An assessment of the conservation importance of the Huong Son (Annamite) Forest, Ha Tinh Province, Vietnam, based on the results of a field survey for large mammals and birds

R. J. Timmins and Trinh Viet Cuong

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Cover: The Huong Son Forest in the Annamite Mountains, Ha Tinh Province, Vietnam. Photo by R. J. Timmins.

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Acronyms and abbreviations

AMNH	American Museum of Natural History
ARL	At Risk in Laos
c.	approximately
CBC	Center for Biodiversity and Conservation of the AMNH
cf.	compare
dbh	diameter at breast height
DD	Data Deficient
EC	European Commission
FIPI	Forest Inventory and Planning Institute
GNT	Globally Near-threatened
GPS	Global Positioning System
GSRV	Government of the Socialist Republic of Vietnam
GT	Globally Threatened
GT-CR	Globally Threatened - Critically Endangered
GT-EN	Globally Threatened - Endangered
GT-VU	Globally Threatened - Vulnerable
ha	hectares
IEBR	Institute of Ecology and Biological Resources
IUCN	the World Conservation Union
LKL	Little Known in Laos
MARD	Ministry of Agriculture and Rural Development
MOSTE	Ministry of Science, Technology and Environment
NAPAC	Northern Annamites Protected Areas Complex
NBCA	National Biodiversity Conservation Area
NL	Not [officially] Logged
NP	National Park
NPT	No Photograph Triggered
NPX	No Photograph Taken
NTFP	Non Timber Forest Product
NR	Nature Reserve
NVT	No Visible Trigger
PARL	Potentially At Risk in Laos
PFPD	Provincial Forest Protection Department
PNBCA	Proposed NBCA
RJT	R. J. Timmins
SFNC	Social Forestry and Nature Conservation in Nghe An Province (project title)
s.l.	sensu lato; an inclusive taxon definition in cases where the taxon boundary can differ depending on taxonomic treatment of its potential entities, i.e., a species including subspecies which other authors might exclude as separate species.
TVC	Trinh Viet Cuong
UTM	The grid system used on the Army Map Service (1965-70) 1:50,000 map series
VRB	Listed in the *Vietnamese Red Book* as threatened or indeterminate in Vietnam
WCS	Wildlife Conservation Society
WWF	World Wide Fund for Nature
WS	Wildlife Sanctuary
[ ]	Species record is provisional or unconfirmed
†	Species not confirmed to be currently present in the Huong Son Forest

Conventions

Abundance categories have been assigned to bird and diurnally active large mammal species according to their relative abundance as determined during the course of the survey. Abundance was assessed on a three-point scale based on the encounter frequency, taking into account the appropriateness of methods used to detect a species, and other factors (including ecology) that affect a species' observability (see Annex 2 for greater detail).

These abundance categories are:
Common: equivalent to being recorded daily, often in large numbers.
Frequent: equivalent to being recorded on over half of survey days.
Occasional: equivalent to being recorded on fewer than half of survey days.
Present: abundance not assessed.

These abundance estimates are given in Tables 5 and 6 but are also stated in text form in the individual Key Species accounts.

Key Species are any species judged to be Globally Threatened, Globally Near-Threatened, or Data Deficient following the definitions of IUCN (1996), or considered At Risk in Laos, Potentially At Risk in Laos or Little Known in Laos (following Duckworth et al. 1999). Selected species listed in the Vietnamese Red Book (MOSTE 1992) have also been considered Key Species for the purpose of this report, but as the list is now aged and includes several species clearly not at any immediate risk in Vietnam (Do Tuoc pers. comm. 1998, J. W. Duckworth pers. comm. 1998, J.C. Eames pers. comm. 1998, Trinh Viet Cuong pers. comm. 1998, Le Trong Trai pers. comm. 1999, RJT own data), it has not been used in its entirety; a revision of the text based on a review of recent information is under way (Vu Van Dung verbally 1999). Information on species listed under IUCN (1996) guidelines for mammals, turtles, and tortoises is taken from IUCN (1996), and for birds from Collar et al. (1994).

Restricted-range species: a species whose estimated historical range is less than 50,000 sq. km (Stattersfield et al. 1998).

Mammal taxonomy and systematics follow Corbet and Hill (1992), with English names following Duckworth et al. (1999); turtle and tortoise taxonomy and systematics follow Ernst and Barbour (1989), with English names following Stuart (1999); bird taxonomy, systematics and English names follow Inskipp et. al (1996), except in the case of a small number of taxa discussed in Annex 2.

Large mammals: mammalian families in which the majority of species are readily identifiable in the field (sensu Dorst and Dandelot 1970 and Duckworth et al. 1999).

Very large mammals: wild cattle *Bos/Bubalus*, Asian Elephant *Elephas maximus,* Tiger *Panthera tigris,* rhinoceroses *Rhinoceros/Dicerorhinus* and Asian Tapir *Tapirus indicus* (sensu Duckworth and Hedges 1998*a*).

Orthographic style of the English names for wildlife follows the guidelines of Inskipp et al. (1996).

Names and spelling of places and features in the study area generally follow those in local use and are referable to those on the Army Map Service (1965-70), 1:50,000 map series by reference to the gazetteer in Annex 1.

Locations from the survey are given as UTM grid references based on the Army Map Service (1965-70) 1:50,000 map series (and subsequent Vietnamese versions of them), unless an actual locality was established by GPS use in Latitude-Longitude coordinates. UTM grid references are to the nearest 100 m, with eastings first. Map sheet numbers are given rather than the two-letter 100 km grid-square reference. Details of the map sheets covering the survey areas can be found in Annex 1. Some of the GPS readings taken during the survey were substantially wrong and have been corrected to a best approximation on the figures and in the gazetteer. Survey routes given on the figures are approximate, between points at which GPS readings were taken. Altitudes are in meters above sea level; all altitudes of observations during the survey are approximate and based on the Army Map Service (1965-70) maps.

Indochina: Laos, Vietnam, Cambodia and parts of southern and southwestern China.

Laos: Lao Peoples Democratic Republic.

Vietnam: Socialist Republic of Vietnam.

Northern Annamites: The mountain area of Vietnam and Laos between 16°30'N and 19°30'N.

Northern Annamite Protected Area Complex (NAPAC): composed of three principal units; (northern unit) Pu Mat Nature Reserve (NR), Nam Chouan Proposed National Biodiversity Conservation Area (PNBCA) and the proposed Northern Extension to Nakai-Nam Theun National Biodiversity Conservation Area (NBCA); (central unit) Nakai-Nam Theun NBCA and Vu Quang NR; (southern unit) Hin Namno NBCA and Phong Nha-Ke Kang National Park (NP).

Effectively protected area: one in which hunting activity and habitat loss has been significantly reduced over 70% of the protected area relative to similar unprotected areas (based on the definition given by Robichaud 1999).

Executive Summary

This report is based on a large mammal and bird survey of the Huong Son Forest in Ha Tinh Province as part of a joint three-year program (1998-2000) between the Center for Biodiversity and Conservation at the American Museum of Natural History (CBC-AMNH), and the Institute of Ecology and Biological Resources (IEBR). The Huong Son Forest lies in Ha Tinh Province in the Annamite Mountains along the international border with Laos (18°15'-18°37' N, 105°07'-105°17' E; Figure 1).

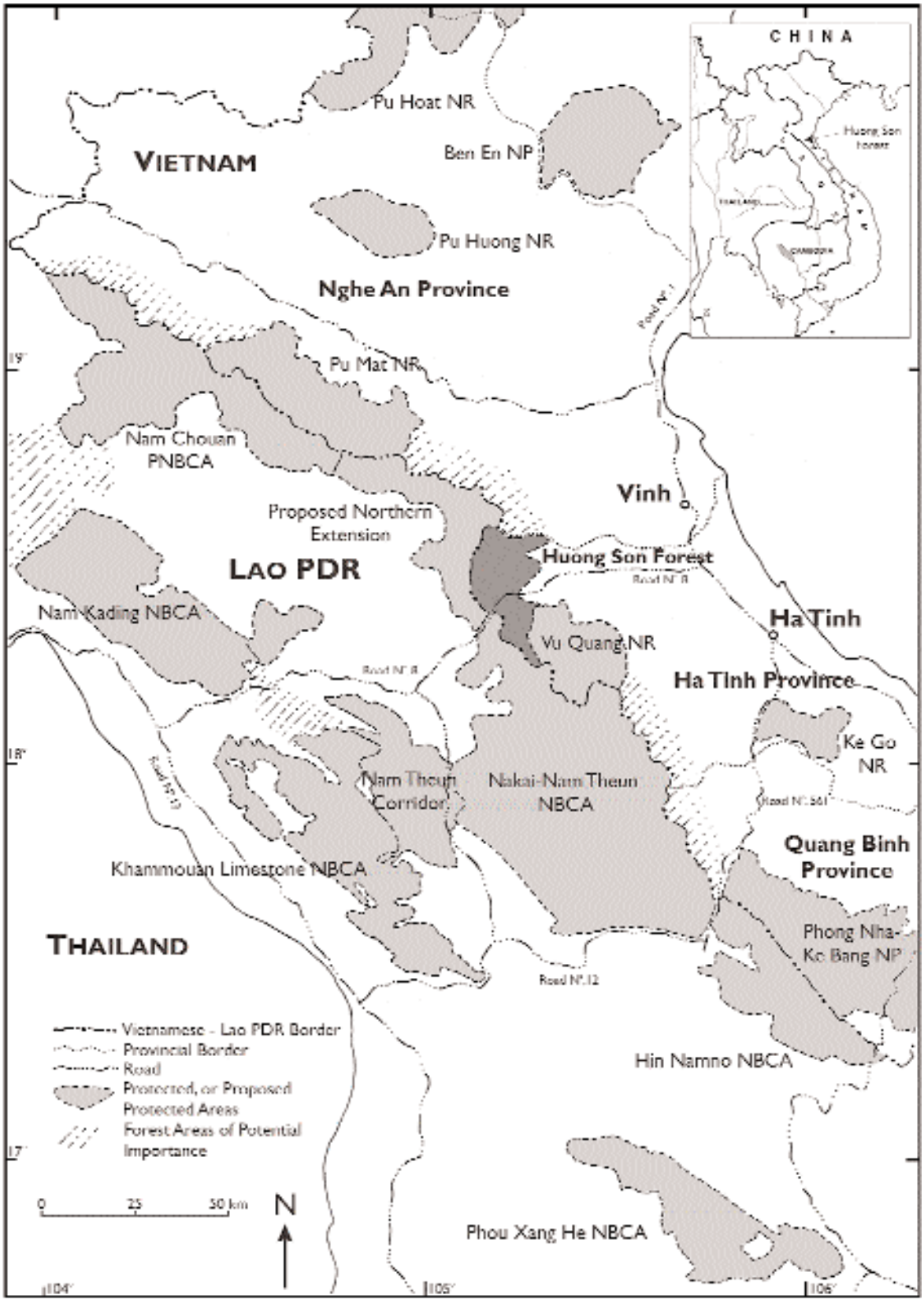
This survey was undertaken between 22 April and 24 May 1999 and complements additional systematic studies and collecting of selected small mammal taxa by the CBC-AMNH/IEBR program in the Huong Son Forest from April to May 1998 and again in April and May 1999 (Musser and Lunde, in prep.). This report principally covers the finding of the former survey; details of the latter studies will be reported on separately. This broad-ranging survey was meant to determine the status of large mammals and birds in the Huong Son Forest, as well as using traditional species groups to assess the potential of the Huong Son Forest for nature conservation. The complementary CBC-AMNH/IEBR mammal studies in the Huong Son focused on intensively surveying understudied small mammals in areas of the lower Rao An valley to gather both systematic and baseline data for use in future conservation work (Musser and Lunde in prep.).

The northern Annamite Mountains lie along the international border between Laos and Vietnam. The potential area for wildlife and habitat protection is made up of three principal units that straddle the Vietnam-Laos border and are divided by low passes across the Annamites. Each of these three units has a considerable area incorporated into established or proposed protected areas. For the purpose of this report, this proposed and established protected-areas network in the northern Annamites is collectively referred to as the Northern Annamites Protected Areas Complex (NAPAC). The Huong Son Forest forms a link between the northern and central units of the NAPAC. The Huong Son Forest is contiguous with both the established Vu Quang Nature Reserve (NR) in Vietnam and the Nakai-Nam Theun National Biodiversity Conservation Area (NBCA) in Laos. Together these areas form the central unit, which is the largest consolidated area of natural habitat in the NAPAC (Figure 1).

The Huong Son Forest contains the headwaters of the four main rivers (Rao An, Nam Sot, Nam Mac and Song Con) that go on to form the Song Ngan Pho river, in a horseshoe-like formation along the international border with Laos (Figure 2). The apex of the horseshoe is a low pass across the Annamites, through which Road no. 8 passes. Between Nuoc Sot and the international border this road runs directly through the Huong Son Forest. Evergreen forest, reaching a maximum altitude of c. 1900 m on the international border, still covers generally steep, although not precipitous, slopes closer to the international border, right down to the flat valley bottoms at < 200 m.

Almost all forest habitat within Huong Son district comes under the jurisdiction of the Huong Son Forest Enterprise. The Huong Son Forest Enterprise lands cover three communes, Son Hong, Son Kim and Son Tay. Logging in the existing forest areas has been under way since at least 1970, and probably almost all areas of the Huong Son Forest below c. 600 m have been logged, though in some cases only very selectively, by the Forest Enterprise or illegal logging operations.

FIGURE 1: THE HUONG SON FOREST IN A REGIONAL SETTING



species found in such habitat was Short-tailed Parrotbill *Paradoxornis davidianus*. The lowland valleys are characterized by certain species, in particular Blyth's Kingfisher *Alcedo hercules,* Rufous-throated Fulvetta *Alcippe rufogularis* and Grey-faced Tit Babbler *Macronous kelleyi*. The balance of evidence suggested that Inornate Squirrel *Callosciurus inornatus,* a widespread but poorly understood species, was common at the time of the survey, and this habitat could well represent its favored type.

The highest altitude areas surveyed had a bird community transitional between characteristically mid-altitude species and those of montane to sub-montane altitudes. High-altitude areas (1500 m+) are represented in the Huong Son Forest mainly along the international border with Laos, and are likely to support a typical montane fauna; however, they have relatively minor regional or national importance, since much higher areas can be found in the NAPAC on the international border between Vu Quang NR and Nakai-Nam Theun NBCA and along the international border in Nam Chouan (P)NBCA.

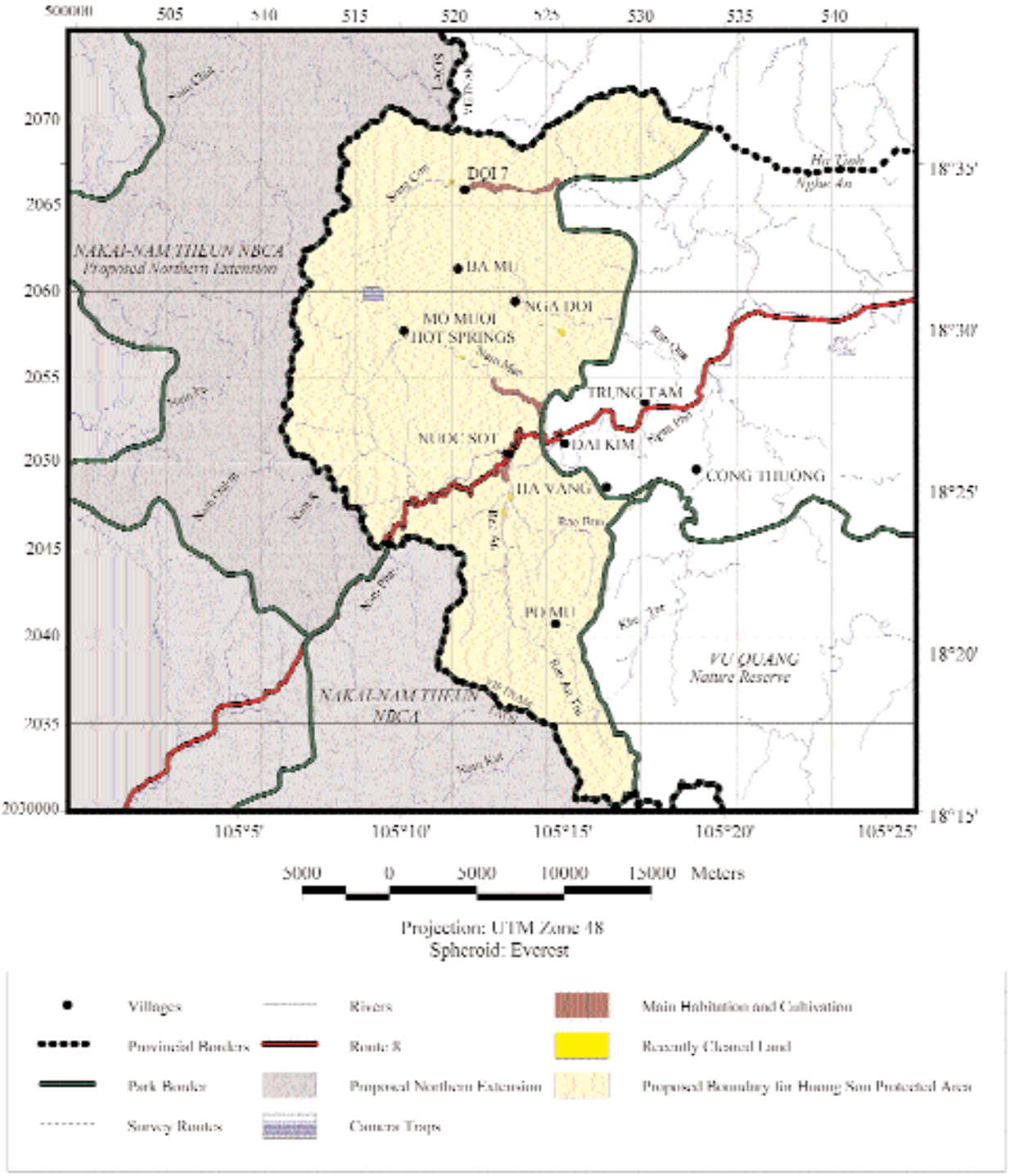
The findings, particularly in relation to the apparent abundances of Short-tailed Scimitar Babbler *Jabouilleia danjoui,* Crow-billed Drongo *Dicrurus annectans,* Moustached Barbet *Megalaima incognita,* Crested Argus *Rheinardia ocellata,* Owston's Civet *Hemigalus owstoni,* and Fork-tailed Sunbird *Aethopyga christinae,* reinforce what is known and suspected of the faunal difference between the eastern and western slopes of the Annamites.

The majority of smaller bird species are common in their respective habitats, but a very different picture is evident with large mammals and some large bird species. Only three of the potential seven species of diurnal primates were found, and the combined encounter rate for all species was considerably lower than in comparable habitats within the region. Similarly, gibbon calling density was greatly below findings from comparable areas within the region. Both results without doubt reflect reduced population densities. The small number of records of macaques was startling, since macaques appear to fare better in Laos and Vietnam than langur or gibbon populations in areas of high human use. Mammal signs were very few. Even small carnivore faeces, which are generally obvious, were found surprisingly rarely, and no signs of wild cattle *Bos*, Asian Elephant *Elephas maximus,* big cats *Panthera/Pardofelis* or large deer *Cervus/Axi*s were found. There was not a single sighting or vocal registration of a muntjac *Muntiacus* during the survey. Very few signs of small carnivores were found on the two river stretches surveyed, and the encounter frequencies during the nocturnal survey work were poor compared with similar work within the region. Very clearly, populations of the majority of large ground-living mammal species are well below capacity.

Larger birds likely to be quarry species followed a similar pattern to large mammals, with very few registrations in particular of large hornbills *Buceros/Aceros*. Crested Argus, although still common, did not approach the calling density found in the adjacent area of Laos. Although expected to be found, there were no records of Hill Myna *Gracula religiosa* or imperial pigeons *Ducula,* suggesting that these species were scarce or even absent over large areas.

The apparent low abundance of many large species, assessed by several methods, is strong evidence that hunting is having a considerable effect on wildlife populations, and is probably the major determinant of abundance of almost all large mammals and the species of quarry birds. As with almost all forest areas in Indochina, corroborative direct evidence showed that hunting was widespread and locally intensive. Such intensity of hunting is clearly commercially motivated, although there is presumably considerable consumption of low-value species locally. As with other areas of Vietnam, there has been confiscation of guns in civilian use. While this has probably

Figure 2. The Huong Son Forest showing proposed boundary for the conservation area, survey routes, and named localities.



Sources: Army Map Service 1965-1970, 1:50,000 L7011 US Department of Defense, US Army Topographic Command, Washington, DC.

reduced pressure on small arboreal species, primate populations are at low densities and are likely to be still considerably at risk from gun use.

Most hunting takes the form of snaring. Snarelines were ubiquitous in the areas surveyed. Snaring is most intensive in the peripheral areas, where snarelines can be reached easily in 2-3 hours from human habitation. Snaring, however, is still intensive in more distant areas, where snarelines are placed and visited perhaps only every 3-4 days, and in the most distant areas, where excursions are made by groups of men for from several days up to a couple of weeks for a period of intensive snaring. Most people visiting the forest for other reasons (i.e., logging, fishing and a wide variety of other non-timber forest product harvests) probably also set snares. Snares are particularly damaging to wildlife communities because they are unselective, and very high snare densities can be achieved with minimal effort and cost. Densities of all large ground-dwelling mammals and pheasants are probably much reduced solely as a result of snaring. Populations of a large number of species are likely to be at considerable risk from the practice, including all bears *Ursus,* big cats *Panthera/Pardofelis,* large deer *Cervus/Axis*, Saola *Pseudoryx nghetinhensis* and Southern Serow *Naemorhedus sumatraensis*.

Wildlife of value, particularly animals caught alive, such as civets, pangolins, turtles, large game animals, and presumably more highly prized quarry and their body parts such as big cats, bears and wild cattle, are largely taken by hunters to local dealers. These are in turn visited daily by buyers from further afield. Investigation of the wildlife trade importance of Road no. 8 found that a probably significant proportion of wildlife in trade coming across from Laos went directly through dealers in Trung Tam. These traders had organized schemes for transport to the north of Vietnam (Compton et al. in press). The impression gained from both the present survey results and those of Compton et al. (in press) is that wildlife trade is an integral component of the Huong Son communities, with a broad range of activities by those involved and a multitude of different routes and arrangements being used. Such is the pervasiveness of wildlife trade within the area that it will be one of the most significant concerns and greatest hurdles to overcome in conservation strategies aimed at this area of the NAPAC.

Although the activities of the Huong Son Forest Enterprise are now very limited, timber poaching is rife and large timber volumes are still being removed over a wide area, with evidence found in all of the major valleys. The majority of large trees (> 50 cm diameter at breast height) have been removed from the lower slopes (c. < 500 m) in almost all areas, and, in many areas, the higher slopes (c. 500-800 m) as well, as a result of the activities of the Enterprise and illegal groups. Within the next few years trees of value that remain will largely have been felled. More damagingly, in peripheral areas much smaller trees are being removed and forest structure is quickly deteriorating.

Evidence was found for obviously unsustainable collection of an oil from the basal heart-wood of trees called locally Dau De, provisionally identified as *Cinnamomum glaurescens,* and the collection of a latex-like substance from the bark (stripped from the felled tree) of a tree by the local name of Cay Nha. Other resources such as fan palm leaves and rattan are clearly collected, but little detail on such exploitation was obtained. Rattan harvest has apparently been so heavy that harvesters now go to Laos. Similarly, valuable forest products such as *Aquilaria* resin are now reportedly rare. The lack of evidence from the survey for other uses of forest resources should certainly not be taken to indicate that extraction of other forest products is low, or that collection of some such resource has not been intensive in the past. Exploitation may be localized, not obvious, undertaken primarily at other times of the year, or involve scarce resources unlikely to be encountered during the survey.

Aquatic life, particularly fish, appeared to be heavily exploited based on equipment and fish remains found along rivers. Riverine environments suffer both from this direct exploitation of resources and also because they are a focus for humans in the majority of forest uses.

Small areas of secondary forest and tall secondary growth had recently been cleared for paddy-type cultivation in the Rao An, Nam Mac, Song Con, and Nga Doi/Rao Qua valleys. Clearance of the lowland valleys is not only a serious loss of a regionally threatened habitat, but it also threatens the integrity of the Huong Son Forest. With the lowland valleys cleared, the remaining forest will become dendritic in shape, with a considerably reduced value for nature conservation.

In contrast to many areas of Indochina, conversion of forest slopes to agricultural land does not seem to be a problem, and no evidence of recent clearance for "short-term, non-paddy" type agriculture was seen in the Huong Son Forest during the survey. However, vegetation is being lost in other ways, of which logging (as discussed above) is but the first stage. Much of this deterioration after the removal of timber seems to be due to the extraction of fuelwood. Potential threats to the integrity of the Huong Son Forest are associated with Road no. 8, particularly with respect to infrastructural development.

Growing evidence suggests that many bird and mammal species (several with restricted ranges) with distributions centered on the Annamite Mountains have ranges completely or largely limited to the eastern Annamite slopes or lowland areas. Contrary to this, few if any species with a predominantly Annamite distribution have natural distributions centered on the western slopes or lowlands. Thus, for conservation of species with natural distributions focused on the Annamites, the forests on the eastern Vietnamese slopes have a higher importance than areas further west in Laos. On this ground there is a higher global priority to protect Vietnamese forests, despite their fragmented state and heavily reduced faunas. The survey findings, particularly in relation to the apparent abundances of Short-tailed Scimitar Babbler *Jabouilleia danjoui,* Crow-billed Drongo *Dicrurus annectans*, Moustached Barbet *Megalaima incognita,* Crested Argus *Rheinardia ocellata,* Owston's Civet *Hemigalus owstoni,* and Fork-tailed Sunbird *Aethopyga christinae,* reinforce what is known and suspected of the faunal difference between the eastern and western slopes of the Annamites.

Indochina has variously been subdivided into several biotically distinct biogeographic units. However, the majority of bird and mammal species of Indochinese evergreen forest habitats, including many Key Species, are found throughout the Annamite Mountains. The largest continuous area of habitat remaining in the Annamites is in the northern part of the range, and the central section of the NAPAC is the most significant section within this region. Although not impressively large, the Huong Son Forest is still an important area of eastern-slope Annamite forest, with added significance because of its continuity with an even greater extent of the same habitat in both Vietnam and Laos. Protection of the Huong Son Forest will help to consolidate the central unit of the NAPAC.

Lowland forests, especially forested lowland river valleys, are one of the most threatened habitats in Southeast Asia. There is high pressure from the human population for agricultural land, permanent settlement and temporary camping on watercourses and harvesting of aquatic resources. Combined with the ease of access, this means that few if any lowland river valleys in the evergreen forests of the Annamites remain in a relatively undisturbed state. The Huong Son Forest has a concentration of lowland river valleys, totalling some 53 km in length, which, although degraded, compares favorably with the amount included in other eastern-slope protected areas in the Vietnamese sections of the NAPAC.

The Huong Son Forest, along with the forest forming the northern edge of Nakai-Nam Theun NBCA and the southern edge of its proposed northern extension, form an isthmus between the central and northern blocks of the NAPAC. Almost everywhere else in the NAPAC, forest is more extensive on the Lao side than on the Vietnamese side. However, the Huong Son Forest forms the greater part of this forest isthmus. Preservation of the Huong Son Forest will go a long way toward maintaining continuity of forest communities between the northern and central units of the NAPAC along the Annamite spine. Protecting this link is crucial since at no other point in the northern and central NAPAC areas is exploitation of natural resources so directly concentrated on opposite points across the Vietnam-Lao border.

Protection of the Huong Son Forest will help to consolidate the existing protected areas in the central area of the NAPAC. The level of exploitation of natural resources in Indochina means that large blocks of forest habitat are generally significantly richer than are small, easily accessible areas. Large forests in a sense are self-protecting, particularly if they have large areas of habitat a day's walk from human habitation. Given that conservation efforts are generally limited by resources, in principle at least it is better to concentrate on a small number of large areas to optimize natural protection.

If Vietnam is to conserve populations of the very large mammals (wild cattle *Bos/Bubalus,* Elephants *Elephas maximus* and Tiger *Panthera tigris*) in the long term, the NAPAC probably offers the greatest potential and most effective area for their conservation. There are two necessities for very large mammal conservation in Indochina; protecting remnant populations and preserving large blocks of habitat. Although the Vietnamese parts of the NAPAC appear to have low abundances of many large mammal species, they are contiguous with habitat blocks in Laos that, by both Lao and Vietnamese standards, have some of the best large mammal populations in either country. The NAPAC is one of few areas with more than a small handful of such species, and one of the few areas of large size. The only comparable site in Vietnam is the area covering the international border area of Vietnam, Laos and Cambodia, and perhaps the Yok Don National Park (NP) and surrounding areas including the adjacent Cambodian forests.

The Huong Son Forest encompasses much of the upper catchment of the Song Ngan Pho River (a part of the catchment falls within Vu Quang NR). As such, the Huong Son Forest provides catchment protection for a relatively large area of the Song Ngan Pho River lowlands.

Pressure on Lao forests is increasing as forest diminishes in Vietnam, because of the massive demand for natural resources that Vietnam exerts. Protection of a strip of forest along the international border in Vietnam is likely to help nature conservation efforts in Laos significantly. This regional conservation action may perhaps be more effective in the future.

The accumulation of biological data from the recent surveys gives the Huong Son Forest a potential benchmark status, with considerable potential for monitoring and comparative purposes. Loss and deterioration of such a benchmark site will slow the progress of understanding the Annamite ecosystem.

It is recommended that the Huong Son Forest be given nature conservation status, and protected accordingly, to consolidate and connect existing and proposed protected areas in the NAPAC of both Vietnam and Laos. However, in protecting the Huong Son Forest, resources should not be detracted from the conservation of the existing protected areas within the NAPAC. The role of the Huong Son Forest as a corridor and in forest consolidation only has value if the forest areas to which it abuts are intact and well protected over a wider area. Detailed recommendations concerning this are given in Section 6.

1. Context of the large mammal and bird survey, and conservation assessment component of the CBC-AMNH/IEBR Huong Son Forest project

1.1. The CBC-AMNH/IEBR project, and the selection of the Huong Son Forest

This report and the large mammal and bird survey and conservation assessment on which it is based are components of a multidisciplinary Huong Son Forest survey carried out as one part of a joint three-year program (1998-2000) between the Center for Biodiversity and Conservation at the American Museum of Natural History (CBC-AMNH) and the Institute of Ecology and Biological Resources (IEBR) to select and study three forest areas within Vietnam. Selection of study sites has been made on the basis of their likely biological interest (mainly based on geographical factors), forest condition with respect to human-related disturbance, and the potential value of the area to nature conservation in Vietnam. Study sites within protected areas, or where there has previously been substantial biological work, have been avoided. At each site a range of taxa, principally poorly studied taxonomic groups including plants, insects, spiders, amphibians, reptiles, fish, and small mammals, were systematically studied.

The Huong Son Forest lies in Ha Tinh Province on the international border with Laos (18°15'-18°37'N, 105°07'-105°17'E; Figures 1 and 2). It was an obvious choice for the initial project study site because of its position in the Annamite Mountains (see Section 2.1.), with accessible forest in good condition over a wide altitude range. The first systematic studies and collecting of selected taxa by the CBC-AMNH/IEBR program in the Huong Son Forest took place from April to May 1998; some of these studies were continued again in April and May 1999 (Musser and Lunde in prep.). The present report, however, covers only the results of a survey (the large mammal and bird survey, and conservation assessment component) undertaken between 22 April and 24 May 1999, which complemented the other systematic studies and collecting of selected taxa undertaken by the CBC-AMNH/IEBR program in the Huong Son Forest. Details of these other studies will be reported separately in publications and on the CBC web site. This broad-ranging survey was intended to determine the status of large mammals and birds in the Huong Son Forest, as well as using traditional species groups to assess the potential of the Huong Son Forest for nature conservation in a regional and national context. In contrast, the other CBC-AMNH/IEBR mammal studies in the Huong Son Forest focused on intensively surveying small mammals in areas of the lower Rao An valley to gather both systematic and baseline data for use in future conservation work (Musser and Lunde in prep.). The principal taxonomic focus of these complementary surveys was on groups previously poorly studied in Indochina, and they have provided a wealth of new data on little-known taxa. While comparative data for these taxa is currently unavailable, information of this type will be used to develop baseline datasets for assessing and monitoring the conservation status and priorities of forested ecosystems.

Large mammal findings and accounts of other work resulting from the complementary systematic CBC-AMNH/IEBR program studies were first presented in the preliminary document CBC-AMNH/IEBR (1998), which included many provisional identifications. The account of the mammal studies in this document has now been fully superseded by Musser and Lunde (in prep.); the document which should be referred to for details of final identifications and other specimen details. The remainder of this report deals only with the methods, results and conclusions of the large mammal and bird survey and the conservation assessment component, unless explicitly stated otherwise.

