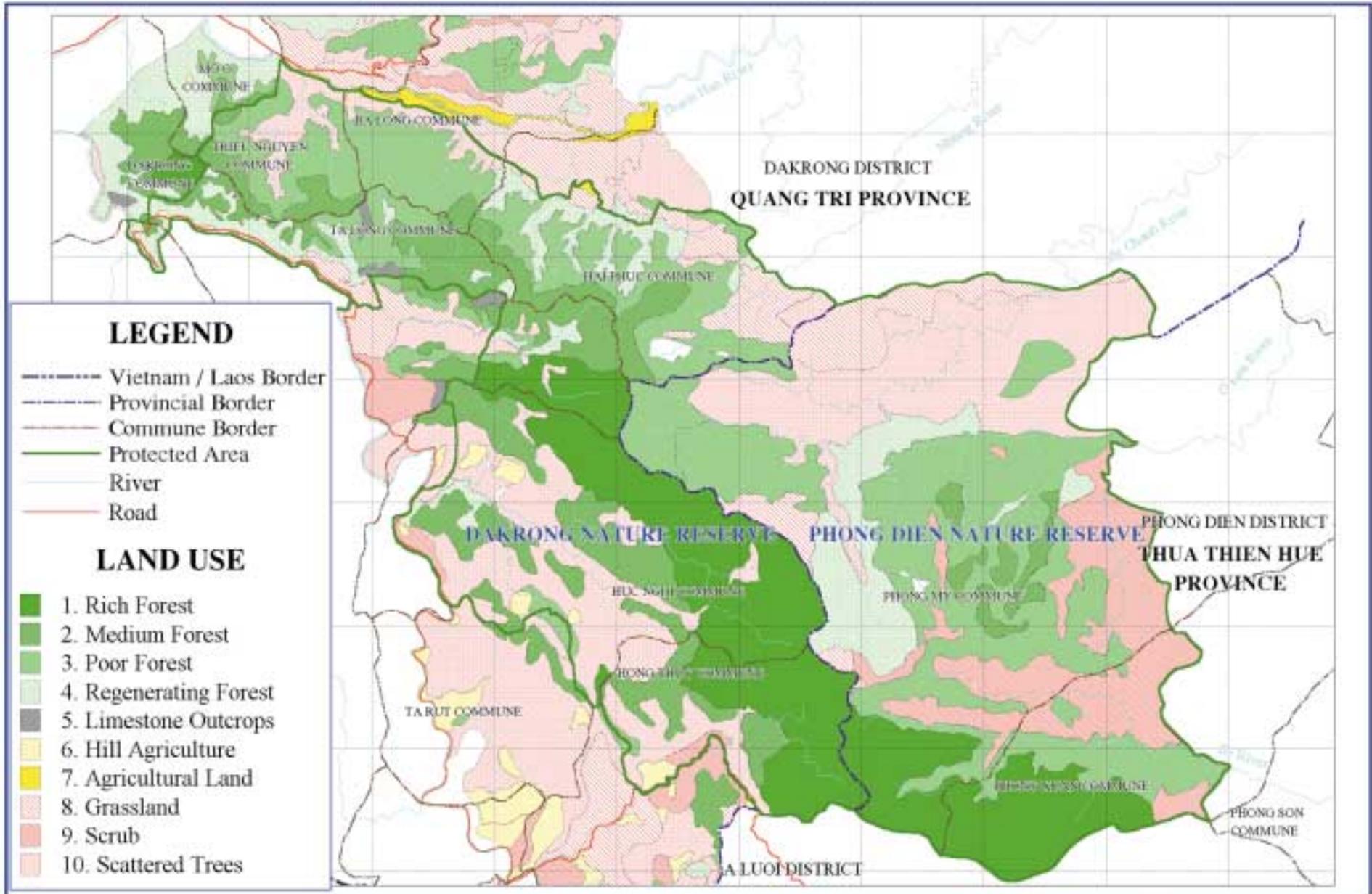
- Average tree height: 9.5 m
- Average tree diameter (dbh): 11.3 cm
- Number of trees/ha: 1,060
- Cross sectional area of timber: 16.1 m²
- Volume of timber: 74.9 m³/ha
- Canopy cover: 60 %

Patch Forest (Degraded Forest)

This category includes trees which are found in forest isolates and individual trees growing in grasslands (totalling about 20 % of the study area). Although the study area is technically patch forest, the term 'patch' refers to very small forests and mature tree isolates.

Some of these areas could potentially revert to pioneer forests (as the soil profile is still intact) and are probably important for seed dispersal, as well as acting as transitional areas or ecotones, particularly for certain bird and mammal species.

Map 2: Land Use in Phong Dien and Dakrong Proposed Nature Reserves



Map based on field survey in 1998
 Grid: UTM, zone 48; Horizontal Datum: India 1960

SCALE 1:120,000

Produced by the Forest Resources and Environment
 Centre of FIPI 15 February 1999

Scrub

Scrub is distributed mostly upon flat floodplains contiguous with rivers and streams, and also occurs on slightly sloping hillsides. Some of the associated tree species are desiccation-resistant acidophiles growing on extremely poor soils, such as *Melastoma* spp and *Rhodomyrtus tomentosa*. These thickets are dense, creating good shade cover at a height of about one metre. Any forest regeneration and succession from this vegetation type is unlikely.

Grasslands

Grasslands cover about 5 % of the proposed nature reserves, and most, if not all, were created from the slash and burn practices of shifting cultivators and by war-time use of chemical defoliant. These grasslands are perpetuated by cattle-grazing and dry-season burn-offs.

Most grasses found here are tall and coarse, such as *Imperata cylindrica*, *Saccharum arundinaceum*, *S. spontaneum* and *Thysanolaema maxima*. In some areas, growth is very dense with grasses reaching as high as two metres.

Randomly distributed mature tree species are found in these grasslands, which are isolated forest remnants from extensive chemical defoliation, and probably also represent fire-resistant species. This commonly includes tree species from the Rubiaceae and Juglandaceae.

This habitat is probably of limited economic or watershed protection value but is a potentially valuable area as a habitat for grazing mammals.

2.10 Mammals

A total of 43 mammal species, in eight orders and 20 families, have been recorded to date in Phong Dien and Dakrong WPFs (Appendix 2).

Of the 43 mammal species currently known, 24 are listed in the IUCN Red List of Threatened Animals (IUCN 1996) or in the Red Data Book of Vietnam (Anon. 1992) (Table 5). This figure represents 63 % of the known mammal fauna of the proposed nature reserves.

The 21 mammal species that are listed in the IUCN Red List of Threatened Animals include six endangered, eight vulnerable and four near-threatened species. A further 15 species are listed in the Red Data Book of Vietnam, three of which are not also included in the IUCN Red List. These species comprise eight endangered, six vulnerable and one rare species.

These forests are within the known ranges of several restricted-range mammal species endemic to Indochina, in particular Sao La and Giant Muntjac.

The orders Rodentia and Chiroptera remain unstudied at Phong Dien and Dakrong Proposed nature reserves. A study of these groups could potentially reveal several new species records for Vietnam, and would probably increase the number of threatened species known from the study area.

Mammal Records

Incidental sightings and confirmations for some rare and endangered mammal species were collected during this study; several are detailed below.

Tiger *Panthera tigris*. Interviews with local hunters and gatherers, in both Dakrong and Phong Dien districts, have confirmed the presence of Tiger in the region. An interview with Mr Muoc of the Ba-hi

Table 5: Threatened Mammals Recorded in the Study Area

Species	Scientific Name	Current Status	
		IUCN 1996	Anon. 1992
Pangolins:	Pholidota:		
Pangolins	Manidae		
1. Chinese Pangolin	<i>Manis pentadactyla</i>	NT	
2. Sunda Pangolin	<i>M. javanica</i>	NT	
Primates:	Primates:		
Lorises	Loridae		
3. Slow Loris	<i>Nycticebus coucang</i>		V
Old-World Monkeys	Cercopithecidae		
4. Pig-tailed Macaque	<i>Macaca nemestrina</i>	EN	V
5. Rhesus Macaque	<i>M. mulatta</i>	NT	
6. Bear Macaque	<i>M. arctoides</i>	VU	V
7. Douc Langur	<i>Pygathrix nemaeus</i>	EN	
Gibbons	Hylobatidae		
8. Buff-cheeked Gibbon	<i>Hylobates gabriellae</i>	DD	E
Carnivores:	Carnivora:		
Dogs and Foxes	Canidae		
9. Indian Wild Dog or Dhole	<i>Cuon alpinus</i>	VU	E
Bears	Ursidae		
10. Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	E
11. Sun Bear	<i>U. malayanus</i>	VU	E
Weasels, etc.	Mustelidae		
12. Yellow-throated Marten	<i>Martes flavigula</i>	DD	
13. Large-toothed Ferret Badger	<i>Melogale personata</i>	DD	
Civets	Viverridae		
14. Binturong	<i>Arctictis binturong</i>		V
Cats	Felidae		
15. Asian Golden Cat	<i>Catopuma temmincki</i>	NT	
16. Clouded Leopard	<i>Pardofelis nebulosa</i>	VU	V
17. Tiger	<i>Panthera tigris</i>	EN	E
Even-toed Ungulates:	Artiodactyla:		
Pigs	Suidae		
18. Wild Boar	<i>Sus scrofa</i>	VU	
Deer	Cervidae		
19. Giant Muntjac	<i>Megamuntiacus vuquangensis</i>	EN	E
Cattle, Antelopes, Goats	Bovidae		
20. Gaur	<i>Bos gaurus</i>	VU	E
21. Sao La or Vu Quang Ox	<i>Pseudoryx nghetinhensis</i>	EN	E
22. Southern Serow	<i>Naemorbedus sumatraensis</i>	EN	V
Rodents:	Rodentia:		
Flying Squirrels	Sciuridae		
23. Red Giant Flying Squirrel	<i>Petaurista philippensis</i>		R
Old-world Porcupines	Hystriidae		
24. Malayan Porcupine	<i>Hystrix brachyura</i>	VU	

Follows Corbet & Hill (1992).

Notes: En?E = Endangered; VU/V = Vulnerable; NT = Near Threatened; R = Rare; DD = Data Deficient as per IUCN (1996) and Anon. (1992).



ethnic minority in Phong My commune, Phong Dien district reported that, in March 1998, he observed a Tiger of approximately 100 kg, 200 m from his village. He also reported that, in May 1998, a Tiger preyed upon one of his cows in the Moi Valley (location: 16° 27' N and 107° 15' E). He further noted that, judging by footprints, there were two adults and one cub present. In the Ma Valley, the upstream catchment of the Bo River, some rattan *Aquilaria crassna* gatherers stated seeing Tiger footprints in the area on many occasions. In July 1998, forestry officials in Phong My commune, Phong Dien district seized a Tiger cub (37 kg) from local hunters in the upper O Lau River Valley. Various other reports have been collected from people in Ba Long, Trieu Nguyen and Ta Long communes of Tiger footprints, and of buffaloes and cows being killed by Tigers.

Gaur *Bos gaurus*. Information from hunters in Khe Tran village referred to a herd of 10 Gaur in the upstream basin of the O Lau River, known as the Moi Valley area, and located approximately 15 km west of their village.

Sao La or Vu Quang Ox *Pseudoryx nghetinhensis*. Recent sightings of Sao La have been reported by local hunters on three separate occasions. In 1995, after a forest fire near Ha Long village in Khe Da commune, villagers discovered a dead Sao La. In August 1997, Mr Muoi, a hunter, found a 50 kg Sao La in a stream 500 m from his village, in secondary forest, 350-400m above sea level. A Ba-hi hunter from Ta Long commune, Dakrong district caught a Sao La in 1995, along National Highway 14, 22 km from the Dakrong River; the specimen was purchased by a Mr Phuc in Trieu Nguyen commune to use as a decoration and for medicinal purposes.

Giant Muntjac *Megamuntiacus vuquangensis*. Giant Muntjac was identified during the survey from frontlets. Information from hunters suggests that it is quite common locally. Records collected from local hunters suggest that Giant Muntjac is most common in Ba Long, Hai Phuc, Trieu Nguyen and Dakrong communes of Dakrong district. However, Giant Muntjac sightings have also been reported from Khe Ma and Khe Moi village areas in Phong My commune, Phong Dien district. Other Giant Muntjac sightings have been reported from Khe Lau, Dong Nom, Dong Che and Dakrong (at the Dakrong Bridge) communes in Dakrong district.

2.11 Birds

A total of 171 bird species were recorded in the study area, belonging to 13 orders and 35 families (Appendix 3). Of these species, seven are considered to be globally threatened and a further nine are designated as near threatened (Collar *et al.* 1994). The Red Data Book of Vietnam (Anon. 1992) lists 18 species, of which seven are not listed by Collar *et al.* (1994).

Two of the four restricted-range species endemic to the Annamese Lowlands EBA were recorded: the critically endangered Edwards's Pheasant and the endangered Annam Partridge *Arborophila merlini*. Six other restricted-range species were recorded: Red-vented Barbet *Megalaima largandieri*, White-cheeked Laughingthrush *Garrulax vassali*, Red-collared Woodpecker *Picus rabieri*, Grey-faced Tit-babbler *Macronous kelleyi*, Crested Argus *Rheinardia ocellata* and Short-tailed Scimitar-babbler *Jabouilleia danjoui*.

Edwards's Pheasant

Field surveys in 1988, 1991 and 1992 failed to find any new evidence for the continued existence of this species (Eames *et al.* 1989 and 1992, Robson *et al.* 1993). In 1996, 500 "wanted" colour posters of a male Edwards's Pheasant were distributed to Forest Protection Department officials in Thua Thien Hue and Quang Nam-Da Nang provinces (Eve 1997). Following this, incidental reports, sightings and descriptions by local hunters suggested that the area was still inhabited by potentially viable populations of Edwards's Pheasant. In 1996, the species was rediscovered in Phong My commune, Thua Thien Hue



Table 6: Restricted-range and Threatened Birds Recorded in the Study Area

Species	Scientific Name	Restricted Range Species	Current Status	
			Collar <i>et al.</i> 1994	Anon.1992
	Phasianidae			
1. Annam Partridge	<i>Arborophila merlini</i>	RRS	EN	E
2. Edwards's Pheasant	<i>Lophura edwardsi</i>	RRS	CR	E
3. Siamese Fireback	<i>L. diardi</i>		VU	T
4. Crested Argus	<i>Rheinardia ocellata</i>	RRS	VU	T
	Picidae			
5. Red-collared Woodpecker	<i>Picus rabieri</i>	RRS	VU	T
	Megalaimidae			
6. Red-vented Barbet	<i>Megalaima lagrandieri</i>	RRS		
	Bucerotidae			
7. Brown Hornbill	<i>Anorrhinus tickelli</i>		NT	T
8. Great Hornbill	<i>Buceros bicornis</i>			T
	Alcedinidae			
9. Blyth's Kingfisher	<i>Alcedo hercules</i>		VU	T
	Halcyonidae			
10. Stork-billed Kingfisher	<i>Halcyon capensis</i>			T
11. Ruddy Kingfisher	<i>H. coromanda</i>			R
	Cerylidae			
12. Crested Kingfisher	<i>Megaceryle lugubris</i>			T
	Cuculidae			
13. Coral-billed Ground Cuckoo	<i>Carpococcyx renauldi</i>		NT	T
	Columbidae			
14. Yellow-vented Pigeon	<i>Tieron seimundi</i>		NT	R
	Pittidae			
15. Blue-rumped Pitta	<i>Pitta soror</i>		NT	
16. Bar-bellied Pitta	<i>P. elliotii</i>		NT	T
	Eurylaimidae			
17. Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>			T
	Corvidae			
18. White-winged Magpie	<i>Urocissa whiteheadi</i>		NT	
19. Indochinese Green Magpie	<i>Cissa hypoleuca</i>		NT	
20. Ratchet-tailed Treepie	<i>Temnurus temnurus</i>			T
	Sylviidae			
21. White-cheeked Laughingthrush	<i>Garrulax vassali</i>	RRS		T
22. Short-tailed Scimitar-babbler	<i>Jabouilleia danjoui</i>	RRS	VU	T
23. Grey-faced Tit-babbler	<i>Macronous kelleyi</i>	RRS	NT	
24. Rufous-throated Fulvetta	<i>Alcippe rufogularis</i>		NT	

Follows Inskipp *et al.* (1996).

Notes: CR = Critically endangered; EN = Endangered; VU = Vulnerable; T = Threatened; NT = Near Threatened as per Collar *et al.* (1994) and Anon. (1992).

RRS = Restricted-range species (Stattersfield *et al.* 1998).



province, and in Huong Hoa commune, Quang Tri province (Vo Quy 1997). In December 1997, at least four specimens were trapped in Ba Long commune, Quang Tri province.

The Phong Dien and Dakrong WPFs support the only known population of Edwards's Pheasant in the world.

The following represent sightings and records for Edwards's Pheasant since its rediscovery in 1996:

- (a) **Khe Lau Area** (16°30'N 107°13'E). Within a forest area in the Phong My commune, Phong Dien district, a female specimen of Edwards's Pheasant was trapped at an altitude of 300-400 m by local people on 26 August 1996. A male specimen was captured on 28 August 1996 in the same area. Both specimens died in captivity shortly after. These two specimens of Edwards's Pheasant are preserved in the headquarters of Bach Ma National Park;
- (b) **Kreng village** (16°35'N 107°05'E). In Huong Hiep commune, Dakrong district, a pair of Edwards's Pheasants were trapped by local people on 31 December 1996. The female died shortly thereafter and the male is now held in Hanoi Zoo;
- (c) **Ba Long Valley** (16°35'N 107°02'E). In December 1997, in Ba Long commune, Dakrong district, four Edwards's Pheasant specimens were trapped by local hunters at altitudes between 50 and 300 m; and
- (d) **Dong Che Area**. On the boundary between Hai Phuc and Trieu Nguyen communes (Dakrong district), sometime between the end of 1997 and the beginning of 1998, local hunters caught two Edwards's Pheasants and further reported seeing a flock of 8-10 individuals foraging in the same area.

2.12 Herpetiles

A total of 57 herpetile species were recorded during this study: 38 species of reptile from three orders and 15 families, and 19 species of amphibian from one order and four families (Appendix 4).

Of the herpetiles, a total of 20 species are listed either in the IUCN Red List of Threatened Animals (1996) or the Red Data Book of Vietnam (Anon. 1992), accounting for 35 % of the total number of herpetiles recorded in Phong Dien and Dakrong WPFs (Table 7).

The 19 species of herpetile (15 reptiles and four amphibians) listed in the Red Data Book of Vietnam include one species listed as endangered, eight listed as threatened, eight listed as vulnerable and two listed as rare. There are a two species, one amphibian and one turtle, that are endemic to Vietnam.

All eight of the species listed in the IUCN Red List of Threatened Animals are reptiles (five turtles and three snakes); no amphibians are listed. Of the five turtle species listed, one is listed as endangered, one as vulnerable and three as near-threatened. The three snake species listed include one threatened, one near-threatened and one data deficient.

Compared to species records for the whole of central Vietnam, Phong Dien and Dakrong Proposed Nature Reserves are home to 67 % of the orders, 75 % of the families and 44 % of the species of herpetile recorded for central Vietnam. More comprehensive field studies would undoubtedly increase the number of species recorded.

Section 2 - Site Features

A comparison of herpetile species richness attests that this study area is as species rich as the four nearest protected areas: Vu Quang Nature Reserve (Ha Tinh province), Phong Nha Nature Reserve (Quang Binh province), Bach Ma National Park (Thua Thien Hue province) and Ngoc Linh Nature Reserve (Kon Tum province).

Undisturbed forests have a higher herpetile species richness than neighbouring agricultural or disturbed areas. Thirty nine species (68 % of the total) were recorded in forest habitats. Montane areas have a relatively low species richness. Twenty seven species (47 % of the total) were found in association with

Table 7: Endemic and Threatened Herpetiles Recorded in the Study Area

Order, Family, Species	Endemic Species	Current Status	
		IUCN 1996	Anon. 1992
Squamata:			
Gekkonidae			
1. <i>Gekko gecko</i>			T
Agamidae			
2. <i>Physignathus cocincinus</i>			V
3. <i>Acanthosaura lepidogaster</i>			T
Varanidae			
4. <i>Varanus nebulosus</i>			V
5. <i>V. salvator</i>			V
Boidae			
6. <i>Python molurus</i>		NT	V
Colubridae			
7. <i>Ptyas korros</i>			T
8. <i>P. mucosus</i>		T	V
Elapidae			
9. <i>Bungarus fasciatus</i>			T
10. <i>Ophiophagus hannah</i>		DD	E
11. <i>Naja naja</i>			T
Testudinata:			
Emydidae			
12. <i>Cuora galbinifrons</i>	EV	NT	V
13. <i>C. trifasciata</i>		E	V
Platysternidae			
14. <i>Platysternum megacephalum</i>		NT	R
Trionydnidae			
15. <i>Palea steindachneri</i>		NT	
Testudinidae			
16. <i>Indotestudo elongata</i>		V	V
Anura:			
Bufonidae			
17. <i>Bufo galeatus</i>			R
Ranidae			
18. <i>Rana andersoni</i>			T
19. <i>R. microlineata</i>	EV		T
Rhacophoridae			
20. <i>Rhacophorus nigropalmatus</i>			T

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

Notes: E = Endangered; V = Vulnerable; T = Threatened; NT = Near Threatened; R = Rare; DD = Data Deficient as per IUCN (1996) and Anon. (1992).

EV = Endemic to Vietnam.



humans, all of which are common species with widespread distributions. Of the amphibians, 13 out of the 19 species recorded were found in riparian habitats, in streams, or in forest areas adjacent to streams.

2.13 Butterflies

Butterflies were collected in three major habitats in the study area: areas of primary, mature secondary and immature secondary forest; riparian areas comprising gallery forest, and areas along streams and rivers; and open areas of degraded but regenerating forest, isolated forest patches, grasslands and other areas.

A total of 213 species from 10 families were collected within Dakrong and Phong Dien WPFs (Table 8 and Appendix 5).

Table 8: Butterflies Recorded in the Study Area

Butterfly Family	No. of Species in Each Family	No. Species Common to Both Areas	No. of Species Recorded	
			Phong Dien	Dakrong
1. Papilionidae	23	14	16	21
2. Pieridae	22	13	16	19
3. Danaidae	14	6	7	13
4. Satyridae	11	5	9	7
5. Amathusiidae	8	2	7	3
6. Nymphalidae	41	25	31	34
7. Libytheidae	3	1	1	3
8. Riodinidae	5	3	5	3
9. Lycaenidae	41	9	27	19
10. Hesperidae	46	10	24	28
Total	213	88	14	150

Follows Corbet, Pendlebury and Eliot (1992).

No species new to science were recorded during the survey, although more detailed surveys would probably reveal new taxa, most likely within the Lycaenidae and Hesperidae. There are seven species within three families which are new species records for Vietnam (Table 9).

