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The Biodiversity of Bac Huong Hoa Nature Reserve, Quang Tri Province, Vietnam

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The Biodiversity of Bac Huong Hoa Nature Reserve, Quang Tri Province, Vietnam

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Cover Photograph
Forest near Cup village in Bac Huong Hoa Nature Reserve.

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Conventions Used

Plant names, and species limits follow Anon (2007). Mammal names (common) follow Wilson and Reeder (2005) and (scientific) IUCN (2007), sequence follow Wilson and Reeder (2005) and species limits follow IUCN (2007), with scientific names given at first mention and in Appendix 2. Bird names (common and scientific), sequence and species limits follow BirdLife International (2008), with scientific names given at first mention and in Appendix 3. Reptile and amphibian names, sequence and species limits follow Nguyen Van Sang and Ho Thu Cuc (1996), with scientific names given in Appendix 4. Diacritical marks are omitted from Vietnamese names due to typographical limitations and the restricted understanding of international readers.

Glossary of Terms

Endemic Bird Area (EBA) refers to an area supporting at least two restricted-range bird species. A restricted-range bird species is one with a global breeding range of less than 50,000 km^2. Globally threatened species refers to a species assigned a category of threat in the IUCN Red Lists of Threatened Animals and Plants (IUCN 2007); the term excludes species listed as Near Threatened or Data Deficient. Indochina refers to the biogeographic region of Cambodia, Laos and Vietnam.

Abbreviations and Acronyms Used

EBA - Endemic Bird Area
IBA – Important Bird Area
FIPI - Forest Inventory and Planning Institute, Hanoi
FPD - Forest Protection Department
IEBR - Institute of Ecology and Biological Resources
IUCN - World Conservation Union
MARD - Ministry of Agriculture and Rural Development
NTFP - Non-timber forest products
WWF – World Wildlife Fund
VRDB – Vietnam Red Data Book 2007
CR – Critically Endangered
EN – Endangered
VU – Vulnerable
DD – Data Deficient
NT – Near Threatened

Executive Summary

Prior to their designation as a nature reserve, the forests of Bac Huong Hoa, together with adjacent forest in Quang Binh Province, represented the largest block of unprotected forest in the Central Annamites. The establishment of the nature reserve presents an opportunity to conserve a significant area of forest, with a fauna representative of the Greater Truong Son Landscape. This report brings together biological information relevant to Bac Huong Hoa Nature Reserve, to enable effective management.

Bac Huong Hoa Nature Reserve covers 25,200 hectares, including 20,646.2 hectares of natural forest. These forests support a fauna representative of the Central Annamites and the Greater Truong Son Landscape. The reserve supports globally threatened mammal species such as the Saola *Psuedoryx nghetinhensis* and Red-shanked Douc Langur *Pygathrix nemaeus*, and four of the seven restricted-range bird species which define the Annnamese Lowlands Endemic Bird Area. Site Support Groups set up by BirdLife to monitor populations of key mammal and bird species also report the continued existence of the globally Endangered Edwards's Pheasant *Lophura edwardsi* in the nature reserve. Due to the populations of threatened and restricted-range species it supports, Bac Huong Hoa Nature Reserve forms part of the Truong Son Important Bird Area.

Although it is of global importance due to the species and habitats it protects, in recent years the biodiversity value of Bac Huong Hoa Nature Reserve may have been considerably reduced due to intensive commercial hunting for the wildlife trade. A number of teams of professional hunters from Quang Binh Province operate in the nature reserve and a very high density of traps has been observed. The trade in wildlife is likely to have been facilitated by the construction of the Ho Chi Minh Highway.

Bac Huong Hoa Nature Reserve therefore presents a management challenge and a significant conservation opportunity. This report recommends that effective management must be established at Bac Huong Hoa Nature Reserve, in order to protect the globally important biodiversity attributes of the Central Annamites. Professional hunting must be eradicated quickly and surveys of species representative of the Greater Truong Son Landscape need to be conducted, to inform management decisions. Traditional projects to improve management of protected areas in the Central Annamites have been limited in their success. Due to the intensity of threat processes at Bac Huong Hoa Nature Reserve, the same is likely to be true there. The recent establishment of this protected area presents an opportunity to pursue innovative forms of management. New management strategies which work within established national frameworks may be the most effective way to manage Bac Huong Hoa Nature Reserve and the species of global importance it protects. This innovative approach could provide a successful alternative model for conservation of protected areas throughout Vietnam.

Executive Summary: Vietnamese

Trước khi xây dựng khu bảo tồn, rừng ở khu vực Bắc Hướng Hóa và phía giáp tỉnh Quảng Bình là vùng rừng rộng lớn nhất miền trung Trường Sơn còn chưa được bảo vệ. Thành lập khu bảo tồn thiên nhiên ở đó là một cơ hội tốt để bảo vệ khu rừng quan trọng với đại diện của nhiều loài động vật của dãy Trường Sơn hùng vĩ. Báo cáo này nhằm cung cấp thông tin về đa dạng sinh học của khu bảo tồn thiên nhiên Bắc Hướng Hóa và tạo cơ sở quản lý hiệu quả nguồn tài nguyên sinh vật trong khu bảo tồn.

Khu bảo tồn thiên nhiên Bắc Hướng Hóa có diện tích là 25.200 ha, trong đó rừng tự nhiên là 20.646,2 ha. Khu rừng này là môi trường sống của nhiều loài động vật đại diện miền Trung Trường Sơn cũng như của dãy Trường Sơn rộng lớn. Cụ thể, nó là môi trường sống của nhiều loài thú đang bị đe dọa ở mức toàn cầu như Sao la (*Psuedoryx nghetinhensis),* Voọc vá chân nâu (*Pygathrix nemaeus*) và của năm trong số bẩy loài chim có vùng phân bố hẹp tại Vùng chim đặc hữu đất thấp Trường Sơn. Các nhóm tuần tra giám sát do Tổ chức Birdlife thành lập nhằm giám sát số lượng của các loài chim và thú quan trọng, đặc biệt là của loài Gà lôi lam mào trắng (*Lophura edwardsi)* trong khu bảo tồn. Khu bảo tồn Bắc Hướng Hóa là một phần của vùng chim quan trọng trong dãy Trường Sơn vì nó có quần thể của các loài phân bố hẹp và đang bị đe dọa.

Mặc dù có tầm quan trọng toàn cầu vì rừng ở Bắc Hướng Hóa là môi trường sống của nhiều loài động thực vật và sinh cảnh quan trọng, nhưng những năm gần đây, giá trị đa dạng sinh học trong khu bảo tồn thiên nhiên Bắc Hướng Hóa đã bị suy giảm nghiêm trọng do việc săn bắn và buôn bán động vật hoang dã trái phép. Có rất nhiều nhóm thợ săn chuyên nghiệp từ tỉnh Quảng Bình đang ráo riết hoạt động trong khu bảo tồn và sử dụng rất nhiều bẫy khác nhau. Việc xây dựng đường Hồ Chí Minh cũng tạo thêm điều kiện cho việc buôn bán, vận chuyển động vật hoang dã.

Vì vậy, Khu bảo tồn thiên nhiên Bắc Hướng Hóa đang phải đối mặt với những thách thức trong quản lý nhưng lại có cơ hội để thực hiện sứ mệnh bảo tồn. Để bảo vệ giá trị đa dạng sinh học của miền trung Trường Sơn, cần phải thành lập ban quản lý khu bảo tồn và thực hiện các hoạt động có hiệu quả tại khu bảo tồn thiên nhiên Bắc Hướng Hóa, ngăn chặn các hoạt động săn bắn trái phép và tiến hành điều tra bổ sung thông tin về các loài đại diện của dãy Trường Sơn để làm cơ sở quản lý hiệu quả hơn nữa. Với mức độ đe dọa đến khu bảo tồn thiên nhiên Bắc Hướng Hóa như vậy, thì rất có thể kết quả quản lý khó được như mong muốn. Những khu bảo tồn được thành lập trong thời gian gần đây có thể có cơ hội để thực hiện những biện pháp quản lý mới nhằm bảo vệ các loài có tầm quan trọng toàn cầu và đó có thể sẽ là mô hình quản lý bảo tồn phù hợp cho các khu bảo vệ trên toàn lãnh thổ Việt Nam.

1. Introduction

1.1 Conservation in Vietnam

The Socialist Republic of Vietnam is a relatively narrow strip, running north-south along the eastern coast of the Indochinese Peninsula. The population of Vietnam is approximately 85 million (CIA Sourcebook 2008). Vietnam is currently undergoing an economic transition towards a more market-oriented economy. The country's annual per capita gross national product (GNP) has been growing rapidly for the past decade. Economic growth, infrastructure development, population growth, protracted wars, and the development of agriculture, forestry and fishing industries, have resulted in over-exploitation of Vietnam's natural resources. The environment in Vietnam has largely been compromised: 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.

Due to a rapidly expanding population and an economic growth rate which has now reached over 8%, there is increasing pressure on land and resources in Vietnam. The national conservation movement now faces its greatest challenge yet: conserving biodiversity in the face of these mounting pressures. Forest is being lost due to the agricultural needs of the rural poor, whilst high value timber trees are now targeted wherever they occur, to manufacture high quality furniture for the expanding rich middle class. A concurrent trend has been the equally rapid commercialisation and expansion of wildlife trade, facilitated by an increasingly efficient transport and communications network and driven by new found wealth and a growing demand for wildlife products (WCS/FPD 2008).

The government of Vietnam recognised the need for conserving and rehabilitating the natural environment at the end of the 1970s. However, it was not until the 1990s that the conservation emphasis moved towards protecting endangered habitats and species. Vietnam's forests are divided into three categories, of which nature reserves fall under the designation Special-use Forests (Protected Areas) and are managed by the Ministry of Agriculture and Rural Development (MARD). A countrywide analysis of protected area coverage conducted by the BirdLife International Vietnam Programme and the Forest Inventory and Planning Institute of MARD, was published in 1999 as a response to the government's strategy to expand the Special-use Forest system from one million to two million hectares (Wege *et al*. 1999). As a result of achievement of this policy goal, the Vietnamese government considers their protected area system complete, and Bac Huong Hoa Nature Reserve is likely to be last protected area designated in Vietnam.

1.2 The Annamese Lowlands Endemic Bird Area

Initial surveys conducted by BirdLife International identified 218 centres of bird endemism world-wide, termed Endemic Bird Areas (EBAs) (Stattersfield *et al.* 1998). Endemic Bird Areas are areas which support at least two restricted-range bird species (species with a global range of less than 50,000 km^2), and are considered to be priority areas for conservation (Stattersfield *et al.*

1998). Three Endemic Bird Areas were initially identified in Vietnam: the Southern Vietnamese Lowlands, the Da Lat Plateau, and the Annamese Lowlands.

The Annamese Lowlands Endemic Bird Area covers the level lowlands and foothills of north-central Vietnam (in southern Ninh Binh, Thanh Hoa, Nghe Anh, Ha Tinh, Quang Binh, Quang Tri and Thu Thien Hue provinces) and part of adjacent central Laos, up to an elevation of 1,000 m. As such, much of the forest at Bac Huong Hoa Nature Reserve falls into this Endemic Bird Area. The natural vegetation of this Endemic Bird Area, is tropical lowland evergreen and semi-evergreen rain forest below approximately 1,000 m elevation. This adjoins tropical mid-montane rain forest above this altitude. Habitat loss in this Endemic Bird Area has been severe, the coastal lowlands have been almost entirely deforested since 1945, and the forest in the foothills is now highly fragmented and degraded, with few substantial areas of good quality forest remaining (Statterfield *et al.* 1998).

The Endemic Bird Area was defined by the ranges of nine species, although of these, one is now considered a hybrid taxon (Imperial Pheasant *Lophura imperialis*) and another (Annam Partridge *Arborophila merlini*), is now regarded by BirdLife International as a subspecies of the more widespread Chestnut-necklaced Partridge *Arborophila chaltonii*. Of the remaining seven species, the range of Crested Argus *Reinardia ocellata* also extends upwards into montane forest, and White-cheeked Laughingthrush *Garrulax vassali* is principally a lower montane species of only marginal occurrence in this Endemic Bird Area. Sooty Babbler *Stachyris herberti* is a localised species with a distribution confined to forest on limestone outcrops. The Annamese Lowlands Endemic Bird Area also support a number of widespread Near Threatened species, such as Red-collared Woodpecker *Picus rabieri* and Blyth's Kingfisher *Alcedo hercules*.

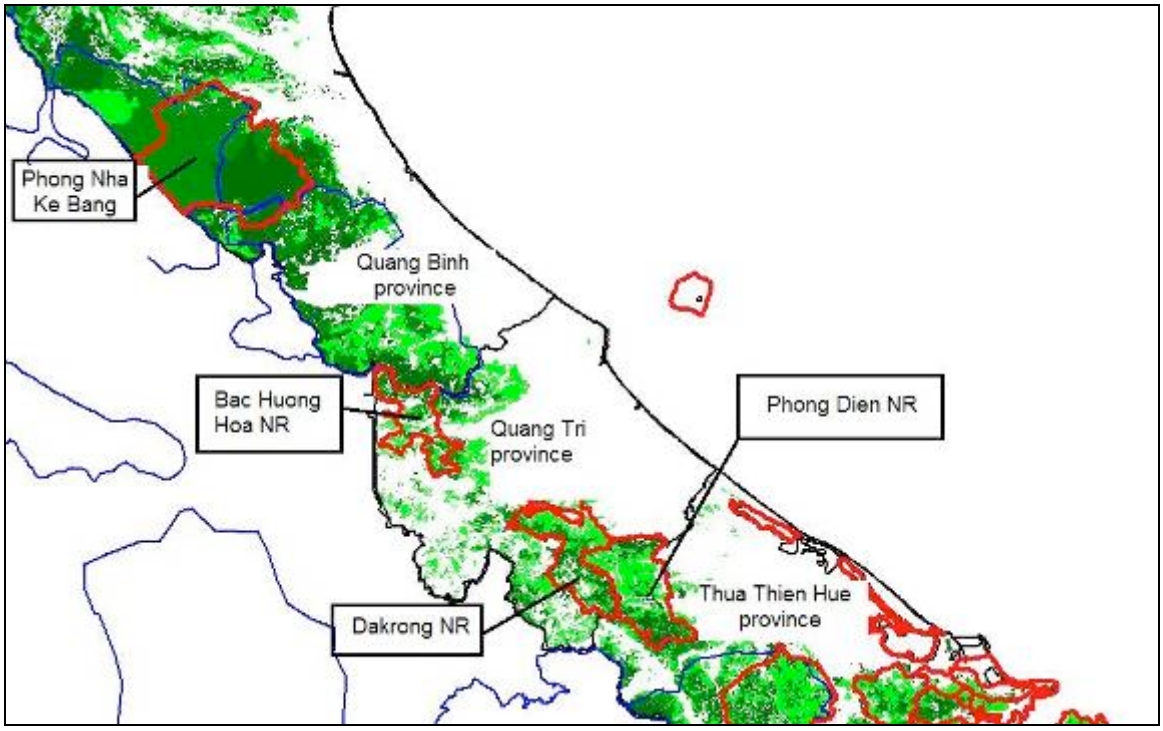
Deforestation in this Endemic Bird Area has been intense; the only remaining good quality lowland forest is in small valleys and on the lower slopes of the hills. Causes of deforestation in the past include clearance for agriculture to feed a rapidly increasing population, warfare and logging. The remaining forests are subject to commercial logging, further clearance for permanent agriculture and settlements and degradation as a result of fuelwood collection, shifting agriculture and fire (Collins *et al.* 1991, Eames *et al.* 1992).

There are 13 protected areas in the Annamese Lowlands Endemic Bird Area in Vietnam, which protect blocks of forest along the eastern edge of the Annamite Range and the coastal lowlands. Approximately 50 kilometres to the south of Bac Huong Hoa are the Dakrong and Phong Dien nature reserves, which support 40,526 and 41,548 hectares respectively. Nearly 70 kilometres to the north, Phong Nha Ke Bang protects 85,745 hectares of lowland broad-leaf evergreen and limestone karst forest. Together with adjacent forest in Quang Binh Province, the forests of Bac Huong Hoa constituted the largest area of unprotected lowland evergreen forest in the Central Annamites Landscape. As such, its addition to the protected area network represents an important contribution to conservation in the region.

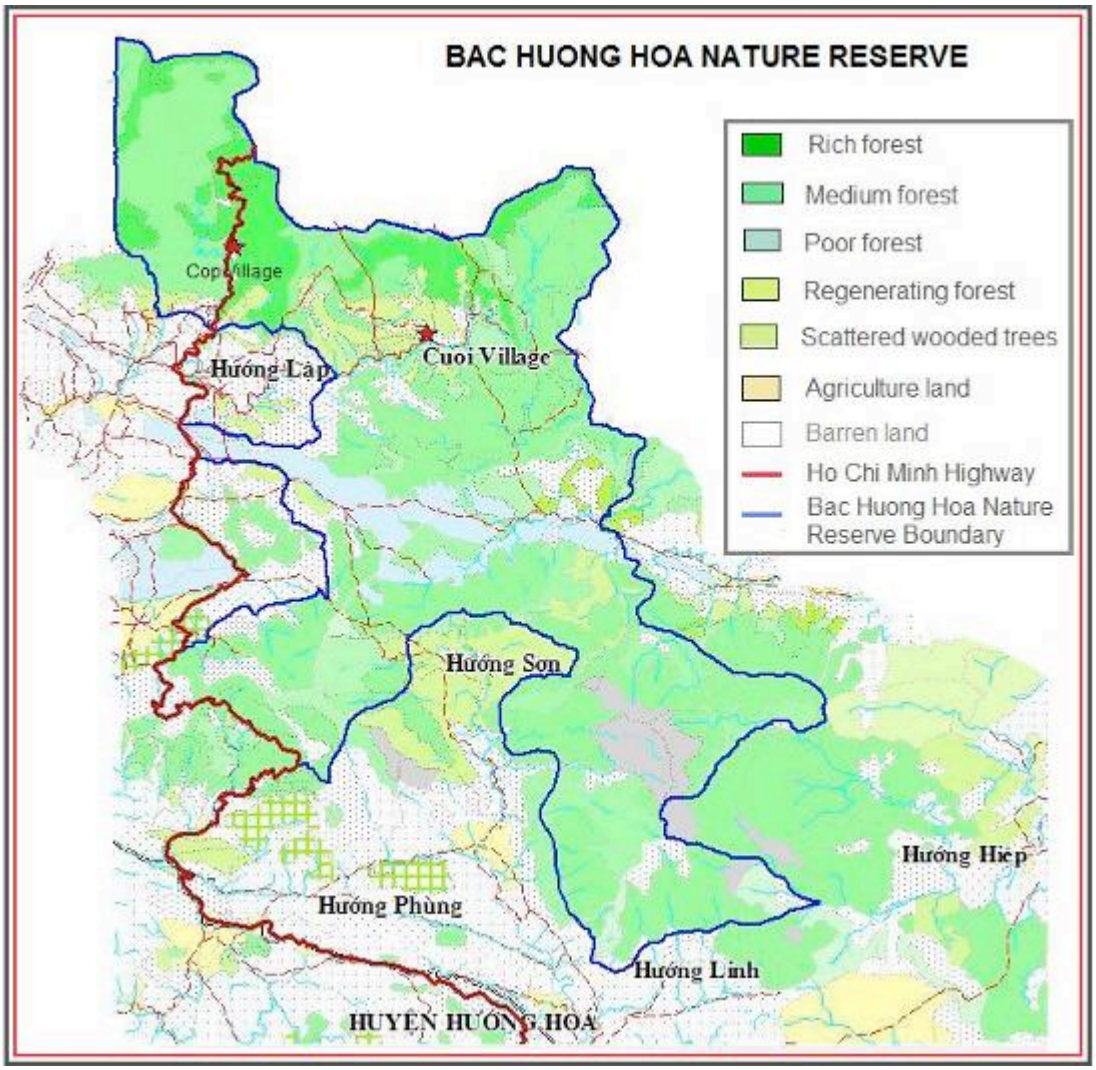
2. Characteristics of Bac Huong Hoa Nature Reserve

2.1 Location

Bac Huong Hoa Nature Reserve encompasses an area of lowland and mid-montane evergreen forest in central Vietnam, adjacent to the international border with Laos (Map 1.). It covers 25,200 hectares, including 20,646.2 hectares of natural forest. It is located in the north of Huong Hoa District, Quang Tri Province, 50 kilometres north-west of Khe San town, and 120 kimometres west of Dong Hai town. The nature reserve is bisected by the Ho Chi Minh Highway. It encompasses the territory of five communes, namely Huong Linh, Huong Son, Huong Phung, Huong Viet and Huong Lap (Map 2). To the north, it is bordered by Quang Binh Province and to the east it is bordered by three districts, Vinh Linh, Gio Linh and Dakrong. The nature reserve is bounded by the coordinates 16°43'22''N and 106°33'00''E to 16°59'55''N 106°47'03''E. Within the boundary of Bac Huong Hoa Nature Reserve, there are two villages with c. 30 households, of which 12 households belong to Cuoi village and 18 households belong to Cop village. Both villages are in the Huong Lap Commune.