1.2. Aim of the large mammal and bird survey and conservation assessment component

To survey large mammals and birds, and make an assessment of the regional and national conservation importance of the Huong Son Forest.

1.3. Objectives

To carry out a survey of large mammals and birds, with emphasis on establishing the status of species of elevated conservation concern (Key Species).

To make a preliminary assessment of the area of remaining forest and river habitats of importance to wildlife conservation.

To assess survey findings in the context of their national and regional importance.

To provide recommendations for habitat and wildlife conservation in the Huong Son Forest.

1.4. Participants and specialization

R. J. Timmins (RJT): Consultant to CBC-AMNH (birds and large mammals); extensive experience working in Laos in protected and proposed protected areas in the NAPAC, and knowledge of Phong Nha-Ke Bang National Park and Pu Mat Nature Reserve, Vietnam, from short surveys. Trinh Viet Cuong (TVC): Scientist at the Institute of Ecology and Biological Resources (large mammals); extensive experience working in the NAPAC of Vietnam.

2. Introduction to the Huong Son Forest area

2.1. Regional geographic and biological setting

The Huong Son Forest lies on the eastern slope of the northern Annamite Mountains of Indochina. The main spine of the Annamites forms the natural border between Laos and Vietnam, rising in Laos from a plateau of c. 500 m, but in Vietnam rising directly from the lowlands at c. 50 m. Most of the international border ridge ranges between 1000 m and 1600 m, with higher peaks that reach 2000 m and over. A considerable amount of forest still remains on the slopes of the Annamites, although the adjacent lowlands and low river valleys have largely been cleared in both countries, particularly in Vietnam (Thewlis et al. 1998, Wege et al. 1999). Forest habitats are contiguous (except for two road crossings) along the spine of the Annamites for c. 450 km from 19°10' N to 17°20' N.

The Annamite Mountains of Indochina have attracted considerable interest from biologists and conservationists because of the presence of a relatively large number of restricted-range taxa (e.g., Stattersfield et al. 1998) and the paucity of work on most taxonomic groups in the past. This is most spectacularly illustrated by the recent discovery of several new species of large mammals, most of them probably restricted-range species (Vu Van Dung et al. 1993, Do Tuoc et al. 1994, Giao et al. 1998, Surridge et al. 1999). Despite this attention, the biology of the area still remains surprisingly unknown; for example, little other than anecdotal information exists on the ecology of Saola *Pseudoryx nghetinhensis,* despite it being the most publicized of all the "discoveries," and although undoubtedly threatened, its status even in localized areas is still very poorly understood

(Robichaud 1997, 1999, Mallon and Eames in press, Timmins in press). For another species, Heude's Pig *Sus bucculentus,* even its external appearance is still a mystery (Groves 1981, Groves et al. 1997, C. P. Groves pers. comm. 1998-99). Growing evidence suggests that areas within the Annamites were a Pleistocene refugia for evergreen forest ecosystems, as opposed to drier and more open habitats that still exist and have probably been more extensive at intervals during the past (Heaney 1991, Brandon-Jones 1996, Baltzer 2000, Rundel 2000, Timmins and Duckworth 2000, Davidson et al. 2000). The presence of a relatively high proportion of restricted-range species, and the likely presence of Pleistocene refugia within the Annamites together give the area considerable importance regionally and globally for biodiversity conservation.

Climatic conditions are complex, but a notable general pattern is a difference across the Annamite Mountain spine, particularly with respect to rainfall and cloud cover. The western slopes have a relatively pronounced dry season, while the eastern slopes experience a more even distribution of rainfall throughout the year (Delacour 1929, Vidal 1959, RJT own data). The main Annamite ridge forms an effective barrier to rain-bearing clouds coming from the east.

2.2. Regional protected areas

There has been a strong emphasis both nationally and internationally on conservation of the Annamite Mountains. This has resulted in the establishment of protected areas both in Vietnam and Laos, with assistance from several nature conservation NGOs and financial donors. In Laos there has been a concerted effort to protect the continuity of the remaining forest, and all of the central area of the northern Annamite spine has been incorporated into or proposed as protected areas (Berkmüller et al. 1995*a*, 1995*b*, IUCN 1997). In Vietnam protection has been more piecemeal, but there is growing emphasis on prioritization and consolidation of the protected area system (GSRV 1994, Eve 1998, Wege et al. 1999).

For the purpose of the report, the protected areas network in the northern Annamite Mountains (existing and proposed areas) is collectively referred to as the Northern Annamites Protected Areas Complex (NAPAC). The potential area for wildlife and habitat protection in the northern Annamites is made up of three principal units that each straddle the Vietnamese-Lao border and that are divided by low passes across the Annamites with an established road.

The southern unit consists of Hin Namno National Biodiversity Conservation Area (NBCA) in Laos (865 sq. km) and the Phong Nha-Ke Bang National Park (NP) in Vietnam (1,479 sq. km) (Timmins and Khamkhoune Khounboline 1996, FIPI 1999, Timmins et al. 1999, Walston and Vinton 1999) (Figure 1). This southern unit is primarily karst limestone, and relatively safe from major habitat exploitation. There is potential for further extension of protected area coverage further south still, as forest habitat remains to the south of these protected areas in both countries, but this forest is somewhat fragmented, with smaller core areas, and already the potential linkages to the southern unit are relatively tenuous. There is still a viable but narrow isthmus of habitat across which Road no. 561 (no. 12 in Laos) runs, connecting the southern unit with the central unit consisting of Nakai-Nam Theun NBCA in Laos (3,710 sq. km), Vu Quang Nature Reserve (NR) (556 sq. km) in Vietnam and unprotected forest along the international border south of Vu Quang NR (Timmins and Evans 1994, IUCN 1997, Tobias 1997, Eve 1998, Vu Quang Conservation Project 1998, Russian Vietnamese Tropical Center undated). This central unit is the largest and the most intact of the three, with the greatest diversity of habitats, but the forest remaining on the Vietnamese side of the international border is relatively narrow. The northern unit consists of the Proposed Northern Extension to Nakai-Nam Theun NBCA (645 sq. km)

and the Nam Chouan Proposed NBCA (1,610 sq. km) in Laos and Pu Mat Nature Reserve (912 sq. km) and unprotected forest along the international border south of Pu Mat NR in Vietnam (Timmins and Evans 1994, Berkmüller et al. 1995*b*, EC/MARD 1997, IUCN 1997, Tobias 1997, SFNC/EC 1998, SFNC/EC (Round) 1999). This northern unit has probably the most substantial representation of eastern Annamite slope habitats (Section 5) on non-calcareous terrain. The Huong Son Forest constitutes the eastern side of the isthmus between the central and northern units. This isthmus has a higher long-term potential than the isthmus between southern and central units, because of its currently greater width.

Each unit in the NAPAC has its own particular value to nature conservation, but the synergistic value from their continuity is certainly far higher. Several factors have a bearing on the importance of the continuity of habitat. Of particular note, the future and effectiveness of conservation activities in Lao areas of the northern unit are considerably more uncertain than in Lao portions of either the southern or central units (J. Baker pers. comm. 1999, W. G. Robichaud pers. comm. 1999). Exploitation of wildlife resources is considerably higher in Vietnam than in Laos (with the possible exception of some areas of the northern unit where exploitation in Laos may be equally high) (Robichaud 1997, 1999, Robichaud and Stuart 1999, Timmins et al. 1999, W. G. Robichaud pers. comm. 1999, RJT own data). In contrast both the volume and rate of habitat loss may well be higher in Laos, particularly in the northern unit, although this is offset by the greater expanse of habitat currently remaining in Laos in comparison to Vietnam.

There is a further western unit in Laos on outlying Annamite massifs, consisting of Khammouan Limestone NBCA (1,580 sq. km) and Nam Kading NBCA (1,740 sq. km), and proposed habitat corridors linking them together and to the central and northern units (IUCN 1997, Timmins 1997, WCS in press). However the proposed linkages face an uncertain future, and the value of this western unit to long-term viability and maintenance of the three main international border units is probably not of the same order of magnitude as the value of preserving continuity between the international border units.

The combined area of habitat in proposed and existing protected areas in the three main international border units is 9,777 sq. km (with perhaps a potential 10,500 km), and 13,097 sq. km if the western unit is included, making it the equal (at least in size) of any other protected areas within Southeast Asia (Kerinci Seblat NP, Sumatra: 14,846 sq. km; Gunung Leuser NP, Sumatra: 7,926 sq. km; Sungai Kayan Sungai Mentarang NR, Kalimantan: 16,000 sq. km; Taman Negara NP, Malaysia: 4,343 sq. km; Huai Kha Khaeng WS/Thung Yai Naresuan WS/Umphang WS-complex Thailand: 12,065 sq. km; IUCN 1992, MacKinnon 1997).

In none of the established protected areas is wildlife protection effective (see definition in Conventions), and in most (especially Lao areas) neither is habitat protection (SFNC/EC 1998, Timmins et al. 1999, SFNC/EC (Long and Do Tuoc) 1999, Robichaud 1999, R. Eve pers. comm. 1999, RJT own data). All areas still face an uncertain future. Pressure from rural communities on the remaining forests is high in both countries, particularly the hunting of large mammals. Large mammal populations are at reduced densities, often vastly so, in all but perhaps a few exceptional areas (Tobias 1997, Duckworth 1998*a*, Duckworth and Hedges 1998*a*, SFNC/EC 1998, Timmins et al. 1998*b*, Duckworth et al. 1999, Timmins et al. 1999, SFNC/EC (Long and Do Tuoc) 1999, Osborn and Vinton 1999, Robichaud 1999, Robichaud and Stuart 1999, R. Eve pers. comm. 1999, RJT own data). Habitat loss for agricultural land is still occurring widely and is a considerable threat in many areas, particularly on the Lao slopes (IUCN 1997, Robichaud 1999). Degradation through timber and firewood removal is ubiquitous in peripheral forest areas in both countries. Commercial exploitation and infrastructural development is likely to have

major impacts in several areas, of which logging concerns, particularly for high-value timbers such as *Fokienia hodginsii,* are currently the most threatening (IUCN 1997, SFNC/EC 1998, RJT own data). Hydroelectric power development poses a significant threat in several areas of both Vietnam and Laos, not only from direct unmitigable habitat loss, but also from the associated changes in human use patterns that are a consequence of such projects (IUCN 1997, WCS 1995*a,* 1995*b*, RJT own data).

The Huong Son Forest lies directly adjacent to the northwestern boundary of Vu Quang NR, the two forming a natural continuation of Annamite habitat. Inclusion of areas of Huong Son Forest into Vu Quang NR, or, alternatively, elevation of the protected status of the Huong Son Forest have been proposed at the provincial level by the Ha Tinh Kiem Lam (Provincial Forest Protection Department), although there appears to be no official documentation of this (R. Eve pers. comm. 1999).

2.3. Previous work

The Huong Son area appears to have received very little attention from biologists in the past, the first extensive work being that of the CBC-AMNH/IEBR project between April and May 1998 (Musser and Lunde in prep.). Visits were apparently made to the area by Rozendaal (1990), although this manuscript has not been seen by the current authors. Delacour (1929) certainly passed through the area, but appears to have mainly collected on the Lao slopes, although his reference to "east of Nape" may have included parts of the western-central Huong Son Forest. However, a large proportion of the previous work that has taken place in Indochina in recent years has focused on the northern Annamites and surrounding areas. Data are generally more readily available for areas of Laos than for Vietnam, particularly with respect to refereed scientific literature. However, work in Laos has largely ignored taxa other than higher vertebrates. There was not scope in the present work to review the extent of data outside its relevance to the current survey's findings. Existing information varies widely in quality and availability, and covers a diverse range of taxa. The quality of survey reports varies markedly, with concerns raised recently by several authors, for example, Duckworth and Hedges (1998), Russian Vietnamese Tropical Center (undated) and Timmins et al. (1999). Several important publications that provide a synthesis of the data are available for birds and large mammals (syntheses for other groups may be available, but are unknown to the current authors). These include Duckworth et al. (1999), a synthesis of all higher vertebrate data from Laos; Duckworth and Hedges (1998), a synthesis of very large mammal data from Indochina; and Thewlis et al. (1998), a review of birds of conservation concern in Laos. Additionally, the WWF Vu Quang Conservation Project is in the process of establishing a biological database of the NAPAC and some other surrounding areas. At present this project is still in its infancy and currently data screening is minimal, thus some information is incorrect or misleading, and available contextual information is limited (Eve et al. 1998, R. Eve pers. comm. 1999).

Biodiversity is both an overused and a misused designation in Indochinese conservation studies. Nearly every report uses the term, often very loosely, yet little work has been done to assess the claims of "high biodiversity" attached to a large number of survey areas. A list of species is the commonest evidence used to indicate the "biodiversity" of an area, and a general sense pervades that numbers of previously undescribed species equate directly to "high biodiversity." Too few authors give essential details, including relative survey effort, assessment of how complete coverage of each taxonomic group was, abundance assessments of each taxon, and the relationship of these with habitats.

Assessment and comparison of areas within the NAPAC for their relative biological importance should not be largely dependent on "raw" species lists (although this has been done in previous instances) for a number of reasons. Firstly, data are still extremely patchy for the majority of sites, and even the best surveyed area, Nakai-Nam Theun NBCA, could not be considered exhaustively surveyed. Thus lack of data inevitably confounds interpretation of natural patterns. Species composition is likely to be relatively uniform within similar biogeographic areas. Richness of a protected area is most likely to reflect primarily its size and altitude range (which correlate with habitat variety), and the major habitat types present. These factors are better assessed directly rather than indirectly through analysis of species lists.

The overuse and misuse of survey data is classically exemplified by Kemp et al. (1995) from a survey of Pu Mat NR. This example is particularly relevant, since Pu Mat NR, being part of the NAPAC, is a primary candidate for comparison with the Huong Son Forest. However, considerable caution is warranted in making a comparison between the current findings and those of Kemp et al. (1995). The survey of Kemp et al. (1995) recorded 85 bird species; the observers were inexperienced and the report states that "identification was difficult." However, they appear to have been careful in their identifications, with only one particularly implausible species (Purple-throated Sunbird *Nectarinia sperata*) recorded. Little time ("c. 105 hours") was spent surveying for birds and a relatively small area was covered. The authors quite rightly assumed that their list represented probably only a small proportion of the bird species present. More recent surveys have recorded c. 290 species (Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999), but the list is still undoubtedly incomplete.

Their assumptions, however, did not stop there. They suggested, on the basis of species abundance ratings, that their findings were similar to tropical areas "where diversity and species richness is very high," on the basis of there being "many rare species and far fewer abundant or common species," and that this "indicates that Pu Mat is a complex and diverse ecosystem with many specialised ecological niches." In making such claims, they seem to have ignored the fact that they found identification difficult or that they thought the list substantially incomplete. Taking bird lists from experienced observers who have worked in the region (Tizard 1996, Tobias 1997, Duckworth et al. 1998, Evans and Timmins 1998, Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999) and scaling their findings to the abundance categories in Kemp et al. (1995), one finds a different picture, where common and abundant species predominate. One should not presume these lists represent areas with low diversity. Abundance assessment largely depends on an observer's familiarity with a species; unfamiliarity often results in apparent rareness. Kemp et al. (1995) go on to state "that the composition of the bird fauna was found to be very different from Ba Be NP"; the two bird lists on which they base this may well be very different between the two areas, but clearly comparison of substantially incomplete bird lists is not a valid method of determining faunal similarities. The quoted Ba Be NP list (Kemp et al. 1994) has perhaps only four species unlikely to be found in Pu Mat NR.

On the basis of the total area and type of forest in Pu Mat NR, and the species recorded (which did not include any Globally Threatened species) Kemp et al. (1995) concluded that "in an ornithological context Pu Mat is a site of national and international importance." Protected area size and habitat are important factors, but justification for such a statement on the basis of the bird list is not appropriate. Such a conclusion runs the danger of being used to promote the exact opposite; if, for example, Pu Mat NR were compared to areas with much larger species lists and many Globally Threatened species, and the surveyors' strong conviction in their results and conclusions were taken into account, Pu Mat NR might in fact be judged of relatively low impor-

tance. A conclusion of high importance for an area, based on little evidence, also gives the potential for the importance of other areas to be inflated; if a bird list of 85, not including any Globally Threatened species, makes an area internationally important, then many more areas of Vietnam must have equivalent status. Although there are probably several areas of higher importance in Vietnam, we now know Pu Mat NR is of at least moderate international significance.

Astoundingly, Kemp et al. (1995) suggest that Silver-eared Mesia *Leiothrix argentauris* and Short-tailed Parrotbill *Paradoxornis davidianus*, each of which was only identified on a single occasion, "could be described as indicators of primary evergreen hill-forest." One only has to read the accounts in King et al. (1975) or Lekagul and Round (1991) to realize that both these species are just the opposite; better indicators of degraded habitats. The habitat association of a species cannot be judged on the basis of a few encounters in a short period of survey.

2.4. Physical characteristics and habitat

The Huong Son Forest contains the headwaters of the Ngan Pho River, in a horseshoe-like formation along the international border with Laos. The apex of the horseshoe is a low pass across the Annamite Mountains (c. 700 m at its lowest), through which Road no. 8 passes. The Annamite ridge is relatively low on both sides of the pass, but in the south increases in height to 1900 m. Displaced from the main Annamite ridge toward the center of the horseshoe, Ba Mu mountain rises to c. 1350 m. Evergreen forest still covers the slopes closer to the international border, right down to the flat valley bottoms, and is also extensive on Ba Mu mountain. Almost all lower altitude forest (< 800 m) has been logged to some degree; the extent of logging, however, varies greatly, with some minor areas remaining essentially untouched. Higher altitudes, with the exception of one area of *Fokienia* forest, are generally in much better condition. For the most part the terrain is steep, although not precipitous. Lower hills and slopes subsidiary to those of the main international border ridge become progressively more degraded, over a relatively short distance, eastward toward the coastal lowlands.

2.5. Human demography

Human population density increases quickly down the Ngan Pho valley, with relatively little permanent settlement above the village of Dai Kim. All valleys (Nam Sot, Nam Mac and Rao An) above this have a small resident population. The lower sections of the Song Con and Khe Tre valleys have relatively large populations, but their narrower upper valleys are again less densely settled. Extent of main permanent settlement and extent of agriculture is shown on Figure 2. A small settlement lies along a 100-m strip of Road no. 8 below the Vietnamese border post on the Vietnamese-Lao border; it is dependent solely on cross-border traffic. Permanent paddy rice, and alluvial peanut and maize cultivation appear to be the predominant agriculture, with no evidence seen of cultivation on the hill slopes. Small areas of secondary forest and tall secondary growth have recently been cleared for paddy-type cultivation in the Rao An, Nam Mac, Song Con, and Nga Doi/Rao Qua valleys, but no evidence of recent clearance for "short-term, non-paddy" type agriculture was seen.

2.6. Huong Son Forest Enterprise

All information in this section comes from Lam Truong-Huong Son (1996), Trinh Hong Minh and Nguyen Huu Can (pers. comm. 1999). Almost all forest habitat within Huong Son district comes under the jurisdiction of the Huong Son Forest Enterprise (see also Annex 9; Figure 3). The Huong Son Forest Enterprise lands cover three communes, Son Hong, Son Kim and Son Tay. A number of plots have in the past been given over to commune or international border

army control. Most of these are heavily degraded. The Enterprise area is split into five sectors based on the main river valleys that provide access to the forests. These in turn have been split into plots amounting to a total of 42,097 ha; each sector has a small staff and control post located close to Road no. 8. Logging in the existing forest areas has been under way since at least 1970. The Huong Son Forest Enterprise in its current form was created by a Decision of the Council of Ministers in 1986. Later it was switched from a state enterprise to a commercial one, by a Decision of the State in 1993. Almost all plots have had some logging, although in those plots adjacent to the international border with Laos logging was terminated by government mandate in 1989. With most accessible areas now logged, the Enterprise is scaling down its operation. Current plans for the future are to try to obtain funding for catchment protection of those plots along the international border, with concentration on the Rao An area if only limited funding can be obtained, and continued logging and agricultural development in other areas. As of mid-1999, small areas in three of the lowland valleys (Rao An, Nam Mac, Nga Doi/Rao Qua and Song Con) had been converted to agricultural land.

3. Survey areas and methods

3.1. Survey areas and effort

Dates, effort and locations of the bird and large mammal survey are given in Table 1, and survey sites are mapped on Figure 2.

The survey concentrated on surveying lower-altitude slopes and the valley bottoms, as it was clear that these areas were the most used by people. Furthermore, regionally these are some of the most threatened habitats, with a higher priority for nature conservation. Some time was spent at higher altitudes. An attempt was made to visit all of the main lowland river valleys.

3.2. Methods

Birds and large mammals were used as the focal groups for investigation during the survey. The use of these taxa for achieving the aim of the survey has several advantages. A majority of species are easily identifiable and easily recorded in the field; and logistically simple and low-resource-use methods can be used for assessing abundance. Many large-bodied representatives are more prone to exploitation and the gross effects of habitat loss than are taxonomic groups mainly composed of small-bodied species; and there is considerable comparative work on these groups from within Indochina. Thus, realistically, they are the only groups for which a reasonably complete assessment of species composition and status can be made during a short survey over a large area. More importantly, they are the only groups for which results can be compared on national and regional bases in an informative manner for conservation purposes without considerable uncertainty. Furthermore, biogeographic patterns of birds and larger mammals are likely to have some similarity to those of other terrestrial animal taxa (Stattersfield et al. 1998); therefore a focus on these two groups is relevant to the conservation of biodiversity across the range of terrestrial taxa.

This study's broad scope meant that very general survey methods were used, as opposed to structured quantitative methods. The latter approaches would not have provided a broad overview within the constraints of the current project, and the results would not have been comparable with survey results from other sites within the region.

Table 1. Dates, effort and locations of the survey.

Survey Area	Dates	Effort* (person/ days)	Location	Altitude	Percent of field time affected by rain-related problems
Lower Rao An valley	23-26/4, 11-13/5	8.5	6045 IV 246316 (centered on)	100-700 m	0
Rao An Tren valley	26/4-2/5	6	6045 IV 253270 & 6045 I 286235 (centered on)	700-1250 m	c.20
Khe Tre valley	2 & 5/5	1	6045 I 298240 - 343405	50-1050 m	c. 25
Nam Mac valley	6-8 & 20-23/5	7	6046 III 173462 (centered on)	250-950 m	c. 60
Nga Doi/Rao Qua area, Ba Mu	9-10/5	1.5	6046 III 228474 - 6045I 276430	100-550 m	0
Song Con valley	15-19/5	5	6046 III 135482 - 175518	100-800 m	c. 5

Note:
*Does not discard time affected by rain-related problems (rain reduces the likelihood of many wildlife encounters, but its effects are difficult to quantify). Both RJT and TVC surveyed all sites

3.2.1. Habitat and observations of human use

Notes on general structural characteristics of forest (canopy structure, frequency of large trees, openness of mid and understory, basic plant groups in the understory, abundance of bamboos, palms, vines and lianas, and signs of disturbance), and basic categorization of other habitat types followed the previous experience of the researchers in the region. Such observations were made at each major site, with an emphasis on comparison and recognition of major differences between sites.

Observations of human use (frequency of people observed in forest areas, signs indicating the frequency of general use, abundance of signs of timber extraction, abundance of traps, and other indications) were made whenever applicable during the survey. No attempt was made to carry out more structured recording of specific uses.

An approximation of the forest edge was mapped directly onto Army Map Service (1965-70) 1:50,000 maps while in the field. The extent of main human settlement, and the position of outlying areas of cultivation were similarly mapped while in the field.

3.2.2. General opportunistic diurnal observation (birds and mammals)

This method is primarily aimed at birds and diurnally active mammals (primates, squirrels and treeshrews) and mammal signs. As the use of "opportunistic" in the title suggests, the method follows no rigorous protocol. Rather, the emphasis was on maximizing a broad range of bird and large mammal encounters by a variety of approaches. Three main approaches were used: 1) Concentrated searches for mammal signs, covering as much ground as possible and trying to keep to routes and areas likely to be favored by large mammals, using either smaller trails or making a

route of least resistance through the forest. Using this approach, opportunities for general wildlife observations are much reduced, because of the need to concentrate on looking for signs, and the difficulty of moving quietly when trying to cover distance on difficult-to-follow routes. 2) Surveys of rivers for mammal signs. The difficulty of moving along rivers results in very limited opportunity for general wildlife observation. This approach was only used on two stretches of river. 3) General wildlife observation, with an emphasis on stealth. This approach concentrated on recording Key Species; thus, for example, little time was spent in determining the species composition of small-bird mixed species flocks. To maximize encounter rates, routes generally followed trails so as to make less noise. Pace varied, depending on the potential for encountering animals; habitat, terrain, trail type, time of day, and specific focal species were all factors affecting pace. Periods of static watching were also included. Effort was concentrated in areas thought likely to be productive for recording Key Species.

The heaviest emphasis was placed on the third approach, since it produces the greatest potential range of data; that is, although proportionally more mammal signs are overlooked than if searching for them specifically, a reasonable proportion of signs are still likely to be found. An attempt was always made to cover a suitably sized portion of each survey area, to allow a realistic assessment of the general status of birds and large mammals (especially Key Species). This usually amounted to the equivalent of making observations along at least two trails of at least 1.5 km over the course of at least three days. The details of data recording depended on the species and type of encounter; for instance, signs might necessitate measurement and sketches; a well-known bird call would simply require registration; sighting of a group of gibbons would warrant details of pelage, group characteristics and reaction to observer.

3.2.3. Slow-pace nocturnal spotlighting (nocturnal mammals)

The methods followed those of Duckworth et al. (1994; see also Duckworth 1998*b*). Paths were walked at a slow, very quiet pace with a continuously running head torch. After detection a more powerful Nitech spotlight was used to illuminate animals for identification.

Suitable trails are needed for this method to be effective, and these can often be difficult to find. Work should also probably coincide with the new moon; the observer is more visible to animals on moonlit nights, and some species may be less active then. In a short survey hoping to cover many areas, it is often difficult to use this method effectively. During the current survey the diurnal methods were given priority over nocturnal spotlighting, since diurnal communities provide a potentially larger range of species for observation, and in general have a larger range of comparative data from other areas than do nocturnal communities.

Little time was devoted to this method for reasons including a lack of easy-to-follow paths through habitats in which reasonable encounter rates could be expected, rain, and moon phase.

3.2.4. Camera trapping

Seven TrailMaster 1500 Active Infrared Trail Monitor units with Yashica T4superD cameras were used. Pictures were taken on Fuji Superia 400 ASA (36 exposures) film. Receivers and transmitters were usually mounted on posts to allow strategic placement and to avoid potential problems of movement associated with mounting on small trees in windy conditions. The beam was set to an approximate height of 15-30 cm above ground level. Receiver and transmitter were set between 4 and 6 m apart. Cameras were set to incorporate where possible all of the area between receiver and transmitter up to a height of at least 50 cm (the latter was not always possible). Because of the likelihood of heavy rain during the trapping period and a perceived problem with splashing of the lens, a shelter was constructed around the camera, consisting of blue plastic sheets

(c. 30 x 30 cm) both above and below the camera. Delay between photographs was set to the minimum of 6 seconds, and sensitivity to the maximum of 1 (0.05 seconds). Camera traps were set at positions where it was thought likely that large mammals might pass through, principally where terrain and vegetation might route large mammals through the trap area.

3.2.5. Interviews with local people

Interviews with local people are a necessity for almost any field survey. However, depending on the method of approach and focus, the results can vary between valuable and highly misleading information. At the most basic level, interviews are valuable for selection of field sites. Minimal emphasis was placed on village interviews during the survey because, given the limitations of such methods (Duckworth and Hedges 1998*a,* Timmins et al. 1999), it was believed that data could be collected more efficiently by other means. An effort was made to find the remains of wildlife kept in villages, and more specifically to make acquaintances with local wildlife dealers, in an attempt to gather data on potentially interesting wildlife records, particularly species not easily recorded by the field methods used. No attempt was made to thoroughly investigate wildlife trade and hunting practices per se, or to visit villages or wildlife dealers other than when the opportunity arose during the field survey schedule.

3.2.6. Determination of locations

A Magellan 2000XL GPS receiver was used during the survey, along with Army Map Service (1965-70) 1:50,000 maps or Vietnamese copies (some with modifications) of the same. An attempt was made to take UTM co-ordinate readings at meaningful points, such as campsites, significant wildlife sightings, and camera placements, but dense forest cover and poor weather conditions sometimes precluded this. Suitable points with canopy breaks within the survey areas were used when found. It was sometimes possible to truth these with the locations of easily assignable features on the 1:50,000 map series. The UTM co-ordinates obtained were found to be generally accurate to within a few hundred meters. Occasionally considerably less accurate locations were obtained, generally under situations where precise location determination by other means was difficult. A best guess was used in such situations. The co-ordinates given in the text and gazetteer, and locations marked on the maps, have been corrected where appropriate to a best approximation; all are likely to be within two kilometers of actual locations.

3.2.7. Data analysis

All records and observations are those of RJT unless otherwise stated. Records from TVC are attributed specifically, to allow the survey records to be placed in the context of survey effort. All information from local people unless otherwise stated was through the translation of TVC while RJT was present.

Analysis was focused on assessing records of Key Species in the context of national, regional and global significance for wildlife conservation.

Abundance of all bird and mammal species recorded was assessed on a three-point scale based on the encounter frequency, taking into account the appropriateness of methods for detection of a species, and other factors (including ecology) that affect a species' observability (see Annex 2 for greater detail).

These abundance categories are:

Common - equivalent to being recorded daily, often in large numbers.
Frequent - equivalent to being recorded on over half of survey days.
Occasional - equivalent to being recorded on fewer than half of survey days.
Present - abundance not assessed.

The field notes on habitat and human use, along with forest edge and cultivation mapped during fieldwork, were used as the basis for a subjective assessment of the most appropriate boundaries in the proposal to protect the area (Section 6).

4. Results

4.1. Habitat description, condition and extent

4.1.1. Lowland valleys

The four main lowland valleys visited (Rao An, Nam Mac, Khe Tre and Song Con) were very similar. All were degraded by human activity and remaining vegetation was largely secondary in nature. River size varied between the valleys. The Rao An and Nam Sot, which are similar in size (c. 8-15 m river channel width), are substantially the largest. The Rao An is relatively fast and rocky; long stretches of the Nam Mac and Song Con were slower, gravelly and braided. The latter river courses were characterized by thick, shrubby vegetation at the immediate water's edge, with an open secondary vegetation structure in surrounding areas dominated by young trees of a very distinctive species (pale flaking bark, open crowned, with smallish soft leaves).

Relatively flat valley forest and tall secondary growth habitats were predominant in the Nam Mac, Rao An and Song Con valleys (although in the latter the majority were very heavily degraded). There was little flat terrestrial habitat in the Nam Sot because of the narrowness of the valley. Secondary forest and tall secondary growth in the valleys were relatively heterogeneous; bananas and/or an understory of large-leafed monocotyledonous herbs under a low and open secondary-tree canopy were common; in other areas vines and other climbers (but few rattans and few or no bamboos) in combination with small trees and a relatively open understory predominated. All valleys had glades of grass and short scrub, of varying sizes (c. 10-500 m), which were particularly prominent in the Song Con valley. Some areas, particularly in the Rao An valley, retained a reasonable forest structure, with trees to 20-30 cm dbh relatively common (several trees in view from any point), with an understory of saplings and herbs.

4.1.2. Lower slopes 150-500 m

The condition of lower slopes seemed to relate generally to their accessibility from the main areas of habitation. At the upper ends of most of the lowland valleys, although the old signs of logging could be seen, forest structure was still good right down to the bottom of the slopes; with mid-sized trees (20-35 cm dbh) ubiquitous, a reasonably closed canopy and much sapling growth. This was exceptionally the case at the head of the lower Rao An valley. In more accessible areas signs of degradation were greater. These signs included broken canopy, rareness of large and mid-sized trees, predominance of vines and climbers (including rattans and bamboos), presence of small species of bamboo and relatively much less sapling growth.

The Song Con valley lower slopes seemed to have been more heavily degraded than those in the Nam Mac or Rao An, perhaps from more intensive logging with secondary features extending

further up the slopes. Two areas in the Song Con valley were dominated by a relatively large, smooth-stemmed bamboo, perhaps the result of much older disturbance. Also more noticeable in the Song Con valley were two large palms, one with simple leaflets, and the other with pinnate leaflets. The former seems to characterize disturbed areas and perhaps well-draining, unstable slopes. Both, on the basis of previous experience, seem to be particularly prominent in limestone areas (RJT own data).