Table 9: New Butterfly Records and their Associated Habitat Types in the Study Area

Species	Previously Known Distribution	Phong Dien	Dakrong
<i>Lasippa monata</i>	Burma, Thailand and Indonesia	Forest	—
<i>Libythea geoffroy alompra</i>	Thailand and southern Burma	—	Open
<i>Bibasis sena</i>	Thailand, Sri Lanka, India, Burma, Andaman Islands and Hainan Island (China)	—	Open
<i>Zographetus doxus</i>	Thailand, Burma and western Malaysia	—	Forest
<i>Isma umbrosa</i>	Thailand, western Malaysia and Sumatra	—	Forest
<i>Plastingia pellonia</i>	Thailand, southern Burma, western Malaysia, Sumatra, Borneo and Java	—	Forest
<i>Unkana ambassa</i>	Thailand, north-eastern India and Burma	—	Forest

Endemic Butterfly Species. Most of the butterfly species recorded have restricted distributions within the Indochinese Peninsula and South-East Asia. Of the total 213 species, there are 129 species (62 %) with distributions confined to the Indo-Malayan region and 34 species (16 %) with distributions further restricted to Indochina and India. Six species are endemic to northern Indochina. A further 19 species have extended distributions which include the Indo-Australian tropics. There are another 19 species whose distributions are unknown. *Stichophthalma louisa* could be an undescribed subspecies endemic



to central Vietnam. Other endemic species have been collected in Bach Ma National Park and in Vu Quang nature reserve. Preliminary checks suggest that only eight butterfly species endemic to central Vietnam have been recorded previously (Table 10).

Table 10: Tentative List of Butterflies Endemic to Central Vietnam

Species	Family	Collecting Locality and Date	References
<i>Papilio noblei</i>	Papilionidae	Ba Na Nature Reserve, September 1995	Vitalis de Salvaza 1919
			Dubois and Vitalis de Salvaza 1921 Metaye 1957a
<i>Graphium arycles</i>	Papilionidae	Bach Ma National Park, July 1996	Dubois and Vitalis de Salvaza 1921 Metaye 1957a
<i>Eurema novapallida</i>	Pieridae	Ba Na Nature Reserve, 1995	Yata 1989
<i>Euploea modesta</i>	Danaidae	—	Metaye 1957b
<i>Zeuxidia amethystus</i>	Amathusiidae	Bach Ma National Park	New sample as yet undescribed
<i>Amathuxidia amythaon anamensis</i>	Amathusiidae	Central Vietnam	Okano 1996
<i>Athyma asura</i>	Nymphalidae	Vu Quang Nature Reserve, 1997	Metaye 1957b
<i>A. kanwa</i>	Nymphalidae	Bach Ma National Park, 1996	Metaye 1957b

Rare and Endangered Butterfly Species. One species of Papilionidae, *Papilio noblei*, is listed in Appendix 1 of CITES (1994). To date, this species is only known in Vietnam from records in central Vietnam (Vitalis de Salvaza 1919, Dubois and Vitalis de Salvaza 1921, Metaye 1957a,b) and northern Vietnam (Metaye 1957a,b, A. Monastyrskii pers. comm.). This species has a patchy distribution within its known range (Vietnam, Laos and Thailand) and is known to have specific habitat requirements.

In Phong Dien and Dakrong WPFs, *Papilio noblei* is found mostly in secondary forests and along rivers and streams. The current status of *Papilio noblei* in the study area is insufficiently known and should be assessed. The initial survey suggests that this species is rare in the Phong Dien area but more common in the Dakrong area. Moreover, this is the second record for this species in central Vietnam in the past three years. *Papilio noblei* is a candidate for inclusion in the Red Data Book of Vietnam.

There are also two species from the Amathusiidae with very specific habitat requirements; *Amathuxidia amythaon* and *Zeuxidia amethystus masoni* are only associated with disturbed secondary forests. Both are very rare and represent new species records for central Vietnam.

Habitat Distribution. Of the 213 butterfly species collected, 152 species are forest dependent, 89 species are found in riparian areas, and 33 species are associated with open habitats.

The majority of butterfly species were recorded in primary and secondary forests. In Phong Dien and Dakrong WPFs, this habitat accounts for 59 % and 52 % of the total species recorded in each area, respectively. Riparian habitats serve as feeding and ovipositing areas (Table 11).

Many species in the Nymphalidae, Satyridae and Amathusiidae are forest-dependent, such as species of *Eulacera*, *Lexias*, *Lebadea*, *Stichophthalma*, *Faunis*, *Thaumantis*, *Amathuxidia*, *Zeuxidia*, *Erites* and *Mycalis*. Some rarer species are typically found in primary lowland forest, such as *Amathuxidia amythaon* and *Zeuxidia amethystus* (Amathusiidae), as well as species of *Athyma* (Nymphalidae), *Arhopala*, *Dacalana*, *Flosand* *Surendra* (Lycaenidae). Species of *Tajuria* (Lycaenidae) are found only in secondary and primary lowland forests. Finally, most Hesperidae species are forest dependent.



Table 11: Distribution of Butterflies by Different Habitat Types within the Study Area

Butterfly Family	Forest Areas		Riparian Areas		Open Areas	
	Phong Dien	Dakrong	Phong Dien	Dakrong	Phong Dien	Dakrong
Papilionidae	8	8	12	19	5	4
Pieridae	14	13	14	16	5	6
Danaidae	4	5	4	11	3	4
Satyridae	9	7	1	1	0	2
Amathusiidae	7	3	0	0	1	1
Nymphalidae	24	24	16	1	1	2
Libytheidae	0	0	1	0	0	3
Riodinidae	5	3	1	1	1	1
Lycaenidae	21	19	6	3	0	0
Hesperiidae	19	22	7	2	0	3
Total	111	104	62	71	16	26
Area Total	152		89		33	

Regional Distribution. This initial survey is valuable for further understanding the diversity, distribution and endemism of butterfly species within the Annamese Lowlands EBA. *Papilio noblei*, *Thaumantis diores*, *Ypthima tappana*, *Paralaxita dora* and *Stichopthalma louisa* are typical Indochinese species.

2.14 Socio-cultural Features

Phong Dien district

Phong My, Phong Xuan and Phong Son communes contain the most heavily populated areas which are located along the eastern border of the proposed Phong Dien Nature Reserve. These local communities consist of two main ethnic groups, the Kinh (majority Vietnamese) and the Ba-hi (Table 12).

Table 12: Population Composition of Phong Dien district

Commune	Area (ha)	Pop.	Ethnic Group		Density (pers/km ²)
			Kinh	Ba-hi	
Phong My	39,500	4,172	3,815	367	10.6
Phong Xuan	18,100	4,059	4,059	0	22.4
Phong Son	15,443	9,086	9,050	36	58.8
Total	73,043	17,317	16,914	403	30.6

Source: Thua Thien Hue Department of Statistics (1997).

In Phong Dien district there are currently:

- * 3,212 households;
- * 17,317 people;
- * 23 persons/km²; and
- * 2.44 % population growth per annum.

Ethnic Groups. The Ba-hi ethnic minority, a sub-group of the Ta-oi ethnic minority and a member of the Mon-Khmer language group, is concentrated in the two villages of Khe Ban and Ha Long in Phong My commune. These ethnic minority communities include 70 households and 367 people; the majority of the rest of the population is composed of Kinh Vietnamese.

Health Care. Each commune has a health centre but medical equipment and medicines are in short supply. The staffing of health care facilities averages one nurse and one assistant nurse per 2,000 people, and are considered inadequate. Because of this, the health care facilities of Thua Thien Hue province sometimes co-ordinate with communes and villages to conduct both examination and immunisation programmes. The most common ailments for adults are malaria and goitre (a potentially life-threatening enlargement of the thyroid gland caused by an acute iodine deficiency). Children commonly suffer



malnutrition and its complications. Respiratory problems are also very common, particularly in households with indoor hearths.

Education. Schools in the district are constructed of thatch (grass) and are often in a dilapidated condition. The lack of properly trained teachers further affects the educational system. While all communes have kindergartens and primary schools, only Phong My commune has a secondary school.

Transportation. The transportation system in the district is comparably well developed with roads leading to each commune and village. Besides the secondary roads, the O Lau and My Chanh Rivers are also navigable in this region.

Cultivation Practice and Household Incomes. Local communities largely cultivate wet rice. Other staple foods grown locally are beans, peanuts and cassava, in both sedentary plots and shifting cultivation. The local agricultural industry is based on sugar cane and rubber trees. Most of the population centres are in valleys with fertile soils. The Ba-hi ethnic minority people also cultivate dry rice and maize on steep hill slopes.

Household incomes are based on three sources: agriculture (primarily), forestry and animal husbandry. In the Phong Dien area, 95 % of the population subsist on agriculture. There are two major harvests per year for most crops. Wet rice cultivation yields approximately 8 tonnes/ha; dry rice cultivation (one crop per year) yields approximately 3.8 tonnes/ha.

The average food consumption per person is 312 kg/year. However, some people must supplement their diets by exploiting neighbouring forests. The range of forest exploitation includes hunting and trapping, as well as cutting timbers, and collecting scented wood and resins, tannins for pigments, bamboo, rattan, honey, and ornamental, edible and medicinal plants.

Dakrong district

In Dakrong district there are nine communes, all distributed along the northern and western borders of the proposed nature reserve area. Some of the commune borders are within the WPF area. There are, however, no settlements in the proposed nature reserve area. Huong Hoa Forest Enterprise is located in this district.

In Dakrong district there are currently:

- 2,603 households;
- 14,489 people;
- 20 people/km²; and
- 2.0 % population growth per annum.

The population density is lower than for Phong Dien district and more unevenly distributed. It is dispersed along roads rather than in villages.

Ethnic Groups. The population is comprised of three ethnic groups: Kinh (majority Vietnamese) (33 %); Bru-Van Kieu (52 %); and Pa-co (15 %). The Bru-Van Kieu ethnic minority, also known as the Van Kieu, are member of the Mon-Khmer language group, have the largest local population. The Pa-co ethnic minority are a subgroup of the Ta-oi ethnic minority closely akin to the Ba-hi ethnic minority and live in the Ta Rut commune (Table 13).

Health Care. Health facilities are sparse in this newly established district. In the nine communes of the district, there are only three commune health centres (Ta Rut, Ba Long and Mo O communes). Dakrong, the largest commune, does not have a health centre.



Table 13: Population Composition of Dakrong district

Commune *	Area (ha)	Population	Ethnic Groups			Density (persons/km ²)
			Kinh	Van Kieu	Pa-co	
Ta Rut	6,045	2,219	75	0	2,144	36.7
Huc Nghi	12,490	823	0	823	0	6.6
Ta Long	18,570	2,111	0	2,111	0	11.4
Dakrong	11,810	3,003	0	3,003	0	25.4
Mo O	2,890	1,343	242	1,101	0	46.4
Trieu Nguyen	5,100	1,966	1,966	0	0	38.5
Ba Long	5,657	2,651	2,451	200	0	46.8
Hai Phuc	8,440	373	44	329	0	4.4
Total	71,002	14,489	4,778	7,567	2,144	20.0

Source: Quang Tri Department of Statistics (1997).

* Information about Hong Thuy commune is still being gathered.

The health care facilities are understaffed and lack properly trained health care workers, and the staff housing is primitive and inadequate. The most common ailments are malaria, goitre and tuberculosis.

Education. The educational system is also poorly established and lacks both schools and teachers. The literacy rate in Dakrong district is uncommonly low for Vietnam. Kindergarten facilities do not exist in any of the nine communes. However, each commune has a primary school. Ba Long and Trieu Nguyen also have secondary schools within the primary school facilities. Very few children attend secondary school. In total, there are 122 teachers but only 11 are ethnic minority people, all of whom teach at the primary school level.

Transportation. Currently, two communes (Ba Long and Hai Phuc) are not accessible by road, and the main mode of transportation to these two communes is the Quang Tri River. There are two existing roads which are within the national road system and which cross the district: National Highways 9 and 14B.

Cultivation Practice and Household Incomes. The main sources of income are agriculture and forestry. Average income is low, cultivation practices are antiquated and arable land is scarce. Total food consumption per person is only 120 kg/year. Malnutrition and poverty are common, especially among ethnic minority people. A sizeable portion of the district's population supplement their diets by gathering and hunting in the WPFs.

Animal husbandry is also a source of income, particularly the breeding of water buffaloes, cows and pigs. Buffalo and cows are free ranging and are commonly used as draft animals for timber exploitation and transportation.

2.15 Land Use

Phong Dien district

Currently, forested land covers 24,299 ha (84 %) of the district's land area and agricultural land covers 3,972 ha (14 %), with the remaining 673 ha (2 %) being used for special use and residential purposes. Until recently, the Ba-hi people practised slash-and-burn cultivation, growing mainly rice and maize. In recent years, the Ba-hi have been the focus of government programmes to settle them in more permanent villages.

Agricultural practices are intensive in the communes of Phong Dien district. The cultivation of annual crops is widespread but perennial crops make up a significant proportion of the cultivation in Phong



My commune (Table 14). Since the resettlement programmes were initiated, there have been no ethnic minority people living within the proposed nature reserve area.

Current Management. Phong Dien WPF preserves the upstream catchments of the O Lau and My Chanh River systems. Management responsibility rests with Thua Thien Hue Provincial Forest Protection Department.

Thua Thien Hue Provincial Forest Protection Department has decreed that Phong Dien district Forest Protection Department is responsible for carrying out inspections and enforcing the protection of these forests: a formidable task given the wide range of cultivation practices in the area.

Table 14: Land Use Practices in Phong Dien communes which Overlap the Watershed Protection Forest

Land Use and Cultivation Practices	Land Use (ha)		
	Phong My	Phong Xuan	Phong Son
Agricultural Lands	2,654.60	524.23	785.90
Annual Cultivation	538.38	413.57	685.13
Miscellaneous Cultivation	133.84	110.66	100.77
Perennial Cultivation	650.00	0	0
Animal Husbandry	1,332.38	0	0
Forest Lands	17,811.90	2,744.50	3,742.28
Primary Forest	17,059.30	2,694.00	3,732.30
Regenerating Forest	752.60	50.50	7.98
Silviculture	0	0	2.00
Special Use Lands	177.51	188.71	236.41
Residential Lands	19.20	15.84	35.48

Source: Thua Thien Hue Department of Statistics (1997).

Economic Growth. Over the past few years, the district has experienced some economic growth in the form of infrastructure projects. Benefits have been realised from several government programmes, namely the 327 programme, district resettlement programme, and the establishment of a new economic zone.

Since the approval of the Phong Son-Phong My New Economic Zone in 1993-1994, government investment has reached VND2,823 million in infrastructure development, and has included the construction of seven bridges, one irrigation gate, one irrigation dam and 3 km of 10 kV electrical supply lines.

In addition, in 1995, approximately VND120 million was invested in the agriculture-forestry resettlement programme for the management and protection of 300 ha of forests, reclamation of 30 ha of land, construction of two village sewage systems, and the drilling of 10 freshwater wells.

Dakrong district

Currently, forested land covers 19,937 ha (29 %) of the total district land area (Table 15), and agricultural land covers 2,681 ha (4 %) of the district's land area (Table 16). Unproductive land currently accounts for 45,485 ha (67 %) of the total; unproductive lands include agriculturally exhausted land, barren lands, and hills.

The high percentage of unproductive land area was originally created by slash-and-burn cultivation. Although there have been determined efforts to reform land use practices, the amount of unusable land is increasing as a result of continued slash-and-burn cultivation, and is further compounded by progressive soil erosion.

Current Management. Dakrong district is participating in an agroforestry programme aimed at allocating stewardship of existing agricultural areas, still classified as forested land, to local farmers.

There are a wide range of local practices in need of change. The most pressing are to curtail shifting



cultivation, to reclaim cultivated areas classified as forest land, to provide buffer zones for remaining forest areas, to promote sustainable agriculture, and to provide tree crops and windbreak/erosion control measures.

Table 15: Forested Land in Dakrong district

Commune	Forest Land (Total 19,937 ha)	
	Natural Forests (ha)	Silviculture (ha)
Ta Rut	2,417.00	—
Huc Nghi	4,840.00	—
Ta Long	7,762.00	3.10
Dakrong	3,266.00	7.11
Mo O	1,080.54	45.50
Trieu Nguyen	501.98	8.51
Ba Long	—	5.10
Hai Phuc	—	—
Total	19,867.52	69.32

Source: Quang Tri Department of Statistics (1997)

Silviculture is being piloted on a short-term basis and will be upgraded to long-term status pending successful implementation. This silviculture programme was begun in 1990 and is administered by the Provincial Forest Protection Department, which provides assistance to the district government in both the relocation of inhabitants to low-lying areas and in teaching sustainable agricultural methods. The total area of reforested land, however, remains quite limited, and continued slash and burn practices present difficulties for future land planning and management.

Table 16: Current Agricultural Land Use in Dakrong district

Communes	Agricultural Land (Total 2,681 ha)			
	Primary Food Crops	Secondary Food Crops	Long-term Agroforestry Plots	Short-term Agroforestry Plots
Ta Rut	416.70	5.5	5.5	14.0
Huc Nghi	170.50	4.5	4.5	14.0
Ta Long	447.70	3.0	3.0	41.4
Dakrong	601.50	7.2	7.3	3.0
Mo O	134.50	32.3	32.3	8.5
Trieu Nguyen	50.50	71.0	71.0	-
Ba Long	81.44	167.0	167.0	-
Hai Phuc	48.50	11.0	56.5	-
Total	1,951.34	301.5	347.1	80.9

Source: Quang Tri Department of Statistics (1997)

An agroforestry land allocation programme sponsored a more equitable land distribution and has assisted in enforcing responsible land stewardship. Long-term land allocation for the agroforestry programme will soon begin in two communes (Huong Hiep and Mo O) with allocated areas of 376 ha and 300 ha, respectively. Short-term trials have begun in three communes: Ba Long, Hai Phuc and Trieu Nguyen.

The land allocation programme has proven to be an effective land management method that has been applied in many other forest areas in Vietnam. However, in order to increase the likelihood of communities adopting more sustainable agricultural practices, the programme requires proper education, the creation of related income-generating activities, and long-term programme monitoring and management.

3. Evaluation

3.1 Criteria for Evaluating the Proposed Nature Reserves

Establishing a set of criteria for assessing a protected area’s conservation coverage is a useful means of evaluating the overall importance and value of the site. Phong Dien and Dakrong WPFs satisfy most of the main criteria to be considered as having high conservation value (Table 17).

Table 17: Conservation Criteria and Evaluation of the Proposed Nature Reserves

Conservation Criteria	Site Evaluation
<p>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.</p>	The area represents the largest contiguous tract of lowland forest within the Annamese Lowlands EBA. Some of the currently less viable populations can be anticipated to recover with comprehensive conservation management.
<p>Richness And Diversity: Usually linked with the diversity of habitat types; ecological gradients or ecotones should be represented because they support transitional communities.</p>	The area is as equally species diverse as other protected areas in Vietnam. Ecological gradients are present between eight distinct major floral habitat types.
<p>Naturalness: Assessment of the extent of primary habitats.</p>	Although highly modified in places, comparatively large contiguous areas with a minimum of human influence exist.
<p>Rarity: 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.</p>	There are 18 endangered, 23 vulnerable, 22 threatened, 10 rare and 19 Vietnam-endemic species recorded: all forest-dependant species. Lowland forests in central Vietnam are under-represented in Vietnam’s protected areas system. The rarity of the study area has been precipitated by both subsistence hunting and habitat loss.
<p>Uniqueness: Areas which exhibit particular natural processes or which are poorly represented in the national protection system.</p>	The proposed nature reserves are unique because they supports the world’s only known population of Edwards’s Pheasant and because of the biogeographic overlap.
<p>Typicalness: It is important to represent typical areas of common habitats and typical communities of a biome.</p>	The proposed nature reserves are typical examples of lowland forest in central Vietnam.
<p>Fragility: A measure of an area’s susceptibility to change through either natural or man-made processes.</p>	Modified areas that are undergoing seral succession indicate the area is sensitive but robust and regenerating.
<p>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.</p>	Linked by continuous forest cover to Bach Ma National Park and to the Tam Giang wetlands.
<p>Economic Value: An area may protect a valuable water catchment or a higher level of biogeographic subdivision.</p>	The areas were established to protect a water catchment. Thus these two proposed protected areas will assist in maintaining the economic value of adjacent agricultural land by maintaining hydrological processes. The area is not of great scenic appeal and is more reliant on the area’s intrinsic biological importance.
<p>Conservation Opportunity: Socio-political climate is highly determinate in the success of any conservation area’s future objectives and priorities.</p>	Strong political support at the provincial level. No human communities are known within the proposed protected areas.

Conservation criteria follow Ratcliffe (1977)

3.2 Evaluation of Lowland Forests in Central Vietnam

Ecological Unit. The lowland forests of central Vietnam are typically evergreen and semi-evergreen forests. They lie at the intersection of three major ecoregions and, furthermore, support several threatened and endemic species. Ecologically, these forests are different from the adjacent karst limestone outcrops and montane areas in species composition, richness and diversity.

The study area is of global conservation significance because it lies within the Annamese Lowlands EBA (Stattersfield *et al.* 1998). The combined area of Phong Dien and Dakrong Proposed Nature Reserves will conserve the largest remaining area of Vietnam's most threatened habitat type: lowland forest in central Vietnam. Representative conservation areas of these rapidly disappearing and sensitive forests have been neglected in Vietnam's network of 'Special-Use Forests'.

Total Conservation Coverage. An area of 35,072 ha is proposed for Dakrong Nature Reserve, and an area of 34,406 ha is proposed for Phong Dien Nature Reserve. The total contiguous cover would be 69,478 ha.

Also within the Annamese Lowlands EBA, Bach Ma National Park (with an area of 22,031 ha) includes similar but more extensively-degraded habitat types than the proposed nature reserves, as well as montane habitats. To the north, Phong Nha Nature Reserve, in Quang Binh province comprises 41,132 ha of habitats associated with karst limestone formations. Ke Go Nature Reserve, in Ha Tinh province, established to protect an equally unique biological component of this, comprises 24,801 ha of mostly degraded lowland forest.

If Phong Dien and Dakrong Nature Reserves are established, this would represent the largest area within the Annamese Lowlands EBA under conservation coverage. Phong Dien and Dakrong Nature Reserves could be linked by contiguous forest cover to Bach Ma National Park. The proposed conservation coverage is considerable and comparable to the second largest protected area currently established in Vietnam: Pu Mat Nature Reserve in Nghe An province, which covers 91,713 ha of montane and karst limestone habitats.

Environmental Impacts and Fragmentation. Several factors have played a role in the reduction and fragmentation of primary forest cover in this area, particularly wartime defoliation. Virtually all forests in the demilitarised zone of central Vietnam experienced extensive environmental degradation from aerial spraying of chemical defoliant.

Although the area has suffered considerable, human-induced environmental impacts, this should not rule out the area's obvious conservation advantages. For example, this area is the largest fragment of forest within the Annamese Lowlands EBA known to exist. The majority of forest types in the study area show signs of seral succession, and the species assemblages appear to have successfully endured wide-scale environmental degradation. The high species diversity implies that the existing threatened habitat types are stable complexes; the larger forest fragments are presumably active corridors for migration of species. Additionally, no human settlements are known within the proposed boundaries and no known introduced species were recorded during the study.