Map 1. The location of Bac Huong Hoa Nature Reserve.
Note: Darkness of green indicates richness of forest. Areas enclosed in red are protected areas.



Map 2. Bac Huong Hoa Nature Reserve (Quang Chi Forest Protection Department)

2.2 Demographics

The residents of Cop and Cuoi villages are an indigenous ethnic minority group, the Van Kieu. They have a low economic status, 83% of households in the nature reserve are classified as poor and the remainder rank as average. The Van Kieu in the nature reserve have three main sources of income, namely: cattle, small-scale agriculture and forest resource exploitation. On average, these people obtain 40% of their income from exploitation of forest resources and this percentage is increasing due to the activities of wildlife traders.

2.3 Biogeographical location

The nature reserve is just beyond the northern limit of Priority Landscape CA1, of the Greater Truong Son Landscape (Tordoff *et al.* 2003). However, it is included in the Central Annamites Landscape, which is bounded by the coordinates 14°00'N and 106°00' to 17°30'N and 109°00'E and the Greater Annamite Ecoregion (Baltzer *et al.* 2001). Biogeographically, this region is

characterized by a species community typical of the Central Annamite chain. Bac Huong Hoa Nature Reserve is also situated in the Annamese Lowlands Endemic Bird Area (Stattersfield *et al.* 1998), since it supports a number of the restricted-range bird species which characterise the Endemic Bird Area.

Bac Huong Hoa Nature Reserve forms the southernmost part of the Truong Son Important Bird Area (Tordoff *et al.* 2002). This Important Bird Area, and the forests of Bac Huong Hoa Nature Reserve, support a fauna typical of the Annamese lowlands. The site qualified as an Important Bird Area under criteria A1, due to the presence of globally threatened species (at the time of assessment a number of species found in the nature reserve, such as Crested Argus, were considered globally threatened); A2, due to the presence of restricted-range species; and A3, due to the presence of biome restricted species. It is also a Key Biodiversity Area (KBA), part of a globally important network of sites for conservation, due to the presence of Saola *Pseudoryx nghetinhensis* and Edwards's Pheasant *Lophura edwardsi.*

Bac Huong Hoa Nature Reserve also lies within the Indo-Burma Biodiversity Hotspot (Djik *et al.* 1999). This large designation covers all of the Indochinese subregion, including the Central Annamites and the Annamese lowlands.

2.4 History of Bac Huong Hoa Nature Reserve

Following the first field surveys in the region, BirdLife designated the forests of Bac Huong Hoa as an Important Bird Area, recognising the global importance of the area (Tordoff *et al.* 2002). BirdLife has continued its interest in and commitment to the forests of Bac Huong Hoa, through two MacArthur Foundation funded projects. The first of these projects conducted biodiversity surveys in the area and established two Site Support Groups (SSGs) in Bac Huong Hoa, in Cup and Cuoi villages. These were established in August 2004 with the purpose of monitoring populations of key bird and mammal species and increasing law enforcement. The second project (of which this report forms a part) aimed to consolidate BirdLife's involvement in the area through the designation of a nature reserve, continued support to Site Support Groups and promotion of synergies with other relevant local stakeholders, to facilitate more effective forest protection.

BirdLife was successful in its efforts to establish a nature reserve in Bac Huong Hoa. The proposal for the establishment of Bac Huong Hoa Nature Reserve was prepared by Quang Tri Forest Protection Department (FPD), with technical assistance from BirdLife and was appraised by the Ministry of Agriculture and Rural Development (MARD). On 14th March 2007, Quang Tri Provincial People's Committee issued Decision no. 479/QD-UBND, approving the Investment Plan for Bac Huong Hoa Nature Reserve. The Investment Plan for the nature reserve was appraised by Quang Tri Provincial People Committee.

2.5 History of Biological Research

Bac Huong Hoa Nature Reserve has received limited contemporary biological research. The first surveys in modern times were conducted by Le Manh Hung *et al.* (2002) in July 2002, for BirdLife International Vietnam Programme, as part of the DANIDA funded project entitled:

"Improved conservation planning through institutional strengthening in Cambodia, Laos and Vietnam". The primary aim of this seven day rapid field survey was to assess whether forests in Huong Hoa district qualified as an Important Bird Area. This survey used interviews and opportunistic fieldwork to investigate the occurrence of Important Bird Area trigger species.

Recognising the importance of the forests of Bac Huong Hoa, a second week long survey was conducted in February 2004, focussing on the most intact areas of forest, those close to Khe Cuoi and Ban Cup villages (Le Manh Hung *et al.* 2004 and Dan Ngoc Can 2004). The aim of this survey was to create a more complete inventory of the bird and mammal species of the forests of Bac Huong Hoa and to collect status and distribution data on globally and nationally threatened species.

In April and May 2004, experts from the Institute of Ecology and Biological Resources conducted herpetological surveys in the forests of Bac Huong Hoa, again focussing survey effort on the well forested areas close to Khe Cuoi and Ban Cup villages. These surveys recorded 61 species of reptile and amphibian, including one frog species *Philautus truongsonensis*, which they described as new to science (Orlov and Ho Thu Cuc 2005). This remains the most comprehensive herpetological survey of the forests of Bac Huong Hoa but the results were not widely published.

Le Trong Trai conducted biodiversity surveys in Bac Huong Hoa in mid 2005 in preparation for the creation of an investment plan for Bac Huong Hoa Nature Reserve. The results of this survey were published in the investment plan for the nature reserve (Anon 2005). During this survey, a number of additional species were recorded for the first time and includes the only comprehensive plant survey of the area. Although this survey focused on only one relatively small area close to Cup village, 920 plant species were recorded. As part of the 2005 surveys, Jeremy Holden conducted one month of camera trapping with nine cameras in the forests of Bac Huong Hoa (Holden 2005). However, no mammals or birds were recorded (Le Trong Trai pers. com.), although this may in part have been because ideal locations for cameras were all already taken by snare traps set by hunters.

In 2006 a rapid survey of reptiles and amphibians in Quang Tri Province was conducted, which included a short survey in the forests of Bac Huong Hoa (Cao Tien Trung in prep.). A wildlife trade survey was conducted in 2006 in 10 villages and three towns in or close to Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006). This survey recorded a small number of mammal species not previously reported from the nature reserve.

Since the establishment of the nature reserve, monitoring of key mammal and bird species has been conducted by Site Support Groups set up by BirdLife. Monitoring by these groups has yielded data on most of the key species through a series of short surveys in 2004 and 2005. However, the quality of the data is variable and difficult to quantify (Wilkinson and Nguyen Thanh Van 2006); apparent trends in populations are equally likely to relate to trends in observer skills or behavior.

Bac Huong Hoa Nature Reserve has been visited briefly by other ornithologists on a number of occasions, for instance, Andrew Tordoff visited in January 2005, Nicolas Wilkinson in 2006 and

Jonathan C. Eames and Simon Mahood in May 2008. Unpublished incidental observations made during their visits have been incorporated into this report.

No data on fish, small mammals, bats or invertebrates have ever been recorded in Bac Huong Hoa Nature Reserve.

2.6 Physical characteristics of Bac Huong Hoa Nature Reserve

2.6.1 Topography

Bac Huong Hoa Nature Reserve encompasses low lying land to the south of the northern section of the Annamite Range, and a ridge of 1,000 m elevation which runs in a northwest-southeast direction along the boundary between the provinces of Quang Binh and Quang Tri (Anon 2005). The forest on the Quang Binh side of this ridge is dominated by low lying areas with slopes of 15 to 25 degrees, although there are some steeper areas. On the other side of the ridge in Bac Huong Hoa Nature Reserve, low-lying land and a number of limestone peaks are present, such as Sa Mu Cave at 1,550 m and Lying-down Elephant Mountain, so named due to its shape, at 1,771 m. Although predominately low in elevation, the land is hilly and slopes are steep. Another limestone ridge runs in a west-east direction, on the boundary between Huong Lap and Huong Viet communes and near the center of Huong Viet Commune and a further runs in a south-north direction.

2.6.2 Soils

Bac Huong Hoa Nature Reserve is characterised by the following soil types (taken from Anon 2005):

- On hills and low mountains there is yellow-brown feralite. This soil is composed of broken down rock, in particular mica-schist, which gives it a silky texture.
- Other hills are dominated by a yellowish feralite soil. It is similar to yellow-brown feralite but has a higher sand content and consequently a coarse texture.
- On small and medium-sized mountains there is red-yellow humus feralite. Like yellow-brown feralite, this soil has a silky texture but contains more organic matter.
- Riverine areas are characterized by alluvial deposits.

2.6.3 Hydrology

Rivers in Bac Huong Hoa Nature Reserve are mostly short and relatively steep. They flow from the Central Annamites to the South China Sea in an east or northeast direction. The following are the main rivers of the area:

- The Ben Hai river is located in the northeast of Bac Huong Hoa Nature Reserve from where it flows into the sea at the Cua Tung estuary. All streams which have their origins in the eastern side of the nature reserve flow into the Ben Hai river.
- In the north-east and south of the nature reserve is the Xe Pang Hieng river. It flows into Laos and down to the Mekong river.
- The Cam Lo river has its source on the northern slope of Lying-down Elephant Mountain. It flows into the sea at the Cua Viet estuary;

- The Rao Quan river flows from the southern part of the nature reserve out to the Thach Han river (Anon 2005). A hydropower plant is being constructed on the Rao Quan river.

2.6.4 Meteorology

Bac Huong Hoa Nature Reserve is located in a region with a tropical monsoon climate (Anon 2005). It is hot in summer and cooler in winter. Since the central Annamite range which runs along the western edge of Bac Huong Hoa Nature Reserve is relatively high and orientated almost perpendicular to the north-east and south-west monsoons, the nature reserve receives a considerable amount of rain. There are rains in summer and autumn-winter; the dryer period lasts only 2-3 months. Most rain falls during August, September and October. The nature reserve also receives the "Phon", a warm dry wind originating in Laos, during the months of March-June.

Temperature
The average annual temperature is 24-25^{o} C, however monthly temperature variation is considerable. December and January are the coolest months when temperatures drop to 20 and sometimes as low as 15 in areas above 500 m elevation. In contrast, in June and July temperatures average 29 and regularly reach 39 when the Phon is blowing.

Sunshine
There are on average 4.5 hours of sunshine per day. July is the sunniest month, with an average of 6.7 hours per day, and February is the cloudiest, with an average of 2.3 hours of sunshine each day.

Rainfall
Annual rainfall totals for Bac Huong Hoa Nature Reserve are between 2,400 and 2,800 mm. There are two main rainy seasons, the first lasts from August to November and accounts for nearly 50% of the annual rainfall. The second rainy season lasts from April to August and is characterised by less heavy rain. Between February and March there is light rain and December to January is the driest period.

High levels of rainfall on unstable slopes lead to frequent landslides in Bac Huong Hoa Nature Reserve, particularly along the Ho Chi Minh Highway. Low lying areas also receive occasional partial flooding.

Humidity
In the context of humidity, there are two seasons. The humid season lasts from August to May, during these months the humidity is 85-90%. In June and July the Phon causes the humidity to decrease, sometimes to less than 30%.

2.7 Threats to Bac Huong Hoa Nature Reserve

Although Bac Huong Hoa Nature Reserve has a small human population, the newly established protected area faces a number of threats. Some of the problems the reserve faces originate from the residents of the nature reserve, but the majority, and the most severe, are presented by people from outside of the nature reserve (Le Manh Hung *et al*. in prep.). The construction of the Ho Chi

Minh Highway through the nature reserve has facilitated a rapid increase in negative pressures acting on Bac Huong Hoa Nature Reserve. The road enables illegally extracted forest products, including timber and wildlife, to be rapidly transported to towns such as Khe San.

Hunting

Hunting is probably the most significant threat to the biological integrity of Bac Huong Hoa Nature Reserve. Circumstantial evidence indicates that hunting has intensified in recent years, probably following the construction of the Ho Chi Minh Highway but also as part of a nationwide trend which has seen the wildlife trade network become increasingly commercial. Local residents have always hunted forest animals in Bac Huong Hoa for their subsistence needs. However, rapid commercialisation of the wildlife trade has brought large economic incentives for exploiting wildlife and has encouraged teams of professional hunters to exploit the wildlife of the nature reserve (Dang Ngoc Can *et al.* 2006).

Since the reduction in the number of guns in the Bac Huong Hoa Nature Reserve area, most hunting is done with wire snare traps (Le Manh Hung *et al.* in prep.). Hunters construct low fences of brush wood with gaps at five metre intervals in which they place wire snare traps made of bicycle brake cable. These catch any animals that attempts to pass through the gaps in the fence. Trap lines can be over one kilometre in length and contain hundreds of traps. They are placed on ridgelines or up the side of hills to block the passage of animals. Traps are also placed on paths leading to streams.

There are three types of hunters in Bac Huong Hoa Nature Reserve, professional, semi-professional and opportunistic. Professional hunters obtain all of their income from hunting. In Bac Huong Hoa Nature Reserve, professional hunters come from outside the nature reserve, often from Quang Binh Province. They operate in teams and have huge numbers of traps in the forest. All of the animals they catch are either caged or processed in the forest and the then sold directly to traders in towns such as Khe San, either for local consumption or for transport to other provinces.

Semi-professional hunters obtain only part of their income from hunting. They usually also farm rice, cassava or corn, and also harvest non-timber forest products. During the rainy season when their crops require less attention, they hunt animals in the forest, which they sell into the wildlife trade. Semi-professional hunters don't usually have direct connections with traders in towns, instead they sell the animals they catch to middlemen, who collect the animals from villages and sell them on to traders in towns such as Khe San. Nearly half of the households in the villages in Bac Huong Hoa Nature Reserve have at least one semi-professional hunter (Dang Ngoc Can *et al.* 2006).

Opportunistic hunters are people who work in the fields or forest where they collect non-timber forest products or take part in farming. When they encounter an animal that is easily caught, such as a pangolin or a turtle, they catch it and sell it on to the middlemen who visit their village (Dang Ngoc Can *et al.* 2006).

Although evidence is patchy, it appears that the hunting intensity in Bac Huong Hoa Nature Reserve is very high. In 2005, when selecting sites for camera trapping, all suitable sites were already taken by snare traps (Holden 2005). During that time, trap lines were found on all

ridgelines in the Cha Ly area. In September 2006, members of the Cuoi SSG reported that three groups of professional hunters from Le Thuy and Bo Trach districts, Quang Binh Province, were operating in the forest area close to the village. One group of four men operated in Khe Ta Nia where they had about 1,500 traps, another group of six men operated in Khe Tan Nap with about 2,000 traps, and another group of four men operated in Khe Xa Gi with about 2,000 traps. In addition, residents of Tria village reported that three or four groups of professional hunters, also from Quang Binh Province, were operating in their area with thousands of traps (Dang Ngoc Can *et al.* 2006).

It is highly likely that hunting is causing the rapid decline of mammals and terrestrial birds in Bac Huong Hoa Nature Reserve. The effects of hunting on populations of threatened and priority species is difficult to quantify, because their abundance in the nature reserve has always been poorly known. Such intense hunting activity is likely to lead to significant reductions in the populations of hunted species, as it has in other protected areas in Vietnam. Incidental trapping of species such as Edwards's Pheasant will continue even when they have very low population sizes, because trapping is indiscriminate and setting traps for commoner species such as Silver Pheasant *Lophura nycthemera* will still be economically viable (BirdLife International 2001).

Logging

The forests of Bac Huong Hoa Nature Reserve were selectively logged after 1975 and some selective logging continues in Bac Huong Hoa Nature Reserve. For instance, in November 2007 three groups of men from Quang Binh Province stayed for one month in Cup village to log timber and sell it to villagers and people from outside the area. Selective logging is likely to continue to pose a significant threat to the continued existence of some species which require large trees for nesting (e.g. Austen's Brown Hornbill), or feeding (e.g. Red-collared Woodpecker). Additionally, logging roads constructed along rivers have caused considerable damage to riparian vegetation.

Gold mining

Deep pits in the forest, particularly to the north and west of Cuoi village, are clear evidence of gold mining activities (Le Manh Hung *et al.* 2002 and 2004). Chemical washing of the soil to extract the gold has led to severe contamination in the streams in this area (Le Manh Hung *et al.* in prep.). Additionally, gold miners hunt animals with guns and snares, leading to local population declines of many species, particularly large and obvious mammals.

Rattan exploitation

Rattan collection has been intense in the forests around Cuoi village between 2000 and 2005 (Le Manh Hung *et al.* in prep.). Since then rattan supplies have been exhausted and rattan collection has declined. Rattan collectors usually also set snares in the area in which they are operating, to provide meat for food. This extra pressure on terrestrial animal populations is likely to have caused them to decline.