The understory was generally dominated by saplings and herbage in the form of large-leafed monocotyledons and various ferns (with the latter varying in extent from about 5-50 %). In stream valleys and damper depressions herbage cover approached 100%, with the additional presence of tree ferns.

4.1.3. Higher slopes 500-800 m

Higher slopes were generally in good condition, having suffered the loss of the largest trees only in the most accessible locations. Large fan-leafed palms were characteristic of many areas. Large (> 50 cm dbh) trees were not uncommon (more often than not at least one tree in view from any point) to frequent (several trees in view from any point). The understory was similar to that of the lower slopes. Cycads were seen not infrequently, particularly on ridges.

4.1.4. Forest above 800 m

Forest structure in the Rao An Tren valley appeared rather open and short, with few large trees (> 50 cm dbh). In many areas no trees of this size were in view, and even 30-50 cm dbh trees were scarce (more often than not at least one tree was in view, but at certain times none were visible and rarely were more than a few trees in view at a time). Ground cover was heterogeneous but with greater coverage on average than the slopes. It included much the same elements, but a mid-sized bamboo in small open clumps was noticeable, and monocotyledonous herbage was scarcer. Forest at and just above this altitude to the west of both the Nam Mac and Song Con river valleys had a greater proportion of large trees.

Ridges were characterized by an understory often including a small species of bamboo, and considerable ground herbage, particularly ferns and 50-120 cm tall sturdy herbs. Rattan growth was more prominent than elsewhere, except on ridges at lower altitude.

4.1.5. *Fokienia* forest

Fokienia hodginsii, growing among other conifers, was found dominant in one area locally called Po Mu (after the Vietnamese name for *Fokienia hodginsii*) at 1150-1250 m. However, virtually all larger trees had been logged in this area between 1990 and 1994. The species was absent or very scarce further south on the same ridge at approximately the same altitude, and on all other slopes and ridges of similar altitude visited during the survey.

4.2. Bird and large mammal results

This section details the findings with respect to birds and large mammals. Lists of all species of birds and mammals found during the survey can be found in Annexes 2 and 3, Tables 5 and 6. The findings and discussion of significance in this section mainly focus on the status of Key Species. These are species that are thought to be at an elevated risk of extinction globally or regionally (see Conventions). All records of Key Species from the survey are detailed in this section. Some Key Species records of significance to the conservation importance of the Huong Son Forest, given in Musser and Lunde (in prep.) are included where appropriate.

The Key Species categories used are as follows (see also "Conventions"):

Threat categories for global populations (following IUCN 1996):

GT *Globally Threatened* Species that are facing a high risk of extinction in the wild in the medium-term future.

GT-CR *Critically Endangered*. This is the highest category of threat, and is only used for species facing an extremely high risk of extinction in the wild in the very near future.

GT-EN *Endangered* Species that are not critically endangered but are facing a very high risk of extinction in the wild in the near future.

GT-VU *Vulnerable* Species that do not fall into the two higher categories, but face a high risk of extinction in the wild in the medium-term future.

GNT *Globally Near-threatened* Species at Lower Risk which are close to qualifying for the Globally Threatened-Vulnerable category.

DD *Data Deficient* Species for which there is inadequate information to determine whether they are Threatened or at Lower Risk.

Threat categories for regional populations (following MOSTE [1992] for Vietnam and Duckworth et al. [1999] for Laos):

VRB *Vietnamese Red Book*. Listed in the *Vietnamese Red Book* as threatened or indeterminate in Vietnam.

ARL *At Risk in Laos* This category is roughly equivalent at a national level to the Globally Threatened categories of IUCN (1996). Minor amendments (see Thewlis et al. 1998) result in the exclusion of some species for which the only threat is long-term habitat loss and which might be considered "Vulnerable" following the criteria of IUCN (1996).

PARL *Potentially At Risk in Laos* This category includes species (a) suspected to be At Risk in Laos but where information about threats or species status is insufficient to make a firm categorization, and (b) species on or close to the borderline of At Risk in Laos.

LKL *Little Known in Laos* This category provides for species where the conservation status is difficult to assess, i.e., those with detection or identification problems, or where fieldwork within their preferred range and habitats has been restricted, or where threats or species status are not clear for other reasons.

The Key Species list given by Duckworth et al. (1999) for Laos is considered appropriate for assessing importance of the findings, because the faunas of Laos and Vietnam are very similar, and the wildlife in both countries face very similar threats.

4.2.1. Coverage and significance of results

The survey was not intended to be comprehensive for any taxon, but rather to establish an assessment of the status of wildlife communities as a whole. The survey findings were sufficient to establish a broad overview of wildlife status in relation to habitat and human factors, and for birds

and diurnally active mammals a relatively clear interpretation of the communities present was possible. But even for these groups, the survey findings cannot be taken as approaching complete inventories of the Huong Son Forest. Many more species, particularly of large mammals, are undoubtedly present. At least in the case of birds, the vast majority of species are widespread within their altitudinal range and preferred major habitat types (forest, river, secondary, etc.). It is unlikely that many species were overlooked solely because of highly localized natural distribution outside of the areas surveyed.

Survey work was restricted to areas below 1250 m, with relatively little time devoted to areas above 800 m (except in the Rao An Tren valley). From a conservation perspective, lower altitude areas have greater importance, and suffer a heavier burden of human-induced threats.

The survey findings for birds, in contrast to those for the majority of large mammals, were sufficient to determine familiar patterns of altitudinal and habitat-related distribution. Communities of the secondary growth and secondary forest of the lowland river valleys and slope forests to 600 m were most comprehensively covered. Assessment was particularly good for the conspicuous (including vocally) Key Bird species for which the opportunistic observation methods used are particularly suited. In the case of most birds, particularly smaller passerines, the survey coincided with the nesting/fledging period of many species. As a result, singing activity was much reduced from pre-nesting levels (observed elsewhere) and observability of some species was lower. Mixed-species flocks in particular were very few. This breeding activity seemed somewhat earlier than had been previously noted by RJT in Laos. These factors were confounded by inclement weather conditions, which also reduced bird activity, and very high levels of cicada song (particularly above c. 700 m), which drowned out other forest sounds, and seemed to reduce bird-calling activity.

A further consideration in the interpretation of these bird findings is the seasonality of bird movements. The survey coincided with the tail end of the spring passage period, marked particularly by the presence of flocks of Blue-throated Bee-eater *Merops viridis,* and records of Asian Brown Flycatcher *Muscicapa dauurica* and Dark-sided Flycatcher *Muscicapa sibirica*. Many winter visitors had presumably left already; for example, the only *Phylloscopus* species recorded was Arctic Warbler *Phylloscopus borealis*. However, as most such species are of little conservation concern, their absence does not severely hinder ability to assess the area's conservation value. A few other absences in the birds recorded are likely because of local altitudinal movements. The lack of records of Lesser Racket-tailed Drongo *Dicrurus remifer* and Grey-headed Canary Flycatcher *Culicicapa ceylonensis* was presumably due in part to local movements from the lower altitudes surveyed to higher altitudes for breeding that these species are known to make (Lekagul and Round 1991, Duckworth et al. 1999).

Large mammal communities present greater difficulties for effective surveying than do birds. For the diurnally active primates, squirrels, and treeshrews, survey methods were sufficient to make a reasonable status assessment of individual species; if present, these species are relatively easy to detect. Reasonable confidence can be placed in status assessment of the community of ground-living large mammals leaving obvious signs (particularly deer, wild cattle, elephants, and big cats) from the amount of signs seen during the survey. High levels of sign cannot be overlooked, and although low levels can be, specific searches for signs were made on several occasions (see Annex 6). The similarity of signs between related species, however, precludes status assessment at the species level of many of the large mammals. Thus status assessment is best made at species group level, i.e., the two likely *Ursus* species and the three or more likely *Muntiacus* species are treated together. Such an approach is adequate for basic conservation and management purposes. Assessment of the status of the majority of other mammal species was less clearly determined, but no method based on sign searches is likely to give clearly interpretable data during a short survey.

Only two stretches of river were surveyed and very little substrate suitable for retaining tracks was found. However, conditions were favorable for finding the faeces of river-associated small carnivores (Annex 6). It is unlikely that the majority of the latter signs present could have been overlooked.

Nocturnal survey work was limited in both time and area covered, due to inclement weather, lack of suitable trails and moon phase (Annex 5), but the encounter frequencies are probably indicative of large mammal abundance, particularly when viewed in combination with the results from the other survey methods.

The photo-trapping involved few cameras over a short time period in only one small area of the Nam Mac valley (Annex 7). To further confound results, there are few published regional photo-trapping studies for comparison. However, as with the nocturnal survey work, the results are probably indicative of mammal abundance.

The above three methods were the most important for assessing small carnivore status, yet given the limitations of each, little can be determined of small carnivore status and species composition.

Effectiveness of survey methods for determining status has been taken into account in the bird and mammal species abundance tables in Annexes 2 and 3 and greater detail on the reliability of data for determination of Key Species status is given where appropriate in individual Key Species accounts.

4.2.2. Bird and large mammal communities; their status and patterns of abundance within the Huong Son Forest

The bird and large mammal communities of the Huong Son Forest are most logically interpreted in terms of altitudinal and habitat bands, as they have been in Tables 5 and 6, Annexes 2 and 3 respectively. Strongly superimposed on these patterns are the effects of human exploitation of the Huong Son Forest.

The species found and their status largely mirror what is currently known from surrounding areas. The bird communities in particular are characteristic of habitat types and altitude range present and secondarily of the biogeographic location of Huong Son. Degraded areas were characterized by a suite of mainly widespread species. One of the more interesting species found in such habitat was Short-tailed Parrotbill *Paradoxornis davidianus,* which, although not unexpected, has a relatively poorly understood distribution (Duckworth 1996, Duckworth et al. 1999). The survey records for this species are some of the most southerly yet (Collar et al. 1994). A further interesting record was the presence of Pied Kingfisher *Ceryle rudis*, which is considered "At Risk in Laos" (Duckworth et al. 1999), but inexplicably is still widespread over a variety of riverine habitats in Vietnam and Cambodia (see species account).

The lowland valleys are characterized by certain species, in particular Blyth's Kingfisher *Alcedo hercules*, a species that appears to be a specialist of fast, low- to mid-altitude streams and small rivers (see species account). Others included Rufous-throated Fulvetta *Alcippe rufogularis* and Grey-faced Tit Babbler *Macronous kelleyi*. For Inornate Squirrel *Callosciurus inornatus,* a widespread but poorly understood species, the balance of evidence suggested that the species was common at the time of the survey, and this habitat type could well represent its favored type (see species account). A small number of species of high conservation importance, in particular Lowe's Otter Civet *Cynogale lowei* and Vietnamese Pheasant *Lophura hatinhensis* known from elsewhere in Vietnam, but not yet confirmed from any of the central or northern NAPAC areas, may be largely dependent on what little remains of such habitats scattered over Vietnam. The lack of evi-

dence of either of these species from the survey means little, since there was little other than chance recording of small carnivores, and encounter rates with pheasants were very poor. More dedicated, structured surveys for these species in the Huong Son Forest and other Vietnamese areas of the NAPAC are warranted.

The highest altitude areas surveyed were transitional between characteristically mid-altitude species and those of montane to sub-montane altitudes; for example, Mountain Bulbul *Hypsipetes mcclellandii*, Puff-throated Bulbul *Alophoixus pallidus*, and Mrs Gould's Sunbird *Aethopyga gouldiae* (a characteristically montane species) were found only on a higher ridge of 1200-1250 m. High-altitude areas (1500 m+) are represented in the Huong Son Forest mainly along the international border with Laos. They are likely to support a typical montane fauna, but can have only relatively minor regional or national importance since much higher areas can be found in the NAPAC on the international border between Vu Quang NR and Nakai-Nam Theun NBCA and along the international border in Nam Chouan PNBCA.

The findings reinforce what is known and suspected of the faunal difference between the eastern and western sides of the Annamites. Short-tailed Scimitar Babbler *Jabouilleia danjoui* was common on slopes in the Huong Son Forest but rare only c. 5 km to the west (Tobias 1997, Thewlis et. al. 1998). Moustached Barbet *Megalaima incognita,* which is the commonest mid-altitude barbet in Nakai-Nam Theun NBCA (Evans and Timmins 1998, RJT own data) was not recorded in the Huong Son Forest. The commonness of Crested Argus *Rheinardia ocellata* despite hunting pressure contrasts with the species' scarcity over much of the western Annamites (see Annex 10). The photo-trapping of an Owston's Civet *Hemigalus owstoni* adds to the apparent disparity of status of the species across the Annamites (see Annex 10). Fork-tailed Sunbird *Aethopyga christinae* was found commonly down in the lowland river valleys, but in Laos the species has a very restricted distribution to the higher eastern-most Annamite areas (Evans and Timmins 1998, Duckworth et al. 1999).

There were few if any inexplicable absences in the birds recorded. Most absences can be explained by the reasons given above, were of species that could have been simply overlooked, were winter visitors or passage birds, or concern species reduced to unnaturally low levels by human exploitation. Possible exceptions were the apparent paucity of records of Imperial Pigeons *Ducula,* Pied Falconet *Microhierax melanoleucos* and Greater Flameback *Chrysocolaptes lucidus*. Findings in general reinforce a pattern apparent from recent surveys, where the vast majority of species are widespread, and where there are few species with localized distributions that are not explained by either altitude or habitat preference. The forest faunas of Vu Quang NR, Huong Son Forest and Pu Mat NR are likely to be very similar, as with few exceptions are the Lao forests of the NAPAC.

The majority of smaller bird species are common in their respective habitats; however, a very different picture is evident with large mammals and some large bird species. Only three of the potential seven species of diurnal primate were found, and the combined encounter rate for all species was considerably lower than in comparable habitats within the region (compare species accounts with those of Ruggeri and Timmins 1995-1996, Timmins and Khamkhoun Khounboline 1996, Duckworth 1998*a,* Timmins and Duckworth 1999, Timmins et al. 1999, Timmins et al. in SFNC/EC 1998*a*). Similarly, gibbon calling density was greatly below findings from comparable areas within the region (see species account). Both results without doubt reflect reduced population densities. The small number of records of macaques, which appear to fare better in Laos and Vietnam than langur or gibbon populations in areas of high human use (Ruggeri and Timmins 1995-1996, Timmins and Duckworth 1999, Timmins et al. 1999), was

particularly startling. Although in most areas of Indochina large ground-living mammals are difficult to see directly, signs are generally relatively easy to observe if present. Mammal signs were very few (Annex 6). Even small carnivore faeces, which are generally obvious, were found surprisingly rarely. No signs of wild cattle *Bos,* Asian Elephant *Elephas maximus,* big cats *Panthera/Pardofelis* or large deer *Cervus/Axis* were found. Usually during surveys of this type muntjacs are one of the more frequently encountered mammal taxa (RJT own data), but there was not a single sighting or vocal registration during this survey. Very clearly populations of the majority of large ground-living mammal species are far from numerous.

Of the two river stretches surveyed, very few signs of small carnivores were found (Annex 6). Comparison with findings from elsewhere (see Annex 6), gives a clear indication that very few animals were present. Given the level of apparent human use of the rivers and the findings for large mammals in general, these findings are likely to represent the river areas throughout the Huong Son Forest.

The encounter frequencies during the nocturnal survey work (Annex 5) were very poor compared with similar work within the region (see Annex 5), and almost certainly reflect reduced mammal densities.

Larger birds that are likely to be quarry species followed a pattern similar to that of mammals, with very few registrations in particular of large hornbills *Buceros/Aceros*. Additionally, there appeared to be a low density of Brown Hornbills *Anorrhinus tickelli*. These seem to fare better in other areas of Vietnam and Laos than do the large species (see species account). Crested Argus, although still common, did not approach the calling density previously found in the adjacent area of Laos (see species account). There were no records of Hill Myna *Gracula religiosa* or Imperial Pigeon *Ducula,* suggesting these species were scarce or even absent over large areas; the reasons for this are unclear but hunting pressure, and, for Hill Myna, collection of birds for the pet trade are likely to be involved.

That several independent methods indicate low abundance of many large species is strong evidence that wildlife populations are depressed. Hunting is probably the major determinant of abundance of almost all large mammals and the species of quarry birds. The effects of hunting are likely to be exacerbated by the small extent of forest habitat and low mammal densities directly across the international border in Laos. In contrast to many areas of Laos, the forest area adjacent to the Huong Son Forest is relatively narrow (c. 6 km), has a high density of actively hunting locals (higher certainly than areas further south in Laos), and lower large mammal densities than many adjacent areas (Timmins and Evans 1994, Tizard 1996, Tobias 1997, IUCN 1997, Robichaud 1997, 1999). The apparently somewhat more numerous large mammal populations in Pu Mat NR and Phong Nha-Ke Bang NP (Timmins et al. in SFNC/EC 1998*a,* Timmins et al. 1999), where hunting pressure is perhaps not much less than in Huong Son, are likely in part to be due to the buffering effect of higher animal densities and larger forest areas in Laos (Timmins and Khamkhoun Khounboline 1996, Walston and Vinton 1999, RJT own data). Given this assumption, one can imagine the implications for Vietnamese wildlife populations of losing adjacent habitat in Laos, and of losing habitat corridors. It is also plausible that Vietnamese forests absorb some hunting pressure; hunting pressure on Lao forests would likely intensify if forests in Vietnam were lost.

Table 2. Key Species recorded during the survey or previously, threat status, the level of threat and priority for conservation action in the Huong Son Forest.

Species	Threat Status	Threat from lowland hab. loss	Threat from hunting	Level of threat	Priority for conservation action
Key Species with a global threat assessment					
BIRDS					
Chestnut-necklaced Partridge *Arborophila charltonii*	GT-VU		**S**	Mid	Low
Crested Argus *Rheinardia occellata*	GT-VU		**S,T?**	High	High
Red-collared Woodpecker *Picus rabieri*	GT-VU	+		Mid	Mid (Hab)
Brown Hornbill *Anorrhinus tickelli*	GNT		+	Mid-High	Mid
[Rufous-necked Hornbill] *Aceros nipalensis*	GT-VU		+	Acute?	High
Blyth's Kingfisher *Alcedo hercules*	GT-VU	+		Mid	Mid (Hab)
Coral-billed Ground Cuckoo *Carpococcyx renauldii*	GNT		**S**	Mid?	Low
Yellow-vented Green Pigeon *Treron seimundi*	GNT		+	Mid?	Low
[Von Schrenck's Bittern] *Ixobrychus eurhythmus*	GNT	+?		Low?	Mid? (Hab?)
Blue-naped/Blue-rumped Pitta *Pitta nipalensis/soror*	GNT			Low?	Low
Bar-bellied Pitta *Pitta elliotii*	GNT			Low?	Low
White-winged Magpie *Urocissa whiteheadi*	GNT		+	Low-Mid	Low
Indochinese Green Magpie *Cissa hypoleuca*	GNT	+		Mid?	Low
Grey Laughingthrush *Garrulax maesi*	GNT			Low	Low
Short-tailed Scimitar Babbler *Jabouilleia danjoui*	GT-VU			Low	Low
Grey-faced Tit Babbler *Macronous kelleyi*	GNT	+		Mid	Mid (Hab)
Rufous-throated Fulvetta *Alcippe rufogularis*	GNT	+		Mid?	Mid (Hab)
Short-tailed Parrotbill *Paradoxornis davidianus*	GN-VU			Low	Low
MAMMALS					
Sunda Pangolin *Manis javanica*	GNT		**S,T**	High?	High
[Assamese Macaque] *Macaca assamensis*	GT-VU		**T**	High-Acute	High
Bear Macaque *Macaca arctoides*	GT-VU		**S, T**	High-Acute	High
Douc Langur *Pygathrix nemaeus*	GT-EN		**T**	Acute?	Very High

Table 2.(continued)

Species	Threat Status	Threat from low-land hab. loss	Threat from hunting	Level of threat	Priority for conservation action
White-/Yellow-cheeked Crested Gibbon *Hylobates (Nomascus) leucogenys/gabriellae*	DD		**T**	Acute	Very High
Sun Bear (and Bear sp[p]) *Ursus malayanus* (and *Ursus* sp[p]).	DD		**S, T**	Acute?	Very High
Owston's Civet *Hemigalus owstoni*	GT-VU		**S, T?**	Mid?	Mid
† [Asian Elephant] *Elephas maximus*	GT-EN		**T**	Acute	High
† [Gaur] *Bos gaurus*	GT-VU		**T**	Acute	High
† Southern Serow *Naemorhedus sumatraensis*	GT-VU		**S, T?**	High-Acute?	Mid
† Saola *Pseudoryx nghetinhensis*	GT-EN		**S, T?**	Acute	**Highest**
Inornate Squirrel *Callosciurus inornatus*	GT-VU	+		Low	Low (Hab)
East Asian Porcupine *Hystrix brachyura*	GT-VU		**S**	Low-Mid?	Low
Key Species with a regional threat assessment					
BIRDS					
Crested Kingfisher *Megaceryle lugubris*	VRB	+		Mid?	Mid (Hab)
Pied Kingfisher *Ceryle rudis*	ARL			Low?	Low
Brown Dipper *Cinclus pallasii*	PARL	+		Low?	Mid (Hab)
MAMMALS					
Hog Badger *Arctonyx collaris*	LKL		**S**	Mid?	Mid
Small-toothed Ferret Badger (PR) *Melogale moschata*	LKL		**S**	Mid?	Mid
Spotted Lingsang (PR) *Prionodon pardicolor*	LKL		**S, T?**	Mid-Low?	Low-Mid
Pig sp(p). *Sus sp(p).*	LKL		**S, T**	Mid	Mid
† Sambar *Cervus unicolor*	PARL		**S, T**	High	Mid
Roosevelt's/Annamite Muntjac (PR) *Muntiacus cf. M rooseveltorum/truongsonensis*	LKL		**S**	Mid?	Low-Mid
† Large-antlered Muntjac *Muntiacus vuquangensis*	PARL		**S**	High?	Mid
Black Giant Squirrel *Rattufa biocolor*	VRB, PARL		**S**	Mid?	Low-Mid
Annamite Striped Rabbit *Nesolagus timminsi*	LKL		**S**	Mid?	Mid

Table 2.(continued)

Notes

[ ] Identification provisional or unconfirmed.

† Species not confirmed to be currently present in the Huong Son Forest.

(PR) Species recorded previously but not during the survey.

Threat status:
ARL: At Risk in Laos
GNT: Globally Near-Threatened
GT-CR: Globally Threatened – Critically Endangered
GT-EN : Globally Threatened – Endangered
GT-VU: Globally Threatened – Vulnerable
LKL: Little Known in Laos
PARL: Potentially At Risk in Laos
VRB: Threatened or indeterminate in Vietnam.

Threatened by loss of lowland valley forest and riverine habitat:
A plus (+) is given to indicate which species are associated with such habitat.

Threatened by hunting:
An annotation is given to indicate which species are, or are likely to be, routinely hunted. Species that are vulnerable to snares are marked with an 'S', while those species with high value or high volume in the wildlife trade are marked with a 'T'.

Level of threat in the Huong Son Forest:
Acute: species acutely threatened by hunting pressure and at high risk of local extinction in the near future, or, for more mobile species, whose numbers are being bolstered from elsewhere.
High: species experiencing high hunting pressure, often with relatively small populations.
Mid: species still reasonably numerous experiencing mid to high hunting pressure and/or a species largely confined to the forests of the lowland valleys.
Low: species widespread in Huong Son Forest experiencing little to no hunting pressure.

Priority in the Huong Son Forest:
Subjective ranking based on likely significance of the Huong Son Forest for species conservation and threat level, considering the continuity of wildlife populations in the Huong Son Forest with those in Vu Quang NR and Nakai-Nam Theun NBCA. The (Hab) designation indicates species for which species protection of the lowland valley forest habitats is particularly important; protection of the lowland valleys is an 'Acute' priority.

4.2.3. Key Species accounts

Brackets [ ] indicate that the identification of the species or individual record is provisional or was unconfirmed. The inclusion of a dagger † by a species account is used to denote that, irrespective of the level of identification, current presence of the species in the Huong Son Forest is not confirmed. Key Species, their significance and the threats facing them are summarized in Table 2.

Note the following species (and subspecies) that were found at this site are listed as threatened or indeterminate (VRB) by MOSTE (1992), but are clearly not at immediate risk within Vietnam (Do Tuoc pers. comm. 1998, J. W. Duckworth pers. comm. 1998, J. C. Eames pers. comm. 1998, Trinh Viet Cuong pers. comm. 1998, Le Trong Trai pers. comm. 1999, RJT own data), and are thus not considered in any further detail within this report:

[Red Muntjac *Muntiacus muntjak annamensis* (subspecific identification provisional)]
Silver Pheasant *Lophura nycthemera*
Blue Pitta *Pitta cyanea*
Long-tailed Broadbill *Psarisomus dalhousiae*
Ratchet-tailed Treepie *Temnurus temnurus*

4.2.3.1. Key Species with a global threat assessment

Birds

Chestnut-necklaced Partridge *Arborophila charltonii* **GT-VU**
Survey records: Still common in forest on the lower slopes and in forested areas of the valley bottoms, although rarely more than a few groups recorded during the course of a day.

Inskipp et al. 1996 considered the taxon conspecific with Scaly-breasted Partridge *A. charltonii s.l.* (the latter also including the races *chloropus* and *merlini*), which is not considered a Key Species globally or regionally. Calling densities were low (relatively few groups recorded per day, with a large proportion of distant registrations) compared with those encountered for Scaly-breasted Partridge in some areas of Laos (many more groups, with a high proportion of close registrations) by RJT, but were similar to other areas of Vietnam surveyed (Round et al. in SFNC/EC 1998, Timmins et al. 1999) and presumably reflect hunting pressure.

Crested Argus *Rheinardia occellata* **GT-VU**
Survey records: The species was common and recorded in all survey areas from lower slopes up to the highest altitude surveyed; however, rarely were ten or more (estimated) calling birds recorded during the course of a day when over 5 km was covered. A single clearly active display ground was found. All others found seemed not to have been used for some time, with leaf-litter, small branches, and short herbage present.

The records suggest a status similar to that in other areas of Vietnam (Robson et al. 1993*a,* 1993*b,* Eames et al. 1994, Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999, Russian Vietnamese Tropical Center undated). Densities are probably much below natural levels. In the Nam Kwai valley in Laos less than 1 km from the international border area of the central Huong Son Forest, calling densities were found to be much higher, with commonly five or more birds audible from a single spot between January and late February in 1994 (although calling seemed somewhat reduced during a short re-visit in late April of the same year), and active display

grounds were easily found (Thewlis et al. 1998, RJT own data). Crested Argus has a naturally limited range in Laos, predominantly in international border areas close to Vietnam (see Annex 10).

Red-collared Woodpecker *Picus rabieri* **GT-VU**
Survey records: probably at least locally common in secondary forest of the lowland valleys and forest of the lower slopes; the species was recorded on three occasions, twice in the Song Con valley (17 and 18 May) and once in the Nam Mac valley (22 May).

The species is widespread in Laos and Vietnam and common in several Lao protected areas (Robson et al. 1993*b,* Eames et al. 1994, Thewlis et al. 1998, Duckworth et al. 1999, Le Trong Trai 1999*b*, Russian Vietnamese Tropical Center undated, J. C. Eames pers. comm. 1998).

Brown Hornbill *Anorrhinus tickelli* **GNT**
Survey records: a group of birds seemingly disoriented by the logging activity at Nga Doi were recorded on the 9 May. A group was recorded on 13 May on the ridge between the Rao An and Rao Bun. Groups were recorded in two areas of the Song Con valley (certainly representing two different groups, but probably no more), with records on more than one date from both areas. Groups were recorded in two areas of the Nam Mac valley (certainly representing two different groups but probably no more). One of these groups could conceivably have been the same as one of the groups recorded in the Song Con valley.

The number of encounters was somewhat discouraging, but is comparable to other areas of Vietnam (Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999, Timmins et al. 1999, Russian Vietnamese Tropical Center undated, J. C. Eames pers. comm. 1998). Encounter rates have been higher in some areas of Laos, probably reflecting lower hunting pressure there (Thewlis et al. 1998, RJT own data).

[**Rufous-necked Hornbill** *Aceros nipalensis* **GT-VU**
Survey records: there were only two records of large hornbills. On the 26 April "pock" calls were heard from slopes at the southern end of the Rao An valley at c. 500-800 m. Based on the call, Rufous-necked Hornbill seems the most likely species; however, Wreathed Hornbill *Aceros undulatus* (**VRB, ARL**) cannot be ruled out. On 1 May "wruff" vocalizations were heard from the Rao An Tren valley at c. 1200 m. Based on the call, they were most likely Great Hornbill *Buceros bicornis* (**VRB, ARL**).

Rufous-necked Hornbill is a montane species with a localized distribution in Indochina (in Vietnam only recently recorded in the NAPAC), populations almost certainly being larger in Laos (Thewlis et al. 1998, Round et al. in SFNC/EC 1998, Duckworth et al. 1999, Eames and Tordoff in prep.). Its status in other range areas appears to be precarious (Collar et al. 1994, Kemp 1995, Round et al. in SFNC/EC 1998). The central unit of the NAPAC may well be the stronghold of the species in Indochina and the most appropriate area for its conservation regionally (Thewlis et al. 1998, Duckworth et al. 1999). It is clearly also a globally important site for the species.

All large hornbills in Indochina are under considerable pressure from hunting, but also presumably from habitat fragmentation, loss of nesting trees and possibly disturbance at, and loss of, fruiting trees (Kemp 1995, Thewlis et al. 1998, Duckworth et al. 1999, Kannan and James 1999, Wells 1999). Populations of all have been vastly reduced from historical levels in many areas (Kemp 1995); in Laos this appears to have been particularly the case for Great Hornbill, and to a lesser extent Wreathed Hornbill (Thewlis et al. 1998). All species (particularly Wreathed) appear to be somewhat nomadic and range over large areas (see Kemp 1995, Wells 1999). Wreathed Hornbill is

one of few animal species in Laos where movement between protected areas has been documented as not uncommon (Thewlis et al. 1998). Habitat fragmentation is likely to pose a significant threat to all three species, and large blocks of habitat and continuity between protected areas are likely to offer the best chances for their conservation (Kemp 1995, Thewlis et al. 1998, Duckworth et al. 1999, Kannan and James 1999, Wells 1999).]

Blyth's Kingfisher *Alcedo hercules* **GT-VU**
Survey records: recorded in the upper reaches of the Nam Mac and the Song Con, and on the Rao Qua.

The species appears to be widely distributed in Laos and Vietnam (Eames et al. 1994, Thewlis et al. 1998, Duckworth et al. 1998, 1999, Le Trong Trai et al. 1999*b*, Russian Vietnamese Tropical Center undated, Eames and Tordoff in prep.), and is characteristic of small, fast-flowing rivers and streams, with tall bank-side vegetation or forest, at low to mid elevation (Thewlis et al. 1998, Duckworth et al. 1999). It is at some risk from the loss of such habitats through heavy degradation of bank-sides.

Coral-billed Ground Cuckoo *Carpococcyx renauldii* **GNT**
Survey records: two, perhaps more, birds recorded calling at c. 500 m in the Song Con valley in forest with a high proportion of tall, smooth-stemmed bamboo, for most of the morning on 18 May.

It is unclear why birds were only heard from one area during the survey, especially as calling levels found in Laos at a similar time of the year are generally high (Thewlis et al. 1998); perhaps calling ceases earlier than in Laos. The species is still widespread and locally common in several protected areas in its limited range of Thailand and Indochina (Robson et al. 1993*a*, Eames et al. 1994, Round et al. in SFNC/EC 1998, Thewlis et al. 1998, Round 1988, Eames and Tordoff in prep.).

Yellow-vented Green Pigeon *Treron seimundi* **GNT**
Survey records: at least one bird was positively identified amongst ten or more unidentified green pigeons in a fruiting tree on 21 May in the Nam Mac valley. Birds most probably of this species were seen in flight on 18 May (a single individual) in the Song Con valley, and twice on the 20 May (two and three) in the Nam Mac valley. Unidentified green pigeon vocalizations were heard frequently throughout the areas surveyed.

The species is probably widespread and locally common in the Annamite Mountains of Indochina (Thewlis et al. 1998, Duckworth et al. 1999, Eames and Tordoff in prep.).

[**Von Schrenck's Bittern** *Ixobrychus eurhythmus* **GNT**
Survey records: a single bird, provisionally identified, was flushed from the road through shading secondary forest in the Nam Mac valley on 20 May.

The bird was briefly glimpsed and had pale tawny panels in the wings contrasting with the rest of the wings and body. The wing panels seemed not to be the bright buffy colour of Yellow Bittern *I. sinensis,* and the flight feathers not contrastingly blackish. Von Schrenck's Bittern is an elusive species that seems to favor pools or well-vegetated stream banks in forest or forest-like situations, but can occasionally turn up well away from forest in migration (Thewlis et al. 1998, Duckworth et al. 1999, C. Robson pers. comm. 1999). The species is a bird of passage and perhaps wintering bird in Laos and Vietnam (King et al. 1975, Lekagul and Round 1991).]

