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A Wildlife and Habitat Survey of Phou Xang He Proposed Protected Area

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A wildlife and habitat survey of Phou Xang He proposed protected area, Savannakhet, Laos

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A report to the Protected Areas and Wildlife Division of the National Office for Nature Conservation and Watershed Management Vientiane, Laos

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Main findings

Phou Xang He proposed protected area (PXH) covers 1140km^2 of south-central Laos (16^{o}42' - 17^{o}04'N, 105^{o}19' - 106^{o}06'E) mainly at 200-500m altitude. The hilly regions of Phou Xang He itself and of Phou Hinho are separated by a flatland Corridor. The first two are largely intact in terms of habitat though are being degraded from their edges inwards, while the Corridor is much degraded and its relict areas of forest are becoming increasingly isolated.

The hilly areas support Evergreen and Semi-evergreen forests, with clear floristic differences between the two ranges reflected by the bird and mammal communities. Evergreen/Semi-evergreen forests (including the remaining isolates in the Corridor) support the highest concentrations of key wildlife species of any habitat in PXH. Mixed deciduous forests contain fewer key species; they grow primarily in the flat areas and so are consequently threatened. Dry dipterocarp forest dominates much of the flat areas but was found to be of conservation importance only for two regionally-threatened bird species. It is less at risk than the other flatland forest-types.

Most bird species to be expected at these altitudes in southern Laos were found, including a satisfying complement of globally- and regionally-threatened species (17 in total). The area supports large populations of most of these 17. There were no major surprises but the absence of certain others (vultures and large waterbirds) could be worrying.

PXH supports of a rich assemblage of large mammals (big cats, bears, wild cattle and elephants). Mammal survey effort concentrated on the nocturnal mammals of the Corridor forests where two little-known species were found (Large-spotted Civet *Viverra megaspila* and Pygmy Loris *Nycticebus pygmaeus* ; both may be the first records from few protected areas anywhere within their ranges). During the dry season Elephants *Elephas maximus* cannot find enough water in the hills and visit water sources in the Corridor.

The Corridor is important as a forested link between the two hill ranges but is the part of PXH most threatened by shifting cultivation and other uses. It has a high priority for management implementation.

Despite current levels of hunting, most animal species probably persist in PXH because of the sheer size of the forests; however two globally threatened primates with extremely restricted world ranges have been hunted out from sections of the forest (Douc Langur *Pygathrix nemaeus* and a gibbon *Hylobates* as yet unidentified). Very large species, especially wild cattle, are probably also at risk.

Recommendations

Sections of the Corridor where existing vegetation could be conserved to maintain an ecological link between the two hill areas must be protected quickly in view of the ceaseless piecemeal degradation of remaining Corridor forest. Three suitable areas are detailed.

Hunting of Douc Langurs and gibbons must be halted as soon as possible.

Future survey needs in PXH are visits to as yet unsurveyed areas, establishment of ranges of key species at all seasons and a better understanding of the patterns of human use (hunting and forest clearance in particular).

Detailed recommendations concerning the boundary are given.

Abbreviations

a.s.l. above sea level
DBH diameter at breast height (primarily applied to trees)
DDF Dry dipterocarp forest
DWFC Department of Wildlife and Fisheries Conservation (now known as PAWD)
EF Evergreen forest
MDF Mixed deciduous forest
NONC National Office for Nature Conservarion and Watershed Management
PAWD Protected Areas and Wildlife Division
PPA proposed protected area
PXH Phou Xang He PPA
SEF Semi-evergreen forest
SFA Selected Field Area

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1 GENERAL BACKGROUND AND OBJECTIVES

1.1 TERMS OF REFERENCE

A team of three British biologists and two Lao counterparts surveyed the wildlife of the Phou Xang He proposed protected area (PXH), which falls in part in the Selected Field Area (SFA) Phin, from 20 March to 21 April 1993, following a reconnaissance visit from 17 to 20 February 1993. Over a period of approximately 30 working days the following terms of reference were met:

1.1.1 Habitat-specific

a) A description of habitat types occuring in the Phou Xang He and Phou Hinho hill ranges, the Corridor which lies between the two areas and the flat land to the west and south of Phou Xang He.
b) An assessment of overall habitat conditions with particular reference to settled parts of the study area and the use of resources by the local population.
c) The identification of threatened habitats within the study area and an evaluation of the relative importance of habitat to selected wildlife species.

1.1.2 Wildlife-specific

a) The determination of the status of species of conservation interest.
b) A list of bird and mammal species confirmed to occur in each habitat, with assessments of status.
c) The provision of a detailed description of survey methodology.
d) The collection of incidental observations on hunting methods, levels and localities.

1.2 SITE DESCRIPTION

The Phou Xang He proposed protected area is about 85km northeast of Savannakhet town (16^{o}42' - 17^{o}04'N, 105^{o}19' - 106^{o}06'E). The area (Figs 1 and 2) consists of two largely forested hill ranges, mostly at 200 - 500m altitude, orientated northwest-southeast. The two ranges are divided by a flat Corridor, 6-10km wide, containing many villages and forest fragments. Boundaries proposed in July 1993 enclose 1140km^{2}; the present survey considered a total of 1750km^{2}. PXH is surrounded by flat plains and drained largely to the south by two main rivers (Xe Xangxoy and Xe Thamouak).

The area adjoins, in its southeastern part, the SFA Phin, established by the Lao-Swedish Forestry Programme (under the Department of Forestry). The management priorities were stated in January 1993 after a preliminary survey as being the gathering of more detailed information on ecological and socioeconomic characteristics of the area and the integration of PXH planning and management with that of the SFA.

Phou Xang He is a large sandstone formation dominated by semi-evergreen and deciduous vegetation enduring marked drought conditions in the dry season. Phou Hinho is a steeply hilly igneous formation with narrow ridges and valleys, supporting predominantly evergreen forest with many moist areas. Most streams in Phou Hinho are probably perennial whilst even major rivers in Phou Xang He are seasonal. The Corridor separating the two hill ranges contains a large number (30) of settlements resulting in widespread habitat degradation. The southern parts of PXH are flat, mainly lateritic and dominated by dry dipterocarp forest.

1.2.1 Phou Xang He

Phou Xang He is a large sandstone plateau sloping gently towards the southwest and very steeply towards the northeast. The higher grounds along the ridge are at 500-700m a.s.l., reaching 730m. Wide parallel river valleys (particularly the Xe Kong, Xe Kang and Houey Gnang) lead south to the Xe Xangxoy-Xe Kasok catchment. Geologically, it is formed by middle "Indosinias", sandstone clays (marnes) of red saliferous soil (French geological survey, details at Division of Inventory, Vientiane).

Throughout Phou Xang He shallow soils are common and the underlying rock is frequently exposed. Rocky barren land is present from the northern ridge down to the Xe Xangxoy river near Ban Nalay and, from aerial photographs, appears to occupy larger areas in the northwest. Forest-type distribution is probably determined by edaphic conditions with Mixed deciduous forest and, to a lesser extent, Dry dipterocarp patches occupying shallower soils or the steepest and rockiest terrains and Semi-evergreen forest being present where the soils are better.

1.2.2 Phou Hinho

The Phou Hinho hills are located to the east of the Xe Thamouak valley and delimited to the south and east by route 9 between Ban Xethamouak, M. Phin and Xepon and to the north and northeast by the Xe Namkok. The area covers 332km^2 with the highest point being Phou Lom (818m). Geologically it is mainly an igneous formation containing granites, gneiss, micas, dacites, rhyolites etc. (French Geological Survey map, Division of Inventory, Vientiane). Numerous steep hills ranging between 400 and 800m a.s.l. are separated by deep valleys with short streams which drain mostly into the Xe Thamouak.

