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and the
Forest Inventory and Planning Institute
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**An Investment Plan for the Establishment of
Phong Dien Nature Reserve,
Thua Thien Hue Province, Vietnam**

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Number 15

An Investment Plan for the Establishment of
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Thua Thien Hue Province, Vietnam

by

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Table of Contents

Table of Contents	i
Acknowledgements	v
Conventions Used	vi
Executive Summary	vii
Executive Summary in Vietnamese	ix
1. Introduction	1
1.1 Location, Description and Objectives	1
1.2 Legal and Scientific Justification	1
1.3 External Context	3
Other Protected Area Initiatives in Central Vietnam	3
Highway Development	3
Related Development Projects	3
2. Physical and Biological Description	5
2.1 Biogeography	5
2.2 Topography	5
2.3 Geology	5
2.4 Soil	5
2.5 Meteorology	5
2.6 Hydrology	6
2.7 Habitat Types and Condition	7
Primary and Mature Secondary Forest (Rich and Medium Forest)	7
Immature Secondary Forest (Poor Forest)	8
Regenerating Forest	8
Scrub with Scattered Trees	9
Scrub	9
Grassland	9
2.8 Flora and Plant Resources	9
2.9 Mammals	10
Key Mammal Records	10
2.10 Birds	12
2.11 Reptiles and Amphibians	13
2.12 Fish	14
2.13 Butterflies	14
2.14 Landscape, Historical and Cultural Features	16
3. Socio-economic Features	17
3.1 Summary of Key Socio-economic Features	17
3.2 Population, Demographics and Ethnicity	18
Demographics	18
Ethnicity	18
Population Distribution	18
Population Change, War and Forest Change in Recent History	19
3.3 Public Health and Reproductive Health Services	20
Summary of Health Issues	20
Access to Health and Reproductive Health Services	20
3.4 Education	21
3.5 Infrastructure	21
Transportation	21
Electricity	22
3.6 Economic activities	22
3.7 Agricultural and Agro-ecological Resources	22
The Influence of Agricultural Activities on Access to Forest Resources	23

Agriculture and Land-use Trends: Opportunities for Buffer Zone Management?	25
Livestock and Animal Husbandry	25
3.8 Forest Resources	26
Causes of Recent Forest Change	26
Existing Forest Management	26
Threats to Forest Resources	28
Hunting and Trapping	28
Extraction of Timber Resources	29
Extraction of Non-timber Forest Products	30
3.9 Forest Services	31
Flood and Erosion Control	32
Water Supply and Irrigation Projects	32
4. Stakeholders	33
4.1 Local Communities	33
4.2 Downstream Water Users	33
4.3 Thua Thien Hue Provincial People's Committee	33
4.4 Provincial and District Forest Protection Departments	33
4.5 Phong Dien Forest Enterprise	34
4.6 Bo River Watershed Protection Forest	35
4.7 International Organisations and Projects	35
5. Evaluation	36
5.1 Biodiversity Evaluation	36
5.2 Threat Evaluation	37
5.3 Institutional Evaluation	38
5.4 Economic Evaluation	39
Least-cost Alternative	39
Opportunity Cost	40
5.5 Evaluation of Other Potential Benefits	40
6. Management Planning for Phong Dien Nature Reserve	42
6.1 Special-use Forest Name	42
6.2 Rationale for Designation of Special-use Forest Category	42
6.3 Management Objectives of the Special-use Forest	42
6.4 Management Responsibility for the Special-use Forest	42
6.5 Physical Description of Boundary and Justification	42
Description	42
Justification	42
6.6 Management Zoning	43
Strict Protection Area	43
Forest Rehabilitation Area	44
Administration and Services Area	45
Buffer Zone	45
7. Proposed Project Activities and Indicative Costs	46
7.1 Protection Programme	46
Infrastructure Development Component	46
Conservation and Protection Component	47
7.2 Rehabilitation Programme	48
Forest Restoration and Plantation Component	48
Forest Protection Component	48
7.3 Monitoring and Research Programme	49
7.4 Awareness and Extension Programme	49
7.5 Tourism Development Programme	49
8. Special-use Forest Management Structure and Finance	51
8.1 Proposed Management Structure	51
Directorate	51
Administration Department	51

Technical and Financial Department	51
Protection Department	51
8.2 Finance	53
Investment Capital	53
8.3 Implementation of the Investment Plan for Phong Dien Nature Reserve	53
9. Summary of Project Benefits	56
References	57
Appendix 1: Flora Recorded at Phong Dien and Dakrong Nature Reserves	63
Appendix 2: Mammals Recorded at Phong Dien and Dakrong Nature Reserves	68
Appendix 3: Birds Recorded at Phong Dien and Dakrong Nature Reserves	70
Appendix 4: Reptiles and Amphibians Recorded at Phong Dien and Dakrong Nature Reserves	75
Appendix 5: Butterflies Recorded at Phong Dien and Dakrong Nature Reserves	77
Appendix 6: Village Histories for Four Villages Compiled Using Timeline Analysis	82
Appendix 7: Seasonal Calendars for Agricultural Activities in Three Villages	84
Appendix 8: Village Maps Developed by the Villagers of Four Villages	86
Appendix 9: Duration of Hunting and NTFP Collection Compared with Seasonal Labour Demands and Rainfall	90
Appendix 10: Historical and Current Threats to Forest and Wildlife at Four Villages	91
Appendix 11: Hunting Data for Four Villages	92
Appendix 12: Forest Product Exploitation Data for Four Villages	95
List of Tables	
Table 1: On-going and Planned ODA-funded Rural Development Projects in Districts Adjacent to Phong Dien and Dakrong Nature Reserves	4
Table 2: Central Vietnam Meteorological Data	6
Table 3: Land-use at Phong Dien Nature Reserve	7
Table 4: Plants Recorded at Phong Dien and Dakrong Nature Reserves	9
Table 5: Red-listed Plant Species Recorded at Phong Dien and Dakrong Nature Reserves	10
Table 6: Red-listed Mammal Species Recorded at Phong Dien and Dakrong Nature Reserves	11
Table 7: Restricted-range and Red-listed Bird Species Recorded at Phong Dien and Dakrong Nature Reserves	13
Table 8: Endemic and Red-Listed Reptile and Amphibian Species Recorded at Phong Dien and Dakrong Nature Reserves	14
Table 9: Butterfly Species Recorded at Phong Dien and Dakrong Nature Reserves	14
Table 10: New Butterfly Records at Phong Dien and Dakrong Nature Reserves	15
Table 11: Tentative List of Butterflies Endemic to Central Vietnam	15
Table 12: Distribution of Butterflies Species by Habitat Type at Phong Dien and Dakrong Nature Reserves	16
Table 13. Ethnic Composition of the Buffer Zone Communes	18
Table 14. Population Distribution and Density in the Buffer Zone Communes	19
Table 15: Numbers of Teachers and Pupils in the Schools of the Buffer Zone in 1999-2000	21
Table 16: Agricultural Land in the Buffer Zone Communes	23
Table 17: Land under the Management of Phong Dien Forest Enterprise in two Buffer Zone Communes	26
Table 18: Hunting Information Collected in Ha Long Village, Phong Dien District	30
Table 19: Local Perceptions of Forest and Biodiversity Value Expressed by Women Villagers of Khe Tran Village	30
Table 20: NTFPs Collected by the Villagers of Dut 5 Village, A Luoi District	31

Table 21: Globally Threatened and Near-threatened Bird Species Recorded at Five Sites in Central Vietnam	37
Table 22: Red-listed Species Recorded at Phong Dien and Dakrong Nature Reserves	37
Table 23: Coverage of Forest Quality Categories (in hectares)	43
Table 24: Management Regime for the Strict Protection Area	44
Table 25: Management Regime for the Forest Rehabilitation Area	44
Table 26: Commune Areas in the Nature Reserve and Buffer Zone	45
Table 27: Investment Schedule for the Investment Plan for Phong Dien Nature Reserve (in VND million)	53
Table 28: Cost Estimates for the Five Year Investment Plan for Phong Dien Nature Reserve (in VND million)	54
Table 29: Disbursement Schedule for the Investment Plan for Phong Dien Nature Reserve (in VND million)	55

List of Maps

Map 1: Location of Phong Dien Nature Reserve	59
Map 2: Land-use in and around Phong Dien Nature Reserve	60
Map 3: Population Density and Ethnic Composition of Communes in the Buffer Zone of Phong Dien Nature Reserve	61
Map 4: Proposed Management Zoning of Phong Dien Nature Reserve	62

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Conventions Used

Plant names, sequence and species limits follow Pham Hoang Ho (1991). Mammal names (common and scientific), sequence and species limits follow Corbet and Hill (1992), with scientific names given at first mention and in Appendix 2. Bird names (common and scientific), sequence and species limits follow Inskipp *et al.* (1996) (except in the case of Annam Partridge *Arborophila merlini*, which follows Sibley and Monroe (1990)), 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).

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

Locality names follow Department of Cartography 1:50,000 series maps.

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 km².

Globally threatened species refers to a species assigned a category of threat in the IUCN Red Lists of Threatened Animals and Plants (IUCN 1996, 1997); the term excludes species listed as Near Threatened or Data Deficient.

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

Stakeholders refers to groups who are likely to benefit from, and/or bear the costs of, establishment of the nature reserve.

The study area refers to Phong My, Phong Xuan and Phong Son communes, Phong Dien district, and Hong Van, Hong Trung, Bac Son, Hong Kim and Hong Ha communes, A Luoi district, Thua Thien Hue province.

Abbreviations and Acronyms Used

ADB	-	Asian Development Bank
DARD	-	Department of Agriculture and Rural Development
dbh	-	diameter at breast height (1.3 m)
EBA	-	Endemic Bird Area
FIPI	-	Forest Inventory and Planning Institute, Hanoi
FINNIDA	-	Finnish International Development Assistance
FPD	-	Forest Protection Department
GEF	-	Global Environmental Facility
ICBP	-	International Council for Bird Preservation (now BirdLife International)
IUCN	-	World Conservation Union
IUD	-	intra-uterine device
MARD	-	Ministry of Agriculture and Rural Development
NGO	-	non-governmental organisation
NTFP	-	non-timber forest product
ODA	-	official development assistance
PRA	-	Participatory Rural Appraisal
SNV	-	Netherlands Development Agency
UNDP	-	United Nations Development Programme
UNICEF	-	United Nations International Children's Education Fund
WPF	-	Watershed Protection Forest

Executive Summary

Prior to 1993, the forest at Phong Dien Nature Reserve was classified as production forest and, as such, was managed by logging enterprises administered by the provincial department of forestry. In 1992, after the value of preserving the area as a water catchment was recognised, a proposal was submitted to central government to change the status of the site to watershed protection forest.

In 1998, following the rediscovery of Edwards's Pheasant *Lophura edwardsi* at the site, Phong Dien was included on the 2010 list as a 33,900 ha nature reserve (FPD 1998). In June and July 1998, the BirdLife International Vietnam Programme and the Forest Inventory and Planning Institute (FIPI) conducted a field survey in order to assess the feasibility of upgrading Phong Dien and the adjacent Dakrong Watershed Protection Forests to Special-use Forest status. The resulting feasibility study proposed that the total area of Phong Dien Nature Reserve should be 34,406 ha (Le Trong Trai *et al.* 1999).

In January 2000, after the contents of the feasibility study had been approved by Thua Thien Hue Provincial People's Committee, BirdLife and FIPI worked closely with the provincial forest protection department to prepare a nature reserve investment plan for Phong Dien. This investment plan proposes establishing 41,548 ha nature reserve in Phong Dien and A Luoi districts.

The topography of Phong Dien Nature Reserve is dominated by a ridge of low mountains, which extends south-east from the Annamite mountains, and forms the border between Quang Tri and Thua Thien Hue provinces. The highest points within the nature reserve are Coc Ton Bhai (1,408 m), Ca Cut (1,405 m), Ko Va La Dut (1,409 m), Coc Muen (1,298 m) and Co Pung (1,615 m). The nature reserve is drained by three main river systems: the My Chanh, O Lau and Bo rivers.

Phong Dien Nature Reserve, together with the contiguous Dakrong Nature Reserve, supports the largest remaining area of lowland evergreen forest in the Annamese Lowlands Endemic Bird Area (EBA) (Le Trong Trai *et al.* 1999). Lowland areas are the most extensively deforested elevation zone of Vietnam (Wege *et al.* 1999), and lowland evergreen forest is perhaps the most threatened forest type in the country. Phong Dien Nature Reserve supports six of the nine restricted-range bird species that occur in the Annamese Lowlands EBA: Edwards's Pheasant, Annam Partridge *Arborophila merlini*, Crested Argus *Rheinardia ocellata*, White-cheeked Laughingthrush *Garrulax vassali*, Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Grey-faced Tit Babbler *Macronous kelleyi* (Le Trong Trai *et al.* 1999, Stattersfield *et al.* 1998). The table below provides a summary of the species recorded at Phong Dien and Dakrong Nature Reserves that are listed in the *IUCN Red Lists of Threatened Animals and Plants* (IUCN 1996, 1997) or the *Red Data Books of Vietnam* (Anon 1992, 1996).

Red-listed Species Recorded at Phong Dien and Dakrong Nature Reserves

Group	Total No. of Species	Total No. of Red-listed Species	No. of Species in IUCN Red Lists	No. of Species in Red Data Books of Vietnam	% of Species Red-listed
Mammals	43	23	17	17	53
Birds	171	23	16	17	13
Reptiles	38	16	6	15	42
Amphibians	19	4	0	4	21
Butterflies	213	0	0	0	0
Plants	597	16	5	14	3
Total	1,081	82	44	67	8

The species of greatest conservation importance at Phong Dien is Edwards's Pheasant. Until its rediscovery in 1996, this species was believed to be extinct in the wild. Edwards's Pheasant has a very restricted range in central Vietnam, and is only known to occur at a handful of sites. Rather little information is available about the population of Edwards's Pheasant at Phong Dien but reports from hunters suggest that this species is still relatively common at the nature reserve. Detailed information is also lacking on the status of other key species recorded at the site, such as Annam Partridge and Short-tailed Scimitar Babbler.

The mammal fauna of Phong Dien includes a large number of species of global conservation concern, including two recently described species: Saola *Pseudoryx nghetinhensis* and Giant Muntjac *Megamuntiacus vuquangensis*. Saola and Giant Muntjac are endemic to Indochina, as are two other mammals found at Phong Dien: Buff-cheeked Gibbon *Hylobates gabriellae* and Red-shanked Douc Langur *Pygathrix nemaeus nemaeus*. Recent survey results suggest that the populations of a number of large mammal species at Phong Dien are small in size and scattered, presumably due to the effects of hunting and disturbance (Le Trong Trai *et al.* 1999).

Historically, the forest at Phong Dien has been threatened by a number of factors. The direct impact of war was dramatic. However, while the indirect legacy of war continues to exert an influence on habitats and wildlife, other threats are now more significant. Hunting levels are now probably lower than in the post-war years, due to lower animal abundance and lower availability of weapons. However, it is possible that hunting patterns have now changed in response to lower animal numbers, with the use of snares now more common than in previous years. Forest fires continue to exert an important and widespread influence on forest cover but clearance of forest for swidden agriculture is now less common.

Different threats have distinctly different impacts on habitats and wildlife. For example, it seems likely that the most direct threat to the wildlife of Phong Dien is hunting, as this has a disproportionate impact on the species of highest conservation concern, notably pheasants and large mammals. Nearly half the mammals known to occur at Phong Dien are listed in the 1996 IUCN Red List of Threatened Animals (IUCN 1996), and these are usually the species most vulnerable to hunting. In the case of large carnivores, such as Tiger *Panthera tigris* and Clouded Leopard *Pardofelis nebulosa*, heavy hunting pressure on prey species may have contributed significantly to their low population densities at Phong Dien today. Alongside hunting, collection of timber and non-timber forest products (NTFPs) may well represent the most substantive threat to the remaining forest. Further research will be required to understand better whether these practices are being undertaken at sustainable or non-sustainable levels, and to explore ways of addressing these issues effectively.

In summary, the main threats to biodiversity at Phong Dien Nature Reserve are hunting (particularly through use of snares); collection of firewood and other NTFPs (although sustainable levels require assessment); illegal timber cutting (either for house construction or by loggers from outside the area); forest fires (caused by swidden cultivation, deliberate setting of fires to collect metal from bomb and shell casings, and spontaneous detonation of unexploded ordnance); and clearance of forest land for agriculture.

The forest at Phong Dien Nature Reserve may play an important role in protecting downstream water supplies and reducing flooding in the lowlands of Thua Thien Hue province. Poor management of the forest at Phong Dien is likely to have negative impacts on downstream communities, in the form of more severe and more sudden floods, and shortages of water for drinking, irrigation and other uses. These impacts are very likely to be significant in economic terms.

Unfortunately, the low density of large mammals, combined with a lack of prominent landscape features, limits the potential of Phong Dien Nature Reserve for ecotourism. The nearest area of interest for tourism is Hue city, and some residual tourism could be expected to reach the nature reserve from there. With a creative approach to marketing, it may be possible to develop niche aspects of tourism at Phong Dien, especially if combined with visits to other sites in the area. For example, Tam Giang lagoon, Cau Hai lagoon, Bach Ma National Park and the A Luoi valley, as well as sites of historical and cultural interest in Hue city itself.

This investment plan proposes the establishment of a 41,548 ha nature reserve at Phong Dien. This nature reserve will be contiguous with the recently established Dakrong Nature Reserve in Quang Tri province. Taken together, these two sites will form an 82,074 ha block of contiguous conservation coverage in the lowlands of central Vietnam.

Following the official guidelines for feasibility studies and investment plans, this investment plan proposes that management activities for the nature reserve should be grouped into five programmes, with a sixth programme area focussing on socio-economic development in the buffer zone.

Tóm tắt

Dự án đề xuất tu bổ Khu bảo tồn thiên nhiên Phong Điền là một phần thành quả của dự án hợp tác giữa Tổ chức BirdLife Quốc tế và Viện Nghiên cứu Quy hoạch Rừng trong khuôn khổ dự án “Mở rộng hệ thống các khu rừng đặc dụng Việt Nam cho thế kỷ 21” do Liên minh Châu Âu tài trợ. Dự án đề xuất tu bổ và xây dựng trên cơ sở các thông tin về đa dạng sinh học trong dự án nghiên cứu khả thi thành lập khu bảo tồn thiên nhiên Phong Điền và Đakrông năm 1999 và các đợt khảo sát bổ sung để xác định ranh giới và nghiên cứu, đánh giá nông thôn và o tháng 1/2000.

Trước đây và hiện nay rừng trong khu vực nghiên cứu đề xuất thành lập khu bảo tồn là rừng sản xuất và phòng hộ do ngành lâm nghiệp tỉnh Thừa Thiên Huế quản lý. Năm 1998, với sự kiện phát hiện lại loài Gà lôi lam mà o trắng - loài đặc hữu của Việt Nam tại khu vực. Khu vực đã lôi cuốn sự quan tâm của Năm 1998, do tái phát hiện loài Gà lôi lam mà o trắng *Lophura edwardsi* tại đây, Phong Điền đã được liệt kê trong "danh lục 2010" là một khu bảo tồn thiên nhiên với diện tích 33.900 ha (FPD 1998). Trong tháng Sáu và Bảy năm 1998, Chương trình BirdLife Quốc tế tại Việt Nam và FIPI đã tiến hành đề xuất thực địa để đánh giá tiềm năng của việc nâng cấp Phong Điền và vùng Rừng Phòng hộ Đakrông thành Quảng Trị thành rừng đặc dụng. Nghiên cứu khả thi đã đề xuất cả thành lập một khu bảo tồn có diện tích 34.406 ha tại Phong Điền (Lê Trọng Trãi *et al.* 1999).

Tháng Một năm 2000, sau khi nội dung nghiên cứu khả thi đã được UBND tỉnh Thừa Thiên Huế thông qua, BirdLife và FIPI đã hợp tác chặt chẽ với Chi cục Kiểm Lâm tỉnh Thừa Thiên Huế cùng xây dựng dự án đề xuất thành lập Khu Bảo tồn Thiên nhiên Phong Điền. Dự thảo dự án đề xuất thành lập một khu bảo tồn thiên nhiên có diện tích 41.548 ha ở hai huyện Phong Điền và A Lưới.

Địa hình đặc trưng của Khu bảo tồn thiên nhiên Phong Điền là một dãy núi thấp, là phần kéo dài về phía đông nam của dãy Trường Sơn, dãy núi này cũng chính là ranh giới giữa hai tỉnh Quảng Trị và Thừa Thiên Huế. Các đỉnh cao nhất trong khu đề xuất bảo tồn thiên nhiên là đỉnh Coc Ton Bhai (1.408m), Ca Cut (1.405m), Ko Va La Dut (1.409m), Coc Men (1.298m) và Co Pung (1.615m). Hệ thống thủy văn của khu đề xuất bảo tồn thiên nhiên bao gồm 3 con sông chính là Mỹ Chánh, Ô Lâu và sông Bồ.

Khu bảo tồn thiên nhiên Phong Điền cùng với Khu bảo tồn thiên nhiên Đakrông ngay cạnh đó là nơi có diện tích rừng thường xanh trên đất thấp còn lại rộng nhất trong Vùng Chim Đặc hữu Vùng đất thấp Trung Bộ (Lê Trọng Trãi *et al.* 1999). Những vùng đất thấp là những nơi mà rừng bị phá hủy nặng nề nhất trong cả nước, và rừng thường xanh trên đất thấp có lẽ là kiểu rừng bị đe dọa nghiêm trọng nhất ở Việt Nam.

Đến nay, các nghiên cứu về khu hệ động vật nhận tại khu bảo tồn thiên nhiên Phong Điền và Đakrông: 597 loài thực vật bậc cao có mạch, 43 loài thú, 171 loài chim, 57 loài bò sát ếch nhái và 213 loài bướm. Có 82 loài có trong sách đỏ của IUCN và sách đỏ Việt Nam, trong đó 44 loài trong sách đỏ của IUCN và 67 loài trong sách đỏ Việt Nam.

Khu bảo tồn thiên nhiên Phong Điền là nơi cư trú của 6 trong 8 loài chim có vùng phân bố hẹp của Vùng Chim Đặc hữu Vùng đất thấp Trung Bộ, đó là Gà lôi lam mà o trắng, Gà so Trung Bộ *Arborophila merlini*, Trĩ sao *Rheinardia ocellata*, Khu mỏ đầu xám *Garrulax vassali*, Khu mỏ dài *Jabouilleia danjoui* và Chích chạch má xám *Macronous kelleyi* (Lê Trọng Trãi *et al.* 1999, Stattersfield *et al.* 1998).

Tầm quan trọng bảo tồn cao nhất ở Phong Điền là Gà lôi lam mà o trắng. Trước khi phát hiện lại năm 1996, loài này đã bị coi là tuyệt chủng ngoài thiên nhiên. Gà lôi lam mà o trắng là một loài phân bố rất hẹp ở miền Trung Việt Nam và mới chỉ được ghi nhận ở một số rất ít vùng. Tuy thông tin về quần thể của Gà lôi lam mà o trắng tại Phong Điền còn rất ít, nhưng theo thực địa phương thì loài này còn tương đối phổ biến trong khu bảo tồn thiên nhiên. Thông tin chi tiết về một số loài quan trọng khác đã được ghi nhận trong vùng cũng chưa đầy đủ, ví dụ như đối với Gà so Trung Bộ và Khu mỏ dài, chỉ có đề xuất của BirdLife/FIPI năm 1998 đã khẳng định đề xuất Trĩ sao còn tương đối phổ biến. Trong tháng Một năm 2000, một cá thể Gà lôi lam mà o đen đã bắt được ở vùng rừng già trong Khu bảo tồn thiên nhiên Phong Điền. Vì những lý do đó, Khu bảo tồn thiên nhiên Phong Điền là một điểm quan trọng cho công tác bảo tồn đa dạng sinh học các loài chim ở Vùng Chim Đặc hữu Vùng đất thấp Trung Bộ.

Khu hệ thú ở Phong Điền hiện vẫn còn một số loài thú lớn có tầm quan trọng bảo tồn, trong số đó có hai loài mới được phát hiện trong thời gian gần đây là Sao La *Pseudoryx nghetinhensis* và Mang lớn *Megamuntiacus vuquangensis*. Sao La là các loài đặc hữu Đông Dương cũng như hai loài khác được phát

hiện tại Phong Điền là Vườn đ en máhung *Hylobates gabriellae* và Voọc váchâ n nâ u *Pygathrix nemaeus nemaeus*. Những kết quả đ iều tra gần đ â y cho thấy quâ n thể của các loài thú lớn ở Phong Điền u đ ã rất nhỏ và phâ n bố rải rác, có thể do hậu quả của săn bắ n và các nhiê u loạn khác (Lê Trọng Trá i *et al.* 1999).

Trướ c đ â y, rừng ở Phong Điền bị đ e dọa a bởi rất nhiê u các nhâ n tố khác nhau. Những ảnh hưởng của chiế n tranh đ ối vớ i vùng rất nặng nề , và trong khi hậu quả của chiế n tranh vẫn tiế p tục ảnh hưởng lên các sinh cảnh và các loài i đ ộng vật hoang dã thì những mối đ e dọa a mới đ ã xuất hiệ n. Mức đ ộ săn bắ t có vể ã giảm đ i nhiê u so vớ i thời gian mới hòa bì nh do đ ộ phong phú của các loài i đ ộng vật đ ã u đ ã giảm và số lượng vũ khí tồn lại trong dân cũ ng giảm đ i nhiê u. Tuy vậy, hì nh thức săn bắ n hiệ n nay có vể ã thay đ ổi đ ể đ áp ứng vớ i số lượng đ ộng vật thấp hơn thể hiệ n trong việ c sử dụng bắ y đ ã trở nên thông dụng hơn nhiê u so vớ i những năm trướ c. Cháy rừng cũ ng gâ y ảnh hưởng nghiêm trọng đ ối vớ i đ ộ che phủ rừng trong khi việ c đ ốt rừng làm nương rẫy đ ã không còn phổ biế n như trướ c.

Đe dọa a trực tiế p và ảnh hưởng mạnh đ ể n các loài i đ ộng vật hoang dã ở Phong Điền là săn bắ n, đ ã c biệ t đ ối vớ i Gà lôi mà o trắng, Trĩ sao và các loài thú lớn. Gâ n một nửa số lượng các loài thú đ ã ghi nhận tại Phong Điền n có liệt kê trong Sách Đỏ của IUCN về các loài i Đ ộng vật bị Đ e dọa a, và có một số loài i đ ã c biệ t đễ bị đ e dọa bởi hoạt đ ộng săn bắ n. Đ ối vớ i những loài thú ăn thịt lớn, như Hổ *Panthera tigris* và Báo gấm *Pardofelis nebulosa*, việ c săn bắ n quá mức các con mồi hiệ n nay có thể dẫn đ ể n mật đ ộ quâ n thể của chú ng giảm đ i ở Phong Điền n. Cũ ng vớ i săn bắ n, khai thác gỗ và lâm sản phi gỗ là mối đ e dọa a lớn nhất hiệ n nay đ ối vớ i các vùng rừng còn lại.

Nhì n chung, những mối đ e dọa a chí nh đ ối vớ i nh đ a dạng sinh họ c ở Khu đ ã xuất bảo tồn thiên nhiên Phong Điền là săn bắ n (đ ã c biệ t là sử dụng bắ y); khai thác củ i và các lâm sản phi gỗ; khai thác gỗ trái phép; cháy rừng (do canh tác nương rẫy, đ ốt rừng đ ể tìm các mảnh bom và vỏ đ ạn pháo, những vật liệ u sau chiế n tranh tự phát nổ); và đ ốt rừng canh tác nông nghiê p.

Rừng ở Phong Điền n đ ó ng một vai trò rất quan trọng trong việ c bảo vệ nước đ ã u nguồn và hạn chế lũ lụt ở các vùng đ ất thấp của tỉ nh Thừa Thiên Huế . Nế u không quản lý tốt rừng ở Phong Điền n sẽ dẫn đ ể n những tác đ ộng có hại đ ể n cuộc sống của các cộng đ ồng ở vùng hạ lưu như lũ lụt trở nên bất ngờ và nghiêm trọng hơn, không đ ù nước cho sinh hoạt, tưới tiêu và các hoạt đ ộng khác.

Thà nh lập khu bảo tồn thiên nhiên Phong Điền n vớ i diệ n tí ch 41.548 hecta, cũ ng vớ i khu bảo tồn thiên nhiên Đ akrông vừ a mới thà nh lập, tổ ng diệ n tí ch của hai khu bảo tồn liên tiế p là 82.074 hecta. Đ â y có thể là nơi có diệ n tí ch rừng thường xanh trên đ ịa hì nh thấp lớn nhất đ ã đ ược bảo vệ ở Việ t Nam.

Dự án đ ã u tư khu bảo tồn thiên nhiên Phong Điền n đ ã xâ y dựng 5 chương trì nh câ n phải đ ã u tư cho khu bảo tồn và đ ã xuất một chương trì nh phát triể n kinh tế xã hộ i vùng đ ệ m. Các chương trì nh trên bao gồm: chương trì nh quản lý bảo vệ (xâ y dựng hạ tầ ng cơ sở và công tác bảo vệ /bảo tồn); chương trì nh phục hồi hệ sinh thấ i rừng; chương trì nh giám sát và nghiê n cứu; chương trì nh giáo dục môi trường; chương trì nh phát triể n du lịch.

1. Introduction

1.1 Location, Description and Objectives

Phong Dien Nature Reserve is located within Thua Thien Hue province, and is contiguous with the recently established Dakrong Nature Reserve in Quang Tri province. The nature reserve is located approximately 40 km north-west of Hue city and 50 km south-east of Dong Ha town. The nature reserve includes parts of Phong My, Phong Xuan and Phong Son communes, Phong Dien district, and Hong Kim commune, A Luoi district.

Phong Dien Nature Reserve lies approximately 18 km west of National Highway 1, within the catchments of the Chanh, O Lau and Bo rivers. The nature reserve borders Ha Lang district to the north, Dakrong district to the west and A Luoi district to the south. The nature reserve extends from 16°18' to 16°35'N, and from 107°03' to 107°20'E.

This investment plan assesses the costs and benefits of establishing a nature reserve to conserve forest resources in Phong Dien and A Luoi districts, Thua Thien Hue province. Approval of the investment plan will require a change in the status of the site from Watershed Protection Forest (WPF) to Special-use Forest. The investment plan also makes detailed boundary recommendations for the nature reserve and buffer zone, and outlines costs for staffing and the establishment of basic nature reserve management infrastructure.

1.2 Legal and Scientific Justification

The Ministry of Agriculture and Rural Development (MARD) has proposed to the government of Vietnam that Phong Dien be upgraded to Special-use Forest status. Phong Dien Nature Reserve lies within the Annamese Lowlands Endemic Bird Area (EBA), one of four EBAs in Vietnam. EBAs are recognised centres of bird endemism, which, is believed to be a good indicator of overall biodiversity (ICBP 1992, Stattersfield *et al.* 1998). Added protection for this area is also supported by the findings of a recent review of Vietnam's protected area system, which found that evergreen forest in the 300 to 700 m altitude range is under-represented (Wege *et al.* 1999).

The legal and regulatory basis for the designation of Phong Dien Nature Reserve is defined by the following official documents:

- Official Letter No. 547/BNN-KH of MARD, dated 4 May 1999: approval of the feasibility study for Phong Dien and Dakrong Nature Reserves; guidelines for management of these sites as Special-use Forests, and instruction to prepare investment plans for these sites as soon as possible.
- Official Letter No. 572/TT-UB of Thua Thien Hue Provincial People's Committee, dated 27 March 1999: approval of the feasibility study for the establishment of Phong Dien Nature Reserve.
- Vietnam's Forest Strategy, approved under Section 9 of the ninth National Assembly in March 1997: commitment to increase the area of Special-use Forests to 2 million ha by the year 2010.
- Decision No. 08/QD-TTg of the Prime Minister on the management of Special-Use Forest, protection forest and production forest, dated 11 January 2001.
- Management regulations for production forests, protection forests and Special-use Forests: attached to Decision No. 1171/QD of the Minister of Forestry, dated 30 December 1986.
- Official Letter No. 1586 of the Ministry of Forestry, dated 13 July 1993: planning guidelines for buffer zones of national parks and nature reserves.
- Decision No. 62/LN-KL of the Ministry of Forestry, dated 3 February 1990: regulation of principles and procedures for the establishment of Special-use Forests.

- Decision No. 202/TTg of Prime Minister, dated 2 May 1994: definition of policies and legislation regarding the protection, regeneration and growing of forest.
- Ministry of Forestry Guidelines No. 09/KH, dated 13 September 1994: guidelines for investment of capital in the forestry sector.

Edwards's Pheasant *Lophura edwardsi* was described by Oustalet in 1896, from four skins sent to the Paris Natural History Museum, by a French missionary named Reverend Father Renauld (Eve 1997). The French ornithologist Delacour organised seven expeditions to French Indochina between 1923 and 1939, including trips to Quang Tri and Thua Thien Hue provinces, during which at least 64 specimens of the newly described Edwards's Pheasant were collected (Eve 1997). In 1925, Delacour officially requested that the colonial administration establish a 50,000 ha national park solely for the protection of Edwards's Pheasant (de Clermont *et al.* 1925 cited in Eve 1997).

Prior to 1993, the contiguous forest areas in western Phong Dien and eastern Dakrong districts were classified as Production Forest, and, as such, were the site of logging enterprises administered by the provincial departments of forestry. The value of preserving these areas as water catchments was recognised, and a proposal was submitted to the government for upgrading them to WPF status in 1992. The two provincial governments managed, despite limited funds, to upgrade these two areas to WPF status in 1993.

In the late 1980s and 1990s, lowland forests in central Vietnam were a focus of biodiversity surveys, because they were believed to support little-known and endemic species. Specialists from several Vietnamese institutions and BirdLife International conducted surveys for restricted-range bird species in 1988, 1991 and 1992 (Eames *et al.* 1989, 1992, 1994, Lambert *et al.* 1994). However, it was not until 1996 that the continued survival of Edwards's Pheasant was confirmed (Box 1). Subsequent surveys were then undertaken by BirdLife International and the Forest Inventory and Planning Institute (FIPI) in June and July 1998, as part of the feasibility study for Phong Dien and Dakrong Nature Reserves (Le Trong Trai *et al.* 1999). Lowland forests in central Vietnam are also known to be significant for endemic mammals, particularly Saola *Pseudoryx nghetinhensis*, which was discovered in 1992 (Vu Van Dung *et al.* 1993), and Giant Muntjac *Megamuntiacus vuquangensis*, which was discovered in 1993 (Do Tuoc *et al.* 1994). Both discoveries represent previously undescribed genera, and it is possible that both species still occur at Phong Dien Nature Reserve.

Box 1: The Rediscovery of Edwards's Pheasant

Initially described by Oustalet in 1896, Edwards's Pheasant had not been recorded since 1929 (Eve 1997). Field surveys in 1988, 1991, 1992 and 1994 failed to find Edwards's Pheasant, and concluded that all the historical collecting sites for the species had been deforested (Eames *et al.* 1992).

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

The rediscovery of Edwards's Pheasant, 67 years after its last documented sighting, increased the conservation importance of forest areas in Phong Dien and Dakrong district significantly, and provided the impetus for Special-use Forest establishment. Edwards's Pheasant is one of three *Lophura* pheasant species endemic to the Annamese Lowlands EBA. Phong Dien and Dakrong Nature Reserves are two of the most important sites for the conservation of this species.

1.3 External Context

Other Protected Area Initiatives in Central Vietnam

Within Nghe An, Ha Tinh, Quang Binh, Quang Tri and Thua Thien Hue provinces, there are eight protected areas for which investment plans have been prepared: Pu Mat, Pu Huong, Pu Hoat, Vu Quang, Ke Go, Phong Nha and Dakrong Nature Reserves, and Bach Ma National Park. In addition a feasibility study for the establishment of a nature reserve at Khe Net has been prepared (Map 1).

Phong Dien Nature Reserve is contiguous with the recently established Dakrong Nature Reserve in Quang Tri province. This represents the most significant ecological linkage. Taken together, these two sites will form an 82,074 ha block of contiguous conservation coverage, the largest such unit in the lowlands of central Vietnam.

Efforts are also underway to protect a 'Green Corridor' of natural forest from the Hai Van pass, on the coast of Vietnam, to Xe Sap National Biodiversity Conservation Area, in Laos. This proposal, which adopts a landscape management approach, will include activities aimed at the gazettement of new protected areas and the rehabilitation of forest cover in key fragments throughout the 'Green Corridor'. Funding from the Global Environment Facility (GEF) is being sought for this project.

Highway Development

The government of Vietnam is currently upgrading stretches of the existing National Highway 14, as part of a project to establish National Highway 2, a second north-south arterial highway. National Highway 14 runs through the A Luoi valley, to the west and south of Phong Dien Nature Reserve. As this road does not pass through the nature reserve, and as there is already a considerable amount of human settlement along its route, it seems unlikely that this development will have significant direct or indirect impacts on the forest resources of Phong Dien Nature Reserve.