Blue-naped/Blue Rumped Pitta *Pitta nipalensis/soror* **GNT**
Survey records: single birds were seen on 2 May in the upper Khe Tre valley and 9 May at the Nga Doi area. Both were most probably Blue-rumped.

Birds were likely to have been greatly overlooked. The status of Blue-rumped Pitta is likely to parallel closely that of the more easily surveyed Bar-bellied Pitta *P. elliotii* (Thewlis et al. 1998, Eames and Tordoff in prep.).

Bar-bellied Pitta *Pitta elliotii* **GNT**
Survey records: common in all areas surveyed up to c. 600 m, with records up to c. 800 m.

The species remains widespread and is found at similar abundance in many protected areas in Laos and Vietnam. It is of low regional conservation priority (Thewlis et al. 1998, Duckworth et al. 1999, Eames and Tordoff in prep., J. C. Eames pers. comm. 1998).

White-winged Magpie *Urocissa whiteheadi* **GNT**
Survey records: frequently recorded and probably common in the secondary forest of the lowland valleys and forest of the lower slopes. Frequent on the higher slopes.

Similar abundances have been found at several other sites in Vietnam and Laos (Thewlis et al. 1998, SFNC/EC (Round) 1999, Timmins et al. 1999, J. C. Eames pers. comm. 1998). In much of Laos (in contrast to Vietnam), the species naturally occurs in localized areas (see Annex 10).

Indochinese Green Magpie *Cissa hypoleuca* **GNT**
Survey records: positively identified on 25 April in the Rao An valley and on 10 May in the Nga Doi area. Probably common in the secondary forest of the lowland valleys and forest of the lower slopes.

Status assessment is difficult because of the species' skulking nature, and vocalizations that are not confidently distinguishable (by RJT) from those of other species. The species has a small range in Laos and Thailand but is more widespread in Vietnam (see Annex 10). It is widespread and still common in several protected areas (Robson et al. 1993*a, b*, Eames et al. 1994, Le Trong Trai et al. 1999*a, b*, SFNC/EC (Round) 1999, Timmins et al. 1999, Russian Vietnamese Tropical Center undated, J. C. Eames pers. comm. 1998).

Grey Laughingthrush *Garrulax maesi* **GNT**
Survey records: common at the highest altitudes surveyed and found in both the Rao An Tren and the Nam Mac survey areas.

The species remains common in forest at mid to high altitude in most other recently surveyed areas in the northern Annamites (Round et al. in SFNC/EC 1998, Thewlis et al. 1998, SFNC/EC (Round) 1999, Timmins et al. 1999, Russian Vietnamese Tropical Center undated).

Short-tailed Scimitar Babbler *Jabouilleia danjoui* **GT-VU**
Survey records: common on the slopes, with some records down in the valley bottoms. Recorded up to at least 1100 m.

In Phong Nha-Ke Bang NP an association with rocky areas was noted (Timmins et al. 1999), but this appeared not to be the case in the Huong Son Forest. The species is predominantly restricted to Vietnam (see Annex 10), where it is still widespread and common in several protected areas (Robson

et al. 1993*a, b*, Eames et al. 1994, Le Trong Trai et al. 1999*a, b*, SFNC/EC (Round) 1999, Timmins et al. 1999, Russian Vietnamese Tropical Center undated, J. C. Eames pers. comm. 1998).

Grey-faced Tit Babbler *Macronous kelleyi* **GNT**
Survey records: seemingly common in the secondary forest of the lowland valleys; however, relatively few vocal registrations per day, and very few sightings.

Numbers recorded were relatively low. For its size, and particularly in comparison with its congener Striped Tit Babbler *Macronous gularis*, density was clearly low, presumably naturally. The species is still widespread and common in southern parts of its range (Robson et al. 1993*a, b*, Eames et al. 1994, Duckworth and Hedges 1998*b,* Thewlis et al. 1998, Duckworth et al. 1999, Le Trong Trai et al. 1999*b*, J. C. Eames pers. comm. 1998). In some areas of Laos it can have a similar "common" abundance to Striped Tit Babbler, when each is in their respective favored habitats (RJT own data).

Rufous-throated Fulvetta *Alcippe rufogularis* **GNT**
Survey records: common in the secondary forests of the Song Con and Nam Mac valleys, with one surprising record on a broad ridge at c. 400 m+ in the Nam Mac valley. Unexpectedly this species was not recorded in the Rao An valley.

Vocal activity was clearly reduced in comparison with results of surveys at other times of the year in Laos (RJT own data). The species, although unobtrusive, is difficult to overlook, and the lack of records from the Rao An valley was surprising. The species is characteristic of valley bottom forest habitats, but appears to tolerate relatively high degrees of degradation in some areas. It has been found in reasonable numbers in several protected areas of Laos and appears to be still widespread in Vietnam (Robson et al. 1993*a,* Eames et al. 1994, Thewlis et al. 1998, Duckworth et al. 1999, Le Trong Trai et al. 1999*b*).

Short-tailed Parrotbill *Paradoxornis davidianus* **GT-VU**
Survey records: four or more birds seen together in an area of dense short bamboo in extensive secondary growth at 6045 I 332340 in the Khe Tre valley on 2 May. Two or more birds seen together in an area of predominantly dense, relatively short bamboo, at the edge of a forest area with substantial bamboo (mainly taller and partly under a tree canopy), in the Song Con valley on 18 May.

The species was relatively little known (Collar et al. 1994, Duckworth 1996), but recently it has been found in Laos at a number of locations generally associated with bamboo in degraded habitats (Duckworth et al. 1999), and thus, given the ubiquity of such habitats in northern Indochina, is unlikely to be under any serious risk (Duckworth et al. 1999, Eames and Tordoff in prep.).

Mammals

Sunda Pangolin *Manis javanica* **GNT**
Survey records: a single animal was photographed, at c. 400 m, as part of the photo-trapping in the Nam Mac valley (see Annex 7 for more details). †A single animal was seen in the possession of a wildlife dealer in Trung Tam.

Pangolins appear to be one of the more commonly traded species, commanding relatively high prices (Duckworth et al. 1999, Compton et al. in press). This suggests they are still relatively widespread, but clearly under tremendous pressure.

[**Assamese Macaque** *Macaca assamensis* **GT-VU**
Survey records: vocalizations heard on 21 May from c. 800 m in the Nam Mac valley were perhaps from this species. Prints and droppings, most probably those of unidentifiable macaques, were found along the Rao An on 25 April.

Musser and Lunde (in prep.) recorded unidentified macaques on a number of occasions. The extreme paucity of records of macaques and primates in general from the Huong Son Forest is considerable cause for concern. Encounter rates with diurnal primates during the survey were the lowest ever experienced by RJT in relatively intact forest. Primates in Vietnam, especially in the northern half of the country, appear to be under considerable pressure, from both a domestic and presumably a north Asian wildlife trade market (Timmins et al. 1999). Although reduced in numbers, Assamese Macaque appears to be still widespread in hill and mountain forest areas of Laos and probably also Vietnam, and is perhaps the commonest macaque species in the NAPAC (Ruggeri and Timmins 1995-1996, Timmins et al. in SFNC/EC 1998*a,* Duckworth et al. 1999, Timmins et al. 1999, RJT own data).]

Bear Macaque *Macaca arctoides* **GT-VU**
Survey records: the species was encountered on a single occasion in the Nam Mac valley on 20 May at c. 800 m, at least three animals being seen (TVC). Two animals travelling together were photographed as part of the photo-trapping in the Nam Mac valley (see Annex 7 for more details).

Bear Macaques are still likely to be relatively widespread in Laos and Vietnam in the NAPAC, although seemingly not as common as Assamese (Ruggeri and Timmins 1995-1996, Timmins et al. in SFNC/EC 1998*a*, Duckworth et al. 1999, SFNC/EC (Round) 1999, Timmins et al. 1999, RJT own data). The species is ground-dwelling to a significant degree, which puts it at greater danger from snaring than most of the other primates.

Douc Langur *Pygathrix nemaeus* **GT-EN**
Survey records: A group was flushed from slopes at c. 500 m in the Nam Mac valley on 7 May. A group of at least five animals was seen in the Rao An Tren valley at c. 900 m on 27 April (TVC). All animals were of the "Red-shanked" subspecies *P. n. nemaeus.* A group of four to six adult Douc Langurs was seen in the Roa An Tren valley at c. 700 m on 10 March (E.J. Sterling pers. comm. 1999). They were observed for approximately 5 minutes from 10 m away, during which time they called to each other and toward the observers. Only their faces were seen clearly but this group was presumably also of the same "Red-shanked" subspecies as the other two sighted.

The recording of Douc Langurs was encouraging in the face of the very poor findings for other primates; Douc Langurs are often reported to be one of the easiest diurnal primates to hunt and are clearly more sensitive to human pressures than are macaques (Timmins et al. 1999, Timmins and Duckworth 1999). However their status in the Huong Son Forest is likely to be precarious.

White-cheeked/Yellow-cheeked Crested Gibbon *Hylobates (Nomascus) leucogenys/gabriellae* **DD**
Survey records: Groups were heard on only two mornings; on the 29 April from the Rao An Tren at c. 850 m, and on 2 May from a second camp further south on the Rao An Tren at c. 950 m.

As no animals were seen and no tape recordings of song duets recorded, the identity of the taxa present cannot be established. Even with such data, identification would be tentative. It is not wise even to speculate on the identity of the Huong Son Forest animals (Duckworth et al. 1999, Timmins et al. 1999). The extremely low calling density is real cause for concern, particularly

considering that habitat is still in reasonable condition and is contiguous with one of the largest remaining forest areas in Southeast Asia. Low calling densities have been recorded in the Nam Kwai area of Laos, adjacent to the Huong Son Forest, in the winter, probably due in part to inclement weather (Evans et al. 2000), but also in the summer in other areas of the proposed northern extension to Nakai-Nam Theun NBCA during better weather (Tizard 1996, Tobias 1997, Duckworth 1998*a*), and calling densities were relatively low in Pu Mat (Timmins et al. in SFNC/EC 1998*a*, SFNC/EC (Round) 1999). In contrast, in the heart of the Nakai-Nam Theun NBCA forest, including at a similar time of the year to the Huong Son survey (e.g., early May 1996), one to six estimated groups could be heard from almost any spot each morning (Evans et al. 2000, Tobias 1997, Duckworth 1998*a,* N. Ruggeri pers. comm. 1999).

Sun Bear *Ursus malayanus* **DD**
Survey records: a not fully grown female was found in the possession of hunters in the Rao An Tren valley on 29 April. The animal had been caught in a snare and battered to death (TVC). Claw marks on tree trunks, which are not confidently identifiable to species (Asiatic Black Bear *Ursus thibetanus* **GT-VU,** was also likely to have once been present), were found widely (see Annex 6). All such signs found were old; possibly several years in many cases.

The lack of recent signs suggests that bears were at low density, which is not surprising given the apparent level of threat facing them (Duckworth et al. 1999). The pattern mirrors that found during recent surveys in Laos (Duckworth et al. 1999) and Vietnam (Timmins et al. in SFNC/EC 1998*a,* Timmins et al. 1999). Despite their size, distribution, prominence in trade and familiarity to human cultures, little is known of the status of either species or their regional ecology. Sun Bear was recently considered the "least known of the world's bears" (Servheen 1999).

Owston's Civet *Hemigalus owstoni* **GT-VU**
Survey records: a single animal was photographed as part of the photo-trapping in the Nam Mac valley (see Annex 7 for more details).

The species is still probably locally common and widespread in forests of the eastern Annamite slope (see Annex 10 for more detail). However, given its relatively small range, predominantly centered on Vietnam, and recently revealed levels of snaring pressure in Vietnam (Timmins et al. 1999, Do Tuoc pers. comm. 1998, Trinh Viet Cuong pers. comm. 1998, R. Eve pers. comm. 1999, Le Trong Trai pers. comm. 1999), there is probably cause for some concern.

†[**Asian Elephant** *Elephas maximus* **GT-EN**
No evidence was found for the species during the survey.

Several local people, one (a Huong Son Forest Enterprise worker) claiming first-hand sighting of signs, reported the species was present in the southwestern Ba Mu mountain area until recently. None of the better substantiated reports claimed more than a small number of animals (probably only two to three in most cases). Most reports suggested that these animals had moved out of the area in which signs had recently been seen because of the initiation of logging activity in the Ba Mu area, the general consensus being that they had probably moved to the Song Con valley. Given the level of human activity in the Song Con valley, it is not inconceivable that the animals may have moved much further afield.

Small numbers of elephants have been reported from Huong Son previously (Rozendaal 1990, Duckworth and Hedges 1998*a*). Elephant numbers in Vietnam are currently barely viable. The small remnant groups in a very small handful of sites through the country are under considerable

stress (Duckworth and Hedges 1998*a,* Timmins et al. in SFNC/EC 1998*a,* Timmins et al. 1999, Osborn and Vinton 1999 and references therein). Larger numbers, although still far from buoyant populations, are present in Laos, with one of the more important regional populations centered on the Nakai Plateau area of Nakai-Nam Theun NBCA (Duckworth and Hedges 1998*a*, Osborn and Vinton 1999 and references therein, Duckworth et al. 1999). Given the continuity of habitat in the NAPAC, the Huong Son Forest could once again become part of the range of Asian Elephants, if the tremendous pressure on the species were reduced.]

†[**Gaur** *Bos gaurus* **GT-VU**
No evidence was found for the species during the survey.

Small numbers of wild cattle, presumably Gaur, had reportedly been seen on occasion in international border areas, particularly in the Rao An Tren. It seems certain that groups and probably even individuals no longer occur on a regular basis in the Huong Son Forest. Gaur are still present in Nakai-Nam Theun NBCA, although their numbers are small, and groups probably rarely exceed a few animals (Tobias 1997, Duckworth et al. 1999, Evans et al. 2000). There is also recent evidence of animals from Vu Quang NR (J. C. Eames pers. comm. 1999).]

†Southern Serow *Naemorhedus sumatraensis* **GT-VU**
Survey records: remains in the form of trophy frontlets were seen in a number of houses, some seemingly from animals killed recently. Recent signs, most likely those of Southern Serow, were seen at c. 500 m in the Khe Tre valley, and at c. 400 m in the Nam Mac valley.

The species appears to be widespread in Indochina, although its status is a matter of debate. There are few areas where signs thought to be those of Serow have been found commonly and widely (Duckworth et al. 1999, Timmins et al. 1999, Evans et al. 2000*,* RJT own data).

†Saola *Pseudoryx nghetinhensis* **GT-EN**
Survey records: a trophy frontlet of an animal reportedly shot in forest of the Ha Vang area was seen in one village.

The species was still reportedly present in the upper valleys of the Huong Son Forest. Most reports were second-hand and of animals which were subsequently killed. Encounter rates (which seemed to include snared animals) reported were very low compared with those for pigs, muntjacs and even Serow; one knowledgeable local who had clearly spent considerable time in many areas of the Huong Son Forest said that he had only seen Saola on seven occasions. The species is probably elusive, but also at extreme low density. The threatened status of this species cannot be overstated, particularly in view of the tremendous pressure on large, ground-living mammals over most areas of its range in Laos and Vietnam. Nowhere is there good evidence to suggest Saola is still numerous. Indeed, most evidence points to the opposite, and it seems not overly dramatic to suggest the species could become extinct with barely a notice (see also Robichaud 1997, 1999, Timmins in press, RJT own data). Its Endangered status is almost certainly over-optimistic; an 80% decline in the next ten years is certainly not inconceivable, suggesting that Saola might be more appropriately considered Critically Endangered.

Field signs of the species are poorly understood and in many cases they are likely to be only equivocally separable from other ungulate species.

Inornate Squirrel *Callosciurus inornatus* **T-VU**
Survey records: recorded frequently in all the lowland valleys, where the species is most probably common.

This is the first recent survey site in the species' range where the population has been documented to be numerous (J. W. Duckworth pers. comm. 1999, Wang Sung in litt. to J. W. Duckworth 1998, RJT own data, see also Duckworth et al. 1999). At most other sites the species is clearly at low density. However, it is likely that other areas in the NAPAC support the species at similar abundance. A high proportion of recent records are associated with disturbed forest micro-habitats, with proportionally more records from lower altitude sites (J. W. Duckworth pers. comm. 1999, RJT own data).

East Asian Porcupine *Hystrix brachyura* **GT-VU**
Survey records: spines from this species were found in the Nam Mac valley in two places, in one case associated with an old snare in a snare line.

The species is still widespread in Laos and clearly not threatened with extinction there (Duckworth et al. 1999). The same is probably true in Vietnam, although populations are likely to be reduced through snaring.

4.2.3.2. Key Species with a regional threat assessment

Birds

Crested Kingfisher *Megaceryle lugubris* **VRB**
Survey records: singles were recorded on 25 April in the Rao An valley and 19 May in the Song Con valley.

At least in Laos, the species appears to prefer large, fast-flowing rivers (Thewlis et al. 1998). The record on the Song Con in the upper valley where the river is relatively narrow (c. 2-5 m) and quite shallow (c. 15-30 cm) was thus rather surprising. In Laos the species seems relatively tolerant of habitat degradation and is not greatly affected by hunting pressure (Thewlis et al. 1998, Duckworth et al. 1999), but in Thailand the species is considered to be threatened by habitat loss (Round 1997). In Vietnam it is local, and probably threatened wherever there is piecemeal clearcutting of substantial swathes of forest, since it appears to need at least some tree-lined stretches of river (C. Robson pers. comm. 1999).

Pied Kingfisher *Ceryle rudis* **ARL**
Survey records: two birds were seen together along the Song Ngan Pho close to Trung Tam on 4 May.

The species has undergone a serious decline for unknown reasons in Laos (Thewlis et al. 1998, Duckworth et al. 1999), and has also declined in Thailand (P. D. Round pers. comm. 1998). However, in Cambodia and Vietnam the species still appears to be widespread in reasonable numbers (Robson et al. 1993*a, b,* Duckworth and Hedges 1998*b,* Timmins and Men Soriyun 1998, J. C. Eames pers. comm. 1998).

Brown Dipper *Cinclus pallasii* **PARL**
Survey records: birds were recorded daily when looked for along the Rao An, the Rao An Tren, the Song Con and the Nam Mac. The number of birds in each area was difficult to judge.

The species appears to have a patchy distribution in Laos, where it is scarce or absent on some seemingly suitable rivers (Thewlis et al. 1998, Duckworth et al. 1999). The same appears to be true in Vietnam (C. Robson pers. comm. 1999).

Mammals

Hog Badger *Arctonyx collaris* **LKL**
No evidence was found for the species during the survey.

Musser and Lunde (in prep.) found a partial skeleton at 300 m in the Rao An area. There are relatively few records of the species from Laos and Vietnam in comparison with some other small carnivore species (Duckworth 1997, Duckworth et al. 1999, Timmins et al. 1999). The majority of records come from areas with relatively low hunting pressure. The species is reportedly easy to hunt by gun (Timmins et al. 1999), and living on the ground must be vulnerable to snaring.

Small-toothed Ferret Badger *Melogale moschata* **LKL**
No evidence was found for the species during the survey.

Musser and Lunde (in prep.) caught one animal at 1150 m, which they identified as Small-toothed Ferret Badger *M. moschata*. There are relatively few recent records of ferret badgers from Laos (Duckworth 1997, Duckworth et al. 1999), while in Vietnam the status of the two species is confused by many issues (Le Xuan Canh et al. 1997*a*; for general issues see also Duckworth and Hedges 1998*a,* Timmins et al. 1999). This specimen may represent the most southerly confirmed record of the species.

Spotted Linsang *Prionodon pardicolor* **LKL**
No evidence was found for the species during the survey.

Musser and Lunde (in prep.) found one animal in a snare at 250 m. There are few records of this species from Indochina (Schreiber et al. 1989, Duckworth 1997, Duckworth et al. 1999), or for that matter anywhere else within its world range (Schreiber et al. 1989). It seems tolerant of degraded habitats in parts of its range (Van Rompaey 1995). As it is partially arboreal (Kuznetzov and Baranauskas 1993), it is at less threat from snaring than most small carnivores.

Pig *Sus* **LKL**
Survey records: a live female and a dead male were seen in the possession of one of the wildlife dealers on separate occasions. Hair and skin remains of another were seen at the house of a different wildlife dealer. Signs of pigs, predominantly old farrowing nests, were widespread in the Rao An Tren valley, but few tracks or rooting signs were found, none of which was fresh or recent. Elsewhere signs were seen infrequently.

Pig densities are clearly well below natural levels, although they perhaps remain more numerous than the majority of other ungulates.

All wild pig species have been considered Little Known in Laos, because of the uncertainty in separation of Eurasian Wild Pig *Sus scrofa* from Heude's Pig *S. bucculentus* (Duckworth et al. 1999). On the basis of a suite of skull characteristics the two species appear to be separable; however, the range of both inter- and intra-specific variation is not fully understood and at present no external characteristics are known to separate the two species (P. Groves pers. comm. 1998-99, RJT own data). Thus, the same cautious approach taken in Laos applies to Vietnam. There are

very few positive identifications of either species from either country (Groves 1981, Duckworth et al. 1999, RJT own data). One or both species, however, remain relatively numerous (in comparison to similar-sized ungulates) in most forested areas of both countries (Duckworth et al. 1999, Do Tuoc pers. comm. 1998, Trinh Viet Cuong pers. comm. 1998, RJT own data).

†Sambar *Cervus unicolor* **PARL**
Survey records: old trophy antlers were seen in a couple of houses. No evidence was found for the species in the field.

The species still reportedly occurs. Clearly it is scarce and perhaps absent from large areas of the Huong Son Forest, as it is in many areas of Indochina (Le Xuan Canh et al. 1997*a,* Timmins et al. in SFNC/EC 1998*a*, Timmins and Men Soriyun 1998, Duckworth et al. 1999, Timmins et al. 1999).

†Large-antlered Muntjac *Muntiacus vuquangensis* **PARL**
Survey records: several trophy frontlets were seen in villages.

Field signs are not unequivocally separable from those of other muntjac species (Timmins et al. 1998*b,* Timmins et al. 1999), making status assessment difficult. However, since field evidence of muntjacs was very sparse, it is safe to assume that the species is not common and could well be scarce. The species is still reasonably numerous in some areas of Laos (Timmins et al. 1998*b*) and relatively widespread in Vietnam (Do Tuoc pers. comm. 1998, Le Trong Trai pers. comm. 1999). Nakai-Nam Theun NBCA is probably the most significant area for their conservation in Laos (Timmins et al. 1998*b*).

Roosevelts'/Annamite type Muntjac *Muntiacus* cf. *M. rooseveltorum/truongsonensis* **LKL**
No evidence was found for either of these species during the survey.

Musser and Lunde (in prep.) found remains of one immature male identifiable as this type in the Rao An area at 900-960 m (specimen AMNH#272186). A second collected juvenile *Muntiacus* specimen is morphologically unidentifiable. Animals of this type are known from the Nakai-Nam Theun NBCA and Pu Mat NR (Timmins et al. 1998*b*, Timmins et. al. in SFNC/EC 1998*b,* RJT own data). Published diagnoses of the two species are inadequate for identification, and on current knowledge probably only genetic analysis can with certainty be used for positive diagnosis of either species (Timmins in prep.*,* RJT own data). The distribution over which specimens of this type of muntjac have been taken, the range of variation of available material, and yet the small sample size of material that has been positively identified, suggest that the taxonomy and diagnosis of animals is likely to be complex (RJT own data).

Black Giant Squirrel *Rattufa bicolor* **VRB, PARL**
Survey records: common on the higher slopes, although usually only one and rarely more than two registrations in a day.

The status of this species seems to correlate more closely with that of diurnal primates than with other squirrels over many recently surveyed areas of Laos and Vietnam. In some forest areas within its range, the species has clearly been extirpated through hunting (Duckworth et al. 1994, Duckworth 1996, Duckworth 1998*a,* Timmins et al. in SFNC/EC 1998*a,* Duckworth et al. 1999, Timmins et al. 1999). Clearly it is more numerous than diurnal primates in the Huong Son Forest, and even compares favorably with other areas of Vietnam in the NAPAC (Timmins et al. in SFNC/EC 1998*a,* Timmins et al. 1999). However, the number of registrations per day was low compared with some areas where populations are probably at more natural levels (WCS 1995*a,* Duckworth 1998*a*, RJT own data).

Annamite Striped Rabbit *Nesolagus timminsi* **LKL**
Survey records: a partial skeleton was found in a snare in a snareline in the Nam Mac valley at c. 280 m.

Musser and Lunde (in prep.) found a skeleton of this species associated with a snare in a snareline in the Rao An valley at c. 250 m. Little is known of this taxon (unknown to science before 1995), which has now been found at several sites in both Laos and Vietnam (Timmins et al. in prep. *b*, R. Eve pers. comm. 1999).

4.3. Factors of concern in the nature conservation of the Huong Son Forest

4.3.1. Hunting

As with almost all forest areas in Indochina, hunting in the Huong Son Forest is widespread and locally intensive. The long-term consequences have clearly been major reductions in populations of large wildlife. The intensity of hunting is commercially motivated, although there is presumably considerable consumption of low-value species locally (see Annex 8).

As with other areas of Vietnam, there has been confiscation of guns in civilian use. No guns were seen or heard during the survey (this was also the case for the time D. Lunde and G. Musser (pers. comm.) spent in the area). Given their illegality, most guns are probably kept hidden and used sparingly. Local people reported that the use of guns was still widespread. A dead pig seen at one of the wildlife dealers had been shot. Although the confiscation of guns has probably reduced pressure on small arboreal species considerably, primate populations are clearly at low densities and are likely to be still considerably at risk from gun use (see also the account of hunting practices in Timmins et al. 1999).

Most hunting takes the form of snaring; usually snares made from single, double or triple strands of bicycle cables are set with a small (1.5-2.5 m long by 2-4 cm diameter) spring pole, in gaps (every 2-4 m) in a long drift fence (often several hundred meters in length) made from underbrush. Such snarelines were ubiquitous in the areas surveyed. Snarelines are clearly left in place for considerable periods; in some cases until spring poles become rotten and ineffective. Snaring is most intensive in the peripheral areas where snarelines can be easily reached in 2-3 hours from human habitation. It is also intensive in more distant areas, where snarelines are visited perhaps only every three or four days. In the most distant areas, excursions are made by groups of men for from several days up to a couple of weeks for a period of intensive snaring. Most people visiting the forest for other reasons (i.e., logging, fishing, and a wide variety of other NTFP harvests, etc.) probably also set snares. This is particularly likely to be the case with logging, where groups of men are camped for extended periods in localized areas, usually in interior rather than peripheral forest areas. Snares were seen being carried by men on their way to logging sites on at least two occasions, and evidence of snaring around two logging sites was seen. In two areas of the Nam Mac valley, snares had been abandoned but not disabled, and animals had continued to be caught. Snaring intensity was perhaps somewhat less than that found by Timmins et al. (1999), but of the same order of magnitude.

Snares are particularly damaging to wildlife communities because they are unselective, and very high snare densities can be achieved with minimal effort and cost to the operator. Densities of all large ground-living mammals and pheasants are probably much reduced solely as a result of snaring. Populations of a large number of species are likely to be at considerable risk from the practice, including all bears *Ursus,* big cats *Panthera/Pardofelis,* large deer *Cervus/Axis*, Saola *Pseudoryx nghetinhensis* and Southern Serow *Naemorhedus sumatraensis*. Timmins et al. (1999) suggested that

larger species may often break free from such snares, and this has been widely assumed. However, a not-fully-grown Sun Bear *Ursus malayanus* was caught by a single-strand bicycle cable on a small spring pole, indicating that these snares are effective for rather larger animals than previously assumed. Animals clearly do escape, but perhaps these are mainly older, "wiser" animals. The possibility that snaring could be reducing recruitment to some already reduced animal populations is very worrying.

Wildlife of value, particularly animals caught alive such as civets, pangolins, turtles, large game animals, and presumably more highly prized quarry and their body parts such as big cats, bears and wild cattle are largely taken by local hunters to local dealers. These are in turn visited daily by buyers from further afield (TVC). The investigation of Compton et al. (in press) of the wildlife trade importance of Road no. 8 found that a probably significant proportion of wildlife in trade coming across from Laos went directly through dealers in Trung Tam. These traders had organized schemes for transport to the north of Vietnam. They also found that the settlement on the Vietnamese-Lao border was a significant staging post. The impression gained from both the present survey results and those of Compton et al. (in press) is that wildlife trade is an integral component of the Huong Son communities, with a broad range of activities by those involved and a multitude of different routes and arrangements being used. Such is the pervasiveness of wildlife trade within the area that it will be one of the most significant concerns and greatest hurdles to overcome in conservation strategies aimed at this area of the NAPAC.

4.3.2. Logging

Almost all areas of the Huong Son Forest below c. 600 m have been logged to some extent by the Forest Enterprise, in some cases many years ago or very selectively. Continued pressure is being exerted on these and other areas by illegal logging operations. Most large trees (> 50 cm dbh) have been removed, and those that remain are mainly twisted or hollow. Within the next few years trees of value that remain will have largely been felled. In peripheral areas much smaller trees are now being removed and forest structure is quickly deteriorating. There has been a general scaling down of Forest Enterprise operations in recent years, with activity in 1999 only in one area of c. 50 ha in the Nga Doi area of Ba Mu mountain. The time at which logging took place varies between plots, but most of the lowland valleys were apparently logged in the 1970's and 1980's (see Annex 9). Although the activities of the Enterprise are now very limited, timber poaching is rife and large timber volumes are still being removed over a widespread area (Annex 8). Evidence of poaching was found in all of the major valleys. Such poaching mainly uses the routes created previously by the activities of the Huong Son Forest Enterprise. Timber is being taken from both the already-logged lower slopes and previously unlogged higher-altitude areas. Such logging appears to be mainly done by hand axes, with felled trees cut by handsaw into rectangular logs at the site. These prepared logs are hauled by buffalo along specially constructed logging trails to the lowland valleys, to await collection by lorry. In most cases these logging operations involved few people (c. 3-10 at any one time in the forest) and the selection of trees seemed to be conservative, with the proportion of trees felled in an area quite low. The Forest Enterprise logging was more intensive. There was some use of chain saws, and a road was constructed up-slope close to the logging area. There was less preparation of wood undertaken in the forest. A large number of people were involved (reportedly c. 100; Trinh Hong Minh pers. comm. 1999). A much greater proportion of the trees in an area was cut.

Despite the logging that has taken place, the Huong Son Forest is still in reasonable condition over large areas. If left as it is, it would retain considerable importance to wildlife; natural regeneration would undoubtedly restore much of what has been lost in terms of forest structure and composition. At present the direct effects of logging on the forest communities of Huong Son

are probably minimal, and certainly in the case of mammals and birds only a very small proportion of species are likely to have been seriously affected. If the forest were to deteriorate further, the effects on forest communities would become far more substantial. Unfortunately, given current trends a steady deterioration is inevitable.

4.3.3. Other forest resource uses

Short surveys are not adequate for assessing the extent and effects of the range of natural resource uses being carried out in a forest area. Generally only a small proportion of such activity is found, excepting that for timber and wildlife. Thus, findings should certainly not be taken to indicate that extraction of other forest products is low, or that collection of some such resource has not been intensive in the past. Exploitation may be localized, not obvious, undertaken at different times of the year from the survey, or involve scarce resources unlikely to be encountered during the survey.

In the Rao An Tren valley a group of about six people were involved in the extraction of an oil from the basal portions of a large species of tree with the local name Dau De (identified as *Cinnamomum glaurescens* by Nguyen Tien Hiep (IEBR); voucher specimen deposited in the IEBR Herbarium). The tree is felled and the base up to about 50 cm above ground and the large proximal sections of the roots are cut into small pieces, which are then boiled or steamed for 12 hours. The oil vaporizes and is collected by a distillation process. At the group's active base, a lathe powered by a petrol motor was being used to make wood chips. These were being boiled in a boiler c. 1.3 m diameter x 1.3 m high. A c. 8-15 cubic meter pile of processed chips lay close by, from which reportedly c. 10 liters of oil had been extracted. Two felled trees were found in the area. A previous base less than 1 km away in the upper Khe Tre valley had an even larger pile of processed wood chips, and five felled trees were found in the vicinity. The oil is apparently sold for 35,000 dong per liter. Those involved said that they came from Nghe An Province.

Also in the Rao An Tren valley 19 trees by the local name of Cay Nha (voucher specimen deposited in the IEBR Herbarium) were found cut down with their bark removed. The bark is apparently soaked in water and then crushed to extract a latex-like substance used for bird liming. This bird lime is apparently sold in coastal areas rather than locally. The activity appeared to be from one group of people encountered during the survey who had been working their way in a systematic manner through the forest. Soaking bark which they had left for later collection was found at one place in a small stream.