The lower slopes, river valleys and ridges are dominated by Evergreen forest which does not occur on Phou Xang He. Whereas the northwestern and eastern boundaries of the forest are clearly defined by the surrounding agricultural landscape, to the southwest the forest intergrades with Semi-evergreen and Mixed deciduous forests.

1.2.3 Corridor

A lowland Corridor lies between Ban Muangsen to the north and Ban Xethamouak in the south. It rises slightly towards the north on gently rolling landscape forming the Xe Thamouak catchment; this is delimited by the slopes north of Ban Naphilang leading into the catchment of the Xe Bay which flows towards the northwest. The Xe Thamouak, maintained by the streams flowing from the Phouh Hinho hills, is virtually dry upstream at Ban Katep and Ban Phongsavang during the dry season. Settlements have developed along the Xe Thamouak river, its tributaries and the main Corridor road.

1.3 ACCESS

The area is easily reached from Savannakhet via route 9, an all-weather road. Numerous seasonal roads lead from there to the reserve area.

1.3.1 Phou Xang He

Road: The eastern and northern fringe is accessible for most of its length from the road running through the Corridor and then to rhe northwest. From the south, the road to Ban Nalay was recently repaired but the village is the other side of a river which can only be crossed on a footbridge or by boat. A track to the village of Ban Tin-Gnalong was apparently not accessible by vehicle. Reportedly, one could drive north to "good" forest by the Xe Kang from Ban Namouang in the south.

Foot: The hilly area can be visited only on foot. Several good paths lead into the interior from most adjacent villages; in particular, there are many from Ban Nalay, often following wide and flat river courses. From the north and east, all villages have good paths leading to the top of Sayphou Xang He and there are some from Ban Phongsavang to the Xe Kong river. Within the forest itself paths are generally few and poorly defined.

1.3.2 Phou Hinho

Road: Access is only known for the western portion of the study area; the Corridor road runs along the western fringe. No roads penetrate the interior.

Foot: The local population makes little use of the forested area and few paths lead into the core of Phou Hinho.

1.3.3 The Corridor

Road: A seasonal road the length of the Corridor branches towards Ban Nathou at the height of Ban Nathom Xe. Villagers travel mostly by bicycle, motorbike and horse-drawn cart. Many logging lorries use the road.

Foot: Paths from the road and numerous villages permeate the entire area.

1.3.4 Access points used

The Corridor villages from Ban Ngoikasan to Ban Muangsen were used as access for most of the area. The forest around Ban Nalay was also surveyed and brief visits were made to many peripheral areas. Figs 3 and 4 show the areas visited and access points used.

2. METHODS

2.1 CONVENTIONS IN TERMINOLOGY AND LIMITATIONS

2.1.1 Conventions

The Phou Xang He Proposed Protected Area as a whole is referred to as PXH, to distinguish it from discussion specific to the Phou Xang He hills themselves. The hills in the south-eastern portion are referred to as Phou Hinho. The northern section of the Xe Thamouak Valley, which separates these two hilly areas, is called the Corridor.

Names of villages and natural features have been taken from the Service Geographique d'Etat 1:100,000 series of maps (sheets: E-48-104, 105, 116, 117, 128 and 129). There are sometimes discrepancies between map names of villages and those in verbal use; furthermore, some villages are unmapped (Annex 1). The study sites and villages referred to in the text are shown in Fig. 3; map names are used throughout.

Mammal nomenclature and systematics

Corbett and Hill (1992) has been followed for species limits and scientific nomenclature. Where the former are volatile, information has been given to allow interpretation under alternative classification. Some English names have been modified where appropriate.

Bird nomenclature and systematics

Species limits, English and scientific names have all been taken from Boonsong Lekagul and Round (1991); for species not covered in this book, the nomenclature of King *et al*. (1975) has been used.

2.1.2 Limitations

1. The northern and eastern parts of Phou Hinho and the western area of Phou Xang He were not visited due to security problems in the latter area and poor road conditions.
2. Unexploded wartime material throughout the area made it unwise to leave established trails; some promising animal sounds could not be followed up.
3. Communication obstacles and the novelty of the team's presence often made the planning of itineraries difficult; this was occasionally exacerbated by discrepancies in place names between the maps and common usage.
4. Local informants probably detracted from some areas which it would have been productive to survey (there were inconsistencies in prior advice, and later information leaked out that areas not recommended were in fact productive at the time of the survey). This gave particular problems in assessing the status of large mammals.
5. Mammal survey effort was targetted towards a few selected localities and the least-known species. This approach resulted in important discoveries but it means that comparison between regions and habitats of PXH is inappropriate because of the widely-varying survey effort between them.

2.2 METHODS: HABITAT SURVEY

Information was gathered by non-random sampling in high priority areas as well as during discussions with local people and from incidental observations. The aim was to identify forest-types present, non-forest habitats and locate within them critical habitats, determine the extent of disturbance and identify priorities for conservation management.

2.2.1 Village inquiries

Villages were selected as study sites on the basis of previous interviews undertaken by the DWFC. Informal enquiries were made about the best places for wildlife, recent sightings of key species, the nature and condition of forest in areas they recommended, and the presence of salt licks and access routes.

A short questionnaire was later formulated concerning the Corridor area concerning the amount of cultivated land in each village's territory and the area cleared for agriculture (Annex 4).

2.2.2 Habitat evaluation

To gain an overview of the area's habitat, routes of variable length (due to the presence of unexploded ordinance, the itinerary was chosen by the local guides) were followed with the intention of visiting as many

areas as possible: approximately 147km of tracks and paths in the study area, 80% on foot were surveyed in nine lines (Fig. 3). These nine matrix lines traversed disturbed areas; habitat was similarly categorised on an opportunistic basis in less disturbed areas. Distances were paced, a suitably accurate method when maps or the vehicle odometer allowed comparisons.

Seven basic vegetation categories were distinguished:
1. Phou Hinho Evergreen forest (EF)
2. Phou Xang He forest
3. Corridor Evergreen/Semi-evergreen forest
4. Mixed deciduous forest (MDF)
5. Dry dipterocarp forest (DDF)
6. Cultivation
7. Scrub

Additionally for some purposes, scrub and cultivation were separated as in Table 2. The forests of Phou Xang He were a fine matrix of Semi-evergreen (SEF) and Mixed deciduous forests containing numerous grassy and scrubby glades, but the three habitats have been treated together for most purposes as they intergrade and share similar threats. The Evergreen and Semi-evergreen forests in the Corridor were very similar to those of the adjacent hills, except in terms of degradation. Because of their shared threats, similar wildlife communities, and the close proximity of patches of each to each other, they are treated as one functional unit in this report.

Forest was classified into four categories of degradation (Table 1); ten different features of non-forest land were recorded (Table 2).

Table 1: categories of forest degradation attributed to forest types present in PXH.

Clear-felled forest (land):
recently-cleared forest.
Heavily-disturbed forest:
containing a substantial proportion of felled or damaged trees, stumps, old or recent;
showing removal, absence or severe alterations to one or more natural layers;
burning of the understorey, recent or current.
Disturbed or semi-natural forest:
with good secondary forest regeneration following past disturbance or moderate logging;
with some stumps and other signs of disturbance, but not affecting general structure.
Natural forest:
without noticeable signs of disturbance .