Related Development Projects

On-going and planned rural development projects for districts and communes adjacent to the nature reserve boundary are outlined in Table 1. This table also highlights projects of thematic relevance to natural resource management at Phong Dien Nature Reserve. These initiatives may offer important opportunities to support the management of the nature reserve through:

- buffer zone development;
- institutional strengthening and capacity building of forestry and planning staff; and
- integration of biodiversity into provincial and district land-use and natural resource planning.

There are a number of environmental management and conservation projects of potential existing or future relevance to Phong Dien Nature Reserve. These include:

- (a) **The Green Corridor Project.** This ambitious, proposed project aims, among other objectives, to design a natural resource management mosaic for a forest corridor linking the Annamite mountains with the coast of central Vietnam. It will also seek to strengthen the capacity of relevant provincial and district government agencies (notably the forest protection department (FPD) and the land administration or cadastral department) in participatory land-use planning, in order to improve the implementation of the national 661 Programme (5 million hectares reforestation programme) for reforestation, forest protection, and land allocation. The project will also seek to develop an umbrella programme to bring existing protected areas and surrounding forest areas under coordinated forest management.
- (b) **Tiger Conservation Project.** WWF is currently implementing a Tiger conservation project in Thua Thien-Hue, Quang Nam and Kon Tum provinces. This project, which builds on a previous project implemented by Thua Thien Hue Provincial FPD, includes conservation awareness activities, as well as capacity building and Tiger surveys. The project area includes Quang Nam and Kon Tum provinces, as well as Bach Ma National Park (Thua Thien-Hue province) and Mom Ray Nature Reserve (Kon Tum province). WWF also plans to support Thua Thien Hue Provincial FPD to undertake surveys of Saola and pheasants at Phong Dien Nature Reserve.

Table 1: On-going and Planned ODA-funded Rural Development Projects in Districts Adjacent to Phong Dien and Dakrong Nature Reserves

Project Title	Date	Objectives	Target Districts, Communes and/or Institutions	Commitment (US\$)	Donor
On-going Projects					
Thua Thien Hue Rural Development Programme	1999-2003	Improved living standards for poor people living in Thua Thien Hue province	Phong Dien district (all communes)	4,100,000	FINNIDA
Quang Tri Rural Development Programme	1997-2000	Improved living standards for poor people living in Quang Tri province	Hai Lang district (along the northern border of Dakrong Nature Reserve)	5,800,000	FINNIDA
Development programme 1997/1999, Phong Dien district	1997-1999	Commune-level development programme in Phong Dien district	Phong Dien district (Phong Son, Phong Chuong, Phong Hoa, Phong Binh communes)	167,000	ICCO
Integrated rural development projects in Thua Thien Hue province	1997-1999	Organisational development, liberation of human resource development, management of natural resources and sustainable livelihoods	Community management boards and other beneficiaries in A Luoi, Phong Dien, Nam Dong, Huong Thuy and Quang Dien districts	905,000	Norwegian Church Aid, Diakonia, DanChurch Aid
Dakrong Development Programme	1999-2000	Improved livelihoods of poor people in the poorest communes in Dakrong district, Quang Tri province, with special focus on women, ethnic minorities and the environment	Dakrong district (Ba Long and Hai Phuc communes)	277,000	Oxfam Hong Kong
A Luoi Area Development Project	1999-2001	Integrated development activities in agriculture, health, education and capacity building	A Luoi district	202,000	World Vision International
Primary health care	1996-2000	Promotion, development and strengthening of integrated service delivery capacity at district level, based on the Bamako Initiative approach, in 124 selected districts with high infant, under five and maternal mortality rates	124 districts, including Phong Dien	5,300,000 (over 124 districts)	UNICEF
Planned Projects					
Central Region Poverty Reduction Project	2001-TBA	Reduction in the level of absolute poverty in rural areas through increased incomes, access to improved small-scale infrastructure, agricultural and agro-industrial services. The project will be based on participatory processes and will include substantial capacity building for local authorities	Seven provinces, including both Quang Tri and Thua Thien Hue	40,000,000	ADB
Forestry Hue	2000-2003	Improved forest management capacity	Thua Thien Hue	500,000	Netherlands Government
Forestry Hue	2000-2003	Improved forest management capacity	Thua Thien Hue	200,000	SNV

2. Physical and Biological Description

2.1 Biogeography

Phong Dien Nature Reserve is situated within the Northern Vietnam Coastal Moist Forests, Annamite Range Moist Forests and Bolovans-Kon Tum Montane Forests Ecoregions (Wikramanayake *et al.* 1997). The biogeographical region of central Vietnam is characterised by high levels of distinctiveness and endemism (Dang Huy Huynh 1998, MacKinnon 1997, Stattersfield *et al.* 1998). In addition, the area is notable for its overlapping northern and southern faunas. Phong Dien Nature Reserve lies at the southern limit of the Annamese Lowlands Endemic Bird Area (EBA) (Stattersfield *et al.* 1998).

2.2 Topography

The topography of Phong Dien Nature Reserve is characterised by a ridge of low mountains, which extends south-east from the Annamite mountains, and forms the boundary between Quang Tri and Thua Thien Hue provinces. The highest points within Phong Dien Nature Reserve are Coc Ton Bhai (1,408 m), Ca Cut (1,405 m), Ko Va La Dut (1,409 m), Coc Men (1,298 m) and Co Pung (1,615 m).

2.3 Geology

Phong Dien Nature Reserve is situated within the Viet-Lao Caledon enfolded syncline of central Vietnam. This syncline is confined between the lines of the Ma river fault to the north and the Tam Ky-Hiep Duc fault to the south. This syncline complex developed from the Cambrian Period to the beginning of the Devonian Period.

The geology of most of the mountains is characterised by granite, which is widespread in the region. The geology of lowland areas is characterised by sedimentary rocks from the Ordovician-Silurian Age, including hyaline rock, stratified arenaceous rock, stratified sandstone and argillaceous rock.

2.4 Soil

At Phong Dien Nature Reserve, the following soils are typical:

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

2.5 Meteorology

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

Temperature. The average annual temperature at Phong Dien Nature Reserve ranges from 22-24°C. Winters are cold and humid, due to north-easterly winds. In the highlands (over 400–500 m), average

winter temperatures drop below 20°C and, during December and January, the average temperature can drop below 10°C.

In contrast, summers experience hot and dry westerly winds, and, from May to August, the average temperature is over 25°C. The hottest months of the year are usually June and July, with an average temperature of 29°C. Peak temperatures can reach 39-40°C.

Precipitation and Humidity. Phong Dien district experiences high annual rainfall, averaging 2,500–3,000 mm. Cloud formations borne by north-easterly winds are often dispersed as they cross the Annamite mountains, resulting in localised rainfall patterns. September and October have the highest rainfall and account for up to 45% of the total annual rainfall. The dry season usually begins in February and ends in July.

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

Meteorological data from four weather stations in the region are indicative of the prevailing meteorological conditions within the nature reserve (Table 2). Of particular relevance are the data from the Khe Sanh and A Luoi weather stations, which are closest to the nature reserve.

Table 2: Central Vietnam Meteorological Data

Meteorological Data	Weather Station			
	Khe Sanh	A Luoi	Quang Tri	Hue
Total annual rainfall (mm)	2,262	3,018	2,564	2,868
Highest average monthly rainfall (mm) and month of occurrence	470 September	732 October	621 October	796 October
Lowest average monthly rainfall (mm) and month of occurrence	17 February	16 February	66 April	47 March
Annual no. of rainy days	161	212	151	158
Annual mean temperature (°C)	22.4	21.5	25.0	25.2
Annual no. of sunny hours	-	1,736	1,886	1,894
Absolute high temperature (°C) and month of occurrence	38.2 July	38.1 July	42.0 July	41.3 July
Absolute low temperature (°C) and month of occurrence	7.7 December	4.0 December	9.8 January	8.8 January
Annual humidity (% RH)	87	86	85	84

Source: Phong Dien and A Luoi district statistics offices

2.6 Hydrology

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

The principal river systems in this area are the:

- (a) **O Lau and My Chanh River Systems.** Located to the south and south-east of Phong Dien and Dakrong Nature Reserves. These two short river catchment basins originate within Phong Dien and Dakrong Nature Reserves.
- (b) **Bo River Basin.** This tertiary watercourse is located in the south-east of Phong Dien Nature Reserve. Primary and secondary streams, many originating within the nature reserve, flow into the Bo river.

- (c) **Quang Tri and Thach Han River Basins.** Located in the north of Phong Dien and Dakrong Nature Reserves, the Quang Tri and Thach Han rivers are tertiary waterways, which receive western mountain catchments of the Annamite mountains.
- (d) **Dakrong River System.** Located along the western boundary of Dakrong Nature Reserve, the Dakrong river receives several smaller catchments originating in the nature reserve.

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

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

2.7 Habitat Types and Condition

Although the forest types at Phong Dien Nature Reserve were originally classified according to forestry criteria, such as standing timber volume, this classification can also be used to indicate forest succession stages: the categories of 'rich', 'medium' and 'poor' forest can be interpreted as primary, mature secondary and immature secondary forest respectively. Interpreting the forest classification in this way is justified on the grounds that the species composition among these forest types is highly similar. However, a discrepancy exists in that primary forest stunted by microclimates, poor soil percolation, hydrology or nutrient depauperate soils is included as immature secondary forest under this classification.

Forest cover has been considerably reduced, degraded and fragmented throughout most of the nature reserve by a combination of logging, shifting cultivation, over-exploitation of non-timber forest products, and wartime spraying of defoliants. However, not only are the remaining fragments of primary forest relatively large (Table 3) but they are also contiguous with patches of mature secondary forest.

Formerly, the nature reserve would have been covered throughout by closed, evergreen forest. Elevations below 700 m would have supported lowland evergreen forest, while those above 700 m would have supported lower montane evergreen forest. Map 2 shows land-use in and around Phong Dien Nature Reserve.

Table 3: Land-use at Phong Dien Nature Reserve

Vegetation Type	Area (ha)	%
Rich evergreen forest	8,114	19
Medium evergreen forest	2,928	7
Poor evergreen forest	11,940	29
Regenerating forest	6,050	15
Scrub with scattered trees	9,004	22
Scrub and grassland	3,512	8
Total	41,548	100

Primary and Mature Secondary Forest (Rich and Medium Forest)

These forest types are distributed mainly along the border between Thua Thien Hue and Quang Tri provinces, and within the south and south-west of the nature reserve. Disturbance is minimal, and the forest structure is dense and largely intact, with a very species-rich floral composition. These forest types are generally stratified into five layers:

- (a) **Emergent Layer.** This layer is comprised of emergent tree species, >30 m in height, including *Dracontomelum duperreanum*, *Tetrameles nudiflora*, *Aglaia gigantea* and *Dacrydium elatum*.
- (b) **Canopy Layer.** This is a complex and continuous forest layer, between 20 and 30 m in height, with high species diversity. The most common species present belong to the Fagaceae, including *Castanopsis* spp., *Lithocarpus* spp. and *Quercus* spp. Other species present include *Cinnamomum* spp., *Michelia mediocris*, *Rhodoleia championii*, *Calophyllum* spp., *Dacryodes dungii*, *Polyalthia nemoralis*, *Erythrophleum fordii*, *Sindora tonkinensis*, *S. siamensis*, *Madhuca pasquieri* and *Heritiera cochinchinensis*.

- (c) **Middle Layer.** This layer is patchy, and dominated by shade-loving plants in the Myrtaceae, Euphorbiaceae, Annonaceae, Ulmaceae, Myristicaceae, Elaeocarpaceae, Ebenaceae, Lauraceae, Rubiaceae, Lecythidaceae, Myrsinaceae and Arecaceae. Immature specimens of tree species common in the canopy layer are well represented in this layer, as is the palm, *Licuala bracteata*.
- (d) **Shrub Layer.** This layer consists mainly of species in the Myrsinaceae and immature specimens of species represented in the canopy and middle layers.
- (e) **Ground Layer.** This layer is sparse, and comprised predominantly of grasses and ferns, as well as some members of the Acanthaceae.

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

- Mean tree height: 15 m
- Mean tree dbh: 24 cm
- Mature tree density: 620 trees/ha
- Total basal area: 28-30 m²/ha
- Timber volume: 210-225 m³/ha
- Canopy cover: 50-70%

Immature Secondary Forest (Poor Forest)

This forest type is distributed in easily accessible and exploitable areas, such as along rivers and streams, and close to National Highway 1. This forest type has been seriously degraded, and the forest canopy is open. Canopy cover is only about 10-40% and there is no clear stratification into forest layers.

Tree species of high economic value, such as *Erythrophleum* spp., *Sindora siamensis*, *S. tonkinensis*, *Madhuca pasquieri*, *Heritiera cochinchinensis* and *Nageia wallichiana* are rare. Even trees with low economic value, such as *Polyalthia nemoralis* and *Calophyllum* spp., have been heavily exploited. Typical tree species remaining are *Dacryodes dungii*, *Gironniera subaequalis*, *Sindora circumcissimum* and other fast-growing pioneer species.

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

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

- Mean tree height: 13.7 m
- Mean tree dbh: 26.1 cm
- Mature tree density: 300 trees/ha
- Total basal area: 16 m²/ha
- Timber volume: 107 m³/ha
- Canopy cover: 10-40%

Regenerating Forest

There are two sub-types of regenerating forest at Phong Dien Nature Reserve:

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

Data from regenerating forest plots (40 x 40 m) show:

- Mean tree height: 9.5 m
- Mean tree dbh: 11.3 cm
- Mature tree density: 1,060 trees/ha
- Total basal area: 16.1 m²
- Timber volume: 74.9 m³/ha
- Canopy cover: 60%

Scrub with Scattered Trees

This vegetation type includes remnant forest patches and individual trees growing in grasslands. Some of these areas could potentially revert to regenerating forest (as the soil profile is still intact) and are probably important for seed dispersal, as well as acting as transitional areas or ecotones, particularly for certain bird and mammal species.

Scrub

Scrub is distributed mostly upon flat floodplains contiguous with rivers and streams, although it also occurs on hillsides. Some of the associated plant species are desiccation-resistant acidophiles growing on extremely poor soils, such as *Melastoma* spp. and *Rhodomyrtus tomentosa*. These thickets are dense, creating good shade-cover at a height of about 1 m. Any forest regeneration and succession from this vegetation type is unlikely.

Grassland

Most of the grassland at the nature reserve was created as a result of either shifting cultivation or wartime spraying of defoliants. Succession is inhibited by cattle-grazing and fires in the dry season. This vegetation type is dominated by tall, coarse grass species, such as *Imperata cylindrica*, *Saccharum arundinaceum*, *S. spontaneum* and *Thysanolaema maxima*. In some areas, growth is very dense, with grasses reaching as high as 2 m.

2.8 Flora and Plant Resources

The flora of Phong Dien and Dakrong Nature Reserves exhibits both high species richness and significant importance as a potential genetic, medicinal and ornamental resource. Field surveys of Phong Dien and Dakrong Nature Reserves have revealed 597 plant species, within 366 genera and 118 families (Table 4). Out of these 597 species, there are 175 timber species, 159 known medicinal species and 41 common ornamental species (Appendix 1).

Table 4. Plants Recorded at Phong Dien and Dakrong Nature Reserves

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

Source: Le Trong Trai *et al.* (1999).

Of the 597 species recorded, 14 species are listed in the *Red Data Book of Vietnam* (Anon. 1996) and five species are listed in the *1997 IUCN Red List of Threatened Plants* (IUCN 1997) (Table 5).

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

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

The tree flora of Phong Dien and Dakrong Nature Reserves is dominated by members of the following families: Guttiferae, Annonaceae, Euphorbiaceae, Caesalpiniaceae, Sapotaceae, Myrtaceae, Fagaceae, Lauraceae, Anacardiaceae, Sapindaceae and Moraceae.

The high floral diversity of lowland forests in central Vietnam is largely attributable to their position at the meeting point of four distinct floral regions. The flora of Phong Dien and Dakrong Nature Reserves contains elements of the subtropical/temperate Chinese flora, the Indo-Pacific or Sundaic flora, the Himalayan foothills flora and the Indomalayan/Indo-Burmese floral complex.

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

Other components of the subtropical/temperate Chinese flora include the members of the Fagaceae and Lauraceae, whereas members of the Pinophyta and Lycopodiophyta are characteristic of the Himalayan foothills flora. The Indomalayan/Indo-Burmese floral complex is represented by members of the Combretaceae, and species in the genera *Lagerstroemia* and *Tetrameles*.

2.9 Mammals

A total of 43 mammal species, in seven orders and 20 families, have been recorded to date at Phong Dien and Dakrong Nature Reserves (Appendix 2). Of the 43 mammal species currently known, 23 are listed in the 1996 IUCN Red List of Threatened Animals (IUCN 1996) or the Red Data Book of Vietnam (Anon. 1992) (Table 6). This figure represents 53% of the known mammal fauna of the two nature reserves.

A total of 17 mammal species are listed in the 1996 IUCN Red List of Threatened Animals, including three endangered and eight vulnerable species. A total of 17 species are listed in the Red Data Book of Vietnam, comprising five endangered, nine vulnerable, one threatened and two rare species.

Phong Dien and Dakrong Nature Reserves support four mammals endemic to Indochina: Buff-cheeked Gibbon *Hylobates gabriellae*, Red-shanked Douc Langur *Pygathrix nemaeus nemaeus*, Saola and Giant Muntjac.

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

Key Mammal Records

Tiger *Panthera tigris*. Interviews with local hunters and gatherers, in both Phong Dien and Dakrong districts, have confirmed the presence of Tiger in the area. For instance, Mr Muoc of the Pa-hi ethnic group in Phong My commune, Phong Dien district reported that, in March 1998, he observed a Tiger of approximately 100 kg, 200 m from his village. He also reported that, in May 1998, a Tiger preyed upon

Table 5: Red-listed Plant Species Recorded at Phong Dien and Dakrong Nature Reserves

Species	Current Status	
	IUCN 1997	Anon. 1996
<i>Cibotium barometz</i>		R
<i>Dacrydium elatum</i>		K
<i>Nageia wallichiana</i>		V
<i>Cinnamomum parthenoxylon</i>		K
<i>Rhodoleia championii</i>		V
<i>Symplocos disepala</i>	R	
<i>Madhuca pasquieri</i>	R	K
<i>Ardisia silvestris</i>		V
<i>Aquilaria crassna</i>		E
<i>Sindora siamensis</i>		K
<i>S. tonkinensis</i>	V	V
<i>Gymnocladus angustifolius</i>	R	
<i>Chukrasia tabularis</i>		K
<i>Rauvolfia cambodiana</i>		T
<i>Dendrobium amabile</i>		R
<i>Calamus poilanei</i>	V	K

Source: Le Trong Trai *et al.* (1999).

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

one of his cows in the Moi valley (16°27'N 107°15'E). He further noted that, judging by footprints, there were two adults and one cub present. In the Ma valley, in the upstream catchment of the Bo river, some rattan *Aquilaria crassna* collectors reported seeing Tiger footprints in the area on many occasions. In July 1998, forestry officials in Phong My commune, Phong Dien district seized a Tiger cub (37 kg) from local hunters in the upper O Lau river valley. Various other reports have been collected from people in Ba Long, Trieu Nguyen and Ta Long communes of Tiger footprints, and of buffaloes and cows being killed by Tigers.

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

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

Giant Muntjac *Megamuntiacus vuquangensis*. Giant Muntjac was identified during the 1998 survey from frontlets. Information from hunters suggests that the species is quite common locally, and commonest in Ba Long, Hai Phuc, Trieu Nguyen and Dakrong communes, Dakrong district. However, Giant Muntjac sightings have also been reported from around Khe Ma and Khe Moi village, Phong My commune, Phong Dien district. Other Giant Muntjac sightings have been reported from Khe Lau, Dong Nom, Dong Che and Dakrong communes, Dakrong district.

Table 6: Red-listed Mammal Species Recorded at Phong Dien and Dakrong Nature Reserves

Species	Scientific Name	Current Status	
		IUCN 1996	Anon. 1992
1. Chinese Pangolin	<i>Manis pentadactyla</i>	NT	V
2. Sunda Pangolin	<i>M. javanica</i>	NT	
3. Slow Loris	<i>Nycticebus coucang</i>		V
4. Pig-tailed Macaque	<i>Macaca nemestrina</i>	VU	V
5. Rhesus Macaque	<i>M. mulatta</i>	NT	
6. Bear Macaque	<i>M. arctoides</i>	VU	V
7. Red-shanked Douc Langur	<i>Pygathrix nemaeus nemaeus</i>	EN	
8. Buff-cheeked Gibbon	<i>Hylobates gabriellae</i>	DD	
9. Indian Wild Dog or Dhole	<i>Cuon alpinus</i>	VU	E
10. Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	E
11. Sun Bear	<i>U. malayanus</i>	DD	E
12. Large-toothed Ferret-badger	<i>Melogale personata</i>		R
13. Eurasian Otter	<i>Lutra lutra</i>		T
14. Binturong	<i>Arctictis binturong</i>		V
15. Asian Golden Cat	<i>Catopuma temminckii</i>	NT	V
16. Clouded Leopard	<i>Pardofelis nebulosa</i>	VU	V
17. Tiger	<i>Panthera tigris</i>	EN	E
18. Lesser Malay Mouse-deer	<i>Tragulus javanicus</i>		V
19. Gaur	<i>Bos gaurus</i>	VU	E
20. Saola	<i>Pseudoryx nghetinhensis</i>	EN	
21. Southern Serow	<i>Naemorhedus sumatraensis</i>	VU	V
22. Red Giant Flying Squirrel	<i>Petaurista philippensis</i>		R
23. Malayan Porcupine	<i>Hystrix brachyura</i>	VU	

Follows Corbet and Hill (1992).

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

2.10 Birds

A total of 171 bird species in 13 orders and 35 families have been recorded at Phong Dien and Dakrong Nature Reserves to date (Appendix 3). Of these species, 16 are considered globally threatened or near threatened (Collar *et al.* 1994), and 17 are listed in the *Red Data Book of Vietnam* (Anon. 1992) (Table 7). In addition, villagers in Khe Tran village, Phong Dien district, report the continued occurrence of small numbers of the globally threatened Green Peafowl *Pavo muticus*, although these reports remain unconfirmed.

Six restricted-range bird species have been recorded at Phong Dien and Dakrong Nature Reserves, including two species restricted to the Annamese Lowlands EBA: Edwards's Pheasant (Box 2) and Annam Partridge *Arborophila merlini*.

Box 2: Edwards's Pheasant Records at Phong Dien and Dakrong

Phong Dien and Dakrong Nature Reserves support one of the few remaining populations of Edwards's Pheasant in the world. Field surveys in 1988, 1991 and 1992 failed to find any evidence for the continued existence of this species (Eames *et al.* 1989, 1992, Robson *et al.* 1993). In 1996, 500 colour "wanted" posters of a male Edwards's Pheasant were distributed to forest protection department staff in Thua Thien Hue and Quang Nam-Da Nang provinces (Eve 1997). Following this, incidental reports, sightings and descriptions by local hunters suggested that the area still supported a potentially viable population of Edwards's Pheasant. In 1996, the species was rediscovered in Phong My commune, Thua Thien Hue province, and Huong Hiep commune, Quang Tri province (Vo Quy 1997). In December 1997, at least four specimens were trapped in Ba Long commune, Quang Tri province.

In Phong Dien and Dakrong districts, there are recent records of Edwards's Pheasant from the following localities:

- **Khe Lau Area** (16°30'N 107°13'E). Within a forest area in Phong My commune, Phong Dien district, a female Edwards's Pheasant was trapped at an altitude of 300-400 m by local people on 26 August 1996. A male was captured on 28 August 1996 in the same area. Both birds died in captivity shortly after. These two specimens of Edwards's Pheasant are preserved at the headquarters of Bach Ma National Park.
- **Kreng Village** (16°35'N 107°05'E). In Huong Hiep commune, Dakrong district, a pair of Edwards's Pheasants was trapped by local people on 31 December 1996. The female died shortly thereafter and the male is now held in Hanoi Zoo.
- **Ba Long Valley** (16°35'N 107°02'E). In December 1997, in Ba Long commune, Dakrong district, four Edwards's Pheasants were trapped by local hunters at altitudes between 50 and 300 m.
- **Dong Che Area**. On the boundary between Hai Phuc and Trieu Nguyen communes, Dakrong district, sometime between the end of 1997 and the beginning of 1998, local hunters caught two Edwards's Pheasants and further reported seeing a flock of 8 to 10 individuals foraging in the same area.
- **My Chanh**. Two males and one female were trapped in the upper catchment of the My Chanh river on 11 March 2000, and a nest containing four eggs was discovered by a hunter in Hai Lang district, Quang Tri province.

A hunter from the Van Kieu ethnic group in Ha Long village and hunters living near Khe Tran village report that Edwards's Pheasant is still common in the forests of Phong Dien district.

Table 7: Restricted-range and Red-listed Bird Species Recorded at Phong Dien and Dakrong Nature Reserves

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

Follows Inskipp *et al.* (1996).

Notes: CR = Critical; EN = Endangered; VU = Vulnerable; T = Threatened; R = Rare; NT = Near Threatened as per Collar *et al.* (1994) and Anon. (1992). RRS = Restricted-range species as per Stattersfield *et al.* (1998).

Square brackets indicate that the occurrence of this species is unconfirmed.

2.11 Reptiles and Amphibians

A total of 57 species of reptile and amphibian have been recorded at Phong Dien and Dakrong Nature Reserves to date, comprising 38 species of reptile in two orders and 14 families, and 19 species of amphibian in one order and four families (Appendix 4). Of the 57 species, 20 are listed in either the 1996 IUCN Red List of Threatened Animals (IUCN 1996) or the Red Data Book of Vietnam (Anon. 1992). All six of the species listed in the 1996 IUCN Red List of Threatened Animals are reptiles (five turtles and one snake); no amphibians are listed. The 19 species of reptile and amphibian listed in the Red Data Book of Vietnam include one species listed as endangered, eight listed as threatened, eight listed as vulnerable and two listed as rare. One species of amphibian and one species of turtle are endemic to Vietnam (Table 8).

Together, Phong Dien and Dakrong Nature Reserves support 44% of the reptile and amphibian species known from central Vietnam. More comprehensive field studies would undoubtedly increase this figure. In terms of reptiles and amphibians, Phong Dien and Dakrong Nature Reserves are at least as species rich as four other protected areas in central Vietnam for which comparable data is available: Vu Quang Nature Reserve (Ha Tinh province), Phong Nha Nature Reserve (Quang Binh province), Bach Ma National Park (Thua Thien Hue province) and Ngoc Linh (Kon Tum) Nature Reserve (Kon Tum province).

Undisturbed forests have higher reptile and amphibian species richness than disturbed forest and non-forest areas: a total of 39 species were recorded in forest habitats. Lower montane evergreen forest supports relatively low species richness compared with lowland evergreen forest. A total of 27 species were recorded in anthropogenic habitats, all of which are common species with widespread distributions. Of the 19 amphibian species recorded, 13 were found in riparian habitats, in streams, or in forest areas adjacent to streams.

Table 8: Endemic and Red-Listed Reptile and Amphibian Species Recorded at Phong Dien and Dakrong Nature Reserves

Scientific Name	Endemic Species	Current Status	
		IUCN 1996	Anon. 1992
1. <i>Gekko gekko</i>			T
2. <i>Acanthosaura lepidogaster</i>			T
3. <i>Physignathus cocincinus</i>			V
4. <i>Varanus nebulosus</i>			V
5. <i>V. salvator</i>			V
6. <i>Python molurus</i>		NT	V
7. <i>Pytas korros</i>			T
8. <i>P. mucosus</i>			V
9. <i>Bungarus fasciatus</i>			T
10. <i>Naja naja</i>			T
11. <i>Ophiophagus hannah</i>			E
12. <i>Platysternum megacephalum</i>		DD	R
13. <i>Cistoclemmys galbinifrons</i>	EV	NT	V
14. <i>Cuora trifasciata</i>		EN	V
15. <i>Indotestudo elongata</i>		VU	V
16. <i>Palea steindachneri</i>		NT	
17. <i>Bufo galeatus</i>			R
18. <i>Rana andersoni</i>			T
19. <i>R. microlineata</i>	EV		T
20. <i>Rhacophorus nigropalmatus</i>			T

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

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

2.12 Fish

No information on fish diversity is available for Phong Dien Nature Reserve.

2.13 Butterflies

A brief survey of the butterfly fauna of Phong Dien and Dakrong Nature Reserves was conducted during 1998 (Le Trong Trai *et al.* 1999). Butterflies were collected in three major habitat types at the two nature reserves: forest habitats, comprising primary, mature secondary and immature secondary forest; riparian habitats, comprising gallery forest and areas along streams and rivers; and open habitats, comprising regenerating forest, isolated forest patches, grasslands and other areas. A total of 213 species from 10 families were collected at Phong Dien and Dakrong Nature Reserves, of which 143 species were collected at Phong Dien Nature Reserve (Table 9 and Appendix 5).

Table 9: Butterfly Species Recorded at Phong Dien and Dakrong Nature Reserves

Family	No. of Species	No. Common to Both Areas	No. of Species Recorded	
			Phong Dien	Dakrong
1. Papilionidae	23	14	16	21
2. Pieridae	22	13	16	19
3. Danaidae	14	6	7	13
4. Satyridae	11	5	9	7
5. Amathusiidae	8	2	7	3
6. Nymphalidae	41	25	31	34
7. Libytheidae	3	1	1	3
8. Riodinidae	5	3	5	3
9. Lycaenidae	41	9	27	19
10. Hesperidae	46	10	24	28
Total	213	88	143	150

No species new to science were recorded during the survey; although more detailed surveys would probably reveal new taxa, most likely within the Lycaenidae and Hesperidae. Seven species within three families recorded during the survey are new records for Vietnam (Table 10).

Table 10: New Butterfly Records at Phong Dien and Dakrong Nature Reserves

Species	Previously Known Distribution	Habitat Type	
		Phong Dien	Dakrong
<i>Lasippa monata</i>	Burma, Thailand and Indonesia	Forest	-
<i>Libythea geoffroy alompra</i>	Thailand and southern Burma	-	Open
<i>Bibasis sena</i>	Thailand, Sri Lanka, India, Burma, Andaman islands and Hainan island	-	Open
<i>Zographetus doxus</i>	Thailand, Burma and western Malaysia	-	Forest
<i>Isma umbrosa</i>	Thailand, western Malaysia and Sumatra	-	Forest
<i>Plastingia pellowia</i>	Thailand, southern Burma, western Malaysia, Sumatra, Borneo and Java	-	Forest
<i>Unkana ambassa</i>	Thailand, north-eastern India and Burma	-	Forest

Endemic Butterfly Species. Most of the butterfly species recorded have restricted distributions within the Indochinese peninsula and South-East Asia. Of the total of 143 species, there are 103 species (72%) with distributions confined to the Indo-Malayan realm and 17 species (12%) with distributions further restricted to Indochina and India. Five species are endemic to northern Indochina. A further 15 species have extended distributions which include the Indo-Australian tropics, and there are another 19 species whose distributions are unknown. *Stichopthalma louisa* subsp. could be an undescribed subspecies endemic to central Vietnam. Other endemic species have been collected at Bach Ma National Park and Vu Quang Nature Reserve. Preliminary checks suggest that only eight butterfly species endemic to central Vietnam have been recorded to date (Table 11).

Table 11: Tentative List of Butterflies Endemic to Central Vietnam

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

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

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

Phong Dien and Dakrong Nature Reserves also support two species in the Amathusiidae with very specific habitat requirements, *Amathixidia amythaon* and *Zeuxidia amethystus masoni*, which are only

associated with disturbed secondary forest. Both are very rare and represent new species records for central Vietnam.

Habitat Distribution. Of the 213 butterfly species collected, 152 species are forest dependent, 89 species are found in riparian areas, and 33 species are associated with open habitats. The majority of butterfly species were recorded in forest habitats. Riparian habitats, in which the next largest number of species were recorded, serve as feeding and ovipositing areas (Table 12).

Table 12: Distribution of Butterflies Species by Habitat Type at Phong Dien and Dakrong Nature Reserves

Family	Forest Habitats		Riparian Habitats		Open Habitats	
	Phong Dien	Dakrong	Phong Dien	Dakrong	Phong Dien	Dakrong
Papilionidae	8	8	12	19	5	4
Pieridae	14	13	14	16	5	6
Danaidae	4	5	4	11	3	4
Satyridae	9	7	1	1	0	2
Amathusiidae	7	3	0	0	1	1
Nymphalidae	24	24	16	18	1	2
Libytheidae	0	0	1	0	0	3
Riodinidae	5	3	1	1	1	1
Lycaenidae	21	19	6	3	0	0
Hesperiidae	19	22	7	2	0	3
Total	111	104	62	71	16	26
Total for both areas	152		89		33	

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

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

2.14 Landscape, Historical and Cultural Features

The proximity of the area to the World Heritage Site at Hue offers some potential for developing niche market tourism. An old trail still exists that could potentially link the A Luoi valley with Phong My commune, offering the potential for three-or-four-day hikes for more adventurous tourists (see Section 5).

3. Socio-economic Features

3.1 Summary of Key Socio-economic Features

The buffer zone of Phong Dien Nature Reserve contains all or part of eight communes, all of which are either included within or adjacent to the nature reserve. These communes are Phong My, Phong Xuan and Phong Son in Phong Dien district, and Hong Van, Hong Trung, Bac Son, Hong Kim and Hong Ha in A Luoi district.

The socio-economic 'landscape' of the communes in the buffer zone of Phong Dien Nature Reserve is both diverse and dynamic. The population is growing rapidly, even in comparison with other parts of Vietnam. During the 1960s and 1970s, there were substantial population movements in this area, as people fled heavy fighting during the Second Indochina War, and then subsequently returned to the area. More recently, population increase has been driven by both in-migration and endogenous factors. The ethnic composition of these communes is extremely diverse, and varies greatly from village to village. Currently, the population is comprised of people from six ethnic groups, and these are settled most densely along rivers (particularly in Phong Dien district) and roads (such as National Highway 14 in the A Luoi valley).

Demographic changes are only one of several inter-related factors that have shaped the extent and quality of the forests of Phong Dien district. One of the most important other factors is the direct and indirect impacts of the Second Indochina War during the 1960s and 1970s. The implications of this conflict continue to exert a profound influence on the forests and biodiversity of the area to this day. Other factors include fire, swidden cultivation (although this has declined markedly in recent years) and the impacts of logging.

The population of the buffer zone is served by rather poor services. For example, education and health services in both districts are over-subscribed and under-resourced. Furthermore, these services are less accessible to non-Kinh ethnic groups. There are several reasons for this: most teachers are Kinh and all teaching is undertaken in Vietnamese; and most health workers are also from the Kinh ethnic group, which introduces both linguistic and cultural constraints for other ethnic groups wishing to access these services. Low incomes and poverty also constrain access to health and education services, for both Kinh and non-Kinh ethnic groups. On the other hand, access to road infrastructure is comparatively good, and this sector is likely to improve substantially in the coming years.

The inhabitants of the buffer zone are highly dependent on agriculture and exploitation of natural resources, particularly forest resources. Agricultural practices have changed considerably over recent years and these changes look set to continue. For example, the introduction of irrigation technology has allowed many villages to expand wet rice production. Land shortages now constrain further expansion, and this will mean that increases in productivity and intensity will now be needed if rice production is to continue to increase in the two districts. Most non-Kinh ethnic groups depend on a diverse range of cereal, non-cereal and tree crops, supplemented by use of forest resources. Not surprisingly perhaps, there is a close relationship between agricultural and forest-use activities. Forest products tend to be exploited during times of low agricultural activity, and those villages with greater access to better cropping land and alternative livelihoods (such as trading and service provision) appear to depend less on forest resources.

Both agriculture and forest management practices are strongly influenced by external intervention and state policies. The extent to which these have contributed to either enhanced farm incomes or to sustainable forest management is, however, not clear. For example, sugar cane was recently promoted as an industrial crop in the area but delivered steadily falling revenues to farmers, and the factory has now failed. It is understood that other industrial crops are now being promoted in the area but there is a danger that markets for these crops will also decline in the medium to long term. Likewise, forest management has been strongly influenced by intervention payments, previously through the 327 Programme and now through the 661 Programme. The sustainability of this approach to forest management is discussed in Section 3.8 below.

3.2 Population, Demographics and Ethnicity

Demographics

The population growth rate is relatively high in all buffer zone communes. According to official statistics, the annual growth rate is 1.52% in Phong Dien district and 1.74% in A Luoi district. Hong Van commune has the highest annual growth rate at 2.9%. Provincial and district health authorities are attempting to provide support for family planning, partly in an attempt to reduce population growth rates. However, family planning methods offered to local communities are often inappropriate to their needs. For example, intra-uterine devices (IUDs) are often offered but, to be effective, these require regular check-ups at health centres, which is often difficult for many women (see Section 3.3). Access to these health centres is not always possible, and cultural and language differences between non-Kinh people and Kinh health workers can constrain access still further. Furthermore, many couples have little incentive to limit the number of children they have because of high infant mortality rates.