Other resources such as fan palm leaves and rattan are clearly collected, but little useful information on such exploitation was collected during the survey. Rattan harvests have apparently been so heavy that now harvesters go to Laos. Other valuable forest products such as *Aquilaria* resin are now reportedly rare.

Aquatic life, particularly fish, are heavily exploited. A large number of riverside camps with signs attributable to fishing (fish remains, discarded nylon lines and fishing nets) were seen during the survey. Riverine environments are suffering as a result of this direct exploitation and other human activity. Rivers are a focus for humans in the majority of forest uses; the mere act of camping leads to degradation since firewood, an open place for the campsite, and materials for the campsite are required. Furthermore, people tend to damage vegetation to an extent greater than required. Campsites are ubiquitous on all rivers and larger streams in the Huong Son Forest.

4.3.4. Cultivation of lowland valleys

Recently cleared land for agriculture was seen in the Nam Mac, Nga Doi, Song Con and Rao An valleys. In all cases, tall secondary growth/secondary forest (3-6 m high) had been cleared; that in the Rao An had probably been the most valuable to wildlife. The Huong Son Forest

Enterprise has sanctioned the use of c. 20 ha in the Nga Doi area for agricultural land for three or four households, 30 ha in the Nam Mac valley and 10 ha in the Rao An valley (Trinh Hong Minh pers. comm. 1999). The land in the Rao An has been specifically for staff of the Forest Enterprise. Clearance of the lowland valleys is not only a serious loss of a regionally threatened habitat, but it also threatens the integrity of the Huong Son Forest. With the lowland valleys cleared, the remaining forest will become dendritic in shape, with considerably reduced value for nature conservation.

4.3.5. Vegetation deterioration and loss

In contrast to many areas of Indochina, conversion of forest slopes to agricultural land does not seem to be a problem, with no evidence found during the survey. However, vegetation is being lost in other ways, of which logging as discussed above is but the first stage. As one moves east down the Song Ngan Pho valley there is a deterioration in forest condition to secondary growth, to scrub, and eventually to grass. Much of this deterioration after the removal of timber seems to be due to the extraction of fuelwood. Wood is the dominant domestic energy source in the area, and fuelwood was the main resource seen being carried out of peripheral degraded areas during the survey. The extraction of wood-based construction materials also probably contributes to this degradation, although to a lesser extent. At current levels, continued deterioration of logged forest, rather than regeneration, is predominant. This poses a serious threat to the long-term integrity of the Huong Son Forest.

4.3.6. Road No. 8

Road No. 8 bisects the Huong Son Forest and the adjacent forest area in Laos, and thus forms a potential barrier to animal movement between northern and central forest areas of the NAPAC. Nowhere is there continuous tree canopy cover across the road. In the c. 16 km of road up to the international border with Laos, steep slopes mean that the road cutting itself serves as a significant barrier to all but species that can scale near-vertical slopes, fly or glide. Several road maintenance crews were based at stream crossings, but there was no indication of major impacts from the camps (there is some localized pollution of the streams and local vegetation damage) or from the work being carried out. The road is old and well established, and there was little evidence of slope instability and associated environmental impacts such as siltation of rivers, except for a single area of landslide. The Huong Son Forest Enterprise has a small camp at 6045 IV 220362 for activities in the Nam Sot area.

There has clearly been some development of the Vietnamese international border post and international border crossing area in recent years. A new impoundment was being used to store cars at the time of the survey. A small community, based on income from cross-border traffic, has grown up around the international border post. The scope for further expansion of either the official border area or its associated community is limited by the nature of the terrain. A potential problem for the local area is the need for fuelwood, and the disposal of waste from the community.

A power line is being constructed that will reportedly follow the road over to Laos, seemingly to the Nam Phao hydroelectric power plant just across the international border in Laos. There are no other signs of development along the road between Nuoc Sot and the international border post, and the forest area abutting the road is in reasonable condition.

4.3.7. Use of Lao resources

All Huong Son locals who were asked about their use of the forest talked either of going to Laos themselves or of close associates who had done so. Forest resources were said to be more plentiful there. Some of the more notable accounts included a Huong Son resident going to the Nakai Plateau for hunting where an attempt was made to kill an elephant, and the organization of a

group of almost 100 people for an intensive three-day collection of rattan in the Nam Pheo area. Working in Laos one gets the feeling that Lao international border areas are predominantly used by Vietnamese nationals (Timmins and Evans 1994, Tobias 1997, Robichaud 1999, Robichaud and Stuart 1999).

There are very worrying implications of Vietnamese exploitation of Lao resources. Resources in Vietnam must be extremely depleted, perhaps to the point of there being doubt as to whether any conservation strategies could assist in their conservation. If Lao resources become similarly depleted, the potential for recovery of natural ecosystems in Vietnam, and nature conservation in the northern Annamites as a whole, is put into serious jeopardy.

5. Regional importance of the Huong Son Forest for nature conservation

5.1. Biogeographic importance and forest consolidation

Annamite endemicity is widely known (i.e., Stattersfield et al. 1998). There is growing evidence to suggest that many of the bird and mammal species with distributions centered on the Annamites have ranges limited to or predominantly on the eastern Annamite slope or eastern lowlands (see Annex 10). Contrary to this, few if any bird and mammal species with a predominantly Annamite distribution have natural distributions centered on the western slopes or lowlands. This is presumably strongly correlated with the greater and less seasonal rainfall on the eastern side than on the western side (Section 2.1.). Thus for conservation, particularly of restricted-range species, the Vietnamese forests have a higher importance that the Lao forests, and protecting Vietnamese forests has a higher priority than protecting areas further west in Laos. Furthermore, the percentage of ancestral Annamite habitat remaining in Laos is greater than that in Vietnam.

Indochina has variously been subdivided into several ecoregions (Mackinnon and MacKinnon 1986, Wikramanayake et. al. 1997), but most bird and mammals species of dense forest habitats, including a large proportion of the "Annamite" restricted-range species and many Key Species, are found throughout the Annamites. Bird and mammal species, by comparison with other taxonomic groups, require large areas. The largest continuous area of habitat in the Annamites is clearly in the northern Annamites (Section 2; Wege et al. 1999, RJT own data on the basis of a variety of personal observations and those of acquaintances and depiction of vegetation from various sources). Thus, the main focus for the protection of these species should be in this northern block. However, there is still a need to protect representative areas in the central and southern Annamites, because of their minor differences in communities, reflecting biogeography.

Although not very large, the Huong Son Forest is still a significant area of eastern Annamite forest. It has added significance because of its continuity with an even greater extent of similar habitat. Protection of the Huong Son Forest will consolidate the central unit of the NAPAC. This complex almost certainly encompasses the single most important landscape of Annamite habitat, and probably also of eastern Annamite slope habitat (with the possible exception of the northern block of the NAPAC).

5.2. Lowland forest habitat conservation

Lowland forest, and in particular forested lowland river valleys, are one of the most threatened habitats in Southeast Asia (Round 1997, Thewlis et al. 1998, Timmins and Men Soriyun 1998, Duckworth et al. 1999, Wege et al. 1999). There is heavy pressure from the human population for agricultural land, permanent settlement and temporary camping on watercourses and harvesting central and northern blocks of the NAPAC. Almost everywhere else in the NAPAC, forest cover

Table 3. Lowland river lengths in Vietnamese areas of the NAPAC.

Area	Length of River*	Notes
Huong Son Forest	c. 53 km	An additional 27 km of relatively gentle flowing river above 500 m, none of the other areas has such habitat to any great extent
Phong Nga-Ke Bang NP	c. 8-29 km	Most rivers seasonal, broken by limestone topography and heavily degraded.
Pu Mat NR	c. 100-165 km	Most rivers in very steep-sided valleys
Vu Quang NR	c. 50-78 km	19 km is in Khe Tre valley, which is linked strongly to the Huong Son river system

*Altitude below 500 m, stream sizes averaging over 3 m wide, based on 1: 50,000 topographic maps, and prior experience of the authors in the region.

of aquatic resources. Combined with the ease of access, this means that few if any lowland river valleys in the evergreen forests of the Annamites remain in a relatively undisturbed state. In Laos, rivers with only minor disturbance are still relatively widespread, while in Vietnam they have been lost to a considerably greater extent (except for some westward-draining catchments in the south; Duckworth and Le Xuan Canh 1998). Because of the apparent differences between the east and west sides of the Annamites, conserving lowland valleys in Vietnam is probably a greater priority than attending to those to the west. Although the number of Threatened and/or restricted-range bird and mammal species predominantly centered on lowland rivers is relatively small, the importance for organisms in other taxonomic groups may well be much higher. One species in particular, Lowe's Otter Civet *Cynogale lowei*, deserves consideration. The species is known only from a single specimen collected in Tonkin (Schreiber et al. 1989), and it was considered in a global review of mustelids and viverrids, along with only one other species, to rank of the highest order of concern (Schreiber et al. 1989). Its only congener, Sunda Otter Civet *Cynogale bennettii,* is also relatively little known. It seems to be strongly associated with wetland habitats, probably over a wide altitudinal range (Schreiber et al. 1989). The two taxa are listed, conspecifically, as GT-EN by IUCN (1996). It would not be over-dramatic to assume that quite possibly it is the most threatened species of small carnivore in Indochina, and that eastern Annamite forest could be its principal refuge. The Huong Son Forest has a concentration of lowland river valleys totalling c. 53 km, which although degraded and not perhaps seemingly significant, compare favorably with the amount in other eastern Annamite protected areas in the NAPAC (Table 3). There is still the possibility of good continuity of wildlife populations in three of the main river valleys in the Huong Son Forest. Recovery of habitats would not be beyond hope.

5.3. Habitat continuity in the NAPAC

The Huong Son Forest is a vital link at what is probably the weakest point in a huge contiguous area of forest habitat. The Huong Son Forest, along with that at the northern edge of Nakai-Nam Theun NBCA and the southern edge of its proposed extension, forms an isthmus between the

remains more extensive in Laos than in Vietnam. By contrast the Huong Son Forest forms the greater part of the habitat of this isthmus. Furthermore, the continuity of forest north and south of the road on the Lao side of the international border is certainly becoming more tenuous. Development of a hydropower project, commercial warehousing and considerable habitat clearance for slope agriculture are all reducing its area (Timmins and Evans 1994, IUCN 1997, Robichaud 1999, RJT own data). Due to the pressures being exerted on the Huong Son Forest within Vietnam, this habitat isthmus is in a precarious position; at no other point in the northern and central NAPAC areas is pressure on natural resources so directly concentrated on opposite points across the Vietnamese-Lao border. Because of its position, the Huong Son Forest could take a significant role in the long-term conservation of the NAPAC as a large functioning ecosystem. Preservation of the Huong Son Forest will go a long way toward maintaining continuity of forest communities in the northern and central units of the NAPAC along the Annamite spine.

Protection of several separate habitat blocks could in many cases be less efficient than protecting the same amount of habitat (or even less) in a single area. Particularly with respect to management resources, greater imput would be required. Because of the level of natural-resource exploitation in Indochina, large blocks of forest habitat are often significantly richer in quarry species than are small, easily accessible areas. Pressure on natural resources in a protected area is generally concentrated around the perimeter, so that larger areas tend to have a proportionally larger "little-visited" core area. Thus, large areas are partly self-protecting, particularly if a substantial proportion of their habitat is a day's walk or more from human habitation. The non-linear relationship of total area to its perimeter also favors the protection of large areas over smaller ones, because given the same rate of incursion per unit of perimeter, larger areas on average will have a lower pressure to area ratio than small areas. The larger the area, the greater a species' population, and thus the greater its potential buffer to adverse effects. The latter three factors are likely to be important, particularly in large carnivore populations that are at naturally low density (Woodroffe and Ginsberg 1998). Given that conservation efforts are generally limited by resources, this indicates greater efficiency through concentration on a few large areas.

5.4. Large mammal conservation

If Vietnam has any aspirations to conserve populations of very large mammals (wild cattle *Bos/Bubalus,* Elephants *Elephas maximus* and Tiger *Panthera tigris*) in the long term, the NAPAC probably offers the greatest potential and most effective area for their conservation. There are two necessities for very large mammal conservation in Indochina: protecting remnant populations and preserving large blocks of habitat. The NAPAC is one of few areas with more than a handful of such species, and one of the few areas of large size. The only comparable site in Vietnam is the international border area of Vietnam, Laos and Cambodia, and perhaps the Yok Don NP and adjacent Cambodian area. Although some small areas may be able to maintain small populations, particularly of Asian Elephant, the limitations of area pose considerable problems in the long-term management of such populations. Given current trends, considerable habitat loss is still likely throughout the protected area systems of Indochina, but there is a strong likelihood of the core area of the NAPAC remaining largely continuous (of which protection of the Huong Son Forest is a factor). This is less likely with areas in the central and southern Annamites. The significance of the NAPAC for very large mammals largely lies in Laos, where populations, although far from healthy, are certainly more substantial than in Vietnam. In Vietnam, including those forest areas of Vietnam in the NAPAC, populations of very large mammals are so small that many will be lost before conservation becomes effective. Remnant populations in Laos, if they can be preserved, will be the basis for the recovery of the species in Vietnam in the future. Given current trends in the NAPAC, in the future remnant populations will only remain in the central unit,

restricted to areas within Laos. In such a scenario, potential natural recovery of populations in the northern unit will be facilitated by the Huong Son Forest corridor. Increasing realization of these facts among conservation agencies in Vietnam warrants several approaches: (1) protecting remaining areas of habitat and guarding against fragmentation; (2) drastically reducing hunting pressure in remaining habitat; and (3) collaborating wholeheartedly with Laos on a multi-faceted strategy to preserve selected populations of large mammals in Laos.

The benefits of habitat continuity and total area are more easily envisioned for the very large mammals, but similar positive effects are likely for many other species. For example, the best encounter rates for primates in Laos have been in the largest areas of habitat. In three recent surveys in the NAPAC of Vietnam (including the current survey) calling frequency of gibbons was highest in the Ban Cha Lo area at the northern extremity of Phong-Nha Ke Bang, a relatively thin belt of forest in Vietnam, but contiguous with the core of Nakai-Nam Theun NBCA in Laos; intermediate in the Pu Mat Nature Reserve, which is a relatively more substantial area of forest in Vietnam, but abuts a narrower strip of habitat in Laos; and very low in the Huong Son Forest, which abuts only a thin strip of forest in Laos, and within which gibbon density is certainly low. Although these findings probably reflect a variety of factors, correlation with the area of remaining habitat (irrespective of the international border) should not be discounted. Theoretically, for population viability large habitat areas and corridors are likely to be important for all taxa (however immobile), at least in the very long term, especially in consideration of global climate changes.

5.5. Catchment protection

The Huong Son Forest encompasses much of the upper catchment of the Song Ngan Pho River (a part of the catchment lies within Vu Quang NR). As such, the Huong Son Forest provides catchment protection for a relatively large area of the Song Ngan Pho River lowlands. As in other Vietnamese lowlands, irrigated rice cultivation dominates.

5.6. An aid to conservation of adjacent contiguous Lao forests

Pressure on Lao forests is increasing as forest diminishes in Vietnam, at least partly because of the massive demand for natural resources that Vietnam exerts. Protection of a strip of forest along the international border in Vietnam is likely to help nature conservation efforts in adjacent Laos significantly. This will allow conservation action, initiatives and effort in both countries to be more effective in the future.

5.7. A biological benchmark for the future

The scientific value of the biological work that has been carried out to date in the Huong Son Forest is of some significance to conservation in the area. When fully analysed and published or deposited in accessible databases, these data will make the area one of the very few in Indochina with extensive systematic work covering a range of faunal groups. This accumulation of data gives the Huong Son Forest a benchmark status, with considerable potential for monitoring and comparative purposes. Loss and deterioration of such a benchmark site will slow the progress of understanding the Annamite ecosystem.

5.8. A cautionary note

Protecting the Huong Son Forest should not detract resources from the conservation of the existing protected areas within the NAPAC. The Huong Son Forest in its corridor and forest consolidation role only has value if the forest areas with which it connects remain largely intact and well protected.

5.9. Comments on Wege et al. (1999), Ling (1999) and Wikramanayake et al. (1997)

The concepts, analysis and conclusions of Wege et al. (1999), Ling (1999) and Wikramanayake et al. (1997) all have relevance to the conservation significance and priority of the Huong Son Forest in a national or regional context. There is particularly a need to discuss the former two projects (Wege et al. 1999, Ling 1999), both based on objective processes, since using their rationale one might conclude that conservation and active protection of the Huong Son Forest would be a low priority. Wege et al. (1999) gives an assessment of the needs of the protected area system of Vietnam, based on equal representation in relation to ecoregions (ecological regions), habitat type, elevation, threatened species and provinces. Ling (1999) considers the prioritization of protected areas in Laos on the basis of complementarity and ordination of bird communities and other biotic factors. Wikramanayake et al. (1997) mapped ecoregions for South-east Asia, and between 1997 and the present various versions of an "ecoregion map" have come into wide circulation in the region. (Note that the text of Wikramanayake et al. (1997), which apparently explained the mapping process, has not been seen by the present author.) The many versions of the maps in circulation up to the end of 1999 were drafts (E. D. Wikramanayake, J. Morrison and C. Loucks pers. comm. 1999), but unfortunately this was not stated on them, nor was any significant indication given on the maps as to how the ecoregions were defined. As of May 2000 the ecoregion map was said to be finalized (C. Loucks pers. comm. 2000); however, justification and adequate data sources for the drawn ecoregion boundaries were still lacking from the maps.

The general conclusions of both Wege et al. (1999) and Ling (1999) concur with what is intuitively obvious, but some consideration is required of the rationale behind and application of some of the detailed recommendations. This is particularly the case with respect to one of the main statements of Wege et al. (1999) that "the Northeast Indochina Montane Forest Ecoregion [in which the Huong Son Forest lies] . . . should be considered a low priority for further protection." Although Ling (1999) is specific to Laos, the case could be made for rationalization of the Huong Son Forest's priority using the same methods; on the basis of a complementarity and ordination analysis one might assume the Huong Son Forest to be a relatively low priority, when set within the existing protected areas.

National-level analyses (on which both Wege et al. (1999) and Ling (1999) were based) are only really appropriate for nationally orchestrated initiatives; most interest, funding, conservation organization, and expertise is governed by an international approach. Representation needs and prioritization of a country's protected area system may differ radically between global and national biodiversity conservation approaches. From a national perspective, equal representation of species, habitats or ecoregions may be warranted. But from a global conservation perspective (applied nationally), equal conservation weighting of a small area(s) of an ecoregion with marginal occurrence in the country (and with much better representation in other countries) and areas of an ecoregion largely or solely confined to the country in question can rarely if ever be justifiable.

The conservation importance and priority of different ecological regions (ecoregions) is almost certain to differ between them. Thus there is a need when using ecoregions in an analysis, such as that of Wege et al. (1999), to weight areas in terms of factors that potentially vary between different ecoregions, and thus affect importance and priority. The main factors are likely to be:

- the number of shared taxa (thus uniqueness) between ecoregions;
- the number of defining elements for an ecoregion;
- the level of threat facing ecoregions and their defining elements;
- the potential for effective conservation strategies; and
- the conservation needs of species and habitats.

Thus all ecoregions are not of equal value for conservation purposes, and equal representation in a protected area system is not necessarily justifiable. These general thematic considerations are more than minor concerns against the application of representation analyses. Furthermore, at least in Indochinese ecoregions, the vast number of bird and mammal taxa (and therefore presumably taxa from other taxonomic groups) will be shared in similar abundance over several ecoregions. One consequence is that for conservation of many species an approach over several ecoregions could be considered, concentrating on protection of a suite of shared species in one ecoregion rather than giving equal protection in the ecoregions in which they are found. In a theoretical example of a suite of species found in both Ecoregions A and B, the measures needed for their conservation may be most appropriately concentrated in Ecoregion A (for example a larger continuous area of habitat exists in Ecoregion A than in Ecoregion B, and there is better long-term conservation potential for political reasons in Ecoregion A) and a large protected areas network established there. If this protected areas network also protects the defining biological elements of Ecoregion B, the combined conservation value based on shared A and B species and defining Ecoregion A species of the protected area network in Ecoregion A could be higher than the value of the most expansive protected areas network feasible in Ecoregion B (particularly if shared A and B species and defining Ecoregion B species could not be protected within the same areas in Ecoregion B). Thus there would be justification only for minimal protected areas in Ecoregion B, to cater for the needs of its defining Ecoregion B species.

By the principle of equal representation of c. 16 % of natural habitat, Wege et al. (1999) suggest that the 95,924 ha of protected evergreen forest (which represents 8 % of the total) in the Kon Tum Montane Forest Ecoregion area should be increased, but that the 89,192 ha of protected evergreen forest (which represents 25 % of the total) in the Northeast Indochina Mountain Forest Ecoregion does not require increasing. However, it does not logically follow that the evergreen forest ecosystems of the Kon Tum Montane Forest Ecoregion require a larger area than those of the Northeast Indochina Mountain Forest Ecoregion to ensure their long term survival; probably they do not. In deciding priorities for protected area establishment, the actual empirical area is more important than its percentage representation. Weighting to the area requirements of the faunal and floral elements (themselves weighted on their uniqueness to the ecoregion, their conservation status or other factors) is a further factor that should not be ignored; if it is, the resulting priorities are unlikely to be in the global interest. The Northeast Indochina Mountain Forest Ecoregion probably has more viable very large mammal populations and probably a more viable Saola population than the Kon Tum Montane Forest Ecoregion. On these grounds, a larger area is probably warranted in the former.

The same need for weighting is true for the complementarity and ordination approach used by Ling (1999). Complementarity treats each constituent as equal, but the conservation needs of all species (or habitats) are not equal. Areas ranked high by complementarity or as out-groups by

ordination may not be the most appropriate areas for the protection of the species that gave the areas their uniqueness. The species that give a high uniqueness rating to an area might not be those of highest conservation value, and they might not require much in the way of conservation measures. In contrast, species of high conservation concern might be best protected in an area of low complementarity rating. Based on complementarity, adding an area to the protected area system with very similar fauna to existing areas will be afforded low priority compared with adding an area with quite different, "novel," faunal elements. However if one proposed addition (already represented in the protected area system) were an area of eastern Annamite forest with known populations of Saola, Crested Argus, Nesolagus, Owston's Civet, and similar species, and the other, "novel" (poorly represented in the protected area system) proposed addition were an example of a widespread Southeast Asian degraded forest fauna (or rice paddies and eucalyptus plantations), their priority in terms of global conservation needs would be quite the opposite.

An ordination analysis such as that of Ling (1999) separates areas based on the differences in their species assemblages. Areas with similar assemblages will group together. Ling (1999) used such groupings to further prioritize among areas (after complementarity analysis) on the premise that selection of areas from different groups gave better biological representation in the protected area system than selection of areas from the same group. However, addition of the Huong Son Forest to the protected area system, which in an ordination analysis is likely to group very closely with Vu Quang and Pu Mat NRs, is probably better interpreted as beneficial, since it increases coverage of the eastern Annamite slope species assemblage and consolidates existing areas, rather than something to be avoided in preference for an area with a dissimilar species assemblage (particularly if that area covered a species assemblage of low conservation priority). A further potential pitfall to ordination analysis is that sites with a missing component of species relative to other sites, or novel combinations of species components otherwise better represented elsewhere, can potentially form groupings in the same manner as sites with a number of unique species components. Whether this type of novelty of assemblage should be accorded conservation priority at the same level as that to assemblages with unique species components of high conservation concern is debatable.

Ling (1999) discusses some of the limitations of his approach, but their potential effects on the results are not fully considered. Differences between the efforts used to obtain the data from different areas in the analysis may have more considerable effects than suggested, particularly when observer differences or biases are considered. These effects are further confounded by the arbitrariness of species recorded, especially non-obvious and migratory ones.

The effect this might have on prioritization can be seen, for example, in the difference in rank of Bolaven Southwest PNBCA between table 3a (ranking of (P)NBCAs on the basis of confirmed Key Species of birds from each) and 3b (ranking of (P)NBCAs on the basis of confirmed and provisional Key Species of birds from each). Between the two tables, four (of 20) areas changed rank, by an average of four ranks; Bolaven Southwest PNBCA changed 8 ranks. Another example can be seen in the many differences in ranking between tables 4a and 4b (respectively: ranking of (P)NBCAs on the basis of confirmed Key Species of mammals from each, and ranking of (P)NBCAs on the basis of confirmed and provisional Key Species of mammals from each. Between the two tables, 20 (of 25) areas changed rank, by an average of four ranks.

In Indochina, the difference between the number of confirmed species and the combined number of confirmed and provisional species recorded from an area is likely to be of similar magnitude to the difference between the number of confirmed species and the actual number of species present in an area. In fact, the latter is likely more often than not to be higher. The possibility that ranking of areas (based on incomplete species lists), particularly those of intermediate ranking (those more

likely to have incomplete lists), could well differ quite substantially based on which species have been recorded cannot be overlooked from a conservation standpoint. Some threshold will inevitably be employed when picking areas for management. Neglecting a protected area because it ranked below others due to an arbitrary quirk of the data must be a serious concern.

A second significant limitation to Ling's (1999) approach is the arbitrariness of the areas used in the analysis. If, for example, the highest priority area, Nakai-Nam Theun NBCA, were sliced in two, the individual priorities of these two new areas would probably drop down the scale. Clearly, selection and delimitation of areas depends on an ultimately subjective process, which alone indicates that the results must be modified subjectively. Future selection of a large area of degraded habitat (proposed through other means) would take on a high priority if previous selection of areas (and survey effort) has concentrated on areas of little-degraded habitat. Few people would consider this desirable; the extreme example is given to indicate the dangers of the concept.

Of particular importance to the conclusions of both approaches are the limitations of conservation reality within Indochina. Financial resources, national and international capacity, and political and cultural will are major limiting factors in a fight against the short-term profitability of natural-resource exploitation and burgeoning population pressures. Trade-offs will have to be made. Achieving viable protected areas systems will be a major challenge, but consolidation of large blocks of remaining habitat as one of the primary focuses is likely to be more effective than an approach based on attempting complete representation of species, leading to a system with numerous and often small blocks of habitat.

The purpose of this foregoing discussion is not to discredit the objective approach of Wege et al. (1999) or Ling (1999). It is to point out the need for subjective assessment (as is attempted in this report) of any such analyses on an area-by-area basis.

Lastly, some comment is required on the applicability and utility of the zonation of biological communities (as ecoregions) given by Wikramanayake et al. (1997) in the northern Annamites for conservation planning and prioritization in the NAPAC area. Understanding and identifying ecological units, particularly large-scale units of ecological similarity, is fundamental to global biodiversity conservation. Such ecological regions have been widely used in protected area system planning and prioritization; for example, Wege et al. (1999) used Wikramanayake et al. (1997) for Vietnam, and in Laos Berkmüller et al. (1995*a,* 1995*b*) used MacKinnon and MacKinnon (1986); then Ling (1999) used the updated MacKinnon (1997). However, there are pitfalls to the non-subjective use of such ecological regions in further analyses. One of the major handicaps to the application of ecological regions to a conservation area system needs and prioritization exercise is the very delimitation of the ecological regions. Delimitation will always be to some degree arbitrary (and thus subjective) because strict associations of species with geographic, climatic and edaphic factors, and with perfect overlap with other species in their respective distributions, are unlikely to be found. Thus species and communities present in any small area will rarely if ever be identical throughout a larger ecological region.

Wege et al. (1999) state that the ecoregions of Wikramanayake et al. (1997) on which they base their analysis "may require redefinition." This would appear to have been the case, since ecoregions have been revised considerably since then. Such revision is of serious consequence to the analysis of Wege et al. (1999), whose results already require considerable clarification in light of this. Worryingly, the apparently finalized ecoregion map of May 2000 had ecoregions that often did not follow intuitive floristic patterns (P. Rundel pers. comm. 2000), nor obvious bird and mammal faunal patterns (RJT pers. obs.). It is, however, impossible to make a sensible critique of

the map without having access to the data upon which it is based. Equally, it would be inadvisable to use such an ecoregion map as the basis for any analysis. A case in point, based on the version of the ecoregions used by Wege et al. (1999): Vietnamese areas of the northern Annamites are mapped as being part of two ecoregions (Northeast Indochina Montane Forest and Annamite Range Moist Forest) and probably in reality areas of a third (Northern Vietnam Coastal Moist Forest). However, limestone elements within these three ecoregions are probably more similar to each other than to other forest types either in their own or a different ecoregion. Such similarity probably exists between the evergreen forests of the three ecoregions, once altitude factors are taken into account. Based on current knowledge, evergreen forest bird and mammal species are likely to be present at similar abundance in all three ecoregions (except for human-related factors), once elevation has been taken into account. On the basis of bird and mammal communities, limestone would be better considered an ecoregion rather than as one of the subdivisions of an ecoregion, and evergreen forests of the three ecoregions amalgamated into a single ecoregion, with perhaps subdivisions based on elevation.

The identifying elements and boundaries of ecoregions need to be defined; currently they do not appear to be. Without such background data, weighting of ecoregions and individual areas within ecoregions is not fully possible. An element of transitional zonation would also help in the definition and use of ecoregions. This would allow the importance of areas in transition zones to be more easily relatable to respective ecoregions, and thus give a more appropriate representation. Perhaps more importantly, the core area(s) of an ecoregion, within which the defining biological elements are at their most pronounced, would be clearly identified.

6. Recommendations

Recommendations are given for what is thought to be optimal for nature conservation within the Huong Son Forest in the roles outlined in Section 5. It is also assumed that adequate resources are available for the conservation of the main protected areas within the NAPAC, and that conservation strategies in these areas will become effective before substantial loss of habitat occurs. Conservation of these areas takes precedence over that of the Huong Son Forest. The recommendations are meant as guidelines for the direction in which conservation should proceed if both authorities and local communities alike are eager and able to participate. There was no scope within the project to look outside the narrow confines of a biological assessment; socio-economic factors, current political thinking, relevant legislation, and commercial interests have largely not been taken into account. All are clearly important considerations, however, for the direction in which nature conservation in the Huong Son Forest will proceed. Clearly, much depends on the future intentions of the Huong Son Forest Enterprise and their willingness to look beyond current practices.

Detailed recommendation for gazettement and the management framework and scheduling cannot be given, neither can clear guidelines be given for prescriptive activities to counter the many threats to the area.

6.1. Formal designation and protection of the Huong Son Forest to consolidate the central unit of the NAPAC, and as a habitat corridor in the NAPAC

How to achieve a protected status to benefit nature conservation is outside of the scope of this report. The main consideration to note is that designation and management of the Huong Son Forest should reflect its role as consolidation of an existing block of protected and proposed protected areas, and as a corridor. Thus it may well require measures and rationale quite different from other protected areas in the region.

We are not in a position to determine the most suitable protecting authority. If the Huong Son Forest Enterprise wishes to keep an interest in the forest area, there is a precedent in the case of Tan Phu in the south of Vietnam (Osborn and Vinton 1999 and references therein).

The boundary proposed in Figure 2 has been based on observations made during the survey. For conservation of the Huong Son Forest, the greater the area of habitat incorporated the better. Thus, areas of highly modified habitat have been incorporated. Such areas are not beyond recovery and could become important components of the protected area. The most crucial of such habitats proposed as part of the protected area are the degraded forests in the Nuoc Sot area. Every effort should be made to incorporate this habitat.

The Huong Son Forest does not have a higher conservation value than existing protected areas in the NAPAC, and its value is directly related to the effectiveness of nature conservation within the other protected areas. This must be central to the development of the Huong Son Forest for nature conservation. Management of the Huong Son Forest should not require the same high level of resources as a protected area focusing on biodiversity conservation. Instead, a strategy requiring low external resource use should be developed.

6.2. Concepts and raising awareness

Because the function of consolidation and corridor is as relevant to adjacent forests as it is to the Huong Son Forest itself, there is a greater requirement for widespread recognition (both geographically, politically and culturally) of the area's conservation importance to ensure that it does not become a protected area in isolation.

It is important to recognize, especially within Huong Son district, that protecting the forest for nature conservation is a positive step and should be viewed as a potential benefit for all. Equally, it should be recognised that the goals of nature conservation should be respected. Abuse may have short-term benefit for the individual, but the loss would be great. The area will not conserve itself; government and local communities alike will need to put in effort and forgo short-term gains.