Table 2: selected indicators of human disturbance and water sources.

1.	**Settlement**: villages (X) or isolated seasonal huts (I)
2.	**Shifting cultivation**: bananas, vegetable gardens etc.
3.	**Rice paddies**
4.	**Pasture**: abandoned rice paddies, grazing.
5.	**Scrub:** cleared areas reverting to wooded land with stunted vegetation, shrubs and sometimes grassland. Often impenetrable vegetation on formerly forested land.
6.	***Eupatorium* scrub**: scrub dominated by *Eupatorium odoratum* (Compositae), a good indicator of recent forest clearance or major disturbance (Vidal 1958).
7.	**Scattered trees**: including forest species evincing former forest.
8.	**Bamboo groves**: sparse to absent tree cover, bamboo sometimes to 30m. Can be naturally occuring.
9.	**Bamboo**: in patches (X) or the understorey (U), often a result of repeated burning of the shrub layer.
10.	**Burning**: large (B) or small (b) scale burning.
11.	**Pools**: (**D**, dry or **W,** containing water at the time of survey)
12.	**Rivers and streams**: (D or W as above)
13.	**Other**: numbering referred to annotations accompanying tables

Rating of habitats

Rating of habitats for their wildlife value and imminence of threats is strongly connected to their position within the study area and confounded by the varying proportion of survey effort for each habitat type. Generalisations may be misleading. However, for summarisation purposes the different areas and habitats have been ranked according to management urgency to highlight which areas should receive attention soonest (sect. 6.1).

2.2.3 Sampling of forest structure

The Evergreen forests on Phou Hinho, Semi-evergreen forests of Phou Xang He and both in the Corridor were the most important habitats for wildlife (sects 4.3, 6.1) and accordingly these forests were structurally categorised (Annex 3). In 20 plots for each of these forests, structural features were recorded by sampling 15m radius (30m for canopy observations) circular plots within homogeneous areas of vegetation for classification and physiognomic description.

2.3 METHODS: BIRD SURVEY

2.3.1 Finding birds

Birds were surveyed primarily by diurnal field observation from paths which showed little sign of current use and which could be walked quietly. Streams were also used, particularly on Phou Hinho where no well-defined trails were found. Progress along stream beds was not so quiet and dense fringing vegetation often obscured birds within the forest. Although guides were used on initial forays, observations were conducted alone on the same routes to reduce disturbance and so increase sighting rates. The observer moved through the habitat in the way likely to maximise sighting rates. Mixed flocks were checked carefully and some time was spent sitting and watching at selected points, particularly:

- fruiting trees (of which there were many at the time of the survey).
- areas of broken canopy (scanning for overflying species).
- areas of surface water.

Ground-living birds such as pheasants and pittas are best recorded by walking quickly and quietly along paths with little leaf litter and with good understorey visibility to either side. The noticeable absence of such paths, particularly in the Phou Hinho area, hindered detection of these birds.

A tape recorder was used for unknown calls and songs, both for later identification, and for luring out skulking species at the time. Some calls remain unidentified, but are likely to result in retrospective findings. Pishing (squeaking sounds produced using the lips and hand) was also used to draw out some birds.

One observer concentrated on searching for birds, with the primary aim of locating species of high conservation interest ('key species') rather than producing exhaustive species lists for each habitat. Key bird species are those listed in any of the following three sources:

Collar and Andrew (1988): Red Data Book species, i.e. those threatened or near-threatened with global extinction. Round (1988), Uthai Treesucon and Round (1990): species threatened in Thailand (there is no comparable list for Laos or Indochina).

2.3.2 Areas surveyed

Birds were surveyed extensively in Phou Hinho, Phou Xang He and the Corridor (Fig. 4). From previous experience (particularly in Xe Piane PPA) most key species were expected to inhabit forest. As forests in flatter areas were under imminent threat, most effort was directed towards these areas.

2.3.3. Assessment of status

At each site 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.

The three bands of abundance can be loosely defined as follows, for a medium-sized bird of average detectability:

Common: seen daily, often in large numbers, in favoured habitat
Frequent: seen on most days favoured habitat is visited, but not usually in large numbers
Occasional: seen only occasionally, on fewer than half the days

Three to five days were needed in a new area of forest to make a fair assessment of bird species present and their status, especially as several key species are difficult to detect. Only in areas where it was felt that several further key species remained undetected were extra days spent. More cursory visits were made to less important habitats. This approach maximised the information gained on key species and areas supporting concentrations of them, but means that poor areas appear disproportionately so.

Especially for key species, careful notes were taken on tolerance to habitat degradation and fragmentation. All breeding indications and other interesting ecological observations were recorded.

2.3.4 Assessment of threats

Field observations of birds were carefully related to forest condition. Information about status in degraded or fragmented forest helps reveal species likely to be most threatened by further habitat degradation. It should be interpreted cautiously, because the large, intact forests on Phou Hinho and Phou Xang He are close population sources of forest birds for the Corridor isolates. Thus, birds may be recorded, sometimes very frequently, using degraded areas, when they could not survive in such areas. Similarly-degraded forest surrounded by agricultural land would almost certainly support only a small fraction of the species found in the forest isolates here. Also, it is difficult to assess the bird communities of an area unless it is visited throughout the yearly cycle. The several key species discovered in poor-quality forest should not be seen as adapting well to habitat degradation, unless similar findings come from throughout the species's geographical and habitat range at all times of year.

Direct persecution was observed and recorded by all the team on an opportunistic basis. Systematic questioning of hunters on methods, target species, and hunting results was not undertaken as such work was not particularly appropriate to the expertise of the team members.

2.4 METHODS: MAMMAL SURVEY

2.4.1 Field methodology

Mammals are much harder to survey than are birds particularly in tropical forests. Many bats, shrews and small rodents are impossible to identify under field conditions, so were not surveyed because of internal restrictions on the collection of specimens. In addition, such groups are so poorly known that information gained is often in a rather limited context and not of great immediate conservation benefit. Therefore, survey effort was restricted to mammals identifiable in the field (carnivores, ungulates, primates, squirrels and others). Interviews around PXH in January 1991 and October 1992 by DWFC staff revealed an impressive complement of species of conservation importance (Table 18), so field work on large mammals was deemed a high priority. Field searching, especially by night, was selected as the main method as it gave reliable data, especially about species not on the interview list (small carnivores, lorises, etc.). To maximise the range of species encountered the following methods were employed.

1. Direct field observation by night. Observation sites (Fig. 4) were chosen on the basis of habitat and visibility; human disturbance was a secondary consideration. Surveys were concentrated where a wide road (therefore allowing a greater volume of habitat to be searched than from a foot trail) ran through Corridor forest isolates. Such roads were also frequented by hunters, but the much greater visibility than in deep forest outweighed the disturbance. Observations in variably-degraded Evergreen and Semi-evergreen forest isolates, especially around Ban Khame, totalled 78.25 hours. Comparative walks were undertaken in Dry dipterocarp (16.5 hours), in degraded areas (8 hours) and in the poor quality Semi-evergreen forest around Ban Nalay (3.25 hours).