Several other areas under 'Special-Use Forest' designation share similar extensive environmental degradation and fragmentation but have proven to be of conservation value. These include Bach Ma National Park, Ke Go Nature Reserve, Vu Quang Nature Reserve, Pu Huong Nature Reserve, Pu Mat Nature Reserve, Pu Hoat Proposed Nature Reserve and Phong Nha Nature Reserve, all of which are located in central Vietnam.

Existing Lowland Forest Patches. Extant primary forest in Phong Dien and Dakrong WPFs is limited in area; however, there are four existing fragments or patches which are relatively large, uniformly distributed and in close proximity to each other. Primary forest patches comprise approximately 18 % of the area of the proposed nature reserves. The primary forest fragments are all virtually encircled by the more complex secondary forest (which makes up a further 12 % of the area), and the tree species composition exhibits signs which suggest mid and late-seral succession stages.

Primary forest remnants provide an important source point for dispersal and recolonisation of other areas, a habitat for residual populations of plant and animal species not present in degraded areas, and a refuge for species that are unsuccessful or slow in colonising degraded areas and secondary forest. Loss of plant diversity is not an inevitable consequence of forest fragmentation, and diverse forest patches can form stable components of tropical landscapes (Kellman *et al.* 1996).

Secondary forests may gradually accumulate additional species of trees, birds, bats and other fauna, reducing the importance of primary forest remnants (Nepstad *et al.* 1996). The species composition of the secondary forests suggests a buffering of the primary forest and possibly edge effects. Edge effects are of limited extent in stabilised tropical forest patches but can still play a significant role in promoting tree species diversity in patches and have beneficial affects on forest composition (Kellman *et al.* 1996).

Forest remnants are best perceived as one component of a larger strategy to conserve tropical forests (Nepstad *et al.* 1996). As such, the most pragmatic strategy would involve establishing corridors which link forest patches to other areas of conservation coverage.

Potential Linkages and Corridors. Although fragmented, the remaining forest cover in Phong Dien and Dakrong WPFs is evenly distributed over between Thua Thien Hue and Quang Tri provinces. The large area of existing forest can be expected to have an equally large carrying capacity for viable populations of restricted-range, endangered and endemic animal species. Furthermore, the geographical position of the proposed nature reserves suggests that they will act as a prime emigration/immigration point for plant and animal populations.

Corridor-linkage promotes immigration and emigration; biodiversity of small, insular populations; more stable species composition; increased or stable genetic variability; and the buffering of populations from potential small-scale and large-scale stochastic perturbations. Small-scale stochastic effects may arise from disease, poaching, flood, fire, etc.; whereas, large-scale stochastic effects may arise from prolonged drought, intense monsoons, or seasonal cyclones: all common annual events to this region of central Vietnam.

Unfortunately, areas adjacent to the northern section of Dakrong WPF are isolated from the nearest remnant forests located in southern Quang Binh province by a large expanse of agriculture, scrubland and grassland areas.

Surveys for remnant forest patches to the north would probably suggest it is not feasible to link the proposed nature reserves to the nearest northern area of conservation coverage, because the karsts of Phong Nha Nature Reserve effectively divide the study site from Ke Go Nature Reserve, approximately 150 km to the north. Providing corridors to other, smaller lowland forest patches to the north of study area may be still be feasible.

Nevertheless, the forest coverage of southern Thua Thien Hue province is larger, and the remaining forest of Phong Dien WPF is adjacent to Huong Thuy and Nam Dong districts to the south, which include Bach Ma National Park. The intersecting area extending from Hue city to A Luoi district south of the study area was especially affected by chemical defoliation. Existing forest patches could be preserved



to rebuild corridors between Phong Dien and Dakrong Proposed Nature Reserves and Bach Ma National Park.

The eastern sections of Phong Dien and Dakrong WPFs abut the Tam Giang wetlands, and there are existing riparian habitats linking these two areas. Although this wetland area is not within the proposed protection area and was not included in this study, it is a unique habitat type for fauna and flora and is recommended for inclusion in the national network of 'Special-Use Forests'. Linking this wetland habitat to the proposed Phong Dien and Dakrong Nature Reserves via riparian corridors would also act to promote more sustainable water management in the area.

The adjacent areas to the west and south-west of Phong Dien and Dakrong WPFs have also suffered a long history of conversion to agriculture but there are still remaining primary forests in the A Luoi Valley and neighbouring, contiguous forested areas in Laos.

The overall potential linkage to other areas of existing lowland forest patches, is:

- (1) **North:** doubtful linkage to areas of conservation coverage without including long stretches of tropical montane rainforests above 1,000 m. Possible linkage to nearby lowland forest patches which could provide increased habitat area should be assessed.
- (2) **East:** existing linkage to the Tam Giang wetlands, a presumably valuable but unstudied wetland system of tropical finger lakes bisected by National Highway 1, is highly recommended for inclusion in the proposed nature reserves.
- (3) **West:** lowland forests exist in the A Luoi Valley in A Luoi district adjacent to Dakrong district but linkage would have to be propagated, possibly by including intervening areas in Dakrong district's agroforestry programme.
- (4) **South:** a large enough number of lowland forest patches exist to the south of the study area for the feasibility of a possible corridor link to Bach Ma National Park to be considered.

3.3 Evaluation of Regional Biodiversity Conservation

The initial survey of the study area found 171 bird species, 43 mammal species, 38 reptile species, 19 amphibian species, 213 butterfly species and 597 plant species.

The shortcomings of this survey were that, firstly, it was a quick assessment and that, secondly, nocturnal species were not specifically included. Freshwater fauna and flora were entirely excluded from the survey, as were terrestrial invertebrates with the exception of butterflies. Two particularly important mammal orders in tropical forests, the Rodentia and Chiroptera, were also not included in the survey. With this in mind, further surveys would reveal additional new species records for the area.

The bird component of the survey primarily represents resident species because the survey was conducted during the summer months. Some important migrants that can be expected to occur seasonally in the study area have not yet been identified. Furthermore, the survey took place during the height of the dry season and many forest fruits were not in season. However, the lack of water probably acted to congregate resident species at available water sources, and thus the record for resident birds is probably comprehensive. The flora of the study area appears to have levels of species-richness comparable to other protected areas in central Vietnam (Table 18).

Table 18: Botanical Diversity in the Annamese Lowlands EBA

Conservation Area	Area (ha)	Families	Genera	Species
Bach Ma National Park	22,031	124	351	501
Vu Quang Nature Reserve	52,360	—	—	508
Ke Go Nature Reserve	24,801	117	367	567
Phong Dien and Dakrong WPFs	69,478	118	366	597

3.4 Conservation of Threatened and Recently-Described Species

The total number of red-listed species found in the Phong Dien and Dakrong WPFs is high (Table 19). Range-restricted endemism, loss of suitable habitat and hunting pressure are the primary factors contributing to this rarity.

Table 19: Number of Total, IUCN and Vietnam Red-listed Species

Group	Total No. of Species	IUCN Listed Species	Vietnam Listed Species	Total No. Listed Species	% of Total Species Listed
Mammals	43	21	15	24	56
Birds	171	16	18	23	13
Reptiles	38	8	15	16	42
Amphibians	19	0	4	4	21
Butterflies	213	0	0	0	0
Plants	597	4	14	16	3

Although the percentage of threatened species represents only 7 % of the total species recorded in the study area, the figure climbs to 23 % of the total if only higher vertebrates are considered. Mammals, reptiles and amphibians, in particular, have high proportions of threatened species. However, the total number of threatened bird species is very high and includes species of particular importance as indicator species.

Birds

The Phong Dien and Dakrong WPFs are most likely the last refuge of Edwards's Pheasant, a critically endangered species, rediscovered in 1996. Another resident bird species endemic to Vietnam and endangered is Annam Partridge, presently known from only two areas. The ten species of birds in the Phasianidae found in the study area are ground-nesting species particularly prone to hunting pressure and habitat degradation.

Additionally, there are five resident bird species listed as vulnerable: Siamese Fireback *Lophura diardi*, Red-collared Woodpecker, Crested Argus, Blyth's Kingfisher *Alcedo hercules* and Short-tailed Scimitar-babbler (a highly specialised, monotypic genera). Seven other resident bird species are listed as near threatened: Yellow-vented Pigeon *Treron seimundi*, Coral-billed Ground Cuckoo *Carproccocyx renauldi*, Blue-rumped Pitta *Pitta soror*, Bar-bellied Pitta *P. ellioti*, Grey-faced Tit-babbler, White-winged Magpie *Urocissa whiteheadi*, Indochinese Green Magpie *Cissa hypoleuca* and Brown Hornbill *Anorhynchus tickelli* (Collar *et al.* 1994).

There are seven restricted-range bird species which occur in Phong Dien and Dakrong WPFs. Of these, three species are endemic to Vietnam: Edwards's Pheasant, Annam Partridge and Short-tailed Scimitar-babbler. Four more species have distributions with ranges restricted to Vietnam and Laos. These are the Red-vented Barbet, White-cheeked Laughingthrush, Red-collared Woodpecker and Grey-faced Tit-babbler. One more species, Crested Argus, has a distribution limited to Peninsular Malaysia, and Vietnam. Phong Dien and Dakrong Proposed Nature Reserves would add significant conservation coverage for restricted-range and endemic bird species within Vietnam's 'Special-Use Forest' system.



The species composition of Bach Ma National Park, a predominantly mountainous area with limited lowland forests, is similar to Phong Dien and Dakrong WPFs with the exception of Edwards's Pheasant. This pheasant was historically found in Bach Ma National Park and was the original reason proposed for the establishment of the park in 1925 and again in 1941. However, the park was not gazetted until 1965 (Eve 1997), and recent surveys suggest that Edwards's Pheasant no longer exists in the national park (Eve 1997, Eames 1997).

Ke Go Nature Reserve lies within the Annamese Lowlands EBA. The restricted-range endemic bird species of conservation significance differ, however. In Ke Go Nature Reserve, they include the vulnerable Chestnut-necklace Partridge *Arborophila charltonii* and White-winged Duck *Cairina scutulata*, the endangered Vietnamese Pheasant *Lophura hatinhensis*, and the critically-endangered Imperial Pheasant *Lophura imperialis*. Ke Go Nature Reserve does not provide conservation coverage for either the endemic Annam Partridge or the critically-listed Edwards's Pheasant, which Phong Dien and Dakrong WPFs do. Thus the two protected areas would be complimentary. In addition, the Imperial Pheasant, found in Ke Go Nature Reserve, has been reported by hunters in A Luoi district, Thua Thien Hue province: the district bordering the study area to the south.

Various authors have speculated that Vietnamese Pheasant and Edwards's Pheasant belong to the same species but the only supporting data available are comparisons of physiognomic characteristics of mainly captive bred populations (Rasmussen 1998). The majority of captive-bred Edwards's Pheasant originated from specimens transported to France, Germany, Japan and possibly England in 1924, 1928 and 1930 by Delacour (Ciarpaglini and Hennache 1997). The bloodline of the few remaining specimens after World War II is thought to have been compromised by extensive inbreeding, crossbreeding with the Imperial Pheasant, and the subsequent hybridisation of these crossbred progeny (Hennache 1997, Rasmussen 1998).

Phong Dien and Dakrong WPFs are of international importance for the conservation of Edwards's Pheasant, as this is the only currently known site for this critically-threatened species and represents the only known genetically pure stocks in existence.

Mammals

Out of the 43 mammal species recorded in Phong Dien and Dakrong WPFs, 24 mammal species are red-listed. Several endemic endangered species are of extreme conservation significance, including two of the most recently discovered large mammal species in the world: Sao La and Giant Muntjac, both representing a new genera, and discovered in 1992 and 1994 respectively. Both Sao La and Giant Muntjac are listed by IUCN as endangered (IUCN 1996).

The presence of several other endangered and vulnerable species greatly increases the conservation value of this area. Other mammal species that are listed in the IUCN Red List of Threatened Animals as endangered include Tiger, Douc Langur *Pygathrix nemaeus*, Southern Serow *Naemorhedus sumatraensis* and Pig-Tailed Macaque *Macaca nemestrina*. Mammal species that are listed as vulnerable include Bear Macaque *M. arctoides*, Gaur, Clouded Leopard *Pardofelis nebulosa*, Asiatic Black Bear *Ursus thibetanus*, Sun Bear *U. malayanus*, Malayan Porcupine *Hystrix brachyura* and Dhole or Indian Wild Dog *Cuon alpinus*. Notable listed near-threatened mammal species are Chinese Pangolin *Manis pentadactyla*, Sunda Pangolin *M. javanicus*, Rhesus Macaque *Macaca mulatta* and Golden Cat *Catopuma temmincki*.

Many of the records of endangered and threatened mammal species made during this survey were based solely on incidental reports from hunters. This further suggests that the larger mammal species are under intensive hunting pressure and/or limited to a restricted habitat type and may only be present in small numbers.



Herpetiles

A total of 19 herpetile species are included in the Red Data Book of Vietnam (Anon. 1992). Of these, 15 are reptiles and four are amphibians. The primary and less degraded secondary forests provide habitat for the majority of herpetiles (68 % of the total species). A similar 68 % of the amphibian species are found in riparian habitats.

Many of the species are probably threatened as a result of over-collecting, primarily for food, medicine and purported aphrodisiac qualities. Unfortunately, the demand is high and the market value for these animals increases with their rarity.

Butterflies

Many of the butterfly species recorded are typically found throughout Indochina or have even broader geographic distributions; however, seven butterfly species can be considered endemic to central Vietnam. One species, *Papilio noblei*, is included Appendix I of CITES (1994), and has been recommended for inclusion in the Red Data Book of Vietnam.

In order to evaluate the similarity between the butterfly species recorded in Dakrong and Phong Dien WPFs with other areas of central Vietnam, the species recorded were compared with those known from Bach Ma National Park in Thua Thien Hue province and Vu Quang Nature Reserve in Ha Tinh province (Table 20); both are in the same region as the proposed nature reserves.

Table 20: Similarity in Butterfly Fauna of Dakrong (DK) and Phong Dien (PD) in comparison with Bach Ma National Park (BM) and Vu Quang Nature Reserve (VQ)

Butterfly Family	Total Number of Species			Number of Shared Species		
	DK+PD	BM	VQ	DK+PD & BM	DK+PD & VQ	BM & VQ
Papilionidae	23	21	25	19	20	18
Pieridae	22	24	18	19	14	16
Danaidae	14	12	13	10	9	9
Satyridae	11	22	25	6	7	13
Amathusidae	8	8	8	7	6	6
Nymphalidae	41	54	56	27	35	37
Riodinidae	5	5	6	3	4	5
Hesperiidae	42	46	45	19	15	16
Total	166	192	196	110	110	120

The study area was further compared using the Soreson Similarity Index (Magurran 1988) (Appendix 5). This analysis is considered appropriate in this application as an indication of habitat diversity, as butterfly species are well documented for a high degree of niche separation, utilising a wide variety of species-specific food plants. The Soreson Similarity Index C_s is calculated 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 C_s indices suggests greater similarity between two areas. The comparison was conducted for each butterfly family. The comparison of Soreson Similarity Index results shows a great similarity between species among main family groups, with the exception of two families: the Satyridae and Hesperiidae which have very low index values ($C_s = P < 0.05$).



The low similarity of the Satyridae may be a geographical characteristic of the family, as it is known that species of Satyridae in the *Lethe* genus are associated with temperate highland areas. However, the Hesperidae is the most species-diverse family in the areas compared and warrants a better explanation.

High C_s values suggest high similarity in species composition and therefore habitat types among the areas compared (the C_s in seven areas of northern and central Vietnam are 0.0267 and 0.4842). Therefore, butterfly species diversity and composition in Phong Dien and Dakrong are typical for lowland forests in central Vietnam.

Table 21: Average Global Distribution of Butterfly Families Found in the Study Area

Butterfly Family	Average Value of Butterflies in Phong Dien and Dakrong	Average Value of Butterflies in Ngoc Linh
Papilionidae	3.09	2.55
Pieridae	2.86	2.56
Danaidae	3.21	3.22
Satyridae	2.55	2.19
Amathusidae	1.88	0.78
Nymphalidae	3.12	2.59
Riodinidae	2.40	1.91
Lycaenidae	2.70	2.67
Hesperidae	2.79	2.45
All Species	2.86	2.44

To confirm that butterfly species diversity and composition in Phong Dien and Dakrong WPFs is typical of lowland forest areas in central Vietnam, the average values for global distribution of butterflies found in Ngoc Linh Nature Reserve (a nearby protected area in Kon Tum province) were compared with those in Phong Dien and Dakrong WPFs (Table 21). The species in each butterfly family was tallied and an average taken, which was then divided by the global distribution area of the family as a means of comparing different areas of Vietnam. Those families found in the study area were comparatively more diverse than those found in a nearby protected area indicating a relatively high number of butterfly species in the study area.

The average global distribution is calculated by using the following formula:

$$\text{Average value} = G/N$$

Where: G = Global distribution areas
N = Number of species

The high average global distribution values indicate most families have broad distributions with conversely low endemism. Species with distributions in the Sino-Himalayan region are more numerous than the species found in northern Indochina or endemic species in Vietnam.

In conclusion, although the study area is mostly secondary and degraded forest, butterfly species diversity is high. The initial survey included six new butterfly species records for Vietnam. The butterfly communities of Phong Dien and Dakrong WPFs are typical of lowland forests in central Vietnam.

3.5 Comparison with Biodiversity in Vietnam's National Parks

Conservation coverage for total species is comparable to the available data for other areas protected under Vietnam's network of 'Special-Use Forests' (Table 22) and is deserving of comparable conservation protection coverage.



Table 22: Biodiversity in Selected Protected Areas

Special Use Forest Area	Mammal Species	Bird Species	Reptile Species	Amphibian Species	Plant Species
Ba Vi National Park	38	113	41	27	812
Cat Ba National Park	28	37	20	—	—
Cuc Phuong National Park*	64	137	36	17	1,967
Ba Be National Park	38	111	18	6	354
Bach Ma National Park*	55	158	—	—	501
Yok Don National Park	62	196	—	13	464
Cat Tien National Park	62	121	22	14	632
Con Dao National Park	18	62	19	6	361
Phong Dien/Dakrong WPF*	43	171	38	19	597

Sources: Sung (1997) and MOF (1991b)

* situated in the Annamese Lowlands EBA.

3.6 Potential Value of the Proposed Nature Reserves

Protected areas are increasingly required to provide justification on both biological and socio-economic grounds. The roles of protected areas are often undervalued or poorly understood by the public.

Conservation Value

The proposed nature reserves are significant for their comparatively large conservation coverage, patches of lowland forest, high species diversity, levels of endemism, and populations of threatened species. Given the historic degradation, reduction and fragmentation of forest cover, along with continuing environmental stress and regional population growth, the existing remnants of lowland forest in central Vietnam will increase in conservation value as they become scarcer and more threatened in the future.

Flood and Erosion Control

Phong Dien and Dakrong districts include the upstream catchments for four river systems: the Dakrong (Thach Han), My Chanh-O Lau, Bo Huong and A Sap. Because of the topography, localised rainfall patterns and temporal rainfall intensity, downstream areas can be especially prone to erosion and flood damage. Further protection of these WPFs is highly recommended for the prevention and reduction of flash floods, soil erosion, and as rainwater intrainment and internment areas. Upgrading to nature reserve status would confer more effective forest management and thus greater watershed protection to the conservation area and downstream areas.

Water Supply and Irrigation Projects

The rivers fed by the catchments of the study area supply freshwater for several major agricultural areas downstream. Two national irrigation projects have been constructed to serve these areas:

- The first is an agricultural irrigation project in south Thach Han inaugurated in 1981. This dam project has the capacity to service an irrigated area of 16,900 ha and is currently irrigating 8,700 ha of wet rice in the districts of Trieu Phong, Hai Lang, Phong Dien and parts of Quang Tri province.
- The second is the Hoa My irrigation project, located in Rao Quao district along the O Lau River. This man-made lake of 218 ha has a volume of 12 million m³ and provides water for 2,000 ha of wet rice cultivation.

Although both irrigation projects have helped the local economy, poor management in the region has caused several problems. Exploitation and degradation of forests has resulted in excessive soil erosion, and the resulting siltation has significantly decreased the life expectancy of the aforementioned irrigation



projects. Recent surveys indicate that the build-up of alluvial silt in the irrigation dam of the south Thach Han irrigation project is already two metres deep after 17 years. At low water, previously navigable waterways are now rendered impassable. In 1998, a particularly long drought coupled with seasonal hot, dry winds caused a severe water shortage in Quang Tri province with serious repercussions for local agriculture and human health.

The two WPFs currently provide irrigation water for 10,700 ha of agricultural land and supply the two irrigation projects. More irrigation projects have been proposed for areas serviced by these water catchments and better management of riparian areas would have a high value in offsetting erosion and siltation.

Comprehensive environmental cost-benefit analysis are highly recommended for any future irrigation projects in this area, particularly for the proposed irrigation projects already scheduled for the area, such as the Khe Lau Dam in Ba Long and Hai Phuc communes.

Knowledge of the current status and management of forests, accurate flow rate models, sediment-loading rates, and seasonal evaporation budgets are essential before further projects are begun.

Buffer Zones

Exhausted agricultural lands surrounding the proposed nature reserves are potentially useful for buffer zones. Inclusion of these areas in the agroforestry programme would not only provide forest resources for local people but would decrease the current use of existing forest patches.

The vicinity of the study area is not as densely populated as other protected areas in Vietnam, and development capital should be notably less than for protected areas in more densely-populated areas, such as Bach Ma National Park. Funds allocated for afforestation of buffer zones under the current agroforestry programme would improve the living standards of the local people and help to prevent future immigration of people into the proposed nature reserve areas.

In changing the agroforestry programme, it is strongly advised that the indigenous tree species of high value are used in any reforestation efforts. Current practices commonly involve replanting with introduced *Casuarina equisetifolia* and *Eucalyptus* spp., both of which produce highly flammable alkaloids and growth-inhibiting hormones thereby increasing fire risk and deterring seed germination of indigenous plant species.

Beneficial areas for establishing buffer zones include:

- (a) adjacent to the O Lau and My Chanh Rivers and its navigable tributaries which extend into the proposed Phong Dien Nature Reserve;
- (b) along both sides of National Highway 14 which include the intersecting area between the proposed Phong Dien Nature Reserve and the Tam Giang wetlands in Phong Dien district;
- (c) along the northern-most proposed border of Dakrong Nature Reserve in Trieu Nguyen, Hai Phuc and Ba Long communes;
- (d) along access roads which traverse areas inside the proposed Dakrong Nature Reserve, namely, the areas outside of the proposed conservation area on the road extending through Ba Long and Ta Long communes and intersecting Huc Nghi commune; and
- (e) between the northern and western proposed boundaries of Dakrong Nature Reserve and existing adjacent settlements in the nine communes in Dakrong district, with particular

emphasis on those communes whose borders include areas of the proposed Dakrong Nature Reserve.