There seemed a widespread belief among Huong Son residents that they were relatively less well off than those in the rice-growing lowlands. Living in a predominantly forest area was considered second-rate, with diminishing options for the future, compared to living in the major rice-growing areas of the coastal lowlands. Although it seemed a common concern that local people in the vicinity of the forest do not have alternative livelihoods to forest exploitation, it should not be forgotten that a large proportion of the rural population of Vietnam does not have the luxury of forests and their relative bounty of natural resources. It is inevitable that in the not-too-distant future, Huong Son Forest resources will be largely exhausted if no alternative course of action is taken. Changing practices now is a more viable option than putting such actions off until there is no choice; by such a time, many possibilities will have closed.

Huong Son also has the added advantage of Road No. 8, which very likely could become one of the major overland routes between central and northern Vietnam and Vientiane and northern Thailand. Revenue from cross international border traffic could be considerable (however, note point 6.7. below).

6.3. Potential material benefits to Huong Son district of protecting the Huong Son Forest

There are clear benefits from sustainable use of the forest. However, this is an option that perhaps should be explored only if and when reasonable protection has been achieved and current over-exploitation has been halted.

The presence of a protected area adjacent to a major tourist route could have considerable ecotourism potential. Of particular significance in this respect is the path of Road No. 8 through good forest on what is a very scenic drive. It is and should be seen as a considerable asset, and its potential for ecotourism should be utilized to the full (but note point 6.7. below).

Districts with intensive commercial agriculture in the Song Ngan Pho River basin should perhaps pay a levy toward the catchment protection value of conserving the Huong Son Forest. The Huong Son Forest is clearly in a transitional phase. Its catchment value is equal in magnitude to that of sustainable logging and nature conservation. With logging coming to a close, an uncertain future and little precedent for effective conservation, the potential catchment value of the Huong Son Forest should be used to the full in realizing its protection; a levy for this value is justifiable.

6.4. Recommendations for nature conservation

As the primary conservation importance of the Huong Son Forest is in a consolidation and corridor role, the focus of protection should be on habitat conservation, with effort concentrated on valley bottoms rather than mountain tops.

Habitat is lost by encroachment at the edges, i.e., the lower altitudes. Thus there should be immediate development of effective initiatives to prevent encroachment. Intensive environmental education, widespread project awareness, continuous monitoring and active forest protection are all equally important and in combination stand a chance of success. Unlike in the majority of protected areas, where maintenance of a core area is often the priority for nature conservation, the priority in Huong Son Forest should be protection and maintenance of edge habitats. Priority for protection in edge areas should be the lowland riverine valleys, as they are particularly threatened ecosystems (as discussed in Section 5).

The edge should be defined as a strip extending 1 km in from the designated boundary. All river valleys below 500 m altitude should be considered edge to a distance of 500 m on either side of the river. One km on either side of Road No. 8 should also be considered edge.

The forest edge should be the barometer of the project's effectiveness.

All removal of timber, firewood and other wood-based construction materials needs to be phased out as soon as possible in edge areas. Equally important, however, is that viable alternatives be found for firewood and small-scale wood-based construction materials. Thus, better utilization must be made of areas of extensive secondary growth outside the designated boundary. In Indochina, assisted regeneration is a much more viable approach to providing alternatives than plantation. (P. van der Poel Gesellschaft Fuer Agrarprojekte Coordinator pers. comm. 1999). Innovative alternatives in fuelwood efficiency and building techniques are likely to be as important as establishing sustainable sources for use with current practices.

Utilization of timber should come under a forest-wide plan for its sustainable use. In edge areas, however, there should be no timber removal for the foreseeable future.

Locals should be allowed to use the river valleys for such things as non-intensive fishing, but on a daily basis. Overnight camping should be phased out in the river valleys.

Although obviously only a recent development, the clearance of secondary and degraded forest habitat for agriculture in lowland valleys poses a significant threat to the integrity of the lowland valleys. If at all possible no further habitat should be cleared, and those recently cleared areas (which are relatively few) should be abandoned and allowed to regenerate. The relatively small loss in agricultural land is a small price to pay for the integrity of the lowland valleys.

It would be useful for good aerial photography and satellite landcover data to be gathered and used to map current edge habitats. These data should be one of the bases for monitoring the project. The emphasis should be on mapping that uses biological, rather than forestry-based, landcover criteria. It is probably also pertinent, if data are available, to assess forest loss and degradation in the recent past and the relationship of these practices with socio-economic data from the same period, particularly in determining the likely rate at which wood extraction can be phased out and in assessing the various alternatives to the extraction of wood-based resources from the edge. Neither of these tasks should be an undertaking of the protecting authority; instead they should be solicited as a research project undertaken by a foreign scientific institution (with its own funding), with emphasis on empirical investigation and formulation of outputs for more effective management of the Huong Son Forest.

Although habitat conservation is the most important immediate goal, hunting represents a serious threat to wildlife of the area. Hunting of selected species should be phased out as soon as possible, and guidelines developed for sustainable use of wildlife resources. As with habitat conservation, hunting control activities should be concentrated on the edge and especially in the river valleys. As with habitat encroachment, hunting is most intensive in peripheral areas.

Of the hunting methods practiced, snaring is the most devastating and should be banned, and the activity phased out as soon as possible. Enforcement will be aided by the fact that snares are relatively easy to find and collect. Although relatively cheap, the cost of snares is a consideration in a hunter's finances, and the repeated loss of snares is likely to be a significant deterrent. Such enforcement by the confiscation of snares will not stop the hunting of highly prized quarry, but it will considerably reduce the pressure on the majority of ground-living mammals and birds. Snares, of course, should be disposed of so as to prevent their re-use.

Turtle and tortoise hunting should also be banned. Once again, enforcement could be relatively easy (with a dedicated protection staff), and a significant reduction in hunting activity achieved. The main action points are banning the entry of dogs to the forest area, and banning night-time searching of rivers.

Targeted awareness campaigns should focus on trying to encourage cessation of hunting of high-profile threatened species, in particular Saola, Tiger, gibbons, Douc Langur, Asian Elephant, wild cattle, Crested Argus, Vietnamese and Imperial Pheasants (if they occur) and hornbills.

The benefits of focusing on the edge include:

> Visible success undoubtedly leads to greater positive feedback than hidden accomplishments. Because of the geography of Huong Son, the forest edge is a daily sight for the majority of residents; recovery and protection of the edge would thus give a very clear and visible advertisement of the project and what it represents.

The edge should be logistically easier to manage than a distant core zone; however, this does not mean less effort needs to expended or that the task will be easier.

Project monitoring should prove easy as changes (both negative and positive) are likely to be rapid and quickly apparent.

A high visibility of active protection and other management activities in edge areas is likely to discourage exploitation of the higher altitude interior forests.

Concentration of effort on well-protected core areas may not effectively protect all species, in particular large carnivores that range widely, and will thus come into conflict with humans outside core areas. Studies indicate that this "edge effect" for large carnivores can be a significant factor in the viability of populations (Woodroffe and Ginsberg 1998). There are several reasons for this: persecution by humans is by far the greatest threat to an individual's survival and this is concentrated around the edge. Prey densities are without doubt low, and thus necessitate larger ranges of the large carnivores. The lowland valleys may be more favored by ungulates than the higher slopes, despite higher hunting pressure. Thus the lowland valleys may also be more attractive than higher slopes to larger carnivores.

6.5. Patrolling regime

While awareness campaigns and the provision of alternative resources can be effective, during the initial years the only way to control encroachment will be to have members of a protection staff in the field on a daily basis. People confined to guard or control posts have little effectiveness in deterring offenders. Without active protection, the Huong Son Forest will become a free-for-all, a scenario that can be seen in well-funded protected areas such as Cuc Phong, Yok Don and Cat Ba NPs (Le Xuan Canh et al. 1997*a*, Duckworth and Walston in prep., J. W. Duckworth pers. comm. 1999, T. Nadler pers. comm. 1999, J. Walston pers. comm. 1999, RJT own data). It would be ludicrous for a bank to leave its vault open without a guard, yet the Huong Son Forest resources are the equivalent of any bank vault.

Daily patrolling of all valley roads and low paths could and should be undertaken by a relatively small protection staff; as few as 25 people could achieve a very adequate coverage. Regular weekly patrolling of lower slopes and patrolling twice a month into the interior on a longer excursion (4-5 days) should also be undertaken. A group of 40 dedicated people could adequately handle such a regime. Forest exploitation is not carried out only during office hours; patrolling should take place around the clock

The protection staff could be divided logistically into six contingents based on the following locations: Rao An, Ha Vang, Nam Sot, Nam Mac, Nga Doi/Rao Qua and Song Con

6.6. Commercial timber extraction in the Huong Son Forest

From a nature conservation point of view it would be better to cease logging altogether. But, if logging is considered the best way to maintain interest in conserving the forest, then continuation should be considered along sustainable lines. This will require compromises in operating practices to maintain the richness of wildlife and habitat.

Logging clearly cannot continue at present rates indefinitely. The sooner there is better control over logging, the greater the chance that the enterprises could continue in a sustainable manner. The relatively small size of the forest area means that any logging will have to be a scaled-down operation, but development of alternative forest products could presumably counteract reduction in timber revenue.

One advantageous action would be the sole use of buffaloes for timber extraction, rather than the more damaging use of lorries. This might seem outlandish for a commercial operation, but is likely to become economically viable when long-term costs and benefits are considered.

Timber extraction should cease for an indefinite period within the edge. Outside this area, no timber removal should occur within 100 m of major watercourses; similarly, camps and staging posts should be situated away from major watercourses.

Timber removal at present (legal and illegal) seems to cater to demand from within Vietnam. For a sustainable operation, there is a possibility of forming considerably more lucrative links with ecofriendly consumer markets in the West.

6.7. Development along Road No. 8

Clearly development should be avoided along the road between the present international border post and Nuoc Sot (because of the threat to the corridor's integrity, the loss of its scenic value, and the threat to the catchment area). This should not be a point of contention if the status of the area and its importance is widely publicized in government ministries and departments: Ministry of Transport (roads), Ministry of Industry (electricity, industrial development), Ministry of Post and Communications, Ministry of Defence (international border security), Department of Customs (international border customs), Department of Tourism, Ministry of Agriculture and Rural Development (rural development and transmigration).

Work on the road should avoid disturbance of flanking habitat as much as possible. Before any work is carried out, qualified biologists should assess the proposed plans, and modifications should be made (by close consultation between biologists and engineers) where appropriate to reduce potential threats to habitat and wildlife.

Overcoming the barrier effect of the road on animal and plant movement is a concern of little relevance at present; it is a consideration for the long to very long term. For now it is sufficient to make sure that current habitat flanking the road cutting is not lost. A 1-km strip on either side of the road should be considered and managed as edge (as described above). This should not be difficult to implement, since patrolling the road on a regular basis is extremely easy.

In the long term, consideration should be given to improving the conditions for animal and plant dispersal across the road. This would be helped by road bridges spanning forest valleys and road tunnels through the ridges. All of these would probably be a necessity anyway if the road were to be upgraded for higher traffic volume. Another less costly measure in the mid- to long term would be to create gently sloping paths down to the road in suitable places where larger mammals might cross, and encouraging regrowth of larger trees along the road margins.

6.8. Limitations

The recommendations given are idealistic. However, there is little precedent in Vietnam or for that matter in most adjacent nations for effective nature conservation. Realistically, therefore, few of the recommendations are likely to be implemented. By far the greatest difficulty will be in finding a motivated and dedicated protection staff. If such people could be found, then many of the recommendations could be achievable; even as few as ten people could accomplish a considerable amount. The second difficulty is gaining high-level commitment and support to counter commercial exploitation. This could be as difficult to achieve as the finding of suitable staff.

References

Averanov, A. O., Abramov, A. A., and Tikhonov, A.N. 2000. A new species of Nesolagus (*Lagomorpha, Leporidae*) from Vietnam with osteological description. *Contributions from the Zoological Institute,* St. Petersburg 3: 1-22.

Army Map Service. 1965-70. *1:50,000 Topographic map series of Indochina.* US Department of Defense, US Army Topographic Command, Washington D.C.

Baltzer, M. (compiler). 2000. *Briefing book for the Ecoregion-based conservation in the forests of the lower Mekong biological assessment workshop.* WWF Indochina Programme, Phnom Penh.

Berkmüller, K., Evans, T. D., Timmins, R. J. and Vene Vongphet. 1995*a*. Recent advances in nature conservation in the Lao PDR. *Oryx* 29: 253-260.

Berkmüller, K., Sangthong Southammakoth and Vene Vongphet. 1995*b*. Protected area system planning and management in Lao PDR: status report to mid-1995. *Forest Resources Conservation Sub-Programme,* Lao-Swedish Forestry Cooperation Programme, Vientiane, Lao PDR.

Brandon-Jones, D. 1996. The Asian Colobinae (Mammalia: Cercopithecidae) as indicators of Quaternary climatic change. *Biological Journal of the Linnean Society* 59: 327-350.

CBC-AMNH/IEBR. 1998. *Interim draft report: biodiversity surveys and inventories of the northern Truong Son range, April-May 1998.* CBC-AMNH/IEBR, Hanoi.

Collar, N. J., Crosby, M. J. and Stattersfield, A. J. 1994. *Birds to watch 2.* BirdLife International, Cambridge, U.K.

Compton J., Khamkhoun Khounboline and Le Hai Quang. In press. *Vanishing point: an investigation of cross-border trade between Lao PDR and Vietnam*. WWF Indochina Programme, Hanoi.

Corbet, G. B. and Hill, J. E. 1992. *The mammals of the Indomayalan Region: a systematic review.* Natural History Museum Publications and Oxford University Press, Oxford, U.K.

Davidson, P., Poole, C., Keo Omaliss, Robson, C., Timmins, R., and Duckworth, W. 2000. *Priorities for Bird Conservation in the region of analysis: desk study for the Ecoregion-based conservation in the forests of the lower Mekong biological assessment workshop.* WWF Indochina Programme, Phnom Penh.

Delacour, J. 1929. On the birds recorded during the 4th expedition to French Indochina. *Ibis* (12)5: 193-220, 403-429.

Do Tuoc, Vu Van Dung, Dawson, S., Arctander, P. and MacKinnon, J. 1994. [Introduction of a new large mammal species in *Vietnam. Science and Technology News* (March) pp. 4-13, Forest Inventory and Planning, Hanoi]. [In Vietnamese.]

Dorst, J. and Dandelot, P. 1970. *A field guide to the larger mammals of Africa.* Collins, London.

Duckworth, J. W. 1996. Bird and mammal records from the Sangthong District, Vientiane Municipality, Laos, in 1996. *Natural History Bulletin of the Siam Society* 44: 217-242.

Duckworth, J. W. 1997. Small carnivores in Laos: a status review with notes on ecology, behaviour and conservation. *Small Carnivore Conservation* 16: 1-21.

Duckworth, J. W. 1998*a*. A survey of large mammals in the central Annamite mountains of Laos. *Zeitschrift für Säugetierkunde* 63: 239-250.

Duckworth, J. W. 1998*b*. The difficulty of estimating population densities of nocturnal forest mammals from transect counts of animals. *Journal of Zoology,* London 246: 466-468.

Duckworth, J. W. and Hedges, S. 1998*a*. *A review of the status of Tiger, Asian Elephant, Gaur and Banteng in Vietnam, Lao, Cambodia and Yunnan (China), with recommendations for future conservation action.* WWF Indochina Programme, Hanoi.

Duckworth, J. W. and Hedges, S. 1998*b*. Bird records from Cambodia in 1997, including records of sixteen species new for the country. *Forktail* 14: 29-36.

Duckworth, J. W. and Le Xuan Canh 1998. The Smooth-coated Otter *Lutrogale perspicillata* in Vietnam. *IUCN Otter Specialist Group Bulletin* 15 (1): 38-43.

Duckworth, J. W., Salter, R. E. and Khounboline, K. (compilers). 1999. *Wildlife in Lao PDR: 1999 status report*. IUCN-The World Conservation Union / Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.

Duckworth, J. W., Timmins, R. J., Thewlis, R. C. M., Evans, T. D. and Anderson, G. Q. A. 1994. Field observations of mammals in Laos, 1992-1993. *Natural History Bulletin of the Siam Society* 42: 177-205.

Duckworth, J. W., Tizard, R. J., Timmins, R. J., Thewlis, R. M., Robichaud, W. G. and Evans T. D. 1998. Bird records from Laos, October 1994-August 1995. *Forktail* 13: 33-68.

Duckworth, J. W. and Walston, J. L. In prep. *Reconnaissance bird and mammal survey of Hai Phong - Ha Long - Cat Ba - Cam Pha - Ba Mun area, Hai Phong and Quang Ninh Provinces, Vietnam, with emphasis on the endemic langur.* Report to World Bank Resident Mission, Hanoi.

Eames, J. C., Lambert, F. R. and Nguyen Cu. 1994. A survey of the Annamese lowlands, Vietnam, and its implications for the conservation of Vietnamese and Imperial Pheasants *Lophura hatinhensis* and *L. imperialis*. *Bird Conservation International* 4: 343-382.

Eames, J. C. and Tordoff, A. W. In prep. *Recent records and a conservation status review of some threatened and near-threatened bird species from Vietnam*.

European Commission and the Ministry of Agriculture and Rural Development [EC/MARD]. 1997. *Social Forestry and Nature Conservation in Nghe An Province, ALA/VIE/94/24: overall workplan and budget 1997-2003*. Ministry of Agriculture and Rural Development and the European Commission, Hanoi.

Ernst, C. H. and Barbour, R. W. 1989. *The turtles of the world*. Smithsonian Institution Press, Washington D.C. and London

Evans, T. D., Duckworth, J. W., and Timmins, R. J. 2000. Field observations of larger mammals in Laos, 1994-1995. *Mammalia* 64: 55-100.

Evans, T. D., Thewlis, R. C. M., Towll, H. C. and Stones, A. J. In prep. *b*. Mammal records from southern Laos in 1996.

Evans, T. D. and Timmins, R. J. 1998. Records of birds from Laos during January-July 1994. *Forktail* 13: 69-96.

Eve, R. 1998. *Vu Quang Nature Reserve: a link in the Annamite chain: volume 1, presentation and maps.* WWF Indochina Programme, Hanoi.

Eve, R., Nguyen Viet Dung and Meijboom, M. 1998. *Vu Quang Nature Reserve: a link in the Annamite chain: volume 2, list of species: fauna and flora*. WWF Indochina Programme, Hanoi.

Forest Inventory and Planning Institute [FIPI]. 1999. *Xay Dung Vuon Quoc Gia Phong Nha-Ke Bang Quang Binh* [proposal for the Phong Nha-Ke Bang National Park]. FIPI, Hanoi. [In Vietnamese.]

Giao, P. M., Tuoc, D., Dung, V. V., Wikramanayake, E. D., Amato, G., Arctander, P. and MacKinnon, J. R. 1998. Description of *Muntiacus truongsonensis,* a new species of muntjac (Artiodactyla: Muntiacidae) from central Vietnam, and implications for conservation. *Animal Conservation* 1: 61-68.

Government of the Socialist Republic of Vietnam [GSRV] 1994. *Biodiversity action plan for Vietnam*. GSRV, Hanoi.

Groves, C. 1981. *Ancestors for the pigs: taxonomy and phylogeny of the genus* Sus. Department of Prehistory, Research School of Pacific Studies, Australian National University (Tech. Bull. 3), Canberra.

Groves, C. P., Schaller, G. B, Amato, G. and Khamkhoun Khounboline. 1997. Rediscovery of the wild pig *Sus bucculentus. Nature* 386: 335.

Heaney, L. R. 1991. A synopsis of climate and vegetational change in Southeast Asia. *Climate Change* 19: 53-61.

Inskipp, T., Lindsey, N. and Duckworth, W. 1996. *An annotated checklist of the birds of the Oriental Region*. Oriental Bird Club, Sandy, Bedfordshire, U.K.

IUCN 1992. *Protected areas of the world: a review of national systems: volume 1, Indomalaya, Oceania, Australia and Antarctic.* IUCN, Gland, Switzerland and Cambridge, U.K.

IUCN 1996. 1996 *IUCN Red List of threatened animals.* IUCN, Gland, Switzerland.

IUCN 1997. *Environmental and social action plan for Nakai-Nam Theun catchment and corridor areas.* IUCN, Vientiane.

Jenkins, M.D. 1995. *Tortoises and freshwater turtles: the trade in Southeast Asia*. TRAFFIC International, U.K.

Kannan, R and James, D. A. 1999. Fruiting Phenology and the conservation of the Great Pied Hornbill (*Buceros bicornis*) in the Western Ghats of Southern India. *Biotropica* 31: 167-177.

Kemp, A. C. 1995. *The hornbills: Bucerotiformes.* Oxford University Press, Oxford, U.K.

Kemp, N., Dilger, M., Burgess, N. and Chu Van Dung. 1997. The Saola *Pseudoryx nghetinhensis* in Vietnam: new information on distribution and habitat preferences, and conservation needs. *Oryx* 31: 37-44.

Kemp, N., Le Mong Chan and Dilger, M. 1994. *Site description and conservation evaluation: Ba Be National Park, Cao Bang Province, Vietnam*. FRONTIER, Hanoi.

Kemp, N., Le Mong Chan and Dilger, M. 1995. *Site description and conservation evaluation: Pu Mat Nature Reserve, Nghe An Province, Vietnam*. FRONTIER, Hanoi.

King, B. F., Woodcock, M. and Dickinson, E. C. 1975. *A field guide to the birds of South-east Asia*. Collins, London.

Kruuk, H., Kanchanasaka, B., O'Sullivan, S. and Wanghongsa, S. 1994. Niche separation in three sympatric otters *Lutra perspicillata, L. lutra* and *Aonyx cinerea* in Huai Kha Khaeng, Thailand. *Biological Conservation* 69: 115-120.

Kruuk, H, Kanchanasaka, B., Wanghongsa, S. and O'Sullivan, S. 1993. Identification of tracks and other sign of three species of otter *Lutra lutra, L. perspicillata* and *Aonyx cinerea* in Thailand. *Natural History Bulletin of the Siam Society* 41: 23-30.

Kuznetzov, G.V. and Baranauskas, K. 1993. Notes on the behaviour, activity and feeding of the Spotted Linsang (*Prionodon pardicolor*). *Small Carnivore Conservation* 8: 5.

Lam Truong-Huong Son 1996. *Ho so: xin cap dat theo ND 02 CP. Lam Truong-Huong Son,* Huong Son, Ha Tinh, Vietnam. [In Vietnamese.]

Le Dien Duc and Broad, S. 1995. *Investigations into tortoise and freshwater turtle trade in Vietnam*. IUCN Species Survival Commission, Gland, Switzerland and Cambridge, U.K.

Le Trong Trai, Richardson, W. J., Bui Dac Tuyen, Le Van Cham, Nguyen Huy Dung, Ha Van Hoach, Monastyrskii, A. L. and Eames, J. C. 1999*a*. *An investment plan for Ngoc Linh Nature Reserve, Kon Tum Province, Vietnam: a contribution to the management plan*. BirdLife International Vietnam Programme, Hanoi.

Le Trong Trai, Richardson, W. J., Le Van Cham, Tran Hieu Minh, Tran Quang Ngoc, Nguyen Van Sang, Monastyrskii, A. L. and Eames, J. C. 1999*b*. *A feasibility study for the Establishment of Phong Dien (Thua Thien Hue Province) and Dakrong (Quang Tri Province) Nature Reserves, Vietnam*. BirdLife International Vietnam Programme, Hanoi.

Le Xuan Canh, Pham Trong Anh, Duckworth, J. W., Vu Ngoc Thanh and Lic Vuthy. 1997*a*. *A survey of large mammals in Daklak Province.* IEBR / IUCN / Wildlife Protection Office, Cambodia / WWF, Hanoi.

Le Xuan Canh, Truong Van La, Dang Thi Dap, Ho Thu Cuc, Ngo Anh Dao, Nguyen Ngoc Chinh, Vu Van Dung, Pham Nhat, Nguyen Thai Tu, Nguyen Quoc Thang and Tran Minh Hien. 1997*b. A report on field surveys on biodiversity in Phong Nha-Ke Bang Forest (Quang Binh Province) central Vietnam*. IEBR / FIPI / Forestry College / University of Vinh / WWF Indochina Programme, Hanoi.

Lekagul, B. and Round, P. D. 1991. *A guide to the birds of Thailand*. Saha Karn Bhaet, Bangkok.

Ling, S. 1999. *A biological system of prioritization for protected areas in the Lao PDR*. Centre for Protected Areas and Watershed Management / Wildlife Conservation Society Cooperative Program, Vientiane.

MacKinnon, J. (editor) 1997. *Protected areas systems review of the Indo-Malayan Realm*. The Asian Bureau for Conservation Limited, Canterbury, UK.

MacKinnon, J. and MacKinnon, K. 1986. *Review of the protected areas system in the Indo-Malayan realm*. IUCN, Gland, Switzerland.

MacKinnon, J. and Vu Van Dung. 1992. *Draft management plan for Vu Quang Nature Reserve, Huong Khe District, Ha Tinh Province, Vietnam*. WWF Indochina Programme, Hanoi.

Mallon, D. P. and Eames, J. C. In press. S. R. Vietnam. In: *Global antelope survey and action plan, part 4,* Mallon, D. P. and Kingswood S. C. (compilers). IUCN, Gland, Switzerland.

Ministry of Science, Technology and Environment [MOSTE] 1992. [*Red Data Book of Vietnam: Volume 1, animals*]. Science and Technics Publishing House, Hanoi. [In Vietnamese.]

Musser, G. and Lunde, D. In prep. *Biodiversity surveys and inventories of the northern Truong Son range, April-May 1998*.

Nguyen Xuan Dang, Pham Nhat, Pham Trong Anh and Hendrichsen, D. K. 1998. *Ket qua dieu tra nghien cuu khu he thu o Phong Nha - Ke Bang* [survey results on fauna in Phong Nha-Ke Bang]. Fauna & Flora International - Indochina Programme / IEBR, Hanoi. [In Vietnamese.]

Osborn, F. V. and Vinton, M. D. (editors) 1999. *Proceedings of the conference: conservation of the Asian Elephant in Indochina, Hanoi, Vietnam 24-27th November 1999*. Fauna & Flora International, Hanoi.

Provincial Forest Protection Department [PFPD] Quang Nam 1996. *Results of preliminary survey on the Saola,* Pseudoryx nghetinhensis *in Quang Nam, Da Nang Province.* Provincial Forest Protection Department Quang Nam Da Nang, Vietnam.

Robichaud, W. 1997. *Environmental and social action plan for Nakai-Nam Theun catchment and corridor areas: Saola conservation action plan for Lao PDR*. WCS, Vientiane.

Robichaud, W. 1999. *Saola conservation action plan for Lao PDR: 1999 revision*. WCS / IUCN - Lao Programme, Vientiane.

Robichaud, W. and Stuart, B. L. 1999. *Summary of Saola, herpetological and wildlife trade studies in Nakai-Nam Theun NBCA and the proposed Nam Theun extension*. WCS / IUCN - Lao Programme, Vientiane.

Robson, C. R. 2000. *An identification guide to the birds of South-East Asia*. New Holland, London.

Robson, C. R., Eames, J. C., Nguyen Cu and Truong Van La 1993*a*. Further recent records of birds from Vietnam. *Forktail* 8: 25-52.

Robson, C. R., Eames, J. C., Nguyen Cu and Truong Van La 1993*b*. Birds recorded during the third BirdLife/Forest Birds Working Group expedition in Vietnam. *Forktail* 9: 89-119.

Round, P. D. 1988. *Resident forest birds in Thailand*. ICBP monograph No. 2. International Council for Bird Preservation, Cambridge, U.K.

Round, P. D. 1997. The current status of bird conservation in Thailand. Paper presented at the National Wildlife Seminar, Kasetsart University, Bangkok.

Round, P. D., Timmins, R. J. and Truong Van La. 1998. Birds. pp. 60-77. In: *Technical report on the biodiversity survey of Pu Mat Nature Reserve.* Baltzer, M. C. (compiler). SFNC/EC, Vinh, Vietnam.

Rozendaal, F. 1990. Unpublished. Report on surveys in Hoang Lien Son, Lai Chau and Nghe Tin Provinces, Vietnam.

Rozhnov, V.V., Kuznetzov, G.V. and Pham Trong Anh 1992. New distributional data on Owston's Palm Civet. *Small Carnivore Conservation* 6: 7.

Rundel, P.W. 2000. *Forest habitats and flora in Lao PDR, Cambodia and Vietnam: desk study for the Ecoregion-based conservation in the forests of the lower Mekong biological assessment workshop.* WWF Indochina Programme, Phnom Penh.

Ruggeri, N. L. and Timmins, R. J. 1995-1996. An initial summary of diurnal primate status in Laos. *Asian Primates* 5: 1-3.

Russian Vietnamese Tropical Center (undated). *Vu Quang Field Survey on Flora and Fauna.* Russian Vietnamese Tropical Center, Hanoi.

Schaller, G. B. and Rabinowitz, A. 1995. The Saola or Spindlehorn Bovid *Pseudoryx nghetinhensis* in Laos. *Oryx* 29: 107-114.

Schreiber, A., Wirth, R., Riffel, M. and Van Rompaey, H. 1989. *Weasels, civets, mongooses and their relatives: an action plan for the conservation of mustelids and viverrids.* IUCN, Gland, Switzerland.

Servheen, C. 1999. Sun Bear conservation action plan: chapter 11. pp. 219-223. In: *Bears: status survey and conservation action plan.* Servheen, C., Herrero, S. and Peyton, B. (compilers). IUCN/SSC Bear and Polar Bear Specialist Groups, IUCN, Gland, Switzerland and Cambridge UK.

Social Forestry and Nature Conservation in Nghe An Province / European Commission [SFNC/EC] (Baltzer, M. C. compiler) 1998. *Technical report on the biodiversity survey of Pu Mat Nature Reserve.* SFNC/EC, Vinh, Vietnam.

Social Forestry and Nature Conservation in Nghe An Province / European Commission [SFNC/EC] (Long, B. and Do Tuoc) 1999. *A participatory conservation strategy for the Khe Bong valley, Pu Mat Nature Reserve, Nghe An Province, Vietnam.* SFNC/EC, Vinh, Vietnam.

Social Forestry and Nature Conservation in Nghe An Province/European Commission [SFNC/EC] (Round, P. D.) 1999. *Avifaunal surveys of the Pu Mat Nature Reserve, Nghe An Province, Vietnam: 1998-1999.* SFNC/EC, Vinh, Vietnam.

Stattersfield, A. J., Crosby, M. J., Long, A. J. and Wege, D. C. 1998. *Endemic bird areas of the world: priorities for biodiversity conservation.* BirdLife conservation series No. 7. BirdLife International, Cambridge, U.K.

Stuart, B. L. 1999. Amphibians and reptiles. pp. 43-67. In: *Wildlife in Lao PDR: 1999 status report.* Duckworth, J. W., Salter, R. E. and Khounboline, K. (compilers). IUCN-The World Conservation Union / Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.

Surridge, A. K., Timmins, R. J., Hewitt, G. M. and Bell, D. J. 1999. Striped rabbits in Southeast Asia. *Nature* 400: 26.

Thewlis, R. M., Duckworth, J. W., Anderson, G. Q. A., Dvorak, M., Evans, T. D., Nemeth, E., Timmins, R. J. and Wilkinson, R. J. 1996. Ornithological records from Laos, 1992-1993. *Forktail* 11: 47-100.

Thewlis, R. M., Timmins, R. J., Evans, T. D. and Duckworth, J. W. 1998. The conservation status of birds in Laos: a review of key species. *Bird Conservation International* 8 (supplement): 1-159.

Timmins, R. J. (editor). 1997. *Notes on wildlife and habitats in Khammouan Limestone National Biodiversity Conservation Area, Khammouan Province, Lao PDR.* Centre for Protected Areas and Watershed Management / The Wildlife Conservation Society Lao Program, Vientiane.

Timmins, R. J. In press. Lao PDR. In: *Global antelope survey and action plan, part 4.* Mallon, D. P. and Kingswood S. C. (compilers). IUCN, Gland, Switzerland.

Timmins, R. J. in prep. Morphology and diagnosis of *Muntiacus rooseveltorum* and *M. truongsonensis.*

Timmins, R. J., Baltzer, M. C. and Round, P. D. 1998*a*. Large mammals. pp. 78-94. In: *Technical report on the biodiversity survey of Pu Mat Nature Reserve.* Baltzer, M. C. (compiler). SFNC/EC, Vinh, Vietnam.

Timmins, R. J., Do Tuoc, Trinh Viet Cuong and Hendrichsen, D. K. 1999. *A preliminary assessment of the conservation importance and conservation priorities of the Phong Nha-Ke Bang Proposed National Park, Quang Binh Province, Vietnam*. Fauna & Flora International, Indochina Programme, Hanoi.

Timmins, R.J., and Duckworth, J.W. 2000. Priorities for mammal conservation in the ROA: desk study for the Ecoregion-based conservation in the forests of the lower Mekong biological assessment workshop. WWF Indochina Programme, Phnom Penh.