Fragrant oil extraction

A few species of *Cinnamomum* tree produce fragrant oil with many commercial uses. This oil commands a high price and is therefore extracted from trees in the forest by well organised groups. Oil is found in all woody parts of the trees but the highest concentrations are in the roots. Consequently, the entire tree is felled, typically using a chainsaw and the roots are dug up. The

woody parts are distilled in large pots which require constant heating. In similar locations, up to 20 medium-sized trees have been felled daily to feed the fires which heat the pot and teams have operated in the same area for up to one month (Eames *et al.* 1994). In Bac Huong Hoa Nature Reserve, most fragrant oil extraction now takes place in remote forested areas, such as east of Cuoi village (Le Manh Hung *et al.* in prep.). Groups of up to thirty people originating from Quang Binh and Ha Tinh provinces have been recorded in Bac Huong Hoa Nature Reserve collecting fragrant oil. The felling of trees for fuel and hunting to feed the large teams required for this activity are likely to be significantly negatively affecting the biological integrity of Bac Huong Hoa Nature Reserve.

Iron collection
The forests of the Central Annamites still contain a large quantity of iron from the American War. The opening of the Ho Chi Minh Highway has facilitated the easy transport of iron to Khe San. Many young people from the villages in the nature reserve, particularly from villages along the Ho Chi Minh Highway, regularly go to the forest to collect iron. Of greater concern is that professional iron collectors from outside the local area have moved in to exploit the iron (Le Manh Hung *et al.* in prep.). These people first clear the forest by burning, to make finding and collecting the iron easier, causing severe environmental degradation.

Destructive fishing methods
Fishing for subsistence use is common in Bac Huong Hoa Nature Reserve. Most fishing is conducted with nets but people also catch fish using mines and other explosives. This is not only dangerous (one child in Cuoi village lost a hand from fishing with mines in 2001) but is also damaging to aquatic life (Le Manh Hung *et al.* in prep.).

Deforestation
Approximately 15% of Bac Huong Hoa Nature Reserve had already been completely cleared before the nature reserve was established. Forest loss continues at a gradual rate and is likely to further reduce the area of forest of high conservation value in the nature reserve, particularly close to new settlements along the Ho Chi Minh Highway. The effects of defoliant spraying and bombing can be seen clearly in satellite images of central highland provinces taken in 1969. However, such areas are not diagnosably different from surrounding land in recent satellite images and it is not conclusive as to whether or not the present forest conditions can be attributed to the use of defoliants. There are a number of factors that may have influenced how present forest cover is affected by past defoliant use, including: the number of times the area was sprayed; what kind of defoliant was used; whether or not the area was also bombed or napalmed; the topography; the relative susceptibility of the forest community to the defoliants; and, perhaps most importantly, how the defoliated area was subsequently used by people (Koy *et al.* 2006).

2.8 Habitat types at Bac Huong Hoa Nature Reserve

The original vegetation cover of Bac Huong Hoa Nature Reserve is evergreen forest. Below 600 m elevation the land supports tropical lowland evergreen forest and above 600 m the forest is classified as subtropical mid-montane evergreen forest. Almost 85% of the nature reserve still retains natural forest cover, of various degrees of quality (Table 1.). Quality in this analysis refers to a classification based on timber yield. All forest in Bac Huong Hoa Nature Reserve has been

affected to some degree by logging, shifting cultivation and wars, especially through the use of chemical defoliants.

Table 1. Land cover of Bac Huong Hoa Nature Reserve

Land cover	Area (ha)	Proportion (%)
High quality evergreen forest	1,923	8
Medium quality evergreen forest	14,158	56
Poor quality evergreen forest	983	4
Regenerating forest	2,268	9
Bamboo forest	3	0.01
Limestone karst forest	1,311	5
Natural forest (all types)	20,646	82
Land with scattered trees	2,224	9
Grass and scrub	861	3
Rocky mountains without forest	889	4
Other land uses*	580	2
Total area	25,200	100

*Other land uses includes agriculture, residential and water bodies

2.8.1 High quality forest

Although there is no primary forest in Bac Huong Hoa Nature Reserve, forest with a structure unaltered since 1975 is classified as rich forest and is broadly analogous to primary lowland forest in terms of species composition and structure. This forest type makes up less than 10% of Bac Huong Hoa Nature Reserve. It is distributed in the north of the nature reserve in two blocks situated close to Cup and Cuoi villages, close to the Ho Chi Minh Highway.

Tropical lowland evergreen forest

Below 600 m elevation on soils with a low sand content, tropical lowland evergreen forest supports a diverse flora composed of broadleaf evergreen trees with large crowns and thick trunks. Trees in this habitat are from the families Meliaceae, Sapindaceae, Burceraceae, Eleocarpaceae, Myrtaceae, Ebenaceae, Annonaceae, Fabaceae, Fagaceae, Euphorbiaceae, Lauraceae, Simplocaceae, Sterculiaceae, Apocynaceae, Flacoutiaceae, Araliaceae, Rubiaceae and Moraceae. These forests support many large lianas, some up to 30 metres long and 10 cm in diameter. These are typically of the families Apocynaceae, Annonaceae, Fabaceae, Vitaceae, Aslepiadaceae and Arecaceae. Under the forest canopy small trees and bushes of the families Rubiaceae, Acanthaceae, Melastomataceae, Araliaceae, Arecaceae and Cyatheaceae are found. On the forest floor there are ferns from the families Polypodyophyta, Araceae, Urticaceae, Pandanaceae, Maranthaceae, Zingiberaceae, Commelinaceae and Myrsinaceae; and in light gaps flowers from the families Rubiaceae, Poaceae, Asteraceae and Begoniaceae grow. The layers in this forest type in Bac Huong Hoa Nature Reserve are detailed below:

Emergent layer: This layer is characterised by large trees which can reach a height of 30 metres, although they are typically no more than 20-25 metres. Trees in this layer exhibit diameters of

40-80 cm, although some reach up to 120 cm. However, these large trees are relatively scarce and despite their size, this layer accounts for just 15-20% of the total area. Typical species on this layer are: *Canarium subulatum, Canarium album*, and trees from the family Burceraceae.

Canopy layer: The canopy layer is dominated by trees of 10-15 metres. These trees are relatively uniform in height; they have round canopies and trunks of 30-40 cm in diameter. There is high species diversity in this layer and depending on location; the dominant families may be: Fagaceae, Lauraceae, Fabaceae, Meliaceae or Sapindaceae.

Mid-story: This layer is dominated by small tree species of 7-10 m in height, and young specimens from the canopy and emergent layers. Typically, species are of the families Apocynaceae, Rubiaceae, Lauraceae, Euphorbiaceae, Myrtaceae, Araliaceae, Moraceae, Sapindaceae, Eleocarpaceae, Fagaceae, Flacourtiaceae, Annonaceae, Meliaceae, Rutaceae, Ebenaceae, Fabaceae, Simplocaceae and Myristicaceae. In moist valleys, trees from the families Cyatheca, Ficus, Moraceae, Actinidiaceae, Dillenia and Dilleniacea are found.

Understory: This layer is composed of small shrubs and saplings of taller species below five metres in height. These species are predominantly shade tolerant species, or species which require shady conditions. Typical species are from the families Melastomataceae, Acanthaceae, Rubiaceae and Arecaceae.

Ground flora: This layer is composed of ferns and herbaceous plants, typically of the families Polypodyophyta, Araceae, Zingiberaceae, Maranthaceae, Urticaceae, Commelinaceae and Poaceae. High quality forest is relatively stable in structure and very little light reaches the forest floor. As a consequence, this layer is relatively sparse and ground flora is mainly found in areas where light can reach the forest floor, such as at the edge of streams.

Evergreen forest on limestone karst.
On limestone karst, vegetation cover is distinctly different to that growing on soils. There is only a very thin soil layer on these hills and although the forest it supports still exhibits the same five layers, it has a more open canopy and trees are shorter in stature. Typically, the forest is dominated by trees of 10-15 metres in height and 50 cm in diameter. Karst vegetation is dominated by species which can tolerate dry soil conditions and species which can grow on bare rock. Typical tree species and families are: Pterospermum, Sterculliaceae, Syzygium, Myrtaceae, Diospyros, Ebenaceae, Garcinia, Guttiferae, Spondias, Allospondias, Choerospondias, Semecarpus, Anacardiaceae, Vitex, Verbenaceae, Ulmaceae, Celtis, Tiliaceae, Sonneratiaceae, Caryota, Arecaceae, Rhapis, *Duabanga sonneratoides* and *Caryota bacsonensis*. On limestone karst, lianas are represented by individuals from the families Araceae, Urticaceae and Piperaceae, and the species: *Dendrocnide urentissima*, *Laportea interrupta* and *Laportea thorelli*. On bare limestone cliffs *Ficus* grow and in more humid places they are found in association with *Schefflera* and *Araliaceae* species.

Mid-montane evergreen forest
This is the natural vegetation cover on land above 600 m elevation, on soil with a low sand content. It has a variable forest structure dependant on the angle of slope. In valleys or flat land it has the same five 5 layer structure as lowland evergreen forest, on steep slopes and ridges there are no emergents and therefore has only four layers. On high mountain tops where the soil layer

is thin and there is strong sunlight and winds, plant diversity is low and the community is dominated by species which can tolerate these harsh conditions. In these areas the forest only has three layers and is dominated by the family Poaceae and the species *Miscanthus floridulus*, *Thysanoloena maxima* and *Sinarundinaria griffithiana*. In areas with less harsh conditions, members of the family Fagaceae account for up to 60% of the population and trees like *Podocarpus neriifolius*, *Dacrycarpus imbricatus*, *Podocarpus pilgeri* are found. Other families strongly represented in this vegetation type are species from the families Aceraceae, Engelhardtia, Juglandaceae, Hamamelidaceae and Theaceae, as well as the species *Symingtonia populnea*, *Sinarundinaria griffithiana*, *Michelia faveolata*, *Paramichella baillonii, Madhuca pasquieri* and *Paphiopedilum amabile.*

2.8.2 Medium quality forest

Just over half of Bac Huong Hoa Nature Reserve is covered in medium quality forest. Lowland evergreen forest and mid-montane evergreen forest habitats in Bac Huong Hoa Nature Reserve have been strongly and negatively affected by people. Lowland evergreen forest has been extensively logged for high value timber and because it occupies the most productive agricultural land, it has also been cleared for shifting cultivation. Mid-montane evergreen forest has also experienced some selective logging and in common with lowland forest, it was affected by aerial spraying of chemical defoliants during the American War. Faunal and floral diversity of medium quality forest is considerably lower than that of high quality forest types.

Secondary forest following shifting cultivation

This is the dominant forest type on land below 600 m elevation. In Bac Huong Hoa Nature Reserve, short stature secondary forest develops 8-10 years after shifting cultivation. The plant composition, structure and appearance of this forest type, are completely different from primary forest. There are very few lianas in secondary forest, fern diversity is low and orchids and arboreal ferns are typically absent. It is generally very dense and chaotic in structure, with no defined layers; however, the following four layers can sometimes be defined.

Upper canopy layer: This layer is characterised by light-demanding tree species which have grown up from stumps or from the seed bank, following a cessation of farming activities. These trees typically have a height of 8-10 m and a diameter of between 10 and 15 cm. Typically, species from the families Litsea, Machilus, Lindera, Lauraceae, Euphorbiaceae, Rutaceae, Ulmaceae, Fabaceae, Moraceae, Sapindaceae, Anacardiaceae and the genera *Macaranga, Mallotus*, *Sapium*, *Bridelia*, *Canarium*, and *Ficus* are found; as well as the species *Endospermum sinensis, Euodia melifolia*, *Acronychia pedunculata, Gironniera subaequalis*, *Trema orientalis* and *Centis sinensis*.

Lower canopy layer: This layer is characterised by smaller trees, often similar to those in the upper canopy layer, and shrubs with a height of 5-7 metres. The families most often recorded in this layer are Rubiaceae, (especially *Camellia* spp. and *Eugenia* spp), Theaceae (especially *Grewia* spp.) and Tilliaceae.

Mid-story: This layer consists of small trees and shrubs. Typically, species from this layer include representatives from the families Melastomataceae, Rubiaceae, Verbenaceae and Arecaceae and in particular, *Rapis excelsa*.

Understory: This layer is usually composed of ferns and grasses from the families Zingiberaceae and Araceae. In areas where light penetrates to the ground, members of the family Poaceae are often found and members of the Rubiaceae, Hydeotis and Acanthaceae families occur in humid places.

2.8.3 Low quality forest and non-forest habitats

Bamboo forest
At elevations of 700-1200 metres, degraded land is colonised by the large bamboo species *Arundiunria peteloti*. It reaches 3-5 metres in height and grows in dense stands. Interspersed with the bamboo are small trees from the families Fagaceae, Theaceae, Styraceae, Aquifoliaceae, Eleocarpaceae, Magnoliaceae and Aeraceae.

Scrub and grassland
Bac Huong Hoa Nature Reserve has fairly extensive tracts of anthropogenic scrub and grassland, both below and above 600 m elevation. There are four main reasons behind the formation of scrubland, namely: shifting cultivation, forest fires, spraying of chemical defoliants and the use of land by armies for bases during the Vietnam War. Structure and species composition of the habitat is determined by the reason for the loss of original forest cover and the land use since.

Dense scrub
On land which received heavy spraying with chemical defoliants and subsequent repeated burning, scrub usually reaches less than 1.5 metres in height. This habitat is usually dominated by stunted individuals of a small number of species normally found in dry or poor soil areas. Typically, these species are of the family Poaceae, and include *Misclanthus floridulus*, *Thysanolaena maxima*, *Imperata cylindrical* and *Imperata conferta.* Other species from the families Fagaceae, Juglandaceae, Theaceae, Aquifoliaceae, Lauraceae and Eleocarpaceae are sometimes found.

Light scrubby grassland
This habitat has a predictable structure consisting of grass 1-2 metres high, with shrubs and small trees of 5-8 metres high scattered throughout. Grass cover typically reaches 70-80 %. Dominant grass species are usually of the Poaceae family, such as: *Misclanthus floridulus*, *Thysanolaena maxima*, *Saccharum spontaneum*, *Imperata cylindrical* and *Imperata conferta*.

Grazed areas
Habitat structure and species composition of this habitat is determined by grazing intensity. In lightly grazed areas, shrub diversity can be relatively high; species from the families Rubiaceae, Acanthaceae, Asteraceae, Verbenaceae and Melastomataceae are usually well represented. Grass typically reaches only 70-80 cm in height and includes members of the Paspalum family such as *Imperata cylindrica*, and various *Cymbopogon* spp., *Eragrostis* spp. *Isachne* spp. and *Sertaria* spp. In heavily grazed areas, low bushes such as *Stachytarpheta jamaicensis* and other members of the Verbenaceae and Scrophuliaceae families are found. The grasses are represented by *Digitaria* spp., *Cynodon dactylon*, *Chrysopogon aciculatus* and *Paspalum* spp.

3. Faunal and floral diversity

3.1 Floral diversity

Field surveys in Bac Huong Hoa Nature Reserve have recorded 920 plant species in 518 genera and 130 families (Appendix 1). A significant proportion of these species have economic value to local residents; 125 tree species are used for timber, 161 species are sources of traditional medicine, 44 species are used for ornamental purposes and 89 species provide food.

Of the 920 species currently recorded at Bac Huong Hoa Nature Reserve, 21 are classified as threatened at a national level and nine are threatened at a global level (Table 2.). These species are almost all threatened due to overexploitation. Most of these are trees with high value timber, such as the *Dipterocarpus* spp., although others are exploited for other purposes. *Cinnamomum* spp. and *Aquilaria crassna* are heavily exploited for use in the perfume industry.

Table 2. Globally and nationally threatened plant species recorded in Bac Huong Hoa Nature Reserve

Scientific name	Vietnam Red Data Book	IUCN 2007
Cephalotaxus manii	VU	VU
Amoora dasyclada		VU
Aquilaria crassna	EN	CR
Ardisia silvestris	VU	
Chukrasia tabularis	VU	
Cinnamomum balansae	VU	EN
Cinnamomum parthenoxylon	CR	DD
Coscinium fenestratum	VU	
Croton touranensis	VU	VU
Dalbergia entadoides		DD
Dipterocarpus grandiflorus	VU	CR
Dipterocarpus hasseltii		CR
Dipterocarpus kerrii		CR
Erythrophleum fordii		EN
Meliantha suavis	VU	
Sindora tonkinensis		DD
Anoectochilus cetaceus	EN	
Dendrobium amabile	EN	
Dendrobium farmeri	VU	
Livistona tonkinensis		DD
Asarum balansae	EN	
Cirsium japonicum	VU	
Lithocarpus fenestratus	VU	
Lithocarpus haemispherica	VU	
Strychnos ignatii	VU	
Paramichelia baillonii	VU	
Fagerlindia depauperata	VU	
Madhuca pasquieri	EN	

3.2 Mammal diversity

The mammal community of Bac Huong Hoa Nature Reserve is typical of the Central Annamites. A total of 47 mammal species (not including bats) have been recorded in Bac Huong Hoa NR (Appendix 2). Of these, the presence of 29 is confirmed and 17 are only known from interview data with hunters. Confirmed records here include all species directly sighted or reliably identified through field signs or vocalisations and species recorded in the illegal wildlife trade which are known to have come from Bac Huong Hoa Nature Reserve. The species recorded include just over half of the priority mammal taxa for the Central Truong Son Landscape (Tordoff *et al.* 2003), including Saola, one of only three mammal taxa to be assigned the highest priority score by Tordoff *et al.* (2003), in their assessment of the Central Truong Son Landscape.

No attempt to survey the small mammals (e.g. Rodentia and Insectivora) or the bats (Chiroptera) of Bac Huong Hoa Nature Reserve has been made. One small mammal species, Indomalayan Leopoldamys *Leopoldamys sabanus,* was opportunistically recorded, found in a snare trap set by a hunter (Holden 2005). Additionally, subterranean tunnels thought to have been made by a mole species were seen in bare ground between Cup and Cuoi villages in May 2008 (Eames and Mahood pers. obs).

Of the 47 species reported from the nature reserve, 21 species are considered globally threatened, Near Threatened or Data Deficient (IUCN 2007) (Table 3.). This constitutes nearly half of the documented mammal fauna of the nature reserve. 26 species are considered threatened or Near Threatened at a national level (Anon 2007). Taken together, this means that over half of the mammal species of Bac Huong Hoa NR are of conservation concern.

Table 3. Nationally and globally threatened and Near Threatened mammals reported from Bac Huong Hoa Nature Reserve

English name	Scientific name	Vietnam Red Data Book	IUCN 2007
Slow Loris	*Nycticebus coucang*	VU	
Pygmy Slow Loris	*Nycticebus pygmaeus*	VU	VU
Stump-tailed Macaque	*Macaca arctoides*	VU	VU
Northern Pig-tailed Macaque	*Macaca leonina*	VU	VU
Rhesus Monkey	*Macaca mulatta*	NT	NT
Red-shanked Douc Langur	*Pygathrix nemaeus*	EN	EN
Hatinh Langur	*Trachypithecus hatinhensis*	EN	VU
Northern White-cheeked Gibbon	*Nomascus leucogenis*	EN	DD
Black Giant Squirrel	*Ratufa bicolor*	VU	
Malayan Porcupine	*Hystrix brachyura*		VU
Annamite Striped Rabbit	*Nesolagus timminsi*	EN	DD
Sunda Pangolin	*Manis javanica*	EN	NT
Asian Golden Cat	*Catopuma temminckii*	EN	VU
Clouded Leopard	*Neofelis nebulosa*	EN	VU
Leopard	*Panthera pardus*	CR	

English name	Scientific name	Vietnam Red Data Book	IUCN 2007
Binturong	*Arctictis binturong*	EN	
Dhole	*Cuon alpinus*	EN	EN
Sun Bear	*Helarctos malayanus*	EN	DD
Asian Black Bear	*Ursus thibetanus*	EN	VU
Oriental Small-clawed Otter	*Aonyx cinereus*	VU	NT
European Otter	*Lutra lutra*	VU	NT
Lesser Mouse-deer	*Tragulus kanchil*	VU	
Large-antlered Muntjac	*Muntiacus vuquangensis*	VU	DD
Sambar	*Cervus unicolor*	VU	
Gaur	*Bos frontalis*	EN	VU
Saola	*Pseudoryx nghetinhensis*	EN	CR
Chinese Serow	*Capricornis sumatraensis*	EN	VU

The following species accounts detail all records of species of conservation concern, recorded in Bac Huong Hoa Nature Reserve.