Forestry Resources

Forests in Phong Dien and Dakrong districts contain valuable timber species and were classified as 'Production Forest' sometime after 1976, and as such were the site of a forest enterprise administered by the Provincial Forestry Departments. However, it was soon found that wartime aerial spraying of defoliants, coupled with small-scale exploitation by local inhabitants, had reduced the timber value so much that attempts at logging were halted.

Potentially exploitable forests are limited and currently inaccessible. Primary forest areas with valuable timber trees account for only 12,559 ha or 18 % of the total proposed conservation area. Low densities and inaccessible locations render them too costly to remove by constructing logging roads. Despite this, small-scale extraction of timbers continues, especially for the more valuable wood species.

Medicinal and Ornamental Plants

Medicinal plants are valuable, widely sought after and easily depleted by over-exploitation. The efficacy of wild medicinal plants is well understood in Asia, and they are regularly used for various prophylaxis. Potential pharmaceutical drugs isolated from these plants could provide valuable chemical compounds.

Ornamental plants can be of great commercial value, particularly popular species with aesthetic characteristics such as varieties with uncommon variegated colours, unusual leaf or flower morphology, and/or naturally stunted (miniature) species.

Genetic Variability

Tropical forests are increasingly regarded as valuable genetic reservoirs with many possible agricultural and husbandry applications. They represent not only many potentially untapped, commercially exploitable animal resources but also a source for valuable plant strains with increased production, hardiness and disease resistance.

Tourism

Unfortunately, the low density of large mammals, combined with the lack of prominent landscape features, limits the potential for ecotourism in the area. The nearest area presently of cultural tourist interest is Hue city and some residual tourism could be expected to reach the study area.

Birdwatching. Ornithological tours, on the other hand, are increasingly popular in western countries, and the study area shows promise as a desirable destination to be included in ornithological itineraries. One potential drawback is that the most endangered and visually stunning species are especially difficult to observe; Edwards's Pheasant falls into this category.

Ethnotourism. Another area of tourism potential is ethnotourism, tours that emphasise ethnographic interest in the region. These tours, which show participants the lifestyles and culture of the local ethnic groups, are becoming popular in Vietnam. Tours which respect and recognise the intrinsic value of local customs can help to preserve these cultures and their customs. The minorities found in the study area and some of their ethnographic characteristics (Dang Nghiem Van *et al.* 1993) of potential tourist interest are:

- (a) **The Ta-oi (Pa-co and Ba-hi).** These people traditionally hunted and domesticated elephants. Their village communal house is used for receiving guests and exhibiting jars, gongs and hunting trophies. Women traditionally file their teeth, stretch their earlobes and wear various intricate ornaments such as earrings, necklaces and bracelets. The society is patrilineal



which includes complex matrimonial rites forming a triple-alliance system. They practice ritual buffalo sacrifices and have rich spiritual beliefs and musical customs.

- (b) **The Bru-Van Kieu (Van Kieu).** These people live in houses compartmentalised on religious and social beliefs. Women's hairstyle denotes their marital status. Functional chiefs exist at the village or/and district levels. Matrimony involves complex patriarchal rites and customs resulting in a tribal triple-alliance system. Ancestor worship is often combined with vestiges of ancient totemism and is sometimes incorporated with social and cultural taboos. Their material and social culture, particularly musical instruments, story telling, folk singing, popular art and literature, are rich and varied.

The amount of ethnographically unique characteristics that have been retained by these ethnic minorities remains undetermined. If local ethnic minorities have not retained some of their more unique characteristics (face tattooing, teeth lacquering, body ornamentation) or rituals (buffalo sacrifices, matrimonial ceremonies) which are readily observable, then ethnotourism may be of little potential. The area is implicitly as anthropologically and culturally rich as several other areas in Vietnam of high ethnotourist interest, such as Lai Chau and Sa Pa in the mountains of northern Vietnam.

Agricultural Self-sufficiency and Agroforestry

Approximately 49 % of the proposed nature reserves is degraded forest habitat, exhausted agricultural land, scrubland or grassland. Much of it shows signs of seral succession but has minimal potential for new agriculture.

The most common local subsistence crops include rice, maize, cassava and green beans. Forest products range from various meats, tubers and plants, traditional medicines, scented wood and resins, tannins, ornamental plants, bamboo, construction material, and timber products.

Incorporating buffer zones into Vietnam's agroforestry programme would potentially realise several benefits. Teaching more productive agricultural methods and the sustainable exploitation of forest products are the most immediate and valuable benefits to the local inhabitants. The objective should be to produce sufficient food and materials to alleviate the hunting and collecting pressure on the remaining lowland forest.

Research and Local Stewardship

Available research on forest patches is sparse and limited. Understanding the dynamic nature of forest patches is crucial for proposing land use alternatives aimed at minimising the loss of species. The proposed protected area provides an opportunity to determine the progression of seral succession, minimum viable population sizes, rates of extinction, and levels of migration between populations living within this habitat type.

Local ethnic minorities have a history of hunting and gathering in the study area and retain a wealth of information on species diversity, ethology, distributions, richness and other useful information. They are potentially valuable as local stewards for the protected areas. Future educational programmes, management activities, conservation measures, law enforcement, and research efforts should aim to incorporate these ethnic minorities in their programmes.

3.7 Evaluation of Management Roles, Policy and Objectives

Management Roles of government and NGOs

Vietnam's system of 'Special-Use Forests' is unlikely to succeed in its objectives without the assistance

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and support of local communities, various government agencies, and Non-Governmental Organisations (NGOs). These various entities are particularly important in terms of defining and prioritising long-term objectives.

The Ministry of Agriculture and Rural Development (MARD) is responsible for Vietnam's National Parks. Management of Nature Reserves is the responsibility of the Provincial People's Committees. Limited resources are available to the government bodies responsible for development and management of protected areas.

NGOs should have a particularly active role, not only in management and conservation training, sustainable development, tourism training, educational awareness, but also in developing assistance and co-ordinating multilateral efforts.

The general scope of activities for NGOs includes to:

- Conduct environmental and social awareness programmes;
- Perform environmental and conservation education programmes;
- Assist in professional management training programmes;
- Devise and implement management and conservation plans;
- Conduct environmental assessment, management and monitoring;
- Supervise sustainable resource and forestry management;
- Identify economic, biodiversity and conservation priorities;
- Monitor environmental law compliance;
- Protect genetic variability and resources;
- Oversee on-going research and long-term monitoring studies;
- Recommend expansion, linkage and corridor prospects;
- Supervise policies regarding threatened species and habitats; and
- Acquire funds and grants for long-term management.

Devising a Management Policy

Devising a management policy for the proposed nature reserves is determined by site-specific requirements. The proposed nature reserves' management requirements are a function of three factors:

- (a) determining the features which require protection;
- (b) determining the management actions; and
- (c) establishing compatible usage with limited disturbance.

Features Protection. These specific protection features are the basis for devising a site-specific management policy (Table 23).

Table 23: Protected Features of the Study Area

Features that should be Protected	Site Considerations
Characteristic or unique ecosystems	Lowland forest fragments
Special species of interest, value, rarity or under conservation threat	23 % of higher vertebrates, including 24 mammals, 23 birds and 20 herpetiles are red-listed
Sites of unusual species diversity	Remnant patches of key habitat types
Landscapes or geophysical features of aesthetic or scientific value	Little aesthetic appeal, only key habitat types are valuable
Hydrological protective functions	Watershed, flood control, irrigation, erosion
Nature recreation and tourism facilities	Possible niche tourism
Sites of special scientific interest	Forest patches of high scientific value
Cultural sites	None known

Management Actions. Nature reserves are “areas where natural conditions are assured in order to protect nationally significant biotic communities; these areas may require human manipulation for their perpetuation” (MacKinnon *et al.* 1986). Recommendations for manipulative management actions are intended to increase management access and effectiveness, and promote more favourable conditions for habitat and animal populations to recover. The recommended management actions for the proposed nature reserves are aimed at habitat restoration and species conservation.

The interventionist measures recommended for the proposed nature reserves are: preserving fauna associated with habitat types that are in threat of being completely lost, and protecting less viable animal populations that are under threat of immediate extinction.

It is possible that the management efforts that would have to be expended to meet the conservation objectives of the proposed nature reserves may be too extensive to be implemented.

Compatible Usage. Conservation areas are increasingly required to realise benefits for local inhabitants whose livelihoods have been either altered or lost by establishing a conservation area. Unfortunately, if immediate benefits are not realised by the local inhabitants, at least to some extent, the area’s success as a conservation site may be destined to failure.

Visitors should be accommodated in their desire to witness firsthand the areas, habitats, populations and/or species which have been targeted for conservation efforts. Habitats and species which are threatened should be accessible to a limited extent as a means of promoting awareness of the conservation area but should be as non-interventionist as possible.

A concerted effort should be made to determine which target species are intolerant of human contact. Also, access increases the need for regulatory enforcement, and the cost/benefit of visitor access versus affects on threatened species should be considered.

Scientific research is essential for understanding poorly studied areas, particularly small animal populations, forest patches, and unstable habitat dynamics. The potential benefits from research efforts in ecology, ethology, biology, conservation, population dynamics, floristics, dispersal, and sociology within the fragmented lowland forests of central Vietnam are of great potential and should be promoted. Even preliminary studies of density, diversity, richness, distribution and range are valuable for conservation and management efforts.

Recommendations for compatible usage of the proposed nature reserves have been considered with the least amount of potential disturbances to the key habitats and to the critical and more threatened species (Table 24).

Any use with the likelihood of causing significant disturbance is not recommended for the proposed nature reserves on several grounds: available refuge is limited and patchily distributed; habitats are already heavily degraded and unstable; most threatened species presumably have large home ranges; and the viability of existing wildlife populations have not yet been determined.

Table 24: Recommended Compatible Usage of the Proposed Nature Reserves

Utilisation/Disturbance	Nature Reserves Recommendations
Collecting firewood and forest products	not for recovering or damaged habitats
Traditional hunting and fishing	not for depleted threatened populations
Villages	none currently known within boundary
Grazing of domestic stocks	not if conflicts with wild animal stocks of if inhibits seral succession
Limited agricultural use	not permitted
Selective logging	not permitted
Clear felling with reforestation	not permitted
Silviculture	not permitted
Agroforestry/polycultures	only if polyculturing species
Mining or quarrying	not permitted

Management Objectives

Site-specific management objectives for the proposed nature reserves are based on the protection features, the extent of management actions contemplated for the area, and the range of compatible usage with limited disturbances.

The management objectives for the proposed Phong Dien and Dakrong Nature Reserves are to:

- (a) conserve the remaining lowland forest patches;
- (b) protect the populations of rare, threatened, endangered, range-restricted and endemic species, especially Edwards's Pheasant;
- (c) protect and maintain the area's rich biodiversity;
- (d) conserve the potential genetic resources in the area;
- (e) promote the creation of buffer zones and corridors which provide linkage to other areas of conservation coverage;
- (f) safeguard the watershed protection to reduce soil erosion, siltation, drought effects, and flooding;
- (g) help maintain a source for freshwater and irrigation supply for downstream users;
- (h) improve local knowledge and practices for responsible land stewardship, sustainable land use and tourism;
- (i) promote the on-going management of the reserve and the co-operation of the local community, government and non-governmental organisations in determining the reserve's goals;
- (j) promote and facilitate research, particularly in the conservation of endangered animal populations and the dynamics of forest patches; and
- (k) demonstrate the ability to manage and sustainably utilise forest resources while managing a comprehensive conservation protection area and to do this without overexploiting the inherently limited resources of adjacent areas.

4. Constraints on Management and Development of the Proposed Nature Reserves

4.1 Physical Factors

Topography. The easternmost parts of the proposed nature reserves are comparatively flat and suitable for agriculture. Forests in this area are easily accessible for exploitation and have been largely degraded. Fortunately, the terrain also makes the area more accessible for protection coverage.

The western areas of the proposed nature reserves are dominated by hill and mountain terrain. This topographically complex area is difficult to protect from exploitation but also represents a particularly difficult area to exploit and extract forest products from. However, a large portion of forested area is easily accessible to the inhabitants of the A Luoi Valley, presenting an enforcement problem.

Rivers. Many of the local waterways are navigable and provide access to the area: the Dakrong River to the north-west, the Quang Tri and Thach Han Rivers to the north, the Bo River to the south, and the O Lau and My Chanh Rivers to the south and south-east allow easy access routes and the means for transporting larger forest products out of the proposed conservation areas.

Precipitation and Flooding. This area has an average annual rainfall rate of 2,500-3,000 mm. Flooding and standing water make many areas in the proposed nature reserves inaccessible, and guard posts should be located with this in mind.

4.2 Biological Factors

Management of Forest Patches. Historic fragmentation processes have created non-contiguous forest patches of different habitat types. Management coverage of widely-distributed forest patches places a high demand on the proposed nature reserves' manpower. In Phong Dien and Dakrong WPFs, efforts should be made to determine each habitat type's potential seral succession, linkage coverage, and associated target species in need of conservation efforts in order to rank the long-term conservation importance of larger patches.

The prioritised areas should be regularly assessed, owing to their dynamic nature, to determine if they are fulfilling the conservation objectives and justifying management efforts. Furthermore, these same considerations should be applied on a larger scale to include assessment for large-scale corridors linking the entire conservation area with adjacent areas for maximising conservation coverage.

Ethology of Conservation Targeted Species. Understanding the ethology of species targeted for conservation efforts is crucial for assuring their survival and proper management. Knowledge of the distribution, range, habitat preferences, mating, feeding, roosting, resting and predation pressure of a particular species is of tantamount importance in any conservation effort.

Comprehensive knowledge for each species targeted for conservation is a key factor in formulating specific management objectives, particularly given the extremely high number of threatened species found within the proposed nature reserves. An exemplary case is presented.

Edwards's Pheasant. Having been rediscovered in 1996, Edwards's Pheasant's natural behaviour and requirements in the wild are poorly known. Some basic tenants can be made regarding the species (Delacour and Jabouille 1931, Delacour 1977, King *et al.* 1975, Vo Quy 1975, Eames pers. comm.).

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As a member of the Phasianidae, Edwards Pheasant characteristics are:

- (a) large and easily identifiable bird;
- (b) does not have loud territorial vocalisations but advertises by wing-whirring;
- (c) capable of limited short flights;
- (d) terrestrial nature, preferring to run rather than fly;
- (e) ground-nesting;
- (f) temperamental species, shuns civilisation;
- (g) extremely difficult to observe in the wild;
- (h) requires daily drinking water source;
- (i) ranges from sea level to approximately 350 m and, possibly, 600 m;
- (j) can flock, probably during mating season;
- (k) may flock in response to seasonally available fruits;
- (l) may pair-bond during brooding; and
- (m) may possibly have non-overlapping ranges during brooding.

These considerations further influence the overall management objectives of the proposed nature reserves by requiring that:

- (a) the entire habitat range should be under strict access regulations to avoid disturbances;
- (b) all hunting of the species should be stopped; and
- (c) strict management and linkage of potential habitats from sea level to around 400 m and, possibly, to 600 m are required throughout the entire conservation area.

Any comprehensive conservation effort for Edwards's Pheasant must include the aforementioned criteria in the management policy as minimal requirements for this species. Equally important is to provide an assessment of the requirements for each conservation-targeted species in the proposed nature reserves. This is an important component of the management plan which should be periodically updated from staff observations.

4.3 Socio-Cultural Factors

Illegal Timber Extraction. The timber resources in the study area are largely unprotected, and small-scale timber extraction operates unhindered. The scarcity of economic timber is causing tree felling in both less accessible areas and the targeting of less valuable tree species. Where roads are non-existent, timber is extracted via ferries on the O Lau and My Chanh Rivers.

In Dakrong district, timber extraction is equally critical. Water buffalo and bullock teams haul most felled timbers to National Highway 14. Pathways are cleared for the bullock teams creating further problems by disturbing and damaging the forest's understory.

Trapping and Hunting. Common trapping methods include box traps and wire snares. Unfortunately, these trapping methods are indiscriminate, capturing any small animal found in the area and probably causing injury to larger animals.

Rough estimates acquired during the field study suggest that approximately 2,000 traps are in the proposed protection area at any single time. Pheasants are particularly vulnerable to such intensive trapping pressure.

Other Incompatible Uses. Several other forms of exploitation are common but incompatible with conservation efforts in the area. Most notable are activities such as forest burning, agriculture, plant



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gathering, and animal trading. Livestock grazing takes place in the proposed nature reserves, and its effects on wildlife would have to be determined before allowing continued grazing within the nature reserves (Table 25).

Table 25: Status of Current Exploitative Activities in the Study Area

Activity	Method	Impact	Status	Proposed Management
Logging	Chopping, ferry and bullocks	Forest fragmentation and patchiness	Uncontrolled and widespread	Strictly Prohibited
Firewood Collecting	Chopping and hand collecting	Forest fragmentation and patchiness	Uncontrolled and widespread	Strictly Prohibited
Trapping	Box traps and wire snares	Indiscriminate and damaging	Uncontrolled and widespread	Strictly Prohibited
Hunting	Guns	Indiscriminate and damaging	Uncontrolled and widespread	Strictly Prohibited
Forest Clearing	Burning and ring barking	Forest fragmentation and patchiness	Uncontrolled and widespread	Strictly Prohibited
Animal Trading	Via hunting and trapping	Further promotes hunting and trapping	Uncontrolled and widespread	Strictly Prohibited
Grazing	Free access	May impede seral succession	Limited and income source	Limited
Poison and Dynamite Fishing	Ordnance and fertilisers, chemicals	Polluting, large areas, possibly toxic	Unknown	Strictly Prohibited
Leaf Collecting (e.g. for thatch)	Hand-picking	Reduction in ground cover	Seasonal, only 2-3 months/year	Limited
Honey Collecting	Destructive collecting & burning	Reduction in potential income, forest destruction	Seasonal	Limited
Bamboo Collecting	Hand collecting	Habitat loss, forest degradation	Unknown	Limited
Fragrant Oil/Wood	Hand collecting	Habitat loss, forest degradation	Unknown	Strictly Prohibited
Mining	Various methods	Large-scale destruction	Unknown	Strictly Prohibited
Immigration	Relocating	Forest destruction and resource demands	Unknown	Strictly Prohibited

5. Proposed Management and Development Structure

5.1 Current Infrastructure

Phong Dien and Dakrong WPFs are currently poorly administered. Both areas lack appropriate facilities. Neither area has support vehicles or communications equipment. Forestry personnel salaries are low and subsidised by MARD. However, one Forestry Protection Department branch does exist in Phong Dien district and three Forestry Protection Department branches exist in the Dakrong district.

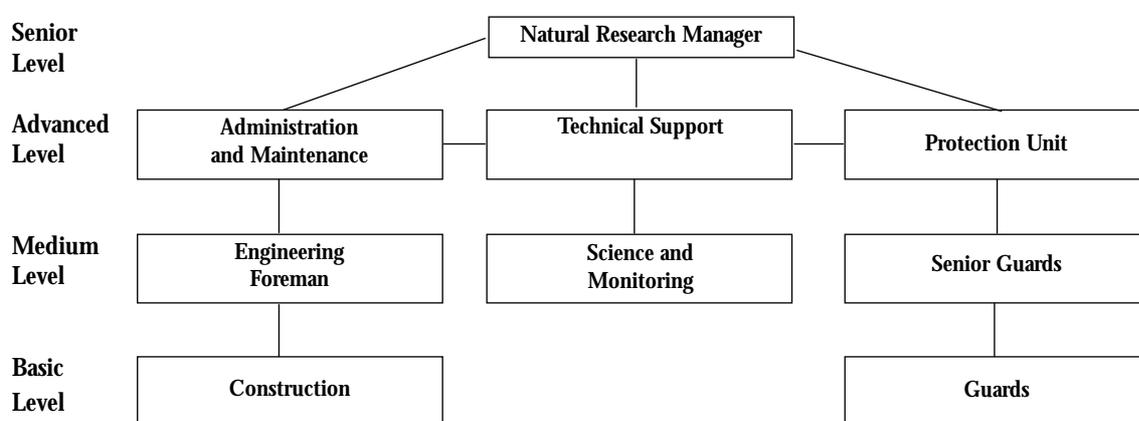
Phong Dien district has three staff responsible for managing resources in Phong My, Phong Xuan and Phong Son communes. They are responsible for managing 33,875 ha of the WPF. In Dakrong district, three Forestry Protection Department branches are responsible for managing 32,171 ha of the WPF.

5.2 Proposed Staffing

Initial personnel required to manage the proposed nature reserves includes the following staff:

- (1) **Nature Reserve Director.** Responsible for managing all nature reserve staff and co-ordinating with government bodies, institutions, consultants and NGOs. Integrate, support, co-ordinate and present all activities and programmes that address the reserve’s objectives.
- (2) **Administrative Director.** Responsible for overall operational aspects of the reserve. Reports to director on physical, institutional and personnel activities, as well on the budgetary status.
- (3) **Technical Director.** Responsible for co-ordinating scientific specialists in investigating specific aspects of the nature reserve necessary for management and interpretative programmes. Must be aware of any occurring impacts and responsible for technical support and maintenance.
- (4) **Protection Supervisor.** As head ranger, responsibilities include working with scientists to design and implement necessary resource management activities. Interacts with visitors, controls and monitors resources, applies reserve laws and policies, and co-ordinates the activities of guards.

Figure 1: Schematic Diagram of the nature reserves’ Staff Hierarchy



The personnel responsible for enforcing the conservation coverage may be recruited locally or appointed

from outside the region; distinct disadvantages and advantages exist for both (Table 26).

Table 26: Locally versus Regionally Recruited Conservation Personnel

Local Recruitment		Regional Recruitment	
Advantages	Disadvantages	Advantages	Disadvantages
Can select most able and best members of the local community.	Locals often have low education levels and are poorly qualified.	Regional searches offer a much wider pool of potential employees.	May have little empathy for locals or their customs and traditions.
Locals are familiar with conservation area and have local knowledge.	Locals may be more lenient on infringements by other locals.	Regional employment can select more highly educated personnel.	May be reluctant to explore and provide cover of unknown areas.
Locally employed work force generates goodwill amongst the local communities.	Locals may be involved in long-standing local divisions, feuds or clan conflicts.	Regional staff can be posted where no previous loyalties or relationships exist.	May be unsuitable for work in remote areas or feel they are upper management level.
Locals are more likely to maintain their posts if families are either nearby or accompany.	Loyalties may be stronger towards family or local clans, creating resentments.	Regionally hired staff can be moved in the event of local problems or serious trouble.	May be of poor qualification or standard as applicants for lower paying jobs.

Local recruitment of protection personnel is more desirable than hiring regionally. With training and education, local recruits can fulfil all but the highest levels of conservation protection positions. With local recruits, the benefits in both local knowledge and social goodwill are great and can be a long-term benefits in meeting the management objectives.