Observations commenced at a suitable stretch of road shortly after dusk (usually by 19h30) and continued until dawn (05h00). While walking slowly (about 1 -1.3km/h), a headtorch was continuously used to search vegetation carefully at all levels for reflecting eyes and illuminated body shapes. Animals are easily overlooked when obscured by foliage, so vegetation was searched at all angles including directly behind. The observer was alert for sounds indicating animals: dropping fruit, vegetation movements and vocalisations. The headtorch

did not illuminate animals sufficiently for identification (animals may be missed with brighter lamps, as they avert their eyes), so a powerful spotlamp was used to view the animal. Most arboreal animals were identified (a few fled too quickly), but those on the ground were frequently too obscured by dense fringing ruderals. The explosions heard at night deterred the observer from leaving the road to investigate animal sounds coming from the ground. For each sighting the following were recorded: species, basis of identification for difficult species, time, habitat, height in vegetation, vegetation stratum, observer-animal distance, angle bewteen path midline and observer-animal line, method of detection and reaction to light. Interesting behaviour was also noted.

A fairly constant pace was maintained, except that fruiting trees were searched especially diligently: sometimes for 30 - 90 minutes at a time. At least half an hour was spent sitting silently at a turning point before return along the same road, to avoid duplication (quite long enough for animals found on return to bear no relation to those seen outward; even in fruit trees it was exceptional to see the same animal on both passes). Areas with smouldering fires were walked rapidly. Brightly moonlit periods were avoided as many fully nocturnal species are then detected less frequently.

The main forest blocks lacked suitable trails. Three overnight watches overlooking a stream, a fruiting tree and a bare area with many scats were unproductive. They were conducted during moonlit periods, and animals searched for by moonlight and infrequent scanning with the torch.

2. Direct field observation by day. Diurnal species were recorded during the course of birdwatching (sect. 2.3.1); information comes from the same areas of PXH (sect. 2.3.2) and is subject to the same limitations as for birds.

3. Examination of captive animals and trophies in houses. No living animals found in villages belonged to species not detected in the field. Systematic searches were not made.

4. Searches for signs. Footprints and other signs were recorded incidentally in all the areas where bird recording took place. These are usually identified only to genus, as many genera have several species difficult to tell apart even for experienced trackers.

5. Hunted animals. Animals for sale in adjacent markets were noted and photographed.

2.4.2 Area surveyed and habitat categorisation

Habitats were categorised as in sect. 2.2.2, but the proportions of night and daytime effort greatly varied (Table 17). Only small amounts of time were spent by night in the Corridor MDF and no significant observations were made, so all Corridor tall forest observations have been considered together. Routes walked are shown in Fig. 4.

3 FINDINGS WITH RESPECT TO HABITAT

The habitats present and their predominance differs between the three main parts of PXH (Table 3). Results from the nine matrix lines traversed are in Annex 2.

Table 3: details of habitats in PXH.

1. some fair to good strips and patches in the eastern most Mid Corridor region;
2. becoming a more prominent feature in the south-east (Nalay area), and probably also in the west;
3. Uppermost north Corridor: the area above Ban Naphilang, east to Ban Muangsen.
4. Northwest Corridor: Ban Naphilang to Ban Natou and probably east to Xetamouak.
5. Former dominant.
6. Northeast Corridor Ban Donggnang south to Ban Ngonsai and probably west to Xetamouak.
7. Mid-east Corridor Ban Ngonsai south to Ban Ngoikasan and east to the Hinho hills.
8. Becoming dominant to continuous in the eastern most section, fair to good.

Areas: those presented and the percentages refer to the area considered during the survey (Fig. 1); areas were calculated from extrapolated ground observations, hence the wide ranges quoted.
Numbers of forest patches: these are the same as used in sect. 3.5.2.

3.1 PHOU XANG HE

Three main habitats were observed in the Xang He hills.

Semi-evergreen forest

This probably predominated throughout the range, with tall, well-structured stands amongst more extensive lower-stature forest. The best areas seen were on the the steep northern slopes of Phou Xang He. This forest type formed a mosaic with Mixed deciduous forest, especially in the south on hills north and east of Ban Nalay where dispersed patches of low-stature Semi-evergreen forest (canopy 10-15m) were frequent, often intergrading with Mixed deciduous forest.

Mixed deciduous forest

This was the second most common habitat on the Xang He hills, dispersed as patches on shallower soil within Semi-evergreen forest. It often fringed areas of natural scrub. The intermediate position between Semi-evergreen and open habitats gave Mixed deciduous forest heterogeneity from open, stunted, almost completely deciduous types around open areas, to taller forest with thick shrubby evergreen mid- and understorey on transition to Semi-evergreen. Leaflessness was at its peak at the time of survey and there were many fruiting and flowering trees. The habitat was prone to burning, particularly drier types and more open areas.

Scrub

On the plateau natural scrub fringed barren rock outcrops and sparsely vegetated grassy glades: such areas were also often characterised by tiny patches of Dry dipterocarp. Open patches seemed more frequent on the west of the range, judging from aerial photographs, and in the south around the Nalay area.

Rivers

Four rivers drain the main area of Phou Xang He (Xe Kong, Xe Kang, Houey Gnang, Houey Tin-Gnalon): all are confluent with the Xe Xangxoy in the south. At the time of survey they had mostly dried to standing pools. Vegetation along rivers often resembled the surrounding forest; however dense Semi-evergreen forest frequently grew as thin bankside strips through more open forest types. Small trees, willow-like and hygrophitic shrubs grow along larger river beds.

Lowlands adjacent to Phou Xang He

The area southwest of Phou Xang He was not a direct object of the survey but was traversed on several occasions. The lowlands between the lower slopes and the Xe Xangxoy had been largely cleared for cultivation (3-5km or more to the north and east of Ban Nalay), mainly shifting, leaving a mosaic of agriculture and various degraded habitats. Riparian forests had particularly suffered; frequently, very tall, scattered *Dipterocarpus alatus* trees towered over a scrub-dominated landscape as a remnant of dense forest. Settlements predominated along route 9 and (especially) the Xe Xangxoy. South of the Xe Xangxoy, Dry dipterocarp forest dominated with some strips of degraded Semi-evergreen forest.

Around Ban Muangsen, in the north, much lowland habitat had been cleared for cultivation, predominantly along the Xe Bay. Recent clearance is also extending up the slope of the main ridge for a kilometre or more either side of Ban Muangsen , but also by Ban Sopxe and Ban Phonbok (R. Dobias) and probably in many intervening areas.

3.2 PHOU HINHO

All areas of Phou Hinho visited supported Evergreen forest, with other habitats occurring peripherally.

Evergreen forest

This forest covered the western areas of Phou Hinho, extending into the lowlands around Ban Khame. Structure and composition varied, with distinct sub-types on some steeper slopes, along valleys, and in previously-disturbed areas. Forest on steep slopes was more stunted and open, with more climbers and many sturdy herbs. In the river valleys draining west, moister, lusher vegetation predominated, especially in the understorey and ground layers. Other areas, predominantly patches along rivers, resembled Semi-evergreen with a few deciduous trees.

At least two clump-forming bamboos grew under the tall dipterocarp canopy; the larger (18-20m) was not found outside Evergreen forest. Both may have been associated with previous disturbance. Signs of wartime bombing, forest inroads and military wreckage were frequent in the lower areas and on gentler slopes.

The extent of Evergreen forest is unknown, though it is likely to be relatively small, compared to other forest habitats in PXH as a whole. To the south and west, the flatlands and lower slopes in the Corridor around Ban Laboun supported predominantly tall Mixed deciduous forest. The eastern parts of Phou Hinho (not visited, but viewed from route 9 between Muang Phin and Xepon) seemed to be more sparsely vegetated, probably mainly Semi-evergreen forest, containing many open patches, many on the top of the ridge and a greater proportion of deciduous species. The surrounding lowlands were dominated by a mosaic of scrub and Dry dipterocarp forest.