Slow Loris *Nycticebus coucang*
Local residents provided credible information on the occurrence of this species in the forests of Cup and Cuoi areas (Dang Ngoc Can 2004 and 2006).

Pygmy Slow Loris *Nycticebus pygmaeus*
Local people provided credible information on the occurrence of this species in the forests of Cup and Cuoi areas (Dang Ngoc Can 2004). A caged individual said to have come from the study area was recorded by Dang Ngoc Can *et al.* (2006).

Stump-tailed Macaque *Macaca arctoides*
Based on survey results this species appears to be relatively common in Bac Huong Hoa Nature Reserve. During one week of survey near Cup and Cuoi villages in February 2004 it was recorded three times: one group of about 15 individuals was observed in forest near Cuoi village (16°55'24”N, 106°39'15”E); fresh droppings were found at 870 m asl. on the top of an unnamed limestone hill near Cup village (16°55'38”N, 106°35'36”E) and near to a stream at 16°53'49”N, 106°395'04”E (Dang Ngoc Can 2004). In October 2005, surveys found three troops, one on the trail between the Ho Chi Minh Highway and the Lao border at milestone 25, consisted of about 30 individuals (Anon 2005). The other two troops, one recorded on the same trail as the large troop and the other at the upper end of Cop stream, numbered three individuals each. Caged individuals have also been recorded in villages in and close to Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006)

Northern Pig Tailed Macaque *Macaca leonina*
A caged individual in Huong Son Commune was said to have come from the study area (Dang Ngoc Can *et al.* 2006). This species has not been recorded on field surveys and is presumably scarce in the study area.

Rhesus Monkey *Macaca mulatta*
A caged individual in Huong Son Commune was said to have come from the study area (Dang Ngoc Can *et al.* 2006). This species has not been recorded on field surveys and is presumably scarce in the study area.

Red-shanked Douc Langur *Pygathrix nemaeus*
According to Site Support Group data this species is relatively common in Bac Huong Hoa Nature Reserve (Wilkenson and Van 2006). During the February 2004 survey, one troop of five individuals was seen from the trail between Cup and Cuoi villages (16°55'43"N, 106°35'45"E) (Dang Ngoc Can 2004). In 2005 a troop containing three individuals was seen on the trail between the Ho Chi Minh Highway and the Laos border (Anon 2005). In 2006 one troop was seen in forest near Cuoi village. Site Support Groups recorded a troop of 30 individuals on 17th October 2004 at Doc Mang and another troop of 10 individuals at Rao Thep on 14th November 2004. In May 2008 this species was also reported by local residents from ridges at least half a day's walk from Cuoi village (Eames and Mahood unpublished data).

Hatinh Langur *Semnopethicus francoisi*
This species is associated with limestone outcrops and as such it has a localised distribution in Bac Huong Hoa Nature Reserve. The subspecies in the nature reserve is *S. f. hatinhensis,* sometimes regarded as a separate species. Following information from local people, a troop of 12 individuals was found in early November 2005 (Anon 2005). Local people from Cup village report that they also occur near Tri village, where there is a small troop numbering 2 or 3 individuals, which sometimes visit gardens near to the village (Anon 2005).

Northern White-cheeked Gibbon *Nomascus leucogenis*
This species was at least formerly common in Bac Huong Hoa Nature Reserve; however it may have declined in recent years. In 2008, residents of Cuoi village reported that it was only found in forest over one day's walk from the village (Eames and Mahood unpublised data) One group was heard in the forest between Cuoi and Cup in February 2004 and in November 2005 a group of three was seen near Cup village at 0670237 N, 1872190 E (Dang Ngoc Can 2004, Anon 2005). Another group was heard near to Cuoi in August 2006 (Wilkinson and Nguyen Thanh Van 2006). Local residents report that there are at least three groups near Cup, two west of the Ho Chi Minh Highway and one to the east (Anon 2005). It was also listed for Huong Hoa District by Le Manh Hung *et al.* (2002). Site Support Groups reported seeing one group of two individuals near Khe Suot in October 2004, and another with three individuals in the same area in November of the same year.

Black Giant Squirrel *Ratufa bicolour*
Hunters reported the presence of this species in Bac Huong Hoa Nature Reserve (Dang Ngoc Can 2004). Two individuals were seen in forest near Cuoi in August 2006 (Wilkinson and Nguyen Thanh Van 2006). There is little information on the status of this species at Bac Huong Hoa Nature Reserve, not because it is uncommon but because it has only recently been added to the Vietnamese Red List. Consequently, little information on its status has been gathered.

Malayan Porcupine *Hystrix brachyura*
Tracks, quills and a captive individual of this species indicate its presence in Bac Huong Hoa Nature Reserve (Dang Ngoc Can 2004 and 2006, Anon 2005). Its populations are probably much reduced as a result of trapping for the illegal wildlife trade.

Annamite Striped Rabbit *Nesolagus timminsi*
This poorly known species is probably fairly common in Bac Huong Hoa Nature Reserve. A team of hunters operating in the area between Cup and Cuoi reported catching four individuals in 20 days between 10th and 30th April 2005 (Dang Ngoc Can *et al.* 2006). Another hunter in Cup village reported hunting the species and it has been trapped near Cuoi village (Dang Ngoc Can 2004 and 2006). Additionally, a single Annamite Striped Rabbit was seen from the Ho Chi Minh Highway just after sunset near the Sa Mu Pass on 20 January 2005 (Tordoff pers. obs.)

Sunda Pangolin *Manis javanica*
Scales belonging to this species were found in a hunter's house in Cuoi village, Huong Lap commune (Dang Ngoc Can *et al.* 2006). Freshly-dug pangolin burrows were observed in the Cup area (16°55'39"N, 106°35'29"E) on 11 February 2004 (Dang Ngoc Can 2004). Local people report that this species occurs in the mountainous area between Cup and Cuoi villages (Dang Ngoc Can 2004).

Golden Cat *Catopuma temminckii*
Hunters from Cup village provided credible descriptions of this species, which they report is present in the forests of the area (Dang Ngoc Can 2004).

Clouded Leopard *Pardofelis nebulosa*
Hunters from Cuoi and Cup villages reported the occurrence of this species in forest near the border with Quang Binh Province (Dang Ngoc Can 2004).

Leopard *Panthera pardus*
Hunters reported that this species occurs in the area but considered it to be very rare (Dang Ngoc Can 2004). Mr. Ho Tinh from Cup village reported sighting one Leopard in November 2003 (Dang Ngoc Can 2004).

Binturong *Arctictis binturong*
Hunters reported that this species occurs in the primary evergreen forests of Huong Lap Commune (Dang Ngoc Can 2004).

Dhole *Cuon alpinus*
Residents of Cup and Cuoi report the presence of this species in Bac Huong Hoa Nature Reserve. Two hunters reported that one Dhole that was trapped in the Cuoi area in 2002 (Dang Ngoc Can 2004).

Sun Bear *Ursus malayanus*
Local residents provided credible information on the occurrence of this species in the forests of Cup and Cuoi areas (Dang Ngoc Can *et al.* 2004). However, they all stated that Sun Bear is rarer than Asian Black Bear.

Asian Black Bear *Ursus thibetanus*
This species probably occurs at a low density throughout Bac Huong Hoa Nature Reserve. In February 2004, claw-marks were found on a tree at 16°55'51"N, 106°35'22"E, and claw-marks and fresh droppings thought to belong to this species were found in primary forest close to Cup (16°55'40"N, 106°35'46"E) (Dang Ngoc Can 2004). Local residents reported that a hunter from Cup village killed one Asian Black Bear of about 100 kg in the Cup area in December 2003 (Dang Ngoc Can 2004).

Oriental Small-clawed Otter *Aonyx cinerea*
Footprints identified as belonging to this gregarious species were found on the banks of the Se Vang Hieng River in February 2004 (Dang Ngoc Can 2004). The low number of footprints indicates that there is only a small group of this species in the area. In addition, one foot belonging to an Oriental Small-clawed Otter was found in a house in Cup village in 2005 (Anon 2005).

European Otter *Lutra lutra*
Local residents reported the presence of this species in both the Cup and Cuoi areas (Dang Ngoc Can 2004). They stated that it is now rare as a result of hunting for trade.

Lesser Mouse-deer *Tragulus kanchil*
Hunters reported the presence of this species in Bac Huong Hoa Nature Reserve (Dang Ngoc Can 2004).

Large-antlered Muntjac *Megamuntiacus vuquangensis*
Hunters regard this species as fairly common in evergreen forest in Bac Huong Hoa Nature Reserve. One was shot near Cup village in 2003 and another near Cuoi village the same year (Dang Ngoc Can 2004). Three sets of antlers of hunted individuals were found in hunters' houses in Khe Cup, Xa Ly and Cuoi villages (Dang Ngoc Can 2004). A freshly killed individual of this species was seen in Huong Lap Commune in a village adjacent to Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006).

Gaur *Bos frontalis*
Local hunters from both Cup and Cuoi villages reported the occurrence of Gaur in the Cuoi area (Dang Ngoc Can 2004). However, all hunters stated that this species is very rare and data from Site Support Groups indicates that there may only be three individuals in the area. These three are sometimes seen singly, and sometimes in one group. In October and November 2004, the Site Support Groups reported one male near Khe Cuoi, one individual in Doc Mang and one in Ta Lap.

Saola *Pseudoryx nghetinhensis*
All hunters in Cup and Cuoi villages can accurately describe this enigmatic species and report that it still occurs in forest close to both Cup and Cuoi villages (Dang Ngoc Can 2004). It was also recorded by Site Support Groups at both Cup and Cuoi in 2004 and 2005 (Wilkinson and Nguyen Thanh Van 2006). One Saola (c. 70 kg) was trapped near Cup village in 2003 and another Saola (c. 100 kg) was shot in the Cuoi area in November 2003 (Dang Ngoc Can 2004). One hunter from Cuoi reported that he has killed a total of three Saola in the Khe Ta Nap river

during hunting trips with dogs (Dang Ngoc Can 2004). In December 2005, fresh footprints and feeding evidence were found along a dry stream bed in Khe Rao Thep (Le Trong Trai pers obs.).

Chinese Serow *Capricornis sumatraensis*
Records suggest that this species is common in Bac Huong Hoa Nature Reserve. In 2004, one individual was seen at 16°55'33'N 106°35'21'E near Cup and the fresh droppings and footprints of this species were found on several occasions in the Cuoi area (Dang Ngoc Can 2004). Three frontlets with horns were seen in hunter's houses in Cup and Cuoi villages (Dang Ngoc Can 2004). Site Support Groups reported the species at Rao Thep, where one was seen in October 2004 and two were seen a month later. Another was seen by Site Support Groups at Dan Chu in November 2004. Footprints and fresh faeces belonging to this species were regularly recorded in Sa Mu Cave in November 2005 (Anon 2005).

3.3 Bird diversity

The avifauna of Bac Huong Hoa Nature Reserve is typical of the Annamese Lowlands Endemic Bird Area. To date, 207 species of birds have been recorded in Bac Huong Hoa Nature Reserve (Appendix 3). Of these, one species is considered threatened at a global level and nine species are considered Near Threatened at a global level (IUCN 2008) (Table 4). Eight species are considered threatened at a national level (Anon 2007). Four of the seven restricted-range species which define the Annamese Lowlands Endemic Bird Area, have been recorded from Bac Huong Hoa Nature Reserve. The nature reserve also supports 10 of the 28 priority bird taxa for the Central Truong Son Landscape.

Table 4. Threatened, Near Threatened and restricted-range bird species of Bac Huong Hoa Nature Reserve

English name	Scientific name	IUCN	VRDB
Chestnut-necklaced Partridge	*Arborophila charltoni*	NT	
Edwards's Pheasant	*Lophura edwardsi*	EN, RRS	EN
Siamese Fireback	*Lophura diardi*	NT	VU
Crested Argus	*Rheinardia ocellata*	NT	VU
Lesser Fish Eagle	*Ichthyophaga humilis*	NT	VU
Coral-billed Ground Cuckoo	*Carpococcyx renauldi*		VU
Blyth's Kingfisher	*Alcedo hercules*	NT	
Crested Kingfisher	*Megaceryle lugubris*		VU
Austen's Brown Hornbill	*Anorrhinus austeni*	NT	VU
Great Hornbill	*Buceros bicornis*	NT	VU
Red-collared Woodpecker	*Picus rabieri*	NT, RRS	
Short-tailed Scimitar Babbler	*Jabouilleia danjoui*	NT, RRS	
Grey-faced Tit-babbler	*Macronous kelleyi*	RRS	
White-cheeked Laughingthrush	*Garrulax vassali*	RRS	

The following species accounts detail all the species of conservation interest, either threatened, Near Threatened or restricted-range species, recorded from Bac Huong Hoa Nature Reserve. In addition to these species, it is likely that the Near Threatened restricted-range species, Sooty Babbler *Stachyris herberti,* occurs in suitable habitat at Bac Huong Hoa Nature Reserve. A

specialist of forest on limestone, this species has been recorded in suitable habitat in forests to the north and in Dakrong Nature Reserve to the south (Nguyen Cu and Le Manh Hung 2004).

Chestnut-necklaced Partridge *Arborophila charltoni merlini*
This taxon has often been treated as a distinct species, Annam Partridge (e.g. Sibley & Monroe 1990, 1993) and afforded Endangered status. However, following BirdLife International (2008) it is treated as a subspecies of Chestnut-necklaced Partridge and classified as Near Threatened. Chestnut-necklaced Partridge is locally common in lowland evergreen forest in Bac Huong Hoa Nature Reserve. It has been recorded in forest close to the Cha Ly stream, between there and the Laos border (Anon 2005), and in forest near Cuoi village (Wilkinson and Nguyen Thanh Van 2006).

Edwards's Pheasant *Lophura edwardsi*
The occurrence of this species in Bac Huong Hoa Nature Reserve is unconfirmed. This species is uncommon in lowland evergreen forest below 600 m elevation and perhaps only common on gently undulating ground below 300 m elevation. First reported in the forests of Huong Hoa District in November 1923 when a male was collected; it was reported again in February 1924, when another male was collected (BirdLife International 2001). Despite substantial search effort, there were no records between 1935 and 1996 and it was thought to perhaps be extinct. However, following its rediscovery in Phon Dien District in 1996, it was found near Kreng village, Huong Hiep Commune at (16°35'N, 107°05'E), where local hunters trapped a pair (Le Trong Trai, *et al.* 1999). The female of this pair died and the male was transferred to Hanoi Zoo. This area is just outside the nature reserve boundary but suitable habitat extends from there into the nature reserve. It is the most frequently reported Lophura species by the Cuoi Site Support Group, but the Site Support Group at Cup report it very rarely and record other Lophura much more often. This may reflect genuine trends; Wilkinson and Nguyen Thanh Van (2006) assessed identification skills of Site Support Group members and felt that they were of a high quality. However, in 2008 residents of Cuoi village only reported Silver Pheasant Lophura nycthemera and did not know of a black or blue pheasant in their area (Eames and Mahood 2008 unpublished data). Unlike other pheasant species known to exist in Bac Huong Hoa Nature Reserve, no physical evidence of this species has been found in hunters' camps, or in residents' houses. Its presence in the nature reserve still requires confirmation.

Siamese Fireback *Lophura diardi*
Fairly common in broadleaf lowland evergreen and lower montane forest of Bac Huong Hoa Nature Reserve. It was recorded in Huong Lap and Huong Son communes during surveys in 2002 and 2004 (Le Manh Hung *et al.* 2002 and Le Manh Hung *et al.* 2004). The report from the latter survey pertained to a dried head of a male bird in a hunter's house in Cuoi village.

Crested Argus *Rheinardia ocellata*
Formerly common in Bac Huong Hoa Nature Reserve, this species has declined markedly in recent years due to widespread snaring. It was recorded in Huong Lap and Huong Son communes during surveys in 2002 and 2004 (Le Manh Hung *et al*. 2002; Le Manh Hung *et al.* 2004) and feathers of this species were found in hunting camps in 2005. Data from Site Support Groups indicate that it is scarce. There was only one record from near Cuoi and four records from near Cup between 2004 and 2005.

Lesser Fish Eagle *Ichthyophaga humilis*
A scarce resident on large rivers in Bac Huong Hoa Nature Reserve. A single bird was seen on 11 Feb 2004, flying over the forest canopy to the west of Cup village and another bird was recorded on the 14 and 16th February 2004 near to the Khe Cuoi (a large stream), near Cuoi village (Le Manh Hung *et al.* 2004).

Coral-billed Ground Cuckoo *Carprococcyx renauldi*
Probably uncommon in Bac Huong Hoa Nature Reserve. Recorded by Le Trong Trai in 2005 (Anon 2005).

Blyth's Kingfisher *Alcedo hercules*
Fairly common on rivers and large streams surrounded by mature forest in Bac Huong Hoa Nature Reserve. In February 2004, one bird was seen daily on a large stream inside the forest, west of Cup village and other individuals were seen along large streams to the west and north of Cuoi village (Le Manh Hung *et al*. 2004). Similarly, in May 2008, individuals were seen along the river between Cup and Cuoi villages, and along a large stream north of Cuoi village (Eames and Mahood 2008 unpublished data).

Crested Kingfisher *Megaceryle lugubris*
Occurs on the larger rivers in the nature reserve. Recorded by Le Manh Hung *et al.* (2004), and at least one pair seen between Cup and Cuoi villages in May 2008 (Eames and Mahood 2008 unpublished data).

Austen's Brown Hornbill *Anorrhinus austeni*
Uncommon in lowland evergreen forest in Bac Huong Hoa Nature Reserve. A flock of 30 individuals was recorded in the Dan Chu area of Bac Huong Hoa Nature Reserve in 2005 (Anon 2005).

Great Hornbill *Buceros birconis*
Now a very scarce resident of lowland and mid-montane evergreen forest in Bac Huong Hoa Nature Reserve. Recorded by Le Trong Trai only from the remote border area between Quang Binh and Quang Tri provinces (Anon 2005). During surveys no more than three individuals were seen in any one flock. Its persistence in forest along the international border with Laos is reported by hunters (Le Manh Hung *et al.* 2002).