Ethnicity

There are nearly 5,000 households, comprising over 26,000 people in six ethnic groups, inhabiting the buffer zone communes. The three communes of Phong Dien district contain 69% of the total population of the buffer zone. There are important differences in ethnic composition between the buffer zone communes of Phong Dien district and those of A Luoi district. In Phong Dien district, 98% of the population comprises members of the Kinh ethnic group. In stark contrast to this, 98% of the population of the five communes of the buffer zone in A Luoi district comprises members of Pa-hi, Pa-co, Ta-oi and Ca-tu ethnic groups, with less than 2% of the population being comprised of the Kinh ethnic group. The ethnic composition of each of the buffer zone communes is shown in Table 13 and Map 3.

Table 13. Ethnic Composition of the Buffer Zone Communes

District/ Commune	Area (ha)	Population		Ethnic Group					
		H.holds	Popn.	Kinh	Pa-hi	Pa-co	Ta-oi	Van Kieu	Ca-tu
Phong My	39,400	897	4,431	4,075	356	0	0	0	0
Phong Xuan	15,740	964	4,900	4,900	0	0	0	0	0
Phong Son	11,530	1,852	10,441	10,428	0	0	0	13	0
Phong Dien district	66,670	3,713	19,772	19,403	356	0	0	13	0
Hong Van	3,990	357	2,122	48	0	2,074	0	0	0
Hong Trung	6,791	265	1,424	9	0	1,415	0	0	0
Bac Son	1,044	144	858	4	0	854	0	0	0
Hong Kim	4,086	264	1,478	25	0	1,453	0	0	0
Hong Ha	14,100	212	1,176	70	45	231	240	0	590
A Luoi district	30,011	1,242	7,058	156	45	6,027	240	0	590
Total	96,681	4,955	26,830	19,559	401	6,027	240	13	590

Data source: Phong Dien and A Luoi District Departments of Statistics, based on the official results of the general population census 1 April 1999

Population Distribution

Most inhabitants of the buffer zone live to the east of nature reserve boundary. Most of the population within the buffer zone in A Luoi district is distributed along National Highway 14 and Provincial Road 49. There are a total of 68 villages in the buffer zone (Map 3). Population density is greatest along streams, rivers and roads, and in flat areas suitable for wet rice cultivation. In the five buffer zone communes in A Luoi district, most inhabitants live along National Highway 14. In general, population densities are low (around 28 people/km²). However, population density varies greatly between communes (Table 14). The highest population densities are in Phong Son and Bac Son communes, while the lowest are in Hong Ha and Phong My communes. Relatively flat areas are often irrigated, and, consequently, support higher population densities than areas of steep topography.

Table 14. Population Distribution and Density in the Buffer Zone Communes

District/ Commune	Area (ha)	Popn.	Male	Female	Labour Force		No. of villages	Density (people/km ²)
					Male	Female		
Phong My	39,400	4,431	2,103	2,328	810	793	12	11
Phong Xuan	15,740	4,900	2,492	2,408	1,029	981	16	31
Phong Son	11,530	10,441	5,019	5,422	2,015	1,926	13	91
Phong Dien district	66,670	19,772	9,614	10,158	3,854	3,700	41	30
Hong Van	3,990	2,122	1,070	1,052	261	263	6	53
Hong Trung	6,791	1,424	687	737	197	203	6	21
Bac Son	1,044	858	414	444	120	130	4	82
Hong Kim	4,086	1,478	781	697	360	365	6	36
Hong Ha	14,100	1,176	626	550	155	135	5	8
A Luoi district	30,011	7,058	3,578	3,480	1,093	1,096	27	24
Total	96,681	26,830	13,192	13,638	4,947	4,796	68	28

Data source: Phong Dien and A Luoi District Departments of Statistics and buffer zone communes

Population Change, War and Forest Change in Recent History

Demographic change over recent years has played a key role in influencing forest quality, and the nature of land-use that occurs today. Oral histories and village timeline analysis were used to explore the history and past management of the area (Box 3). The results of the timeline analysis are included in Appendix 6. The results show that the reasons for forest loss and degradation are complex, although the effects of war (spraying of defoliants, napalm and bombing) and forest fires seem to have had the largest impact since the late 1960s. There would appear to be little evidence that forest loss can be attributed directly to shifting cultivation practices.

Prior to the Second Indochina War, households were far more dispersed throughout the forest than they are today. Most households depended largely on shifting cultivation, although in some, such as Khe Tran village, there was a mix of shifting and fixed cultivation. Fighting was particularly severe in this area during the war, and, between 1967 and 1969, most of the local people of this area fled heavy aerial bombardment, napalm attacks and spraying of defoliants (including Agent Orange) by US forces. According to US military maps, some areas of forest were sprayed with defoliants up to five times (Hatfield Consultants Ltd. 2000)¹. Attacks by the US military drove the inhabitants of these forests into other parts of A Luoi district or into Laos. Towards the end of the war, people started to return to the forests and villages of the area. In the A Luoi valley, this happened from 1973 onwards, while, in Phong Dien district, this began in 1978. In both areas, villagers returned to find that their forests had been heavily degraded by napalm and defoliants.

Swidden cultivation continued as an important livelihood activity until around 1992-1993, when most households had been 'settled' as part of the government's fixed cultivation and sedentarisation programme. In some parts of the area, local ethnic groups, such as the Pa-co of Dut 5 village, had already started to practice wet rice cultivation, a skill they learned from Kinh people. In others, such as Khe Tran and Ha Long villages, both in Phong Dien district, there was little or no land suitable for wet rice cultivation, and so these villages began to cultivate crops such as maize and peanuts, and to diversify into plantation establishment supported by the national 327 Programme.

In recent years, the inhabitants of both A Luoi and Phong Dien districts have had to cope with bouts of flooding, drought and forest fire. For example, floods caused widespread damage to crops and infrastructure in 1983 and 1999. Widespread fires and drought were reported in 1985, and another drought occurred in 1990. Each of these events led to the loss of crops.

Today, the legacy of war continues to threaten both livelihoods and forest resources. A recent study in the A Luoi valley has found areas where soil and water remain highly contaminated with dioxin: a residue of the defoliant Agent Orange (Hatfield Consultants Ltd. 2000). These are now limited to areas that were formerly used as air bases, where spillage and poor disposal of chemical residues have left a lasting

¹ Hatfield Consultants Ltd. (2000). Development of Impact Mitigation Strategies Related to the Use of Agent Orange Herbicide in A Luoi Valley, Vietnam. CD Rom.

pollution legacy. Unexploded ordnance and landmines still pose a hazard to the people and forests of Phong Dien and A Luoi districts. Fatalities continue to occur, particularly when local people attempt to recover metal from unexploded ordnance discovered in the forest. Villagers also reported that unexploded ordnance continues to cause forest fires, particularly at the start of the wet season².

Box 3: Summary of the Recent History of Khe Tran Village, Phong Dien District

Before the Second Indochina War, there were many more people living in the commune than at present. In 1968, however, napalm was dropped on the land around the village, particularly on the escarpment overlooking it. Maps also show that the area was subjected to multiple bouts of spraying with defoliants. Everyone in the village fled across the border into Laos or southwards into nearby A Luoi district. Many people have since stayed in these areas, as a result of which, there are now fewer people in the village than before the war. In recent years, the population of the village has continued to fall as people have left the village to find work elsewhere. The primary school outside the village closed a few years ago because of a shortage of children.

Source: information collected during interviews with the villagers of Khe Tran.

3.3 Public Health and Reproductive Health Services

Summary of Health Issues

The most common health problems are malaria, diarrhoea and respiratory diseases. The incidence of malaria is highest during the rainy season: from September to December in Phong Dien district, and from August to November in A Luoi district. Unclean water and poor hygiene contribute to a high occurrence of diarrhoea. Malaria used to be particularly prevalent in the area. In recent years, however, the number of cases of malaria has declined sharply. This is attributed to the work of the national malaria eradication campaign, which sends staff to visit the villages on an annual basis. Anti-malaria prophylactics, mosquito nets and insecticide sprays are given to villagers during these visits.

Land-use changes have had a significant impact on health in the area. The establishment of Khe Ma 'New Economic Zone' in Phong My commune has involved the conversion of 'bare' land (often regenerating scrub and forest) to sugar cane plantations. This has attracted workers from other parts of the district. On arrival, they have faced difficult living conditions, and have become prone to diseases and health problems, especially malaria, diarrhoea and tuberculosis. Local officials report that these diseases have often spread to indigenous groups already living in the area.

Local health workers reported that around 50% of children of A Luoi district are malnourished. There have been no detailed assessments of the congenital affects of dioxins on public health in Phong Dien district, although a detailed study of dioxin levels in humans has been undertaken in the A Luoi valley (Hatfield Consultants Ltd. 2000).

Access to Health and Reproductive Health Services

Currently, each buffer zone commune has a health station, located at the commune centre. In A Luoi district, the construction of these stations was largely supported by national and international development projects. However, despite the presence of infrastructure, there is a chronic shortage of trained staff, medical equipment and supplies, which places severe constraints on the quality of health care that can be provided. A typical health station has four staff (normally one physician, two nurses and one midwife). A typical health station in the A Luoi valley must serve over 1,500 people, whereas one in Phong Dien district must serve nearly 6,600 people. Access to adequate health services may also be constrained by ethnic and/or linguistic factors: in Phong Dien, all healthcare staff are Kinh people. In the A Luoi valley, there appears to be greater representation of ethnic minorities in the health service.

In addition to facilities at the district and commune level, all villages within the buffer zone have health workers. These are local people who have been trained in basic health care skills (e.g. first aid, treatment of common diseases, influenza) at commune and/or district health stations, and who then return to

² Although the reasons why this should be a particular problem at the onset of the wet season remain unclear.

practice these skills in their own villages. Village health workers are also responsible for monitoring the occurrence of diseases and the progress of national family planning programmes.

3.4 Education

Each buffer zone commune has a main school at the commune centre and subsidiary schools in other villages. In Phong Dien district, schools in three buffer zone commune centres provide education to lower secondary school level. Children in some villages, such as Khe Tran and Ha Long, have to travel considerable distances to get to lower secondary schools, and this is often impossible during times when water levels in the rivers are high. Consequently, attendance rates at lower and upper secondary school levels are often rather low. A summary of the key statistics for A Luoi and Phong Dien districts is shown in Table 15.

Table 15: Numbers of Teachers and Pupils in the Schools of the Buffer Zone in 1999-2000

Commune	Primary School			Secondary School		
	Pupils	Classes	Teachers	Pupils	Classes	Teachers
Phong My	695	21	34	400	5	26
Phong Son	723	-	32	370	3	*
Phong Xuan	1,526	30	60	824	10	29
Bac Son	159	3	9	0	0	0
Hong Kim	282	5	15	0	0	0
Hong Trung	270	6	15	0	0	0
Hong Van	410	10	18	380	10	10
Hong Ha	255	8	12	105	-	-

Source: Phong Dien and A Luoi District Departments of Education and Training.

* Phong My and Phong Xuan communes share a lower secondary school.

School attendance rates in A Luoi district are even lower, due to the remoteness of many villages and the costs of schooling. Of the five communes in the buffer zone, only Hong Van has a lower secondary school, and this is shared with three other communes: Hong Thuy, Bac Son and Hong Trung. Children from these communes have to travel 5 to 7 km to school. Official figures indicate that attendance rates in these communes are only 70%³. Families are often required to cover the costs of schoolbooks and contribute to the maintenance of school buildings, and these can pose substantial constraints for poor families. The opportunity cost of sending children to school is a further constrain to many families: children often play a key role in household economies, and older children often have responsibility for looking after infants whilst the adults work. Taken together, these factors can impose a substantial burden on poor households, and this constrains the ability of poor households to keep children at school. These factors contribute to the declining attendance rates in older age classes at schools, and become more acute at secondary levels.

Official statistics on school attendance are not disaggregated between boys and girls. However, household interviews suggest that girls tend to be affected disproportionately for cultural reasons: with limited resources, most households choose to invest in the education of boys. Girls are also expected to provide more help in the home, particularly with childcare, and often marry early, before their education can be completed.

Since all teaching is undertaken in Vietnamese, members of the ethnic minorities often find education services both inappropriate and inaccessible. This also poses problems for Kinh teachers, as they are unable to communicate properly with their pupils.

3.5 Infrastructure

Transportation

In general, road infrastructure in the buffer zone communes is good. Since National Highway 14 runs along the centre of the A Luoi valley, transport is considered less of a constraint in this district as compared with Phong Dien. In Phong Dien district all villages in the buffer zone are accessible by both

³ School attendance rates in official figures tend to over-estimate actual attendance rates.

car and truck, with the exception Ha Long village, which can only be reached by way of a narrow suspension bridge which crosses the O Lau river. Khe Tran village also becomes inaccessible by road during periods of high water levels in the river. Not surprisingly, villagers believe that road infrastructure is a key constraint to rural development. However, substantial improvements will still be needed if road access to Khe Tran village, Phong My commune, and Khe Thai village, Phong Son commune, is to be improved during the wet season. The three buffer zone communes in Phong Dien district are only about 15 km from National Highway 1, and road access to these communes will improve once the on-going upgrading of the link road is completed.

In the A Luoi valley, National Highway 14 provides the main transport corridor. However, between A Luoi town and Hue city, the road is in poor condition and was damaged badly by the floods in November 1999. Access to A Luoi town from Hue city is particularly difficult during the wet season, when landslides can block the road. Transportation to and from A Luoi town is likely to improve substantially with the planned development of National Highway 2.

Electricity

All buffer zone communes are connected to the national electricity grid. However, the grid does not extend to many villages in these communes. Provincial authorities plan to extend the electricity grid to two villages in Hong Ha commune and to four villages in Phong My commune (including Ha Long and Khe Tran villages) in the next one or two years. This is likely to improve general living standards in these villages: both villages ranked electricity as a high priority for future village development. Interestingly, men and women expressed different reasons for wanting electricity in Khe Tran village: women looked forward to improved lighting, which could help home learning and study, while men looked forward to being able to watch football on television!

3.6 Economic activities

Living standards of the buffer zone communes are comparatively low by Vietnamese standards, especially in A Luoi district. Hong Van, Hong Trung and Hong Ha communes, A Luoi district, are included in the national 135 Programme (the Poverty Reduction and Hunger Elimination Programme). Most households in the buffer zone communes have three major sources of income: agriculture, animal husbandry and forestry. Agriculture and animal husbandry are discussed in more detail in Section 3.7, while forestry is discussed in Section 3.8. For the purposes of this investment plan, natural resources are defined to include agricultural and agro-ecological resources and forest resources.

3.7 Agricultural and Agro-ecological Resources

Agriculture remains the main livelihood activity in both Phong Dien and A Luoi districts. Swidden agriculture was formerly widespread throughout the forests of these districts. However, the balance between swidden and settled agriculture has changed greatly over the last 10 years or so. Nowadays, almost all households within the buffer zone communes practice settled agriculture, and only a small number of households still practice swidden cultivation. Only around 10 Pa-hi households and three Van Kieu households still depend largely on the cultivation of hill rice; most of which are located in A Luoi district.

Depending on soil fertility, hill rice is cultivated on sloping fields for two or three years. Soil nutrients are usually depleted after the second or third crop, and yields decline. New fields are then cleared and burned. These areas are usually old fields that have been allowed to lie fallow for periods of three to five years. Fields are usually cleared in May and then planted with new crops. Most households that continue to practice swidden cultivation expressed a preference for settled agriculture (especially wet rice) but continued to practice swidden farming because suitable land for wet rice cultivation was not available.

The shift in the balance between swidden and settled agriculture has been driven by economic factors (returns on labour from settled agriculture exceed those for swidden agriculture), and by government policy, manifested through government programmes aimed at encouraging settled agricultural practices.

Table 16 shows the areas of land under different crops in the buffer zone communes, based on data supplied by Phong Dien and A Luoi District Departments of Statistics. These statistics provide an indication of the major crops grown, but it must be stressed that each village is different and the diversity of cropping practices is considerably greater than the figures in the table would indicate. Furthermore, agricultural practices are almost always supplemented by other livelihood activities that have an important bearing on the management of forest resources (for example, collection of non-timber forest products (NTFPs), hunting, and tending of plantations and homegardens).

Table 16: Agricultural Land in the Buffer Zone Communes

District/ Commune	Paddy Rice (ha)	Hill Rice (ha)	Cassava (ha)	Maize (ha)	Peanuts (ha)	Potatoes (ha)	Sugar Cane (ha)	Beans (ha)	Total (ha)
Phong My	150	30	0	1	74	72	450	30	807
Phong Xuan	470	0	110	2	150	110	293	0	1,135
Phong Son	447	0	121	2	246	121	52	3	992
Hong Van	23	54	175	6	1	6	17	5	287
Hong Trung	20	36	130	5	0	5	24	1	221
Bac Son	16	10	40	15	1	5	10	2	99
Hong Kim	26	10	40	10	3	10	23	10	132
Hong Ha	14	15	60	7	0	5	32	4	137
Total	1,166	155	676	48	475	334	901	55	3,810

Source: Phong Dien and A Luoi District Departments of Statistics and commune people's committees

The Influence of Agricultural Activities on Access to Forest Resources

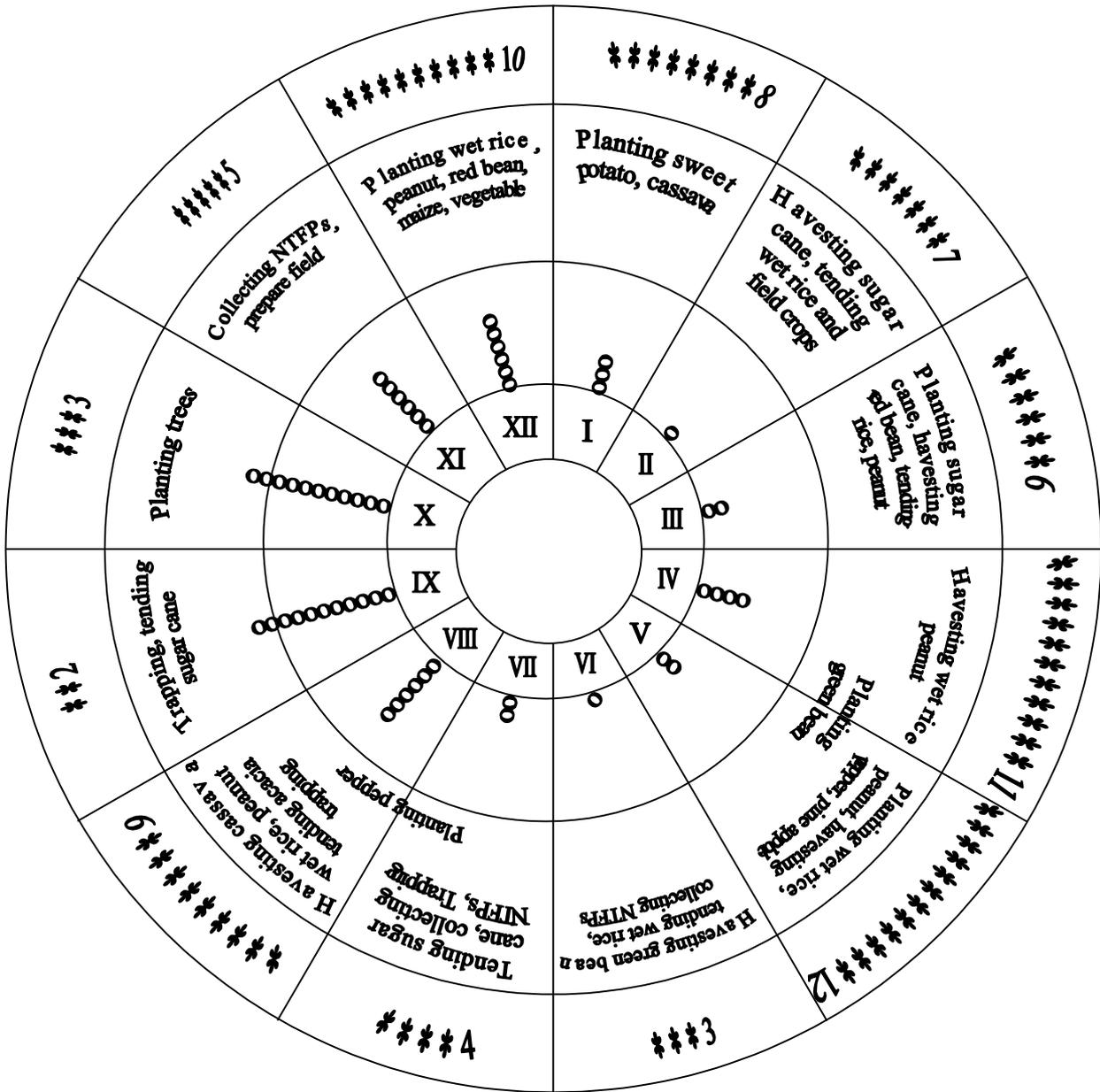
Seasonal calendars compiled for four villages in the buffer zone provide a clearer picture of the diversity of activities in A Luoi and Phong Dien districts. The villagers of Ha Long village compiled the visual representation of the seasonal calendar shown in Figure 1, and seasonal calendars for the other three villages in which participatory rural appraisal (PRA) activities were undertaken are shown in Appendix 7. Ha Long village is shown in Map 4 and the other three villages are shown in Appendix 8. Periods of hunting and NTFP collection are compared with seasonal labour demands and rainfall in Appendix 9.

The seasonal calendars show that:

- (a) Periods for the collection of NTFPs, hunting and trapping of wildlife, tending of homegardens, and management of tree plantations are integrated closely with the seasonal pattern of agricultural activities.
- (b) In the villages visited, both men and women are involved in agricultural work as well as the collection of NTFPs (although hunting is predominantly a male activity). Since both men and women are involved in agricultural activities, the collection of NTFPs and hunting occur during the times of the year when there is a lull in agricultural activities. This is often, but not always, the wettest part of the year. It would appear that villagers hunt and gather NTFPs shortly before, during and immediately after the wet season.
- (c) In all four villages visited, NTFP collection and hunting occurs entirely between May and December. However, because different villages have different seasonal patterns of activity, labour surpluses occur at different times of the year.

Collection of NTFPs and hunting start and finish earlier in the year in A Luoi district (even before the onset of the rains) compared with Phong Dien district. This is mainly because of the determining influence of the planting and harvesting of wet rice on labour availability in A Luoi district. The influence of seasonal agricultural activities on when people access forest resources varies, even between closely located villages. For example, in Khe Tran village, which lacks land for wet rice, labour surpluses occur in October, November and December: between the main periods for planting peanuts and the harvesting of beans, sweet potatoes and peanuts. For this reason, most NTFP collection occurs around this time. However, in nearby Ha Long village, which has more land available for wet rice, the labour surpluses occur earlier: during June, and then September, October and November. These are also the times when the Ha Long villagers visit the forest to hunt and collect NTFPs.

Figure 1: Ha Long Village Seasonal Calendar



Key: I, II, III, etc. = Month; O = Rainfall; * = Labour distribution

Agriculture and Land-use Trends: Opportunities for Buffer Zone Management?

Agricultural production in all communes is relatively low because of a shortage of arable land, lack of capital and lack of irrigation. As a result, many households in these districts undergo food shortages for part of the year. Recently, however, there have been some important changes in the crops cultivated in the two districts. Peanuts have become a popular crop in the communes of Phong Dien district, whereas rice, maize, cassava and potatoes are the major crops in A Luoi district. The trend towards the establishment of 'industrial' crops is another important feature of the area. Phong Dien Forest Enterprise continues to make 'bare' land available to villagers for sugar cane production. This policy was adopted to ensure that a new processing factory built near Phong Dien remained adequately supplied with sugar cane. This 'new' crop initially proved popular with farmers. However, villagers have found that growing sugar cane has led to a depletion of soil fertility, and they have also been faced with falling market prices. Delays in the collection of the crop after harvesting have also led to lower returns, since the factory pays farmers by weight; and sugar cane loses weight rapidly after harvesting as the crop 'dries-out'. As a result of these problems, farmers are already beginning to cease sugar cane production in some areas. The recent closure of the sugar cane factory will accelerate this trend and lead to widespread changes in cropping practices. This will also mean that different options for the use of 'bare' land will need to be investigated.

The provincial government is now considering substitution of sugar cane with other industrial crops (M. McGrath pers. com.). However, two other options might be considered, not least because they offer the opportunity for saving investment costs, enhancing watershed protection and supporting biodiversity. The first is to allocate 'bare land' and 'scarred' forest to households in Phong Dien district. This would ease the growing shortage of agricultural land whilst also reducing extractive uses of forest products from inside the boundary of the nature reserve. Villagers in Khe Tran village, for example, expressed a willingness to assume responsibility for better forest management of bare lands and scarred forest, which they value more highly than the more distant 'rich' forests, in return for more secure tenure rights for forest and/or land resources. This would also lead to a diversification of crops and land-uses, as farmers would select crops according to the suitability of soils, market conditions, etc. A second option would be to issue long-term protection contracts to villagers and allow natural regeneration on bare lands. This would also reduce pressure on the forest resources of the nature reserve, while, at the same time, contributing to improved watershed protection (and thus increased flood protection downstream and protection of dry-season water supplies). Both options are likely to enhance biodiversity conservation inside and outside the boundary of the nature reserve.

In most villages, wet rice has been cultivated for many years. Wet rice has been grown since well before 1975 in Dut 5 village, Hong Kim commune. In Ha Long village, Phong My commune, wet rice cultivation arrived 10 years later. Some villages, such as Khe Tran in Phong My commune, still lack irrigation and, therefore, cannot grow wet rice.

The government has also supported the establishment of tree crops, most notably through the 327 Programme. In A Luoi district, cinnamon has been promoted as an economic tree crop, through the support of tree nurseries and the provision of funds for plantation establishment. As a result, cinnamon is now a common crop in A Luoi district. In Phong Dien district, *Acacia* spp. and rubber plantations have also been established with funds from the 327 Programme. In Khe Tran village, rubber plantations have been established on some of the best land available to the village for agriculture. Since cropping land is scarce, this leads indirectly to an increase in pressure on forest resources, since villagers are left with little alternative but to enter the forest to collect forest resources.

Livestock and Animal Husbandry

Larger livestock, such as buffalo and cattle, are commonly reared in the communes of the buffer zone. This is because of the availability of suitable grazing land, good access to markets and high market values for larger livestock species. Most households raise pigs and chickens. Goats are only grazed in A Luoi district, where villagers believe there is considerable potential for further expansion of goat rearing. In order to promote animal husbandry in the area, various governmental and non-governmental organisations have supported the introduction of new breeds and introduced credit schemes. Aquaculture-based fisheries have also been introduced in both Phong Dien and A Luoi districts, where they have proved popular. A number of governmental and non-governmental agencies believe there is great potential for further development of aquaculture-based fisheries in both districts. However, care will be needed in the

A Luoi valley, where one recent study has found high levels of dioxin contamination in fish and ducks reared in aquacultural ponds (Hatfield Consultants Ltd. 2000). This contamination results from spillage and dumping of Agent Orange by US forces during the Second Indochina War.

3.8 Forest Resources

Causes of Recent Forest Change

All buffer zone communes have a large area of land designated as 'forest land', including natural forest, plantation and 'bare' land. Much of the forest resources of this latter category, which is extensive in parts of the buffer zone, comprise scrub and grassland. The factors responsible for the formation of bare land vary between localities and include:

- previous conflict (including use of defoliants and napalm during the Second Indochina War).
- forest fires.
- swidden cultivation.
- grazing.
- over-exploitation of timber and non-timber forest products.

Village timelines (Appendix 6) demonstrate that these factors are also inter-related and dynamic: degradation during war years has left a structure and composition of forest that is prone to dry season fires. Unexploded ordnance is thought to continue to start fires to the present day. Shifting cultivation may also have been a contributing factor to forest degradation in some areas, and also to the prevalence of fires. This factor is now less prevalent, as shifting cultivation has declined. Grazing may inhibit forest regeneration in some areas, especially bare forest land near villages. Over-harvesting of forest resources also seems to be playing an important part in forest degradation. This pattern of degradation is exacerbated by a general lack of established land tenure and rights for forest resources: a situation that leaves local communities and households with few incentives to manage and protect adjacent forest resources.

Existing Forest Management

In recent times, most forestry activities have been implemented under a series of national forest development programmes, most recently the 661 Programme and its predecessor, the 327 Programme. In Phong Dien district, the 661 Programme is managed by Phong Dien Forest Enterprise and the management board of Bo River Watershed Protection Forest. Figure 2 shows the forest land types managed by Phong Dien Forest Enterprise and Table 17 shows the different land-use types. In A Luoi district, these are managed by the Forest Protection Department (FPD). The data for Phong Dien Forest Enterprise highlight a number of important points. Firstly, in the communes concerned, the forest enterprise has no 'rich' forest under its jurisdiction and very little 'medium' forest. There is, therefore, little prospect for earning substantial revenues from timber extraction in the short or medium term, at least within the communes for which data are available. Secondly, the prevalence of bare lands, particularly in Phong Xuan commune, poses a considerable challenge for re-establishing cost-effective and viable land-use management strategies. These areas also offer tremendous opportunities for decentralising management control over forest land in the area.

Table 17: Land under the Management of Phong Dien Forest Enterprise in two Buffer Zone Communes

Land-use	Phong My	Phong Xuan
I. Natural forest	8,173	630
Rich forest	0	0
Medium forest	90	0
Poor forest	4,081	0
Regenerating forest	1,453	630
II. Plantation forest	2,549	0
Pine	1,803	0
<i>Acacia and Eucalyptus</i>	428	0
Indigenous tree species	278	0
Rubber	40	0
III. Bare land	6,995	25,302
Grass	2,593	7,497
Scrub with scattered trees	4,402	1,781
IV. Other land*	2,102	125

*Other land includes residential and agricultural land.

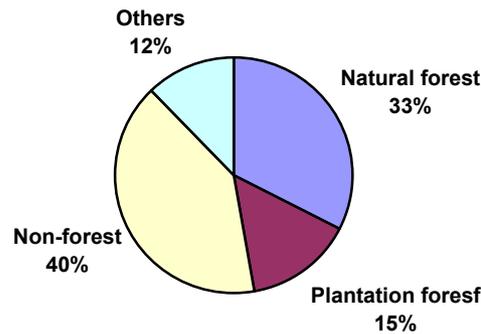


Figure 2: Land under the Management of Phong Dien Forest Enterprise

A few households in the buffer zone have been issued forest protection contracts or have been allocated land for forestry purposes. The main forestry activities are focussed on 're-afforesting' bare and degraded areas, and establishing forest plantations. In Khe Tran and Ha Long villages, households were paid VND 700,000 to 1 million per ha for establishing trees on land allocated for establishing plantations. They were then paid a further VND 450,000 for the first year and VND 250,000 for each of the next two years under the terms of the forest protection contract. They are not allowed to cut the trees but, as the trees mature, they will be allowed to collect fallen branches for firewood. In A Luoi district, households were paid VND 400 for planting each cinnamon tree.

It is clear that payments from these national forestry programmes have benefited villagers in the short term, and it would seem that *Acacia* spp. and pine plantations established under these programmes are growing reasonably well. However, villagers drew attention to a number of problems they faced in responding to the needs of the national forestry programmes. For example, villagers in Khe Tran and Ha Long village pointed out that they faced considerable difficulties whenever the protection contracts expired, and were left without incentives for plantation management. These same villagers expressed a preference for forest management approaches that delivered sustainable benefits from one year to the next, and which allowed them to manage existing forest land (including regenerating forest and 'bare' lands) in a more sustainable manner.

The main species for plantation establishment have been *Acacia auriculaeformis*, *A. mangium* and *Pinus kesiya*, selected by project managers of the national forestry programmes. The total area under forest plantation is substantial: according to Phong Dien Forest Enterprise, 30,366 ha of plantations have now been established in the three buffer zone communes of Phong Dien district, with support from the 327 and 661 Programmes. Most plantations have been established on flat land and lower slopes, where establishment is cheaper and easier.

Cinnamomum cassia plantations have also been established, particularly in the A Luoi valley. Hong Kim commune has largest area of cinnamon plantation, totalling 150 ha. However, these plantations suffer from a disease locally named "yellow leaf", because the leaves of infected trees grow yellow then die. Effective disease control methods are yet to be found. Rubber trees were also established under the 327 Programme in Khe Tran village. Unfortunately, this plantation was established on some of the best land potentially available to the village, and the trees have yet to produce latex.

With an abundance of heavily degraded land potentially available for forest management and other land-uses, there is considerable scope for substantially improving household income throughout the buffer zone, while also reducing overall pressure on the forest resources of the nature reserve. However, current arrangements for forest development and management are costly, create social tensions and are likely to be unsustainable in the long term. Furthermore, continuation of existing procedures for plantation establishment may well continue the trend of establishing plantations in areas unsuitable from social, environmental and economic perspectives. This may lead to increasing conflict, especially as land pressure for croplands continues to increase. Consideration might, therefore, be given to allocating land

tenure rights for a greater proportion of existing forest lands. Data compiled by the PRA studies indicates that, under this arrangement, many households will opt to establish crops on suitable areas of flat land near the villages, whilst opting to manage natural regeneration on sloping land, further from the village. Thus, most existing bare lands will likely return to managed forest cover, will be managed more intensively, and for a broader range of forest products than at present, and will incur lower intervention costs from national forest programmes. This would also enhance watershed protection and would also complement biodiversity conservation at the nature reserve.

Threats to Forest Resources

Perceptions of 'threats' to the forests and biodiversity of Phong Dien and A Luoi districts vary greatly between villages around the boundary of the nature reserve. Data on threats collected using village-level research are included in Appendix 10. This diversity in perceptions is significant and indicates that the nature of threats is highly location specific.

Over-collection of firewood and other NTFPs is considered to be an important factor in the decline of forest quality and wildlife in at least one of the four villages visited: Dut 5 in A Luoi district. In Khe Tran village, villagers considered that NTFP collection, combined with timber cutting, comprises the most pernicious on-going threat to the forest.

In Ha Long village, Phong Dien district, villagers considered that forest fires were the most regular and serious threat to the forest. Fires were also considered to pose a significant threat by the villagers in Khe Tran. These occur mainly during the dry season: between April and September. Forest fires were mentioned by all villages as a key threat to the forest, and are caused by: fires lit to clear hill fields as part of swidden agricultural practices, the spontaneous detonation of unexploded ordnance, and deliberate burning to clear forests to permit villagers to collect scrap metal (shell and bomb casings, etc.).

Clearance of forest land to make way for agriculture was mentioned as a threat in only one village: Dut 6 in A Luoi district, where it was considered to be the most important on-going and future threat to the forest. Dut 6 suffers from a particular shortage of agricultural land, and, as the village grows, this trend is likely to continue.

Timber extraction was cited as a significant threat in three of the four villages visited. However, it was not clear whether they were referring to timber extraction by 'outsiders' for commercial purposes, or by local people extracting timber for house construction, and other domestic and agricultural uses.

Hunting and Trapping

Hunting and trapping of wildlife have long been customary activities in this area. Hunting remains a widespread and common activity, and may now pose the most significant threat to a number of mammal and bird species of critical conservation concern. In some villages in the A Luoi valley, virtually all households hunt at certain times of the year. Information collected as part of this study indicates that hunting pressure is higher in the A Luoi valley than in Phong Dien district, and it is noticeable that many restaurants in the A Luoi valley serve wild meat. Table 18 provides an example of the information collected on hunting and trapping from one village close the boundary of the nature reserve. Information from three other villages is presented in Appendix 11.

Guns are used widely (although less so than in past years, see below), and common trapping methods include box traps and wire snares. Unfortunately, snaring and trapping is indiscriminate, capturing any small animal found in the area and probably causing injury to larger animals. Le Trong Trai *et al.* (1999) reported that levels of trapping in the area are high, and that pheasants are particularly vulnerable to such intensive trapping pressure.

Ironically, most of the information available on the existence of many species of mammal is based solely on incidental reports from hunters and observations of trophies collected in the forests of the area. Data collected during research in four village is included in Appendix 10, and suggests that:

- villagers hunt and collect an extremely wide range of species: it would seem that most species of mammal and bird are taken when the opportunity arises.