Timmins, R.J., Duckworth, J.W., and Rundel, P.W. 2000. Sections: "Boundary to the region of analysis," and "Major subdivisions within the region of analysis." In: Baltzer, M. (compiler). *Briefing book for the Ecoregion-based conservation in the forests of the lower Mekong biological assessment workshop*. WWF Indochina Programme, Phnom Penh.

Timmins, R. J., and Duckworth, J. W. 1999. Status and conservation of Douc Langurs (*Pygathrix nemaeus*). *Laos. International Journal of Primatology* 20: 469-489.

Timmins, R. J., Duckworth, J. W., Tizard, R. J. and Robichaud, W. G. In prep. *a*. Birds recorded from the Annamite mountains and northern highlands of Laos in 1996.

Timmins, R. J. and Evans, T. D. 1994. *A wildlife and habitat survey of Nam Theun National Biodiversity Conservation Area: Draft.* Forest Resources Conservation Sub-Programme, Lao-Swedish Forestry Cooperation Programme and the Wildlife Conservation Society, Vientiane.

Timmins, R. J., Evans, T. E., Khamkhoun Khounboline and Chainoi Sisomphone. 1998*b.* Status and conservation of the Giant Muntjac *Megamuntiacus vuquangensis,* and notes on other muntjac species in Laos. *Oryx* 32: 59-67.

Timmins, R. J. and Khamkhoune Khounboline. 1996. *A preliminary wildlife and habitat survey of Hin Namno National Biodiversity Conservation Area, Khammouan Province, Lao PDR*. The Wildlife Conservation Society, Vientiane.

Timmins, R. J. and Khamkhoun Khounboline. 1999. Occurrence and trade of the Golden Turtle, *Cuora trifasciata,* in Laos. *Chelonian Conservation and Biology* 3: 441-447.

Timmins, R. J. and Men Soriyun 1998. *A wildlife survey of river basins in Northeastern Cambodia*. Fauna & Flora International - Indochina Programme and the Wildlife Protection Office, Hanoi and Phnom Penh.

Timmins, R. J., Surridge, A. K. and Bell, D. J. In prep. *b. Notes on the taxonomic status of* Nesolagus timminsi *(Mammalia: Lagomorpha)*.

Tizard, R. J. 1996. *A preliminary wildlife and habitat survey of the proposed northern extension to the Nakai-Nam Theun National Biodiversity Conservation Area and adjacent Nam Gnouang area, Lao PDR*. Centre for Protected Areas and Watershed Management / The Wildlife Conservation Society Lao Program, Vientiane.

Tobias, J. 1997. *Environmental and social action plan for Nakai-Nam Theun catchment and corridor areas: report of the wildlife survey.* The Wildlife Conservation Society, Vientiane.

van Strien, N. J. 1983. *A guide to the tracks of mammals of western Indonesia*. School of Environmental Conservation Management, CIAWI, Bogor.

Van Rompaey, H. 1995. The Spotted Linsang, *Prionodon pardicolor. Small Carnivore Conservation* 13: 10-13.

Vidal, J. E. 1959. Conditions écologiques, groupements végétaux et flore du Laos. *Mémoires Société Botanique de France* 1958: 1-41.

Vu Quang Conservation Project 1998. *Fact sheet*. Vu Quang Conservation Project.

Vu Van Dung, Pham Mong Giao, Nguyen Ngoc Chinh, Do Tuoc, Arctander, P. and MacKinnon, J. 1993. A new species of living bovid from Vietnam. *Nature* 363: 443-445.

Vu Van Dung, Pham Mong Giao, Nguyen Ngoc Chinh, Do Tuoc and MacKinnon, J. 1994. Discovery and conservation of the Vu Quang Ox in Vietnam. *Oryx* 28: 16-21.

Walston, J. L. and Vinton, M. D. (editors). 1999. *A wildlife and habitat survey of Hin Namno National Biodiversity Conservation Area and adjacent areas, Khammouane Province, Lao PDR*. WWF Lao Project Office and Wildlife Conservation Society Lao Program, Vientiane.

Wege, D. C., Long, A. J., Mai Ky Vinh, Vu Van Dung and Eames, J. C. 1999. *Expanding the protected areas network in Vietnam for the 21st century: an analysis of the current system with recommendations for equitable expansion*. BirdLife International Vietnam Programme, Hanoi.

Wells, D. R. 1999. *The birds of the Thai-Malay Peninsula, vol. 1*. Academic Press, London.

Wikramanayake, E., Dinerstein, E., Hedao, P. and Olson, D. 1997. *A conservation assessment of terrestrial ecoregions of the Indo-Pacific Region*. WWF-US Conservation Science Program, Washington, D.C.

Wildlife Conservation Society [WCS] 1995*a*. *A preliminary wildlife and habitat assessment of the Nam Theun 2 hydropower project area*. Wildlife Conservation Society, Vientiane.

Wildlife Conservation Society [WCS] 1995*b*. *A wildlife and habitat assessment of the Theun-Hinboun hydropower project area*. Wildlife Conservation Society, Vientiane.

Wildlife Conservation Society [WCS]. In press. *A wildlife and habitat survey of Nam Kading National Biodiversity Conservation Area, Bolikhamxai Province, Lao PDR*. The Wildlife Conservation Society, Vientiane.

Woodroffe, R. and Ginsberg, J. R. 1998. Edge effects and the extinction of populations inside protected areas. *Science* 280: 2126-2128.

Annex 1 Gazetteer

Names and spelling of places and features in the study area generally follow those in local use and are referable to those on the Army Map Service (1965-70), 1:50,000 map series by reference to the gazetteer (Table 4) below.

Locations from the survey are given as UTM grid references (as a best approximation to actual location) based on the Army Map Service (1965-70) 1:50,000 map series (and subsequent Vietnamese versions of them). UTM grid references are to the nearest 100 m, with eastings first. Map sheet numbers are given rather than the two-letter 100-km grid square reference. Altitudes are meters above sea level, and based on the Army Map Service (1965-70) maps.

The following map sheets cover the survey areas:

Lower Rao An: 6045 IV
Rao An Tren: 6045 IV and 6045 I
Khe Tre: 6045 I
Nam Sot: 6045 IV
Nam Mac: 6046 III and 6045 IV
Song Con: 6046 III
Nga Doi/Rao Qua: 6046 III, 6045 I and 6045 IV
Trung Tam: 6045 I

Details of localities mentioned in the text are given in the Gazetteer (Table 4) below, and mapped on Figure 2.

Table 4. Gazetteer of localities mentioned in the text.

Name in text	Type of location/habitat	Name on Maps	Name in local use	Location	Altitude
Ba Mu (mountain)	Mountain	Nui Ba Mu	Ba Mu	6046 III 210485	100–1357 m
Camera trapping site	Camera trapping site	None	None	6046 III 165470 (centered on)	350–650 m
Dai Kim	Village	None	Dai Kim	6045 I 266390	50 m
Doi 7	Village	None	Doi 7	6046 III 225533	100 m
Ha Vang	Forest area	(Ha Vang)	Ha Vang	6045 I 295355 (centered on)	100–600 m
Khe Tre	River	Khe Tre	Khe Tre	6045 I 298240-343405	10 m +
Mineral spring	Mineral spring	None	Mo Muoi	6045 IV 178452	250 m
Nam Kwai	River in Laos	None	?	6045 IV 160325	700 m
Nam Mac	River	Nam Mac	Nam Mac/Rao Mac	6046 III 140470-6045 IV 258380	50 m +
Nam Mac survey area	Survey area	None	None	6046 III 173462 (centered on)	250–950 m
Nam Phao hydro-electric power project	Hydroelectric power project	None	?	6045 IV 147298	550 m
Nam Pheo	River in Laos	?	Nam Pheo	6045 III 260130	500 m +
Nam Sot	River	Nam Chot	Nam Sot/Nuoc Sot	6045 IV 130455-238374	100 m +
Nga Doi/Rao Qua survey area	Survey area	None	None	6046 III 228474-6045 I 276430	100–550 m
Nga Doi/Rao Qua	Forest area and rivers	Rao Qua	Nga Doi/Rao Qua	6046 III 245465 (centered on)	150 m +
Nga Doi logging area	Active logging area	None	Nga Doi	6046 III 232475 (centered on)	400–700 m
Nuoc Sot	Settlement	None	Nuoc Sot	6045 IV 237380 (centered on)	150 m
Po Mu	*Fokienia* forest area	None	Po Mu	6045 IV 263285	1200 m
Rao An (lower)	River	None	Rao An	6045 IV 238372-245280	100–400 m
Rao An (lower) survey area	Survey area	None	None	6045 IV 246316 (centered on)	100–700 m
Rao An Tren	River (upper reaches of Rao An)	None	Rao An Tren	6045 IV 250272-6045 I 294205	800 m
Rao An Tren Survey Area	Survey area	None	None	6045 IV 253270 & 6045 I 286235 (centered on)	700–1250 m
Rao Bun	River	None	Rao Bun	6045 I 280300-6045 IV 240354	200 m +
Song Con	River	Song Con	Song Con	6046 III 127488-6046 II 368470	10 m +
Song Con survey area	Survey area	None	None	6046 III 135482-175518	100-800 m
Song Ngan Pho	River	Ngan Pho	Song Ngan Pho	6045 I 265387-6046 II 400460	10-50 m
Trung Tam	Town	Trung Tam	Trung Tam	6045 I 325407	20 m
Vietnamese international border post	International border post	Deo Keo Neua	?	6045 IV 173328	700 m

Annex 2 Bird species recorded

Bird status was assessed subjectively using the overall encounter frequency (the number of records). The following criteria (based on the behavior and ecology of each species that effect their observability) were used in assessing a subjective status for each species:

• overall encounter frequency (the number of records): this baseline is considered in the light of the following factors, to assess how the encounter rate reflects the species' abundance.

• shyness: skulking or shy species are recorded much less frequently than extrovert ones.

• activity level: active birds are recorded more frequently than sluggish or inactive species.

• area of detection: species of dense vegetation are visible only within close proximity while many open-country species can be noticed from hundreds of meters.

• main vegetation story inhabited: forest-canopy species can be more difficult to observe than those of the mid-story or understory.

• aerial species: these can seem disproportionately common in open areas but conversely they are seen only rarely from within forest.

• calling frequency: birds calling nearly continuously are found more often than those giving only occasional calls or songs. Calls may be strongly clustered around certain times of the day or year, and the overlap of observations with the bird's chief calling periods should be considered.

• distinctiveness of calls: a diagnostic call is more readily noticed than an anonymous-sounding call.

• volume of call: loud, strident calls carry further than quiet ones.

• whether common calls of the species are known: when no call is known, the assessment is necessarily less accurate than when calls are known; the abundance is probably usually underestimated. Table 5 indicates those species where calls had an important influence on assessment.

• flocking behavior: a handful of records of large flocks do not equate to many records of singletons. Unusual birds can be seen in large numbers through chance encounters of occasional large flocks. The number of records and dispersion of individual birds is therefore accorded more weight than simply the number of individuals.

• carrying capacity for the bird of its chosen habitat: big birds generally have much larger home ranges than small birds; thus, what is a high absolute density for the former (in terms of birds per unit area, or birds found per day) would be low for the latter.

• seasonality of occurrence: many species are migrants, whose abundance changes throughout the year.

In assessing abundance, consideration was also given to the weather conditions experienced during the survey. Where possible, the abundance of each bird species in each habitat was assessed subjectively on a three-point scale whereby the number of records was assessed in the light of various features of detectability in order to arrive at the bird's true abundance. For some species abundance could not be assessed.

Status of each species was categorized as follows (abundance loosely defined as follows, for a medium-sized bird of average detectability):

Common - equivalent to being recorded daily, often in large numbers
Frequent - equivalent to being recorded on over half of survey days
Occasional - equivalent to being recorded on fewer than half of survey days
Present - not possible to assess abundance

The list is far from complete, and can only be used as an indication of the bird communities present.

Nomenclature and systematics follow Inskipp et al. (1996) except in the case of Chestnut-breasted Partridge *A. charltonii* which (following Collar et al. 1994) is here considered distinct from Scaly-breasted Partridge *A. charltonii,* and Black-browed Fulvetta *A. grotei* which (following Robson 2000) is considered distinct from Mountain Fulvetta *A. peracensis*.

Species notes:

1. Considered conspecific with Scaly-breasted Partridge *A. charltonii* by Inskipp et al. (1996).
2. Excludes birds identified to species.
3. Considered conspecific with Mountain Fulvetta *A. peracensis* by Inskipp et al. (1996).

Key:
Abundance codes: C = common; F = frequent; O = occasional; L (prefix) = local; P = present, abundance unknown; [ ] = provisional or unconfirmed identification.

Notes:V = knowledge of the species' vocalizations greatly helped status assessment;
W = associated with water;
I = species presence in Huong Son Forest is provisional or unconfirmed.

Key Species are highlighted in **bold**

Table 5. Bird species recorded in the Huong Son Forest area during the survey.

Species	**Habitat**				**Notes**
	Valley bottom	**Slopes**	**>850 m**	**Degraded nonforest habitats**	
Chinese Francolin *Francolinus pintadeanus*				LC	V
Bar-backed Partridge *Arborophila brunneopectus*		C	C		V
Chestnut-necklaced Partridge *Arborophila charltonii*	C	LC			V (1)
Red Junglefowl *Gallus gallus*	LC				V
Silver Pheasant *Lophura nycthemera*	P				
Grey Peacock Pheasant *Polyplectron bicalcaratum*	LC?	LC			V
Crested Argus *Rheinardia ocellata*		C	C		V
Rufous Woodpecker *Celeus brachyurus*	C	P			V
Lesser Yellownape *Picus chlorolophus*			P		
Yellownape spp. *Picus chlorolophus/Picus flavinucha*	C	C	P		V(2)
Red-collared Woodpecker *Picus rabieri*	P	P			
Greater Flameback *Chrysocolaptes lucidus*		P			V
Pale-headed Woodpecker *Gecinulus grantia*		LP			
Bay Woodpecker *Blythipicus pyrrhotis*	C	C	C		V
Red-vented Barbet *Megalaima lagrandieri*	C	C	C		V
Green-eared Barbet *Megalaima faiostricta*	C	C			V
Golden-throated Barbet *Megalaima franklinii*		C	C		V
Brown Hornbill *Anorrhinus tickelli*	P	F			V
[Rufous-necked Hornbill *Aceros nipalnesis*]			[P]		I V
Red-headed Trogon *Harpactes erythrocephalus*	C	C	C		V
Blyth's Kingfisher *Alcedo hercules*	LC				W
Common Kingfisher *Alcedo atthis*	P			C	W
Oriental Dwarf Kingfisher *Ceyx erithacus*	LF				(W)
White-throated Kingfisher *Halcyon smymensis*				P	(W)
Black-capped Kingfisher *Halcyon pileata*	P				W
Crested Kingfisher *Megaceryle lugubris*	P				W

Species	Habitat				Notes
	Valley bottom	Slopes	>850 m	Degraded nonforest habitats	
Pied Kingfisher *Ceryle rudis*				P	W
[Blue-bearded Bee-eater *Nyctyornis athertoni*]		[P]			I V
Blue-throated Bee-eater *Merops viridis*		P		P	
Chestnut-winged Cuckoo *Clamator coromandus*	P				
Indian Cuckoo *Cuculus micropterus*	C?	C	C		V
Plaintive Cuckoo *Cacomantis merulinus*	C			LC	V
Drongo Cuckoo *Surniculus lugubris*	C	C			V
Asian Koel *Eudynamys scolopacea*				P	V
Green-billed Malkoha *Phaenicophaeus tristis*	C	C			V
Coral-billed Ground Cuckoo *Carpococcyx renauldi*		P			V
Greater Coucal *Centropus sinensis*	LC			C	V
White-throated/Silver-backed Needletail *Hirundapus caudacutus/cochinchinensis*		P			
Brown-backed Needletail *Hirundapus giganteus*	P	P			
Asian Palm Swift *Cypsiurus balasiensis*	P	P		P	
Mountain Scops Owl *Otus spilocephalus*	C	C			V
Collared Owlet *Glaucidium brodiei*		F-C	P		V
Spotted Dove *Streptopelia chinenesis*	LC			C	
Barred Cuckoo Dove *Macropygia unchall*		P			V
Emerald Dove *Chalcophaps indica*	C				
Yellow-vented Green Pigeon *Treron seimundi*		P			
Green Pigeon spp. *Treron*	F	C	P		V (2)
White-breasted Waterhen *Amauromis phoenicurus*				P	V
Common Sandpiper *Actitis hypoleucos*				P	
Little Ringed Plover *Charadrius dubius*				LC	W
Oriental Honey-buzzard *Pernis ptilorhyncus*		P			
Crested Serpent Eagle *Spilornis cheela*		F			V
[Hawk Eagle sp. *Spizaetus*]		[P]			I
Cattle Egret *Bubulcus ibis*				P	(W)

Species	Habitat				Notes
	Valley bottom	Slopes	>850 m	Degraded nonforest habitats	
Pond Heron sp. *Ardeola*				P	W
Little Heron *Butorides striatus*	P				W
[Von Schrenck's Bittern *Ixobrychus eurhythmus*]	[P]				I W
Blue-naped/Blue-rumped Pitta *Pitta nipalensis/soror*		P			
Blue Pitta *Pitta cyanea*			P		
Bar-bellied Pitta *Pitta elliotii*	C	C			V
Silver-breasted Broadbill *Serilophus lunatus*	P	P			(V)
Long-tailed Broadbill *Psarisomus dalhousiae*		P	P		(V)
Asian Fairy Bluebird *Irena puella*	C	C			V
Blue-winged Leafbird *Chloropsis cochinchinensis*	C	C			
Orange-bellied Leafbird *Chloropsis hardwickii*	P	C	C		
Brown Shrike *Lanius cristatus*				P	
Long-tailed Shrike *Lanius schach*				P	
White-winged Magpie *Urocissa whiteheadi*	C?	F	P		
Indochinese Green Magpie *Cissa hypoleuca*	C?	P			
Racket-tailed Treepie *Crypsirina temia*				P	
Ratchet-tailed Treepie *Temnurus temnurus*	C?	F-C			
Large-billed Crow *Corvus macrorhynchos*				P	V
Oriole sp. *Oriolus*		P			V
Large Cuckooshrike *Coracina macei*		LP	LP		V
Black-winged Cuckooshrike *Coracina melaschistos*	P				
Scarlet Minivet *Pericrocotus flammeus*	C	C	P		V
Bar-winged Flycatcher-shrike *Hemipus picatus*	C?	P			
Black Drongo *Dicrurus macrocercus*				C	
Ashy Drongo *Dicrurus leucophaeus*	C				
Crow-billed Drongo *Dicrurus annectans*	C	C			
Bronzed Drongo *Dicrurus aeneus*	C	P			
Lesser Racket-tailed Drongo *Dicrurus remifer*	P				

Species	Habitat				Notes
	Valley bottom	Slopes	>850 m	Degraded nonforest habitats	
Greater Racket-tailed Drongo *Dicrurus paradiseus*	C	C			
Asian Paradise-flycatcher *Terpsiphone paradisi*	C	C?			V
Black-naped Monarch *Hypothymis azurea*	C	C			V
Great Iora *Aegithina lafresnayei*	C	P			
Large Woodshrike *Tephrodornis virgatus*	P	F	P		(V)
Brown Dipper *Cinclus pallasii*	LC		P		
[White-throated Rock Thrush *Monticola gularis*]		[P]			I
Blue Whistling Thrush *Myophonus caeruleus*			P		V
Dark-sided Flycatcher *Muscicapa sibirica*	P				
Asian Brown Flycatcher *Muscicapa dauurica*	P		P	P	
White-tailed Flycatcher *Cyornis concretus*	LC	LC			V
Hainan Blue Flycatcher *Cyornis hainana*	C	C	C		V
Grey-headed Canary Flycatcher *Culicicapa ceylonensis*			P		
Oriental Magpie Robin *Copsychus saularis*				C	
Slaty-backed Forktail *Enicurus schistaceus*	LC	LC	LC		W
White-crowned Forktail *Enicurus leschenaulti*	P				W
Black-collared Starling *Stumus nigricollis*				C	
White-vented Myna *Acridotheres cinereus*				P	
Crested Myna *Acridotheres cristatellus*				C	
Velvet-fronted Nuthatch *Sitta frontalis*		P			
Great Tit *Parus major*				P	
Sultan Tit *Melanochlora sultanea*	C	C	C		V
Black-crested Bulbul *Pycnonotus melanicterus*	C				
Red-whiskered Bulbul *Pycnonotus jocosus*	C			C	
Puff-throated Bulbul *Alophoixus pallidus*	C	C	C		V
Grey-eyed Bulbul *Iole propinqua*	C	C	P		V
Mountain Bulbul *Hypsipetes mcclellandii*			P		(V)
Lanceolated Warbler *Locustella lanceolata*	P				

Species	Habitat				Notes
	Valley bottom	Slopes	>850 m	Degraded nonforest habitats	
Black-browed Reed Warbler *Acrocephalus bistrigiceps*	P				
Common Tailorbird *Orthotomus sutorius*	LC			C	
Dark-necked Tailorbird *Orthotomus atrogularis*	C	C			V
Arctic Warbler *Phylloscopus borealis*	P				V
Leaf Warbler spp. *Phylloscopus*	C	F-C	P		(2)
Golden-spectacled/Grey-cheeked Warbler *Seicercus burkii/poliogenys*			P		
Rufous-faced Warbler *Abroscopus albogularis*			C		
Yellow-bellied Warbler *Abroscopus superciliaris*		LC			V
White-crested Laughingthrush *Garrulax leucolophus*	C	C			V
Lesser Necklaced Laughingthrush *Garrulax monileger*		P			
Greater Necklaced Laughingthrush *Garrulax pectoralis*			P		
Grey Laughingthrush *Garrulax maesi*		LC	C		V
Black-throated Laughingthrush *Garrulax chinensis*		P			
Buff-breasted Babbler *Pellorneum tickelli*	C	C			V
Scaly-crowned Babbler *Malacopteron cinereum*	F-C	LF?			(V)
Large Scimitar Babbler *Pomatorhinus hypoleucos*	C	F-C		C	V
White-browed Scimitar Babbler *Pomatorhinus schisticeps*				P	
Short-tailed Scimitar Babbler *Jabouilleia danjoui*	F	C	P		(V)
Streaked Wren Babbler *Napothera brevicaudata*		LP	LC		(V)
Eyebrowed Wren Babbler *Napothera epilepidota*		C	P		(V)
Golden Babbler *Stachyris chrysaea*		C	C		(V)
Grey-throated Babbler *Stachyris nigriceps*	C	C			V
Spot-necked Babbler *Stachyris striolata*	LC				(V)
Striped Tit Babbler *Macronous gularis*	C	C			V
Grey-faced Tit Babbler *Macronous kelleyi*	LC				V
Chestnut-fronted Shrike Babbler *Pteruthius aenobarbus*			P		
Rufous-throated Fulvetta *Alcippe rufogularis*	LC	P			(V)
Black-browed Fulvetta *Alcippe grotei*	C	C			V (3)

Species	Habitat				Notes
	Valley bottom	Slopes	>850 m	Degraded nonforest habitats	
Grey-cheeked Fulvetta *Alcippe morrisonia*		C	C		V
Striated Yuhina *Yuhina castaniceps*			P		
Black-chinned Yuhina *Yuhina nigrimenta*				P	
White-bellied Yuhina *Yuhina zantholeuca*	C	C	C		V
Short-tailed Parrotbill *Paradoxornis davidianus*		LP		LP	
Purple-naped Sunbird *Hypogramma hypogrammicum*	C	P			
Mrs. Gould's Sunbird *Aethopyga gouldiae*			LC		
Fork-tailed Sunbird *Aethopyga christinae*	C	C			(V)
Crimson Sunbird *Aethopyga siparaja*	C				
Little Spiderhunter *Arachnothera longirostra*	C				
Streaked Spiderhunter *Arachnothera magna*	C	C			(V)
Eurasian Tree Sparrow *Passer montanus*				LC	
Grey Wagtail *Motacilla cinerea*				P	W
Paddyfield Pipit *Anthus rufulus*				LC	
White-rumped Munia *Lonchura striata*				P	
Chestnut Bunting *Emberiza rutila*	P				
Assessment of coverage	**Fair**	**Fair**	**Poor**	**Poor**	

Annex 3 Mammal species recorded

Mammal abundance was assessed in the same way as for birds (see Annex 2), except that the numbers of signs seen were also taken into account.

Order and scientific nomenclature follow Corbet and Hill (1992). Identification of tracks followed van Strien (1983) and the personal experience of observers. The list is far from complete, and can only be used as an indication of the species present.

Abbreviations:
Abundance codes: C = common; F = frequent; O = occasional; L (prefix) = local;
P = present, abundance not assessed; [ ] = record unconfirmed; † = species not confirmed to be currently present in the Huong Son Forest.

Method of detection: M = remains; C = captive; S = signs; A = sighting/vocalization; R = report;
F = Found in the field; P = Photo-trapped.

Notes:
1. Identified as this species solely on basis of range.

Key Species are highlighted in **bold**

Table 6. Mammal species recorded from the Huong Son Forest area during the survey.

Species	Abundance assessment	Method of detection	Level of identification	
Sunda Pangolin	P	P, C	confirmed	*Manis javanica*
Northern Treeshrew	LC	A	confirmed (1)	*Tupaia belangeri*
Bear Macaque	O	A, P	confirmed	*Macaca arctoides*
Douc Langur	O	A	confirmed	*Pygathrix nemaeus*
White/Yellow-cheeked Crested Gibbon	O	A	confirmed	*Hylobates (Nomascus) leucogenys/ gabriellae*
Sun Bear	P	FM	confirmed	*Ursus malayanus*
Bear	P	S	confirmed	*Ursus*
†Masked Palm Civet	†	C	confirmed	*Paguma larvata*
Owston's Civet	P	P	confirmed	*Hemigalus owstoni*
Crab-eating Mongoose	P	A, FM, [S]	confirmed	*Herpestes urva*
Leopard Cat	P	A	confirmed	*Prionailurus bengalensis*
†[Asian Elephant]	†	[R]	unconfirmed	*Elephas maximus*
Wild Pig sp(p).	P	C, M, S	confirmed	*Sus*
†Sambar	†	M	confirmed	*Cervus unicolor*
Red Muntjac	P	M	confirmed	*Muntiacus muntjak*
†Large-antlered Muntjac	†	M	confirmed	*Muntiacus vuquangensis*
Muntjac sp(p).	P	S	confirmed	*Muntiacus*
†[Gaur]	†	[R]	unconfirmed	*Bos gaurus*
†Saola	†	M, [R]	confirmed	*Pseudoryx nghetinhensis*
†Southern Serow	†	M, [S, R]	confirmed	*Naemorhedus sumatraensis*
Black Giant Squirrel	LC	A	confirmed	*Ratufa bicolor*
Pallas's Squirrel	C	A	confirmed	*Callosciurus erythraeus*
Inornate Squirrel	LC?	A	confirmed	*Callosciurus inornatus*
Cambodian Striped Squirrel	O?	A	confirmed	*Tamiops rodolphii*
Red-cheeked Squirrel	F	A	confirmed	*Dremomys rufigensis*
East Asian Porcupine	P	FM	confirmed	*Hystrix brachyura*
Asiatic Brush-tailed Porcupine	P	FM	confirmed	*Atherurus macrourus*
Annamite Striped Rabbit	P	FM	confirmed	*Nesolagus timminsi*

Annex 4 Turtle and tortoise species recorded

No turtles or tortoises were recorded in the field during the survey. This is the norm in surveys in Indochina, and reflects the massive pressure that is exerted on turtle and tortoise populations from subsistence and commercial exploitation (Jenkins 1995, Le Dien Duc and Broad 1995, Stuart 1999, Timmins and Khamkhoun Khounboline 1999). Two species were found in the possession of wildlife dealers. Accounts of these and additional species recorded by the CBC-AMNH/IEBR (1998) are presented below.

†Big-headed Turtle *Platysternon megacephalum* **DD**
Survey records: a single animal was seen in the possession of one of the wildlife dealers.

CBC-AMNH/IEBR (1998) recorded the species above 900 m in the Rao An valley (specimen AMNH#14142). The species appears at least in Laos to inhabit fast flowing rivers in mountainous areas, and is under considerable pressure from commercially motivated hunting (Stuart 1999).

†Indochinese Box Turtle *Cuora galbinifrons* **GNT**
Survey records: singles were seen in the possession of two of the wildlife dealers. Single old *Cuora* carapaces were also seen in two villages.

In Laos the species appears to be localized to the Annamites and is heavily collected and traded (Stuart 1999).

Keeled Box Turtle *Pyxidea mouhotii* **ARL**
This species was not recorded during the survey.

CBC-AMNH/IEBR (1998) recorded the species below 600 m in the Rao An valley. Most recent records from Laos and Vietnam come from limestone areas (RJT own data).

Impressed Tortoise *Manouria impressa* **GT-VU**
This species was not recorded during the survey.

CBC-AMNH/IEBR (1998) recorded the species above 900 m in the Rao An valley (R. Bain pers. comm. to E.J. Sterling). In Laos the species appears to be widely distributed, but is hunted everywhere (Stuart 1999).

Annex 5 Results of the nocturnal slow-pace spotlighting

Table 7 includes results of the nocturnal survey. Note that a 30-minute period was not elapsed before returning along the same path.

Table 7. Nocturnal slow-pace spotlighting results.

Site	Hours effort	Total contacts	Species Identified	Contact frequency hours/ contact)	Path Type	Ease of survey: ground	Ease of survey: trees	Effectiveness seriously affected by weather and/or moon conditions
Rao An	2	1	[small terrestrial carnivore]	2	Road through valley bottom forest	difficult	medium	No
Nga Doi	4.25	2	[Leopard cat *Prionailurus bengalensis*], Leopard Cat	2.13	Road through degraded slope and valley bottom forest	difficult	medium	No
Rao An	3.3	0	-	~	Path through forest on ridge	easy	easy	Yes
Nam Mac	2.5	0	-	~	Wide path through slope forest	difficult	easy	Yes

Comparative data from evergreen/semi-evergreen forest elsewhere in the region, although probably not appropriate for direct comparison (due to confounding factors such as somewhat different techniques, different seasons, etc.), suggest that nocturnal mammal abundance was low.

Contact frequencies (hours per contact) from evergreen/semi-evergreen forest elsewhere in the region:

Nakai-Nam Theun NBCA (Duckworth 1998 *a*): 1.6, 1 and 0.9
Proposed northern extension to Nakai-Nam Theun NBCA (Duckworth 1998*a)*: 2
Theun-Hinboun Hydroelectric Project area (Duckworth 1998*a*, Evans et al. in prep. *a*): 1.1
Xe Namnoy Hydroelectric Project area (Duckworth 1998*a*, Evans et al. in prep. *a*): 0.7
Phou Xang He NBCA (Duckworth et al. 1994): 1.1
Phou Xiang Thong NBCA (Evans et al. in prep. *b*): 0.9
Xe Pian NBCA (Duckworth et al. 1994): 2.4

Annex 6 Mammal signs found

River surveys

Just over 3 km of the Ran An were surveyed for signs between 6045 IV 236326 and 236297 on the 25 April. The following observations were made:

Calotes type lizards observed twice; probable Calotes type lizard/monitor *Varanus* prints observed four times; probable macaque *Macaca* prints and droppings found at one location; crustacean remains, probably the remains of a scat found once; two active human camps seen.

A length of 2 km of the Nam Mac was surveyed between 6045 IV 183448 and 6046 III 172462 on the 23 May. The following observations were made:

Crustacean remains, probably the remains of scats, were found as follows: probably the remains of two scats together, probably the remains of three scats together, probably the remains of two scats together. Old snareline running away from the river (at a point where a warm mineral spring arose in the river bed), with the following remains: Crab-eating Mongoose *Herpestes urva*, East Asian Porcupine *Hystrix brachyura*.

Neither river stretch surveyed had much suitable substrate for finding tracks, and the Nam Mac was surveyed after water levels had risen substantially, then fallen once again; however, in both stretches substrate was suitable for finding scats. Comparative data from elsewhere suggest that riverine-associated small carnivore densities in the Huong Son Forest are low: for example in areas of Nam Kading NBCA, Nakai-Nam Theun NBCA and its proposed northern extension in Laos signs can be found at a high proportion of sites checked (WCS 1995*a,* 1995*b*, Evans et al. in prep. *a,* Duckworth 1997, Timmins and Evans 1994, Tobias 1997, RJT own data), and the same appears to be true at least in some areas of Thailand (Kruuk et al. 1993, Kruuk et al. 1994).

General surveys

Numbers refer to the number of occasions signs or groups of signs were encountered, with the exception of pig nests. All signs were old unless otherwise stated.