Red-collared Woodpecker *Picus rabieri*
Scarce resident in lowland evergreen forest in Bac Huong Hoa Nature Reserve. Recorded in February 2004 to the west of Cuoi at 350 m asl, at 16°55'16''N 106°37'54''E; a singleton was seen actively feeding in a large tree (Le Manh Hung *et al*. 2004).

Short-tailed Scimitar Babbler *Jabouilleia danjoui*
Probably uncommon in Bac Huong Hoa Nature Reserve. Recorded by Le Trong Trai in 2005 and heard calling in mid-montane forest close to the Ho Chi Minh Highway in May 2008 (Eames and Mahood unpublished data).

Grey-faced Tit Babbler *Macronous kelleyi*
Fairly common in lowland evergreen forest in Bac Huong Hoa Nature Reserve. Recorded by Le Trong Trai (Anon 2005) and fairly commonly heard in lowland evergreen forest near Cup and Cuoi villages.

White-cheeked Laughingthrush *Garrulax vassali*
Fairly common in mid-montane forest in Bac Huong Hoa Nature Reserve (Le Manh Hung *et al. in prep.*).

3.4 Reptiles and amphibians

To date, at least 61 species of reptile and amphibian have been identified in Bac Huong Hoa Nature Reserve (Anon 2005). Survey work by Ho Thu Cuc *et al.* in 2005, constituted the most comprehensive survey of the amphibians and reptiles of Bac Huong Hoa Nature Reserve. Unfortunately, a complete species list from this survey is not available; therefore the species list presented in Appendix 4 is incomplete and contains only species recorded in subsequent surveys.

One frog species, *Philautus truongsonensis,* was described as new to science in Bac Huong Hoa Nature Reserve. The type series was collected in lowland evergreen forest at 400 m elevation near to Cup village, Huong Hoa District (Orlov and Ho Thu Cuc 2005). This species has subsequently been found at other sites in the central highlands including Ban a National Park, Danang Province, Bach Ma National Park, Thua Thien Hue Province and Phong Nha-Ke Bang National Park, Quang Binh Province (Orlov and Ho Thu Cuc 2005).

Of the species listed for Bac Huong Hoa Nature Reserve in this report, five are considered threatened at a global level and 11 are considered threatened at a national level (IUCN 2007, Anon 2007) (Table 5.). It should be noted that assessment of threat has not been undertaken at a global scale for any reptiles except turtles. The Indochina region shows high levels of diversity in freshwater turtles and Bac Huong Hoa Nature Reserve has a number of species representative of central Vietnam.

Table 5. Preliminary list of reptile and amphibian species of conservation concern from Bac Huong Hoa Nature Reserve

English name	Scientific name	Vietnam RDB	IUCN 2007
Annam Spadefoot Toad	*Brachytarsophrys intermedia*		VU
Wallace's Flying Frog	*Rhacophorus nigropalmatus*	VU	
Tokay	*Gekko gecko*	VU	
Indochinese Water Dragon	*Physignathus cocincinus*	VU	
Water monitor	*Varanus salvator*	EN	
Burmese Python	*Python molurus*	CR	NT
Common Rat Snake	*Pytas mucosus*	EN	
Banded Krait	*Bungarus fasciatus*	EN	
Indochinese Cobra	*Naja naja*	EN	
King Cobra	*Ophiophagus hannah*	CR	
Indochinese Box Turtle	*Cuora galbinifrons*	EN	CR
Chinese three-striped Box Turtle	*Cuora trifasciata*	CR	CR

English name	Scientific name	Vietnam RDB	IUCN 2007
Keeled Box Turtle	*Pyxhidea mohotti*		EN
Four-eyed Turtle	*Sacalia quadriocellata*		EN

The following species accounts provide a brief indication of the source of information for the occurrence of threatened reptiles and amphibians in Bac Huong Hoa Nature Reserve and details of their status where possible.

Annam Spadefoot Toad *Brachytarsophrys intermedia*
Listed for Bac Huong Hoa Nature Reserve by Cao Tien Trung (in prep.). Known only from a small area of central Vietnam where it inhabits forest close to streams (van Dijk 2004).

Wallace's Flying Frog *Rhacophorus nigropalmatus*
Listed for Bac Huong Hoa Nature Reserve by Cao Tien Trung (in prep).

Tokay Gecko *Gecko gecko*

In Bac Huong Hoa Nature Reserve, found primarily in primary and secondary lowland and mid-montane evergreen forest (Cao Tien Trung in prep.). Although elsewhere it is often found in human habitation, collection for trade is likely to have eliminated it from this habitat in Bac Huong Hoa Nature Reserve (Cox *et al.* 2006).

Indochinese Water Dragon *Physignathus cocincinus*
In Bac Huong Hoa Nature Reserve, usually found perched on overhanging branches along streams. A density of 2.8 individuals per kilometre of stream has been recorded (Cao Tien Trung in prep.).

Water Monitor *Varanus salvator*
Provisionally listed for Bac Huong Hoa Nature Reserve on the basis of individuals found in trade near the nature reserve (Dang Ngoc Can *et al.* 2006). Found in forested areas up to 1,300 m elevation, where it forages close to water (Cox *et al.* 2006).

Burmese Python *Python molurus*
Provisionally listed for Bac Huong Hoa Nature Reserve on the basis of hunters' reports (Dang Ngoc Can *et al.* 2006). It inhabits forested areas up to 900 m elevation (Cox *et al.* 2006).

Common Rat Snake *Ptyas mucosus*
Provisionally listed for Bac Huong Hoa Nature Reserve on the basis of hunters' reports (Dang Ngoc Can *et al.* 2006). Found in a wide variety of habitats up to 1,000 m elevation (Cox *et al.* 2006).

Banded Krait *Bungarus fasciatus*
Provisionally listed for Bac Huong Hoa Nature Reserve on the basis of hunters' reports (Dang Ngoc Can *et al.* 2006). Found primarily in the forested lowlands, but it has been found over 2,000 m elevation.

Indochinese Cobra *Naja naja*
Provisionally listed for Bac Huong Hoa Nature Reserve on the basis of hunters' reports (Dang Ngoc Can *et al.* 2006). It inhabits the forested lowlands (Cox *et al.* 2006).

King Cobra *Ophiophagus hannah*
Provisionally listed for Bac Huong Hoa Nature ReserveH on the basis of hunters' reports (Dang Ngoc Can *et al.* 2006). It inhabits forested areas up to at least 2,000 m elevation and appears to be more common close to streams (Cox *et al.* 2006).

Indochinese box turtle *Cuora galbinifrons*
Live individuals collected by hunters have been recorded in Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006), probably of the subspecies *C. g. bourreti,* which is endemic to the central highlands of Vietnam (Peter Paul van Dijk pers. comm.).

Chinese three-striped box turtle *Cuora trifasciata*
Live individuals collected by hunters have been recorded in Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006).

Keeled box turtle *Pyxhidea mohotti*
Live individuals collected by hunters have been recorded in Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006).

Four-eyed Turtle *Sacalia quadriocellata*
Live individuals collected by hunters have been recorded in Bac Huong Hoa Nature Reserve (Dang Ngoc Can *et al.* 2006 and Cao Tien Trung *et al.* 2008).

4. Biodiversity evaluation

4.1 Habitat types

Bac Huong Hoa Nature Reserve supports a mosaic of habitats, including 17,392 hectares of forest of high conservation importance (as defined by Tordoff *et al.* 2003). Most importantly, this includes some lowland evergreen forest below 300 m, which may be of critical importance for Edwards's Pheasant. Less than 20% of the nature reserve is non-forest habitat, and with appropriate management, much of this land may be rehabilitated. In general, the level of forest disturbance appears to decrease with increasing altitude, reflecting both the greater accessibility of forests at low altitudes and the greater abundance of valuable forest products at low elevation. Lowland evergreen forest, particularly below 300 metres, should be the highest priority for conservation efforts in the nature reserve.

4.2 Globally threatened Species, restricted-range species and priority taxa

One globally threatened bird species, 21 globally threatened mammal species and at least five globally threatened amphibian species have been recorded from Bac Huong Hoa Nature Reserve. These include Saola, classified as Critically Endangered globally and potentially also Edwards's Pheasant, classified as Endangered globally. Two Critically Endangered turtles occur in the

nature reserve and two Endangered species. Of these, the Critically Endangered Indochinese box turtle *Cuora galbinifrons* is represented by a race endemic to the central highlands of Vietnam, which is often considered a separate species (Peter Paul van Dijk pers. com.). In addition, nine globally threatened plant species have been recorded, including four Critically Endangered species.

Bac Huong Hoa Nature Reserve supports a high proportion of the bird species which define the Annamese Lowlands Endemic Bird Area. Of the three species which do not occur, Edwards's Pheasant and Sooty Babbler are likely to be found in the nature reserve in the future and Vietnamese Pheasant *Lophura hatinhensis* is largely allopatric with Edwards's Pheasant and may indeed be the conspecific with it (Birdlife International 2001). Bac Huong Hoa Nature Reserve compares favourably with other sites in the Annamese Lowlands Endemic Bird Area, only Phuong Dien has more species. Bac Huong Hoa Nature Reserve therefore is of high importance for the conservation of the species which define this Endemic Bird Area.

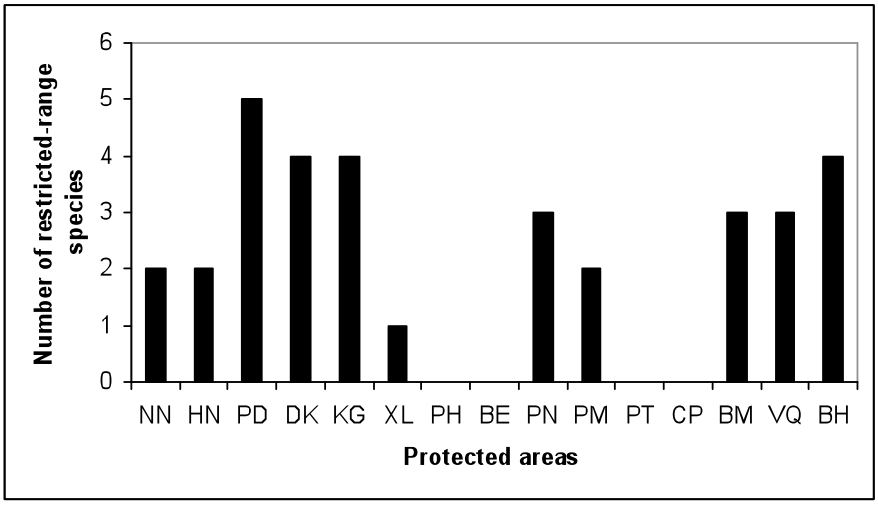


Figure 1. The number of restricted-range bird species in protected areas in the Annamese Lowlands Endemic Bird Area.
NN = Nakai Nam Theun; HN = Hin Nammo; PD = Phong Dien; DK = Dakrong; KG = Ke Go; XL = Xuan Lien; PH = Pu Huong; BE = Ben En; PN = Phong Nha; PM = Pu Mat; PT = Pu Hoat; CP = Cuc Phoung; BM = Bach Ma; VQ = Vu Quang; BH = Bac Huong Hoa.
Note: data for protected areas other than Bac Huong Hoa Nature Reserve taken from Eames *et al.* (2001).

Bac Huong Hoa Nature Reserve also compares favorably with protected areas of Priority Landscape CA1 in the Greater Truong Son Ecoregion (Figures 2-4.), in terms of the number of priority taxa it supports. For instance, Bac Huong Hoa Nature Reserve supports 21 of the priority bird taxa and 10 of the priority mammal taxa of the Priority Landscape. Consequently, Bac Huong Hoa Nature Reserve ranks second out of all of the protected areas in Priority Landscape CA1, regarding its number of priority mammal and bird taxa. Bac Huong Hoa Nature Reserve ranks relatively low in terms of the number of priority reptile taxa, although this may reflect the difficulty of accessing reptile data rather than actual trends. These rankings should be treated with caution since data were taken from a 2003 publication. In addition, the biodiversity of the other protected areas in the analysis is now likely to be better known and therefore, many of them may

rank as highly as Bac Huong Hoa Nature Reserve. However, although this means that the forests of Bac Huong Hoa may be relatively less important than the analysis suggests, it does not affect the conclusion that Bac Huong Hoa Nature Reserve is of high conservation importance for the priority taxa of Priority Landscape CA1.

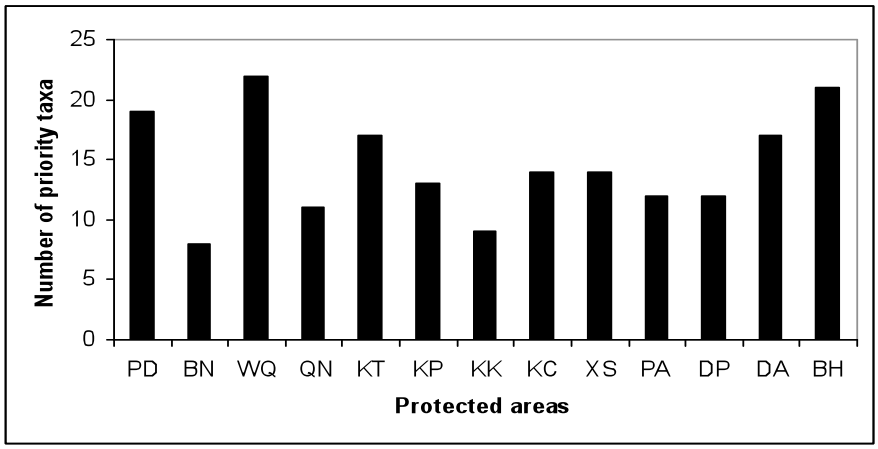


Figure 2. Number of priority mammal taxa in protected areas in Priority Landscape CA1.

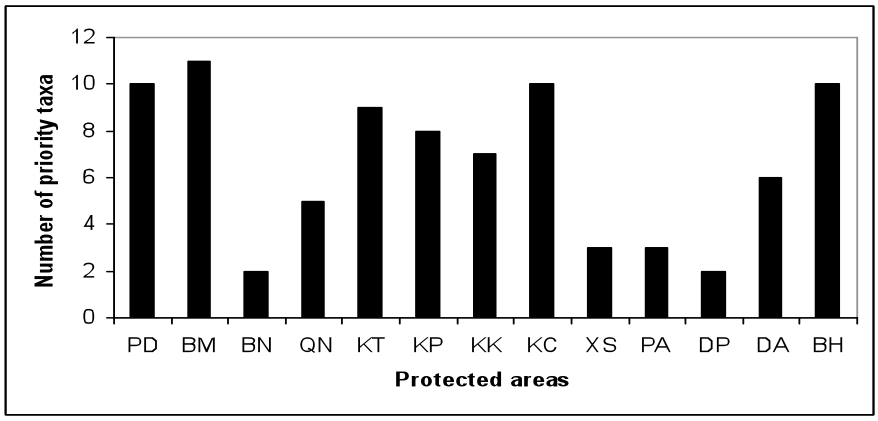


Figure 3. Number of priority bird taxa in protected areas in Priority Landscape CA1.

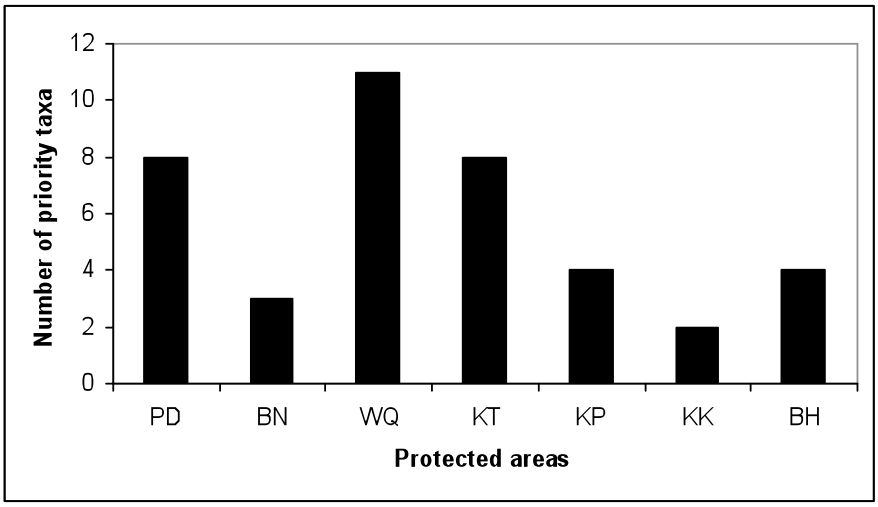


Figure 4. Number of priority reptile and amphibian taxa in protected areas in Priority Landscape CA1.

Site: PD = Phon Dien and Dak Rong; BM = Bach Ma; BN = Ba Na; WQ = western Quang Nam Province; QN = Ngoc Linh (Quang Nam); KT = Ngoc Linh (Kon Tum); KP = Kon Plong; KK = Kon Ka Kinh; KC = Kon Cha Rang; XS = Xe Sap; PA = Phou Ahyon; DP = Dakchung Plateau; DA = Dong Ampham
Note: data for protected areas other than Bac Huong Hoa Nature Reserve were taken from Tordoff *et al.* (2003).

4.3 Overall levels of biodiversity

Due to wide variation in survey effort between protected areas and variation in level of habitat heterogeneity, it is difficult to make meaningful comparisons of overall diversity between sites. The species lists for Bac Huong Hoa Nature Reserve are undoubtedly incomplete and rely on comparatively little fieldwork. However, Bac Huong Hoa Nature Reserve exhibits a similar range of habitats and elevations as other sites in the Annamese Lowlands Endemic Bird Area and probably supports a similar diversity of species.

4.4 Management recommendations

Bac Huong Hoa Nature Reserve is of global significance due to the species and habitats that it protects. An urgent priority is the establishment of a competent and enthusiastic management board. Bac Huong Hoa Nature Reserve faces a number of threats which, when it is established, the management board of the nature reserve should seek to address. The most important threats are hunting, forest clearance and selective logging. These threats are typical of protected areas in the Annamese Lowlands and indeed throughout Vietnam. The following management recommendations address conservation priorities in Bac Huong Hoa Nature Reserve.

Determine distribution of key taxa
Surveys should be conducted to determine the distribution of key taxa, to facilitate priority setting in Bac Huong Hoa Nature Reserve. These surveys should concentrate on threatened species representative of central Vietnam, with a high susceptibility to hunting or habitat degradation. With regards to birds, the priority is to determine whether Edwards's Pheasant occurs in the

nature reserve. These surveys should be conducted in forest below 400 m near to Cuoi village and most importantly in the south-east, close to where the birds were caught in 1999. For mammals, the surveys should determine which forest areas are still inhabited by Saola, White-cheeked Gibbon, Red-shanked Douc Langur and Hatinh Langur. Regarding reptiles, surveys should be conducted to determine which streams still support freshwater turtles.

Development of hunting regulations
Appropriate regulations should be developed and enforced. This should be achieved through involvement of Site Support Groups. Regulations and enforcement should focus on preventing hunting in areas which are found to support populations of Edwards's Pheasant, Saola, White-cheeked Gibbon, Red-shanked Douc Langur and Hatinh Langur. The nature reserve should be zoned using the results of biodiversity surveys and enforcement should be concentrated in areas where professional hunters are known to operate and areas which still hold populations of key species. The nature reserve management should strengthen support to Site Support Groups and seek synergies with other agencies operating in the area, to facilitate more effective enforcement of hunting regulations.