5.3 Nature Reserve Headquarters and Visitor Access

Dakrong Nature Reserve Headquarters. The recommended location for Dakrong Nature Reserve's headquarters is in Trieu Nguyen commune at 16°39'N, 106°58'E. It is centrally located with road access provided by National Highway 9, and is in an area with comparatively high primary and secondary forest cover. This area is also easily accessible by visitors.

Phong Dien Nature Reserve Headquarters. The recommended location for Phong Dien Nature Reserve's headquarters is in Phong My commune at 16°31'N, 107°17'E. It is in the centre of a densely populated area, and controls road and river access to the forest. The headquarters is about 13 km by road from National Highway 1A.

Table 27: Population, Forest Cover and Access for the Study Area

Commune	Total Pop.	Pop. Density (pers/km ²)	Protected Area (ha)	Forest Cover (ha)		Access Via	
				Primary (Rich)	Secondary (Medium)	Road	River
Dakrong district							
Trieu Nguyen	1,966	38.5	2,799.1	6.6	624.5	+	+
Ta Long	2,111	11.4	5,790.3	1,070.2	2,034.6	+	+
Ba Long	2,651	46.8	2,213.9	0	130.4	+	+
Hai Phuc	373	4.4	6,711.0	0	1,042.3	-	+
Huc Nghi	823	6.6	11,945.6	4,484.8	2,742.6	+	-
Ta Rut	2,219	36.7	5,418.7	2,720.6	1,014.4	-	
Phong Dien district							
Phong My	4,172	10.6	28,409.1	1,736.1	858.6	-	+
Phong Xuan	4,059	22.4	5,996.0	2,541.5	0	-	-

Sources: Quang Tri and Thua Thien Hue Departments of Statistics (1997).



Demographics, Access and Protection Units. communes with the highest population densities may represent the highest potential conservation threats to existing forest patches. communes with the largest remaining forest cover are areas should also receive concerted conservation efforts. The total area, the area of existing forest cover, and the degree of restricted access all suggest the amount of effort needed to provide protection coverage (Table 27).

Guard Stations and Conservation Personnel. Recommended placement of guard stations is aimed at achieving maximum conservation protection coverage. Protection coverage includes creating perimeters around the most pristine forest cover, protection of access routes, and establishing stations between the more heavily-populated areas and remaining forests.

Manpower requirements for comprehensive protection coverage includes 12 conservation protection teams, with 12 senior guards and 60 guards (72 staff in total), and the establishment of 10 guard stations. Two teams would be mobile units within the nature reserves (Table 28). All protection units would be required to conduct regular patrols and maintain diaries of useful information, wildlife sightings, animal tracks, fruiting trees, human disturbance, etc.

Table 28: Recommendations for Guard Stations, Staffing Requirements, and Coverage

Guard Station	Location	Guard Staff	Conservation Protection Coverage
Dakrong Nature Reserve			
Trieu Nguyen commune	16°39'N, 106°58'E	Headquarters	Centrally located with good road access to both Nature Reserves and easy visitor access.
Dakrong commune	16°37'N, 107°53'E	1 Senior Guard and 5 Guards	Located in large forest patch that is not included in protection zoning.
Ta Long commune	16°34'N, 107°00'E	1 Senior Guard and 5 Guards	Good monitoring area near centre of population.
Hai Phuc commune	16°37'N, 107°03'E	1 Senior Guard and 5 Guards	Located between northern access and northern extension of largest forest patch.
Huc Nghi commune	16° 27' N, 107°00'E	1 Senior Guard and 5 Guards	Provides coverage for the northern section of largest forest patch with road access.
Ta Rut commune	16°25'N, 107°02'E	1 Senior Guard and 5 Guards	Located between main access road and mid-section of largest forest patch with road access.
Hong Thuy commune	16°24'N, 107°05'E	1 Senior Guard and 5 Guards	Provides coverage for forest in south of nature reserve.
Not Applicable	Mobile Unit	1 Senior Guard and 5 Guards	Mobile team that constantly relocates to check station-based conservation coverage.
Phong Dien Nature Reserve			
Phong My commune	16°31'N, 107°17'E	Headquarters	Centrally located near to O Lau River.
	16°30'N, 107°17'E	1 Senior Guard and 5 Guards	Extends conservation perimeter to the O Lau River and remaining forest patches.
	16°34'N, 107°14'E	1 Senior Guard and 5 Guards	Creates conservation perimeter between upper reaches of the My Chanh River and between heavily degraded areas and remnant forest patches.
Phong Xuan commune	16°29'N, 107°21'E	1 Senior Guard and 5 Guards	Southernmost protection limit of largest forest patch.
A Luoi district	16°21'N, 107°09'E	1 Senior Guard and 5 Guards	Covers access route of nearest road, about 2 km away, and largest forest patch.
Not Applicable	Mobile Unit	1 Senior Guard and 5 Guards	Mobile team that constantly relocates to check station-based conservation coverage.

5.4 Incompatible Uses of the nature reserves

Regulating use of forest resources is crucial to ensuring that the conservation objectives of the nature reserves are achieved. Regulations for visitors and reserve users should be posted on obvious markers in all access areas to the reserves.

Non-compatible uses that must be strictly prohibited include:

- (a) Collection of top soil;
- (b) Timber cutting;
- (c) Collection of building materials;
- (d) Construction of temporary or permanent dwellings;
- (e) Construction of trails or roads;
- (f) Collection of fodder or feed plants;
- (g) Cultivation or disturbance of reserve lands;
- (h) Use of flammable materials;
- (i) Use of open fires, except in designated areas;
- (j) Mining for minerals or construction materials;
- (k) Building of dams, ditches or hydrological structures;
- (l) Polluting or discarding wastes, except in provided receptacles;
- (m) Hunting, collecting or harassing any wildlife;
- (n) Possession of weapons, explosives, traps, nets or poisons;
- (o) Possession of pesticides, herbicides, fungicides or fertilisers;
- (p) Walking or hiking on non-designated trails and paths;
- (q) Use of vehicles, other than within strictly designated areas and roads; and
- (r) Introduction of alien or domestic species.

6. Recommendations for the nature reserves

6.1 Proposed Boundaries for Phong Dien Nature Reserve

The eastern boundary would include compartments 886, 887, 888, 889, 897, 899, 905 and 906 in Phong My commune; and compartments 929 and 940 in Phong Xuan commune.

The southern boundary would be the existing border between Phong Dien and A Luoi districts, which includes the catchment areas for the Bo and O Lau Rivers.

The northern and western boundaries would be the existing border between Thua Thien Hue and Quang Tri provinces.

The total area proposed for conservation coverage is 34,406 ha. The nature reserve would include 34 sub-areas or compartments (Map 3). There are no known human settlements or agricultural areas within the proposed boundaries.

6.2 Proposed Boundaries for Dakrong Nature Reserve

The northern boundary would include compartments 823 and 825 in Trieu Nguyen commune; compartments 826, 828 and 829 in Ba Long commune; and compartments 848, 849, 850, 851 and 859 in Hai Phuc commune.

The eastern boundary would be the existing border between Quang Tri and Thua Thien Hue provinces.

The western boundary would include compartments 701, 702, 703, 722 and 723 in Ta Long commune; compartment 729 in Huc Nghi commune; and parts of compartments 725, 734 and 735, also in Huc Nghi commune.

The southern boundary would include compartment 748 and part of compartment 1019 in Hong Thuy commune; and then follow the border between Quang Tri and Thua Thien Hue provinces.

The total area proposed for conservation coverage is 35,072 ha and includes 29 compartments (Map 3). The proposed boundary area does not include any known human settlements (a socio-economist is verifying this) but does include six patches of limited agricultural area.

6.3 Discrepancies in the Proposed Nature Reserves' Boundaries

Unfortunately, the proposed boundaries for Phong Dien and Dakrong Nature Reserves do not include several areas of potentially important conservation coverage. Several more areas should be considered for inclusion in the nature reserves' conservation coverage.

Recommended Areas for Inclusion in Dakrong Nature Reserve

Dakrong and Quang Tri River Confluence Area in Trieu Nguyen and Ba Long communes. There is a significant forest patch adjacent to the proposed northern boundary. This remnant forest patch of primary and secondary forest is located in Trieu Nguyen and Ba Long communes and extends approximately 2 km from the proposed Dakrong Nature Reserve boundary toward the confluence of the Dakrong and Quang Tri Rivers. The entire area between the confluence of the Dakrong and Quang Tri Rivers, a triangular area of nearly 4 km by 3 km, should be included in the conservation coverage



area and would provide a sufficient buffer zone for the remaining forest.

Compartments 704, 721 and 720 in Ta Long commune; and Part of Compartment 725 in Huc Nghi commune. A small portion of secondary forest that is abutting the northernmost extension of the largest remaining primary forest patch is not included in the proposed nature reserve's conservation coverage.

Three compartments, in Ta Long commune are recommended for inclusion in the proposed nature reserve. It is recommended that the entire area of compartment 725 be included in the conservation coverage rather than just half as currently proposed.

Parts of Compartments 734, 735, 744 and 749 in Huc Nghi commune; and Compartment 750 and part of Compartment 1019 in Hong Thuy commune. A strip of secondary forest, contiguous with the mid-section of the largest primary forest patch, is not in the proposed nature reserve but includes a small patch of potentially important primary forest. A line from the intersection of the western border of compartment 735 and the proposed reserve boundary, extending to the eastern border of compartment 750 and the proposed reserve boundary intersection, should be included in the conservation coverage area.

It is also recommended that the entire Hong Thuy commune compartment 1019 be included for conservation coverage. Compartment 1019 is worthy of conservation coverage owing to an existing secondary forest patch that it contains.

Recommended Areas for Inclusion in Phong Dien Nature Reserve

The Tam Giang Finger Lakes. An area of potentially interesting and significant wetland habitats exists approximately 6 km east of the proposed Phong Dien Nature Reserve area. The Tam Giang wetlands are an area of parallel finger lakes which were not part of the surveyed study area. This unique wetlands type and its associated habitat types are not included in Vietnam's system of protected areas.

The Tam Giang Finger Lakes are linked via riparian corridors to the proposed conservation area. Floral and faunal surveys are recommended before determining the feasibility of linking these areas by extending the conservation coverage. This unique wetlands type could increase the biodiversity of the conservation area considerably.

Southern Extension of Primary Forest Cover. An exceptionally large area of the southern boundary of the proposed Phong Dien Nature Reserve is within primary forest. Potentially large forest tracts remain south of the proposed reserve southern boundary. This potential extension of conservation coverage is the most promising direction for providing linkage to other areas of conservation coverage, Bach Ma National Park in particular, and should be thoroughly surveyed.

6.4 Agroforestry Conversion and Buffer Zone Recommendations

The creation of buffer zones is necessary to offset the continued degradation of the existing forest area, and it is highly recommended that the agroforestry programme be closely integrated with this effort. The agroforestry programme should focus efforts on mixed indigenous tree and plant species, and on areas of converted lands or heavily-degraded forest habitats.

The amount of existing agricultural land in the study area is low. However, the area of shifting cultivation, silviculture or reforestation, and heavily degraded forest is 36 % of the total proposed conservation area.

The conversion of the existing agricultural lands adjacent to the study area into the agroforestry programme offers an excellent opportunity for the creation of buffer zones.

Recommended Agricultural Areas for Agroforestry Programme

Northern Boundary of the Proposed Dakrong Nature Reserve: Compartments 827 and 833 in Ba Long commune. This strip of agricultural land is just north of the proposed conservation area, paralleling the proposed Dakrong Nature Reserve boundary in Ba Long commune Compartments 827 and 833 and would create a buffer for the conservation areas in Ha Long, Trieu Nguyen and Hai Phuc communes.

Western Boundary of the Proposed Dakrong Nature Reserve in Huc Nghi and Ta Rut communes.

The six existing agricultural areas in the eastern compartments of Huc Nghi commune and the southern extension of Ta Rut commune, both within and adjacent to the proposed Dakrong Nature Reserve boundary, are widely distributed and disjointed. Presumably, these agricultural areas are located in the more easily accessible areas and as such would provide good buffer zone inclusion.

Recommended Comprehensive Buffer Zone Coverage

The following communes should be included in or further surveyed for potential buffer zone coverage of the proposed nature reserves:

- (a) Compartments adjacent to the proposed Phong Dien Nature Reserve in Phong My, Phong Xuan and Phong Son communes. These areas are outside of the proposed nature reserve to the north, east and south;
- (b) Compartments in Hai Lam commune of Hai Lang district, Quang Tri province to the north of the proposed Dakrong Nature Reserve;
- (c) Compartments adjacent to the proposed Dakrong Nature Reserve in Trieu Nguyen and Hai Phuc communes, and the previously recommended agricultural areas of Ba Long commune, Dakrong district;
- (d) Compartments to the south and east of Ta Long commune and compartments in Ta Long commune recommended for inclusion in the proposed Dakrong Nature Reserve;
- (e) Compartments to the west of the Huc Nghi commune area of the proposed Dakrong Nature Reserve, including the areas already recommended for inclusion;
- (f) Compartments to the east of the Ta Rut commune area of the proposed Dakrong Nature Reserve; and
- (g) The forest areas adjacent and to the south of Ta Rut commune in Dakrong district and Phong Xuan commune in Phong Dien district, including the A Sau and A Luoi Valleys in A Luoi district, Thua Thien Hue province.

6.5 Recommended Evaluations of Management Effectiveness

Periodic independent evaluations of management effectiveness are recommended to determine if the nature reserves' conservation objectives are being met. Evaluations are further recommended as a component of all routine reports and should be conducted as internal audits as well as external audits. Four areas of management importance should be included in evaluations:



EVALUATIONS	INTERNAL AUDITS	EXTERNAL AUDITS
Expenditures and Budgets	Self Evaluations	Independent Experts
Progress and Time Schedules	Headquarters' Assessments	Local Advisory Committee
Goals and Objectives		Visitors' Responses
Cost-Effectiveness		

6.6 Recommended Management Advisory Committee

Phong Dien Nature Reserve should come under the management jurisdiction of Thua Thien Hue Provincial People's Committee, and Dakrong Nature Reserve should come under Quang Tri Provincial People's Committee. The administration of the nature reserves should be through the respective Provincial Forest Protection Departments.

These departments should be responsible for the staffing and expenditures, as well as approaching potential funding sources. They should also be responsible for economic and technical feasibility studies as an addendum to each of the nature reserves' management plans. It is highly recommended that co-ordination of these functions is supported and guided by a management advisory committee composed of civil servants from both provinces as well as residents living near the protected areas.

6.7 Recommended Nature Reserve Advisory Committee

Both the administrative areas of Phong Dien district and Dakrong district should establish a joint Phong Dien and Dakrong Nature Reserve Advisory Committee comprised of representatives from each of the following:

- (a) Reserve Management from the two protected areas;
- (b) Provincial Forest Protection Department from the two provinces; and
- (c) People's Committee from the two provinces.

The joint Phong Dien and Dakrong Nature Reserve Advisory Committee's recommended responsibilities and duties should be to oversee:

- (1) collaboration of the nature reserves' management boards;
- (2) participation with and inputs from the local communities;
- (3) development and management of the nature reserves;
- (4) collaboration with the provinces' agroforestry programmes;
- (5) mitigation or litigation issues associated with the reserves;
- (6) collaboration with NGOs and institutional work and research;
- (7) establishment and maintenance of the buffer zones; and
- (8) potential extension of conservation coverage via corridors.

6.8 Priority Actions

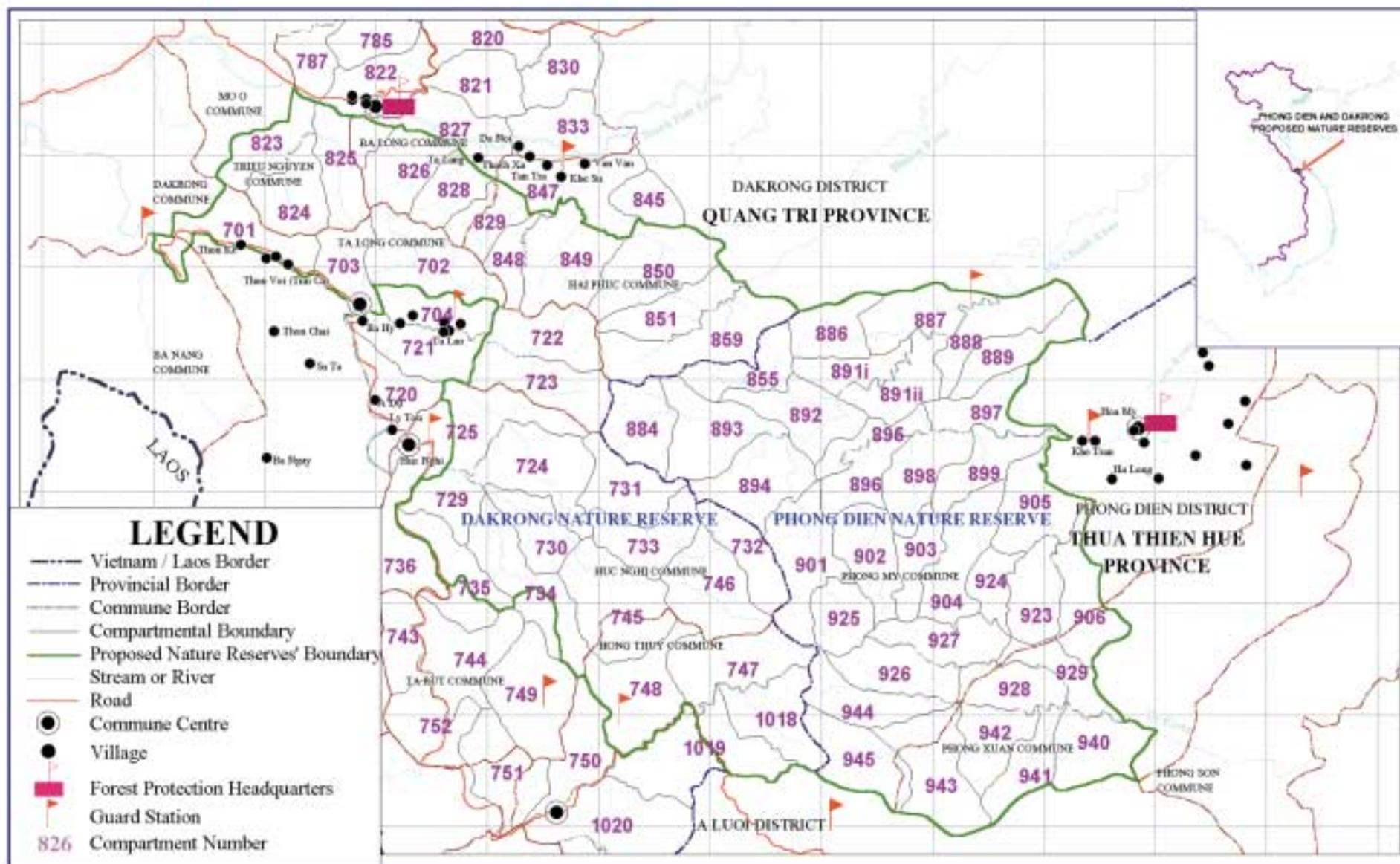
1. Upgrading Phong Dien and Dakrong WPFs within Vietnam's system of 'Special-Use Forests' to nature reserves in compliance with the treaty agreement of the International Conference on Biodiversity initiative to increase Vietnam's conservation coverage from 1,000,000 ha to 2,000,000 ha by the year 2000;
2. Establishing Phong Dien Nature Reserve and Dakrong Nature Reserve under the administrative management of Thua Thien Hue and Dakrong provinces, respectively;



Section 6 - Recommendations for the nature reserves

3. Officially submitting proposals from both Thua Thien Hue and Quang Tri Forest Protection Departments to MARD for funds to establish the two nature reserves;
4. Continued collaboration between the Forestry Inventory and Planning Institute (FIPI) and BirdLife International for financial and technical support to complete management plans for the two nature reserves;
5. Officially announcing the provincial and ministerial policies for the establishment of the two nature reserves via the two Provincial Forest Protection Departments;
6. Instituting education and enforcement of regulations regarding exploitation and protection of the two nature reserves by the respective Provincial Forest Protection Departments, as well as educating and encouraging local stewardship in forest protection and agroforestry development;
7. Conducting resource and biological assessments in the catchment areas of the My Chanh, Khe Moi and Bo Rivers in Thua Thien Hue province and the Khe Lau (Ba Long) and Thuong Che (Trieu Nguyen) Rivers in Quang Tri province;
8. Conducting resource and biological assessments of the Tam Giang Finger Lakes and intervening areas of possible linkage to the proposed Phong Dien Nature Reserve;
9. Conducting detailed socio-economic and forestry surveys of the communes adjacent to the nature reserves' boundaries that have been proposed as buffer zones;
10. Completing project proposals, which include investment estimates, as approved by MARD and the Ministry of Investment and Planning, for establishing Phong Dien and Dakrong Nature Reserves; and
11. Seeking funding from non-government sources to initiate management, protection, scientific studies and socio-economic development of buffer zones, in collaboration with BirdLife International.