Clearance on the western side is still mainly restricted to the lowest slopes, though there is every sign that the forest edge is being pushed into fast retreat. The northern slopes are extensively encroached by shifting cultivation (R. Dobias 1993), and this is almost certainly the cause of the open patches on the eastern slopes.

3.3 CORRIDOR AREA

The corridor has been heavily fragmented and now supports a mosaic of cultivation with predominantly degraded natural vegetation. Precise locations for the best forest isolates are given in sect. 3.5.2.

Evergreen forest

This forest differed but slightly from that on Phou Hinho. Most remaining forest has been degraded and fragmented by clearance for cultivation. The remaining areas were all in the northern part of the corridor where such forest was presumably once more widespread and continuous.

Semi-evergreen forest

Semi-evergreen forest occured mainly as patches amongst other forest-types and as an intergrade around the edges of Evergreen forest. Probably formerly predominant along rivers, now only degraded clumps remained on some banks, with a few more continuous stretches in the mainly Mixed deciduous forest area of the eastern mid-corridor around Ban Labhoun. The majority was heavily degraded, but a larger, less fragmented patch transitional with Evergreen forest occurred between Ban Donggnang and Ban Naphilang.

Mixed deciduous forest

Mixed deciduous forest was common throughout, though much fragmented; it was presumably originally the major mid and north corridor habitat. It was very heterogeneous, intergrading with Semi-evergreen and Dry deciduous forests and affected by degradation, especially burning of the more open areas. Of presumed natural types, one with a tall, even, mid-dense canopy, fairly open lower layers and an absence of bamboo but reasonable herbaceous layer was perhaps commonest, though generally degraded. It grew mainly along the road north of Ban Ngoikasan and to the east especially around Ban Labhoun, the latter area being the least disturbed.

Other areas of Mixed deciduous forest were of lower stature, often with much bamboo (sometimes dominant) and a sparse ground layer containing very few herbs. These may represent areas of greater disturbance, though some seemed to be more natural and associated with the transition to Dry dipterocarp forest.

Dry dipterocarp forest

Dry dipterocarp forest dominated the areas south of Ban Nathou and Ngoikasan, probably on shallower unproductive soils. It was generally fairly low (canopy lower than 10m) and the trees were more thorny and

tangled above a sparser ground layer, compared with Dry dipterocarp forest south of Phou Xang He. It appeared to be the habitat least affected by human disturbance, due presumably to its lower economic importance. However, some cleared valley areas supported rice paddies.

Scrub and Cultivation

The remainder of the corridor was a mosaic of cultivation, heavily-degraded forest with promminent secondary regrowth, and areas of secondary growth on cleared forest land. The main agricultural activities were paddy rice and shifting cultivation. The latter practice requires the frequent clearance of new areas and was mainly for hill rice, but also for other crops such as maize. Settlements were mainly along rivers, especially where they intersected the main valley road.

Scrub in its younger stages was often dominated by *Eupatorium* while older regrowth was often thickly shrubby with many creepers, climbers and bamboos. Riverside regeneration was often particularly dense with a high proportion of bamboo. Some areas were dominated by tall bamboo groves.

3.4 HUMAN USES

Uses throughout PXH are presented in Table 4. The following text amplifies where appropriate.

The Corridor area alone has 30 settlements and hamlets, 21 of which occupy or are immediately adjacent to the area considered for protection. Each village uses the surrounding land for approximately 3km in all directions on a regular basis, such that no part of the Corridor is without human use (Fig. 6).

Cultivation

Paddy rice, probably the main agricultural activity, occupied mainly long-established, usually flat, valley areas. Small areas of new paddy were found.

Shifting cultivation has probably degraded a greater area. It was commonest in the mid and north Corridor, in the lowlands to the north around Ban Muangsen, and to the south around Ban Nalay and Ban Namouang. It was not clearly cyclical and large areas of new forest (seemingly more than in preceding years) were being cut then burnt at the time of the survey. Only Dry dipterocarp forests seemed not to be cleared to any great extent. Secondary regrowth, often with a developing forest structure, seemed the preferred habitat for clearance, while the Evergreen and Semi-evergreen types were probably next most favoured.

Land clearance is the greatest threat to the lowland and peripheral hill areas as a whole.

Logging

Logging seemed restricted to local subsistance use, overwhelmingly for house construction. Trees were taken from peripheral forest areas and remnant patches. Much timber was wasted: only a small proportion of the main trunk was used and furthermore the majority of large trunks in areas cleared for cultivation were merely burnt in situ. Corridor Evergreen forest was favoured as a source because more timber species were found than in adjacent Mixed deciduous forests, and both were more accessible than hill forests. The small size of isolates makes removal of even a small number of trees from them proportionately much more serious than from main forest blocks.

No commercial logging was found or reported. Some old trunks lying in Ban Khame and a few other places along the main Corridor road appeared to have been recently marked for collection. The corridor area was logged commercially under State Forest Enterprise 2 until 1989-91 (DWFC village questionnaires).

Logging is a serious threat for the forest fragments, though it is currently unlikely to be a major problem for the forest on the hills.

Table 4: some human uses of the different habitats of PXH.

Habitat	Uses	Critical threats
Phou Hinho Evergreen	Shifting cultivation (periphery); Hunting and fishing; Bamboo collection (preferred to scrub species); Resin tapping; Timber for local use; Honey collection; Minor forest product collection	Forest clearance at margins; Primate hunting; Fishing and disturbance to rivers in dry season (probably); Resin collection
Phou Xang He forest	Peripheral shifting cultivation: mainly hill rice; Clearance of north slopes for crops such as bananas; Major hunting area; Burning for various reasons, inlcuding to attract ungulates for hunting (mostly in MDF and scrub than in SEF); Grazing of stock reported (1); Fishing interior rivers (especially dry season); Resin tapping (mainly peripheral); Timber for local use; Honey collection; Elephant dung collection; Minor forest product collection	Forest clearance at margins; Hunting of large herbivores; Primate hunting; Fishing and disturbance to rivers in dry season (all aquatic animals); Resin collection; Disturbance
Corridor: Evergreen isolates	Habitat clearance (favoured area); Hunting (most large species extirpated); Resin tapping; Timber (favoured area); Honey collection; Burial ground (for Ban Khame)	Clearance (very grave threat); Timber for local use; Resin collection
Mixed deciduous forest (Corridor)	Clearance (taller types favoured) for cultivation; Hunting; Resin tapping; Timber; Understorey burning and grazing (especially open types)	Clearance; Degradation from fire; Resin collection
Dry dipterocarp forest	Limited clearance; Limited hunting; Wood collection; Incidental burning (use various); Some grazing	Probably none significant
Scrub	Clearance; Hunting; Fishing; Resin tapping; Grazing; Honey collection; Bamboo collection	Clearance of regenerating forest Resin tapping
Cultivation	Rice and other agriculture; Bird hunting	Probably none significant

Notes: many uses are seasonal and may have been unrecorded if not widely practised during March and April. 1, buffalo and cattle seen in peripheral areas around Ban Nalay, more organised grazing of livestock reported further to the southwest (R. Dobias).