- most species are caught using traps, although some arboreal species, such as Clouded Leopard, Red-shanked Douc Langur and Buff-cheeked Gibbon, and larger species, such as Gaur, Asiatic Black Bear *Ursus thibetanus* and Sambar *Cervus unicolor*, are occasionally shot.
- the timing of hunting activity varies from one village to the next, and is defined largely by labour surpluses in the agricultural calendar. These often occur during the wet season, when hunting is also easier, because wet leaves allow hunters to operate more quietly. Hunting is also thought to intensify prior to the lunar new year so that people can eat wild meat during the new year celebrations.
- animals are hunted and trapped for both domestic consumption and sale. Most valuable animals are sold for income. Some species can raise substantial income. For example, pangolin skins can be worth over VND 400,000 (US\$30) and live snakes can fetch over VND 500,000 per kg. Interestingly however, both pangolins and snakes are more commonly caught in agricultural land and areas of degraded forest close to villages. Some villagers suggested that wildlife trade is now more common than in previous years, and there are now more wildlife traders.
- most animals and skins are sold to local dealers, who might come from as far away as Hue city and, perhaps, even further for some animals, such as Tiger and bears.
- virtually all animal species are now scarcer than they were 10 to 20 years ago. Hunters attribute this to over-hunting. Some species have disappeared entirely (for example, Asian Elephant *Elephas maximus*), while others are now only seen or heard very rarely (for example, Tiger, Gaur, Southern Serow *Naemorhedus sumatraensis* and Buff-cheeked Gibbon).
- overall hunting pressure is now lower than 10 years ago. This is because people used to hunt while they visited the forest to practice swidden cultivation. Nowadays, villagers tend to spend more time on settled agriculture, which is often far from the forest. This leaves less time for hunting in the forest.

Hunting activity with guns is likely to be somewhat lower than in the years following the Second Indochina War. This is not only because of the decline in shifting cultivation but also because there were many guns available after the war, and these were used widely for hunting. However, many of these have now been confiscated or returned to various government agencies. Furthermore, the sharp decline in mammal abundance during and after the war has deterred many hunters: there are now fewer animals to hunt. Low mammal abundance may also help explain the increased use of snares and traps. Snares and traps are extremely cheap, can be used to capture a wide range of mammals and birds, and allow animals to be captured with less investment of time and effort.

Efforts to control on-going hunting and trapping have met little success. The FPD has few resources with which to enforce controls on hunting and trapping, or incentives to do so. A recent WWF-supported 'awareness' initiative led to some short-term removal of snares and traps, and also seems to have generated considerable local support through activities with schools. However, to be effective, hunting management efforts will need to be sustained, and there are few on-going activities. Furthermore, the returns from hunting can be significant, although it would also appear that villagers (mainly men) hunt as much for deeply embedded socio-cultural reasons as for economic returns.

Extraction of Timber Resources

Timber continues to be extracted from the forest of Phong Dien Nature Reserve, even though this activity is illegal. Timber is extracted to build houses and for the manufacture of agricultural tools and equipment. In some cases, this is permitted by the local authorities: villagers are allowed to harvest timber for house construction, with permission from the commune people's committee, and provincial and district FPD officials. However, gaining such permission is time-consuming, costly (requiring travel to the provincial capital) and uncertain. Perhaps unsurprisingly, some households may opt to harvest timber without permission, for which the risk of being caught is rather low. Timber is also illegally cut and removed from the forest by groups from outside the local area. Logs are generally floated down the main rivers (the O Lau, Bo, and My Chanh) and then loaded onto trucks. FPD staff are sometimes successful in preventing illegal extraction but their effectiveness in preventing illegal logging is constrained by a general lack of resources. The extent to which illegal timber extraction is occurring at levels that may or may not be 'sustainable' is unclear.

Table 18: Hunting Information Collected in Ha Long Village, Phong Dien District

Species	Where	Months	Who	Method	Use		Market	Price (VND/kg)	Status	
					Use	Sell			<1977	Now
Wild Pig	Forest, fields	9-11	Γ	Trap	✓	✓	Local	15,000	++++	+++
Indian Muntjac	Regen. forest	5-7	Γ	Trap	✓	✓	Local	7,000	+++	++
Giant Muntjac	Good forest	5-7	Γ	Trap	✓	✓	Local	7,000	++	+
Sambar	Good forest	5-7	Γ	Trap, shoot	✓	✓	Local	22,000	++	+
Macaques	Forest, stream	8-11	Γ	Trap	✓	✓	Local	10,000	++++	+++
Gibbon	Good forest	5-8	Γ	Shoot	✓				++	+
Douc Langur	Good forest	5-8	Γ	Shoot	✓				+++	++
Gaur	Good forest	9-11	Γ	Shoot	✓	✓	Local		++	+
Bears	Forest	3-5	Γ	Trap, shoot	✓	✓	Local		++	+
Serow	Rocky forest	9-11	Γ	Trap	✓	✓	Local	10,000	++	+
Tiger	Good forest	All year	Γ	Trap, shoot		✓	Local		++	+
Civets	Fields, forest	8-11	Γ	Trap	✓	✓	Local	70,000	++++	+++
Pangolins	Fields, forest	8-11	Γ	Trap		✓	Local	400,000	+++	++
Leopard	Good forest	All year	Γ	Trap, shoot		✓	Local		++	+
Loris	Forest	5-7	Γ	Trap, catch	✓	✓	Local		++	+
Wild cats	Forest	All year	Γ	Trap	✓				+	+
Dhole	Forest	All year	Γ	Trap	✓				++	++
Mouse-deer	Forest	9-11	Γ	Trap	✓				++	+
Snakes	Anywhere	All year	Γ	Trap, catch		✓	Local	500,000	++	+
Python	Lowland	All year	ΓE	Catch		✓	Local	50,000	++	+
Pheasants	Good forest	All year	Γ	Trap	✓				++	+
Crested Argus	Forest	All year	Γ	Trap	✓				+++	++
Monitor lizards	Stream	All year	ΓE	Catch	✓	✓	Local	50,000	+++	++
Geckos	Forest	All year	Γ	Catch	✓				+	+
Tortoises	Good forest	All year	ΓE	Catch	✓	✓	Local	70,000	++	+
Turtles	River, stream	5-8	E	Catch	✓	✓	Local	200,000	+++	++

Extraction of Non-timber Forest Products

Villagers around the nature reserve extract a wide variety of non-timber forest products, both from forests within the nature reserve, and also from so-called bare land around their villages. Indeed, the villagers in Khe Tran village actually placed higher value on the forest resources of 'bare' land and 'scarred' forest near their village than those of 'good' forest further away (Table 19). They also expressed a willingness to accept responsibility for better management of these forest areas, should they be given responsibility and rights to these areas.

Table 19: Local Perceptions of Forest and Biodiversity Value Expressed by Women Villagers of Khe Tran Village

Land-use	Uses	Relative Value	Trends
Bare land	Cattle grazing, firewood collection	Most important because of proximity to the village	Conversion to agricultural land and plantations
Scarred forest	Firewood collection, NTFP collection (e.g. palm leaves and rattans), hunting of Wild Pigs, honey collection	Second most important, because these forests combine proximity with the supply of a range of forest products.	Over-exploitation. These areas are gradually changing to bare land. Firewood, rattan and palms are now becoming less abundant.
Good forest	Timber harvesting, rattan collection, NTFP collection, honey collection, hunting	Least important because of distance from village. Distance limits access to only periods when there is 'free' time.	Over-exploitation is changing 'good' forests to 'scarred' forests. Villagers are concerned this will damage their water supplies and the forest products they need will disappear.

The most commonly collected NTFPs in the buffer zone communes include rattans, bamboo, honey, various plants used for medicinal purposes, *Machilus* sp. bark (from which essential oils are extracted),

bamboo shoots and mushrooms. NTFPs are collected both to supplement local requirements for materials and food, and also for commercial sale. These are often sold to traders who visit the villagers on a regular basis.

In a number of cases, NTFPs form the basis of cottage industries, such as the making of conical hats. The villagers of Dut 5 and Dut 6 often enter the forest in the dry season, before lunar new year, to collect the flowers of *Thysolaena maxima*, which are used for making brushes and are sold in local markets. These industries 'add value' to NTFPs prior to marketing. Table 20 provides an example of the range of NTFPs collected by the villagers of Ha Long village. Appendix 12 provides information collected from all four villages.

Table 20: NTFPs Collected by the Villagers of Dut 5 Village, A Luoi District

NTFPs	Where	Months	Who	Use	Sell	Price (VND)	Market	Status	
								<1975	Now
Rattan	Good forest	6-7	ΓE		✓	1,000/stem	Local	+++	++
Firewood	Good forest	All year	ΓE	✓				++++	+++
Banana leaf	Bare land	All year	ΓE	✓	✓		Local	+++	+++
Brush material	Regen. forest	1-3	ΓE		✓	50/stem	Local	++++	+
Honey	Good forest	4-5	Γ	✓	✓			+++	+
<i>Cinnamomum</i> sp.	Good forest	All year	Γ					+++	++
<i>Aquilaria crassna</i>	Good forest		Γ		✓	30 million/kg	Local	++	+
<i>Litsea</i> sp.	Good forest	6-7	ΓE		✓	900/kg	Local	++++	+
Orchids	Good forest	All year	Γ	✓				++++	++
Bamboo shoots	Bamboo forest	8-9	ΓE	✓	✓	5,000/kg	Local	++++	+++
Medicinal plants	Anywhere	All year	ΓE	✓	✓	20,000/kg	Local	+++	+++
Bamboo	Bamboo forest	All year	ΓE	✓				+++	++
Palm leaves	Good forest	7-8	Γ	✓				++++	+++
Timber	Good forest	All year	Γ	✓				++++	+++

Key: ++++ = Very abundant; +++ = Abundant; ++ = Common; + = Scarce.

The information from research at village level would indicate that abundances of many, but not all, NTFPs are in decline. Whether this is because of repeated fires and degradation of forest by timber cutting and other factors, or whether this is due to over-exploitation of NTFPs is unclear, and may well vary from one part of the forest to another. In reality, it is likely that trends in NTFP abundance will be due to a combination of factors. Villagers believe that the NTFPs in fastest decline are also those which are collected on a large scale for commercial purposes, including rattans, *Machilus* sp. bark, the leaves of certain palms and various species of bamboo. The high prices paid for certain NTFPs, such as the resin of *Aquilaria crassna*, cinnamon bark and honey may also be driving a general trend of over-exploitation. However, further research is required before firmer conclusions can be drawn.

The seasonal calendars indicate that most NTFP collection occurs during times in the agricultural calendar when there is a surplus of labour. In Ha Long village, this is June and July, and then September and October. However, the exact timing varies from year to year, and from village to village.

3.9 Forest Services

In 1999, extremely severe flooding affected the middle and lower catchments of most river systems in central Vietnam. It is likely that loss of forest cover, especially on the steeper, upper slopes of the catchments of major river systems increased the severity of this flooding. In addition, the forests of Phong Dien Nature Reserve are also likely to contribute to sustaining dry season water flows, and are, therefore, likely to perform a role in protecting water supplies for domestic and agricultural use. Further research would be useful to develop a clearer picture of the link between forest cover, and downstream flooding and water supply, but it is likely that these free 'services' make a substantive economic contribution to downstream areas.

Flood and Erosion Control

Phong Dien and Dakrong districts include the upstream catchments for four river systems: the Dakrong (Thach Han), My Chanh-O Lau, Bo Huong and A Sap. Because of topography, and highly localised and concentrated rainfall patterns, downstream areas can be especially prone to erosion and flood damage. Improved protection of forest in the steeply sloping parts of the upper catchments may comprise a cost-effective approach to improving flood and erosion control in downstream areas. Therefore, further protection of these watershed protection forests is highly recommended. To this end, the on-going Thua Thien Hue Rural Development Project is supporting the identification of priority areas for addressing watershed protection, with a focus on steeply sloping land near to major river systems.

Water Supply and Irrigation Projects

The rivers fed by the catchments of Phong Dien and Dakrong Nature Reserves supply freshwater for several major agricultural areas downstream. Two national irrigation projects have been constructed to serve these areas. The first is the South Thach Han Irrigation Project, inaugurated in 1981. This project involved the creation of a dam with the capacity to irrigate an area of 16,900 ha, and which is currently irrigating 8,700 ha of wet rice cultivation in Thua Thien Hue and Quang Tri provinces. The second is the Hoa My Irrigation Project, located along the O Lau river in Phong My commune. This project involved the creation of a 218 ha reservoir, with a volume of 12 million m³, which provides water for 2,000 ha of wet rice cultivation. Therefore, the existing forest cover in the two nature reserves protects the catchments of these two irrigation projects, which, together, supply water for 10,700 ha of agricultural land.

According to Le Trong Trai *et al.* (1999), both irrigation projects have helped the local economy but poor watershed management in the region has led to several problems. Exploitation and degradation of forests has resulted in excessive soil erosion, and the resulting siltation has significantly decreased the life expectancy of the aforementioned irrigation projects. Recent surveys indicate that the build-up of alluvial silt in the irrigation dam of the South Thach Han Irrigation Project is already 2 m deep after 17 years. At low water, previously navigable waterways are now rendered impassable. In 1998, a particularly long drought, coupled with seasonal, hot, dry winds caused a severe water shortage in Quang Tri province, with serious repercussions for both local agriculture and human health. Better management of riparian areas would be a cost-effective measure to offset erosion and siltation.

4. Stakeholders

The establishment of Phong Dien Nature Reserve will have implications for a number of different stakeholder groups. Whether these impacts will be positive or negative depends on the groups concerned and also the management strategy adopted for the nature reserve. Stakeholder groups can be divided into different groups of local resource users; downstream water users and farmers; government agencies (at district, provincial and national levels); and international organisations, such as donor agencies and non-governmental organisations (NGOs).

4.1 Local Communities

One of the key stakeholder groups is local people who live around the boundary of the nature reserve, and who depend on the forest in the area in various ways. Their current uses of forest resources and forest management practices are described in detail in Section 3. It is extremely important that their needs and perspectives are addressed in plans for the establishment and management of the nature reserve. This is because they are likely to be impacted most by the introduction of new management regulations. Furthermore, they are unlikely to respect management regulations if approaches to nature reserve management fail to take account of their needs.

4.2 Downstream Water Users

A second group of stakeholders is the large number of people who live and work downstream of the nature reserve. Poor management of the forest at Phong Dien Nature Reserve is likely to impact on these people through exposure to more intense and more sudden floods, and through shortages of water for irrigation, industry and domestic use. The links between upstream forest management within the nature reserve and buffer zone, and downstream water users are likely to be significant in economic terms.

4.3 Thua Thien Hue Provincial People's Committee

Thua Thien Hue Provincial People's Committee supports the establishment of Phong Dien Nature Reserve and has approved the feasibility study prepared by BirdLife International and the Forest Inventory and Planning Institute (FIPI), published in 1999 (Official Letter No. 572, dated 27 March 1999, to the Ministry of Agriculture and Rural Development (MARD)). If the provincial people's committee and MARD approve the contents of the investment plan, then the provincial people's committee will assume responsibility for establishing and managing the nature reserve.

4.4 Provincial and District Forest Protection Departments

The Forest Protection Department (FPD) of MARD, has responsibility for the management of the national network of Special-use Forests and their biodiversity. Work at provincial level is undertaken by Thua Thien Hue Provincial FPD. This department is responsible for enforcing forest management regulations in Thua Thien Hue province, through district FPD offices. Presently, Phong Dien and A Luoi District FPDs are responsible for managing all forest land and forest resources in the two districts. Once Phong Dien Nature Reserve is established, management responsibility for forest land and forest resources within the nature reserve will be transferred to the nature reserve management board, under the management of the provincial FPD.

Thua Thien Hue Provincial FPD have some experience of implementing biodiversity conservation activities. For example, they have implemented a conservation awareness programme supported by WWF (focussing on Tiger and threatened pheasant species), and have collaborated with WWF in the preparation of the *Hai Van Range Green Corridor Project* aimed at securing support for a landscape-level approach to biodiversity management. A number of FPD staff have been trained in different skills relating to biodiversity conservation, through projects supported by various conservation organisations.

At the district level, Phong Dien and A Luoi District FPDs work directly under the supervision of Thua Thien Hue Provincial FPD. Their main responsibilities are to:

- enforce forest management regulations in Phong Dien and A Luoi districts.
- monitor and extinguish forest fires.
- assist in the implementation of national forest development programmes, such as the 661 Programme and its predecessor, the 327 Programme.

Phong Dien District FPD has already coordinated with other district and local government agencies to conduct forest protection and conservation awareness programmes, with support from the WWF Indochina Programme. A Luoi District FPD has implemented social forestry activities that have included re-forestation activities, and allocation of forest protection contracts. These activities have been funded by the 327 and 661 Programmes, as well as the 'Fixed Settlement and Cultivation Programme'. Both district FPDs support the establishment of Phong Dien Nature Reserve. Furthermore, staff of Phong Dien District FPD played an important role in the development of the feasibility study (Le Trong Trai *et al.* 1999) and the development of this investment plan.

4.5 Phong Dien Forest Enterprise

Phong Dien Forest Enterprise is the only forest enterprise in Phong Dien district. The forest enterprise is supervised by the provincial department for agriculture and rural development (DARD). Presently, the main roles of Phong Dien Forest Enterprise are to implement forestry activities included in national and provincial forest development programmes.

Currently, the forest enterprise manages the project *Watershed Re-forestation in the West of Phong Dien, Period 1999-2010*, which forms part of the 661 Programme, and has a budget of VND 24,350 million. This project covers an area of 22,110 ha within Phong My, Phong Xuan, Phong Thu and Phong An communes. The main objectives of the project are to:

- protect 5,000 ha of natural forest, through the issuance of forest protection contracts.
- assist natural rehabilitation of 4,000 ha of forest land
- re-forest 3,600 ha of watershed protection forest.
- establish 715 ha of plantation forest.
- manage new and existing plantations.
- upgrade 20 km of local roads.
- construct two guard stations.

The target area of this project includes 6,254 ha of natural forest, 2,804 ha forest plantation, 9,525 ha of open land and bare hills, and 3,527 ha of other land (including agricultural and residential land). The forest enterprise manages 22 forest compartments within two buffer zone communes, covering 20,453 ha and comprising 93% of the total forest area of the forest enterprise. The boundary of the nature reserve will include 8,203 ha of this area, including eight forest compartments. Based on discussions with the forest enterprise, undertaken as part of the development of this draft investment plan, it would seem that these activities would be compatible with nature reserve management. Indeed, many of the activities of Phong Dien Forest Enterprise could be harnessed to complement nature reserve management. There is also scope for forest enterprise activities to be revised to focus more on social forestry activities within the buffer zone.

For the reasons outlined above, the forest enterprise supports the establishment of the nature reserve. The forest enterprise has indicated its support by signing an agreement letter that will allow forest compartments currently managed by the forest enterprise to be incorporated within the nature reserve.

In the first six years of the project, the forest enterprise has planted 1,817 ha of forest, including 632 ha of rubber plantation and 1,230 ha of forest plantations. A total of 1,065 ha of forest has been allocated to individual households through the issuance of forest protection contracts. The programme has been especially active near the villages of Ha Long and Khe Tran.

4.6 Bo River Watershed Protection Forest

The management board of Bo River Watershed Protection Forest, which has six members, is under the management of the provincial DARD. The aim of the management board is to protect and develop the forest of Bo River Watershed Protection Forest. The management board of Bo River Watershed Protection Forest Project is currently implementing a project entitled *Watershed Protection Re-forestation of the Bo River 1999 to 2010*, with support from the 661 Programme. This project is being implemented in 29,943 ha of forest land in Phong Dien, A Luoi and Huong Tra districts, including 19,262 ha in Phong Xuan, Phong Son, and Hong Ha communes in the buffer zone of Phong Dien Nature Reserve. All of this area lies outside the boundary of the nature reserve. The objectives of the project are to:

- protect 9,833 ha of forest, including 9,312 ha of natural forest and 521 ha of plantation forest.
- assist natural rehabilitation of 5,000 ha of land currently covered by scrub and 'scarred' forest.
- plant 2,000 ha of watershed protection forest and 2,000 ha of production forest.
- establish 700 ha of industrial crops, comprising 400 ha of sugar cane and 300 ha of rubber trees.

There is substantial scope for harnessing the benefits and activities of this project to complement and enhance the strategy for buffer zone management around Phong Dien Nature Reserve.

4.7 International Organisations and Projects

The Birdlife International Vietnam Programme has undertaken a number of biodiversity surveys in this area, and has drawn attention to the global significance of Phong Dien Nature Reserve for a number of species of conservation importance (see Section 2). BirdLife International, in collaboration with FIPI, also prepared the feasibility study for the nature reserve, which was published in 1999 (Le Trong Trai *et al.* 1999).

WWF have provided training to strengthen capacity of FPD staff in biodiversity conservation and management and have also supported a conservation awareness project in this area. WWF, in collaboration with Thua Thien Hue Provincial People's Committee, will shortly be submitting a proposal to the Global Environment Facility (GEF) entitled the *Hai Van Range Green Corridor Project*. Whilst the project area does not include Phong Dien, it is hoped that this project will help to improve provincial-level capacity to manage the forests and biodiversity of Thua Thien Hue province.

The Thua Thien Hue Rural Development Project, an 'integrated rural development project', operates in two districts of Thua Thien Hue province, one of which is Phong Dien. This project is currently working to identify priority/critical sub-catchments to improve the watershed protection services that the forests of Phong Dien district provide to downstream farmers, water users and residents.

5. Evaluation

5.1 Biodiversity Evaluation

It is known that levels of biodiversity in the remaining lowland forests of central Vietnam are high. However, comparisons with other protected areas in the region must be undertaken with care. Cuc Phuong National Park and Phong Nha Nature Reserve, which both protect lowland forest, are located in limestone areas, and, therefore, support a somewhat different complement of biodiversity to those of other lowland forest areas in central Vietnam (such as the forests of Khe Net proposed nature reserve and Ke Go Nature Reserve). Comparison with Ben En National Park should also be undertaken with care, as this area has been severely degraded by past forest management activities, and, consequently, supports lower levels of biodiversity, and fewer endemic, threatened and near-threatened species.

Lowland evergreen forest under 400 m altitude is the dominant forest type protected by Ben En National Park, Khe Net proposed nature reserve, and Ke Go, Dakrong and Phong Dien Nature Reserves. Lowland forest also occurs at Vu Quang, Pu Mat and Pu Huong Nature Reserves, and Pu Hoat and Pu Hu proposed nature reserves, although only as a small proportion of the total area of these sites. In terms of habitat conservation, the Annamese lowland forests are extremely threatened: perhaps the most threatened habitat type in Vietnam. Most Annamese lowland forests have already been cleared for agricultural land. The combined area of Phong Dien and Dakrong Nature Reserves would conserve the largest remaining area of this habitat type.

The fauna and flora of Phong Dien Nature Reserve were surveyed in 1998 (Le Trong Trai *et al.* 1999). Most of the information presented in this section is drawn from this report. Table 21 compares the number of threatened and near-threatened species that occur at Phong Dien and Dakrong Nature Reserves with four 'comparison' sites supporting lowland evergreen forest in central Vietnam: Ke Go and Phong Nha Nature Reserves, Khe Net proposed nature reserve and Bach Ma National Park.

Phong Dien Nature Reserve supports six of the nine restricted-range bird species that occur in the Annamese Lowlands Endemic Bird Area (EBA): Edwards's Pheasant, Annam Partridge, Crested Argus *Rheinardia ocellata*, White-cheeked Laughingthrush *Garrulax vassali*, Short-tailed Scimitar Babbler *Jabouilleia danjoui* and Grey-faced Tit Babbler *Macronous kelleyi*. In addition, Imperial Pheasant *Lophura imperialis*, which was recorded at Dakrong Nature Reserve in 2000, may also occur at Phong Dien. Of the 16 threatened and near-threatened bird species recorded at Phong Dien and Dakrong Nature Reserves to date, two species are endemic to Vietnam (Annam Partridge, Edwards's Pheasant) and four species are endemic to Indochina (Red-vented Barbet *Megalaima lagrandieri*, White-cheeked Laughingthrush, Grey-faced Tit Babbler and Short-tailed Scimitar Babbler) (Robson 2000).

Since the publication of the feasibility study for Phong Dien and Dakrong Nature Reserves (Le Trong Trai *et al.* 1999), Edwards's Pheasant has also been recorded in Bao Ninh district, Quang Binh province, and in Phu Loc district, Thua Thien Hue province. However, Phong Dien and Dakrong Nature Reserves remain the only protected areas known to support this species. Rather little information is available on the population of Edwards's Pheasant but reports from hunters suggest that this species is still relatively common at Phong Dien Nature Reserve. Information is also lacking on the status of other key species, such as Annam Partridge and Short-tailed Scimitar Babbler. Hunters and other villagers report that Crested Argus is still common. When established, Phong Dien will become one of only three protected areas known to support Annam Partridge. In addition, Imperial Pheasant has been recently found in an area adjacent to the nature reserve and may also occur within the boundaries of the nature reserve. For these reasons, Phong Dien Nature Reserve is considered an important part of the Annamese Lowlands EBA.

The mammal fauna of Phong Dien Nature Reserve includes 11 globally threatened species, as well as two recently described large mammal species: Saola and Giant Muntjac (the latter may be locally common). The populations of other large mammals at Phong Dien and Dakrong Nature Reserves are small in size and fragmented, presumably due to the effects of hunting and disturbance. Four mammals recorded at Phong Dien are endemic to Indochina: Buff-cheeked Gibbon, Red-shanked Douc Langur, Giant Muntjac and Saola.

Table 21: Globally Threatened and Near-threatened Bird Species Recorded at Five Sites in Central Vietnam

Species	Status	PD-DR	KG	PN	BM	KN
Edwards's Pheasant <i>Lophura edwardsi</i>	CR	*			*	
Imperial Pheasant <i>Lophura imperialis</i>	CR		*			*
Vietnamese Pheasant <i>Lophura hatinhensis</i>	EN		*			*
Annam Partridge <i>Arborophila merlini</i>	EN	*	*		*	*
Chestnut-necklaced Partridge <i>Arborophila charltonii</i>	VU	*	*			*
Siamese Fireback <i>Lophura diardi</i>	VU	*	*	*	*	*
Crested Argus <i>Rheinardia ocellata</i>	VU	*	*		*	*
Blyth's Kingfisher <i>Alcedo hercules</i>	VU	*	*		*	*
Red-collared Woodpecker <i>Picus rabieri</i>	VU	*	*		*	*
Sooty Babbler <i>Stachyris herberti</i>	VU			*		
Short-tailed Scimitar Babbler <i>Jabouilleia danjoui</i>	VU	*	*		*	*
Coral-billed Ground Cuckoo <i>Carpococcyx renauldi</i>	NT	*	*		*	*
Brown Hornbill <i>Anorrhinus tickelli</i>	NT	*	*	*	*	*
Blue-rumped Pitta <i>Pitta soror</i>	NT	*	*	*	*	*
Bar-bellied Pitta <i>Pitta elliotii</i>	NT	*	*	*	*	*
Grey-faced Tit Babbler <i>Macronous kelleyi</i>	NT	*	*		*	*
White-winged Magpie <i>Urocissa whiteheadi</i>	NT	*	*	*	*	*
Indochinese Green Magpie <i>Cissa hypoleuca</i>	NT	*	*	*		*
Yellow-vented Green Pigeon <i>Treron seimundi</i>	NT	*				
Total	19	16	16	7	13	16

Notes: PD-DR = Phong Dien and Dakrong Nature Reserves; KG = Ke Go Nature Reserve; PN = Phong Nha Nature Reserve; BM = Bach Ma National Park; KN = Khe Net proposed nature reserve.

Status: CR = Critical; EN = Endangered; VU = Vulnerable; NT = Near Threatened as per Collar *et al.* (1994).

Other faunal taxa at Phong Dien Nature Reserve are poorly known. Fifty three species of reptile and amphibian have been recorded at Phong Dien and Dakrong Nature Reserves, including two species endemic to Vietnam *Rana microlineata* and *Cistoclemmys galbinifrons*.

Five plant species recorded at Phong Dien and Dakrong Nature Reserves are endemic to Vietnam: *Baccaurea silvestris*, *Breynia septata*, *Macaranga eberhardtii*, *Dendrobium amabile* and *Calamus poilanei*. In addition, one species of *Calophyllum* may be new to science.

Phong Dien and Dakrong Nature Reserve support 47 species listed in the *IUCN Red Lists of Threatened Animals and Plants* (IUCN 1996, 1997) and 65 species listed in the *Red Data Books of Vietnam* (Anon. 1992, 1996) (Table 22).

Table 22: Red-listed Species Recorded at Phong Dien and Dakrong Nature Reserves

Group	Total No. of Species	Total No. of Red-listed Species	No. of Species in IUCN Red Lists	No. of Species in Red Data Books of Vietnam	% of Species Red-listed
Mammals	43	23	17	17	53
Birds	171	23	16	17	13
Reptiles	38	16	6	15	42
Amphibians	19	4	0	4	21
Butterflies	213	0	0	0	0
Plants	597	16	5	14	3
Total	1,081	82	44	67	8

5.2 Threat Evaluation

As outlined in Section 3, the forest and biodiversity at Phong Dien Nature Reserve are threatened by a number of factors. These threats are highly location specific: a significant threat in one area may be

insignificant in another. Threats are also dynamic, and have changed greatly over time. The impact of war has been dramatic, and, while the indirect legacy of war continues to exert an influence on forests and wildlife, new threats are now more significant. Hunting levels are now probably lower than in the post-war years (due to lower animal abundance and lower availability of weapons) but high hunting levels in the past may have contributed to the low wildlife abundance at the site today. It is also possible that hunting patterns have changed in response to lower animal numbers, with the use of snaring now more common than in previous years. Forest fires continue to exert an important and widespread influence on forest cover but clearance of forest for swidden agriculture is now less common.

Different threats have distinctly different impacts on forests and wildlife. For example, it seems likely that the most direct threat to the wildlife of Phong Dien is hunting, as this has a selective impact on species of highest conservation concern, notably ground birds and large mammals. Nearly half the mammals known to occur at Phong Dien are considered globally threatened, and these are usually the species most vulnerable to hunting. In the case of large carnivores, such as Tiger and Clouded Leopard, high hunting pressure on prey species (such as Wild Pig *Sus scrofa* and Indian Muntjac *Muntiacus muntjak*) may have contributed significantly to the low population of carnivores at Phong Dien today. However, hunting does not have a direct impact on forest cover and composition as a whole. Alongside hunting, collection of timber and non-timber forest products (NTFPs) may well represent the most substantive threat to remaining forests. Further research will be required to understand better whether these practices are being undertaken at sustainable or non sustainable levels, and to explore ways of addressing these issues effectively.

Future management strategies must, therefore, be tailored to address specific conservation objectives, and to the needs of each specific area.

The following list provides an overview of the range of threats facing the forests of Phong Dien:

- hunting (particularly through use of snares).
- collection of firewood and other NTFPs (although sustainable levels require assessment).
- illegal timber extraction (either for house construction or by illegal loggers from outside the area).
- forest fires (associated with swidden cultivation; set deliberately to collect metal from bomb and shell casings; or caused by spontaneous detonation of unexploded ordnance).
- clearance of forest land for agriculture.

5.3 Institutional Evaluation

Section 4 outlines the key institutional and other stakeholders of Phong Dien Nature Reserve. This section briefly reviews capacity strengthening requirements for key institutions to promote effective conservation management.

Thua Thien Hue Provincial People's Committee will have overall responsibility for establishing and administering the nature reserve management board. To date, established Special-use Forests cover approximately 8% of Thua Thien Hue province. The establishment of Phong Dien Nature Reserve will increase this proportion to 15%. To enable effective conservation management of the new Special-use Forest, the provincial people's committee will require funding support to enable them to assign a budget for nature reserve management (to be administered by the nature reserve management board).

Conventionally, funding support is made available from the central government, through the Ministry of Agriculture and Rural Development (MARD). However, since the forest at Phong Dien is likely to play a key role in downstream flood mitigation and water supply, consideration might also be given to finding other sources of funding support at provincial level, for example from budgets allocated for flood control or for irrigation management. Funding mechanisms such as these have been introduced in other parts of South-East Asia and world-wide, and can help internalise forest management costs to other downstream beneficiaries.

The provincial and district forest protection departments (FPDs) have some experience of managing forest conservation projects (see Section 4). However, there will be a considerable need to strengthen management and technical capacity at these levels if the new nature reserve is to be managed effectively.

Examples of skill areas that will need strengthening through training include:

- skills in working with local communities.
- day-to-day nature reserve management skills (such as patrolling, documenting observations and management activities, and budget management).
- technical skills in biodiversity and forest survey.
- monitoring skills (using both scientific and participatory approaches).

District and provincial FPDs will also need improved access to:

- information resources, such as technical information on biodiversity (field guides, etc.).
- awareness materials.
- equipment essential for day-to-day reserve management, such as motorbikes and communications equipment.

The provincial people's committee might give consideration to developing a project concept for consideration for funding by international organisations to support management of this area. Links should also be explored with forest management colleges and other training organisations, in order to enhance capacity on a longer-term basis.

Phong Dien Forest Enterprise and Bo River Watershed Protection Forest will have important roles to play in supporting buffer zone management. Currently, most of the funding for these stakeholders originates from the 661 Programme (and its predecessor, the 327 Programme). This change in role implies a shift in emphasis (particularly for the forest enterprise) towards the provision of extension advice and greater attention to activities relating to land allocation. Training and increased levels of awareness will be needed to ensure that buffer zone management activities support the biodiversity conservation objectives of the nature reserve.

5.4 Economic Evaluation

Least-cost Alternative

If the costs associated with establishing and managing Phong Dien Nature Reserve (Thua Thien Hue province) are lower than for other sites of comparable conservation value, it should be given priority for establishment, in order to ensure the most efficient use of the limited funds available for conservation in Vietnam. Furthermore, if the cost of establishing and managing the nature reserve is low, resources available for conservation, either from the province, the government or international donors, can be allocated more effectively.

Factors that can be expected to reduce the cost of establishing and managing Phong Dien Nature Reserve include the following:

- recruitment of forest protection staff is not necessary, as existing staff will be transferred to the nature reserve from within the provincial forest protection and development departments.
- most of the objectives of buffer zone management can be achieved through ensuring that buffer zone management objectives are integrated into other nationally and internationally funded initiatives, such as the work programmes of Phong Dien Forest Enterprise and Bo River Watershed Protection Forest, and the on-going Thua Thien Hue Rural Development Programme.
- the road between the nature reserve headquarters in Phong My commune and National Highway 1 has been recently upgraded, and so will provide good access for nature reserve management and buffer zone development work.
- there are no villages within the strict protection area, therefore there are no cost implications associated with relocation and resettlement.

- the buffer zone development programme will be relatively inexpensive, because the major focus will be on extension and awareness activities, and there will be relatively little expenditure on infrastructure development.
- the adjacent Dakrong Nature Reserve in Quang Tri province has already been established, therefore there is no need to establish guard stations along the northern and north-western boundaries of Phong Dien Nature Reserve.
- funds from the 661 Programme have already been allocated for social forestry activities in the buffer zone, including Phong Dien Forest Enterprise and Bo River Watershed Protection Forest.

Factors that can be expected to increase the cost of establishing and managing Phong Dien Nature Reserve include the following:

- the nature reserve lies within an area that is often affected by floods during the rainy season, which will increase the costs of constructing and maintaining nature reserve infrastructure.
- FPD personnel in Thua Thien Hue province lack experience in Special-use Forest management, which will require investment in staff training.
- investment will be required to increase the capacity of Phong Dien and A Luoi District FPDs and other institutions involved in the buffer zone development programme.

In summary, Phong Dien Nature Reserve can be considered to be a relatively low-cost option for establishing a Special-use Forest to protect lowland evergreen forest habitats in central Vietnam.

Opportunity Cost

If Phong Dien Nature Reserve is established, the provincial and district authorities will experience an opportunity cost, in terms of loss of benefits that could otherwise be gained from managing the area in an alternative way. These might include the financial benefits that could have been derived from logging or converting the area to other land-uses. However, these costs are relatively low, largely because:

- the economic value of the forest resources within the nature reserve has already been severely reduced by logging, wartime spraying of defoliants, forest fires, etc.
- conversion of the area to other land-uses, such as agriculture, is severely constrained, since much of the area lies on steeply sloping and inaccessible land.

Conversely, the costs of allowing the forest at Phong Dien Nature Reserve to degrade further could substantially outweigh the opportunity costs of conserving these forests. This is because, the forest is likely to provide a range of services to downstream inhabitants, such as flood control, water supply and the prevention of soil erosion (see Section 4).

5.5 Evaluation of Other Potential Benefits

Phong Dien Nature Reserve is known to support 175 commercially valuable timber species, including *Erythrophleum fordii*, *Sindora siamensis*, *S. tonkinensis*, *Madhuca pasquieri*, *Heritiera cochinchinensis* and *Nageia wallichiana*. There is, therefore, potential for the nature reserve to act as a seed supply for social forestry outside the boundaries of the nature reserve. In future, it may also be possible to design and implement a plan for the sustainable management and exploitation of timber and NTFPs from the area, although this will need careful ecological and market research, management and monitoring.

Areas of degraded forest around the nature reserve are actually valued more highly by local people (see Section 3) than 'rich' forests, which are usually only found far from the villages. Money allocated for natural regeneration (through forest protection contracts) and buffer zone management could be used to enhance these values and increase returns from high value timber and non-timber species.

The nature reserve is known to support at least 159 medicinal plant species and 41 ornamental plant species. The medicinal plant species are valuable and widely used by local people. The potential pharmaceutical value of these plant species remains largely unstudied. The area also comprises a reservoir

for a wide range of species that may have future value for plant breeding, agriculture, horticulture and animal husbandry.