Map 3: Phong Dien and Dakrong Proposed Nature Reserves



Map based on field survey in 1998
Grid: UTM, zone 48; Horizontal Datum: India 1960

SCALE 1:120,000

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Appendix 1
Flora of the Study Area

Class, Family, Genus and Species	Code
Polypodiophyta	
Angiopteridaceae	
<i>Angiopteris annamensis</i>	O
<i>A. cochinchinensis</i>	O
Lygodiaceae	
<i>Lygodium auriculatum</i>	
<i>L. conferme</i>	
<i>L. flexuosum</i>	M
<i>L. japonicum</i>	
<i>L. microphyllum</i>	
<i>L. salicifolium</i>	
Gleicheniaceae	
<i>Dicranopteris linearis</i>	
Dicksoniaceae	
<i>Cybotium barometz</i>	M
Cyatheaceae	
<i>Cyathea contaminans</i>	
<i>C. latebrosa</i>	
<i>C. glabra</i>	
Lindsaeaceae	
<i>Lindsaea davallioides</i>	
<i>L. ensifolia</i>	
Pteridiaceae	
<i>Pteris biaurita</i>	
<i>P. ensiformis</i>	O
<i>P. grevilleana</i>	
<i>P. linearis</i>	
Adiantaceae	
<i>Adiantum flabellulatum</i>	O,M
<i>A. philippense</i>	
Blechnaceae	
<i>Blechnum orientale</i>	
Aspleniaceae	
<i>Asplenium cheilosorum</i>	
<i>A. varianus</i>	
Athyriaceae	
<i>Diplazium asperum</i>	
Thelypteridaceae	
<i>Cyclosorus triphyllus</i>	
Polypodiaceae	
<i>Drynaria bonii</i>	M
<i>Microsorium hancockii</i>	
<i>Phymatodes nigrescens</i>	
<i>Platyterium coronarium</i>	O
<i>P. grande</i>	O
<i>Pyrosia acrostichoides</i>	
<i>P. lingua</i>	M
Marsileaceae	
<i>Marsilea quadrifolia</i>	M
Lycopodiophyta	
Lycopodiaceae	
<i>Lycopodium cernuum</i>	
<i>L. ovalifolium</i>	
Selaginellaceae	
<i>Selaginella dodderleinii</i>	
<i>S. involvens</i>	
Pinophyta	
Podocarpaceae	
<i>Dacrycarpus imbricatus</i>	W
<i>Dacrydium elatum</i>	W
<i>Nageia wallichiana</i>	W
<i>Podocarpus nerifolius</i>	W
Gnetaceae	
<i>Gnetum formosum</i>	M

Class, Family, Genus and Species	Code
Magnoliophyta	
Magnoliopsida	
Magnoliaceae	
<i>Manglietia dandyi</i>	W
<i>Michelia mediocris</i>	W
Annonaceae	
<i>Alphonsea boniana</i>	W
<i>A. mogyna</i>	W
<i>Desmos cochinchinensis</i>	O
<i>Goniothalamus aff. gabriacianus</i>	
<i>Justicia annamensis</i>	
<i>Milusa elongata</i>	
<i>Orophea harmandiana</i>	
<i>Polyanthia laui</i>	W
<i>P. nemoralis</i>	W
<i>Uvaria cordata</i>	
<i>Xylopietia vielana</i>	M
Myristicaceae	
<i>Horsfieldia amygdalina</i>	W
<i>H. glabra</i>	W
<i>Knema conferta</i>	W
<i>K. corticosa</i>	W,M
<i>K. furfuracea</i>	W
<i>K. pierrei</i>	W
Chloranthaceae	
<i>Chloranthus spicatus</i>	O
Lauraceae	
<i>Actinodaphne pilosa</i>	W,M
<i>Beilschmiedia leavis</i>	W
<i>B. percoriacea</i>	W
<i>Cinnanomum argenteum</i>	W
<i>C. parthenoxylon</i>	W,M
<i>C. validinerve var. poilanei</i>	W
<i>Cryptocaria ferrea</i>	W
<i>C. lenticellata</i>	W
<i>C. maclurei</i>	W
<i>Lindera chenii</i>	
<i>Litsea cambodiana</i>	W
<i>L. cubeba</i>	M
<i>L. glutinosa</i>	W,M
<i>L. verticillata</i>	W
<i>Machilus bonii</i>	W
<i>M. chinensis</i>	W
<i>Neolitsea eleocapa</i>	W
<i>Phoebe cuneata</i>	W
<i>P. lanceolata</i>	
Piperaceae	
<i>Piper bochmeriaefolium</i>	
<i>P. lolot</i>	M
<i>Zippelia begoniaefolia</i>	
Menispermaceae	
<i>Pericampylus glaucus</i>	
Hamamelidaceae	
<i>Rhodoleia championii</i>	W
Ulmaceae	
<i>Celtis orientalis</i>	W
<i>Gironniera cuspidata</i>	W
<i>G. subaequalis</i>	W
<i>Trema cannabina</i>	
<i>T. orientalis</i>	W
Moraceae	
<i>Antiaris toxicaria var. toxicaria</i>	M
<i>Artocarpus rigidus var. asperula</i>	W
<i>A. styracifolia</i>	W
<i>Boussonetia papirifera</i>	M

Class, Family, Genus and Species	Code
<i>Ficus altissima</i>	W
<i>F. abelii</i>	
<i>F. auriculata</i>	
<i>F. callosa</i>	W
<i>F. championii</i>	
<i>F. fistulosa</i>	
<i>F. fulva</i>	
<i>F. fulva var. minor</i>	
<i>F. heterophyllus</i>	M
<i>F. heteropleura</i>	
<i>F. hirta</i>	
<i>F. hirta var. roxburghii</i>	
<i>F. hispida</i>	
<i>F. langkokensis</i>	W
<i>F. macilentia</i>	
<i>F. pimula</i>	
<i>F. racemosa</i>	W
<i>F. stenophylla</i>	W
<i>var. macropodocarpa</i>	
<i>F. variolosa</i>	
<i>Streblus asper</i>	M
<i>S. brennieri</i>	
<i>S. ilicifolius</i>	
<i>Poikilospermum mollis</i>	
Urtiraceae	
<i>Boehmeria tonkinensis</i>	
<i>Debregeasia squamata</i>	
<i>Dendrocnide sinuata</i>	
<i>Pouzolzia sanguinea</i>	
Fagaceae	
<i>Castanopsis cenatacantha</i>	W
<i>C. indica</i>	W
<i>Lithocarpus amygdalifolius</i>	W
<i>L. annamensis</i>	W
<i>L. corneus</i>	W
<i>L. fissa</i>	W
<i>Quercus bambusaefolia</i>	W
<i>Q. thorelii</i>	W
Juglandaceae	
<i>Engelhardia chrysolepis</i>	W
<i>E. spicata</i>	W
<i>E. wallichiana</i>	W
Portulacaceae	
<i>Portulaca oleracea</i>	M
Amaranthaceae	
<i>Alternanthera sessilis</i>	
<i>Celosia argentea</i>	O,M
<i>Cyathula prostrata</i>	M
Polygonaceae	
<i>Cephalophilon chinense</i>	M
<i>C. hydropteris</i>	M
Dilleniaceae	
<i>Dillenia indica</i>	M
<i>Tetracera scandens</i>	
Ochnaceae	
<i>Gomphia serrata</i>	O
Dipterocarpaceae	
<i>Dipterocarpus kerrii</i>	W
Ancistrocladaceae	
<i>Ancistrocladus tectorius</i>	
Theaceae	
<i>Adenandra annamense</i>	W
<i>Archytea wablii</i>	
<i>Camellia caudata</i>	



Class, Family, Genus and Species	Code
<i>Eurya japonica</i>	
<i>E. trichocarpa</i>	
<i>Schima crenata</i>	W
Clusiaceae	
<i>Calophyllum dryobalanoides</i>	W
<i>C. soulatrei</i>	W
<i>C. sp</i>	W
<i>Garcinia bonii</i>	W
<i>G. multiflora</i>	W,M
<i>G. olongifolia</i>	W,M
Hypericaceae	
<i>Cratoxylum formosum</i>	W
<i>C. frunifolium</i>	M
Flacourtiaceae	
<i>Flacourtia rukam</i>	M
<i>Hydnocarpus annamensis</i>	W
<i>H. serratus</i>	W
Passifloraceae	
<i>Passiflora foetida</i>	M
Cucurbitaceae	
<i>Gymnopetalum cochinchinense</i>	M
<i>Gynostemma pentaphyllum</i>	
<i>Hodgsonia macrocarpa</i>	M
<i>Solena heterophylla</i>	M
Datisaceae	
<i>Tetrameles nudiflora</i>	W,M
Begoniaceae	
<i>Begonia aptera</i>	O
<i>B. lecomtei</i>	O
<i>B. rubicola</i>	O
Capparaceae	
<i>Crateva nurvala</i>	
Brassicaceae	
<i>Nasturtium officinale</i>	M
Actinidiaceae	
<i>Saurauia tristyla</i>	M
Symplocaceae	
<i>Symplocos adenophylla</i>	W
<i>S. cochinchinensis</i>	W
<i>S. disepala</i>	W
<i>S. laurina</i>	W
Eberaceae	
<i>Diospyros eriantha</i>	W
<i>D. pilosa</i>	W
Sapotaceae	
<i>Donella lanceolata</i>	W
<i>Madhuca pasquieri</i>	W,M
<i>Palaquium annamensis</i>	W
<i>Sarcosperma kachinense</i>	W
<i>Sinosideroxylon cambodianum</i>	W
Myrsinaceae	
<i>Arsidia argentea</i>	
<i>A. crenata</i>	M
<i>A. florida</i>	
<i>A. quinquegona</i> var. <i>latifolia</i>	M
<i>A. sylvestris</i>	M
<i>Embelia laeta</i>	M
<i>E. scandens</i>	
<i>E. subcoriacea</i>	
<i>Maesa tonkinensis</i> var. <i>annamensis</i>	
Elaeocarpaceae	
<i>Elaeocarpus griffithii</i>	W
<i>E. glabripetalus</i>	W
<i>E. grandiflorus</i>	

Class, Family, Genus and Species	Code
<i>E. hainanensis</i>	
<i>E. nitentifolius</i>	W
<i>E. petiolatus</i>	W
Tiliaceae	
<i>Colona evecta</i>	
<i>Grewia annamica</i>	
<i>G. asiatica</i>	
<i>G. bulot</i>	
<i>G. microcos</i>	
<i>Pragrewia poilanei</i>	
<i>Triumfetta rhomboidea</i>	M
Sterculiaceae	
<i>Commersonia bartramia</i>	
<i>Firmiana colorata</i>	
<i>Helicteres viscida</i>	
<i>Hritiera cochinchinensis</i>	W
<i>Pterospermum heterophyllum</i>	W
<i>P. lanceaefolium</i>	W
<i>P. pierrei</i>	W
<i>Sterculia coccinea</i>	
<i>S. lanceolata</i>	M
Malvaceae	
<i>Sida rhomboidea</i>	M
<i>Urena lobata</i>	M
Euphorbiaceae	
<i>Alchornea rugosa</i>	M
<i>Antidesma bunius</i>	
<i>A. cochinchinensis</i>	
<i>A. diandrum</i>	
<i>A. japonicum</i>	
<i>A. hainanensis</i>	
<i>Aposora microcalyx</i>	W
<i>Baccaurea annamensis</i>	W
<i>B. silvestris</i>	E,W
<i>Bischofia javanica</i>	W,M
<i>Breynia fruticosa</i>	M
<i>B. septata</i>	E
<i>Bridelia monoica</i>	
<i>Claoxylon polot</i>	
<i>Cleistanthus acuminatus</i>	
<i>Croton argyratus</i>	W
<i>C. kongensis</i>	
<i>C. tiglium</i>	
<i>C. tonkinensis</i>	M
<i>Deutzianthus tonkinensis</i>	
<i>Drypetes perreticulata</i>	
<i>Endospermum chinense</i>	W
<i>Erismanthus indochinensis</i>	
<i>Euphorbia hirta</i>	M
<i>E. thymifolia</i>	M
<i>Glochidion hirsutum</i>	
<i>G. octophylla</i>	
<i>G. venutinum</i>	M
<i>Homonoia riparia</i>	
<i>Jatropha curcas</i>	M
<i>Macaranga andersonii</i>	W
<i>M. denticulata</i>	W
<i>M. tananrius</i>	W
<i>M. trichocarpa</i>	
<i>Mallotus apelta</i>	
<i>M. barbatus</i>	W
<i>M. cochinchinensis</i>	W
<i>M. eberhardtii</i>	E,W
<i>M. hookerianus</i>	W
<i>Microdesmis caseariaefolia</i>	W,M

Class, Family, Genus and Species	Code
<i>Phyllanthus emblica</i>	W
<i>P. nirurii</i>	M
<i>P. quangtrienensis</i>	
<i>P. reticulatus</i>	M
<i>P. ruber</i>	
<i>P. urinaria</i>	M
<i>Sapium baccatum</i>	W
<i>S. discolor</i>	W
<i>S. rotundifolium</i>	W
<i>Sumbaviopsis albicans</i>	
<i>Suregada aequoreum</i>	
<i>S. multiflora</i>	
<i>Trewia nudiflora</i>	
<i>Trigonostemon pinnata</i>	
Thymeleaceae	
<i>Aquilaria crasna</i>	M
Rosaceae	
<i>Fragaria indica</i>	
<i>Prunus arborea</i>	W
<i>P. ceylanica</i>	W
<i>Rubus alceaefolius</i>	M
<i>R. cochinchinensis</i> var. <i>glabrescens</i>	M
<i>R. indiscissus</i>	
Mimosaceae	
<i>Adenanthera pavonina</i> var. <i>microsperma</i>	W
<i>Albizia chinensis</i>	W
<i>A. corniculata</i>	
<i>A. lucida</i>	W
<i>Archidendron turgidum</i>	W
<i>Entada phaseolooides</i>	
<i>E. tonkinensis</i>	
<i>Mimosa invisa</i>	
<i>M. pudica</i>	M
<i>Pithecellobium clypearia</i>	
<i>P. pellitum</i>	
Caesalpinaceae	
<i>Cassia alata</i>	M
<i>C. siamea</i>	W
<i>C. tora</i>	M
<i>Erythrophleum fordii</i>	W
<i>Gleditschia australis</i>	W,M
<i>Gymnocladus angustifolius</i>	O
<i>Lasiobema scandens</i>	
<i>Peltophorum dasyrrhachis</i>	W
<i>Phanera bracteata</i>	
<i>P. coccinea</i>	
<i>P. pierrei</i>	
<i>Sindora siamensis</i>	W
<i>S. tonkinensis</i>	W
<i>Tamarindus indica</i>	W,M
Fabaceae	
<i>Abrus precatorius</i>	M
<i>Antheroporum pierrei</i>	W
<i>Crotalaria assamica</i>	
<i>C. mucronata</i>	
<i>Dalbergia balansae</i>	W
<i>D. hypeana</i> var. <i>lancifera</i>	W
<i>D. rimosa</i>	
<i>Desmodium triquetrum</i>	M
<i>D. zolatum</i>	
<i>Erythrina orientalis</i>	M
<i>Millettia nigrescens</i>	O
<i>Ormosia balansae</i>	W



Appendices

Class, Family, Genus and Species	Code
<i>O. cambodiana</i>	W
<i>O. pinnata</i>	W
<i>Pueraria triloba</i>	
Lythraceae	
<i>Lagerstroemia duperreanum</i>	W
<i>L. tomentosa</i>	W
Sonneratiaceae	
<i>Duabanga grandiflora</i>	W
Rhizophoraceae	
<i>Carallia brachiata</i>	W,M
Combretaceae	
<i>Quisqualis indica</i>	M
Myrtaceae	
<i>Decaspermum paniculatum</i>	W
<i>Psidium guayava</i>	M
<i>Rhodomyrtus tomentosa</i>	M
<i>Syzygium bullockii</i>	
<i>S. chanlos</i>	
<i>S. circumcissimum</i>	W
<i>S. cumini</i>	W
<i>S. finetii</i>	
<i>S. polypetaloidum</i>	
<i>S. tsoongii</i>	
<i>S. zeylanicum</i>	W
Melastomaceae	
<i>Melastoma eberhardtii</i>	
<i>M. normale</i>	
<i>M. sanguineum</i>	M
Onagraceae	
<i>Ludwigia hyssopifolia</i>	M
Lecythidaceae	
<i>Barringtonia acutangula</i>	M
<i>B. cochinchinensis</i>	W
Anacardiaceae	
<i>Allopondias lakonensis</i>	W
<i>Canarium album</i>	W,M
<i>C. bangalensis</i>	W
<i>Choerospondias axillaris</i>	W,M
<i>Dacryodes dungii</i>	W
<i>Dracontomelum duperreanum</i>	W
<i>Drymicarpus racemosus</i>	
<i>Mangifera foetida</i>	W
<i>Rhus chinensis</i>	M
<i>Semecarpus anacardiopsis</i>	W
<i>S. myriocarpa</i>	
<i>Toxicodendron succedanea</i>	
Simaroubaceae	
<i>Ailanthus triphysa</i>	W,M
<i>Eurycoma longifolia</i>	M
<i>Picrasma javanica</i>	M
Rutaceae	
<i>Acronychia pedunculata</i>	M
<i>Clausena excavata</i>	M
<i>Euodia leptota</i>	M
<i>E. meliaefolia</i>	
<i>Glycosmis pentaphylla</i>	M
<i>Micromelum falcatum</i>	M
<i>Murraya koenigii</i>	M
<i>Zanthoxylum avicenniae</i>	M
<i>Z. rhetsa</i>	M
Meliaceae	
<i>Aglaiia cochinchinensis</i>	W
<i>A. gigantea</i>	W
<i>Aphanamixis polystachya</i>	W
<i>Chukrasia tabularis</i>	W

Class, Family, Genus and Species	Code
<i>Dysoxylum acutangulum</i>	W
<i>D. binectariferum</i>	W
<i>Melia azedazach</i>	W
Sapindaceae	
<i>Cardiospermum halicacabum</i>	
<i>Mischocarpus poilanei</i>	W
<i>Nephelium bassacense</i>	W
<i>Paranephelium spirei</i>	W
<i>Pometia pinnata</i>	W
Ixonanthaceae	
<i>Ixonanthes cochinchinensis</i>	W
Oxalidaceae	
<i>Averrhoa carambola</i>	M
<i>Oxalis corniculata</i>	M
Polygalaceae	
<i>Xanthophyllum laoticum</i>	W
Alangiaceae	
<i>Alangium kurzii</i>	W
<i>A. ridleyi</i>	W
Araliaceae	
<i>Aralia armata</i>	M
<i>Heteropanax fragrans</i>	M
<i>Schefflera elliptica</i>	M
<i>S. octophylla</i>	W,M
<i>Trevestia palmata</i>	M
Apiaceae	
<i>Celtella asiatica</i>	M
<i>Eryngium foetidum</i>	
<i>Hydrocotyle nepalensis</i>	
Aquifoliaceae	
<i>Ilex crenata</i>	W
Icaniaceae	
<i>Gonocaryum poilanei</i>	
Celastraceae	
<i>Euonymus javanicus</i>	W
Rhamnaceae	
<i>Berberia lineata</i>	M
<i>Gouania javanica</i>	
<i>Ventilago calyculata</i>	
Vittaceae	
<i>Ampelocissus martinii</i>	
<i>A. polythysa</i>	
<i>Cissus adnata</i>	
<i>C. hexangularis</i>	
<i>Tetrastigma quadrangulum</i>	
<i>Vitis balansaeana</i>	
Leeaceae	
<i>Leea rubra</i>	M
Loranthaceae	
<i>Helixanthera brevicalyx</i>	
<i>H. parasitica</i>	
Proteaceae	
<i>Helicia cochinchinensis</i>	
<i>H. nigilarica</i>	
<i>Heliciopsis sesselliflora</i>	W
Caprifoliaceae	
<i>Sambucus javanica</i>	
Loganiaceae	
<i>Gelsemium elegans</i>	
Apocynaceae	
<i>Alstonia scholaris</i>	W,M
<i>Alyxia racemosa</i>	
<i>Bousignonia mekongensis</i>	
<i>Holarrhena antidysenterica</i>	M
<i>Melodinus annamensis</i>	

Class, Family, Genus and Species	Code
<i>Rauvolfia cambodiana</i>	M
<i>Tabernaemontane jasminiflora</i>	
<i>T. microphylla</i>	
<i>T. pitardii</i>	
<i>Wrightia annamensis</i>	W
<i>W. pubescens</i>	W
Asclepiadaceae	
<i>Dischidia chinensis</i>	M
<i>D. collyris</i>	
<i>Streptocaulon griffithii</i>	M
Rubiaceae	
<i>Adina polycephala</i>	W,M
<i>Anthocephalus chinensis</i>	W
<i>Canthium dicoccum</i>	W
var. <i>rostratum</i>	
<i>Hedyotis capitellata</i>	M
<i>H. grudis</i>	
<i>Ixora coccinea</i>	O,M
<i>Lasianthus cyanocarpus</i>	
var. <i>asperatus</i>	
<i>L. kampuensis</i>	
<i>L. tonkinensis</i>	
<i>Mussaenda cambodiana</i>	M
var. <i>annamensis</i>	
<i>Neonauclea stellata</i>	
<i>Paederia scandens</i>	M
<i>Psychotria adenophylla</i>	
<i>P. rubra</i>	M
<i>Randia canthioides</i>	M
<i>R. oxydonta</i>	W
<i>R. spinosa</i>	
<i>R. tomentosa</i>	M
<i>Ulcaria tonkinensis</i>	
<i>Wendlandia glabrata</i>	
<i>W. paniculata</i>	
Convolvulaceae	
<i>Argyreia mollis</i>	O,M
<i>Hewittea sublobata</i>	
<i>Impoeta bonii</i>	
<i>I. digitata</i>	M
<i>Merremia umbellata</i>	M
Boraginaceae	
<i>Heliotropium indicum</i>	M
Solanaceae	
<i>Physalis angulata</i>	
<i>Solanum nigrum</i>	M
<i>S. torvum</i>	M
Bignoniaceae	
<i>Markhamia cauda - felina</i>	
<i>Oroxylum indicum</i>	M
<i>Radermachera alata</i>	
<i>Stereospermum chelonoides</i>	W,M
<i>S. tetragonum</i>	W
Acanthaceae	
<i>Andrographis paniculata</i>	M
<i>Asystasia gangetica</i>	
<i>Gendarussa ventricosa</i>	M
<i>Phlogacanthus annamensis</i>	
<i>Thunbergia laurifolia</i>	O
Plantaginaceae	
<i>Plantago major</i>	M
Verbenaceae	
<i>Callicarpa alpida</i>	
<i>C. cana</i>	M
<i>C. erioclona</i>	



Class, Family, Genus and Species	Code
<i>Clerodendrum cyrtophyllum</i>	M
<i>C. infortunatum</i>	M
<i>C. godefroyi</i>	
<i>C. paniculatum</i>	M
<i>C. robinsonii</i>	
<i>C. squamatum</i>	
<i>Gmelia annamensis</i>	W
<i>G. arborea</i>	W
Premna balansae	
<i>Vitex quinata</i>	M
<i>V. trifoliata</i>	M
Lamiaceae	
<i>Gomphostemma lucidum</i>	
<i>Leonurus artemisia</i>	M
Campanulaceae	
<i>Pentaphragma sinense</i>	
Asteraceae	
<i>Ageratum conyzoides</i>	M
<i>Artemisia vulgaris</i>	M
<i>Blumea balsamifera</i>	M
<i>B. eberhardtii</i>	
<i>B. fistulosa</i>	
<i>B. hieracifolia</i>	
<i>B. lacera</i>	M
<i>B. indica</i>	M
<i>B. subcapitata</i>	M
<i>Eclipta alba</i>	M
<i>Elephantopus scaber</i>	M
<i>Emilia sonchifolia</i>	M
<i>Erigeron linifolium</i>	
<i>Eupatorium odoratum</i>	M
<i>Gassocephalum crepidioides</i>	
Liliopsida	
Liliaceae	
<i>Dianella ensifolia</i>	
<i>Dracena loureiri</i>	M
<i>D. gracilis</i>	O
<i>Ophiopogon dracaenoides</i>	O
<i>O. japonicus</i>	M
Smilacaceae	
<i>Smilax bauhinioides</i>	
<i>S. gagnepainii</i>	
<i>S. perfoliata</i>	M
Dioscoreaceae	
<i>Dioscorea intempestica</i>	
<i>D. persimilis</i>	M
<i>D. poilanei</i>	
<i>D. triphylla</i> var. <i>reticulata</i>	
Taccaceae	
<i>Tacca integrifolia</i>	M
Musaceae	
<i>Musa uranoscopus</i>	
Costaceae	
<i>Costus speciosus</i>	M
Zingiberaceae	
<i>Alpinia bracteata</i>	M
<i>Amomum trilobum</i>	M
<i>A. xanthioides</i>	M
<i>Zingiper zerumbet</i>	
Maranthaceae	
<i>Donax cannaeformis</i>	
<i>Phrynium parviflorum</i>	
Orchidaceae	
<i>Aerides falcatum</i>	O
<i>A. multiflorum</i>	O