Resin tapping

Damar collection, a resin tapped from *Dipterocarpus alatus*, was a significant economic activity in PXH. The damar is collected by cutting a slit (generally 30cm wide and 20cm deep) into the tree to form a well. The initial release of resin is used to burn the trunk in the vicinity of the slit stimulating greater resin flow. The same well can be flamed several times before bark retreat and trunk damage results in low resin flow. Wells are able to heal over once resin tapping has ceased, but the process takes many years. The species seemed mainly restricted to lowland and taller hill forests. This includes much of Phou Hinho (where also grew *D. costatus* which was similarly tapped) and the northern slope of Phou Xang He. They were generally the predominant emergents, many having trunks exceeding 1m dbh. They were often the only large trees in the lowlands, standing as isolated remnants of former forest. Virtually all such lowland trees and a high proportion in the hilly areas further afield had wells. In Ban Nalay resin tappers foraged the forest to a range of 10km. Each tree was reported to yield 7 liters of sap per year which was stored in petroleum barrels and collected by traders who pay 200 kip per liter. The disproportionate number of new wells, especially evident around Ban

Muangsen and Ban Nalay, suggested that resin collection had undergone a recent increase and the multiple number of wells on a large proportion of trees will surely result in overexploitation. Elsewhere in PXH (and also in Xe Piane and Dong Hua Sao, where collection seems to be predominantely for local use) rarely more than one well was seen per tree, and unproductive wells were left to heal before new ones were cut. Multiple wells and no allowance for recovery must put particular strain on a tree. Several trees were already showing the signs of effective ring barking because of wells on three or more sides and there must also be an increased risk of falling during storms.

Hunting, shooting and fishing

Fishing by day and night was evident along all rivers; fishing parties were frequently encountered. In the interior of Phou Xang He, parties of men camped for several days, fishing the various pools along the drying rivers. In main rivers, every pool was probably investigated at least once during the dry season. The great activity along rivers 10km or more from villages suggests that lowland rivers close to villages are seasonally or permanently overfished. Virtually all aquatic animals were taken: bivalve and gatropod molluscs, crustaceans, amphibians, reptiles including their eggs (mainly those associated with water or laying eggs on sand bars: testudines, varanids and large agamids) and a multitude of fish from a few centimeters to well-matured individuals of several tens of centimeters. A variety of methods was used, all greatly disrupting the pools. Nets were sometimes left for two to three days and frequently had fish driven into them by people in the pool or by sticks. Shallow pools were emptied by vigourously scooping out water with a flip-flop shoe and then searching diligently under all stones and in holes; leaves and small stones were ejected to aid detection of animals. With this latter method almost all quarry animals were removed from each pool. Numerous long-term drift fences and pitfalls across riverbeds caught mainly amphibians and reptiles. Less-prevalent methods included baited hooks (which caught turtles as well as fish), wicker traps, and capture by hand of animals like frogs and crustaceans.

Birds and mammals were mainly hunted with locally-made long barrel guns in a non-specific way and generally close to villages. Shots were heard hourly in the corridor by day and frequently on many nights. In the main forest blocks, shots, still heard daily, seemingly represented opportunistic hunting by people on fishing or resin collecting excursions. Snaring (for ground birds and, with fences, mainly for smaller mammals) was more planned (in that traps have to be checked regularly and considerable time and effort is involved in drift fence construction) but of unknown extent.

Small parties, generally with more powerful weapons, sought larger game in the forest areas. On Phou Xang He, the grass was burnt to encourage regrowth and thus attract grazing ungulates. Hunters from Ban Koktong claimed to work the Xe Kang catchment on two to three days each week. Villagers from the Ban Muangsen and Ban Phongsavang areas used Houey Gnang and Xe Kong as their main hunting grounds. For people in Ban Nalay the best forest appeared to be to the northeast and east of the village and those from Ban Namouang used the Xe Kang catchment. Hunters from outside the immediate surroundings of Phou Xang He were also said to use the area.

The steep, dissected terrain of Phou Hinho made the hills unattractive to hunters, who preferred the Phou Xang He area. Shots were only heard in peripheral areas of Phou Hinho. In Ban Phalou, villagers claimed they had been unable to hunt for a year as they lacked guns, owing to delays in government consignment. Their activities were limited to fishing and snaring. Their traditional hunting grounds would have been the areas of Phou Lom and Phou Thaman in the Phou Hinho hills (unmapped).

3.5 IMPORTANCE OF THE CORRIDOR

The Corridor (Figs 6, 7) is an important part of the proposed protected area in its own right (sects 4.3, 6.1) and can provide a crucial link between the two forest blocks of Phou Xang He and Phou Hinho. This will greatly increase the value of the whole area, particularly for large mammals. As it is already so degraded, it needs special and urgent attention.

3.5.1 Features of the Corridor

The following considerations apply in the interpretation of the Corridor:

1. All habitats found on Phou Hinho and Phou Xang He were present in the Corridor.
2. Mixed deciduous forest predominated, with Dry dipterocarp more common to the south and Evergreen and Semi-evergreen to the north.

3. Remaining forest was heavily fragmented or reduced to strips, a condition determined by:
   a) the presence of scattered settlements on either side of the valley;
   b) the likely variability in soil types;
   c) recent carpet bombing and seemingly heavy wartime use by troops;
   d) the denser pre-war population than at present;
   e) widespread shifting cultivation and frequent relocation of hamlets to colonize new areas;
   f) commercial logging by State Forest Enterprise 2 until 1989-91.
4. Forest rarely dominated roadsides for more than 1km.
5. The main threat to remaining forest is from clearance for agriculture.
6. The most commonly recorded forest conditions (sect. 2.2.2) were clear-felled and heavily degraded.
7. Agricultural land was mainly on former Evergreen, Semi-evergreen and Mixed deciduous forests; Dry dipterocarp was not favoured.
8. The Corridor was most degraded west of Xe Thamouak, particularly around Ban Phongsavang and Ban Katep (these villages are older than most in the Corridor: 200 and 60 years respectively) and south of Ban Nathom Xe (where the human population was denser).
9. Evergreen forest, the most important habitat for wildlife (sect. 4.3, 6.1), occupied a very small area and was highly fragmented. Nonetheless, the Corridor Evergreen forests may represent a substantial proportion of this habitat-type in PXH. Some remaining patches were of considerable importance for wildlife: the best of these were east of Ban Muangsen and north and east of Ban Khame (Table 3).

3.5.2 Important remaining forest in the Corridor

Potentially important forest patches were found at:

Evergreen forest:

1. Along the road 1km north of an unnamed village (village 3 on Fig. 3) for about 3km, reaching 8km east of Ban Muangsen; probably continuous with Phou Xang He forests.
2. For about 2km northwest of Ban Khame along the road; more extensive to the northeast and east, where only moderately fragmented, not heavily degraded, and still continuous with Phou Hinho forests.
3. From 3km south of Ban Khame south for a further 7km (reaching 3.5km before Ban Houei Say). This area was much fragmented and also contained some Semi-evergreen and Mixed deciduous forests.
4. From 1.5km east of Ban Naphilang northeast for 4.5km (reaching 1.5km from Ban Donggnang); mainly heavily disturbed and in mosaic with Semi-evergreen forest.

Semi-evergreen forest: in mosaic with Evergreen or Mixed deciduous forest, where considered.