Unfortunately, the low density of large mammals, combined with a lack of prominent landscape features, limits the potential of the area for ecotourism. The nearest area of interest for tourism is Hue city and some residual tourism could be expected to reach the nature reserve. With a creative approach to marketing, it would be possible to develop niche aspects of tourism in Phong Dien, especially if combined with visits to other sites in the area. For example, the Tam Giang-Cau Hai lagoon system, Bach Ma National Park and the A Luoi valley, as well as the features of historical and cultural interest in Hue city.

Features that might appeal to niche market tourism might include:

- Khe Me waterfall in Phong My commune.
- A Nor waterfall in Hong Kim commune.
- the Thanh Tam hot springs in Phong Son commune.
- adventure trekking along a disused road that connects the A Luoi valley to Khe Tran village, Phong Dien district.
- visits to ethnic minority villages. The ethnic minorities inhabiting the area include the Pa-hi, Pa-co and Van Kieu. While the lifestyles of these people may be of considerable interest to tourists and tour operators, care must be taken to ensure that tourism is developed sensitively, and that local people receive tangible benefits.

6. Management Planning for Phong Dien Nature Reserve

6.1 Special-use Forest Name

The name of the Special-use Forest should be Phong Dien Nature Reserve. This was the name proposed by the feasibility study published in 1999 (Le Trong Trai *et al.* 1999), and is also the name included on the '2010 List', a proposed system of Special-use Forests prepared by Forest Protection Department (FPD) of the Ministry of Agriculture and Rural Development (MARD) (FPD 1998).

6.2 Rationale for Designation of Special-use Forest Category

The system of Special-use Forests in Vietnam has three management categories: national parks, nature reserves, and cultural and historical sites. Phong Dien should be established with the status of nature reserve.

6.3 Management Objectives of the Special-use Forest

The management objectives of Phong Dien Nature Reserve should be to:

- conserve a representative component of the forests and biodiversity of the Annamese lowlands.
- conserve populations of globally threatened and endemic species.
- protect and enhance ecosystem services, for example watershed protection for the My Chanh, O Lau and Bo rivers.
- provide a resource for monitoring and research of forest resources and wildlife.
- facilitate the integration of biodiversity conservation needs with the socio-economic needs of communities living around the periphery of the nature reserve.
- provide a resource for environmental education, and promote sustainable approaches to forest and land-use management.

6.4 Management Responsibility for the Special-use Forest

Management responsibility for Phong Dien Nature Reserve should rest with Thua Thien Hue Provincial People's Committee. The day-to-day management of the nature reserve should be carried out by a management board, under the provincial FPD. Administrative duties should include the management and protection of the nature reserve, including the implementation of projects designed to support the implementation of the management objectives outlined above. MARD, on behalf of the government, should be responsible for providing technical and financial resources, as well as for seeking support from international donors for the implementation of the investment plan.

6.5 Physical Description of Boundary and Justification

Description

In the north and west, the nature reserve boundary should follow the border between Quang Tri and Thua Thien Hue provinces; and the nature reserve should be contiguous with Dakrong Nature Reserve to the west. In the east, the boundary should follow the eastern boundaries of forest compartments 889, 897, 899, 905, 923, 929, 940, 1029 and 1030. In the south, the boundary should follow the southern boundaries of forest compartments 1030, 1032, 1033, 1034 and 1027. As defined here, the boundary of Phong Dien Nature Reserve includes an area of 41,548 ha, comprising 42 forest compartments located within four communes (Map 5).

Justification

The boundary of Phong Dien Nature Reserve was delineated according to the following criteria:

- (a) **Forest Condition.** The boundary includes contiguous forest areas that remain in relatively 'good' condition, and which are likely to have high value for sustaining biodiversity.

- (b) **Habitat Requirements of Key Species.** Some species of conservation concern that occur at the nature reserve, for example Tiger and Gaur, have large territories and/or home ranges. The overall extent of the nature reserve has, therefore, taken into account these ecological criteria.
- (c) **Existing Patterns of Land-use and Human Settlement.** The boundary has been adjusted to minimise potential conflicts with local communities, based on information collected during village-level research undertaken as part of the investment plan research phase. There are no villages or village lands within the nature reserve boundary.
- (d) **Topography.** Wherever possible, the boundary follows topographical features, such as ridge tops and watercourses, to assist local communities and nature reserve managers to demarcate the boundary on the ground.

6.6 Management Zoning

Phong Dien Nature Reserve should be zoned into a strict protection area and a forest rehabilitation area. These areas should be further sub-divided into two strict protection sub-areas and two forest rehabilitation sub-areas (Table 23). In addition, an administration and services area and a buffer zone should be established outside of, but adjacent to, the nature reserve (Map 5).

Table 23: Coverage of Forest Quality Categories (in hectares)

Area	Rich Forest	Medium Forest	Poor Forest	Regenerating Forest	Scattered Trees	Scrub and Grassland	Total
SP I	0	1,071	6,972	3,611	1,152	137	12,942
SP II	8,114	1,562	1,455	344	682	737	12,894
FR I	0	0	900	1,882	5,752	0	8,535
FR II	0	295	2,614	213	1,418	2,638	7,177
Total	8,114	2,928	11,940	6,050	9,004	3,512	41,548

Notes: SP = Strict Protection Sub-area; FR = Forest Rehabilitation Sub-area.

Strict Protection Area

The management objective of the strict protection area should be to provide protection for habitats and wildlife. In this area, most activities affecting forest and forest resources should be prohibited. Prohibited activities should include logging, cutting of fuelwood, resin extraction, hunting and trapping. Limited and managed access to forest resources should be granted for forest resource utilisation that is compatible with sustaining forest cover and biodiversity. These activities should include collection of fallen wood, rattans, honey and medicinal plants. These activities should be monitored carefully to ensure that they are sustainable and do not adversely affect biodiversity resources within the core zone. Table 24 provides more details of the management regime for the strict protection area.

The strict protection area should cover 25,836 ha, including 23,129 ha of natural forest. The area should be further sub-divided into two sub-areas:

- (a) **Strict Protection Sub-Area I.** This sub-area should cover 12,942 ha, comprising 12 forest compartments in the catchments of the My Chanh and O Lau rivers. Most of the forest in this sub-area is heavily disturbed as a result of napalm, bombing and spraying of defoliants during the Second Indochina War, and subsequent forest fires and illegal cutting of timber. In silvicultural terms, the forest contains stands of 'medium' timber, as well as regenerating forest of various ages. Despite the history of past disturbance, a number of globally threatened species have been confirmed in this area, including Edwards's Pheasant, Annam Partridge, Crested Argus, Tiger, Gaur, Bear Macaque *Macaca arctoides*, Pig-tailed Macaque *M. nemestrina* and Red-shanked Douc Langur.
- (b) **Strict Protection Sub-Area II.** This sub-area should cover 12,894 ha, comprising 13 forest compartments in the upstream catchments of the Rao Trang and Rao La streams. With the exception of avifaunal data, there is rather little information on the biodiversity value of this sub-area available. In silvicultural terms, 'rich' forest covers 8,114 ha of the sub-area.

Table 24: Management Regime for the Strict Protection Area

Activity	Impacts	Management
Timber extraction	Forest fragmentation, habitat loss, loss of animal and plant species	Strictly prohibited
Charcoal production	Forest fragmentation, habitat loss, loss of animal and plant species, air and ground pollution	Strictly prohibited
Fragrant oil distillation	Forest degradation, habitat loss, loss of plant species, disturbance to natural regeneration	Strictly prohibited
Mining	Forest and habitat loss, pollution, loss of animal and plant species	Strictly prohibited
Construction of roads, houses and other infrastructure	Forest and habitat loss, disturbance to wildlife, pollution	Strictly prohibited
Hunting and trapping, especially Edwards's Pheasant	Loss of animal species, disturbance to wildlife, especially ground-dwelling birds, such as Edwards's Pheasant and Annam Partridge	Strictly prohibited
Fishing with poison or dynamite	Habitat loss, loss of animal species, pollution	Strictly prohibited
Livestock grazing	Retardation of natural regeneration, disturbance of wildlife and habitats	Strictly prohibited
Forest fire	Forest and habitat loss	Strictly prohibited
Ornamental plant collection	Unknown but could threaten plant populations	Strictly prohibited
Firewood collection	Disturbance to natural regeneration	Limited and regulated
Rattan collection	Habitat loss, disturbance of wildlife	Limited and regulated
Medicinal plant collection	Loss of plant species, potential habitat disturbance	Limited and regulated
Honey collection	Possible fire hazard	Limited and regulated

Follows Decision No. 1171/QĐ of the Minister of Forestry, dated 30 December 1986.

Forest Rehabilitation Area

The management objective of the forest rehabilitation area should be to restore high quality, natural forest cover in degraded forest areas. This should be achieved through promoting natural regeneration and, where necessary, 'enhanced' natural regeneration through selective planting of native species. Table 25 provides more detail on the management regime for the forest rehabilitation area.

Table 25: Management Regime for the Forest Rehabilitation Area

Activity	Impacts	Management
Timber extraction	Forest fragmentation, habitat loss, loss of animal and plant species	Strictly prohibited
Fragrant oil distillation	Forest degradation, habitat loss, loss of plant species, disturbance to natural regeneration	Strictly prohibited
Re-forestation with non-native tree species	Habitat loss, loss of plant and animal species	Strictly prohibited
Hunting and trapping	Loss of animal species, habitat disturbance	Strictly prohibited
Mining	Forest and habitat loss, pollution, loss of animal and plant species	Strictly prohibited
Construction of roads, houses and other infrastructure	Forest and habitat loss, disturbance to wildlife, pollution	Strictly prohibited
Livestock grazing	Retardation of natural regeneration, disturbance of wildlife and habitats	Strictly prohibited
Forest fire	Forest and habitat loss	Strictly prohibited
Clearance of forest for cultivation	Forest and habitat destruction, loss of animal and plant species	Strictly prohibited
NTFP collection	Over-exploitation may lead to loss of plant species and habitat loss	Limited and regulated
Honey collection	Possible fire hazard	Permitted
Re-forestation with indigenous tree species	Habitat expansion, maintenance of biodiversity	Encouraged
Forest protection contracts	Habitat protection, maintenance of biodiversity	Encouraged

Follows Decision No. 1171/QĐ of the Minister of Forestry, dated 30 December 1986.

The forest rehabilitation area should cover 15,712 ha, including 5,904 ha of natural forest. The area should be further sub-divided into two sub-areas:

- (a) **Forest Rehabilitation Sub-Area I.** This sub-area should cover 8,535 ha in the north of the nature reserve, and include most of the upstream catchment of the My Chang river. The forest habitats of this sub-area were severely degraded during the Second Indochina War by napalm, bombing and spraying of defoliants. The sub-area is dominated by secondary vegetation, including regenerating forest, scrub and grassland. Natural forest currently covers 33% of the sub-area.
- (b) **Forest Rehabilitation Sub-Area II.** This sub-area should cover 7,177 ha in the catchment of the O Lau river. Most primary vegetation in this sub-area was destroyed during the Second Indochina War but, 30 years on, there are signs that the forest is recovering. Natural forest currently covers 44% of the sub-area. Local people reported that a small group of Gaur occurs in this area and that Edwards's Pheasant have been trapped in this area on a number of occasions.

Administration and Services Area

An administration and services area should be designated for development of infrastructure relating to the management of Phong Dien Nature Reserve. The administration and services area should be located outside the boundary of the nature reserve. Initially, the nature reserve headquarters should be located at the existing Phong My guard station. In the future, the headquarters should be moved to Khe Tran village, adjacent to the road crossing of the O Lau river.

Buffer Zone

The management objective of the buffer zone should be to encourage patterns of resource use that alleviate pressure on the forest and biodiversity of Phong Dien Nature Reserve. Further consideration will be needed as to how best to achieve this broad objective. Section 3 draws attention to a number of potentially cost-effective ways of addressing this objective. Some of these would also help to address broader development goals associated with poverty reduction.

Vietnam's forest management guidelines specify that the buffer zone should include all communes located adjacent to the boundary of the nature reserve. There are, therefore, eight communes, that should be categorised as part of the buffer zone of Phong Dien Nature Reserve: Phong My, Phong Xuan and Phong Son communes, Phong Dien district, and Hong Van, Hong Kim, Hong Ha, Hong Trung and Bac Son communes, A Luoi district. The total area of the buffer zone should be 55,133 ha (Table 26). Parts of Phong Dien Forest Enterprise and Bo River Watershed Protection Forest are also included within the nature reserve and buffer zone.

Table 26: Commune Areas in the Nature Reserve and Buffer Zone

Commune	Total Area (ha)	Area in Nature Reserve (ha)	Area in Buffer Zone (ha)
Phong My	39,400	29,251	10,149
Phong Xuan	15,740	5,328	10,412
Phong Son	11,530	0	11,530
Hong Van	3,990	0	3,990
Hong Trung	6,791	0	6,791
Bac Son	1,044	0	1,044
Hong Kim	4,086	2,924	1,162
Hong Ha	14,100	4,045	10,055
Total	96,681	41,548	55,133

7. Proposed Project Activities and Indicative Costs

Following official guidelines for feasibility studies and investment plans, management activities for the nature reserve should be divided into the following five programmes:

- protection.
- rehabilitation.
- monitoring and research.
- awareness and extension.
- tourism development.

An additional programme focussing on socio-economic development in the buffer zone will be outlined in a separate investment plan, to be prepared after the approval of this investment plan.

7.1 Protection Programme

Infrastructure Development Component

This should be the priority activity during the first year of the five-year programme. This component should include discussing and formally announcing the establishment of the nature reserve, demarcating the nature reserve boundary, building headquarters and guard stations, and upgrading roads necessary for patrolling.

A meeting should be held to formally announce the establishment of the nature reserve, explain the boundaries of both the nature reserve and buffer zone, and explain the management regulations for the nature reserve. Participants at the meeting should include representatives of the relevant provincial, district and commune authorities, as well as village leaders. The management board of Phong Dien Nature Reserve should also hold a series of demarcation workshops to seek agreement on the zoning of the nature reserve from leaders of the relevant districts, communes, state enterprises and other stakeholders.

Following these workshops, the nature reserve management board should implement the following activities:

- (a) Boundary Demarcation.** This is normally achieved through the construction of boundary pillars to mark the nature reserve boundary. These boundary pillars should be made of concrete and set at spacings of between 100 and 150 m along the boundary in Ha Long village, Phong My commune, as well as Hong Van, Hong Kim and Hong Ha communes, A Luoi district. Boundary pillars should also be placed where trails lead into the nature reserve. It is estimated that 150 boundary pillars will be required to demarcate the boundary, at an estimated cost of VND 75 million.
- (b) Regulation Board Setting.** These should be posted at the nature reserve headquarters, guard stations, villages, communes and at the entrance of trails leading into the nature reserve. Regulation boards should be posted in Ha Long village; at the nature reserve headquarters in Phong My commune; Khe Me waterfall, Phong Xuan commune; Ha Long commune; A Nor waterfall, Hong Kim commune; and Khe Lum, on Provincial Road 71, Hong Van commune. It is estimated that the total cost of this sub-component will be VND 60 million.
- (c) Headquarters Construction.** Temporarily, this should be located at the existing Phong My guard station. In future, a new headquarters should be constructed adjacent to the O Lau river, at the crossing of the road that connects Khe Tran village with Phong My commune centre. The exact location should be on the Phong My side of the river crossing (i.e. prior to crossing the river when leaving Phong My commune centre) and immediately to the south of the road. This will enable access from Phong My commune centre even when river levels are high. The headquarters building should also function as Khe Tran guard station (see below). The headquarters building

should provide approximately 1,000 m² of office space. The estimated cost will be VND 2,000 million.

- (d) **Guard Station Construction.** These should provide bases for conducting regular patrols of the nature reserve, and should be built at six locations (Map 5). Each guard station will cost an estimated VND 250 million (including design).
- (i) *My Chanh Guard Station.* This should be located on the My Chanh river in Hai Lang district, Quang Tri province. This guard station should provide a base for conducting regular patrols of forest rehabilitation sub-area I.
 - (ii) *Khe Tran Guard Station.* This should be located at the nature reserve headquarters, near to Khe Tran village (see above). This guard station will provide a base for patrols of strict protection sub-area I and forest rehabilitation sub-area I. It will also provide a base for working with local communities in Phong My commune (for example, to assist and monitor the implementation of forest protection and re-afforestation activities in forest rehabilitation sub-area I).
 - (iii) *Phong Son Guard Station.* This should be located in Phong Son commune (16°29'N 107°22'E). This guard station will provide a base for managing the forest resources of strict protection sub-area II, within the Rao Trang river basin.
 - (iv) *Hong Van Guard Station.* This should be located along National Highway 14 at the junction with Provincial Road 71, in A Luoi district (16°21'N 107°09'E). This guard station will provide a base for managing and protecting the forest resources of strict protection sub-area II, within the upstream catchment of the Rao Trang river.
 - (v) *Hong Kim Guard Station.* This should be located along National Highway 14 in A Luoi district, where a trail leads to A Nor waterfall (16°17'N 107°13'E). This guard station will provide a base for protecting the forest resources of strict protection sub-area II, in the upstream catchment of the Bo river.
 - (vi) *Hong Ha Guard Station.* This should be located along Provincial Road 547 (from A Luoi town to Hue city), near the river crossing at Vi Le (16°17'N 107°20'E). This guard station will provide a base for managing the south-east of the nature reserve in Hong Ha commune, and part of the upstream catchment of the Bo river.
- (e) **Road and Trail Upgrading.** This should focus on improving access for conservation and management activities, and improving visitor access to key features, such as waterfalls. Trails that will require upgrading include:
- (i) *A Nor Waterfall Trail.* This will also improve access for birdwatchers and other groups interested in natural history.
 - (ii) *Provincial Road 71.* Upgrading of this 50 km trail would enable adventure trekking and specialist natural history interest groups to walk from Hong Van commune to Phong My commune. This should not be considered a priority in the short and medium term for reasons of cost. Care is also required, as there is a risk that this will improve access for illegal activities, such as hunting and illegal logging. The estimated cost for improving this trail would be around VND 500 million.

Conservation and Protection Component

The objectives of this component should be to conserve and protect the forest and biodiversity of the nature reserve and to effectively implement nature reserve management regulations.

Activities in this component should include:

- development of a detailed workplan for each guard station, outlining the objectives of forest protection activities, and the scope of activities to be undertaken.
- preparation of weekly, monthly and annual guard schedules for each guard station and mobile protection team.
- enforcement of nature reserve management regulations, with a focus on controlling hunting, trapping, non-timber forest product (NTFP) collection and logging.
- regular liaison with households taking part in the protection and rehabilitation programmes.
- formulation and implementation of a plan for forest fire prevention and control.

7.2 Rehabilitation Programme

The objectives of this programme should be to increase forest cover within the nature reserve by activities that promote the rehabilitation of degraded forest areas; and to provide opportunities for income generation for local communities living around the nature reserve. This programme should be implemented in the forest rehabilitation area of the nature reserve. In most cases, re-forestation through natural regeneration will be the most appropriate and cost-effective method of forest regeneration. However, in some cases, assisted natural regeneration may be more appropriate, for example, in areas where *Imperata* grassland will constrain the regeneration of natural forest. Particular attention should be paid to learning from and building upon on-going experience of the Thua Thien Hue Rural Development Project, which is currently exploring watershed protection management in Phong Dien district.

Where assisted natural regeneration is justified, activities might include:

- design of a detailed forest regeneration programme for the forest rehabilitation area.
- selection of appropriate indigenous tree species.
- collection of seedlings of local trees.
- design and establishment of nurseries to provide young trees for regeneration and agroforestry programmes.
- development of guidelines for nursery, planting and post-planting care.

The total costs of this programme are estimated to be VND 6,025 million, although it must be emphasised that costs could be significantly reduced by opting for natural regeneration, wherever possible. The following sections provide more detailed guidance.

Forest Restoration and Plantation Component

Areas of scrub, grassland and scattered trees, totalling 2,456 ha, in forest rehabilitation sub-areas I and II, should be allocated to individual households in Phong My commune for the purpose of natural regeneration (in line with Prime Ministerial Decision No. 202/TTg, dated 2 May 1994). Households allocated land for natural regeneration should receive VND 90,000 in the first year and VND 80,000 in subsequent years for five years.

Areas of bare land and scrub that are unable to regenerate naturally should be replanted with native tree species. It is estimated that this will cover an area of approximately 788 ha, distributed in forest rehabilitation sub-areas I and II. Appropriate native tree species may include *Hopea odorata*, *Madhuca pasquieri*, *Peltophorum dasyrrhacis*, *Erythrophleum fordii*, *Sindora siamensis* and *S. tonkinensis*. It is important that planting is undertaken with a mix of different species in order to improve habitat and forest quality for conservation.

This component will cost at an estimated VND 4,149 million over five years.

Forest Protection Component

The objectives of this component should be to promote conservation through involving local communities in nature conservation, through the allocation of forest protection contracts to individual households. A total of 6,950 ha of forest, including 'rich' forest and secondary forest (in various stages of regeneration)

should be allocated through forest protection contracts to households living in the buffer zone. Households allocated forest land should receive VND 70,000 per ha for the first year and VND 50,000 per ha for subsequent years. Note that villagers in a number of villages around the nature reserve claim that they do not receive the full amount to which they are entitled through the forest protection contract system. The estimated cost of this component will be VND 1,876 million over five years.

7.3 Monitoring and Research Programme

The objectives of this programme should be to provide biological information to assist with the protection and management of the nature reserve. This programme should also monitor habitat condition, key biodiversity indicators, and threats to biodiversity, such as hunting levels, the frequency and extent of forest fires, and levels of extraction of timber and NTFPs. This programme can also be used as a tool for enhancing the capacity and knowledge of the nature reserve staff, and provides an opportunity to engage with other relevant institutions, such as forestry training colleges, universities and research institutes.

Activities in this programme should include:

- preparation of a research programme that focuses on key themes relevant to nature reserve monitoring and management.
- identification of indicator species for biodiversity monitoring.
- detailed field surveys of the flora and fauna of the nature reserve.
- studies of the population sizes and distribution of key species, in particular Edwards's Pheasant.
- on-going monitoring of forest cover and condition.
- assessment of natural and assisted regeneration within the nature reserve.

The cost of this programme is estimated at VND 4,300 million.

Access to training will be required if these tasks are to be managed and implemented effectively. Options for linkages with governmental institutions (such as Xuan Mai Forestry College, the Forest Sciences Institute of Vietnam and various universities) and non-governmental organisations (NGOs) (such as the BirdLife International Vietnam Programme, the WWF Indochina Programme and Fauna and Flora International-Indochina Programme) should be explored.

7.4 Awareness and Extension Programme

The objectives of this programme should be to involve local communities in conservation, to promote the sustainable use of the natural resources of the nature reserve, and to increase understanding at local, district and provincial levels of the important role played by the nature reserve in watershed protection.

Activities in this programme should include:

- community meetings to discuss key issues regarding nature reserve management.
- district and provincial-level meetings to discuss watershed protection and other values of the nature reserve.
- production and distribution of environmental education and awareness materials for use in schools, and at the district and provincial levels.

The awareness and extension programme should be implemented through existing channels, such as commune people's committees and district departments of education and training.

The cost of this programme is estimated at VND 840 million.

7.5 Tourism Development Programme

At present, the tourism potential of Phong Dien Nature Reserve is somewhat limited. However, efforts could be made to promote special-interest and adventure tourism in the area. If successful, these may

yield modest economic returns for nature reserve management and local communities. Features of potential tourism interest at Phong Dien include:

- a tour linking the nature reserve with other natural features in the area, such as the Tam Giang-Cau Hai lagoon complex, Khe Me waterfall in Phong My commune, Quao irrigation dam in Phong My commune, and the Thanh Tan hot springs between Phong Xuan and Phong Son communes.
- a long trek from the A Luoi valley to Phong My commune, along Provincial Road 71.
- birdwatching tours for small groups of specialised tourists.

The cost of this programme is estimated at VND 2,000 million.

8. Special-use Forest Management Structure and Finance

8.1 Proposed Management Structure

Directorate

The nature reserve directorate should comprise the following members of staff:

- (a) **Nature Reserve Director.** Responsible for managing all nature reserve staff, and cooperating with government bodies, institutions, consultants and non-governmental organisations (NGOs). The director should support, coordinate and present all activities and programmes that aim to address the objectives of the nature reserve. The director is the senior official with responsibility for day-to-day management of the nature reserve. This individual must possess strong leadership and management skills as well as an appropriate professional and academic background. The principal task of the director should be to organise, direct and supervise the work of the management board. The director should also be responsible for the elaboration and implementation of the investment programme activities outlined in this investment plan. The director must also ensure that all relevant government policies and regulations are complied with. The director must coordinate with local authorities and communities during all stages of the establishment and management of the nature reserve.
- (b) **Vice-director (Administrative).** Responsible for the overall operational aspects of the nature reserve regarding management and development. Reports to the director on the progress of investment programme activities, as well as the budgetary status of the nature reserve.
- (c) **Vice-director (Technical).** Responsible for coordinating research to collect scientific data necessary for management of the nature reserve and ensuring that the management of the nature reserve is guided by appropriate research and monitoring. The vice-director (technical) must be aware of any activities that impact on the biodiversity and forest at the nature reserve. The post-holder should also be responsible for providing technical support to other staff of the management board. The vice-directors should assist the director and, in the absence of the director, be responsible for all activities in the nature reserve.

Administration Department

The administration department should consist of one head of department, one accountant, one administrative clerk, one member of support staff and one driver. This department should undertake the day-to-day administrative functions required for the nature reserve to function adequately.

Technical and Financial Department

The technical and financial department should consist of one head of department, two technical experts and one cashier/clerk. This department should assist the directorate in monitoring construction work and the implementation of the investment programme activities outlined in this investment plan. The two technical experts should be responsible for identifying appropriate courses of action for habitat rehabilitation. They should also conduct scientific research in collaboration with national and international organisations. This department should also be in charge of preparing the nature reserve budget, and monthly, quarterly and annual financial reports. The staff of the technical and financial department should be under the direct supervision of the nature reserve directorate (Figure 3).

Protection Department

The protection department should comprise 31 members of staff, of which there should be one head of department, one deputy head, four personnel for each of the six guard stations and five personnel for a mobile protection team to be stationed at the nature reserve headquarters. The deputy head should also be the head of the mobile protection team. The protection department should be responsible for the conservation of habitats and species in the nature reserve, in accordance with the management regulations for Special-use Forests. Under the guidance of the directorate, the head of the protection department should be responsible for coordinating with Phong Dien and A Luoi District Forest Protection Departments (FPDs), Phong Dien Forest Enterprise, relevant local authorities and the police.

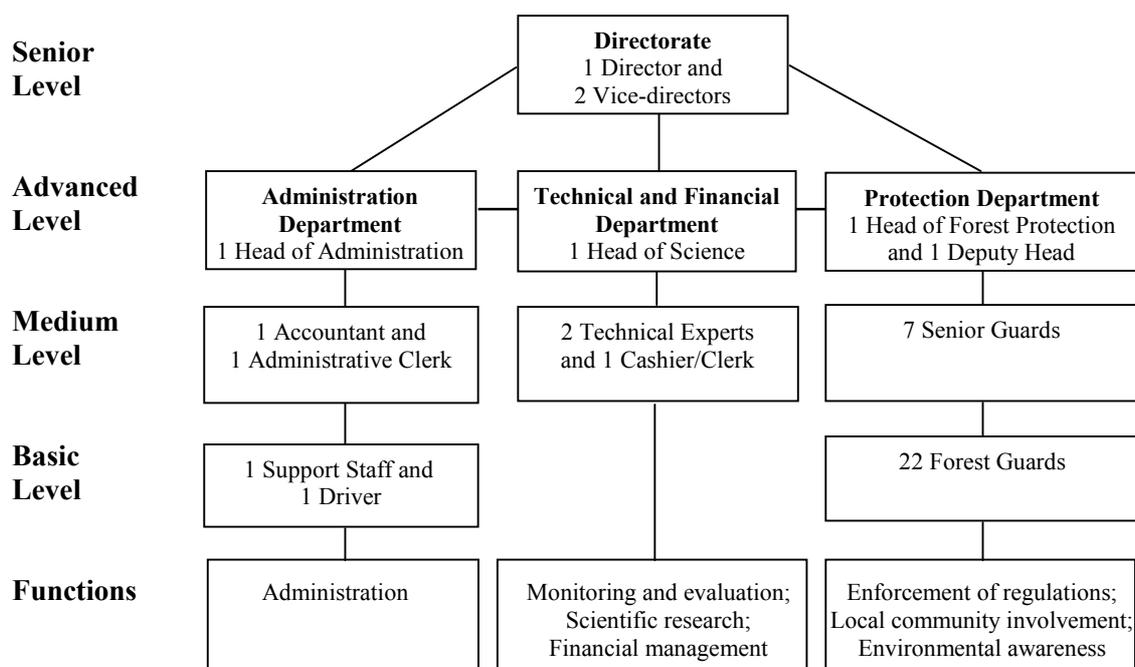


Figure 3: Schematic Diagram of Nature Reserve Staffing Structure

This department's principal daily tasks should be to patrol the nature reserve, prevent violations of nature reserve regulations and stop all illegal activities, especially hunting and timber extraction. The protection department also needs to implement measures for fire control and management. Of equal importance, the department should be responsible for involving local communities in the management and conservation of the nature reserve. This should be achieved through environmental awareness activities; community meetings, through which local people can have input into decisions regarding management of the nature reserve; and social forestry schemes, whereby forest land in the nature reserve and buffer zone can be allocated to individual households on short-term protection contracts or for long-term forestry purposes.

The senior guards should be responsible for the implementation of the activities outlined above, under the guidance of the head of the protection department and the nature reserve directorate. The senior guards should also be responsible for recording and reporting all violations of nature reserve regulations to their superiors.

Three forest guards and one senior guard should be stationed at each guard station. They should be responsible for:

- implementing the conservation and protection component of the protection programme outlined in this investment plan.
- cooperating with local authorities to allocate forest land to households for protection and regeneration.
- enforcing the management regulations of the nature reserve.
- raising awareness among local people about forest-fire prevention, the importance of conservation, and the regulations of the nature reserve.
- organising and conducting patrols of the nature reserve, and inspections of forest land allocated to local people.
- maintaining regular contact with other guard stations and with the head of the protection department.
- recording violations of nature reserve regulations and other field observations.

8.2 Finance

Investment Capital

Investment capital should be apportioned for the management and development of Phong Dien Nature Reserve with the following provisos:

- investment capital for programmes outlined in the nature reserve investment plan should be accounted for in a five-year plan, from 2001 to 2005.
- feasibility studies should be conducted for the construction projects outlined in Section 7.
- investment capital for construction projects should be based on completing the necessary legal documents.

Cost estimates for the management and development of Phong Dien Nature Reserve total VND 19,481 million over a five-year period (Table 27). The average annual cost is estimated at VND 3,896 million (Table 28). Annual disbursements of the investment capital for Phong Dien Nature Reserve should begin in fiscal year 2001 and end in fiscal year 2005 (Table 29).

The investment capital requirements of the nature reserve might be met from the following sources:

- national government budget: VND 12,190 million.
- favourable interest loans: VND 2,151 million.
- international donors: VND 5,140 million.

Funding from international donors should be the main source of funding for the monitoring and research, and awareness and extension programmes.

Table 27: Investment Schedule for the Investment Plan for Phong Dien Nature Reserve (in VND million)

Programme	2001	2002	2003-2005	Total
Protection	3,201	1,953	1,162	6,316
Rehabilitation	687	947	4,391	6,025
Monitoring and research	200	1,300	2,800	4,300
Awareness and extension	165	225	450	840
Tourism development	200	200	1,600	2,000
Total	4,453	4,625	10,403	19,481

8.3 Implementation of the Investment Plan for Phong Dien Nature Reserve

The investment plan for Phong Dien Nature Reserve should be implemented in two phases:

- First Phase (2001):** Activities during this phase focus on infrastructure development, establishing the nature reserve management board and recruiting nature reserve staff; and
- Second Phase (2002 to 2005):** Activities initiated during the first phase should continue during the second phase. Also, the conservation and protection, scientific research and monitoring, and awareness and extension programmes should be initiated. During the second phase, an investment plan for the five years from 2006 to 2010 should be developed. This plan should emphasise the conservation and protection, scientific research and monitoring, and awareness and extension programmes.

Table 28: Cost Estimates for the Five Year Investment Plan for Phong Dien Nature Reserve (in VND million)

Item	Quantity	Unit Price	Cost
1. Protection programme			6,316
Demarcation workshops	2	35	70
Boundary pillars	150	0.5	75
Regulation boards	15	2	60
Surface bulldozing for headquarters	20 shifts	1.5	30
Headquarters building	1,000 m ²	1.47	1,500
Headquarters fence	400 m	0.5	200
Headquarters entrance	1	50	50
Headquarters yard	200 m ²	0.1	20
Water supply	1	200	200
Road upgrading	50 km	10	500
Guard stations	6	250	1,500
Jeeps	2	300	600
Motorbikes	10	25	250
Vehicle registration and maintenance	5 years	60	300
Petrol and oil	5 years	65.5	328
Generators for guard stations	7	7.5	53
Motor boat	2	30	60
Radio handsets	1 set	225	225
Mobile phone relay station	1	20	20
Binoculars	10	5	50
Compasses	10	0.5	5
Cameras	2	10	20
Office equipment	5 years	40	200
2. Rehabilitation programme			6,025
Land allocation for protection	6,950 ha	0.27	1,876
Land allocation for regeneration	2,456 ha	0.41	1,007
Re-afforestation with native tree species	788 ha	3.48	2,742
Nurseries	2 ha	100	400
3. Scientific research and monitoring programme			4,300
Monitoring forest cover	3 years	200	600
Studies of regeneration	3 years	200	600
Studies of mammals	3 years	200	600
Studies of restricted-range birds	3 years	200	600
Monitoring population of Edwards's Pheasant	3 years	200	600
Other case studies	3 years	100	300
Training	5 years	200	1,000
4. Awareness and extension programme			840
Materials	5 years	50	250
Camera	2	15	30
Televisions	2	10	20
Video recorders	2	5	10
Slide projector	1	15	15
Overhead projector	1	15	15
Training courses	10	50	500
5. Tourism development programme			2,000
Infrastructure development			1,000
Training courses for tour guides	5	100	500
Materials			500
Total			19,481

Note: excludes staff wages and buffer zone development programme

**Table 29: Disbursement Schedule for the Investment Plan for Phong Dien Nature Reserve
(in VND million)**

Item	2001	2002	2003-2005	Total
1. Protection programme	3,201	1,953	1,162	6,316
Demarcation workshops	70			70
Boundary pillars	75			75
Regulation boards	60			60
Surface bulldozing for headquarters	30			30
Headquarters building	1,000	500		1,500
Headquarters fence	200			200
Headquarters entrance		50		50
Headquarters yard		20		20
Water supply	200			200
Road upgrading	100	100	300	500
Guard stations	750	750		1,500
Jeeps	300	300		600
Motorbikes	250			250
Vehicle registration and maintenance	20	20	260	300
Petrol and oil	66	65	197	328
Generators for guard stations	30	23		53
Field radio handsets			225	225
Radio relay station			20	20
Motorboats			60	60
Binoculars		50		50
Compasses		5		5
Cameras		20		20
Office equipment	50	50	100	200
2. Rehabilitation programme	687	947	4,391	6,025
Land allocation for protection	487	347	1,042	1,876
Land allocation for regeneration	200	200	607	1,007
Re-forestation with native tree species			2,742	2,742
Nurseries		400		400
3. Scientific research and monitoring programme	200	1,300	2,800	4,300
Monitoring forest cover		200	400	600
Studies of regeneration		200	400	600
Studies of mammals		200	400	600
Studies of restricted-range birds		200	400	600
Monitoring population of Edwards's Pheasant		200	400	600
Other case studies		100	200	300
Training	200	200	600	1,000
4. Awareness and extension programme	165	225	450	840
Materials	50	50	150	250
Camera	15	15		30
Televisions	10	10		20
Video recorders	10	10		10
Slide projector		15		15
Overhead projector		15		15
Training courses	100	100	300	500
5. Tourist development programme	200	200	1,600	2,000
Infrastructure development			1,000	1,000
Training staff for tourist guiding	100	100	300	500
Materials	100	100	300	500
Total	4,453	4,625	1,043	19,481

9. Summary of Project Benefits

Establishing Phong Dien Nature Reserve will have the following benefits:

- increased protection of lowland forest biodiversity in central Vietnam.
- increased protection of *Lophura edwardsi* and other threatened species at the nature reserve.
- protection of the watersheds of three major river systems: the My Chanh, O Lau and Bo rivers, thereby safeguarding the water supply for irrigation and domestic use in Thua Thien Hue and Quang Tri provinces.
- increased living standards of members of the Pa-hi, Van Kieu, Pa-co, Ta-oi, Ca-tu and Kinh ethnic groups inhabiting the buffer zone of Phong Dien Nature Reserve.