Rao An
24 April: bear claw marks: 6, all old; recent/fresh probable Crab-eating Mongoose prints; seed-filled scat; dog-like scat; pig diggings: 2, all old.
26 April: seed and fruit remains-filled scat.
27 April: bear claw marks: 3, all old; pig diggings: 4 old; pig nests: 2 old.
29 April: bear claw marks: 2, all old; pig nests: 8, all old; probable pig tracks.
30 April: bear claw marks: 3, all old; seed-filled scat: 1 and 2 probable; pig nest: 1 old.
1 May: bear claw marks: 4 all old; probable muntjac tracks: 3 all recent/fresh; pig nests: 5 all old.
12 May: seed and fruit remains-filled scat: 1 fresh.
13 May: oblong droppings.

Khe Tre
2 May: bear claw marks: 2 all old; fresh probable Serow/Saola tracks; pig nests: 3 all old; oblong droppings: 2; crustacean remains probably from an old scat.

Nga Doi
9 May: bear claw marks: 2 all old; oblong droppings.

Song Con
18 May: bear claw marks: 3 all old; civet/cat prints; deer-like pilled droppings.
19 May: pig diggings.

Nam Mac
5 May: carnivore scat.
7 May: fresh/recent tracks of probable Serow/Saola or possibly Sambar.
20 May: pig nest.
21 May: bear claw mark: 5 all old.

Annex 7 Results of the camera trapping

Negatives from the photo-trapping survey have been deposited with the AMNH.

Weather during the trapping period:
7 May: rain/drizzle all day
8 May: rain/drizzle all day
9 May: rain drizzle all morning
10 May: drizzle and rain all of mid to late afternoon, clearing in night
11 May: reasonably dry, couple of spots of rain, short rain early evening
12 May: dry morning, few spots rain early afternoon, drizzle late afternoon, drizzle through night
13 May: dry morning, rain and drizzle most of afternoon
14 May: dry and bright except for brief period of heavy rain in late afternoon
15 May: dry and bright morning, clouding over and brief period of heavy rain in afternoon
16 May: dry and bright day
17 May: cloudy with wind gusts and few spots rain
18 May: dry day
19 May: dry early morning, heavy rain late morning, rain on and off in afternoon, rain in the night.
20 May: rain/fine drizzle all day
21 May: rain early morning, light rain on and off in afternoon
22 May: rain early to mid morning

These observations were generally made at survey sites distant from the actual trapping site, and thus may not reflect the weather there. Weather during the night was not always recorded with certainty.

Moon phase during the trapping period:
Full moons on 30 April and 29 May.

Data from individual traps

When photographs were taken at night or when it was obviously wet they are stated as such in the following notes; those taken during the day or at drier periods have no annotation. Data are given in the following order: date, event number, time, photograph number, trigger, notes on apparent time and weather, other notes.
Trapping hours = the length of time over which photographs were taken.
NVT = No Visible Trigger
NPT = No Photograph Triggered
NPX = No Photograph
#x = event number x
x) = photograph number x

Trap No. 1
Location: within 3 m of stream under secondary vegetation, closed and low canopy with little understory vegetation; 6046 III 168468.
Altitude: c. 350 m
Dates in place: 7 - 17 May.
Trapping hours: c. 237

Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 31 pictures had been taken. Film was finished and changed, unfortunately low battery power failed to rewind the film completely and thus later photographs were lost. Later the same day the trap was stolen, but later still it was recovered.
Event data, photographs and triggers: event data lost. Photographs: 1) RJT; 2) Blue Whistling Thrush *Myophonus caeruleus*; 3) No Visible Trigger (NVT); 4) NVT; 5) NVT, wet; 6) NVT; 7) NVT, night; 8) rat sp., night; 9) NVT; 10) Blue Whistling Thrush; 11) Blue Whistling Thrush; 12) Blue Whistling Thrush; 13) NVT; 14) NVT; 15) Blue Whistling Thrush; 16) NVT; 17) NVT, night; 18) probably a rat sp. or possibly a chevrotain *Tragulus* (consensus of several fieldworkers), note Dr. Pham Trong Anh of IEBR believes the animal depicted to be Masked Palm Civet *Paguma larvata* with certainty; 19) Blue Whistling Thrush; 20) Blue Whistling Thrush; 21) NVT, dawn?; 22) NVT, dawn?; 23) NVT, dawn?; 24) Blue Whistling Thrush; 25) NVT; 26) NVT; 27) NVT; 28) NVT; 29) NVT.

Trap No. 3
Location: on steep slope, where natural trail passed on the upper side of a large tree, lightly logged forest, c. 40 m vertically above the river; 6046 III 167469.
Altitude: c. 400 m
Dates in place: 7 - 22 May.
Trapping hours: c. 293
Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 17 pictures had been taken, retrieved on 22 May. Event data lost before 17 May, the result of the actions of an over-enthusiastic guide on 17 May. When cleaning the receiver unit an ants' nest was found inside. This might explain the peculiar event data starting on 19 May.
Event data, photographs and triggers: event data prior to 17 May lost. 1) RJT; 2) NVT, night, wet, 8 May; 3) NVT, night, wet; 4) leaf; 5) NVT; 6) NVT, night; 7) NVT; 8) NVT, night, damp; 9) NVT; 10) moth, night; 11) NVT, night; 12) NVT; 13) NVT; 14) NVT; 15) NVT, night; 16) NVT, night; 17) NVT; 17 May; event #1, 16.41, 18) NVT; #2, 18.39, 19) NVT, night; #3, 23.12, 20) rat sp., night; 18 May; #4, 21.44, 21) NVT, night, wet; #5, 22.38, 22) NVT, night, wet; 19 May; #6, 17.18, 23) NVT, dusk, wet; #7, 17.19, 24) NVT, dusk, wet; #8, 17.20, 25) NVT, dusk, wet; #9, 17.22, 26) NVT, dusk, wet; #10, 17.25, 27) NVT, dusk, wet; #11, 17.25, NPT; #12, 17.26, 28) NVT, dusk, wet; #13, 17.26, NPT; #14, 17.26, 29) NVT, dusk, wet; #15, 17.26, 30) NVT, dusk, wet; #16, 17.27, 31) NVT, dusk, wet; #17, 17.27, 32) NVT, dusk, wet; #18, 17.27, 33) NVT, dusk, wet; #19, 17.28, 34) NVT, dusk, wet; #20, 17.31, 35) NVT, dusk, wet; #21, 17.32, 36) NVT, dusk, wet; #22, 17.32, 37) NVT, dusk, wet; #23, 17.32, 38) NVT, dusk, wet; #24, 17.33; #25, 17.35; #26, 17.35; #27, 17.36; #28, 17.36; #29, 17.36; #30, 17.36, NPT; #31, 17.37; #32, 17.38; #33, 17.38; #34, 17.38; #35, 17.38, NPT; #36, 17.39; #37, 17.40; #38, 17.40; #39, 17.40, NPT; #40, 17.41; #41, 17.43; #42, 17.44; #43, 17.57; #44, 18.01; #45, 18.09; #46, 18.18, NPT; #47, 18.19, NPT; #48, 18.20, NPT; #49, 18.20, NPT; #50, 18.24, NPT; #51, 18.26, NPT; #52, 18.29, NPT; #53, 18.32, NPT; #54, 18.33, NPT; #55, 18.34, NPT; #56, 18.35, NPT; #57, 18.37, NPT; #58, 18.38, NPT; #59, 18.38, NPT; #60, 18.39, NPT; #61, 18.44, NPT; #62, 18.49, NPT; #63, 19.18, NPT; #64, 19.25, NPT; 20 May; #65, 00.18, NPT; #66, 01.54, NPT; #67, 02.08, NPT; #68, 02.30, NPT; #69, 02.38, NPT; #70, 02.40, NPT; #71, 02.45, NPT; #72, 02.47, NPT; #73, 02.49, NPT; #74, 02.58, NPT; #75, 03.08, NPT; #76, 03.39, NPT; #77, 03.39, NPT; #78, 05.44, NPT; #79, 08.28, NPT; #80, 12.12, NPT; #81, 13.37, NPT; #82, 16.02, NPT; #83, 18.27, NPT; #84, 18.41, NPT; 21 May; #85, 17.40, NPT; 22 May; #86, 07.12, NPT; #87, 08.56, NPT, retrieved.

Trap No. 4
Location: slope with natural opening likely to funnel animals, lightly logged forest, c. 30-40 m vertically above river, good cover of ground herbage in surrounding area; 6046 III 167469.
Altitude: c. 400 m
Dates in place: 7 - 22 May.
Trapping hours: c. 356
Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 18 pictures had been taken, retrieved on 22 May.
Event data, photographs and triggers: 7 May; #1, 11.04, 1) RJT; #2, 11.04, NPT; #3, 13.10, 2) leaf?; 8 May; #4, 14.25, 3) NVT, misted; #5, 14.25, NPT; #6, 15.10, 4) Blue Whistling Thrush, misted; #7, 15.11, 5) Blue Whistling Thrush, misted; #8, 15.11, 6) Blue Whistling Thrush, misted; #9, 15.11, 7) Blue Whistling Thrush, misted; #10, 15.13, 8) Blue Whistling Thrush, misted; #11, 15.13, 9) Blue Whistling Thrush, misted; 9 May; #12, 18.57, 10) moth, night; #13, 18.57, NPT; #14, 19.00, 11) moth, night; 11 May; #15, 13.59, 12) NVT; 12 May; #16, 10.22, 13) NVT; #17, 10.22, NPT; 13 May; #18, 11.14, 14) NVT; 14 May; #19, 07.00, 15) NVT; #20, 07.00, NPT; 15 May; #21, 09.26, 16) Blue Whistling Thrush; #22, 14.39, 17) NVT; 16 May; #23, 19.12, 18) NVT, night; 17 May; #24, 14.01, 19) NVT; 18 May; #25, 09.13, 20) NVT; #26, 11.38, 21) NVT; 19 May; #27, 09.45, 22) NVT, misted; #28, 10.39, 23) Blue Whistling Thrush, misted; #29, 13.32, 24) NVT; #30, 18.25, 25) NVT, night, misted; #31, 18.26, 26) Blue Whistling Thrush, night, misted; #32, 18.26, 27) Blue Whistling Thrush, night, misted; 21 May; #33, 10.42, 28) NVT, misted; 22 May; #34, 09.23, 29) RJT, retrieved.

Trap No. 5
Location: rocky, broad gully, relatively shaded and open, with good cover of low ground herbage in places, relatively many palms, lightly logged forest, c. 40 m vertically above river; 6046 III 165469.
Altitude: c. 430 m
Dates in place: 7 - 22 May.
Trapping hours: c. 355
Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 7 pictures had been taken, retrieved on 22 May.
Event data, photographs and triggers: 7 May; #1, 12.20, 1) RJT; #2, 12.20, NPT; #3, 12.20, NPT; #4, 12.20, NPT; 9 May; #5, 22.03, 2) chevrotain or rat sp., night; #6, 22.03, NPT; 11 May; #7, 16.06, 3) NVT, night; 12 May; #8, 11.36, 4) NVT; #9, 18.50, 5) moth, night; 16 May; #10, 14.27, 6) NVT, night; #11, 20.14, 7) NVT, night; 17 May; #12, 08.50, NPX; #13, 08.50, NPT; #14, 08.50, NPX; #15, 08.50, NPT; #16, 18.47, 8) NVT, night; 22 May; #17, 04.50, 9) NVT, night, wet, misted ; #18, 09.52, 10) RJT, retrieved.

Trap No. 6
Location: in shallow gully on fairly gentle slope, relatively good ground cover, logged over but still reasonable tree canopy, c. 150 m vertically above river; 6046 III 158471.
Altitude: c. 650 m
Dates in place: 7 - 22 May.
Trapping hours: c. 354
Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 7 pictures had been taken, retrieved on 22 May.
Event data, photographs and triggers: 7 May; #1, 14.17, 1) RJT; #2, 18.37, 2) NVT, night, misted; 10 May; #3, 23.38, 3) NVT, night, misted; 13 May; #4, 05.12, 4) NVT, night, misted; 15 May; #5, 15.12, 5) NVT; #6, 20.28, 6) NVT, night; 17 May; #7, 05.05, 7) NVT, night; #8, 09.27, NPX; #9, 09.32, NPX; #10, 20.24, 8) NVT, night; 18 May; #11, 03.27, 9) NVT, night; #12,

03.53, 10) NVT, night; #13, 06.26, 11) small white blur; #14, 08.52, 12) NVT; 19 May; #15, 14.49, 13) Stump-tailed Macaque, misted; #16, 14.51, 14) Stump-tailed Macaque, misted; #17, 14.51, 15) Stump-tailed Macaque, misted; 20 May; #18, 21.49, 16) NVT, misted; 22 May; #19, 05.12, 17) NVT, misted; #20, 11.09, 18) RJT, retrieved.

Trap No. 7
Location: relatively flat slope with natural trails, relatively thick tangled understory, well logged over but with a low but closed canopy; 6046 III 169468.
Altitude: c. 400 m
Dates in place: 7 - 22 May.
Trapping hours: c. 288
Itinerary: set on 7 May, checked on 12 May, checked again on 17 May when 24 pictures had been taken, retrieved on 22 May.
Event data, photographs and triggers: 7 May; #1, 17.13, 1) RJT; #2, 17.13 NPT; 9 May; #3, 01.58, 2) NVT, night, wet, misted; #4, 03.00, 3) NVT, night, wet, misted; #5, 03.26, 4) NVT, night, wet; #6, 06.22, 5) NVT, night, wet; #7, 18.10, 6) two pitta sp. *Pitta,* night; 10 May; #8, 05.33, 7) pitta sp., night; #9, 05.40, 8) pitta sp., night; #10, 05.40, NPT; #11, 05.41, 9) pitta sp., night; #12, 05.43, 10) pitta sp., night; #13, 14.53, 11) NVT, night; 11 May; #14, 21.32, 12) Sunda Pangolin *Manis javanica,* night; 13 May; #15, 00.13, 13) Owston's Civet *Hemigalus owstoni,* night; #16, 00.13, NPT; #17, 00.13, NPT; #18, 06.18, 14) leaf, night, misted; #19, 13.50, 15) NVT, misted; 14 May; #20, 05.20, 16) NVT, night; #21, 05.27, 17) pitta sp., night, misted; #22, 05.29, 18) pitta sp., night, misted; 15 May; #23, 02.15, 19) NVT, night; #24, 11.09, 20) NVT; #25, 13.39, 21) butterfly?; #26, 18.31, 22) NVT, night; 16 May; #27, 15.41, 23) NVT; 17 May; #28, 07.35, 24) NVT; 18 May; #29, 02.41, 25) NVT, night; #30, 07.51, 26) NVT; #31, 09.49, 27) NVT; #32, 15.30, 28) NVT; #33, 22.25, 29) NVT, night, wet; #34, 22.30, 30) NVT, night, wet; 19 May; #35, 00.35, 31) NVT, night, wet, misted; #36, 00.57, 32) NVT, night, wet, misted; #37, 11.51, 33) NVT; #38, 13.30, 34) NVT; #39, 17.28, 35) NVT, night, wet; #40, 17.36, 36) NVT, night, wet; #41, 17.53, 37) NVT, night, wet, misted, film finished; #42, 18.21; #43, 18.22; #44, 18.24; #45, 18.24; #46, 18.24, NPT; #47, 18.25; #48, 18.25, NPT; #49, 18.56; 20 May; #50, 02.23; #51, 12.01; #52, 18.04; 21 May; #53, 13.48; #54, 17.50; 22 May; #55, 08.01; #56, 12.13, retrieved.

Trapping rates

Note only 278 hours of data have been used from trap #3. Data from traps are combined. Photographs taken within five minutes of one another are treated as the same non-independent event. The same rationale has been taken with multiple photographs of birds in the same time period. Note independence of photographic events cannot be determined for trap #1, and for most of the data from trap #3. Trapping rates calculated as percent of photographs and photographs per 24 hours (p/h), based both on using and not using consideration of independence.

Results irrespective of independence of photographic events:
Total trapping hours: 1868
Total photographs: 136
No visible trigger: total = 94; 1.21 p/h; 69 %
Falling leaves: total = 3; 0.04 p/h; 2 %
Moths and butterflies: total = 5; 0.06 p/h; 4 %
Birds: total = 25; 0.32 p/h; 18 %
Mammals: total = 9; 0.12 p/h; 7 %

Results taking into account independence of photographic events:
Total trapping hours: 1387
Photographs: independent = 76
No visible trigger: independent = 59; 1.02 p/h; 78 %
Falling leaves: independent = 2; 0.03 p/h; 3 %
Moths and butterflies: independent = 3 ; 0.05 p/h; 4 %
Birds: independent = 7; 0.12 p/h; 9 %
Mammals: independent = 5; 0.07 p/h; 7 %

Further notes

Negatives should be checked for triggers at the edge of the frame as often the photographs as printed are generally cropped somewhat.

The delay between the breaking of the infra-red beam and the taking of a picture is of such a length that fast-moving animals are likely to be missed. One solution would be to have two cameras per trap so that the areas leading up to the trap on both sides could be covered. Two cameras would also have the added advantage of two angles on the same subject which would aid identification of species such as muntjacs and pigs, and allow better individual identification of species with variable markings.

Annex 8 Evidence of hunting, wildlife trade, and illegal logging activity found

Rao An

Several groups of people were seen on a daily basis traversing the road along the Rao An valley bottom, and two active camps were found along the river. A group of three logging buffalo were seen entering the area. A lorry was seen bringing timber out of the Rao Bun valley. Small timber piles were seen at five points along the Rao An valley road, at the end of trails leading to the slopes. An active camp of c. five people was found logging in the upper Rao Bun valley. A total of three snarelines was found in the Rao An valley. In the upper Rao An Tren valley four snarelines, two active and seven old campsites, and one active Dau De oil extraction camp was found. At one of the active campsites with two people in occupation the remains of Red Muntjac *Muntiacus muntjak,* pig sp. *Sus* and Asiatic Brush-tailed Porcupine *Atherurus macrourus,* and a recently killed Sun Bear *Ursus malayanus* were found. The other active camp was of a group collecting Cay Nha resin. A group of three people who had reportedly been snaring were met leaving the area.

Khe Tre

At least three active campsites were found along the river, and one snareline was seen in the upper valley. Timber appears to be still being gathered from the valley.

Nam Mac

Four snarelines found, one with the remains of a murid rodent and Annamite Striped Rabbit *Nesolagus,* another with the remains of a Crab-eating Mongoose *Herpestes urva* and East Asian Porcupine *Hystrix brachyura,* and a third with the remains of a pheasant and a small carnivore. Two groups were found logging in the valley, and numerous other logging trails were seen. Cut logs in piles ready for collection were found as follows: c. 25 logs, c. 30 logs. Many old campsites were found.

Song Con

Three groups were found actively logging in the area, two of the groups were using five or more buffalo and the third an unknown number. Cut logs in piles ready for collection were found as follows: 67 logs, 117 logs, 47 logs. Several other logging trails were seen as well as old campsites. People obviously engaged in logging were seen leaving the village of Doi 7 on two separate dates. Two groups of loggers were seen with snares in their possession, but the remains of only two old snarelines were found. Freshly dead male Red Muntjac *M. muntjak* seen in a village in the lower Song Con valley.

Dai Kim (village)

Wildlife dealer #1: 3 May, pig sp. *Sus* remains seen from an animal apparently sold the same morning, several Black-throated Laughingthrushes *Garrulax chinensis*.

Wildlife dealer #2: 4 May, live pig sp. *Sus* and a Masked Palm Civet *Paguma larvata*. 13 May, dead pig sp. *Sus*, several Black-throated Laughingthrushes *Garrulax chinensis,* and Spotted Dove *Streptopelia chinensis.* 23 May, Indochinese Box Turtle *Cuora galbinifrons.*

Trung Tam (town)

Wildlife dealer #3: 4 May, live Sunda Pangolin *Manis javanica* and Grey Peacock Pheasant *Polypectron bicalcaratum*. 10 May, Indochinese Box Turtle *C. galbinifrons.* 7 May, Big-headed Turtle *Platysternon megacephalum*.

Additionally old trophies of Red Muntjac *M. muntjak*, Large-antlered Muntjac *Muntiacus vuquangensis,* Sambar *Cervus unicolor,* Southern Serow *Naemorhedus sumatraensis* and Saola *Pseudoryx nghetinhensis,* old box turtle *Cuora carapaces,* and caged birds (Black-throated Laughingthrush, Spotted Dove, Oriental Magpie Robin *Copsychus saularis* and Hwamei *Garrulax canorus*) were seen in many houses in the Huong Son Forest area.

Annex 9 Huong Son Forest history

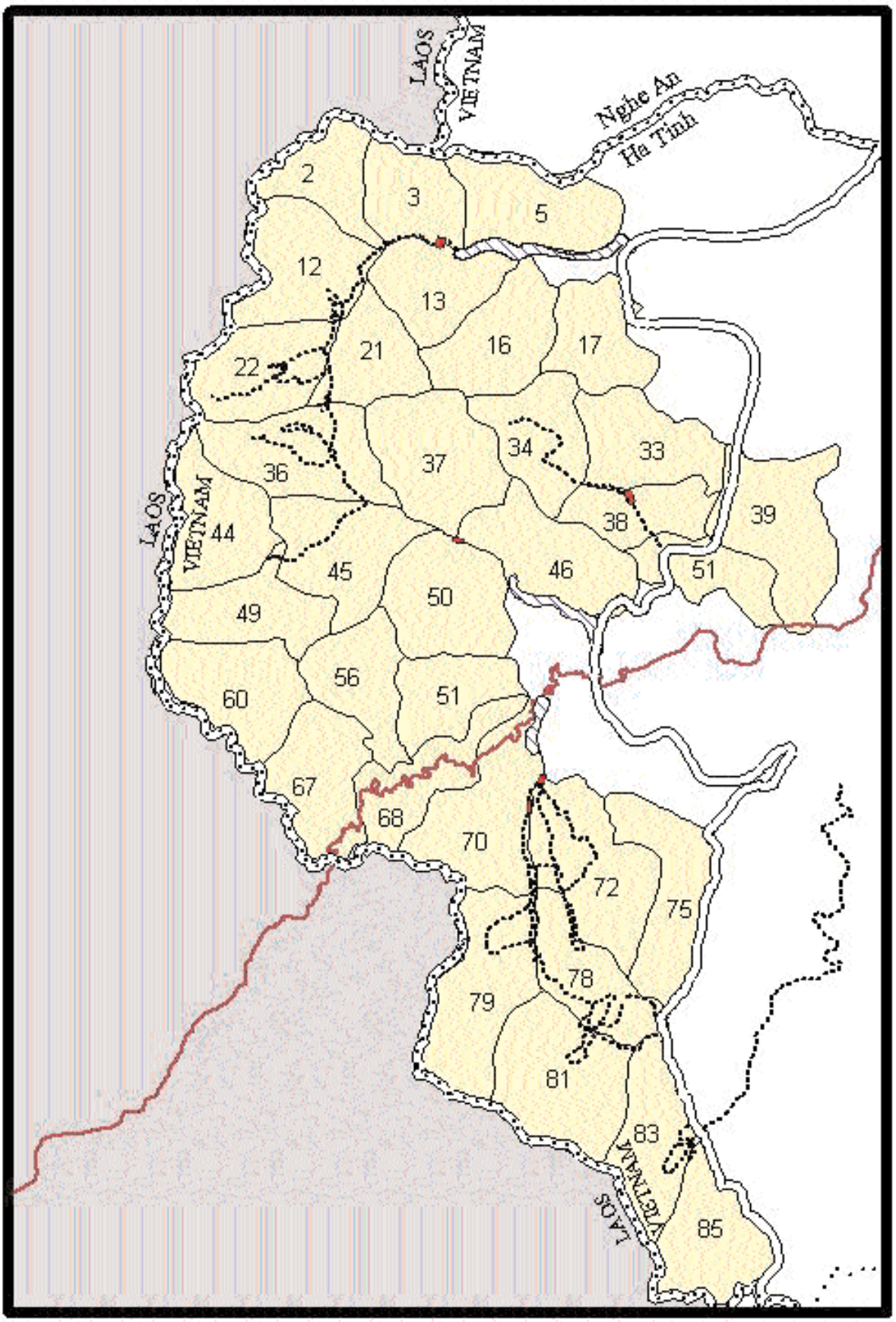
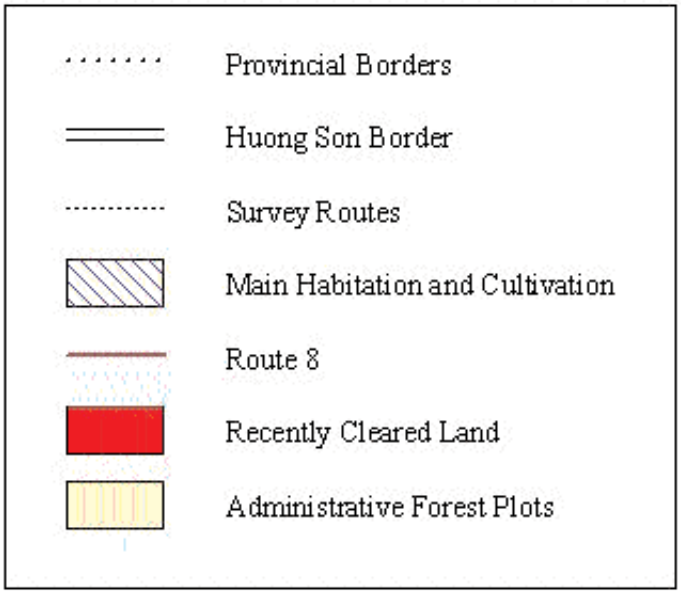


Figure 3. The division of the Huong Son Forest and surrounding lands into administrative forest plots.



Notes: It was not possible to map many of the eastern plots covering the Huong Son District. The accuracy of the forest plot boundaries that are shown is unknown.

Source: 1965-1970 1:50,000 L7014 US Department of Defense, US Army Topographic Command, Washington, D C. Forest plots courtesy of WWF Indochina Programme, Vietnam

Division of the Huong Son Forest by plots is shown in Figure 3, based on Lam Truong-Huong Son (1996). Information in this section comes from Lam Truong-Huong Son (1996) and Trinh Hong Minh and Nguyen Huu Can (pers. comm. 1999).

The following plots are managed by the Huong Son Forest Enterprise and have been logged as indicated. Logging was not necessarily continuous between dates, and logging on any occasion generally did not occur throughout a plot; rather, generally the logging front advanced forward through a plot over time. NL = not officially logged.

Rao An
68: NL
70: 1979-1984
72: 1996
73: NL
78: 1995
79: NL
81: NL
83: NL
85: NL

Nam [Nuoc] Sot
44: NL
49: NL
56: 1992-1996
60: NL
61: 1992-1997
67: NL

Nam [Rao] Mac
36: 1987-1993
37: 1987-1997 with renewed activity in 1999
45: 1987-1993
46: 1986-1997
50: 1987-1997

Nga Doi
33: 1973-1998
34: 1973-1999
38: 1973-1998
39: 1973-1998
51: 1973-1998

Song Con
2: 1972-1986
3: 1972-1986
5: 1973-1985
12: 1985-1989
13: 1973-1986
16: 1973-1986
17: 1973-1986
21: 1985-1989
22: 1985-1989

The following plots are no longer within the jurisdiction of the Huong Son Forest Enterprise:

The international border army controls plots 54 and 63.

Song Hong Commune controls plots 1, 4, 7, 8, 11 and 18.

Song Linh Commune controls plots 27, 28 and 35.

Song Tay Commune controls plots 40, 47, 58, 59, 65 and 66.

Song Kim Commune controls plots 55 and 64.

Vu Quang Nature Reserve controls plots 74, 75, 76, 77, 80, 82 and 84

It was not established who controls plots 31, 57.

Annex 10 Justification for a biogeographic division of east and west Annamite slopes

On the basis of restricted-range species and species with "near" restricted ranges, a clear bias to distribution centered on the eastern Annamite slope can be seen; no restricted-range or "near" restricted-range species appear to have distributions centered on the western Annamite slope.

Restricted-range and "near" restricted-range species with distributions centered on the eastern Annamite slope:

Imperial, Edwards', and Vietnamese Pheasants *Lophura imperialis*, *L. edwardsi* and *L. hatinhensis*: Only known from the Vietnamese lowlands (Robson et al. 1993*a*, Collar et al. 1994, Eames et al. 1994, Eames and Tordoff in prep.), no positive evidence from Laos (Timmins and Khamkhoun Khounboline 1996, Thewlis et al. 1998, Duckworth et al. 1999, Walston and Vinton 1999).

Crested Argus *Rheinardia occellata*: Widespread in Vietnam (Robson et al. 1993*a*, Robson et al. 1993*b*, Collar et al. 1994, Eames et al. 1994, Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999, Timmins et al. 1999, Eames and Tordoff in prep., J. C. Eames pers. comm., this study). In Laos restricted to forest areas close to the international border and common only in localized areas, absent from the majority of forest areas further west (Thewlis et al. 1998, Duckworth et al. 1999).

Short-tailed Scimitar Babbler *Jabouilleia danjoui*: Common in Vietnamese forest, including international border areas over an altitude range which would not prevent the species from crossing the Annamites (Robson et al. 1993*a,* Robson et al. 1993*b,* Eames et al. 1994, Timmins et al. 1999, Eames and Tordoff in prep., J. C. Eames pers. comm. 1998, this study). Very few records from Laos, all from areas close to the international border (Tobias 1997, Thewlis et al. 1998, Duckworth et al. 1999, W. G. Robichaud pers. comm. 1999), which are thought (for other reasons) to be climatically similar to the eastern Annamite slope (RJT own data).

Owston's Civet *Hemigalus owstoni:* sporadic but widespread records (Schreiber et al. 1989, Rozhnov et al. 1992, Eames et al. 1994, Timmins et al. in SFNC/EC 1998*a*, Timmins et al. 1999, S. Heard Rosenthal pers. comm. 1998, this study) from Vietnam contrast with relatively few records from Laos (Duckworth 1997, Duckworth et al. 1999). The very few records from Laos, all of captive animals, reportedly came from close to the international border (Duckworth 1997, Duckworth et al. 1999), which are thought (for other reasons) to be climatically similar to the eastern Annamite slope (RJT own data).

Saola *Pseudoryx nghetinhensis:* Widespread records from Vietnam (Vu Van Dung et al. 1993, Vu Van Dung et al. 1994, PFPD Quang Nam 1996, Kemp et al. 1997, Nguyen Xuan Dang et al. 1998, Timmins et al. in SFNC/EC 1998*a*, Le Trong Trai et al. 1999*b*, Timmins et al. 1999, Mallon and Eames and Tordoff in prep., WWF Indochina Programme files [two separate records from Thua Thien Hue province]) contrast with localized and comparatively fewer records from Laos (Schaller and Rabinowitz 1995, Robichaud 1997, Timmins in prep. *b,* Robichaud 1999, Robichaud pers. comm. 1999)

Restricted-range or "near" restricted-range species that, although widespread on both sides of the Annamites in the south, have a distribution centered on the eastern Annamite slope in the northern parts of their distribution:

Black-browed Fulvetta *Alcippe grotei*: Found commonly in Pu Mat NR, Ke Go NR, Cuc Phong NP, Phong Nha-Khe Bang NP (Eames et al. 1994, Round et al. in SFNC/EC 1998, SFNC/EC (Round) 1999, J. C. Eames pers. comm. 1998, this study). In Laos not found north of the southern part of Hin Namno NBCA (Thewlis et al. 1998, Duckworth et al. 1999, Timmins et al. in prep. *a*).

Grey-faced Tit Babbler *Macronous kelleyi*: Found widely in the Vietnamese areas of the NAPAC and areas further east (Robson et al. 1993*a,* Robson et al. 1993*b,* Eames et al. 1994, this study), but not found in any areas of the NAPAC in Laos (Thewlis et al. 1998, Duckworth et al. 1999).

Of species endemic or near-endemic to Indochina, several show distributions in the NAPAC area centered on the eastern Annamite slope including: Pied Falconet *Microhierax melanoleucos*, White-winged Magpie *Urocissa whiteheadi,* Indochinese Green Magpie *Cissa hypoleuca,* Ratchet-tailed Treepie *Temnurus temnurus,* Crested Myna *Acridotheres cristatellus* and Fork-tailed Sunbird *Aethopyga christinae.* Again no species shows the converse distribution.

A further notable pattern in the distribution of faunas across the Annamites is a westward displacement of the eastern Annamite fauna across the main Annamite ridge in areas of Bolikhamxai and Xiangkhouang Provinces in Laos; Indochinese Green Magpie, Crested Argus, Owston's Civet and Saola all appear to show such a pattern.

Apparently only two Southeast Asian endemic species are much scarcer on the eastern Annamite slope in comparison with the western slope in the NAPAC area: Siamese Fireback *Lophura diardi* and Moustached Barbet *Megalaima incognita*.