Mixed deciduous forest:

1. From 1km east of Ban Muangsen to the Evergreen block (no. 1, above) and south of this block to 2km north of Ban Naphilang. This block contained several Semi-evergreen patches.
2. To the south of the Evergreen/Semi-evergreen block (no. 4, above) between Ban Naphilang and Ban Donggnang.
3. Patches with Semi-evergreen forest between Ban Phongsavang and Ban Katep Noy.
4. From 3.5km north of Ban Ngonasai south to Ban Ngoikasan (a further 3km); fragmented closer to villages. This block probably runs east to Xe Thamouak especially in the northern part, though it probably does not reach so far near Ban Ngonsai. The northwestern boundary is with Evergreen/Semi-evergreen forests of block 3, above. The southwestern boundary probably has little contact with the forests on Phou Hinho as the intervening area especially around Ban Phalou was heavily disturbed.
5. From Ban Ngoikasan west, probably to Xe Thamouak (5km).
6. East of Ban Ngoikasan to the Hinho hills. The best MDF was in the south and east portion of this block. There were large degraded enclaves around Ban Lavay, Ban Phalong and Ban Labhoun. This block contained several Semi-evergreen patches.

Dry dipterocarp forest: considering the substantial remaining tracts of this forest in flat areas (Fig. 5), specific locations are neither meaningful nor relevant to management.

3.5.3 The Corridor as a link between Phou Xang He and Phou Hinho

A habitat link between the two hill ranges is desirable and should show the following features:

1 It should be of Evergreen and Semi-evergreen forests. An uncultivated scrubby area would not be sufficient as a link between two forested hill ranges.

2. Most remaining Evergreen forest patches should be incorporated and joined by areas where re-establishment of forest cover is most practicable.
3. It must be wide enough for edge effects to be minimal: at least 2km.
4. Because of the scale of degradation already, cessation of agriculture within the proposed links would be necessary, to allow regrowth between remaining forest patches.
5. As many rivers as possible should be included. These are an important microhabitat in their own right, are a vital water source for large herbivores in the dry season, and have been particularly degraded. Rivers are often used as boundaries as they are unambiguous; this should not be done here unless a substantial buffer is incorporated to the other side.
6. Although the whole Corridor should be considered for long-term protection, but habitat links between the two hills must take priority.
7. A large area of limestone hills north of the Corridor (Phou Kasaf) is already probably contiguous at its southern extremity (Phou Soung) with the forest of Evergreen isolate 1 above (Fig. 2). There is no limestone in the proposed area, and this would consolidate one suggested link between Phou Xang He and Phou Hinho (see below).

Areas have been assessed from a combination of ground observation and imformation on maps; the resulting suggestions are tentative, and if further patches of forest are found, link boundaries should be moved accordingly. The following four areas seem most suitable for habitat links (Table 5, Figs 6 and 7):
1. **Northern Link** The three northern Evergreen blocks (nos 1, 2 and 4 in sect. 3.5.2) form the most obvious and important habitat link. All parts of them should be included. The proposed boundary could be modified if significant forest was found north of Ban Donggnang. The southern edge leaves southeast from the Phou Xang He ridge just north of Ban Naphilang, passing south of Ban Katep Noy and Ban Khame to join the east fragmented Evergreen forest continuous with Phon Hinho.
2. **Central Link** Mixed deciduous and Evergreen forest blocks south of Ban Khame and continuous with Phou Hinho could form the eastern basis of another link. This would be difficult to establish but would give the greatest width. The western portion, joining the Xang He hills, is very fragmented; and the link would best be somewhere through land from north of Ban Nakaphoung to south of Ban Nathou; further information concerning the human use of this part is necessary before firm recommendations can be made.
3. **Southern Link** A link of Mixed deciduous forest is currently reasonably intact and forms the basis of an easily-realisable link. It includes 4km of the Xe Thamouak river and substantial lengths of smaller streams fringed with fairly intact forest.
4. **Limestone Link** (as an extension to link 1) Limestone hills north of the Corridor (Fig. 2) possess largely intact forest cover and are continuous with the first link and the large Evergreen block east of Muangsen.

Table 5: merits of possible links running across the Corridor between Phou Hinho and Phou Xang He.

Link	Advantages	Disadvantages
1	Most of remaining EF/SEF; only one village, recent and small; forest well-distributed throughout and very little cultivation; some streams, mostly forest-fringed	None major; four large villages closeby
2	Eastern part good forest, overlapping with link 1; extensive stream network, mainly within forest; only one village, small and recent	Western part heavily degraded, making this link more a long-term proposition
3	Forest well-distributed throughout; extensive forested stream network	Some villages large and surrrounded by extensive degraded areas: perhaps best excluded as enclaves
4	Consolidates link 1; adds new forest-type; only two villages	Little water; outside currently-proposed area boundaries

4 FINDINGS WITH RESPECT TO BIRDS

4.1 STATUS OF BIRDS IN PXH

Table 16 (Annex 5) considers the status of all species recorded during the survey. The following sections clarify the table, then focus on key species observed in PXH.

PXH has been divided into seven different main habitats or areas (sect. 2.2.2), and for each of these, each bird species has been assigned a status category (sect. 2.3.3). As the area contained different forest-types which intergraded with each other, it was sometimes difficult to categorise the habitat. This was particularly so with birds heard calling at night in the mosaic area of the flat Corridor; most records of nocturnal species are based on calls and because of the close proximity of various different habitats to the observer, some habitat categorisations may be erroneous. Mixed deciduous forests showed an array of different physiognomies, grading from one transitional with Semi-evergreen forest to one more closely resembling Dry dipterocarp. Many abundance assessments for this habitat, therefore, represent the status only in certain parts, making the community suggested by Table 16 somewhat of an unnatural one, not reflected in any individual patch of Mixed deciduous forest. Such heterogeneity was also found in degraded habitats, which category includes heavily-structurally disturbed areas of all the natural vegetation types and also abandoned cultivation developing scrub. From a conservation point of view, the bird communities found in all degraded areas were of minimal interest, so the habitat was not subdivided into finer categories.

Microhabitat associations have been ignored except for the insertion of "L" (local) if the species was clearly patchy in occurrence and "W" if it chiefly affected areas with water.

4.2 ORNITHOLOGICAL IMPORTANCE OF THE AREA

In total 17 key bird species were found (Table 6). Five are endemic to Indochina. Three, Siamese Fireback, Red-collared Woodpecker and Bar-bellied Pitta, are globally threatened. Some further potential key species are difficult to locate and may have been overlooked.

Table 6: status of key bird species in PXH.

	Habitat						
Species	Hinho	Xang He	Corridor	MDF	DDF	Degr.	Rel. Est
Bar-backed Partridge	C						Mid
Siamese Fireback		F	F	O		x	Low
Grey Peacock-Pheasant	C						Mid
Ruddy Kingfisher	O			O			Low
Brown Hornbill		C					Mid
Wreathed Hornbill	O						High
Red-vented Barbet	C	C	C	C		x	High
Red-collared Woodpecker	C		F	O			High
Black-headed Woodpecker					C		High
Pale-headed Woodpecker	C						High
Bar-bellied Pitta	C	C	C	O		x	High
Ratchet-tailed Treepie	F		O				Mid
Grey-faced Tit-Babbler	C		C				High
Rufous-throated Fulvetta	C						High
Fulvetta sp. A	C		C				High
Golden-crested Mynah				O		x	Mid
Hill Mynah	C	C	C	C	F	x	High
Total	**13**	**5**	**8**	**7**	**2**	**5**	
Coverage	Good	Mid	Good	Mid	Mid	Mid	

Key: Degr, tolerance of habitat degradation; x = found in degraded areas.
Status: C = Common; F = Frequent; O = Occasional (sect. 2.3.3).
Rel. Est, Reliability of estimate: an assessment of the reliability of the species's status categories.
Low = bird inconspicuous and recorded very few times, so status may be different from indicated;
Mid = bird moderately conspicuous or detected several times;
High = bird detected enough times to be confidant of categorisation, or a very conspicuous species.
Coverage: an assessment of the completeness of knowledge of the key species community based upon the amount of effort expended and ease of detection.