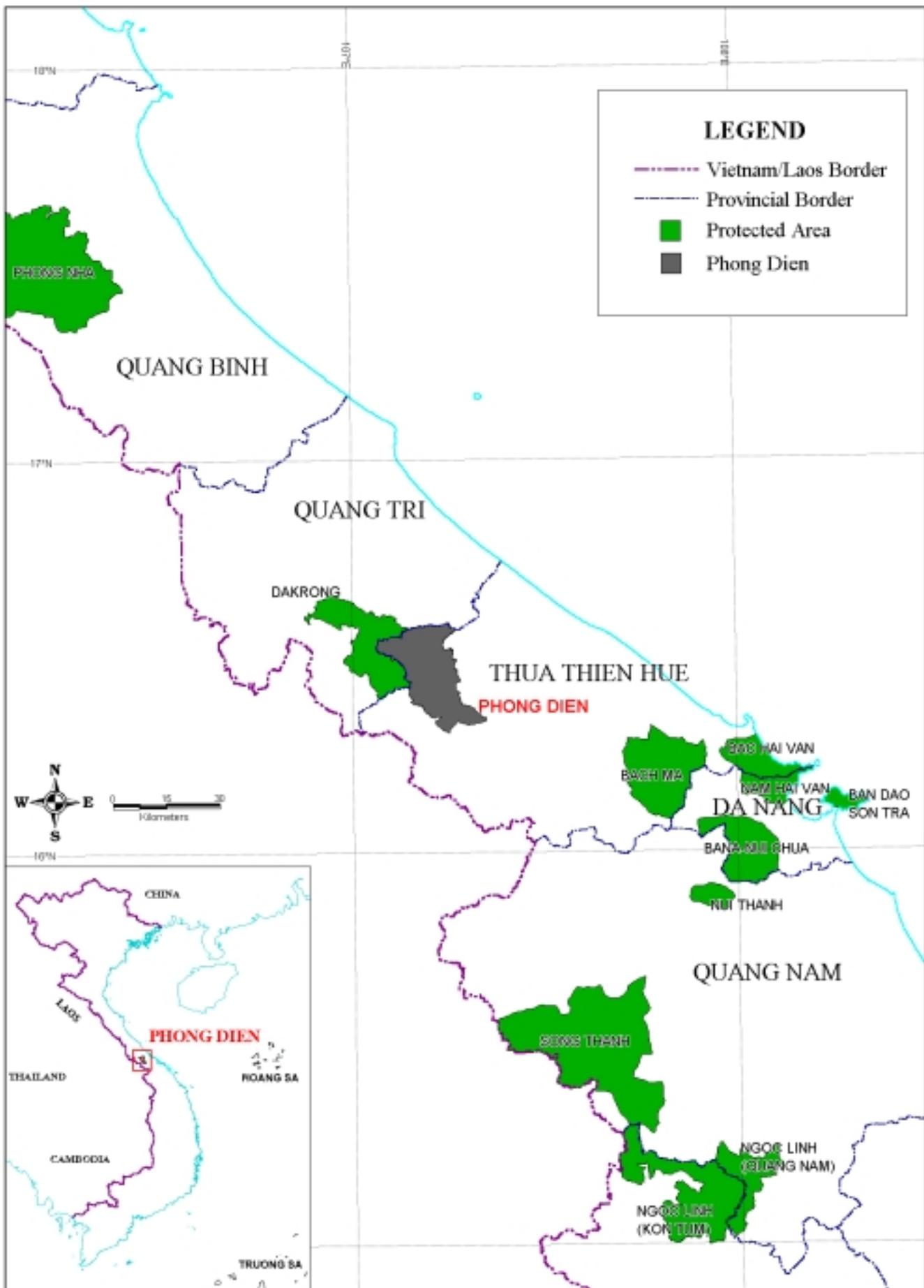
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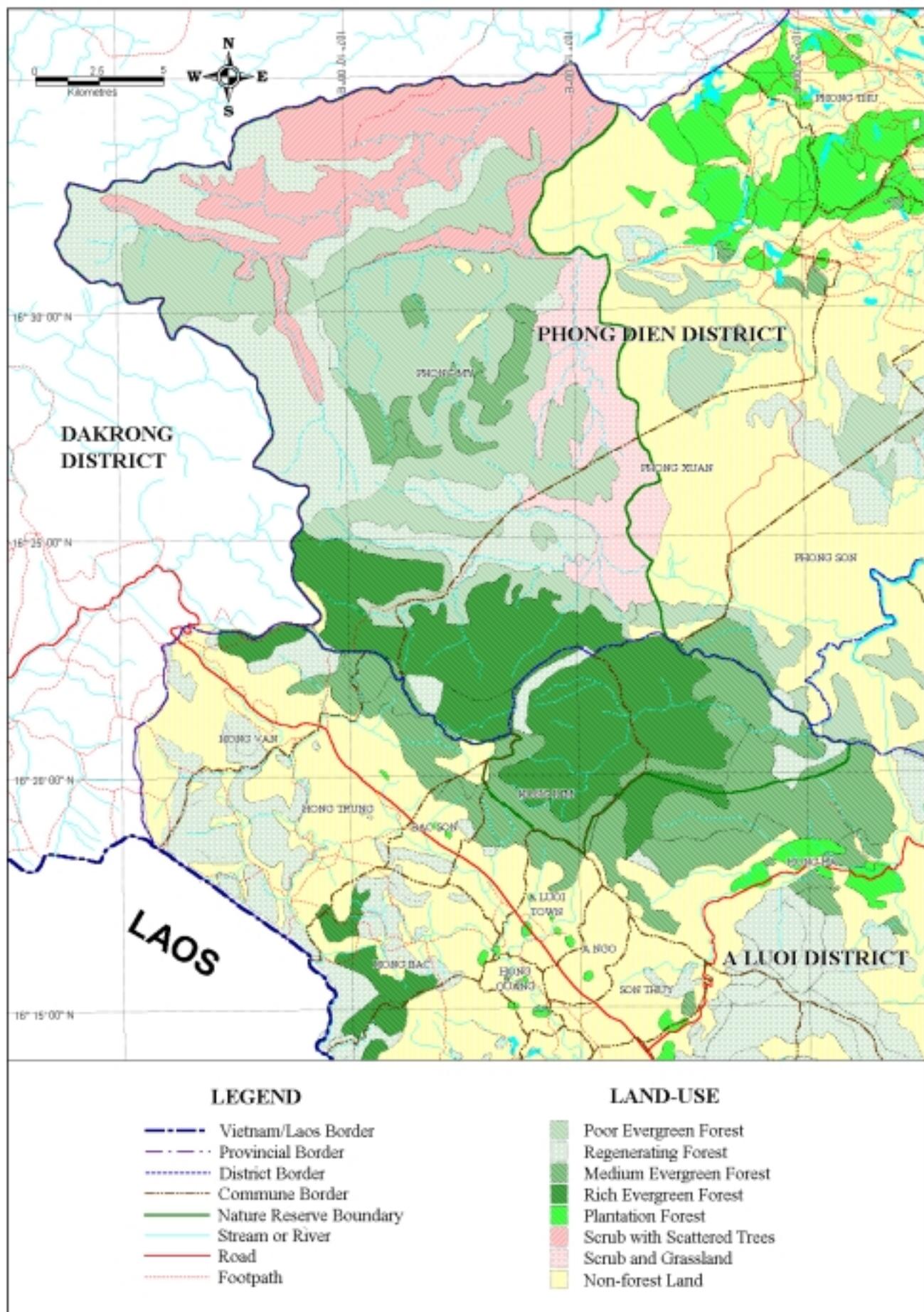
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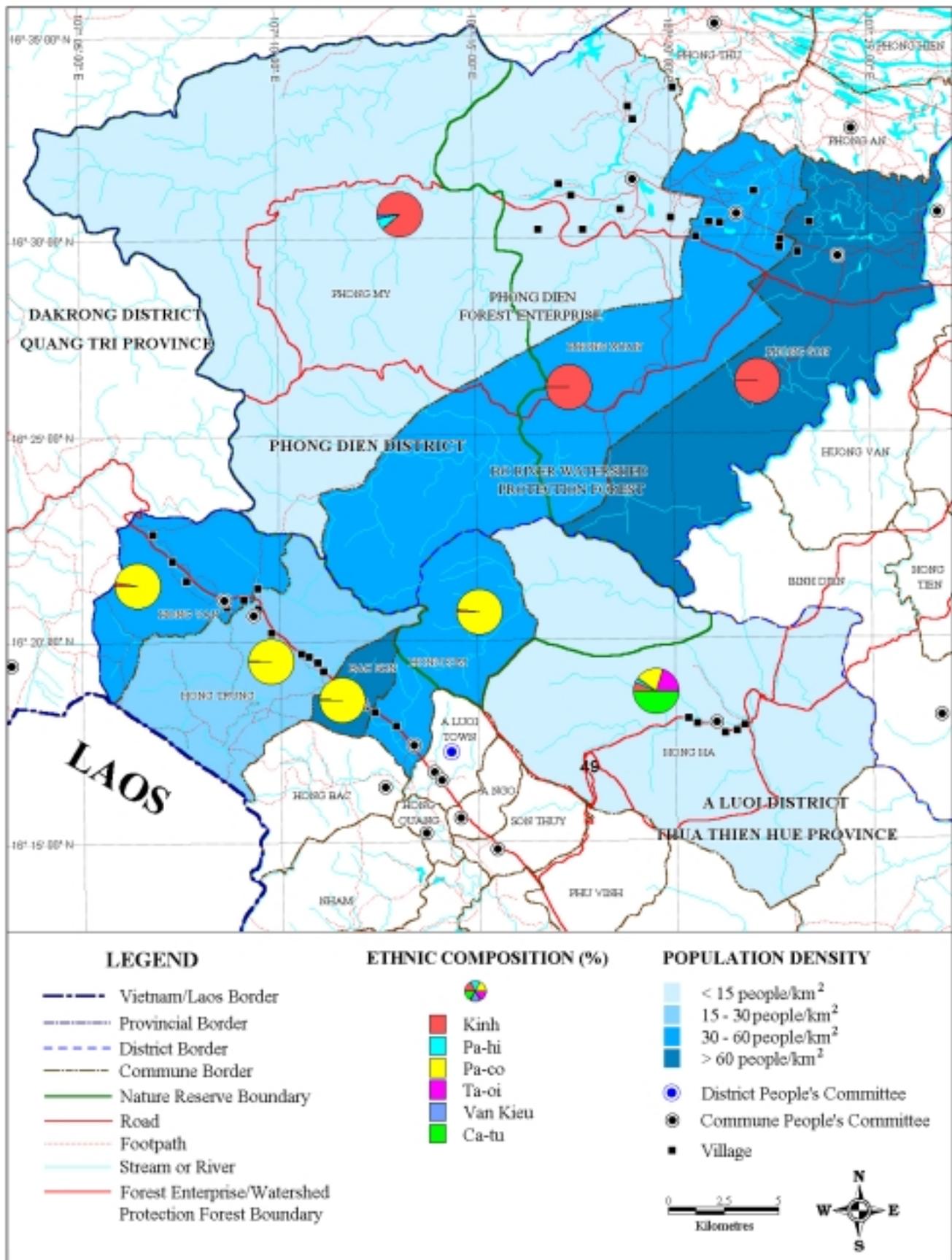
Map 1: Location of Phong Dien Nature Reserve



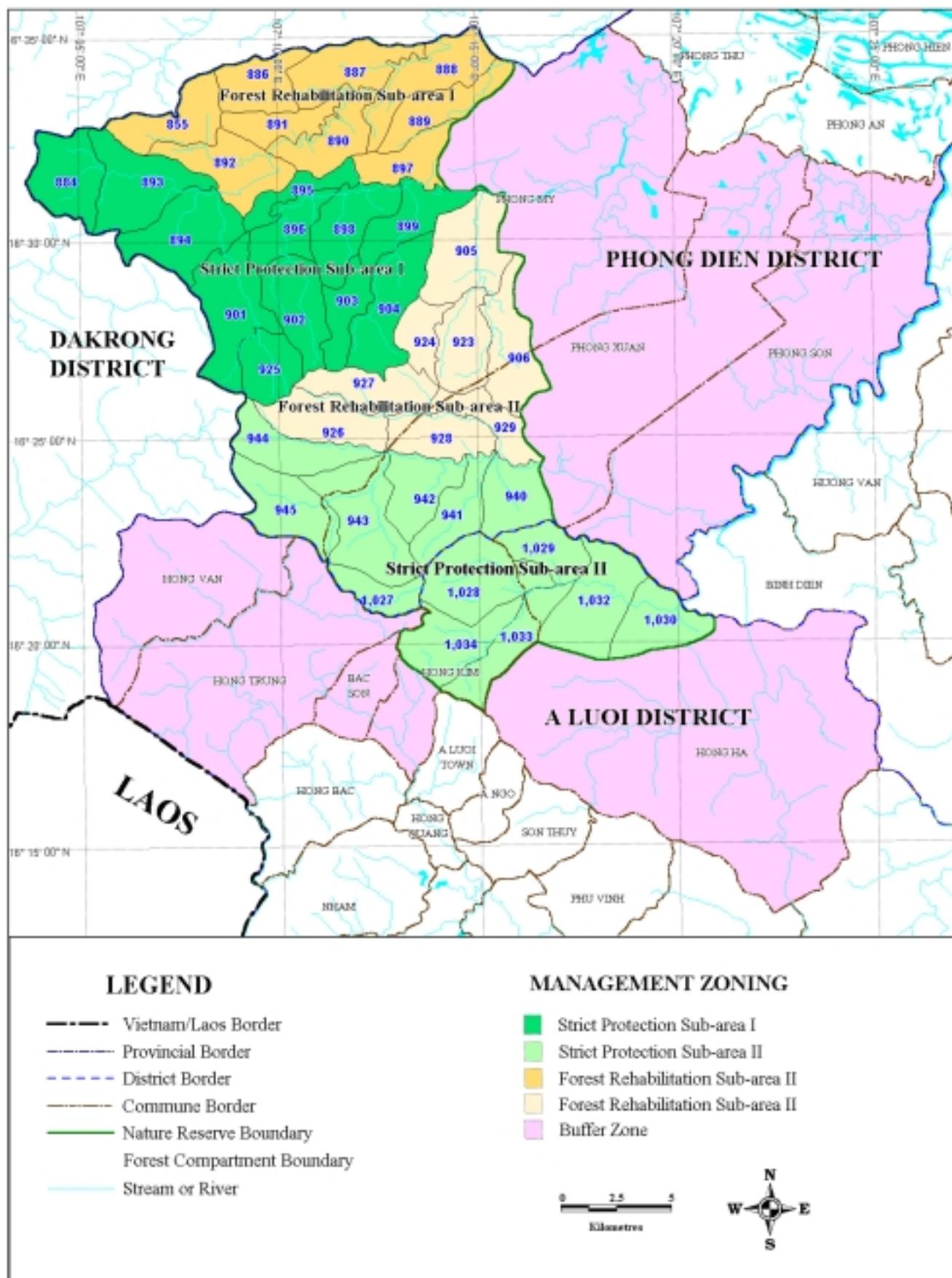
Map 2: Land-use in and around Phong Dien Nature Reserve



Map 3: Population Density and Ethnic Composition of Communes in the Buffer Zone of Phong Dien Nature Reserve



Map 4: Proposed Management Zoning of Phong Dien Nature Reserve



Appendix 1: Flora Recorded at Phong Dien and Dakrong Nature Reserves

Class, Family, Genus and Species	Notes
Polypodiophyta	
Angiopteridaceae	
<i>Angiopteris annamensis</i>	O
<i>A. cochinchinensis</i>	O
Lygodiaceae	
<i>Lygodium auriculatum</i>	
<i>L. conferme</i>	
<i>L. flexuosum</i>	M
<i>L. japonicum</i>	
<i>L. microphyllum</i>	
<i>L. salicifolium</i>	
Gleicheniaceae	
<i>Dicranopteris linearis</i>	
Dicksoniaceae	
<i>Cibotium barometz</i>	M
Cyatheaceae	
<i>Cyathea contaminans</i>	
<i>C. latebrosa</i>	
<i>C. glabra</i>	
Lindsaeaceae	
<i>Lindsaea davallioides</i>	
<i>L. ensifolia</i>	
Pteridiaceae	
<i>Pteris biaurita</i>	
<i>P. ensiformis</i>	O
<i>P. grevilleana</i>	
<i>P. linearis</i>	
Adiantaceae	
<i>Adiantum flabellulatum</i>	O,M
<i>A. philippense</i>	
Blechnaceae	
<i>Blechnum orientale</i>	
Aspleniaceae	
<i>Asplenium cheilosorum</i>	
<i>A. varianus</i>	
Athyriaceae	
<i>Diplazium asperum</i>	
Thelypteridaceae	
<i>Cyclosorus triphyllus</i>	
Polypodiaceae	
<i>Drynaria bonii</i>	M
<i>Microsorium hancockii</i>	
<i>Phymatodes nigrescens</i>	
<i>Platyterium coronarium</i>	O
<i>P. grande</i>	O
<i>Pyrrosia acrostichoides</i>	
<i>P. lingua</i>	M

Class, Family, Genus and Species	Notes
Marsileaceae	
<i>Marsilea quadrifolia</i>	M
Lycopodiophyta	
Lycopodiaceae	
<i>Lycopodium cernuum</i>	
<i>L. ovalifolium</i>	
Selaginellaceae	
<i>Selaginella dodderleinii</i>	
<i>S. involvens</i>	
Pinophyta	
Podocarpaceae	
<i>Dacrycarpus imbricatus</i>	W
<i>Dacrydium elatum</i>	W
<i>Nageia wallichiana</i>	W
<i>Podocarpus neriifolius</i>	W
Gnetaceae	
<i>Gnetum formosum</i>	M
Magnoliophyta	
Magnoliopsida	
Magnoliaceae	
<i>Manglietia dandyi</i>	W
<i>Michelia mediocris</i>	W
Annonaceae	
<i>Alphonsea boniana</i>	W
<i>A. mogyna</i>	W
<i>Desmos cochinchinensis</i>	O
<i>Goniothalamus aff. gabriacianus</i>	
<i>Justicia annamensis</i>	
<i>Miliusa elongata</i>	
<i>Orophea harmandiana</i>	
<i>Polyalthia laui</i>	W
<i>P. nemoralis</i>	W
<i>Uvaria cordata</i>	
<i>Xylopiella vielana</i>	M
Myristicaceae	
<i>Horsfieldia amygdalina</i>	W
<i>H. glabra</i>	W
<i>Knema conferta</i>	W
<i>K. corticosa</i>	W,M
<i>K. furfuracea</i>	W
<i>K. pierrei</i>	W
Chloranthaceae	
<i>Chloranthus spicatus</i>	O
Lauraceae	
<i>Actinodaphne pilosa</i>	W,M
<i>Beilschmiedia laevis</i>	W
<i>B. percoriacea</i>	W
<i>Cinnamomum argenteum</i>	W

Class, Family, Genus and Species	Notes
<i>C. parthenoxylon</i>	W,M
<i>C. validinerve</i> var. <i>poilanei</i>	W
<i>Cryptocaria ferrea</i>	W
<i>C. lenticellata</i>	W
<i>C. maclurei</i>	W
<i>Lindera chenii</i>	
<i>Litsea cambodiana</i>	W
<i>L. cubeba</i>	M
<i>L. glutinosa</i>	W,M
<i>L. verticillata</i>	W
<i>Machilus bonii</i>	W
<i>M. chinensis</i>	W
<i>Neolitsea eleocarpa</i>	W
<i>Phoebe cuneata</i>	W
<i>P. lanceolata</i>	
Piperaceae	
<i>Piper bochmeriaefolium</i>	
<i>P. lolot</i>	M
<i>Zippelia begoniaefolia</i>	
Menispermaceae	
<i>Pericampylus glaucus</i>	
Hamamelidaceae	
<i>Rhodoleia championii</i>	W
Ulmaceae	
<i>Celtis orientalis</i>	W
<i>Gironniera cuspidata</i>	W
<i>G. subaequalis</i>	W
<i>Trema cannabina</i>	
<i>T. orientalis</i>	W
Moraceae	
<i>Antiaris toxicaria</i> var. <i>toxicaria</i>	M
<i>Artocarpus rigidus</i> var. <i>asperula</i>	W
<i>A. styracifolia</i>	W
<i>Boussonnetia papirifera</i>	M
<i>Ficus altissima</i>	W
<i>F. abelii</i>	
<i>F. auriculata</i>	
<i>F. callosa</i>	W
<i>F. championii</i>	
<i>F. fistulosa</i>	
<i>F. fulva</i>	
<i>F. fulva</i> var. <i>minor</i>	
<i>F. heterophyllus</i>	M
<i>F. heteropleura</i>	
<i>F. hirta</i>	
<i>F. hirta</i> var. <i>roxburghii</i>	
<i>F. hispida</i>	
<i>F. langkokensis</i>	W

Class, Family, Genus and Species	Notes
<i>F. macilentata</i>	
<i>F. pimula</i>	
<i>F. racemosa</i>	W
<i>F. stenophylla</i> var. <i>macropodocarpa</i>	W
<i>F. variolosa</i>	
<i>Streblus asper</i>	M
<i>S. brennieri</i>	
<i>S. ilicifolius</i>	
<i>Poikilospermum mollis</i>	
Urticaceae	
<i>Boehmeria tonkinensis</i>	
<i>Debregeasia squamata</i>	
<i>Dendrocnide sinuata</i>	
<i>Pouzolzia sanguinea</i>	
Fagaceae	
<i>Castanopsis ceratocantha</i>	W
<i>C. indica</i>	W
<i>Lithocarpus amygdalifolius</i>	W
<i>L. annamensis</i>	W
<i>L. corneus</i>	W
<i>L. fissa</i>	W
<i>Quercus bambusaefolia</i>	W
<i>Q. thorelii</i>	W
Juglandaceae	
<i>Engelhardia chrysolepis</i>	W
<i>E. spicata</i>	W
<i>E. wallichiana</i>	W
Portulacaceae	
<i>Portulaca oleracea</i>	M
Amaranthaceae	
<i>Alternanthera sessilis</i>	
<i>Celosia argentea</i>	O,M
<i>Cyathula prostrata</i>	M
Polygonaceae	
<i>Cephalophilon chinense</i>	M
<i>C. hydropiper</i>	M
Dilleniaceae	
<i>Dillenia indica</i>	M
<i>Tetracera scandens</i>	
Ochnaceae	
<i>Gomphia serrata</i>	O
Dipterocarpaceae	
<i>Dipterocarpus kerrii</i>	W
Ancistrocladaceae	
<i>Ancistrocladus tectorius</i>	
Theaceae	
<i>Adenandra annamense</i>	W
<i>Archytea wahlilii</i>	
<i>Camellia caudata</i>	

Class, Family, Genus and Species	Notes
<i>Eurya japonica</i>	
<i>E. trichocarpa</i>	
<i>Schima crenata</i>	W
Guttiferae	
<i>Calophyllum dryobalanoides</i>	W
<i>C. soulatrei</i>	W
<i>C. sp.</i>	W
<i>Garcinia bonii</i>	W
<i>G. multiflora</i>	W,M
<i>G. oblongifolia</i>	W,M
Hypericaceae	
<i>Cratoxylum formosum</i>	W
<i>C. frunifolium</i>	M
Flacourtiaceae	
<i>Flacourtia rukam</i>	M
<i>Hydnocarpus annamensis</i>	W
<i>H. serratus</i>	W
Passifloraceae	
<i>Passiflora foetida</i>	M
Cucurbitaceae	
<i>Gymnopetalum cochinchinense</i>	M
<i>Gynostemma pentaphyllum</i>	
<i>Hodgsonia macrocarpa</i>	M
<i>Solena heterophylla</i>	M
Datiscaceae	
<i>Tetrameles nudiflora</i>	W,M
Begoniaceae	
<i>Begonia aptera</i>	O
<i>B. lecomtei</i>	O
<i>B. rubicola</i>	O
Capparaceae	
<i>Crateva nurvala</i>	
Brassicaceae	
<i>Nasturtium officinale</i>	M
Actinidiaceae	
<i>Saurauia tristyla</i>	M
Symplocaceae	
<i>Symplocos adenophylla</i>	W
<i>S. cochinchinensis</i>	W
<i>S. disepala</i>	W
<i>S. laurina</i>	W
Ebenaceae	
<i>Diospyros eriantha</i>	W
<i>D. pilosa</i>	W
Sapotaceae	
<i>Donella lanceolata</i>	W
<i>Madhuca pasquieri</i>	W,M
<i>Palaquium annamensis</i>	W
<i>Sarcosperma kachinense</i>	W
<i>Sinosideroxylon cambodianum</i>	W

Class, Family, Genus and Species	Notes
Myrsinaceae	
<i>Arsidia argentea</i>	
<i>A. crenata</i>	M
<i>A. florida</i>	
<i>A. quinquegona</i> var. <i>latifolia</i>	M
<i>A. silvestris</i>	M
<i>Embelia laeta</i>	M
<i>E. scandens</i>	
<i>E. subcoriacea</i>	
<i>Maesa tonkinensis</i> var. <i>annamensis</i>	
Elaeocarpaceae	
<i>Elaeocarpus griffithii</i>	W
<i>E. glabripetalus</i>	W
<i>E. grandiflorus</i>	W
<i>E. hainanensis</i>	
<i>E. nitentifolius</i>	W
<i>E. petiolatus</i>	W
Tiliaceae	
<i>Colona evecta</i>	
<i>Grewia annamica</i>	
<i>G. asiatica</i>	
<i>G. bulot</i>	
<i>G. microcos</i>	
<i>Paragrewia poilanei</i>	
<i>Triumfetta rhomboidea</i>	M
Sterculiaceae	
<i>Commersonia bartramia</i>	
<i>Firmiana colorata</i>	
<i>Helicteres viscida</i>	
<i>Heritiera cochinchinensis</i>	W
<i>Pterospermum heterophyllum</i>	W
<i>P. lanceaefolium</i>	W
<i>P. pierrei</i>	W
<i>Sterculia coccinea</i>	
<i>S. lanceolata</i>	M
Bombaceae	
<i>Ceiba pentandra</i>	W,M
Malvaceae	
<i>Sida rhomboidea</i>	M
<i>Urena lobata</i>	M
Euphorbiaceae	
<i>Alchornea rugosa</i>	M
<i>Antidesma buniis</i>	
<i>A. cochinchinensis</i>	
<i>A. diandrum</i>	
<i>A. japonicum</i>	
<i>A. hainanensis</i>	
<i>Aporusa microcalyx</i>	W
<i>Baccaurea annamensis</i>	W

Class, Family, Genus and Species	Notes
<i>B. silvestris</i>	W
<i>Bischofia javanica</i>	W,M
<i>Breynia fruticosa</i>	M
<i>B. septata</i>	
<i>Bridelia monoica</i>	
<i>Claoxylon polot</i>	
<i>Cleistanthus acuminatus</i>	
<i>Croton argyratus</i>	W
<i>C. kongensis</i>	
<i>C. tiglium</i>	
<i>C. tonkinensis</i>	M
<i>Deutzianthus tonkinensis</i>	
<i>Drypetes perreticulata</i>	
<i>Endospermum chinense</i>	W
<i>Erismanthus indochinensis</i>	
<i>Euphorbia hirta</i>	M
<i>E. thymifolia</i>	M
<i>Glochidion hirsutum</i>	
<i>G. octophylla</i>	
<i>G. venutinum</i>	M
<i>Homonoia riparia</i>	
<i>Jatropha curcas</i>	M
<i>Macaranga andersonii</i>	W
<i>M. denticulata</i>	W
<i>M. tananrius</i>	W
<i>M. trichocarpa</i>	
<i>Mallotus apelta</i>	
<i>M. barbatus</i>	W
<i>M. cochinchinensis</i>	W
<i>M. eberhardtii</i>	W
<i>M. hookerianus</i>	W
<i>Microdesmis caseariaefolia</i>	W,M
<i>Phyllanthus emblica</i>	W
<i>P. nirurii</i>	M
<i>P. quangtriensis</i>	
<i>P. reticulatus</i>	M
<i>P. ruber</i>	
<i>P. urinaria</i>	M
<i>Sapium baccatum</i>	W
<i>S. discolor</i>	W
<i>S. rotundfolium</i>	W
<i>Sumbaviopsis albicans</i>	
<i>Suregada aequoreum</i>	
<i>S. multiflora</i>	
<i>Trewia nudiflora</i>	
<i>Trigonostemon pinnata</i>	
Thymeleaceae	
<i>Aquilaria crassna</i>	M
Rosaceae	
<i>Fragaria indica</i>	

Class, Family, Genus and Species	Notes
<i>Prunus arborea</i>	W
<i>P. ceylanica</i>	W
<i>Rubus alceaefolius</i>	M
<i>R. cochinchinensis</i> var. <i>glabrescens</i>	M
<i>R. indiscissus</i>	
Mimosaceae	
<i>Adenantha pavonina</i> var. <i>microsperma</i>	W
<i>Albizia chinensis</i>	W
<i>A. corniculata</i>	
<i>A. lucida</i>	W
<i>Archidendron turgidum</i>	W
<i>Entada phaseoloides</i>	
<i>E. tonkinensis</i>	
<i>Mimosa invisa</i>	
<i>M. pudica</i>	M
<i>Pithecellobium clypearia</i>	
<i>P. pellitum</i>	
Caesalpiniaceae	
<i>Cassia alata</i>	M
<i>C. siamea</i>	W
<i>C. tora</i>	M
<i>Erythrophleum fordii</i>	W
<i>Gleditschia australis</i>	W,M
<i>Gymnocladus angustifolius</i>	O
<i>Lasiobema scandens</i>	
<i>Peltophorum dasyrrhacis</i>	W
<i>Phanera bracteata</i>	
<i>P. coccinea</i>	
<i>P. pierrei</i>	
<i>Sindora siamensis</i>	W
<i>S. tonkinensis</i>	W
<i>Tamarindus indica</i>	W,M
Fabaceae	
<i>Abrus precatorius</i>	M
<i>Antheroporum pierrei</i>	W
<i>Crotalaria assamica</i>	
<i>C. mucronata</i>	
<i>Dalbergia balansae</i>	W
<i>D. hypeana</i> var. <i>lancifera</i>	W
<i>D. rimosa</i>	
<i>Desmodium triquetrum</i>	M
<i>D. zolatum</i>	
<i>Erythrina orientalis</i>	M
<i>Millettia nigrescens</i>	O
<i>Ormosia balansae</i>	W
<i>O. cambodiana</i>	W
<i>O. pinnata</i>	W
<i>Pueraria triloba</i>	

Class, Family, Genus and Species	Notes
Lythraceae	
<i>Lagerstroemia duperreanum</i>	W
<i>L. tomentosa</i>	W
Sonneratiaceae	
<i>Duabanga grandiflora</i>	W
Rhizophoraceae	
<i>Carallia brachiata</i>	W,M
Combretaceae	
<i>Quisqualis indica</i>	M
Myrtaceae	
<i>Decaspermum paniculatum</i>	W
<i>Psidium guayava</i>	M
<i>Rhodomyrtus tomentosa</i>	M
<i>Syzygium bullockii</i>	
<i>S. chanlos</i>	
<i>S. circumcissimum</i>	W
<i>S. cumini</i>	W
<i>S. finetii</i>	
<i>S. polypetaloides</i>	
<i>S. tsoongii</i>	
<i>S. zeylanicum</i>	W
Melastomaceae	
<i>Melastoma eberhardtii</i>	
<i>M. normale</i>	
<i>M. sanguineum</i>	M
Onagraceae	
<i>Ludwigia hyssopifolia</i>	M
Lecythidaceae	
<i>Barringtonia acutangula</i>	M
<i>B. cochinchinensis</i>	W
Anacardiaceae	
<i>Allospodias lakonensis</i>	W
<i>Canarium album</i>	W,M
<i>C. bangalensis</i>	W
<i>Choerospondias axillaris</i>	W,M
<i>Dacryodes dungii</i>	W
<i>Dracontomelum duperreanum</i>	W
<i>Drymicarpus racemosus</i>	
<i>Mangifera foetida</i>	W
<i>Rhus chinensis</i>	M
<i>Semecarpus anacardiopsis</i>	W
<i>S. myriocarpa</i>	
<i>Toxicodendron succedanea</i>	
Simaroubaceae	
<i>Ailanthus triphysa</i>	W,M
<i>Eurycoma longifolia</i>	M
<i>Picrasma javanica</i>	M
Rutaceae	
<i>Acronychia pedunculata</i>	M
<i>Clausena excavata</i>	M

Class, Family, Genus and Species	Notes
<i>Euodia leptota</i>	M
<i>E. meliaeifolia</i>	
<i>Glycosmis pentaphylla</i>	M
<i>Micromelum falcatum</i>	M
<i>Murraya koenigii</i>	M
<i>Zanthoxylum avicenniae</i>	M
<i>Z. rhetsa</i>	M
Meliaceae	
<i>Aglaiia cochinchinensis</i>	W
<i>A. gigantea</i>	W
<i>Aphanamixis polystachya</i>	W
<i>Chukrasia tabularis</i>	W
<i>Dysoxylum acutangulum</i>	W
<i>D. binectariferum</i>	W
<i>Melia azedazach</i>	W
Sapindaceae	
<i>Cardiospermum halicacabum</i>	
<i>Mischocarpus poilanei</i>	W
<i>Nephelium bassacense</i>	W
<i>Paranephelium spirei</i>	W
<i>Pometia pinnata</i>	W
Ixonanthaceae	
<i>Ixonanthes cochinchinensis</i>	W
Oxalidaceae	
<i>Averrhoa carambola</i>	M
<i>Oxalis corniculata</i>	M
Polygalaceae	
<i>Xanthophyllum laoticum</i>	W
Alangiaceae	
<i>Alangium kurzii</i>	W
<i>A. ridleyi</i>	W
Araliaceae	
<i>Aralia armata</i>	M
<i>Heteropanax fragrans</i>	M
<i>Schefflera elliptica</i>	M
<i>S. octophylla</i>	W,M
<i>Trevesia palmata</i>	M
Apiaceae	
<i>Celtella asiatica</i>	M
<i>Eryngium foetidum</i>	
<i>Hydrocotyle nepalensis</i>	
Aquifoliaceae	
<i>Ilex crenata</i>	W
 Icacinaceae	
<i>Gonocaryum poilanei</i>	
Celastraceae	
<i>Euonymus javanicus</i>	W
Rhamnaceae	
<i>Berchemia lineata</i>	M
<i>Gouania javanica</i>	

Class, Family, Genus and Species	Notes
<i>Ventilago calyculata</i>	
Vitaceae	
<i>Ampelocissus martinii</i>	
<i>A. polythyrsa</i>	
<i>Cissus adnata</i>	
<i>C. hexangularis</i>	
<i>Tetragium quadrangulum</i>	
<i>Vitis balansaeana</i>	
Leeaceae	
<i>Leea rubra</i>	M
Loranthaceae	
<i>Helixanthera brevicalyx</i>	
<i>H. parasitica</i>	
Proteaceae	
<i>Helicia cochinchinensis</i>	
<i>H. nigilarica</i>	
<i>Heliciopsis sesselliflora</i>	W
Caprifoliaceae	
<i>Sambucus javanica</i>	
Loganiaceae	
<i>Gelsemium elegans</i>	
Apocynaceae	
<i>Alstonia scholaris</i>	W,M
<i>Alyxia racemosa</i>	
<i>Bousignonia mekongensis</i>	
<i>Holarrhena antidysenterica</i>	M
<i>Melodinus annamensis</i>	
<i>Rauvolfia cambodiana</i>	M
<i>Tabernaemontana jasminiflora</i>	
<i>T. microphylla</i>	
<i>T. pitardii</i>	
<i>Wrightia annamensis</i>	W
<i>W. pubescens</i>	W
Asclepiadaceae	
<i>Dischidia chinensis</i>	M
<i>D. collyris</i>	
<i>Streptocaulon griffithii</i>	M
Rubiaceae	
<i>Adina polycephala</i>	W,M
<i>Anthocephalus chinensis</i>	W
<i>Canthium dicoccum</i> var. <i>rostratum</i>	W
<i>Hedyotis capitellata</i>	M
<i>H. grudis</i>	
<i>Ixora coccinea</i>	O,M
<i>Lasianthus cyanocarpus</i> var. <i>asperatus</i>	
<i>L. kampuensis</i>	
<i>L. tonkinensis</i>	
<i>Mussaenda cambodiana</i> var. <i>annamensis</i>	M
<i>Neonauclea stellata</i>	