Class, Family, Genus and Species	Code
<i>Arundina graminifolia</i>	O
<i>Corymborchis veratrifolia</i>	O
<i>Cymbidium dayanum</i>	O
<i>C. linlaysonianum</i>	O
<i>Dendrobium amabile</i>	E,O
<i>D. crystallinum</i>	O
<i>D. lindleyi</i>	O
<i>D. terminale</i>	O
<i>D. thyrsoiflorum</i>	O
<i>Geodorum densiflorum</i>	O
<i>Phalaenopsis manni</i>	O
Cyperaceae	
<i>Carex cryptostachys</i>	
<i>C. leucholora</i>	
<i>Cyperus diffusus</i>	
<i>C. flavidus</i>	
<i>C. panicus</i> var. <i>roxburghianus</i>	
<i>C. pumilus</i>	
<i>C. rotundus</i>	M
<i>C. sesquiflorus</i>	
<i>Fimbristylis complanata</i>	
<i>F. dichotomoides</i>	
<i>F. thomsonii</i>	
<i>Kyllinga nemoralis</i>	M
<i>Lipocarpa chinensis</i>	
<i>Scirpus juncooides</i>	M
<i>S. wallichii</i>	
Commelinaceae	
<i>Commelina diffusa</i>	
<i>Cyanotis barbata</i>	
Poaceae	
<i>Arundo donax</i>	
<i>Bambusa balcooa</i>	
<i>B. spinosa</i>	
<i>Chloris barbata</i>	
<i>Chrysopogon aciculata</i>	M
<i>Cynodon dactylon</i>	
<i>Dactyloctenium aegyptiacum</i>	
<i>Dendrocalamus patellaris</i>	
<i>Eleusine coranaca</i>	M
<i>Eragrostis zeylanica</i>	
<i>Imperata cylindrica</i>	M
<i>Miscanthus floridulus</i>	
<i>Oxytenanthera albo-cyliata</i>	
<i>O. poilanei</i>	
<i>Phragmites karka</i>	
<i>Saccharum arundinaceum</i>	
<i>S. spontaneum</i>	
<i>Tenostachyum dullooa</i>	
<i>Thysanolaena maxima</i>	M
Arecaceae	
<i>Arenga pinnata</i>	O
<i>Calamus bousigonii</i>	
<i>C. poilanei</i>	E
<i>C. pseudoscutellaris</i>	
<i>C. rudentum</i>	
<i>C. tetradactylus</i>	
<i>Caryota mitis</i>	O
<i>C. urens</i>	
<i>Daemonorops pierreanus</i>	
<i>Kortalsia lacsiniosa</i>	
<i>Licuala bracteata</i>	O
<i>Livistona chinensis</i>	O
<i>Pinanga duperreana</i>	
<i>Plectocomia elongata</i>	

Class, Family, Genus and Species	Code
Araceae	
<i>Acorus calamus</i>	M
<i>Aglaonema pierreanum</i>	
<i>Alocaria macrorrhiza</i>	M
<i>Amorphophalus campanulatus</i>	M
<i>Colocaria esculenta</i>	
<i>Epipremnum giganteum</i>	O
<i>E. pinnatum</i>	O
<i>Homalomena occulta</i>	M
<i>Lasia spinosa</i>	M
<i>Pothos angustifolius</i>	
<i>P. cathcartii</i>	O
<i>P. gigantipes</i>	
<i>P. yunnanensis</i>	
Pandanaceae	
<i>Pandanus tonkinensis</i>	

Follows Pham Hoang Ho (1991).
Notes: E = Endemic to Vietnam,
W = Wood, O = Ornamental and
M = Medicinal

Appendix 2
Mammals, Excluding Rodents and Bats, Recorded in or Reported from the Study Area

No.	Common Name	Order, Family, Genus and Species	IUCN Listed	Vietnam Listed
	Pangolins	Pholidota		
	Pangolins	Manidae		
1	Chinese Pangolin	<i>Manis pentadactyla</i>	NT	
2	Sunda Pangolin	<i>M. javanica</i>	NT	
	Treeshrews	Scandentia		
	Treeshrews	Tupaïidae		
3	Common Treeshrew	<i>Tupaia belangeri</i>		
	Primates	Primates		
	Lorises	Loridae		
4	Slow Loris	<i>Nycticebus coucang</i>		V
	Old-world monkeys	Cercopitheciidae		
5	Pig-tailed Macaque	<i>Macaca nemestrina</i>	EN	V
6	Rhesus Macaque	<i>M. mulatta</i>	NT	
7	Bear Macaque	<i>M. arctoides</i>	VU	V
8	Douc Langur	<i>Pygathrix nemaeus</i>	EN	
	Gibbons	Hylobatidae		
9	Buff-cheeked Gibbon	<i>Hylobates gabriellae</i>	DD	
	Carnivores	Carnivora		
	Dog and Foxes	Canidae		
10	Indian Wild Dog or Dhole	<i>Cuon alpinus</i>	VU	E
	Bears	Ursidae		
11	Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	E
12	Sun Bear	<i>U. malayanus</i>	VU	E
	Weasels etc.	Mustelidae		
13	Yellow-throated Marten	<i>Martes flavigula</i>	DD	
14	Hog-Badger	<i>Arctonyx collaris</i>		
15	Large-toothed Ferret-Badger	<i>Melogale personata</i>	DD	
16	Eurasian Otter	<i>Lutra lutra</i>		
	Civets	Viverridae		
17	Large Indian Civet	<i>Viverra zibetha</i>		
18	Small Indian Civet	<i>Viverricula indica</i>		
19	Common Palm Civet	<i>Paradoxurus hermaphroditus</i>		
20	Masked Palm Civet	<i>Paguma larvata</i>		
21	Binturong	<i>Arctictis binturong</i>		V
	Mongoose	Herpestidae		
22	Crab-eating Mongoose	<i>Herpestes urva</i>		
	Cats	Felidae		
23	Leopard Cat	<i>Prionailurus bengalensis</i>		
24	Golden Cat	<i>Catopuma temminckii</i>	NT	
25	Clouded Leopard	<i>Pardofelis nebulosa</i>	VU	V
26	Tiger	<i>Panthera tigris</i>	EN	E
	Even-toed ungulates	Artiodactyla		
	Pigs	Suidae		
27	Wild Boar	<i>Sus scrofa</i>	VU	
	Mouse-deer, Chevrotains	Tragulidae		
28	Lesser Malay Mouse-deer	<i>Tragulus javanicus</i>		
	Deer	Cervidae		
29	Sambar	<i>Cervus unicolor</i>		
30	Giant Muntjac	<i>Megamuntiacus vuquangensis</i>	EN	E
31	Barking Deer	<i>Muntiacus muntjak</i>		
	Cattle, antelopes, goats	Bovidae		
32	Gaur	<i>Bos gaurus</i>	VU	E
33	Southern Serow	<i>Naemorhedus sumatraensis</i>	EN	V
34	Sao La or Vu Quang Ox	<i>Pseudoryx nghetinhensis</i>	EN	E

No.	Common Name	Order, Family, Genus and Species	IUCN Listed	Vietnam Listed
	Rodents	Rodentia		
	Non-flying squirrels	Sciuridae		
35	Black Giant Squirrel	<i>Ratufa bicolor</i>		
36	Pallas's Squirrel	<i>Callosciurus erythraeus</i>		
37	Grey-bellied Squirrel	<i>C. finornatus</i>		
38	Cambodian Striped Tree-squirrel	<i>Tamiops rodolphii</i>		
	Flying squirrels	Pteromyidae		
39	Red Giant Flying Squirrel	<i>Petaurista philippensis</i>		R
	Mice, Rats	Muridae		
	Bamboo rats	Rhizomyidae		
40	Hoary Bamboo Rat	<i>Rhizomys pruinosus</i>		
	Old-world Porcupines	Hystriidae		
41	Malayan Porcupine	<i>Hystrix brachyura</i>	VU	
42	Asiatic Brush-tailed Porcupine	<i>Atherurus macrourus</i>		
	Lagomorphs	Lagomorpha		
	Rabbits	Leporidae		
43	Burmese Hare	<i>Lepus peguensis</i>		

Follows Corbet & Hill (1992).

Notes: EN/N = Endangered; VU/V = Vulnerable; NT = Near Threatened; R = Rare; DD = Data Deficient as per IUCN (1996) and Anon. (1992)

Appendix 3
Birds Recorded in the Study Area

No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et al.</i> 1994	Anon 1992
		Galliformes			
		Phasianidae			
1	Chinese Francolin	<i>Fraucolinus pintadeanus</i>	1, 2		
2	Japanese Quail	<i>Coturnix japonica</i>	1		
3	Bar-backed Partridge	<i>Arborophila brunneopectus</i>	1, 2, 3, 4		
4	Annam Partridge	<i>A. merlini</i>	1, 2, 3		CR, RRS
5	Red Junglefowl	<i>Gallus gallus</i>	1, 2, 3		
6	Silver Pheasant	<i>Lophura nycthemera</i>	1, 2, 4		
7	Edwards's Pheasant	<i>L. edwardsi</i>	1, 2, 4	CR	CR, RRS
8	Siamese Fireback	<i>L. diardi</i>	1, 2, 4	VU	T
9	Grey Peacock Pheasant	<i>Polyplectron bicalcaratum</i>	1, 2, 4		
10	Crested Argus	<i>Rheinardia ocellata</i>	1, 2, 4	VU	T, RRS
		Turniciformes			
		Turnicidae			
11	Barred Buttonquail	<i>Turnix suscitator</i>	4		
		Piciformes			
		Picidae			
12	Speckled Piculet	<i>Picumnus innominatus</i>	4		
13	White-browed Piculet	<i>Sasia ochracea</i>	1, 2		
14	Lesser Yellownape	<i>Picus chlorolophus</i>	4		
15	Greater Yellownape	<i>P. flavinucha</i>	1, 4		
16	Red-collared Woodpecker	<i>P. rabieri</i>	1	VU	T, RRS
17	Pale-headed Woodpecker	<i>Gecinulus grantia</i>	4		
18	Bay Woodpecker	<i>Blythipicus pyrrhotis</i>	1, 2, 3, 4		
		Megalaimidae			
19	Red-vented Barbet	<i>Megalaima lagrandieri</i>	1, 2, 3, 4		RRS
20	Green-eared Barbet	<i>M. faiostricta</i>	1, 2, 3, 4		
		Bucerotiformes			
		Bucerotidae			
21	Oriental Pied Hornbill	<i>Anthracoceros albirostris</i>	(2)		
22	Great Hornbill	<i>Buceros bicornis</i>	(1)		T
23	Brown Hornbill	<i>Anorrhinus tickelli</i>	1, [2]	NT	T
		Trogoniformes			
		Trogonidae			
24	Orange-breasted Trogon	<i>Harpactes oreskios</i>	1, 2		
25	Red-headed Trogon	<i>H. erythrocephalus</i>	1, 2		
		Coraciiformes			
		Coraciidae			
26	Dollarbird	<i>Eurystomus orientalis</i>	4		
		Alcedinidae			
27	Blyth's Kingfisher	<i>Alcedo hercules</i>	1, 2	VU	T
28	Common Kingfisher	<i>A. atthis</i>	1, 2, 3		
		Halcyonidae			
29	Banded Kingfisher	<i>Lacedo pulchella</i>	1		
30	Stork-billed Kingfisher	<i>Halcyon capensis</i>	1		
31	Ruddy Kingfisher	<i>H. coromanda</i>	4		
32	White-throated Kingfisher	<i>H. smyrnensis</i>	1, 2, 3		
		Cerylidae			
33	Crested Kingfisher	<i>Megaceryle lugubris</i>	1		
34	Pied Kingfisher	<i>Ceryle rudis</i>	2		
		Meropidae			
35	Blue-bearded Bee-eater	<i>Nyctornis athertoni</i>	2		
36	Blue-tailed Bee-eater	<i>Merops philippinus</i>	2		
		Cuculiformes			
		Cuculidae			
37	Large Hawk Cuckoo	<i>Hierococyx sparverioides</i>	1		



No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et al.</i> Listed	Vietnam Listed
38	Indian Cuckoo	<i>Cuculus micropterus</i>	1, 2, 4		
39	Eurasian Cuckoo	<i>C. canorus</i>	1, 2, 4		
40	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	1, 2, 3, 4		
41	Drongo Cuckoo	<i>Surniculus lugubris</i>	1, 2, 3, 4		
42	Asian Koel	<i>Eudynamys scolopacea</i>	1, 4		
43	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	1, 2, 3, 4		
44	Coral-billed Ground Cuckoo	<i>Carpococcyx renauldi</i>	1, [2]	NT	T
		Centropodidae			
45	Greater Coucal	<i>Centropus sinensis</i>	1, 2, 3, 4		
46	Lesser Coucal	<i>C. bengalensis</i>	1, 2, 4		
		Psittaciformes			
		Psittacidae			
47	Vernal Hanging Parrot	<i>Loriculus vernalis</i>	3, 4		
		Apodiformes			
		Apodidae			
48	Needletail sp.	<i>Hirundapus</i> sp.	2		
49	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	1, 2, 3, 4		
50	Fork-tailed Swift	<i>Apus pacificus</i>	4		
		Strigiformes			
		Strigidae			
51	Mountain Scops Owl	<i>Otus spilocephalus</i>	1, 2, 3, 4		
52	Collared Scops Owl	<i>O. bakkamoena</i>	1, 2		
53	Buffy Fish Owl	<i>Ketupa ketupu</i>	(1)		
54	Collared Owlet	<i>Glaucidium brodiei</i>	4		
55	Asian Barred Owlet	<i>G. cuculoides</i>	1, 2		
		Caprimulgidae			
56	Grey Nightjar	<i>Caprimulgus indicus</i>	1, 2		
		Columbiformes			
		Columbidae			
57	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	1, 2, 4		
58	Spotted Dove	<i>S. chinensis</i>	1, 2, 3, 4		
59	Red Collared Dove	<i>S. tranquebarica</i>	1, 2, 3, 4		
60	Emerald Dove	<i>Chalcophaps indica</i>	1, 2, 4		
61	Thick-billed Green Pigeon	<i>Treron curvirostra</i>	1, 2, 3, 4		
62	Pin-tailed Green Pigeon	<i>T. apicauda</i>	4		
63	Yellow-vented Green Pigeon	<i>T. seimundi</i>	1	NT	
64	Green Imperial Pigeon	<i>Ducula aenea</i>	1		
65	Mountain Imperial Pigeon	<i>D. badia</i>	3, 4		
		Grviformes			
		Rallidae			
66	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	1		
		Ciconiiformes			
		Accipitridae			
67	Crested Serpent Eagle	<i>Spilornis cheela</i>	1, 4		
68	Crested Goshawk	<i>Accipiter trivirgatus</i>	1		
69	Black Eagle	<i>Ictinaetus malayensis</i>	1, 2, 4		
70	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	1		
		Ardeidae			
71	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	1, 4		
		Passeriformes			
		Pittidae			
72	Blue-rumped Pitta	<i>Pitta soror</i>	1, 2	NT	
73	Bar-bellied Pitta	<i>P. elliotii</i>	1, 2	NT	T
74	Blue-winged Pitta	<i>P. moluccensis</i>	2		
		Eurylaimidae			
75	Silver-breasted Broadbill	<i>Serilophus lunatus</i>	4		
76	Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>	1		T
		Irenidae			
77	Asian Fairy Bluebird	<i>Irena puella</i>	4		

Appendices

No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et al.</i> Listed	Vietnam Listed
78	Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	1, 2, 3		
79	Orange-bellied Leafbird	<i>C. hardwickii</i>	1, 4		
		Laniidae			
80	Long-tailed Shrike	<i>Lanius schach</i>	1, 2, 3, 4		
		Corvidae			
81	White-winged Magpie	<i>Urocissa whiteheadi</i>	1, 4	NT	
82	Indochinese Green Magpie	<i>Cissa hypoleuca</i>	1	NT	
83	Racket-tailed Treepie	<i>Crypsirina temia</i>	1, 2, 3, 4		
84	Racket-tailed Treepie	<i>Temnurus temnurus</i>	1, 2, 3, 4		T
85	Large-billed Crow	<i>Corvus macrorhynchus</i>	1, 2, 3, 4		
86	Ashy Woodswallow	<i>Artamus fuscus</i>	2		
87	Maroon Oriole	<i>Oriolus traillii</i>	4		
88	Large Cuckooshrike	<i>Coracina macei</i>	1, 2, 4		
89	Black-winged Cuckooshrike	<i>C. melaschistos</i>	4		
90	Scarlet Minivet	<i>Pericrocotus flammeus</i>	1		
91	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	4		
92	White-throated Fantail	<i>Rhipidura albicollis</i>	4		
93	Black Drongo	<i>Dicrurus macrocercus</i>	1, 2, 3, 4		
94	Ashy Drongo	<i>D. leucophaeus</i>	2, 3		
95	Crow-billed Drongo	<i>D. annectans</i>	3, 4		
96	Bronzed Drongo	<i>D. aeneus</i>	1, 2		
97	Lesser Racket-tailed Drongo	<i>D. remifer</i>	4		
98	Spangled Drongo	<i>D. hottentottus</i>	1, 2, 4		
99	Greater Racket-tailed Drongo	<i>D. paradiseus</i>	1, 2, 4		
100	Black-naped Monarch	<i>Hypothymis azurea</i>	1, 2, 3, 4		
101	Asian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	1, 2, 4		
102	Great Iora	<i>Aegithina lafresnayei</i>	1, 2, 3		
103	Large Woodshrike	<i>Tephrodornis gularis</i>	4		
		Muscicapidae			
104	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	1		
105	White-gorgeted Flycatcher	<i>Ficedula montileger</i>	4		
106	White-tailed Flycatcher	<i>Cyornis concretus</i>	4		
107	Hainan Blue Flycatcher	<i>C. hainanus</i>	4		
108	Blue-throated Flycatcher	<i>C. rubeculoides</i>	4		
109	Hill Blue Flycatcher	<i>C. banyumas</i>	2		
110	Tickell's Blue Flycatcher	<i>C. tickelliae</i>	4		
111	Grey-headed Canary Flycatcher	<i>Culicicapa ceylonensis</i>	4		
112	Oriental Magpie Robin	<i>Copsychus saularis</i>	1, 2, 3, 4		
113	White-rumped Shama	<i>C. malabaricus</i>	1, 2, 3, 4		
114	Slaty-backed Forktail	<i>Enicurus schistaceus</i>	1, 2, 3, 4		
115	White-crowned Forktail	<i>E. leschenaulti</i>	4		
		Sturnidae			
116	Black-collared Starling	<i>Sturnus nigricollis</i>	1, 2, 3, 4		
117	Common Myna	<i>Acridotheres tristis</i>	1, 2		
118	White-vented Myna	<i>A. cinereus</i>	1, 2		
119	Crested Myna	<i>A. cristatellus</i>	2		
120	Hill Myna	<i>Gracula religiosa</i>	1, 2, 4		
		Paridae			
121	Sultan Tit	<i>Melanochlora sultanea</i>	1, 4		
		Hirundinidae			
122	Red-rumped Swallow	<i>Hirundo daurica</i>	4		
		Pycnonotidae			
123	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	1, 2, 3, 4		
124	Sooty-headed Bulbul	<i>P. aurigaster</i>	4		
125	Stripe-throated Bulbul	<i>P. finlaysoni</i>	1, 2		
126	Puff-throated Bulbul	<i>Alophoixus pallidus</i>	1, 2, 4		
127	Ochraceous Bulbul	<i>A. ochraceus</i>	1		
128	Grey-eyed Bulbul	<i>Iole propinqua</i>	1, 2, 3, 4		
129	Black Bulbul	<i>Hypsipetes leucocephalus</i>	4		



No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et al.</i> Listed	Vietnam Listed
		Cisticolidae			
130	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	2		
		Zosteropidae			
131	Oriental White-eye	<i>Zosterops palpebrosus</i>	4		
		Sylviidae			
132	Common Tailorbird	<i>Orthotomus sutorius</i>	1, 2, 4		
133	Arctic Warbler	<i>Phylloscopus borealis</i>	4		
134	Yellow-bellied Warbler	<i>Abroscopus superciliaris</i>	4		
135	Dark-necked Tailorbird	<i>O. atrogularis</i>	1, 2, 3, 4		
136	Striated Grassbird	<i>Megalurus palustris</i>	4		
137	Masked Laughingthrush	<i>Garrulax perspicillatus</i>	1, 2		
138	White-crested Laughingthrush	<i>G. leucolophus</i>	1, 2, 3, 4		
139	Lesser Necklaced Laughingthrush	<i>G. monileger</i>	1, 2		
140	Black-throated Laughingthrush	<i>G. chinensis</i>	1, 2, 3, 4		
141	White-cheeked Laughingthrush	<i>G. vassali</i>	4		T, RRS
142	Abbott's Babbler	<i>Malacocincla abbotti</i>	2		
143	Buff-breasted Babbler	<i>Pellorneum tickelli</i>	4		
144	Spot-throated Babbler	<i>P. albiventris</i>	4		
145	Puff-throated Babbler	<i>P. ruficeps</i>	2		
146	Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	1, 2		
147	Large Scimitar Babbler	<i>Pomatorhinus hypoleucos</i>	1, 2, 3, 4		
148	White-browed Scimitar Babbler	<i>P. schisticeps</i>	4		
149	Short-tailed Scimitar Babbler	<i>Jabouilleia danjoui</i>	1, 2, 4	VU	T, RRS
150	Streaked Wren Babbler	<i>Napothera brevicaudata</i>	1, 2, 4		
151	Eyebrowed Wren Babbler	<i>N. epilepidota</i>	4		
152	Rufous-capped Babbler	<i>Stachyris ruficeps</i>	4		
153	Golden Babbler	<i>S. chrysaea</i>	4		
154	Grey-throated Babbler	<i>S. nigriceps</i>	4		
155	Spot-necked Babbler	<i>S. striolata</i>	3, 4		
156	Striped Tit Babbler	<i>Macronous gularis</i>	1, 2, 3, 4		
157	Grey-faced Tit Babbler	<i>M. kelleyi</i>	1, 4		RRS
158	Rufous-throated Fulvetta	<i>Alcippe rufogularis</i>	1, 2, 3, 4		
159	Mountain Fulvetta	<i>A. peracensis</i>	1, 2, 3, 4		
160	White-bellied Yuhina	<i>Yuhina zantholeuca</i>	1, 2, 3		
		Nectariniidae			
161	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	4		
162	Plain Flowerpecker	<i>D. concolor</i>	4		
163	Ruby-cheeked Sunbird	<i>Anthreptes singalensis</i>	1, 2		
164	Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	4		
165	Olive-backed Sunbird	<i>Nectarinia jugularis</i>	1, 2		
166	Fork-tailed Sunbird	<i>Aethopyga christinae</i>	2, 4		
167	Crimson Sunbird	<i>A. siparaja</i>	1, 2, 3, 4		
168	Little Spiderhunter	<i>Arachnothera longirostra</i>	1, 2, 4		
169	Streaked Spiderhunter	<i>A. magna</i>	1, 2, 4		
		Passeridae			
170	Eurasian Tree Sparrow	<i>Passer montanus</i>	1, 2, 3, 4		
171	White-rumped Munia	<i>Lonchura striata</i>	1, 2, 3, 4		

Follows Inskipp *et al.* (1996).