Control human settlement along the Ho Chi Minh Highway
Policies should be developed and enforced which strictly control settlement along the Ho Chi Minh Highway in Bac Huong Hoa Nature Reserve (Tordoff *et al.* 2002). New settlement adjacent to medium or high quality forest or within five kilometres of forest which supports populations of key species should not be permitted.

Rehabilitation of poor quality forest and barren land
Even within Bac Huong Hoa Nature Reserve forest cover is fragmented. Poor quality forest and barren land in the centre of the nature reserve and elsewhere should be the focus of a reafforestation programme, using only trees native to the nature reserve. The feasibility of reconnecting blocks of high and medium quality forest, with a minimum number of corridors should first be evaluated. Reafforested areas should form corridors linking existing areas of medium and good quality forest to facilitate dispersal of species.

Support to community based conservation initiatives
A rattan-growing model has been employed by BirdLife in communities in Bac Huong Hoa Nature Reserve. This should be evaluated, and if appropriate, expanded to other communities in the nature reserve.

Management approach
Like other protected areas in Vietnam, the efforts of the reserve management board are likely to be thwarted by inadequate law enforcement from relevant agencies, limited and poorly directed funding and a lack of interest in biodiversity conservation in relevant local stakeholders. Traditional approaches to protected area management in the central highlands of Vietnam may be inadequate to achieve these conservation priorities. Innovative approaches to protected area management offer the chance to source novel areas of funding and trial different methods of achieving conservation aims. Since it is newly established, Bac Huong Hoa Nature Reserve does not suffer from the inertia of poor past management practices, nor is there any precedent amongst local stakeholders for interaction with a protected area. Bac Huong Hoa Nature Reserve is likely

to be last protected area gazetted in Vietnam and therefore it offers the last chance to trial innovative management approaches on a protected area with no previous management history.

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Appendix 1. Plant species recorded in Bac Huong Hoa Nature Reserve

Data from Anon 2006, the results of surveys conducted by Le Trong Trai.

1. Lycopodiaceae	
1	*Lycopodium cernua*
2. Selaginellaceae	
2	*Selaginella doderleinii*
3	*S. involvens*
4	*S. petelotii*
5	*S. repanda*
6	*S. delicatula*
LYCOPODIOPHYTA	
3. Equisetaceae	
7	*Equisetum ramosissimum .*
PLYPODIOPHYTA	
4. Adiantaceae	
8	*Adiantum flabellulatum*
9	*A. philippense*
10	*A. induratum*
11	*A. diaphanum*
12	*Antrophyum annamensis*
13	*A. coriaceum*
14	*Cheilanthes tenuifolia*
15	*Onychium siliculosum*
16	*Pityrogramma culomelanos*
17	*Pteris biaurita*
18	*P. ensiformis*
19	*P. grevilleana*
20	*P. linearis*
21	*P. decrescens*
22	*P. finotii*
5. Angiopteridaceae	
23	*Angiopteris annamensis*
24	*A. cochinchinensis*
25	*A. evecta*
26	*A. palmaeformis*
27	*A. repandula*
28	*Archangiopteris cadieri*
6. Aspleniaceae	
29	*Asplenium cheilosorum*
30	*A. varians*
31	*A. ensiforme*
32	*A. nidus*

33	*A. colaniae*
34	*A. antrophyoides*
35	*A. loriceum*
36	*A. saxicola*
37	*A. crinicaule*
38	*A. hainanense*
39	*Diplazium pinnatifido-pinnatum*
40	*D. conterminum*
41	*D. polypodiodes*
7. Blechnaceae	
42	*Blechnum orientale*
8. Cyatheaceae	
43	*Cyathea cotaminans*
44	*C. latebrosa*
45	*C. gigantea*
9. Dennstaedtiaceae	
46	*Dennstaedtia seabra*
47	*Lindsaea ensiformis*
48	*Microlepia marginata*
49	*M. strigosa*
50	*Pteridium aquilinum*
10. Gleicheniaceae	
51	*Dicranopteris linearis*
52	*D. dichotoma*
11. Grammitidaceae	
53	*Grammitis dorsipila*
54	*Loxogramme acroscopa*
12. Marsileaceae	
55	*Marsilea quadriflia*
56	*M. crenata*
13. Polypodiaceae	
57	*Alaomorpha coronans*
58	*Colysis pothifolia*
59	*Drynaria bonii*
60	*Leptochilus axillaris*
61	*Lemmaphyllum micrpophyllum*
62	*Microsorum hancockii*
63	*M. punctatum*
64	*Phymatorus nigrescens*
65	*Platycerium coronarium*
66	*P. grande*
67	*P. lingua*
68	*Pyrrosia longifolia*
14. Schizeaceae	
69	*Lygodium auriculatum*

70	*L. conferme*
71	*L. flexuosum*
72	*L. japonicum*
73	*L. microstachyum*
74	*L. salicifolium*
GYMNOSPERMAE	
15. Cycadaceae	
75	*Cycas immersa*
16. Gnetaceae	
76	*Gnetum gnemonoides*
77	*G. leptostachyum*
78	*G. montanum*
79	*G. formosum*
17. Podocarpaceae	
80	*Dacrycarpus imbricatus*
81	*Podocarpus neriifolius*
82	*P. pilgeri*
83	*Nageia wallichiana*
18. Cephalotaxaceae	
84	*Cephalotaxus manii*
ANGIOSPERMAE	
Magnoliopsida (Dicotyledones)	
19. Acanthaceae	
85	*Asystasia gangetica*
86	*Clinacanthus nutans*
87	*Dipteracanthus repens*
88	*Isoglossa inermis.*
89	*J. ventricosa*
90	*Justica fragilis*
91	*Staurogyne bella*
92	*Strobilanthes tonkinensis*
93	*Thunbergia alata*
20. Actinidiaceae	
94	*Saurauja roxburghii*
95	*S. nepanlensis*
21. Alangiaceae	
96	*Alangium salviifolium*
97	*A. chinensis*
22. Amaranthaceae	
98	*Amaranthus spinosus*
99	*A. tricolor*
100	*A. viridis*
101	*Achyranthes aspera*
102	*A. bidentata*
103	*Alternanthera paronychioides*

104	*Celosia argentea*
23. Anacardiaceae	
105	*Allospondias lakonensis*
106	*Dracuntomelon schmidii*
107	*Gluta gracilis*
108	*Mangifera foetida*
109	*M. indica*
110	*Rhus javanica*
111	*Semecarpus anacardiopsis*
112	*Toxicodendron succedana*
24. Ancistrocladaceae	
113	*Ancistrocladus tectorius*
25. Annonaceae	
114	*Annona squamosa*
115	*A. muricata*
116	*Desmos cochinchinensis*
117	*Goniothalamus multiovulatus*
118	*Fissistigma oldhami*
119	*Meiogyne subsessilis*
120	*Polyalthia clemensorum*
121	*P. jucunda*
122	*Uvaria cordata*
123	*U. lurida*
124	*Xylopia vielana*
26. Apiaceae	
125	*Centella asiatica*
126	*Cnidium monnierii*
127	*Eryngium foetidum*
128	*Hydnocotyle sibthorpioides*
129	*Trachyspermum roxburghianum*
27. Apocynaceae	
130	*Alstonia scholaris*
131	*Alyxia racemosa*
132	*Bousingonia makongense*
133	*Holarrhena pubescens*
134	*H. curtisii*
135	*Hunteria zeylanica*
136	*Kopsia harmandiana*
137	*Melodinus annamense*
138	*Parabarium micranthum*
139	*Pottsia indora*
140	*Rauvolfia cambodiana*
141	*Tabernaemontana bovina*
142	*Wrightia annamensis*
28. Aquifoliaceae	

143	*Ilex cochinchinensis*
144	*I. crenata*
145	*I. tonkiniana*
146	*I. triflora*
29. Araliaceae	
147	*Aralia armata*
148	*Brassaiopsis glomerulata*
149	*Dendropanax poilanei*
150	*Macropanax dispermus*
151	*Schefflera octophylla*
152	*S. vidaliana*
153	*Treevesia palmata*
30. Aristolochiaceae	
154	*Aristolochia piperrei*
155	*A. tagala*
156	*Asarum balansae*
31. Asclepiadaceae	
157	*Criptolepsis buchananii*
158	*Streptocaulon juventus*
159	*Telosma cordata*
32. Asteraceae (Compositae)	
160	*Ageratum conyzoides*
161	*Bidens bipinnata*
162	*Blumea lanceolata*
163	*Cirsium japonicum*
164	*Eclipta prostrata*
165	*Eupatorium odoratum*
166	*Grangea maderaspatann*
167	*Sigesbeckia orientalis*
168	*Tithonia diversifolia*
169	*Vernonia cinerea*
170	*V. macrachaenia*
33. Begoniaceae	
171	*Begonia aptera*
172	*B. boisiana*
173	*B. eberhardtii*
34. Betulaceae	
174	*Carpinus viminea*
35. Bignoniaceae	
175	*Oroxylon indicum*
176	*Rademachera eberhardtii.*
177	*R. sinica*
178	*Stereospermum colais*
179	*S. neuranthum*
36. Bombacaceae	

180	*Bombac ceiba*
181	*Ceiba pentandra*
37. Boraginaceae	
182	*Cordia grandis*
183	*Cynoglossum zeylanicum*
184	*Heliotropium indicum*
185	*Tournefortia gaudichaudii*
38. Brassicaceae	
186	*Brassica intergrifolia*
187	*B. junca*
188	*B. oleracea*
189	*Raphanus sativus*
190	*Rorippa dubia.*
39. Burceraceae	
191	*Burcera serrata*
192	*B. subulatum*
193	*Canarium album*
194	*C. bengalense*
195	*C. parvum.*
40. Campanulaceae	
196	*Lobelia zeylanica*
197	*L. sinensis*
198	*Wahlenbergia marginata*
41.Capparaceae	
199	*Capparis cantoniensis*
200	*C. pyrifolia*
201	*C. radula*
202	*Cleome chelidonii*
203	*C. gynandra*
204	*C. viscosa*
205	*Crateva magna*
206	*C. nurvala*
207	*Stixis scandens*
42. Caprifoliaceae	
208	*Lonicera japonica*
209	*L. macrantha*
210	*Sambucus simpsonii*
211	*S. hookeri*
212	*Vibrum punctatum*
43. Celastraceae	
213	*Euonymus javanicus*
214	*E. laxiflorus*
215	*Gymnosporia chevalieri*
216	*Maytenus stylosa*
217	*Salacia pallens*

218	*Siphonodon annamensis*
44. **Clusiaceae (Guttiferae)**	
219	*Calophyllum dryobalanoides*
220	*Cratoxylon cochinchinensis*
221	*C. maingayi*
222	*Garcinia cochinchinensis*
223	*G. fusca*
224	*G. oblongifolia*
225	*G. planchonii*
45. Chloranthaceae	
226	*Chloranthus crectus*
46. Combretaceae	
227	*Quiqualis indica*
47. Connaraceae	
228	*Connarus paniculatus*
229	*Roureopis stenopetala*
230	*Rourea minor*
48. Convolvulaceae	
231	*Hewittia scandens*
232	*Ipomoea aquatica*
233	*I. batatas*
234	*Jacmontia paniculata*
235	*Merremia hederacea*
236	*M. hirta*
237	*M. vitifolia*
238	*Prana volubilis*
239	*Xenostegia tridentata*
50. Cucurbitaceae	
240	*Benincasia hispida*
241	*Coccinia grandis*
242	*Cucurbita maxima*
243	*C. moschata*
244	*C. pepo*
245	*Cucurmis sativus*
246	*C. sativus var. conomon*
247	*Diplocyclos palmatus*
248	*Gymnopetalum cochinchinensis*
249	*G. integrifolium*
250	*Hogsonia macrocarpa*
251	*Luffa acutangula*
252	*L. cylindrica*
253	*Momordia charantia*
254	*M. cochinchinensis*
255	*Mukia maderaspatana*
256	*Solena heterophylla*

257	*Trichosanthes tricuspidata*
258	*Zehneria indica*
51. Dilleniaceae	
259	*Dillenia pentagyna*
260	*D. turbinata*
261	*Tetrcera sarmentosa*
262	*T. scandens*
52. Dipterocarpaceae	
263	*Dipterocapus grandiflorus*
264	*D. hasseltii*
265	*D. kerrii*
53. Ebenaceae	
266	*Diospyros kaki*
267	*D. cauliflora*
268	*D. lancaefolia*
269	*D. longebracteata*
270	*D. martabarica*
271	*D. moi*
272	*D. pilosula*
273	*D. rufogemmata*
54. Elaeocarpaceae	
273	*Elaeocarpus grandiflorus*
274	*E. griffithii*
275	*E. hainamensis*
276	*E. limitanus*
277	*E. petiolatus*
278	*E. stipulatus*
279	*E. angustifolius*
55. Euphorbiaceae	
280	*Alchornia rugosa*
281	*A. tiliaefolia*
282	*Aleurites cordata*
283	*Antidesma bunius*
284	*A. ghaesembilla*
285	*A. hainanensis*
286	*A. yunnanensis*
287	*Aporusa ficifolia*
288	*A. sphaerospermum*
289	*Baccaurea silvestris*
290	*Bischofia javanica*
291	*Breynia angustifolia*
292	*B. fruticosa*
293	*Bridelia monoica*
294	*Bridelia ovata*
295	*Claoxylon longifolium*

296	*Croton touranensis*
297	*Endospermum chinense*
298	*Euphorbia hirta*
299	*E. indica*
300	*E. orbiculata*
301	*E. pulcherrima*
302	*E. thymifolia*
303	*Glochidion rubrum*
304	*G. zaylanicum*
305	*Homonoia riparis*
306	*Macaranga balansae*
307	*M. denticulata*
308	*M. henricorum*
309	*Mallotus apelta*
310	*M. barbatus*
311	*M. floribundus*
312	*M. macrostachyus*
313	*M. paniculata*
314	*M. phillippensis*
315	*M. repandus*
316	*M. tetracocus*
317	*Manihot esculanta*
318	*Phyllanthus debilis*
319	*P. emblica*
320	*P. reticulata*
321	*P. rube*
322	*P. urinaria*
323	*Sapium discolor*
324	*S. rotundifolium*
325	*S. sebiferum*
326	*Sauropus androgynus*
327	*Securinega vilosa*
56. Fabaceae	
Ceasalpinioideae	
328	*Bauhinia bracteaca*
329	*B. clemensiorum*
330	*B. curtisii*
331	*B. lakhonensis*
332	*Bauhinia viridescens*
333	*B. hirsuta*
334	*B. saccocalyx*
335	*Caesalpinia bonduc*
336	*C. latisilliqua*
337	*C. mimax*
338	*C. mimosoides*

339	*Cassia alrata*
340	*Dialium cochinchinensis*
341	*Erythrophleum fordii*
342	*Peltophorum dasyrrachis*
343	*P. pterocarpum*
344	*Saraca indica*
345	*Sindora tonkinensis*
Mimosoideae	
346	*Acacia concinna*
347	*Albizia chinensis*
348	*A. corniculata*
349	*A. lucidior*
350	*Archidendron balansae*
351	*A. bauchei*
352	*A. chevalieri*
353	*A. robinsonii*
354	*Entada phaseoloides*
355	*Mimosa diplotricha*
356	*M. pudica*
Papilionoideae	
357	*Arachis hypogea*
358	*Bowringia calicarpa*
359	*Crotalaria incana*
360	*C. bialata*
361	*Dalbergia entadoides*
362	*D. polyadelpha*
363	*D. rimosa*
364	*Deris acuminata*
365	*D. indica*
366	*Desmodium pulchellum*
367	*D. triflorum*
368	*D. zonantum*
369	*Erythrina fusca*
370	*E. variegata*
371	*Indigofera hirsuta*
372	*I. trifolia*
373	*Milletia ichthyotona*
374	*M. ebehardtii*
375	*Ormosia laosensis*
376	*Pueraria phaseoloides*
377	*Tephrosia purpurea*
378	*Vigna radiata*
379	*V. unguiculata*
57. Fagaceae	
380	*Castanopsis armata*

381	*C. ceratacantha*
382	*C. dongchoensis*
383	*C. indica*
384	*C. quangtriensis*
385	*C. teheponensis*
386	*C. nebulorum*
387	*Lithocarpus ahabdostachya*
388	*L. dinhensis*
389	*L. fenestratus*
390	*L. microsperma*
391	*L. ailaoensis*
392	*L. corneus*
393	*L. haemispherica*
394	*L. jacksoniana*
395	*L. pachylepis*
396	*Q. arbutifolia*
397	*Q. bambusaefolia*
398	*Q. gomeziana*
58. Flacourtiaceae	
399	*Casearia balansae*
400	*C. gromerata*
401	*C. membranacea*
402	*Flacourtia rukkam*
403	*Homalium ceylanicaum*
404	*H. myrandrum*
405	*Hydnocarpus annamensis*
406	*H. ilicifolia*
407	*H. kurzii*
59. Hamamelidaceae	
408	*Liquidambar farmosana*
409	*Rhodoleia championii*
410	*Symingtonia populnea*
60. Icacinacea	
411	*Gomphadra tetrandra*
412	*Iodes cirrhosa*
61. Jugladaceae	
413	*Engelhardia roxburghiana*
414	*E. spicata*
415	*E. serrata*
416	*Pterocarya stenoptera*
62. Lamiaceae	
417	*Coleus scutellaroides*
418	*Leucas aspera*
419	*Mentha quatica*
420	*Pogostemon auricularia*

421	*Orthosiphon spiralis*
422	*Perilla frutescens*
423	*Salvia plebeia*
63. Lauraceae	
424	*Alsecodaphne tonkinensis*
425	*Beilschmiedia ferruginea*
426	*Caryodapnosis tonkinensis*
427	*Cassytha filiformis*
428	*Cinnamomum glaucescens*
429	*C. scalarinervium*
430	*C. parthenocylon*
431	*C. bejolgota*
432	*C. camphora*
433	*C. balansae*
434	*Cryptocarya annamensis*
435	*C. ferrea*
436	*C. petelotii*
437	*Dehaasia triandra*
438	*Ediandra rubescens*
439	*Lindera chunii*
440	*Litsea balansae*
441	*L. cubeba*
442	*L. glutinosa*
443	*Machilus platycarpa*
444	*Neolitsea chuii*
445	*Persea velutina*
446	*Phoebe attenuata*
447	*P. sheareri*
64. Leaceae	
448	*Leea indica*
449	*L. thorelli*
450	*L. manillensis*
451	*L. rubra*
65. Lecythidaceae	
452	*Barringtonia acutangula*
453	*B. eberhardtii*
454	*B. macrocarpa*
66. Loganiaceae	
455	*Gelsemium elegans*
456	*Fagraea fragrans*
457	*F. auriculata*
458	*Strychnos angustifolia*
459	*S. ignatii*
460	*S. ovata*
461	*S. vanpruckii*