Class, Family, Genus and Species	Notes
<i>Paederia scandens</i>	M
<i>Psychotria adenophylla</i>	
<i>P. rubra</i>	M
<i>Randia canthioides</i>	M
<i>R. oxydonta</i>	W
<i>R. spinosa</i>	
<i>R. tomentosa</i>	M
<i>Uncaria tonkinensis</i>	
<i>Wendlandia glabrata</i>	
<i>W. panicunata</i>	
Convolvulaceae	
<i>Argyreia mollis</i>	O,M
<i>Hewittea sublobata</i>	
<i>Ipomoea bonii</i>	
<i>I. digitata</i>	M
<i>Merremia umbellata</i>	M
Boraginaceae	
<i>Heliotropium indicum</i>	M
Solanaceae	
<i>Physalis angulata</i>	
<i>Solanum nigrum</i>	M
<i>S. torvum</i>	M
Bignoniaceae	
<i>Markhamia cauda-felina</i>	
<i>Oroxylum indicum</i>	M
<i>Radermachera alata</i>	
<i>Stereospermum chelonoides</i>	W,M
<i>S. tetragonum</i>	W
Acanthaceae	
<i>Andrographis paniculata</i>	M
<i>Asystasia gangetica</i>	
<i>Gendarussa ventricosa</i>	M
<i>Phlogacanthus annamensis</i>	
<i>Thunbergia laurifolia</i>	O
Plantaginaceae	
<i>Plantago major</i>	M
Verbenaceae	
<i>Callicarpa alpida</i>	
<i>C. cana</i>	M
<i>C. erioclona</i>	
<i>Clerodendrum cyrtophyllum</i>	M
<i>C. infortunatum</i>	M
<i>C. godefroyi</i>	
<i>C. paniculatum</i>	M
<i>C. robinsonii</i>	
<i>C. squamatum</i>	
<i>Gmelia annamensis</i>	W
<i>G. arborea</i>	W
<i>Premna balansae</i>	
<i>Vitex quinata</i>	M

Class, Family, Genus and Species	Notes
<i>V. trifoliata</i>	M
Lamiaceae	
<i>Gomphostemma lucidum</i>	
<i>Leonurus artemisia</i>	M
Campanulaceae	
<i>Pentaphragma sinense</i>	
Asteraceae	
<i>Ageratum conyzoides</i>	M
<i>Artemisia vulgaris</i>	M
<i>Blumea balsamifera</i>	M
<i>B. eberhardtii</i>	
<i>B. fistulosa</i>	
<i>B. hieracifolia</i>	
<i>B. lacera</i>	M
<i>B. indica</i>	M
<i>B. subcapitata</i>	M
<i>Eclipta alba</i>	M
<i>Elephantopus scaber</i>	M
<i>Emilia sonchifolia</i>	M
<i>Erigeron linifolium</i>	
<i>Eupatorium odoratum</i>	M
<i>Gassocephalum crepidioides</i>	
Liliopsida	
Liliaceae	
<i>Dianella ensifolia</i>	
<i>Dracena loureiri</i>	M
<i>D. gracilis</i>	O
<i>Ophiopogon dracaenoides</i>	O
<i>O. japonicus</i>	M
Smilacaceae	
<i>Smilax bauhinioides</i>	
<i>S. gagnepainii</i>	
<i>S. perfoliata</i>	M
Dioscoreaceae	
<i>Dioscorea intempestica</i>	
<i>D. persimilis</i>	M
<i>D. poilanei</i>	
<i>D. triphylla</i> var. <i>reticulata</i>	
Taccaceae	
<i>Tacca integrifolia</i>	M
Musaceae	
<i>Musa uranoscopos</i>	
Costaceae	
<i>Costus speciosus</i>	M
Zingiberaceae	
<i>Alpinia bracteata</i>	M
<i>Amomum trilobum</i>	M
<i>A. xanthioides</i>	M
<i>Zingiber zerumbet</i>	

Class, Family, Genus and Species	Notes
Maranthaceae	
<i>Donax cannaeformis</i>	
<i>Phrynium parviflorum</i>	
Orchidaceae	
<i>Aerides falcatum</i>	O
<i>A. multiflorum</i>	O
<i>Arundina graminifolia</i>	O
<i>Corymborchis veratrifolia</i>	O
<i>Cymbidium dayanum</i>	O
<i>C. finlaysonianum</i>	O
<i>Dendrobium amabile</i>	O
<i>D. crystallinum</i>	O
<i>D. lindleyi</i>	O
<i>D. terminale</i>	O
<i>D. thyrsoiflorum</i>	O
<i>Geodorum densiflorum</i>	O
<i>Phalaenopsis mannii</i>	O
Cyperaceae	
<i>Carex cryptostachys</i>	
<i>C. leucholora</i>	
<i>Cyperus diffusus</i>	
<i>C. flavidus</i>	
<i>C. panicus</i> var. <i>roxburghianus</i>	
<i>C. pumilus</i>	
<i>C. rotundus</i>	M
<i>C. sesquiflorus</i>	
<i>Fimbristylis complanata</i>	
<i>F. dichotomoides</i>	
<i>F. thomsonii</i>	
<i>Kyllinga nemoralis</i>	M
<i>Lipocarpha chinensis</i>	
<i>Scirpus juncooides</i>	M
<i>S. wallichii</i>	
Commelinaceae	
<i>Commelina diffusa</i>	
<i>Cyanotis barbata</i>	
Poaceae	
<i>Arundo donax</i>	
<i>Bambusa balcooa</i>	
<i>B. spinosa</i>	
<i>Chloris barbata</i>	
<i>Chrysopogon aciculata</i>	M
<i>Cynodon dactylon</i>	
<i>Dactyloctenium aegyptiacum</i>	
<i>Dendrocalamus patellaris</i>	
<i>Eleusine coranaca</i>	M
<i>Eragrostis zeylanica</i>	
<i>Imperata cylindrica</i>	M
<i>Miscanthus floridulus</i>	

Class, Family, Genus and Species	Notes
<i>Oxytenanthera albo-cyliata</i>	
<i>O. poilanei</i>	
<i>Phragmites karka</i>	
<i>Saccharum arundinaceum</i>	
<i>S. spontaneum</i>	
<i>Teinostachyum dullooa</i>	
<i>Thysanolaena maxima</i>	M
Areceae	
<i>Arenga pinnata</i>	O
<i>Calamus bousigonii</i>	
<i>C. poilanei</i>	
<i>C. pseudoscutellaris</i>	
<i>C. rudentum</i>	
<i>C. tetradactylus</i>	
<i>Caryota mitis</i>	O
<i>C. urens</i>	
<i>Daemonorops pierreanus</i>	
<i>Kortalsia lacsinosia</i>	
<i>Licuala bracteata</i>	O
<i>Livistona chinensis</i>	O
<i>Pinanga duperreana</i>	
<i>Plectocomia elongata</i>	
Araceae	
<i>Acorus calamus</i>	M
<i>Aglaonema pierreanum</i>	
<i>Alocaria macrorrhiza</i>	M
<i>Amorphophalus campanulatus</i>	M
<i>Colocaria esculenta</i>	
<i>Epipremnum giganteum</i>	O
<i>E. pinnatum</i>	O
<i>Homalomena occulta</i>	M
<i>Lasia spinosa</i>	M
<i>Pothos angustifolius</i>	
<i>P. cathartii</i>	O
<i>P. gigantipes</i>	
<i>P. yunnanensis</i>	
Pandanaceae	
<i>Pandanus tonkinensis</i>	

Follows Pham Hoang Ho (1991).
Notes: W = Wood, O = Ornamental;
M = Medicinal.

Appendix 2: Mammals Recorded at Phong Dien and Dakrong Nature Reserves

No.	Common Name	Order, Family, Genus and Species	IUCN 1996	Anon. 1992
	Pangolins:	Pholidota:		
	Pangolins	Manidae		
1	Chinese Pangolin	<i>Manis pentadactyla</i>	NT	V
2	Sunda Pangolin	<i>M. javanica</i>	NT	
	Treeshrews:	Scandentia:		
	Treeshrews	Tupaiaidae		
3	Northern Treeshrew	<i>Tupaia belangeri</i>		
	Primates:	Primates:		
	Lorises	Loridae		
4	Slow Loris	<i>Nycticebus coucang</i>		V
	Old-world Monkeys	Cercopithecidae		
5	Pig-tailed Macaque	<i>Macaca nemestrina</i>	VU	V
6	Rhesus Macaque	<i>M. mulatta</i>	NT	
7	Bear Macaque	<i>M. arctoides</i>	VU	V
8	Red-shanked Douc Langur	<i>Pygathrix nemaeus nemaeus</i>	EN	
	Gibbons	Hylobatidae		
9	Buff-cheeked Gibbon	<i>Hylobates gabriellae</i>	DD	
	Carnivores:	Carnivora:		
	Dog and Foxes	Canidae		
10	Indian Wild Dog or Dhole	<i>Cuon alpinus</i>	VU	E
	Bears	Ursidae		
11	Asiatic Black Bear	<i>Ursus thibetanus</i>	VU	E
12	Sun Bear	<i>U. malayanus</i>	DD	E
	Weasels, etc.	Mustelidae		
13	Yellow-throated Marten	<i>Martes flavigula</i>		
14	Hog-badger	<i>Arctonyx collaris</i>		
15	Large-toothed Ferret-badger	<i>Melogale personata</i>		R
16	Eurasian Otter	<i>Lutra lutra</i>		T
	Civets	Viverridae		
17	Large Indian Civet	<i>Viverra zibetha</i>		
18	Small Indian Civet	<i>Viverricula indica</i>		
19	Common Palm Civet	<i>Paradoxurus hermaphroditus</i>		
20	Masked Palm Civet	<i>Paguma larvata</i>		
21	Binturong	<i>Arctictis binturong</i>		V
	Mongoose	Herpestidae		
22	Crab-eating Mongoose	<i>Herpestes urva</i>		
	Cats	Felidae		
23	Leopard Cat	<i>Prionailurus bengalensis</i>		
24	Golden Cat	<i>Catopuma temminckii</i>	NT	V
25	Clouded Leopard	<i>Pardofelis nebulosa</i>	VU	V
26	Tiger	<i>Panthera tigris</i>	EN	E
	Even-toed Ungulates:	Artiodactyla:		
	Pigs	Suidae		
27	Wild Pig	<i>Sus scrofa</i>		
	Mouse-deer, Chevrotains	Tragulidae		
28	Lesser Malay Mouse-deer	<i>Tragulus javanicus</i>		V
	Deer	Cervidae		
29	Sambar	<i>Cervus unicolor</i>		
30	Giant Muntjac	<i>Megamuntiacus vuquangensis</i>		
31	Indian Muntjac or Barking Deer	<i>Muntiacus muntjak</i>		
	Cattle, Antelopes, Goats	Bovidae		
32	Gaur	<i>Bos gaurus</i>	VU	E

No.	Common Name	Order, Family, Genus and Species	IUCN 1996	Anon. 1992
33	Southern Serow	<i>Naemorhedus sumatraensis</i>	VU	V
34	Saola	<i>Pseudoryx nghetinhensis</i>	EN	
	Rodents:	Rodentia:		
	Non-flying Squirrels	Sciuridae		
35	Black Giant Squirrel	<i>Ratufa bicolor</i>		
36	Pallas's Squirrel	<i>Callosciurus erythraeus</i>		
37	Grey-bellied Squirrel	<i>C. inornatus</i>		
38	Cambodian Striped Tree-squirrel	<i>Tamiops rodolphii</i>		
	Flying Squirrels	Pteromyidae		
39	Red Giant Flying Squirrel	<i>Petaurista philippensis</i>		R
	Mice, Rats, etc.	Muridae		
40	Hoary Bamboo Rat	<i>Rhizomys pruinosus</i>		
	Old-world Porcupines	Hystriidae		
41	Malayan Porcupine	<i>Hystrix brachyura</i>	VU	
42	Asiatic Brush-tailed Porcupine	<i>Atherurus macrourus</i>		
	Lagomorphs:	Lagomorpha:		
	Rabbits	Leporidae		
43	Burmese Hare	<i>Lepus peguensis</i>		

Follows Corbet and Hill (1992).

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

Appendix 3: Birds Recorded at Phong Dien and Dakrong Nature Reserves

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

No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et</i> <i>al.</i> 1994	Anon. 1992
		Cuculiformes:			
		Cuculidae			
37	Large Hawk Cuckoo	<i>Hierococcyx sparverioides</i>	1		
38	Indian Cuckoo	<i>Cuculus micropterus</i>	1, 2, 4		
39	Eurasian Cuckoo	<i>C. canorus</i>	1, 2, 4		
40	Plaintive Cuckoo	<i>Cacomantis merulinus</i>	1, 2, 3, 4		
41	Drongo Cuckoo	<i>Surniculus lugubris</i>	1, 2, 3, 4		
42	Asian Koel	<i>Eudynamys scolopacea</i>	1, 4		
43	Green-billed Malkoha	<i>Phaenicophaeus tristis</i>	1, 2, 3, 4		
44	Coral-billed Ground Cuckoo	<i>Carpococcyx renauldi</i>	1, [2]	NT	T
		Centropodidae			
45	Greater Coucal	<i>Centropus sinensis</i>	1, 2, 3, 4		
46	Lesser Coucal	<i>C. bengalensis</i>	1, 2, 4		
		Psittaciformes:			
		Psittacidae			
47	Vernal Hanging Parrot	<i>Loriculus vernalis</i>	3, 4		
		Apodiformes:			
		Apodidae			
48	Needletail species	<i>Hirundapus</i> sp.	2		
49	Asian Palm Swift	<i>Cypsiurus balasiensis</i>	1, 2, 3, 4		
50	Fork-tailed Swift	<i>Apus pacificus</i>	4		
		Strigiformes:			
		Strigidae			
51	Mountain Scops Owl	<i>Otus spilocephalus</i>	1, 2, 3, 4		
52	Collared Scops Owl	<i>O. bakkamoena</i>	1, 2		
53	Buffy Fish Owl	<i>Ketupa ketupu</i>	(1)		
54	Collared Owlet	<i>Glaucidium brodiei</i>	4		
55	Asian Barred Owlet	<i>G. cuculoides</i>	1, 2		
		Caprimulgidae			
56	Grey Nightjar	<i>Caprimulgus indicus</i>	1, 2		
		Columbiformes:			
		Columbidae			
57	Oriental Turtle Dove	<i>Streptopelia orientalis</i>	1, 2, 4		
58	Spotted Dove	<i>S. chinensis</i>	1, 2, 3, 4		
59	Red Collared Dove	<i>S. tranquebarica</i>	1, 2, 3, 4		
60	Emerald Dove	<i>Chalcophaps indica</i>	1, 2, 4		
61	Thick-billed Green Pigeon	<i>Treron curvirostra</i>	1, 2, 3, 4		
62	Pin-tailed Green Pigeon	<i>T. apicauda</i>	4		
63	Yellow-vented Green Pigeon	<i>T. seimundi</i>	1	NT	R
64	Green Imperial Pigeon	<i>Ducula aenea</i>	1		
65	Mountain Imperial Pigeon	<i>D. badia</i>	3, 4		
		Rallidae			
66	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	1		
		Ciconiiformes:			
		Accipitridae			
67	Crested Serpent Eagle	<i>Spilornis cheela</i>	1, 4		
68	Crested Goshawk	<i>Accipiter trivirgatus</i>	1		
69	Black Eagle	<i>Ictinaetus malayensis</i>	1, 2, 4		
70	Changeable Hawk Eagle	<i>Spizaetus cirrhatus</i>	1		
		Ardeidae			
71	Cinnamon Bittern	<i>Ixobrychus cinnamomeus</i>	1, 4		
		Passeriformes:			
		Pittidae			
72	Blue-rumped Pitta	<i>Pitta soror</i>	1, 2	NT	
73	Bar-bellied Pitta	<i>P. elliotii</i>	1, 2	NT	T
74	Blue-winged Pitta	<i>P. moluccensis</i>	2		

No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et al.</i> 1994	Anon. 1992
		Eurylaimidae			
75	Silver-breasted Broadbill	<i>Serilophus lunatus</i>	4		
76	Long-tailed Broadbill	<i>Psarisomus dalhousiae</i>	1		T
		Irenidae			
77	Asian Fairy Bluebird	<i>Irena puella</i>	4		
78	Blue-winged Leafbird	<i>Chloropsis cochinchinensis</i>	1, 2, 3		
79	Orange-bellied Leafbird	<i>C. hardwickii</i>	1, 4		
		Laniidae			
80	Long-tailed Shrike	<i>Lanius schach</i>	1, 2, 3, 4		
		Corvidae			
81	White-winged Magpie	<i>Urocissa whiteheadi</i>	1, 4	NT	
82	Indochinese Green Magpie	<i>Cissa hypoleuca</i>	1	NT	
83	Racket-tailed Treepie	<i>Crypsirina temia</i>	1, 2, 3, 4		
84	Rachet-tailed Treepie	<i>Temnurus temnurus</i>	1, 2, 3, 4		T
85	Large-billed Crow	<i>Corvus macrorhynchus</i>	1, 2, 3, 4		
86	Ashy Woodswallow	<i>Artamus fuscus</i>	2		
87	Maroon Oriole	<i>Oriolus traillii</i>	4		
88	Large Cuckooshrike	<i>Coracina macei</i>	1, 2, 4		
89	Black-winged Cuckooshrike	<i>C. melaschistos</i>	4		
90	Scarlet Minivet	<i>Pericrocotus flammeus</i>	1		
91	Bar-winged Flycatcher-shrike	<i>Hemipus picatus</i>	4		
92	White-throated Fantail	<i>Rhipidura albicollis</i>	4		
93	Black Drongo	<i>Dicrurus macrocercus</i>	1, 2, 3, 4		
94	Ashy Drongo	<i>D. leucophaeus</i>	2, 3		
95	Crow-billed Drongo	<i>D. annectans</i>	3, 4		
96	Bronzed Drongo	<i>D. aeneus</i>	1, 2		
97	Lesser Racket-tailed Drongo	<i>D. remifer</i>	4		
98	Spangled Drongo	<i>D. hottentottus</i>	1, 2, 4		
99	Greater Racket-tailed Drongo	<i>D. paradiseus</i>	1, 2, 4		
100	Black-naped Monarch	<i>Hypothymis azurea</i>	1, 2, 3, 4		
101	Asian Paradise-flycatcher	<i>Terpsiphone paradisi</i>	1, 2, 4		
102	Great Iora	<i>Aegithina lafresnayeii</i>	1, 2, 3		
103	Large Woodshrike	<i>Tephrodornis gularis</i>	4		
		Muscicapidae			
104	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	1		
105	White-gorgeted Flycatcher	<i>Ficedula monileger</i>	4		
106	White-tailed Flycatcher	<i>Cyornis concretus</i>	4		
107	Hainan Blue Flycatcher	<i>C. hainanus</i>	4		
108	Blue-throated Flycatcher	<i>C. rubeculoides</i>	4		
109	Hill Blue Flycatcher	<i>C. banyumas</i>	2		
110	Tickell's Blue Flycatcher	<i>C. tickelliae</i>	4		
111	Grey-headed Canary Flycatcher	<i>Culicicapa ceylonensis</i>	4		
112	Oriental Magpie Robin	<i>Copsychus saularis</i>	1, 2, 3, 4		
113	White-rumped Shama	<i>C. malabaricus</i>	1, 2, 3, 4		
114	Slaty-backed Forktail	<i>Enicurus schistaceus</i>	1, 2, 3, 4		
115	White-crowned Forktail	<i>E. leschenaulti</i>	4		
		Sturnidae			
116	Black-collared Starling	<i>Sturnus nigricollis</i>	1, 2, 3, 4		
117	Common Myna	<i>Acridotheres tristis</i>	1, 2		
118	White-vented Myna	<i>A. cinereus</i>	1, 2		
119	Crested Myna	<i>A. cristatellus</i>	2		
120	Hill Myna	<i>Gracula religiosa</i>	1, 2, 4		
		Paridae			
121	Sultan Tit	<i>Melanochlora sultanea</i>	1, 4		
		Hirundinidae			
122	Red-rumped Swallow	<i>Hirundo daurica</i>	4		

No.	Common Name	Order, Family, Genus and Species	Site Number	Collar <i>et</i> <i>al.</i> 1994	Anon. 1992
		Pycnonotidae			
123	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	1, 2, 3, 4		
124	Sooty-headed Bulbul	<i>P. aurigaster</i>	4		
125	Stripe-throated Bulbul	<i>P. finlaysoni</i>	1, 2		
126	Puff-throated Bulbul	<i>Alophoixus pallidus</i>	1, 2, 4		
127	Ochraceous Bulbul	<i>A. ochraceus</i>	1		
128	Grey-eyed Bulbul	<i>Iole propinqua</i>	1, 2, 3, 4		
129	Black Bulbul	<i>Hypsipetes leucocephalus</i>	4		
		Cisticolidae			
130	Yellow-bellied Prinia	<i>Prinia flaviventris</i>	2		
		Zosteropidae			
131	Oriental White-eye	<i>Zosterops palpebrosus</i>	4		
		Sylviidae			
132	Common Tailorbird	<i>Orthotomus sutorius</i>	1, 2, 4		
133	Arctic Warbler	<i>Phylloscopus borealis</i>	4		
134	Yellow-bellied Warbler	<i>Abroscopus superciliaris</i>	4		
135	Dark-necked Tailorbird	<i>Orthotomus atrogularis</i>	1, 2, 3, 4		
136	Striated Grassbird	<i>Megalurus palustris</i>	4		
137	Masked Laughingthrush	<i>Garrulax perspicillatus</i>	1, 2		
138	White-crested Laughingthrush	<i>G. leucolophus</i>	1, 2, 3, 4		
139	Lesser Necklaced Laughingthrush	<i>G. monileger</i>	1, 2		
140	Black-throated Laughingthrush	<i>G. chinensis</i>	1, 2, 3, 4		
141	White-cheeked Laughingthrush	<i>G. vassali</i>	4	RRS	T
142	Abbott's Babbler	<i>Malacocincla abbotti</i>	2		
143	Buff-breasted Babbler	<i>Pellorneum tickelli</i>	4		
144	Spot-throated Babbler	<i>P. albiventris</i>	4		
145	Puff-throated Babbler	<i>P. ruficeps</i>	2		
146	Scaly-crowned Babbler	<i>Malacopteron cinereum</i>	1, 2		
147	Large Scimitar Babbler	<i>Pomatorhinus hypoleucos</i>	1, 2, 3, 4		
148	White-browed Scimitar Babbler	<i>P. schisticeps</i>	4		
149	Short-tailed Scimitar Babbler	<i>Jabouilleia danjoui</i>	1, 2, 4	VU, RRS	T
150	Streaked Wren Babbler	<i>Napothera brevicaudata</i>	1, 2, 4		
151	Eyebrowed Wren Babbler	<i>N. epilepidota</i>	4		
152	Rufous-capped Babbler	<i>Stachyris ruficeps</i>	4		
153	Golden Babbler	<i>S. chrysaea</i>	4		
154	Grey-throated Babbler	<i>S. nigriceps</i>	4		
155	Spot-necked Babbler	<i>S. striolata</i>	3, 4		
156	Striped Tit Babbler	<i>Macronous gularis</i>	1, 2, 3, 4		
157	Grey-faced Tit Babbler	<i>M. kelleyi</i>	1, 4	NT, RRS	
158	Rufous-throated Fulvetta	<i>Alcippe rufogularis</i>	1, 2, 3, 4	NT	
159	Mountain Fulvetta	<i>A. peracensis</i>	1, 2, 3, 4		
160	White-bellied Yuhina	<i>Yuhina zantholeuca</i>	1, 2, 3		
		Nectariniidae			
161	Thick-billed Flowerpecker	<i>Dicaeum agile</i>	4		
162	Plain Flowerpecker	<i>D. concolor</i>	4		
163	Ruby-cheeked Sunbird	<i>Anthreptes singalensis</i>	1, 2		
164	Purple-naped Sunbird	<i>Hypogramma hypogrammicum</i>	4		
165	Olive-backed Sunbird	<i>Nectarinia jugularis</i>	1, 2		
166	Fork-tailed Sunbird	<i>Aethopyga christinae</i>	2, 4		
167	Crimson Sunbird	<i>A. siparaja</i>	1, 2, 3, 4		
168	Little Spiderhunter	<i>Arachnothera longirostra</i>	1, 2, 4		
169	Streaked Spiderhunter	<i>A. magna</i>	1, 2, 4		
		Passeridae			
170	Eurasian Tree Sparrow	<i>Passer montanus</i>	1, 2, 3, 4		
171	White-rumped Munia	<i>Lonchura striata</i>	1, 2, 3, 4		

Appendices

Follows Inskipp *et al.* (1996).

Notes: CR = Critical; EN/E = Endangered; VU = Vulnerable; T = Threatened; R = Rare; NT = Near Threatened; DD = Data Deficient as per Collar *et al.* (1994) and Anon. (1992); RRS = Restricted-range species.

Site Number:

1. Khe Lau and Phong My communes, Phong Dien district, Thua Thien Hue province.
2. Ba Long and Trieu Nguyen communes, Dakrong district, Quang Tri province.
3. Ta Rut commune, Dakrong district, Quang Tri province.
4. Road 41 and Ka Kou Village, A Sau commune, A Luoi district, Thua Thien Hue province.

Appendix 4: Reptiles and Amphibians Recorded at Phong Dien and Dakrong Nature Reserves

No.	Class, Order, Family, Genus and Species	Phong Dien	Dakrong	IUCN 1996	Anon. 1992
	Reptilia				
	Squamata:				
	Gekkonidae				
1	<i>Gekko gecko</i>	O	I		T
2	<i>Hemidactylus frenatus</i>	O	O		
	Agamidae				
3	<i>Acanthosaura lepidogaster</i>	S			T
4	<i>Calotes emma emma</i>	S			
5	<i>C. versicolor</i>	O	O		
	Draco				
6	<i>Draco volans</i>	O			
7	<i>Physignathus cocincinus</i>	O	S		V
	Scincidae				
8	<i>Mabuya multifasciata</i>	S	O		
9	<i>Sphenomorphus</i> sp.		S		
	Lacertidae				
10	<i>Takydromus sexlineatus</i>		O		
	Varanidae				
11	<i>Varanus nebulosus</i>	I	I		V
12	<i>V. salvator</i>	I	I		V
	Xenopeltidae				
13	<i>Xenopeltis unicolor</i>	I			
	Boidae				
14	<i>Python molurus</i>	I	I	NT	V
	Colubridae				
15	<i>Ahaetulla prasina</i>	I	O		
16	<i>Amphiesma</i> sp.		S		
17	<i>A. stolata</i>	O			
18	<i>Dendrelaphis pictus</i>	I			
19	<i>Elaphe radiata</i>	I	I		
20	<i>Enhydris plumbea</i>	O	O		
21	<i>Oligodon</i> sp.		I		
22	<i>Ptyas korros</i>	I	I		T
23	<i>P. mucosus</i>	I	I		V
24	<i>Rhabdophis chrysargus</i>	I	I		
25	<i>Xenochrophis piscator</i>	O	O		
	Elapidae				
26	<i>Bungarus candidus</i>	I	I		
27	<i>B. fasciatus</i>	O	I		T
28	<i>Naja naja</i>	I	I		T
29	<i>Ophiophagus hannah</i>	O	I		E
	Viperidae				
30	<i>Trimeresurus albolabris albolabris</i>	I	I		
31	<i>T.</i> sp.	S			
	Testudinata:				
	Platysternidae				
32	<i>Platysternum megacephalum</i>	I	I	DD	R
	Emydidae				
33	<i>Cistoclemmys galbinifrons</i>	I	I	NT	V
34	<i>Cuora trifasciata</i>		I	EN	V
	Testudinidae				
35	<i>Indotestudo elongata</i>	I		VU	V

No.	Class, Order, Family, Genus and Species	Phong Dien	Dakrong	IUCN 1996	Anon. 1992
	Trionychidae				
36	<i>Palea steindachneri</i>	I	I	NT	
37	<i>Pelodiscus sinensis</i>	I	I		
38	<i>Trionyx cartilagineus</i>	I			
	Amphibia				
	Anura:				
	Megophryidae				
1	<i>Leptobrachium hasselti</i>	S			
2	<i>Megophrys major</i>	S			
	Bufonidae				
3	<i>Bufo galeatus</i>	S			R
4	<i>B. melanostictus</i>	O	O		
	Ranidae				
5	<i>Ooeidozyga lima</i>	O	O		
6	<i>Phrynoglossus laevis</i>		S		
7	<i>Rana andersoni</i>	S	O		T
8	<i>R. guentheri</i>	O	O		
9	<i>R. kuhlii</i>	S	O		
10	<i>R. limnocharis</i>	S	S		
11	<i>R. macrodactyla</i>	O			
12	<i>R. microlineata</i>	S	I		T
13	<i>R. nigrovittata</i>	O	S		
14	<i>R. ricketti</i>	O			
15	<i>R. rugulosa</i>	O	I		
16	<i>R. sauteri</i>	S	S		
	Rhacophoridae				
17	<i>Philautus</i> sp.	S			
18	<i>Rhacophorus leucomystax</i>	O	S		
19	<i>R. nigropalmatus</i>	S			T

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

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

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

Appendix 5: Butterflies Recorded at Phong Dien and Dakrong Nature Reserves

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

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

No.	Family, Genus and Species	Global Range	Phong Dien District			Dakrong District		
			Forest	Riparian	Open	Forest	Riparian	Open
114.	<i>*E. phemius</i> Doubleday	3				r ¹		
115.	<i>Lexias dirtea</i> F.	3	c ¹			c ¹		
116.	<i>Eulacera osteria</i> Westwood	3	c			c		
117.	<i>Charaxes bernardus</i> F.	3		u			U	
118.	<i>C. aristogiton</i> C. & R. Felder	2						
119.	<i>Polyura athamas</i> Drury	3		r			R	
	Libytheidae							
120.	<i>Libythea myrrha</i> Godart	3		r				u
121.	<i>L. narina</i> Godart	3						r ¹
122.	<i>L. geoffroy</i> Godart	4						r ¹
	Riodinidae							
	<i>Zemerus flegyas</i> Cramer	3	c	c	c	c	C	c
123.	<i>Dodona deodata</i> Hewitson	2	r					
124.	<i>Abisara echerius</i> Stoll	3	u			u		
125.	<i>Paralaxita dora</i> Fruhstorfer	1	r					
126.	<i>Stiboges nymphidia</i> Butler	3	r			r		
	Lycaenidae							
128.	<i>Miletus cf. mallus</i> Fruhstorfer	2	r					
129.	<i>Allotinus subsrigosus</i> Moore	3	r ¹					
130.	<i>*Castalius rosimon</i> F.	3			?			
131.	<i>Caleta roxus</i> Godart	3				c ¹		
132.	<i>Everes lacturnus</i> Godart	3				r		
133.	<i>Acytolepis puspa</i> Horsfield	3	u					
134.	<i>Neopitecops zalmora</i> Butler	3				r		
135.	<i>Megisba malaya</i> Horsfield	2	u			u		
136.	<i>Jamides celeno</i> Cramer	3	c	c		c	C	
137.	<i>J. alecto</i> C. Felder	3		u		u		
138.	<i>Nacaduba kurava</i> Moore	?		?				
139.	<i>N. pavana</i> Fruhstorfer		?					
140.	<i>N. subperusa</i> Fruhstorfer	?	?					
141.	<i>Prosotas</i> sp.	?		c				
142.	<i>Anthene emolus</i> Godart	3						
143.	<i>A. lycaenina</i> R. Felder	3						
144.	<i>Arhopala cf. silhetensis</i>	?	r					
145.	<i>A. ammonides</i> Doherty	?	r					
146.	<i>A. vihara</i> Corber	?				r		
147.	<i>A. epimuta</i> Evans	?	r					
148.	<i>A. ariana</i>	?	r					
149.	<i>A. sp.</i>	?				r		
150.	<i>Flos diardi</i> Hewitson	3	r					
151.	<i>F. fulgida</i> Hewitson	2	u			u		
152.	<i>Surendra quercetorum</i> Moore	2	u			u		
153.	<i>S. cf. vivarna</i>	3	r					
154.	<i>Amblypodia anita</i> Hewitson	2				r	U	
155.	<i>Spindasis syama</i> Horsfield	3		r		r		
156.	<i>*Loxura atymnus</i> Stoll	3				r		
157.	<i>Yasoda tripunctata</i> Hewitson	2	u			r		
158.	<i>Thamala marciana</i> Hewitson	2				u		
159.	<i>Dacalana burmana</i> Moore	?	r					
160.	<i>Tajuria cf. cyppus</i>	?	r					
161.	<i>T. ister</i>	?	r					
162.	<i>T. cf. luculentus</i>	?	r					
163.	<i>Remelana jangala</i> Horsfield	3	r					
164.	<i>*Zeltus amasa</i> Hewitson	3		r		r		
165.	<i>Deudorix epijarbas</i> Moore	3				r		
166.	<i>Sinthusa chandrana</i> Moore	2				r		
167.	<i>Rapala cf. damona</i>	3				r		
168.	<i>R. varuna</i> Horsfield	3	u					
	Hesperiidae							
169.	<i>Bibasis oedipodea</i> Swainson	3		r				r
170.	<i>B. jaina</i> Moore	3	r			r		
171.	<i>B. sena</i> Moore	3						u

No.	Family, Genus and Species	Global Range	Phong Dien District			Dakrong District		
			Forest	Riparian	Open	Forest	Riparian	Open
172.	<i>Hasora taminatus malayana</i> Felder & Felder	3	u					
173.	<i>H. badra</i> Moore	3	u			u		
174.	<i>H. vitta</i> Butler	3						r
175.	<i>H. chromus</i> Cramer	3	c	c		c	C	
176.	<i>Badamia exclamationis</i> Fabricius	3	c	c		c	C	
177.	<i>Celaenorrhinus asmara</i> Butler	2				r		
178.	<i>Darpa striata</i> Druce	3	r					
179.	<i>Odina decoratus</i> Hewitson	2	r					
180.	<i>Coladenia agni</i> de Niceville	3	r					
181.	<i>C. agnioides</i> Elw. & Edw.	3	u					
182.	<i>Gerosis</i> (near <i>tristis</i> Eliot)	3	u			u		
183.	<i>Mooreana trichoneura</i> C. & R. Felder	3	u					
184.	<i>Tagiades litigiosa</i> Moschler	3	c					
185.	<i>T. menaka</i> Moore	3	r			u		
186.	<i>T. gana</i> Moore	3	r					
187.	<i>Halpe zola</i> Evans	2	r					
188.	<i>Astictopterus jama</i> (?) C. & R. Felder	3				c		
189.	<i>Iambrix salsala</i> Moore	3		c		c		
190.	<i>Koruthaialos rubecula</i>	3				r		
191.	<i>Ancistroides nigrita diocles</i> Moore	3				u		
192.	<i>Notocrypta paralysos</i> Wood-Mason	3				u		
193.	<i>N. clavata</i> Staudinger	3		r				
194.	<i>Zographetus</i> cf. <i>doxus</i> Eliot	3				u		
195.	<i>Isma umbrosa</i> Elw. & Edw.	3				r		
196.	<i>Hyarotis microstictum</i> Wood-Mason & de Niceville	?	r					
197.	<i>Plastingia naga</i> de Niceville	3	r					
198.	<i>P.</i> cf. <i>pellonia</i> Fruhstorfer	3				r		
199.	<i>Salanoemia noemi</i> de Niceville							
200.	<i>Pyroneura margherita miriam</i> Evans	2	c			u		
201.	<i>Lotongus calathus</i> Hewitson	3		r				
202.	<i>Zela</i> (?) sp.	?	r					
203.	<i>Gangara thyrasis</i> F.	3				u		
204.	<i>G. lebadea</i> Hewitson	2				r		
205.	<i>Matapa druna</i> Moore	3	r			r		
206.	<i>M. sasivarna</i> Moore	3	r					
207.	<i>Unkana ambasa</i> Moore	3				r		
208.	<i>Pirdana hyela</i> Hewitson	3				r		
209.	<i>Telicota colon stinga</i> Evans	3						u
210.	<i>Parnara ganga</i> Evans	?						?
211.	<i>Pelopidas assamensis</i> de Niceville	3						?
212.	<i>Pelopidas</i> (?) sp.	?		?				
213.	<i>Caltoris</i> sp.	?	?					

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

Species Occurrence: r = rare (one or two specimens encountered).
u = uncommon (~10 specimens encountered).
c = common (up to 20 specimens encountered).
c^m = common male only; u^{fm} = uncommon female only; c^l = locally common.
* = new species record for Vietnam.