Notes: CR = Critically Endangered; VU = Vulnerable; T = Threatened; NT = Near Threatened as per Collar *et al.* (1994) and Anon. (1992).

RRS = Restricted range species.

Site Number:

1. Khe Lau and Phong My communes, Phong Dien district, Thua Thien Hue province;
2. Ba Long and Trieu Nguyen communes, Dakrong district, Quang Tri province;
3. Ta Rut commune, Dakrong district, Quang Tri province; and
4. A Sau commune, A Luoi district, Thua Thien Hue province.



Appendix 4
Herpetiles Recorded in the Study Area

No.	Class, Order, Family Genus and Species	Phong Dien	Dakrong	IUCN Listed	Vietnam Listed
	Reptilia				
	Squamata				
	Gekkonidae				
1	<i>Gekko gecko</i>	O	I		T
2	<i>Hemidactylus frenatus</i>	O	O		
	Agamidae				
3	<i>Acanthosaura lepidogaster</i>	S			T
4	<i>Calotes emma emma</i>	S			
5	<i>C. versicolor</i>	O	O		
6	<i>Draco volans</i>	O			
7	<i>Physignathus cocincinus</i>	O	S		V
	Scincidae				
8	<i>Mabuya multifasciata</i>	S	O		
9	<i>Sphenomorphus sp.</i>		S		
	Lacertidae				
10	<i>Takydromus sexlineatus</i>		O		
	Varanidae				
11	<i>Varanus nebulosus</i>	I	I		V
12	<i>V. salvator</i>	I	I		V
	Xenopeltidae				
13	<i>Xenopeltis unicolor</i>	I			
	Boidae				
14	<i>Python molurus</i>	I	I	NT	V
	Colubridae				
15	<i>Ahaetulla prasina</i>	I	O		
16	<i>Amphiesma sp.</i>		S		
17	<i>A. stolata</i>	O			
18	<i>Dendrelaphis pictus</i>	I			
19	<i>Elaphe radiata</i>	I	I		
20	<i>Enhydris plumbea</i>	O	O		
21	<i>Oligodon sp.</i>		I		
22	<i>Ptyas korros</i>	I	I		T
23	<i>P. mucosus</i>			T	V
24	<i>Rhabdophis chrysargus</i>	I	I		
25	<i>Xenochrophis piscator</i>	O	O		
	Elapidae				
26	<i>Bungarus candidus</i>	I	I		
27	<i>B. fasciatus</i>	O	I		T
28	<i>Naja naja</i>	I	I		T
29	<i>Ophiophagus hannah</i>	O	I	DD	E
	Viperidae				
30	<i>Trimeresurus albolabris albolabris</i>	I	I	DD	
31	<i>T. sp.</i>	S			
	Testudinadae				
	Platysternidae				
32	<i>Platysternon megacephalum</i>	I	I	NT	EV, V
	Emididae				
33	<i>Cuora galbinifrons</i>	I	I	NT	EV, V
34	<i>C. trifasciata</i>		I	E	V
	Testudinata				
35	<i>Indotestudo elongata</i>	I		V	V
	Trionychidae				
36	<i>Palea steindachneri</i>	I	I	NT	
37	<i>Pelodiscus sinensis</i>	I	I		
38	<i>Trionyx cartilagineus</i>	I			

No.	Class, Order, Family Genus and Species	Phong Dien	Dakrong	IUCN Listed	Vietnam Listed
	Amphibia				
	Anura				
	Megophryidae				
1	<i>Leptobrachium hasselti</i>	S			
2	<i>Megophrys major</i>	S			
	Bufonidae				
3	<i>Bufo galeatus</i>	S			EV
4	<i>B. melanostictus</i>	O	O		
	Ranidae				
5	<i>Oeidozyga lima</i>	O	O		
6	<i>Phrynoglossus laevis</i>		S		
7	<i>Rana andersoni</i>	S	O		T
8	<i>R. guentheri</i>	O	O		
9	<i>R. kuhlii</i>	S	O		
10	<i>R. limnocharis</i>	S	S		
11	<i>R. macrodactyla</i>				
12	<i>R. microlineata</i>	S	I		EV,T
13	<i>R. nigrovittata</i>	O	S		
14	<i>R. ricketti</i>	O			
15	<i>R. rugulosa</i>	O	I		
16	<i>R. sauteri</i>	S	S		
	Rhacophoridae				
17	<i>Philautus</i> sp.	S			
18	<i>Rhacophorus leucomystax</i>	O	S		
19	<i>R. nigropalmatus</i>	S			T

Follows Nguyen Van Sang and Ho Thu Cuc (1996)

Notes: S = Specimen; O = Observed; I = Interview:

EN/E = Endangered; VU/V = Vulnerable; T = Threatened; NT = Near Threatened; R = Rare; DD = Data Deficient as per IUCN (1996) and Anon. (1992).

Appendix 5
Butterflies Recorded in the Study Area

No.	Family Genus and Species	Global Range	Phong Dien district			Dakrong district		
			Forest	River	Deforested	Forest	River	Deforested
	Papilionidae							
1.	<i>*Troides</i> sp.	3						r
2.	<i>Parides aidoneus</i> Doubleday	2	r			r		
3.	<i>Pachliopta coon</i> F.	3	u	u		r	R	
4.	<i>P. aristolochiae</i> F.	3			r		R	
5.	<i>*Chilasa clytia</i> L.	3					R	
6.	<i>Papilio demoleus</i> L.	4		u	c		U	c
7.	<i>P. noblei</i> de Niceville	1	r			u	U	
8.	<i>P. helenus</i> L.	4	c	c	c	c	C	c
9.	<i>P. nephelus</i> Boisduval	3	r			u	U	
10.	<i>P. polytes</i> L.	3	u	c	c	c	C	c
11.	<i>P. memnon</i> L.	3	u	c	c	u	C	c
12.	<i>P. alcmenor</i>	2		r				
13.	<i>P. paris</i> L.	3					C	
14.	<i>Meandrusa payeni</i> Boisduval	4		r				
15.	<i>Pathysa antiphates</i> Cramer	3		c			U	
16.	<i>Graphium sarpedon</i> L.	4	u	c		u	C	
17.	<i>G. doson</i> C. & R. Felder	3		c			C	
18.	<i>G. eurypylus</i> L.	4		c			C	
19.	<i>*G. chironides</i> Honrath	3					R	
20.	<i>G. arycles</i> Boisduval	3		c			U	
21.	<i>*G. agamemnon</i> L.	4					R	
22.	<i>Lamproptera curius</i> F.	3					U	
23.	<i>L. meges</i> Zinken	3					U	
	Pieridae							
24.	<i>Delias pasithoe</i> L.	2	r	r				
25.	<i>D. hyparete</i> L.	3	u					
26.	<i>Leptosia nina</i> F.	3	r	r		r		
27.	<i>*Prioneris thestylis</i> Doubleday	2					R	
28.	<i>P. philonome</i> Boisduval	3		u			U	
29.	<i>Artogeia canidia</i> L.	3				r		
30.	<i>*Cepora nerissa</i> F.	3					R	
31.	<i>C. nadina</i> Lucas	3	u	c	u	u	C	u
32.	<i>Appias lyncida</i> Cramer	3	u ^{fm}	c ^m		u ^{fm}	c ^m	u
33.	<i>A. albina</i> Boisduval	3	c	c	c	c	C	c
34.	<i>A. indra</i> Moore	2	u ^{fm}	c ^m		u ^{fm}	c ^m	
35.	<i>A. olferna</i> Swinhoe	2					c ^l	
36.	<i>Ixias pyrene</i> L.	3					R	
37.	<i>Hebomoia glaucippe</i> L.	3	r ^{fm}	c		r ^{fm}	C	
38.	<i>Pareronia anaïs</i> Lesson	2					c ^m	
39.	<i>Catopsilia pomona</i> F.	5	c	c	c	c	C	c
40.	<i>Eurema hecabe</i> L.	4	u	u	c	u	U	c
41.	<i>E. blanda</i> Boisduval	3	c	c	u	c	C	u
42.	<i>E. andersoni</i> Moore	3	r	r		r	R	
43.	<i>E. ada</i> Distant & Pryer	3	u			u		
44.	<i>E. cf. novapallida</i> Shirozu & Yata	1?		?				
45.	<i>Gandaca harina</i> Horsfield	4	c	c		u	U	
	Danaidae							
46.	<i>*Danaus chrysippus</i> L.	4			?			
47.	<i>D. genutia</i> Cramer	4			c			c
48.	<i>Tirumala septentrionis</i> Butler	4					U	
49.	<i>Parantica aglea</i> Stoll.	2	r	u		r	U	u
50.	<i>P. melaneus</i> Cramer	3				r		
51.	<i>Ideopsis vulgaris</i> Butler	3					R	
52.	<i>Euploea modesta</i> Butler	3					R	

No.	Family Genus and Species	Global Range	Phong Dien district			Dakrong district		
			Forest	River	Deforested	Forest	River	Deforested
53.	<i>E. core</i> Cramer	3	u	u		u	C	
54.	<i>E. silvester</i> F.	4				u	C	c
55.	<i>E. mulciber</i> Cramer	3	c ^f	c ^m	c	c ^f	c ^m	c
56.	<i>E. tulliolus</i> F.	4		u			U	
57.	<i>E. midamus chloe</i> Guerin-Meneville	2					R	
58.	<i>E. klugii</i> Moore	3	r				R	
59.	<i>E. radamanthus</i> F.	3					R	
	Satyridae							
60.	<i>Elymnias hypermnestra</i> L.	3	r			r		
61.	* <i>E. patna</i> Westwood	3	r					
62.	<i>Mycalesis mineus</i> L.	3	u			u		
63.	<i>M. zonata</i> Matsumura	2	u			u		
64.	<i>M. adamsoni</i>	2	r					
65.	<i>Erites medura</i> Horsfield	3	c			r		
66.	<i>Ragadia crisilda</i> Hewitson	2	c	c		u		
67.	<i>Ypthima baldus</i> F.	3				c	C	c
68.	<i>Y. cerealis</i> Watson	3				?		?
69.	<i>Y. savara</i> Grose Smith	3	r					
70.	<i>Y. tappana</i> Matsumura	1	r					
	Amathusiidae							
71.	<i>Faunis canens</i> Hubner	2				r		
72.	<i>F. eumeus</i> Drury	2	c		u	c		u
73.	<i>Stichopthalma louisa</i> ssp Wood-Mason	1	u			u		
74.	<i>Amathuxidia amythaon amythaon</i> Doubleday	2	r					
75.	<i>Zeuxidia amethystus masoni</i> Butler	2	u					
76.	<i>Thaumantis diores</i> Doubleday	1	u					
77.	<i>Discophora deo</i> de Niceville	2	r					
78.	<i>D. sondaica</i> Boisduval	3	r					
	Nymphalidae							
79.	* <i>Cethosia cyane</i> Drury	2				r		
80.	<i>Phalanta palantha</i> Drury	5	u					
81.	<i>Cupha erymanthis</i> Drury	4	u			u		
82.	<i>Vagrans egista</i> Cramer	4	r	u			R	
83.	<i>Cirrochroa tyche</i> C& R. Felder	3	r	r		r	R	
84.	<i>Vindula erota</i> F.	3	r ^{fm}	u		r ^{fm}	U	
85.	<i>Junonia iphita</i> Cramer	3					r ^l	
86.	* <i>J. atlites</i> L.	3		r	c		R	c
87.	<i>J. lemonias</i> L.	4				r		
88.	<i>Hypolimnas bolina</i> L.	4		u			C	
89.	* <i>Ariadne ariadne</i> L.	3						r
90.	<i>Cyrestis themire</i> Honrath	3	c	c		c	C	
91.	<i>C. cocles</i> F.	3	r			r		
92.	* <i>C. thyodamus</i> Doyere	3		r			R	
93.	<i>Chersonesia risa</i> Doubleday	3	c	c		c	U	
94.	<i>Neptis clinia</i> Moore	3				r		
95.	<i>N. hylas</i> L.	4				r		
96.	<i>N. leucoporus</i> Fruhstorfer	3	r			u		
97.	<i>N. miah</i> Moore	2	r	r				
98.	<i>Phaedyma columella</i> Cramer	4	r			r		
99.	<i>Lasippa heliodore</i> F.	3	r					
100.	<i>L. monata</i> Weyenbergh	3	r					
101.	<i>Pantoporia hordonia</i> Stoll	3	u	u		u		
102.	<i>P. paraka</i> Butler	3				r		
103.	<i>Athyma pravara</i> Moore	3	r					
104.	<i>A. azura</i> Moore	3					R	
105.	<i>A. kanwa</i> Moore	3	r			c ^l	U	
106.	<i>A. selenophora</i> Moore	3	u					



Appendices

No.	Family Genus and Species	Global Range	Phong Dien district			Dakrong district		
			Forest	River	Deforested	Forest	River	Deforested
107.	<i>A. nefte</i> Cramer	3		r		r ^{fm}	r ^m	
108.	<i>Moduza procris</i> Cramer	3		r			R	
109.	<i>Lebadea martha</i> F.	3	r			c ^l	R	
110.	<i>Tanaecia julii</i> Lesson	3	c	c		c	C	
111.	<i>T. lepidea</i> Butler	3	c	c		c	C	
112.	<i>Euthalia monina</i> F.	3	u			u		
113.	<i>E. eriphylae</i> de Niceville	3	r			r		
114.	* <i>E. phemius</i> Doubleday	3				r ^l		
115.	<i>Lexias dirtea</i> F.	3	c ^l			c ^l		
116.	<i>Eulacera osteria</i> Westwood	3	c			c		
117.	<i>Charaxes bernardus</i> F.	3		u			U	
118.	<i>C. aristogiton</i> C. & R. Felder.	2						
119.	<i>Polyura athamas</i> Drury	3		r			R	
	Libytheidae							
120.	<i>Libythea myrrha</i> Godart	3		r				u
121.	<i>L. narina</i> Godart	3						r ^l
122.	<i>L. geoffroy</i> Godart	4						r ^l
	Riodinidae							
123.	<i>Zemerus flegyas</i> Cramer	3	c	c	c	c	C	c
124.	<i>Dodona deodata</i> Hewitson	2	r					
125.	<i>Abisara echerius</i> Stoll	3	u			u		
126.	<i>Paralaxita dora</i> Fruhstorfer	1	r					
127.	<i>Stiboges nymphidia</i> Butler	3	r			r		
	Lycaenidae							
128.	<i>Miletus</i> cf. <i>mallus</i> Fruhstorfer	2	r					
129.	<i>Allotinus subsrigosus</i> Moore	3	r ^l					
130.	* <i>Castalius rosimon</i> F.	3			?			
131.	<i>Caleta roxus</i> Godart	3				c ^l		
132.	<i>Everes lacturnus</i> Godart	3				r		
133.	<i>Acytolepis puspa</i> Horsfield	3	u					
134.	<i>Neopithecops zalmora</i> Butler	3				r		
135.	<i>Megisba malaya</i> Horsfield	2	u			u		
136.	<i>Jamides celeno</i> Cramer	3	c	c		c	C	
137.	<i>J. alecto</i> C. Felder	3		u		u		
138.	<i>Nacaduba kurava</i> Moore	?		?				
139.	<i>N. pavana</i> Fruhstorfer		?					
140.	<i>N. subperusia</i> Fruhstorfer	?	?					
141.	<i>Prosotas</i> sp.	?		c				
142.	<i>Anthene emolus</i> Godart	3						
143.	<i>A. lycaenina</i> R. Felder	3						
144.	<i>Arhopala</i> cf. <i>silhetensis</i>	?	r					
145.	<i>A. ammonides</i> Doherty	?	r					
146.	<i>A. vihara</i> Corbet	?				r		
147.	<i>A. epimuta</i> Evans	?	r					
148.	<i>A. ariana</i>	?	r					
149.	<i>A. sp.</i> Evans	?				r		
150.	<i>Flos diardi</i> Hewitson	3	r					
151.	<i>F. fulgida</i> Hewitson	2	u			u		
152.	<i>Surendra quercetorum</i> Moore	2	u			u		
153.	<i>S. cf. vivarna</i>	3	r					
154.	<i>Amblypodia anita</i> Hewitson	2				r	U	
155.	<i>Spindasis syama</i> Horsfield	3		r		r		
156.	* <i>Loxura atymnus</i> Stoll	3				r		
157.	<i>Yasoda tripunctata</i> Hewitson	2	u			r		
158.	<i>Thamala marciata</i> Hewitson	2				u		
159.	<i>Dacalana burmana</i> Moore	?	r					
160.	<i>Tajuria</i> cf. <i>cypus</i>	?	r					
161.	<i>T. ister</i>	?	r					

No.	Family Genus and Species	Global Range	Phong Dien district			Dakrong district		
			Forest	River	Deforested	Forest	River	Deforested
162.	<i>T. cf. luculentus</i>	?	r					
163.	<i>Remelana jangala</i> Horsfield	3	r					
164.	* <i>Zeltus amasa</i> Hewitson	3		r		r		
165.	<i>Deudorix epijarbas</i> Moore	3				r		
166.	<i>Sinthusa chandrana</i> Moore	2				r		
167.	<i>Rapala cf. damona</i>	3				r		
168.	<i>R. varuna</i> Horsfield	3	u					
	Hesperiidae							
169.	<i>Bibasis oedipodea</i> Swainson	3		r				r
170.	<i>B. jaina</i> Moore	3	r			r		
171.	<i>B. sena</i> Moore	3						u
172.	<i>Hasora taminatus malayana</i> Felder & Felder	3	u					
173.	<i>H. badra</i> Moore	3	u			u		
174.	<i>H. vitta</i> Butler	3						r
175.	<i>H. chromus</i> Cramer	3	c	c		c	C	
176.	<i>Badamia exclamationis</i> Fabricius	3	c	c		c	C	
177.	<i>Celaenorrhinus asmara</i> Butler	2				r		
178.	<i>Darpa striata</i> Druce	3	r					
179.	<i>Odina decoratus</i> Hewitson	2	r					
180.	<i>Coladenia agni</i> de Nicev.	3	r					
181.	<i>C. agnioides</i> Elw. & Edw	3	u					
182.	<i>Gerosis</i> sp. (near <i>tristis</i> Eliot)	3	u			u		
183.	<i>Mooreana trichoneura</i> C. & R. Felder	3	u					
184.	<i>Tagiades litigiosa</i> Moschler	3	c					
185.	<i>T. menaka</i> Moore	3	r			u		
186.	<i>T. gana</i> Moore	3	r					
187.	<i>Halpe zola</i> Evans	2	r					
188.	<i>Astictopterus jama</i> ? C. & R. Felder	3				c		
189.	<i>Iambrix salsala</i> Moore	3		c		c		
190.	<i>Koruthaialos rubecula</i>	3				r		
191.	<i>Ancistroides nigrita diocles</i> Moore	3				u		
192.	<i>Notocrypta paralysos</i> W.-M.	3				u		
193.	<i>N. clavata</i> Staudinger	3		r				
194.	<i>Zographetus cf. doxus</i> Eliot	3				u		
195.	<i>Isma umbrosa</i> Elw. & Edw.	3				r		
196.	<i>Hyarotis microstictum</i> W.-M. & de Niceville	?	r					
197.	<i>Plastingia naga</i> de Niceville	3	r					
198.	<i>P. cf. pellonia</i> Fruhst.	3				r		
199.	<i>Salanoemia noemi</i> de Nicev.							
200.	<i>Pyrroneura margherita miriam</i> Evans	2	c			u		
201.	<i>Lotongus calathus</i> Hewitson	3		r				
202.	<i>Zela</i> (?) sp.	?	r					
203.	<i>Gangara thyrus</i> F.	3				u		
204.	<i>G. lebadea</i> Hewitson	2				r		
205.	<i>Matapa druna</i> Moore	3	r			r		
206.	<i>M. sasivarna</i> Moore	3	r					
207.	<i>Unkana ambasa</i> Moore	3				r		
208.	<i>Pirdana hyela</i> Hewitson	3				r		
209.	<i>Telicota colon stinga</i> Evans	3						u
210.	<i>Parnara ganga</i> Evans	?						?
211.	<i>Pelopidas assamensis</i> de Nicev.	3						?
212.	<i>Pelopidas</i> (?) sp.	?		?				
213.	<i>Caltoris</i> sp.	?	?					

Study Sites: Phong Dien district: Khe Lau village, Phong My commune; and Dakrong district: Khe Ba Long village, Ta Ruc commune.

Sample Sites: Forested sites; River and stream beds; and Deforested sites.



Appendices

Species occurrence is divided into three categories:

r - rare (single or two specimens encountered);

u - uncommon (~10 specimens seen);

c - common (up to 20 specimens seen);

c^m - common male only; u^m - uncommon female only; c^l - locally common

* - New species record for Vietnam

Global Range: 1 - East Himalayas (Nepal, Assam, Sikkim, N. Burma, Yunnan, S.W. China, N. Indochina);

2 - Indochina to India;

3 - Oriental region;

4 - Indo-Australian tropics; and

5 - Palaetropics.

Soreson Similarity Index comparing Butterfly Species Composition in Dakrong (DK) and Phong Dien (PD) Watershed Protection Forests with those in Bach Ma National Park (BM) and Vu Quang Nature Reserve (VQ)

(a) Papilionidae

	DK+PD	BM	VQ
DK+PD	-		
BM	0.863	-	
VQ	0.833	0.782	-

(b) Pieridae

	DK+PD	BM	VQ
DK+PD	-		
BM	0.826	-	
VQ	0.700	0.761	-

(c) Danaidae

	DK+PD	BM	VQ
DK+PD	-		
BM	0.769	-	
VQ	0.666	0.761	-

(d) Satyridae

	DK+PD	BM	VQ
DK+PD	-		
BM	0.363	-	
VQ	0.389	0.553	-

(e) Amathusidae

	QT+TTH	BM	VQ
Qtri+TTH	-		
BM	0.875	-	
VQ	0.75	0.75	-

(f) Nymphalidae

	QT+TTH	BM	VQ
Qtri+TTH	-		
BM	0.568	-	
VQ	0.721	0.673	-

(g) Riodinidae

	QT+TTH	BM	VQ
Qtri+TTH	-		
BM	0.608	-	
VQ	0.727	0.909	-

(h) Hesperidae

	DK+PD	BM	VQ
DK+PD	-		
BM	0.423	-	
VQ	0.344	0.352	-

(i) Total of the families

	DK+PD	BM	VQ
DK+PD	-		
BM	0.615	-	
VQ	0.607	0.681	-

Shading Key for Cs Values

	Cs = <0.4
	Cs = 0.4-0.5
	Cs = 0.5-0.6
	Cs = 0.6-0.7
	Cs = 0.7-0.8
	Cs = >0.8



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 fulfill 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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