67. Loranthaceae	
462	*Dendrophtoe pentandra*
463	*Ginalloa siamica*
464	*Macrosolen robinsonii*
465	*Taxillus chinensis*
466	*Viscum liquidambaricum*
68. Lythraceae	
467	*Lagerstroemia ovalifolia*
468	*L. duperreana*
469	*L. tomentosa*
69. Magnoliaceae	
470	*Michelia mediocris*
471	*M. faveolata*
472	*Paramichelia baillonii*
70. Malvaceae	
473	*Abemoschatus moschatus*
474	*Hibiscus grewiaefolius*
475	*H. rosa-sinensis*
476	*H. surattensis*
477	*Sida cordifolia*
478	*S. ocuta*
479	*S. rhombifolia*
480	*Urena lobata*
71. Melastomataceae	
481	*Allomorphia subsessilis*
482	*Blastus borneensis*
483	*B. cochinchinensis*
484	*Medinilla assamica*
485	*Melastoma bauchei*
486	*M. eberhartii*
487	*M. normale*
488	*Memecylon edule*
489	*M. scutellatum*
490	*Osbeckia chinensis*
491	*O. stellata*
492	*Otanthera annamica*
493	*Phyllagathis prostrata*
494	*Pseudodissochaeta lanceolata*
72. Meliaceae	
495	*Aglaia annamensis*
496	*Amoora dasyclada*
497	*A. gigantea*
498	*A. oligosperma*
499	*Chukrasia tabularis*
500	*Cipadessa baccifera*

501	*Dysoxylum juglans*
502	*Melia azedarach.*
503	*Sandoricum binectariferum*
73. Menispermaceae	
504	*Coscinium fenestratum*
505	*Diploclisia glaucescens*
506	*Fibraurea tinctoria*
507	*Limacia scandens*
508	*Pycnarrhena poilanei*
509	*Stephania japonica*
510	*S. rotunda*
74. Moraceae	
511	*Artocarpus borneensis.*
512	*A. melinoxyla.*
513	*A. nitida*
514	*Broussonetia papyrifera*
515	*Ficus altissima.*
516	*F. auriculata.*
517	*F. benjamina*
518	*F. fulva Reinw*
519	*F. glaberrima.*
520	*F. heterophylla*
521	*F. hispida*
522	*F. nervosa.*
523	*F. pandurata*
524	*F. pumila*
525	*F. subpyrifomis*
526	*F. sumatrana.*
527	*F. vasculosa*
528	*F. virens.*
529	*Maclura cochinchinensis*
530	*Pleicospermum andamanicum*
531	*Streblus taxoides*
532	*S. laxiflorus*
533	*S. zeylanicus*
534	*Taxotrophis caudata*
75. Myristicaceae	
535	*Horsfieldia thorelii.*
536	*Knema elegans*
537	*K. erratica*
538	*K. globularia*
76. Myrsinaceae	
539	*Ardisia colorata*
540	*A. expansa*
541	*A. gigantifolia*

542	*A. harmandii*
543	*A. lecomtei*
544	*A. miniata*
545	*A. quiquegona*
546	*A. racemosa*
547	*A. silvestris*
548	*A. stellifera*
549	*A. tinctoria*
550	*A. aciphylla*
551	*Embelia ribes*
552	*E. ferruginea*
553	*Maesa perlarius*
554	*M. ramentacea*
555	*M. sinensis*
556	*M. indica*
557	*M. membranacea*
77. Myrtaceae	
558	*Cleistocalyx nervosum*
559	*Psidium guajava*
560	*Rhodomyrtus tomentosa*
561	*Syzygium abotivum*
562	*S. bullockii*
563	*S. levinii*
564	*S. oblatum*
565	*S. polyanthum*
566	*S. jambos*
567	*S. zeylanicum*
568	*S. wightianum*
78. Ochnaceae	
569	*Gomphia striata*
570	*G. serrata*
571	*Ochna integerrium*
79. Onagraceae	
572	*Ludwidgia adscendens*
573	*L. octovalvis*
574	*L. perennis*
80. Opiliaceae	
575	*Meliantha suavis*
81. Oxalidaceae	
576	*Averrhoa calambola*
577	*Biophytum sensitivum*
578	*Oxalis corymbosa*
82. Passifloraceae	
579	*Passiflora foetida*
83. Piperaceae	

580	*Peperomia pullucida*
581	*Pipe betle*
582	*P. lolot*
583	*P. nigrum*
584	*P. saxicola*
84. Plantaginaceae	
585	*Plantago asiatica*
85. Polygalaceae	
586	*Polygala brachystachya*
587	*P. erioptera*
588	*P. laotica*
589	*Solomonia cantoniensis*
590	*Xanthophyllum glaucum*
591	*X. silvestre*
86. Polygonaceae	
592	*Polygonum barbatum*
593	*P. glabrum*
594	*P. persicaria*
595	*P. tomentosum*
87. Portulacaceae	
596	*Portulaca pilosa*
597	*P. oleracea*
88. Proteaceae	
598	*Helicia cochinchinensis*
599	*H. longepetiolata*
600	*H. nilagirica*
601	*H. obovatifolia*
602	*H. petiolaris*
603	*Heliciopsis terminalis*
89. Ranunculaceae	
604	*Anemone poilanei*
605	*A. sumatrana*
606	*Clematis chinensis*
607	*C. smilacifolia*
90. Rhamnaceae	
608	*Berchemia loureiriana*
609	*Gouania javanica*
610	*Sagerelia theezan*
611	*Ventilago hermandiana*
612	*Zizyphus cambodiana*
613	*Z. oenoplia*
614	*Z. rugosus*
615	*Z. maurantiana*
91. Rhizophoraceae	
616	*Carallia brachiata*

617	*C. suffruticosa*
92. Rosaceae	
618	*Photinia prunifolia*
619	*Prunus arborea*
620	*Raphiolepsis indica*
621	*Rubus asper*
622	*R. cochinchinensis*
623	*R. moluccanus*
624	*R. multibracteatus*
625	*R. niveus*
626	*R. pavifolius*
93. Rubiaceae	
627	*Canthium grabrum*
628	*Fagerlindia depauperata*
629	*Gardenia angustifolia*
630	*Hedyotis biflora*
631	*H. corymbosa*
632	*H. diffusa*
633	*H. grandis*
634	*H. vestica*
635	*Ixora chinensis*
636	*I. finlaysoniana*
637	*Lasianthus condorensis*
638	*Morinda citifolia*
639	*Mussaenda aptera*
640	*M. cambodiana*
641	*Neonauclea purpurea*
642	*Oxyceros vidalii*
643	*Paederia scandens*
644	*Psychotria rubra*
645	*P. samentosa*
646	*Randia canthioides.*
647	*R. spinosa*
648	*Saposma annamense*
649	*Uncaria homomalla*
650	*Wendlandia paniculata*
94. Rutaceae	
651	*Acronychia pedunculata*
652	*Atalantia sessiliflora*
653	*Citrus aurantifolia*
654	*C. deliciosa*
655	*C. grandis*
656	*C. limonia*
657	*C. nobilis*
658	*Clausena indica*

659	*Euodia lepta*
660	*E. melifolia*
661	*Glycosmis cyanocarpa*
662	*G. ovoidae*
663	*G. sapindoides*
664	*Luvunga sarmentosa*
665	*Micromelum minutum*
666	*Murray paniculata*
667	*Severinia monophylla*
668	*Zanthoxylum aviceniae*
669	*Z. nitidum*
95. Sapindaceae	
670	*Amesiodendron chinense*
671	*Arytera littoralis*
672	*Cardiospermum halicacabum*
673	*Dimocarpus fumatus*
674	*D. longan*
675	*Litchi sinensis*
676	*Mischocarpus poilanei*
677	*Nephelium milliferum*
678	*Paviesia annamensis*
679	*Pometia pinnata*
96. Sapotaceae	
680	*Donella lanceolata*
681	*Madhuca pasquieri*
682	*Planchonella annamensis*
683	*Xantolis dongnaiensis*
97. Schisandraceae	
684	*Kadsura roxburghiana*
98. Simaroubaceae	
685	*Ailanthus triphysa*
686	*Brucea javanica*
687	*Eurycoma harmandiana*
688	*Harrisonia perforata*
99. Smilacaceae	
689	*Smilax bauhinioides*
690	*S. corbularia*
691	*S. ganepainii*
692	*S. glabra*
693	*S. lanceifolia*
694	*S. paniculata*
695	*S. riparia*
100. Solanaceae	
696	*Capsicum frutescens*
697	*Physalis angulata*

698	*Solanum americanum*
699	*S. procumbens*
700	*S. torvum*
701	*S. trilobatum*
702	*S. undatum*
703	*S. melogena*
704	*S. erianthum*
101. Sonneratiaceae	
705	*Duabanga grandiflora*
102. Sterculiaceae	
706	*Byttneria pilosa*
707	*B. andamensis*
708	*Helicteres angustifolia*
709	*H. angustifolia*
710	*H. hirsuta*
711	*H. viscida*
712	*Helitiera cochinchinensis*
713	*Pterospermum diversifolium*
714	*P. heterophyllum*
715	*P. truncatolobatum*
716	*Sterculia alata*
717	*S. hymenocalyx*
718	*S. hyposticta*
719	*S. lanceolata*
103. Symplocaceae	
720	*Symplocos adenophylla*
721	*S. anomala*
722	*S. cochinchinensis*
723	*S. disepala*
724	*S. lanceolata*
725	*S. paniculata*
726	*S. pendula*
104. Theaceae	
727	*Adinandra annamensis*
728	*A. rubropunctata*
729	*Camellia assimilis*
730	*C. dormoyana*
731	*C. sinensis*
732	*Eurya cerasifolia*
733	*E. annamensis*
734	*E. cerasifolia*
735	*E. tonkinensis*
736	*Godonia tonkinensis*
737	*Pyrenaria poilaneana*
738	*Schima wallichii*

739	*Ternstroemia japonica*
105. Thymeleaceae	
740	*Aquilaria crassna*
741	*A. baillonii*
742	*Wikstroemia poilanei*
106. Tiliaceae	
743	*Corchorus nestuans*
744	*Grewia bulot*
745	*G. eberhardtii*
746	*G. paniculata*
747	*Triumfetta pseudocana*
748	*T. bactramia*
107. Ulmaceae	
749	*Gironniera cuspidata*
750	*G. subequalis*
751	*G. orientalis*
752	*Trema cannabina*
753	*T. orientasis*
108. Urticaceae	
754	*Boemeria tonkinensis*
755	*Debregeasia squamata*
756	*Dendrocnide urentissima*
757	*Elatostema cuneatum*
758	*E. dissectum*
759	*Laportea interrupta*
760	*L. thorelii*
761	*Pellonia eberhardtii*
762	*P. cristulata*
763	*Poikilospermum suaveolens*
764	*Pouzolzia zeylanica*
765	*P. hirta*
766	*Villebrunea tonkinensis*
767	*V. frutescens*
109. Verbenaceae	
768	*Callicarpa acutidens*
769	*C. longifolia*
770	*Clerodendrum cyrtophyllum*
771	*C. paniculatum*
772	*C. schmidtii*
773	*Gmelia arborea*
774	*G. asiatica*
775	*Lantana camara*
776	*Premna balansae*
777	*P. serratifolia*
778	*Tsoongia axillariflora*

779	*Vitex pierreana*
780	*V. sumatrana*
781	*V. negundo*
782	*V. trifolia*
783	*Verbena officinalis*
110. Vitaceae	
784	*Ampelopsis annamensis*
785	*A. cantiniensis*
786	*Cayratia palmata*
787	*C. trifolia*
788	*Cissus astrotricha*
789	*C. hastata*
790	*C. hexangularis*
791	*C. modeccoides*
792	*Vitis balanseana*
LILIOPSIDA (MONOCOTYLEDONES)	
111. Agavaceae	
793	*Dracaena cochinchnensis*
794	*D. gracilis*
795	*D. cambodia*
796	*Sanseviera hyacinthoides*
112. Amaryllidaceae	
797	*Curculigo disticha*
798	*C. gracilis*
113. Araceae	
799	*Acorus tatarinowi*
800	*Alocasia cuspidata*
801	*A. decumbens B*
802	*Amorphophyllus mekongensis*
803	*Homalonema occulta*
804	*Pothos augustifolius*
805	*P. gigantipes*
806	*P. repens*
807	*P. scandens*
808	*P. yunanensis*
809	*Raphidophora decursiva*
114. Arecaceae	
810	*Arenga pinnata*
811	*Calamus poilanei*
812	*C. tetradactylus*
813	*Caryota urens*
814	*C. bacsonensis*
815	*Daemonorops pierreanus*
816	*Licuala elegans*
817	*L. grandis*

818	*L. radula*
819	*Livistona tonkinensis*
820	*Pinanga duperreana*
821	*Rhapis excelsa*
115. Bromeliaceae	
822	*Ananas comosus*
116. Commelinaceae	
823	*Amischolotype mollissima*
824	*Commelina benganlensis.*
825	*C. communis*
826	*Cyanotis axillaris*
827	*Dictyospermum ovalifolium*
828	*Floscopa glabratus*
829	*F. scandens*
830	*Murdannia spectabilis*
831	*M. spirata*
832	*Tradescentia discolor*
117. Costaceae	
833	*Costus speciosus*
118. Cyperaceae	
834	*Carex spatiosa*
835	*Cyperus dubius*
836	*C. halpan*
837	*C. rottundus*
838	*C. pumilus*
839	*C. trialatus*
840	*Fimbristylis miliacea*
841	*Kyllinga nemoralis*
842	*Scirpus juncoides*
843	*S. massfeldianus*
844	*S. siamensis*
119. Dioscoreaceae	
845	*Dioscorea*
846	*D. cirrhosa*
847	*D. glabra*
120. Flagellariaceae	
848	*Flagellaria indica*
121. Hemodoraceae	
848	*Liriope spicata*
849	*Ophiopogon reptan*
850	*O. longifolius*
851	*O. peliosanthoides*
122. Iridaceae	
852	*Belamcandra chinensis*
853	*Eleuthrine bulbosa*

123. Liliaceae	
854	*Dianella nemorosa*
855	*Disporum trabeculatum*
856	*Oligobotrya henryi*
857	*Paris polyphylla*
124. Maranthaceae	
858	*Calathea clossoni*
859	*Phrynium dispermum*
125. Musaceae	
860	*Musa aucuminata*
126. Orchidaceae	
861	*Aerides falcata*
862	*Agrostophyllum planicaule*
863	*Anoectochilus cetaceus*
864	*A. lylei*
865	*Anoectochilus roxburghii*
866	*Arundina graminifolia.*
867	*Bulbophyllum poilanei*
868	*Calanthe triplicata*
869	*Coelogyne mooreana*
870	*Corymborkis veratrifolia*
871	*Cymbidium banaense*
872	*Dendrobium amabile*
873	*D. farmeri*
874	*D. lindleyi*
875	*D. parciflorum*
876	*D. thyrsiflorum*
877	*Eria amica*
878	*E. corneri*
879	*Erythrorchis ochobiensis*
880	*Herbenaria dentata*
881	*H. viridiflora*
882	*Paphiopedilum amabile*
883	*Podochilus intermedius*
884	*Renanthera coccinea*
885	*Rhynchostylis retusa*
886	*Trichotosia pulvinata*
127. Pandanaceae	
887	*Pandanus tonkinensis*
888	*P. affinis*
128. Poaceae	
889	*Bambusa balcoa*
890	*B. blumeana S*
891	*Centhotheca lappacea*
892	*Chrysopogon aciculatus*

893	*Coix lacryma*
894	*Cynodon dactylon*
895	*Dendrocalamus patellaris*
896	*D. sinuata*
897	*Echinochloa colonum*
898	*Eleusine indica*
899	*Erianthus arundinaceus*
900	*Imperata cylindrica*
901	*Isachne dispa*
902	*Miscanthus floridulus*
903	*Oryza sativa*
904	*Paspalum scrobiculatum*
905	*Phragmites vallatoria*
906	*Saccharum officinarum*
907	*S. spontaneum*
908	*Setaria pumila*
909	*Sinarundinaria griffithiana*
910	*Thysanolaena maxima*
911	*Zea mays*
129. Stemonaceae	
912	*Stemona tuberosa*
130. Taccaceae	
913	*Tacca chantrieri*
914	*T. plantaginea*
915	*T. intergrifolia*
131. Zingiberaceae	
916	*Alpinia chinensis*
917	*Alpinia officina*
918	*Catimbium bracteatum*
919	*Globba pendula*
920	*Hedychium stenopetalum*

Appendix 2. Mammal species recorded in Bac Huong Hoa Nature Reserve

English Name	Scientific Name	2002[1]	2004[2]	2005[3]	2006[4]
	Scandenta				
	Tupaiidae				
Northern Treeshrew	*Tupaia belangeri*		O	X	
	Primates				
	Loricidae				
Slow Loris	*Nycticebus coucang*		I		
Pygmy Slow Loris	*Nycticebus pygmaeus*		I		O
	Cercopithecidae				
Stump-tailed Macaque	*Macaca arctoides*		O	X	O
Northern Pig Tailed Macaque	*Macaca leonina*				O
Rhesus Monkey	*Macaca mulatta*				O
Red-shanked Douc Langur	*Pygathrix nemaeus*	I	O	X	I
Hatinh Langur	*Trachypithecus hatinhensis*			X	I
	Hylobatidae				
Northern White-cheeked Gibbon	*Nomascus leucogenis*	I	I, Ca	X	I
	Rodentia				
	Sciuridae				
Black Giant Squirrel	*Ratufa bicolor*		I		
Indian Giant Flying Squirrel	*Petaurista philippensis*		I		O
Pallas's Squirrel	*Callosciurus erythraeus*		O	X	O
Asian Red-cheeked Squirrel	*Dremomys rufigenis*		O	X	O
Cambodian Striped Squirrel	*Tamiops rodolphii*		O	X	
	Muridae				
Indomalayan Bamboo Rat	*Rhizomys sumatrensis*		I, T	X	
Indomalayan Leopoldamys	*Leopoldamys sabanus*				
	Hystricidae				
Asiatic Brush-tailed Porcupine	*Atherurus macrourus*				O
Malayan Porcupine	*Hystrix brachyura*		R, T	X	O
	Lagomorpha				
	Leporidae				

English Name	Scientific Name	2002[1]	2004[2]	2005[3]	2006[4]
Burmese Hare	*Lepus peguensis*		I		
Annamite Striped Rabbit	*Nesolagus timminsi*	O	O	X	O
	Manidae				
Sunda Pangolin	*Manis javanica*		I, R	X	O
	Carnivora				
	Felidae				
Asian Golden Cat	*Catopuma temminckii*		I		I
Leopard Cat	*Prionailurus bengalensis*		I, T	X	O
Clouded Leopard	*Neofelis nebulosa*		I		
Leopard	*Panthera pardus*		I		
	Viverridae				
Binturong	*Arctictis binturong*		I		O
Masked Palm Civet	*Paguma larvata*		I, Dr	X	O
Common Palm Civet	*Paradoxurus hermaphroditus*				O
Spotted Linsang	*Prionodon pardicolor*				O
Large Indian Civet	*Viverra zibetha*		Dr, T	X	I
Small Indian Civet	*Viverricula indica*		R	X	O
	Canidae				
Dhole	*Cuon alpinus*		I		
	Ursidae				
Sun Bear	*Helarctos malayanus*		I		I
Asian Black Bear	*Ursus thibetanus*		I, T	X	I
	Mustelidae				
Oriental Small-clawed Otter	*Aonyx cinereus*		I, T	X	
European Otter	*Lutra lutra*		I		
Hog Badger	*Arctonyx collaris*		T, Dr	X	
Yellow-throated Martin	*Martes flavigula*		I		
	Artiodactyla				
	Suidae				
Wild Boar	*Sus scrofa*	I	T, I	X	O
	Tragulidae				
Lesser Mouse-deer	*Tragulus kanchil*		I		
	Cervidae				
Red Muntjac	*Muntiacus muntjak*	I	T, I	X	O
Large-antlered Muntjac	*Muntiacus vuquangensis*		T, R	X	O
Sambar	*Cervus unicolor*	I	T, Dr	X	O
	Bovidae				
Gaur	*Bos frontalis*		O	X	O

English Name	Scientific Name	2002[1]	2004[2]	2005[3]	2006[4]
Saola	*Pseudoryx nghetinhensis*	I	I, R	X	I
Chinese Serow	*Capricornis sumatraensis*	I	Dr, T	X	O

[1]Le Manh Hung *et al.* 2002
[2]Dang Ngoc Can 2004
[3]Surveys by Le Trong Trai 2005
[4]Dang Ngoc Can *et al.* 2006
Records are coded as follows: O = field observation; R = specimen or parts of specimen recorded; C = heard only; T = tracks recorded only (footprints, droppings, scratch marks); I = Interview.