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

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

(a) Papilionidae

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

(b) Pieridae

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

(c) Danaidae

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

(d) Satyridae

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

(e) Amathusiidae

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

f) Nymphalidae

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

(g) Riodinidae

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

(h) Hesperidae

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

(i) All Families

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

Shading Key for Cs Values

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

Appendix 6: Village Histories for Four Villages Compiled Using Timeline Analysis

Village History of Khe Tran Village, Phong Dien District

Date	Landmark Events	Relative Extent of Village Land	Relative Extent of Forest Land	Relative Abundance of Wildlife
1967-1968	Napalm is dropped on the village and village lands; 500 households from what was then Ya Hong Tien commune leave the village to flee the bombing	XX	XXXXXXXXXX	XXXXXXXXXXXXXX
1978	After end of war, 30 households return to village from A Luoi district and Laos	XXXXXXXXXXXX	XXXXXX	XXXXXXXXXXXX
1982	Twelve households leave village and move to Ha Long village	XXXX	XXXXX	XXXXXXXXXXXX
1983	Big flood (bigger than one in 1999)	XXX	XXXX	XXXXXXXXXXXX
1985	Major forest fire			
1992	Ten households join village as part of the fixed settlement programme. For the first time, the village stops shifting cultivation	XXXXXXXXXX	XXXX	XXX
1994	<i>Acacia</i> plantations are established	XXXXXXXXXX	XXXXXX	X
1999	Big flood	XXXXXXXXXXXX	XXXXXX	X

Village History of Ha Long Village, Phong Dien District

Date	Landmark Events	Dependence on Forest Resources
Before 1954	A total of 154 Pa-hi people households live in the forest near the location of the present day Ha Long village; 50 Van Kieu households migrate into the area from Quang Tri province	100
1967-1968	Spraying of defoliants; many households move to A Luoi district, Quang Tri province and Laos; forest is extensively destroyed; many large animals are killed	100
1977	Forty households return from A Luoi district, of which 11 households are Van Kieu	50
1982	Ten households migrate from Khe Tran, a neighbouring village	50
1983	Flood; houses and property are damaged	50
1985	Bad drought; large area of forest is burned to clear land for cultivation, and to collect metal and honey; wet rice cultivation is started	50
1993	A total of 45 households are involved in fixed cultivation and sedentarisation programme; suspension bridge crossing the O Lau river close to the village is built; re-forestation activities take place	30
1995	Village is officially named Ha Long	30
1996	Planting of sugar cane for KCP sugar factory starts	30
1999	Village suffers two catastrophic floods	30

Village History of Dut 5 Village, A Luoi District

Date	Landmark Events
1969-1972	Local people living in forest near boundary between A Luoi and Phong Dien district flee bombing to live in Laos
1973	People move to Hong Van commune
1974	The village is established by people moved from the forests of Hong Kim commune as part of state policy
1975	Villagers start cultivating wet rice with skills learned from Kinh people
1987	The village is separated from Dut village
1983	A severe flood causes widespread crop and infrastructure damage and 'degrades' land
1989	Cinnamon is planted for the first time, funded through the 327 programme
1990	A severe drought destroys crops
1999	A severe flood leads to a poor harvest and destroys infrastructure

Appendix 7: Seasonal Calendars for Agricultural Activities in Three Villages

Seasonal Calendar for Khe Tran Village

Calendar Month	Relative Rainfall (10 = wettest)	Relative Temp. (10 = hottest)	Agricultural Labour Γ (20 = most active)	Agricultural Labour E (20 = most active)	NTFP Collection	Activities
Jan	3		20	15		Planting peanuts; harvesting sweet potatoes; planting maize; planting red and green beans.
Dec	4		3	4	Yes	Planting cassava; collecting rattans and palms from forest; harvesting cassava planted previous year.
Nov	6		4	3	Yes	Collecting rattans and forest products.
Oct	11		Free time	Free time	Yes	Stay at home and eat! Collect rattans and forest products; make conical hats from palm leaves.
Sep	4		3	3	Yes	Harvest green beans; harvest peanuts; tend home gardens; repair houses and buffalo pens.
Aug	2	3	3	6		Harvest green beans. Planting sweet potatoes; harvesting and planting sugar cane.
Jul	0	6	4	4		Harvesting sugar cane; harvesting green and red beans; manage Acacia plantations.
Jun	0	10	13	14		Harvesting and planting of peanuts; harvesting sugar cane; planting green beans and harvesting cassava.
May	1	5	11	17		Harvesting sugar cane; harvesting and re-planting of peanuts; planting green beans.
Apr	1	2	4	9		Creating raised beds as the peanuts grow; harvest sweet potatoes.
Mar	2	1	8	9		Applying fertiliser to peanuts; clearing scrub from rubber and acacia plantations.
Feb	5		5	2		Planting peanuts; weeding peanut fields; planting maize which is inter-cropped with peanuts; harvest sugar cane.

Seasonal Calendar for Dut 5 Village

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Wet rice	Plant	Tend		Harvest	Plant	Tend			Harvest			Plant
Hill rice					Plant		Tend				Harvest	
Maize	Plant	Tend and Protect		Harvest	Plant	Tend and Protect				Harvest		Plant
Cassava	Plant	Tend and Protect				Harvest		Harvest				
Potatoes	Plant	Tend		Harvest			Plant	Tend				Harvest
Peanuts	Plant	Tend		Harvest	Plant	Tend		Harvest				Plant
Green beans	Plant	Tend and Protect		Harvest								
Hunting and NTFP collection	*	*	*	***	****	****	****	**	*	*	*	*
Labour distribution	****	**	***	****	*	*	**	***	**	**	*	****

Key: * = Low; ** = Medium; *** = High; **** = Very High

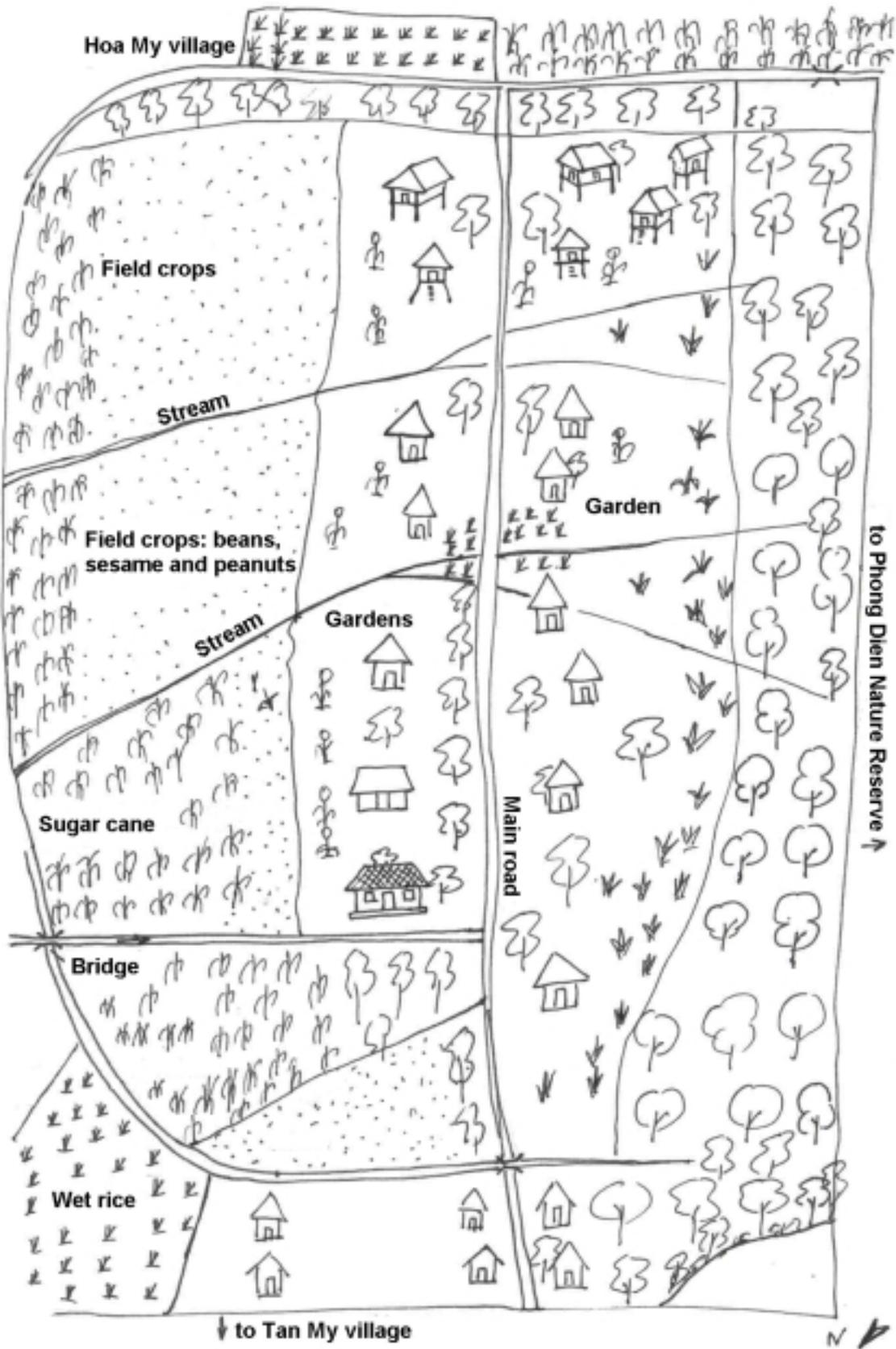
Seasonal Calendar for Dut 6 Village

Activities	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Relative temperature	*	**	***	****	*****	*****	*****	****	***	***	**	*
Relative rainfall	****	***	**	**		*	*****	*****	*****	*****	****	****
Wet rice	Plant	Tend		Harvest	Plant		Tend			Harvest		Plow
Hill rice					Plant		Tend and Protect				Harvest	
Cassava	Plant		Tend		Plant			Harvest				Plow
Maize	Plant	Tend		Plant	Tend and Protect		Harvest					Plant
Beans				Plant		Tend	Harvest					
Pineapple					Harvest							
Other fruits	Plant							Plant				
Cinnamon		Tend						Tend	Plant			
Hunting and NTFP collection	**	**	*	*	*	****	****	***	****	**	**	**
Labour distribution	****	***	**	****	****	*	**	***	*	**	**	****

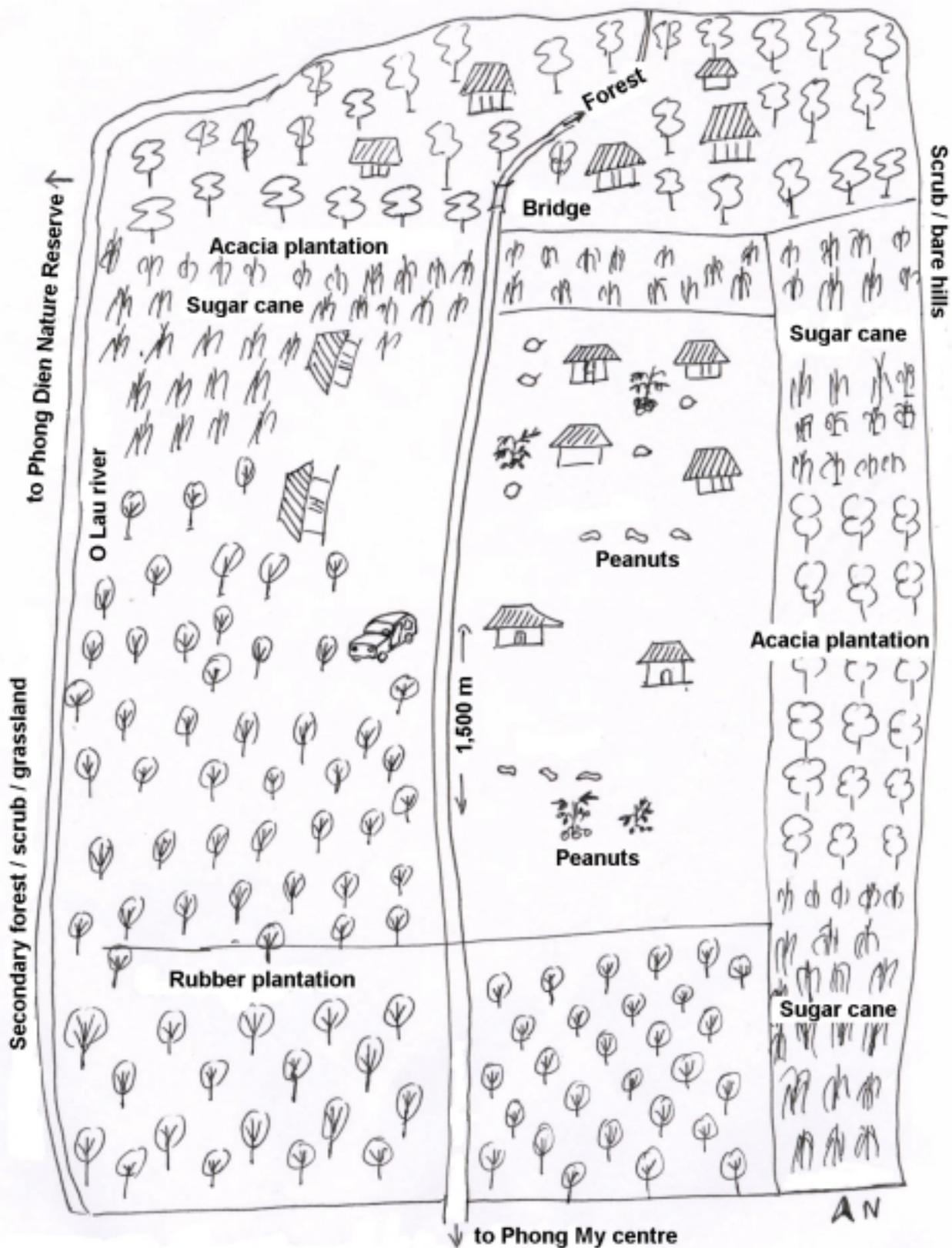
Key: * = Low; ** = Medium; *** = High; **** = Very High

Appendix 8: Village Maps Developed by the Villagers of Four Villages

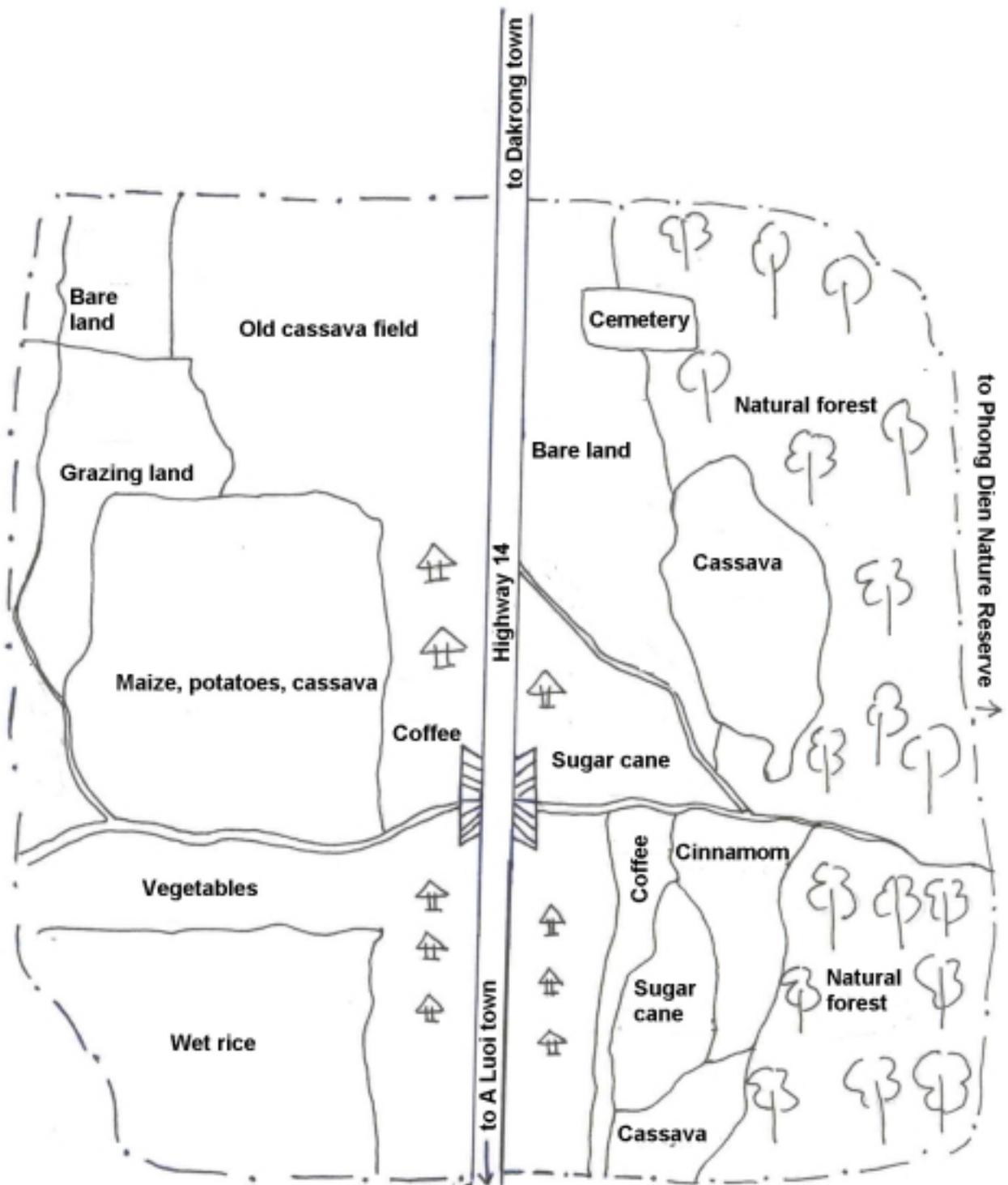
Village Map of Ha Long Village



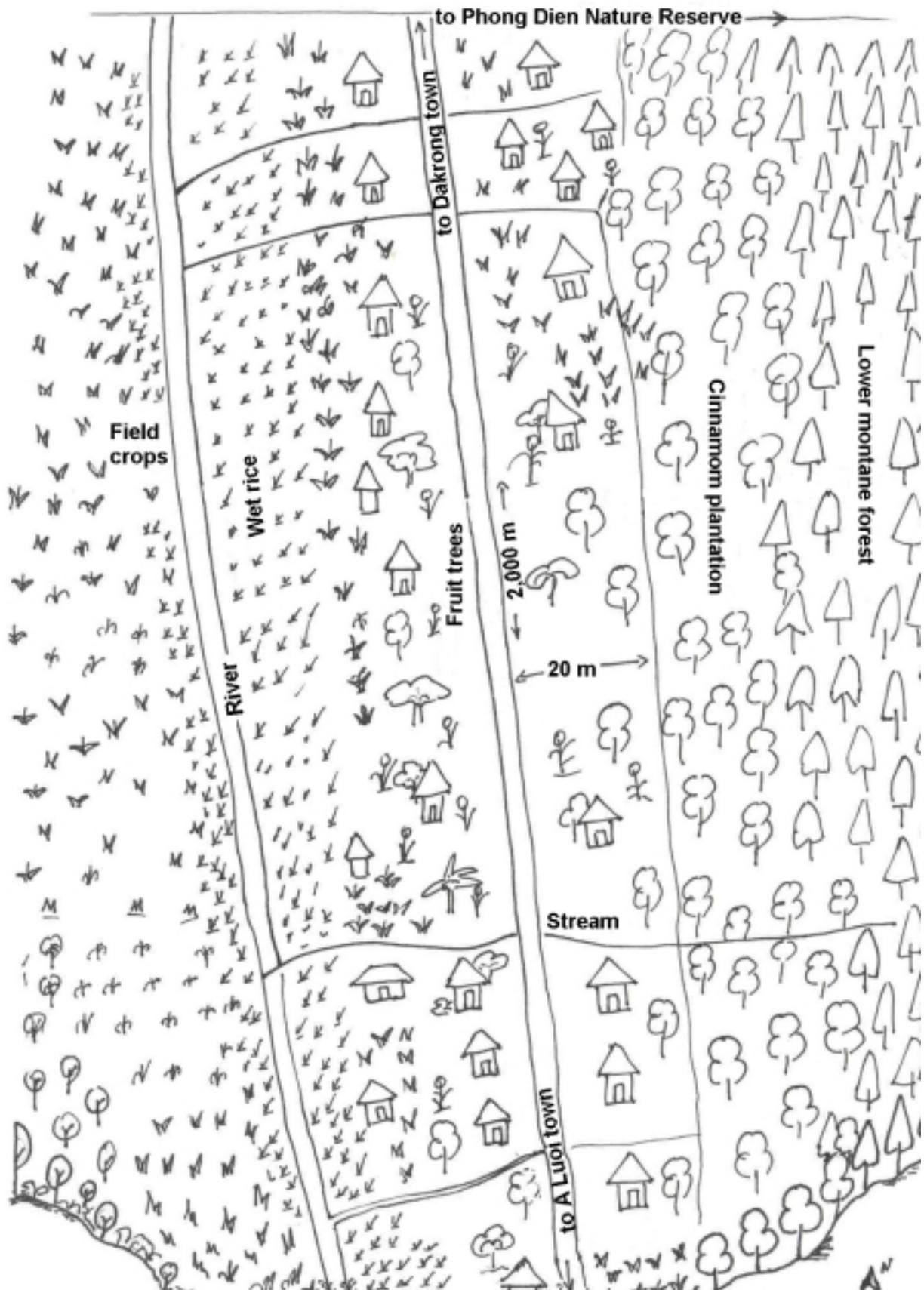
Village Map of Khe Tran Village



Village Map of Dut 5 Village



Village Map of Dut 6 Village



Appendix 9: Duration of Hunting and NTFP Collection Compared with Seasonal Labour Demands and Rainfall

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Khe Tran village												
NTFP collection												
Hunting and trapping												
Labour surplus												
Heaviest rainfall												
Ha Long village												
NTFP collection												
Hunting and trapping												
Labour surplus												
Rainfall												
Dut 5 village												
Hunting and NTFP collection												
Labour surplus												
Rainfall												
Dut 6 village												
NTFP collection												
Hunting and trapping												
Labour surplus												
Rainfall												

Appendix 10: Historical and Current Threats to Forest and Wildlife at Four Villages

Khe Tran Village

Threat	Historical	Current
Cutting of firewood and timber	4 (6)	1 (23)
Forest fire	5 (3)	2 (16)
Shifting cultivation	2 (13)	3 (4)
Hunting	6 (2)	4 (3)
Unexploded ordnance	3 (9)	5 (2)
War	1 (15)	6 (0)

Ranking 1 = most significant threat; Number of votes in brackets ().

Ha Long Village

Threat	Historical	Current
Forest fire	2 (16)	1 (16)
Hunting	3 (12)	2 (14)
Timber extraction	5 (4)	3 (12)
Firewood collection	7 (0)	4 (2)
NTFP collection	6 (1)	5 (4)
Clearance of land for agriculture	4 (6)	6 (3)
War	1 (19)	7 (0)

Ranking 1 = most significant threat; Number of votes in brackets ().

Dut 5 Village

Threats	Last 10 years
NTFP collection	1
Timber extraction	2
Hunting	3
Forest fire	4
Clearance of forest for agriculture	5

Ranking 1 = most significant threat; Number of votes in brackets (). Note: this village was established in 1987, therefore historical data on threats could not be collected reliably before 1987.

Dut 6 Village

Threat	Last 10 years
Clearance of forest for agriculture	1
Hunting	2
Timber extraction	3=
Forest fire	3=
Firewood collection	5
NTFP collection (non firewood)	6

Ranking 1 = most significant threat; Number of votes in brackets (). Note: this village was established in 1987, therefore historical data on threats could not be collected reliably before 1987.

Note: Villagers discussed as a group what they considered to be the most significant threats to the well-being of the forest and its wildlife. Villages made a distinction between threats to the forest since the village was founded, and those over the last 10 years or so. The villagers then each assigned three votes for current threats, and three votes for historical threats. These were the used to produce a ranking.

Appendix 11: Hunting Data for Four Villages

Hunting Data for Khe Tran Village

Species	Where	Method	Who	Use	Sell	Status		Price (VND/kg)	Where Sold
						<1989	Now		
Wild Pig	Ubiquitous	Trap	Men	Yes	Yes	+++	+++	14,000	Dealers
Muntjac	Ubiquitous	Trap	Men	Yes		++	++		
Sambar	Good forest	Shoot	Men	Yes	Yes	++	+	20,000	Dealers
Snake	Ubiquitous	Trap	Men		Yes	+++	++	500,000	Dealers
Pangolin	Ubiquitous	Trap	Men		Yes	+++	++		Dealers
Monkey	Good forest	Trap	Men	Yes		+++	++		
Bear	Good forest	Trap				+++	++		
Porcupine	Ubiquitous	Trap	Men	Yes		+++	++		
Civet	Ubiquitous	Trap	Men	Yes		+++	++		
Birds	Ubiquitous	Trap	Men	Yes		+++	+++		
Tiger	Good forest	Trap	Outsiders			++	+		
Gibbon	Good forest	Shoot	Outsiders	Yes		?	+		
Douc Langur	Good forest	Shoot	Outsiders	Yes		+++	++		
Crested Argus	Good forest	Trap	Men	Yes		+++	++		
Elephant		Shoot	Soldiers	Yes		?	?		
Gaur	Good forest	Shoot	Outsiders			++	+		
Clouded Leopard	Good forest	Trap	Outsiders		Yes				
Green Peafowl	Good forest	Trap	Men	Yes		+++	+		
Edwards's Pheasant	Good forest	Trap	Men	Yes		+++	+++		
Red Junglefowl	Ubiquitous	Trap	Men	Yes		++	++		
Dhole	Good forest	Trap	Men	Yes		++	+++		

Hunting Data for Ha Long Village

Species	Where	Months	Who	Method	Use	Sell	Price (VND/kg)	Market	Status	
									<1977	Now
Wild Pig	Forest, fields	9-11	Γ	Trap	✓	✓	15,000	Local	++++	+++
Indian Muntjac	Regen. forest	5-7	Γ	Trap	✓	✓	7,000	Local	+++	++
Giant Muntjac	Good forest	5-7	Γ	Trap	✓	✓	7,000	Local	++	+
Sambar	Good forest	5-7	Γ	Trap, Shoot	✓	✓	22,000	Local	++	+
Macaques	Forest, stream	8-11	Γ	Trap	✓	✓	10,000	Local	++++	+++
Gibbon	Good forest	5-8	Γ	Shoot	✓				++	+
Douc Langur	Good forest	5-8	Γ	Shoot	✓				+++	++
Gaur	Good forest	9-11	Γ	Shoot	✓	✓		Local	++	+
Bear	Forest	3-5	Γ	Trap, Shoot	✓	✓		Local	++	+
Serow	Rock forest	9-11	Γ	Trap	✓	✓	10,000	Local	++	+
Tiger	Good forest	All year	Γ	Trap, Shoot		✓		Local	++	+
Civets	Fields, forest	8-11	Γ	Trap	✓	✓	70,000	Local	++++	+++
Pangolin	Fields, forest	8-11	Γ	Trap		✓	400,000	Local	+++	++
Leopard	Good forest	All year	Γ	Trap, Shoot		✓		Local	++	+
Loris	Forest	5-7	Γ	Trap, catch	✓	✓		Local	++	+
Wild cat	Forest	All year	Γ	Trap	✓				+	+
Dhole	Forest	All year	Γ	Trap	✓				++	++
Mouse-deer	Forest	9-11	Γ	Trap	✓				++	+
Snakes	Anywhere	All year	Γ	Trap, catch		✓	500,000	Local	++	+
Python	Lowland	All year	ΓE	Catch		✓	50,000	Local	++	+
Pheasant	Good forest	All year	Γ	Trap	✓				++	+
Crested Argus	Forest	All year	Γ	Trap	✓				+++	++
Gecko	Stream	All year	ΓE	Catch	✓	✓	50,000	Local	+++	++
Turtles	Good forest	All year	ΓE	Catch	✓	✓	70,000	Local	++	+
Tortoises	River, stream	5-8	E	Catch	✓	✓	200,000	Local	+++	++

Hunting Data for Dut 5 Village

Species	Where	Months	Who	Method	Use	Sell	Price (VND/kg)	Market	Status	
									<1975	Now
Wild Pig	Forest, fields	5-7	Γ	Trap	✓	✓	20,000	Local	++++	+++
Indian Muntjac	Regen. forest	5-7	Γ	Trap	✓	✓	20,000	Local	+++	++
Giant Muntjac	Good forest	5-7	Γ	Trap	✓	✓	20,000	Local	++++	+++
Serow	Rock forest	4-7	Γ	Trap	✓	✓	15,000	Local	++++	+++
Pangolin	Forest, fields	All year	Γ	Trap		✓	420,000	Local	+++	+
Tiger	Good forest	All year	Γ	Trap, shoot		✓		Local	+++	++
Bear	Forest	4-6	Γ	Trap, shoot	✓	✓	20,000	Local	+++	++
Crested Argus	Forest	All year	Γ	Trap	✓				++++	+++
Pheasant	Good forest	All year	Γ	Trap	✓				++++	++
Gibbon	Good forest	5-8	Γ	Shoot	✓				++	+
Macaques	Forest, stream	5-7	Γ	Trap	✓	✓	10,000	Local	++++	+++
Douc Langur	Good forest	5-7	Γ	Shoot	✓				+++	+++
Loris	Forest	5-7	Γ	Trap	✓	✓		Local	++	+
Leopard	Good forest	All year	Γ	Trap, shoot		✓		Local	++	++
Dhole	Forest	All year	Γ	Trap	✓				++++	+++
Sambar	Good forest	5-7	Γ	Trap, shoot	✓	✓	20,000	Local	++	+
Saola	Good forest	4-7	Γ	Trap	✓	✓			++	+
Porcupine	Forest, fields	All year	Γ	Trap	✓	✓			+++	+++
Otter	River, stream	All year	Γ	Trap	✓	✓			++	+
Civets	Forest, fields	4-7	Γ	Trap	✓	✓	70,000	Local	++++	+++
Wild cat	Forest	All year	Γ	Trap	✓				++	+
Snake	Forest, fields	All year	Γ	Trap, catch		✓	500,000	Local	+++	++
Python	Low area	All year	ΓE	Catch		✓	50,000	Local	+++	++
Monitor lizard	Stream	All year	ΓE	Catch	✓	✓	50,000	Local	+++	++
Gecko	Forest	All year	Γ	Catch	✓				++	+
Turtles	Good forest	All year	ΓE	Catch	✓	✓		Local	++	+
Tortoises	Stream	All year	E	Catch	✓	✓		Local	+++	++

Hunting Data for Dut 6 Village

Species	Where	Months	Purpose	Use	Sell	Status	
						1978	Now
Snakes	Forest, fields	All year	Medicine		✓	+++	+++
Muntjac	Primary forest, secondary forest	8-12	Food	✓	✓	+++	++
Elephant	Primary forest	-	-		✓	?	?
Gaur	Primary forest	-	-	✓	✓	+	?
Serow	Primary forest	8-12	Food	✓	✓	++	+
Tiger	Primary forest	5-8	Medicine		✓	+++	+
Bear	Primary forest	5-8	Medicine		✓	++	++
Wild Pig	Secondary forest, fields	9-12	Food	✓	✓	+++	+++
Gibbon	Primary forest, secondary forest	All year	Medicine		✓	++	+
Macaques	Primary forest	All year	Medicine	✓	✓	+	+
Sambar	Primary forest, secondary forest	8-12	Food		✓	+++	+++
Pheasant	Primary forest, secondary forest	8-12	Food		✓	+++	+++
Crested Argus	Primary forest, secondary forest	All year	Food		✓	+++	++
Pangolin	Primary forest	5-8	Food	✓	✓	++	+
Porcupine	Primary forest	All year	Food	✓	✓	++	+
Turtles	Streams in primary forest	All year	Food		✓	++	+
Civets	Primary forest, secondary forest	All year	Food	✓		++	+
Rats	Primary forest, secondary forest	All year	Food	✓		+++	+++
Squirrels	Primary forest, secondary forest	All year	Food	✓		+++	+++

Appendix 12: Forest Product Exploitation Data for Four Villages

Forest Product Exploitation Data for Khe Tran Village

Forest Product	Rank	Part Gathered	Where	Months	Who	Use		Price (VND)	Organised by	Where Sold	Status	
						Use	Sell				'Before'	Now
Rattan	1	Main stem	Near village	7-8	Γ	✓		700 per stem	Household	Roadside stalls	++++	+++
Timber	2	Trunk	Good forest far from village	6-7	Γ	✓			Household		++++	++
Palm leaves for conical hats	3	Leaf	Good forest far from village	6-8	ΓE		✓	30 per leaf	Household	Roadside stalls	++++	+++
Firewood	4	Branch, trunk	Near village	All year	E	✓			Household		++++	+++
<i>Imperata cylindrica</i> for thatch	5	Grass leaf	Near village	5-6	E	✓			Household		++++	+++
Bamboo	6	Stem	Near village	6-7	Γ	✓			Household		++++	+++
Honey	7	Honey	Good forest far from village	2-3	Γ	✓			Household		++++	+
Bamboo shoots	8	Young shoot	Near village	8	E	✓			Household		++++	+++
Bamboo binding material		Trunk	Near village	5	Γ	✓			Household		++++	++++
<i>Aquilaria crassna</i> resin		Exudate	Good forest far from village	6-7	Γ		✓	3 million/kg	Village	Hue	+++	+
Material for brushes		Whole plant	Near village	6-8	E	✓			Household		+++	+++
Medicinal plants		Various	Near village	5-6	ΓE	✓	✓	25,000/kg	Household	Commune centre	++++	++
Bark for essential oils		Bark	Good for secondary forest	7-8	Γ		✓	1,400/kg	Household	Commune centre	++++	++
Root and stem for essential oils		Root, stem	Good forest far from village	6-7	Γ		✓	25,000/litre	Household	Hue	++++	++
Banana leaves		Leaf	Near village	All year	E	✓			Household		++++	++++
Palm for making brushes		Stem, flower	Near village	2-3	ΓE	✓	✓	25,000/kg	Household	Commune centre	++++	+++

Forest Product Exploitation Data for Dut 6 Village

Forest Product	Where	Months	Part Gathered	Purpose	Use	Sell	Status	
							1978	Now
Firewood	Forest close to village	1-6	Branch, stem	Fuel	✓	✓	++++	+++
Rattan	Primary forest	All year	Stem	House construction, furniture	✓	✓	+++	++
Bamboo shoots	Near village	8-11	Shoot	Food	✓		+++	+++
Bamboo	Near village	All year	Stem	House construction, furniture	✓		++	+++
<i>Aquilaria crassna</i> resin	Primary forest	2-8	Aloe wood	Medicine		✓	+	-
Honey	Primary forest, secondary forest	10-12	Honey	Medicine	✓		++	+
Dot	Scrub	All year	Stem	Brush	✓	✓	+	++
Vegetable	Primary forest, secondary forest	All year	Leaf, stem	Food	✓		++	++

Forest Product Exploitation Data for Ha Long Village

Forest Product	Where	Months	Who	Use	Sell	Price (VND)	Market	Status	
								1977	Now
Palm leaves	Good forest	All year	ΓE		✓	30/leaf	Local	++++	+++
<i>Cinnamomum</i> sp. resin	Regenerating forest	2-3	ΓE		✓	50/stem	Local	++++	+
Rattan	Good forest	All year	ΓE		✓	1,000/stem	Local	++++	+++
<i>Litsea</i> sp.	Good forest	All year	ΓE		✓	900/kg	Local	++++	+
Honey	Good forest	4-6	Γ	✓	✓			++++	++
<i>Aquilaria crassna</i> resin	Good forest		Γ		✓	30 million/kg	Local	+++	+
Firewood	Good forest	All year	ΓE	✓				++++	+++
Bamboo shoots	Bamboo forest	8-9	ΓE	✓	✓	5,000/kg	Local	++++	+++
Medicinal plants	Good forest	All year	ΓE	✓	✓	20,000/kg	Local	+++	++
<i>Fallopia</i> sp.	Forest	All year	ΓE	✓	✓	10,000/kg	Local	++++	+++
Bamboo	Bamboo Forest	All year	ΓE	✓				++++	+++
Palm	Good forest	7-8	Γ	✓				++++	+++
Timber	Good forest	All year	Γ	✓				++++	++++
Orchids	Good forest	5-7	Γ	✓				++++	++
Ornamental plants	Forest	All year	ΓE	✓				+++	++
Fruit	Forest	7-8	Γ	✓				+++	++

Forest Product Exploitation Data for Dut 5 Village

Forest Product	Where	Months	Who	Use	Sell	Price (VND)	Market	Status	
								<1975	Now
Rattan	Good forest	6-7	ΓE		✓	1,000/stem	Local	+++	++
Firewood	Good forest	All year	ΓE	✓				++++	+++
Banana leaves	Bare land	All year	ΓE	✓	✓		Local	+++	+++
Material for making brushes	Regenerating forest	1-3	ΓE		✓	50/stem	Local	++++	+
Honey	Good forest	4-5	Γ	✓	✓			+++	+
<i>Cinnamomum</i> sp. resin	Good forest	All year	Γ					+++	++
<i>Aquilaria crassna</i> resin	Good forest		Γ		✓	30 million/kg	Local	++	+
<i>Litsea</i> sp.	Good forest	6-7	ΓE		✓	900/kg	Local	++++	+
Orchids	Good forest	All year	Γ	✓				++++	++
Bamboo shoots	Bamboo forest	8-9	ΓE	✓	✓	5,000/kg	Local	++++	+++
Medicinal plants	Anywhere	All year	ΓE	✓	✓	20,000/kg	Local	+++	+++
Bamboo	Bamboo forest	All year	ΓE	✓				+++	++
Palm leaves	Good forest	7-8	Γ	✓				++++	+++
Timber	Good forest	All year	Γ	✓				++++	+++