Appendix 3. Bird species recorded in Bac Huong Hoa Nature Reserve

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Galliformes				
Phasianidae				
Francolinus pintadeanus	Chinese Francolin	X	X	X
Arborophila brunneopectus	Bar-backed Partridge		X	X
A. chloropus	Scaly-breasted Partridge	X	X	X
A. charltonii	Chestnut-necklaced Partridge		X	
Gallus gallus	Red Junglefowl	X	X	X
Lophura nycthemera	Silver Pheasant	[X]	X	X
L. edwardsi	Edwards's Pheasant		[X]	
L. diardi	Siamese Fireback	[X]	[X]	X
Polyplectron bicalcaratum	Grey Peacock Pheasant	X	X	X
Rheinardia ocellata	Crested Argus	[X]	[X]	X
Ardeidae				
Ixobrychus sinensis	Yellow Bittern	X	X	X
Dupetor flavicollis	Black Bittern	X	X	X
Butorides striata	Striated Heron		X	X
Ardeola bacchus	Chinese Pond-heron		X	
Falconidae				
Microhierax melanoleucos	Pied Falconet		X	X
Accipitridae				
Pernis ptilorhynchus	Oriental Honey Buzzard	X	X	X
Ichthyophaga humilis	Lesser Fish Eagle	X	X	X
Spilornis cheela	Crested Serpent Eagle	X	X	X
Accipiter trivirgatus	Crested Goshawk	X	X	X
A. badius	Shikra	X	X	X
A. gularis	Japanese Sparrowhawk			X
Butastur indicus	Grey-faced Buzzard	X	X	X
Ictinaetus malayensis	Black Eagle	X	X	X
Hieraaetus kienerii	Rufous-bellied Eagle			X
S. nipalensis	Mountain Hawk Eagle			X
Gruiformes				
Rallidae				
Amaurornis phoenicurus	White-breasted Waterhen	X	X	X
Turniciformes				
Turnicidae				
Turnix suscitator	Barred Buttonquail			X
Ciconiiformes				
Scolopacidae				
Scolopax rusticola	Eurasian Woodcock	X	X	X
Columbiformes				
Columbidae				

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Streptopelia tranquebarica	Red Collared-dove		X	
Streptopelia orientalis	Oriental Turtle-dove		X	
Streptopelia chinensis	Spotted Dove	X	X	X
Chalcophaps indica	Emerald Dove	X	X	X
Macropygia unchall	Barred Cuckoo-dove		X	
Treron bicinctus	Orange-breasted Green Pigeon			X
Treron curvirostra	Thick-billed Green-pigeon		X	
Treron apicauda	Pin-tailed Green Pigeon		X	
Ducula badia	Mountain Imperial-pigeon		X	X
Psittaciformes				
Psittacidae				
Loriculus vernalis	Vernal Hanging-parrot		X	
Cuculiformes				
Cuculidae				
Cuculus sparverioides	Large Hawk Cuckoo		X	
Cuculus micropterus	Indian Cuckoo		X	
Cacomantis merulinus	Plaintive Cuckoo	X	X	X
Surniculus lugubris	Drongo Cuckoo		X	X
Eudynamys scolopaceus	Asian Koel		X	
Phaenicophaeus tristis	Green-billed Malkoha	X	X	X
Carprococcyx renauldi	Coral-billed Ground-cuckoo		X	
Centropodidae				
Centropus sinensis	Greater Coucal	X	X	X
C. bengalensis	Lesser Coucal	X	X	X
Strigiformes				
Strigidae				
Otus spilocephalus	Mountain Scops Owl	X	X	X
O. bakkamoena	Collared Scops Owl		X	X
Glaucidium brodiei	Collared Owlet		X	X
G. cuculoides	Asian Barred Owlet		X	X
Apodiformes				
Apodidae				
Hirundapus cochinchinensis	Silver-backed Needletail	X	X	X
Cypsiurus balasiensis	Asian Palm Swift	X	X	X
Apus affinis	House Swift		X	X
Trogoniformes				
Trogonidae				
Harpactes erythrocephalus	Red-headed Trogon	X	X	X
Coraciiformes				
Coraciidae				
Eurystomas orientalis	Asian Dollarbird		X	

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Halcyonidae				
Halycon coromanda	Ruddy Kingfisher		X	
Halcyon smyrnensis	White-throated Kingfisher	X	X	X
Alcedinidae				
Ceyx erythacus	Black-backed Kingfisher	X	X	X
Alcedo hercules	Blyth's Kingfisher	X	X	X
Alcedo atthis	Common Kingfisher	X	X	X
Cerylidae				
Megaceryle lugubris	Crested Kingfisher		X	
Meropidae				
Nyctyornis athertoni	Blue-bearded Bee-eater		X	X
Merops philippinus	Blue-tailed Bee-eater		X	
Anorrhinus austeni	Brown Hornbill		X	X
Anthracoceros albirostris	Oriental Pied Hornbill	X	X	X
Buceros bicornis	Great Hornbill	[X]	X	X
Megalaimidae				
Megalaima lagrandieri	Red-vented Barbet	X	X	
M. lineata	Lineated Barbet	X		
M. faiostricta	Green-eared barbet		X	
M. franklinii	Golden-throated Barbet	X	X	
Piciformes				
Picidae				
Picumnus innominatus	Speckled Piculet		X	X
Sasia ochracea	White-browed Piculet		X	X
Celeus brachyurus	Rufous Woodpecker			X
Picus chlorolophus	Lesser Yellownape		X	
Picus flavinucha	Greater Yellownape	X	X	X
Picus rabieri	Red-collared Woodpecker	X	X	X
Blythipicus pyrrhotis	Bay Woodpecker		X	X
Eurylamydae				
Psarisomus dalhousiae	Long-tailed Broadbill	X	X	X
Serilophus lunatus	Silver-breasted Broadbill		X	X
Passeriformes				
Pittidae				
Pitta soror	Blue-rumped Pitta		X	X
P. elliotii	Bar-bellied Pitta		X	X
Artamidae				
Artamus fuscus	Ashy Woodswallow	X	X	X
Aegithinidae				
Aegithina lafresnayei	Great Iora		X	
Prionopidae				

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Tephrodornis gularis	Large Woodshrike		X	
Campephagidae				
Coracina macei	Large Cuckooshrike		X	X
C. melaschistos	Black-winged Cuckooshrike		X	
Pericrocotus divaricatus	Ashy Minivet		X	
Pericrocotus flammeus	Scarlet Minivet	X	X	X
Hemipus picatus	Bar-winged Flycatcher-shrike		X	
Laniidae				
Lanius schach	Long-tailed Shrike	X	X	X
Monarchidae				
Hypothymis azurea	Black-naped Monarch		X	X
Terpsiphone paradise	Asian Paradise-flycatcher		X	
Oriolidae				
Oriolus traillii	Maroon Oriole		X	X
Dicruidae				
Dicrurus macrocercus	Black Drongo	X	X	X
D. leucophaeus	Ashy Drongo	X	X	X
D. annectans	Crow-billed Drongo	X	X	X
D. aeneus	Bronzed Drongo		X	
D. remifer	Lesser Racket-tailed Drongo	X	X	X
D. hottenttus	Hair-crested Drongo		X	
D. paradiseus	Greater Racket-tailed Drongo	X	X	X
Rhiphiduradae				
Rhipidura albicollis	White-throated Fantail		X	
Corvidae				
Urocissa whiteheadi	White-winged Magpie		X	X
Cissa hypoleuca	Yellow-breasted Magpie		X	X
Crypsirina temia	Racket-tailed Treepie	X	X	
Temnurus temnurus	Ratchet-tailed Treepie	X	X	X
Corvus macrohynchos	Large-billed Crow		X	X
Paridae				
Melanochlora sultanea	Sultan Tit	X	X	X
Hirundinidae				
Hirundo rustica	Barn Swallow			X
H. daurica	Red-rumped Swallow		X	X
Delichon dasypus	Asian House Martin			X
Cisticolidae				
Prinia flaviventris	Yellow-bellied Prinia		X	
P. inornata	Plain Prinia			X
Pycnonotidae				
Pycnonotus jocosus	Red-whiskered Bulbul	X	X	X
P. aurigaster	Sooty-headed Bulbul	X	X	X
Iole propinqua	Grey-eyed Bulbul		X	

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Alophoixus pallidus	Puff-throated Bulbul	X	X	X
Hypsipetes mcclellandii	Mountain Bulbul			X
H. leucocephalus	Asian Black Bulbul		X	
Sylviidae				
Orthotomus sutorius	Common Tailorbird	X	X	X
O. atrogularis	Dark-necked Tailorbird	X	X	X
Sylviidae				
Urosphena squameiceps	Asian Stubtail			X
Phylloscopus armandii	Yellow-streaked Warbler			X
P. inornatus	Inornate Warbler			X
P. borealis	Arctic Warbler		X	
P. reguloides	Southern Blyth's Leaf-warbler			X
Abroscopus affinis	White-spectacled Warbler		X	X
A. supercilliaris	Yellow-bellied Warbler			X
Timaliidae				
Pellorheum albiventre	Spot-throated Babbler		X	
P. ruficeps	Puff-throated Babbler		X	
Trichostoma tickelli	Buff-breasted Babbler		X	X
Malacopteron cinereum	Scaly-crowned Babbler		X	X
Pomatorhinus hypoleucos	Large Scimitar Babbler		X	X
P. schisticeps	White-browed Scimitar-babbler		X	
P. ruficollis	Streak-breasted Scimitar Babbler			X
P. ocharaciceps	Red-billed Scimitar Babber			X
Jabouilleia danjjoui	Short-tailed Scimitar-babbler		X	
Napothera brevicaudata	Streaked Wren-babbler		X	
N. epilepidota	Eyebrowed Wren-babbler		X	
Stachyris ruficeps	Rufous-capped Babbler		X	
S. chrysea	Golden Babbler		X	X
S. nigriceps	Grey-throated Babbler		X	X
Stachyris striolata	Spot-necked Babbler	X	X	
Macronous gularis	Pin-striped Tit Babbler	X	X	X
Macronous kelleyi	Grey-faced Tit-babbler		X	
Timalia pileata	Chestnut-capped Babbler	X		X
Garrulax leucolophus	White-crested Laughingthrush	X	X	X
G. monileger	Lesser Necklaced Laughingthrush	X	X	X
G. castanotis	Rufous-cheeked Laughingthrush		X	X
G. chinensis	Black-throated	X	X	X

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
	Laughingthrush			
G. vassali	White-cheeked Laughingthrush	X	X	X
Pteruthius flaviscapis	White-browed Shrike-babbler			X
P. melanotis	Black-eared Shrike-babbler			X
Gampsorhynchus torquatus	Collared Babbler			X
Minla cyanouroptera	Blue-winged Minla			X
Alcippe peracensis	Mountain Fulvetta		X	
Alcippe grotei	Black-browed Fulvetta			X
Alcippe morrisonia	Grey-cheeked Fulvetta	X	X	X
Yuhina zantholeuca	White-bellied Yuhina	X	X	X
Zosteropidae				
Zosterops palpebrosus	Oriental White-eye		X	
Irenidae				
Irena puella	Asian Fairy Bluebird	X	X	X
Sittidae				
Sitta frontalis	Velvet-fronted Nuthatch			X
Sturnidae				
Gracula religiosa	Hill Myna		X	X
Acridotheres tristis	Common Myna		X	X
A. cinereus	White-vented Myna	X	X	X
A. cristatellus	Crested Myna	X	X	X
S. sinensis	White-shouldered Starling			X
Sturnus nigricollis	Black-collared Starling	X	X	X
Muscicapidae				
Myophonus caeruleus	Blue Whistling Thrush	X	X	X
Luscinia sibilans	Rufous-tailed Robin			X
Tarsiger cyanurus	Orange-flanked Bush Robin			X
Copsychus saularis	Oriental Magpie Robin	X	X	X
C. malabaricus	White-rumped Shama		X	
Enicurus schistaceus	Slaty-backed Forktail	X	X	X
Enicurus leschenaulti	White-crowned Forktail		X	X
Saxicola torquatus	Common Stonechat		X	
Saxicola ferrea	Grey Bushchat			X
Monticola solitarius	Blue Rock-thrush		X	X
Muscicapa daurica	Asian Brown Flycatcher	X	X	X
Ficedula mugimaki	Mugimaki Flycatcher			X
F. parva	Red-breasted Flycatcher		X	
F. monileger	White-gorgeted Flycatcher		X	X
Eumyias thalassina	Verditer Flycatcher			X
Cyornis concretus	White-tailed Flycatcher		X	
C. hainanus	Hainan Blue-flycatcher		X	
C. banyumas	Hill Blue-flycatcher		X	

Scientific Name	Common Name	2004[1]	2005[2]	In prep.[3]
Culicicapa ceylonensis	Grey-headed Canary Flycatcher	X	X	
Chloropseidae				
Chloropsis cochinchinensis	Blue-winged Leafbird	X	X	X
C. hardwickii	Orange-bellied Leafbird		X	X
Nectariniidae				
D. concolor	Plain Flowerpecker		X	
Dicaeum cruentatum	Scarlet-backed Flowerpecker			X
Hypogramma hypogrammicum	Purple-naped Sunbird		X	
Nectarinia jugularis	Olive-backed Sunbird		X	X
Aethopyga gouldiae	Gould's Sunbird			X
A. christinae	Fork-tailed Sunbird		X	X
A. saturata	Black-throated Sunbird			X
Aethopyga siparaja	Crimson Sunbird			X
Arachnothera longirostra	Little Spiderhunter	X	X	X
A. magna	Streaked Spiderhunter	X	X	X
Passeridae				
Passer montanus	Eurasian Tree Sparrow	X	X	X
Estrilidae				
Lonchura striata	White-rumped Munia		X	
Motacillidae				
Motacilla alba	White Wagtail	X	X	X
M. cinerea	Grey Wagtail	X	X	X
Anthus richardi	Richard's Pipit		X	X
A. hodgsoni	Olive-backed Pipit		X	

Note: records in brackets are not seen or heard, but only from interviews and traded parts

[1] Nguyen Cu and Le Manh Hung (2004)
[2] Anon (2006) Combined list of birds listed by Nguyen Cu and Le Manh Hung (2004) and those recorded on surveys conducted by Le Trong Trai in 2005
[3] Listed by Le Manh Hung *et al.* in prep.

Appendix 4. Reptile and Amphibian species recorded in Bac Huong Hoa Nature Reserve

Scientific Name	English Name	2006[1]	2007[2]
Amphibia			
Anura			

Scientific Name	English Name	2006[1]	2007[2]
Megophryidae			
Brachytarsophrys intermedia	Annam Spadefoot Toad		X
Rhacophoridae			
Philautus truongsonensis			
Rhacophorus nigropalmatus	Wallace's Flying Frog		X
Reptilia			
Squamata			
Gekkonidae			
Gekko gecko	Tokay		X
Hemidactylus frenatus	Spiny-tailed House Gecko		X
Agamidae			
Calotes emma	Emma Lizard		X
Physignathus cocincinus	Indochinese Water Dragon	X	X
Scincidae			
Emoia laobaoensis	Laobao Skink		X
Mabuya multifasciata	Flower Skink		X
Mabuya macularia	Spotted Skink		X
Varanidae			
Varanus salvator	Water Monitor	X	
Boidae			
Python molurus	Burmese Python	X	
Colubridae			
Dryocalamus davisoni	David Snake		X
Enhydris plumbea	Chinese Water Snake		X
Oligodon cyclurus	Long-tailed Kukri Snake		X
Ptyas korros	Indochinese Rat Snake	X	
Ptyas mucosus	Common Rat Snake	X	
Elaphe radiata	Radiated Rat Snake	X	
Rhabdophis subminiatus	Green Keelback		X
Xenochrophis piscator	Black Water Snake		X
Elapidae			
Bungarus fasciatus	Banded Krait	X	
Calliophis macclellandi	Common Leaf Snake		X
Naja naja	Indochinese Cobra	X	
Ophiophagus hannah	King Cobra	X	
Testudinata			
Emydidae			
Cuora galbinifrons	Indochinese Box Turtle	X	
Cuora trifasciata	Chinese Three-striped Box rtle	X	
Pyxhidea mouhoti	Keeled Box Turtle	X	
Sacalia quadriocellata	Four-eyed Turtle	X	X

[1]Dang Ngoc Can *et al.* (2006)

[2]Cao Tien Trung in prep.

BirdLife International
BirdLife International is a global conservation network of non-governmental organisations (NGOs) present in more than 100 countries, with more than 60 autonomous Partner organizations. Together BirdLife is the leading authority on the status of birds and their habitats. Over ten million people now support the BirdLife Partnership. Partners work together on shared priorities, programmes and policies, learning from each other to achieve real conservation results. The BirdLife Partnership is coordinated by a decentralised international secretariat, which supports the partnership to achieve the aims and objectives of BirdLife International. BirdLife International initiated its Vietnam Programme in 1988, which is an office of the secretariat based in Hanoi.

In Vietnam, BirdLife works with a variety of government and non-government organisations to:
• Support improved conservation planning and management of important habitats, sites and species;
• Advocate new ideas for integrating biodiversity conservation into planning and policy;
• Stimulate greater public interest in birds and biodiversity, and awareness of the need for biodiversity conservation;
• Develop capacity for improved management of important habitats, sites and species among local communities and government institutions responsible for conservation in Vietnam; and
• Provide information on biodiversity and protected areas to planners, policy makers and other interest groups.

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