4.2.1 Key species accounts

The following key species were identified. Key species were defined as globally Threatened, globally Near-threatened or At Risk (defined in sect. 2.3.1).

Bar-backed Partridge *Arborophila brunneipectus* (Thailand)

Commonly seen in Phou Hinho, but probably absent from most Corridor isolates and Mixed deciduous areas. The species may be hunted as on several occasions the commoner Scaly-breasted Partridge *A. charltonii* was observed being carried out from forest.

Siamese Fireback *Lophura diardi* (Threatened)

Probably common or present in most Evergreen and Semi-evergreen forest areas and in the tall Mixed deciduous forest at Ban Labhoun. It seemed to tolerate degraded areas, but may be susceptible to hunting, as elsewhere in its range.

Grey Peacock-Pheasant *Polyplectron bicalcaratum* (Thailand)

This species was not seen but calls identical to those given in the Xe Piane PPA were heard fairly commonly in the Phou Hinho area and possibly from tall dense Semi-evergreen forest by the river near Ban Nalay.

Ruddy Kingfisher *Halcyon coromanda* (Thailand)

Singles observed in streamside forest in Phou Hinho and at Ban Lavay. This secretive species may have been commoner. The records could relate to migrants, whereas Round's categorisation refers to the resident population.

Hornbills Bucerotiformes

Hornbills are of special concern as they require extensive areas of habitat and they are susceptible to hunting. Three of Laos's five species were found. Oriental Pied Hornbill *Anthracoceros albirostris* is not currently at risk.

Brown Hornbill *Ptilolaemus tickelli* (Thailand)

Several sightings in association with Oriental Pied Hornbills on Phou Xang He. It is an obvious species and its seeming absence from other sectors of PXH is surprising.

Wreathed Hornbill *Rhyticeros undulatus* (Thailand)

Wreathed was the only large hornbill located (they are more vulnerable than the smaller forms). Only a single pair were seen, on Phou Hinho. The species is easily located by the sounds of its wingbeats and its calls but wingbeats were otherwise heard only once. The scarcity is sure to be genuine and contrasts with the species's abundance in Xe Piane PPA (several parties recorded most days). There was no evidence of disproportionate hunting. The species is a nomadic frugivore, but there were many trees in fruit in the areas surveyed.

Red-vented Barbet *Megalaima lagrandieri* (Near-threatened)

Large barbets basically fitting this species, but differing in a few minor ways from the account in King *et al*. (1975), were widespread in tall forests (Evergreen, Semi-evergreen and Mixed deciduous) and even in small degraded isolates. It was probably commonest in the Phou Hinho area. Calls were tape-recorded and final identification is subject to verification.

Pale-headed Woodpecker *Gecinulus grantia* (Thailand)

Regarded as At risk in Thailand because it is fundamentally extralimital, this woodpecker was found in bamboo stands in the Phou Hinho area, and in forest patches with bamboo clumps. All sightings (four) came from one type of bamboo which grew only under forest canopy; other bamboos (often predominating in scrub and Mixed deciduous areas) seemed to be ignored. The same association was noted in the Xe Piane area. This bamboo seemed to be the preferred one for harvesting.

Red-collared Woodpecker *Picus rabieri* (Threatened)

Birds were seen most days in most Evergreen and Semi-evergreen forest areas (but not on Phou Xang He) including small and degraded remnants, provided large trees remained. There were also two records from taller Mixed deciduous forest.

Black-headed Woodpecker *Picus erythropygius* (Thailand)

This was the commonest woodpecker in Dry dipterocarp, though unrecorded elsewhere. Dry dipterocarp was the vegetation-type least used by villagers, meaning that the woodpecker is under no imminent

threat; if large areas were cleared, this species would probably decline drastically because of its close association with the habitat.

Bar-bellied Pitta *Pitta ellioti* (Threatened)

Common and ubiquitous in Evergreen and Semi-evergreen forests and found even in degraded and secondary areas, provided a good canopy and relatively open understorey remained. The only records from Mixed deciduous forest were from dense areas transitional with Semi-evergreen forest.

Grey-faced Tit-Babbler *Macronous kellyi* (Near-threatened)

Probably common in most Evergreen forest areas and in some less-degraded isolates. Not observed in Phou Xang He or in any Mixed deciduous areas. The birds seemed to be calling much less frequently than in Xe Piane PPA (November - March, May), hampering assessment of their true abundance. It is possible the low calling rates indicate lower densities than in Xe Piane PPA. PXH represents a northward extension of the species's known range in Laos; its restricted world range is south and central Annam and southern Laos (King *et al*. 1975).

Rufous-throated Fulvetta *Alcippe rufigularis* (Near-threatened)

Common in the main Hinho forest area, but almost certainly absent from other areas including even the best isolates, possibly as a result of habitat disturbance.

Fulvetta sp. A *Alcippe* cf. *A. peracensis* (Thailand)

Mountain Fulvetta *A. peracensis* is regarded as At risk in Thailand because it is of marginal occurrence. A fulvetta seen in PXH seemed identical with those in Xe Pian PPA, which had been provisionally identified as this species, though showing minor differences from book descriptions. Subsequent experience in Dong Hua Sao PPA revealed a fulvetta much more similar to the descriptions of *peracensis* in Boonsong Lekagul and Round (1991) and King *et al*. (1975), so the identity of birds in PXH cannot be confirmed. Museum skins will be checked on return to UK.

This fulvetta was common in the main forest block of Phou Hinho, but abundance decreased rapidly with habitat degradation and it was not found on Phou Xang He. It appears less affected by fragmentation as some were recorded in small patches provided they retained a tall forest structure. The dependance on good-quality forest strengthens its inclusion as a key species, its initial selection being on rather illegitamate grounds.

Ratchet-tailed Treepie *Temnurus temnurus* (Near-threatened)

This secretive species was observed twice in the main Hinho Evergreen forest and once in a large isolate. Although difficult to observe it has a distinctive call and so its scarcity may be genuine.

Golden-crested Mynah *Ampeliceps coronatus* (Thailand)

Five sightings, mostly from degraded areas of Semi-evergreen / Mixed deciduous forest intergrade. It was probably fairly common (little time was spent in what appeared to be its favoured habitat) although it was not found in the most degraded areas. It is probably not under imminent threat in the area; in Thailand it is at risk from overtrapping as a cagebird.

Hill Mynah *Gracula religiosa* (Thailand)

This species was common throughout the areas surveyed, including heavily-disturbed habitats (except open cultivation). In Thailand it is threatened by trapping for the cagebird trade. Several villagers were seen with recently-taken nestlings in PXH but population levels are still high.

4.2.2 Key species not found

Based on the geographical position of PXH and the habitats it supports, various further key species might have been expected. Consideration of some such species will help focus future survey work, and reasons for their possible absence may shed light on management priorities.

Large waterbirds (pelicans, storks, ibises and cranes)

All representatives of this group are sensitive to hunting and other forms of disturbance. No suitable habitat was found for Spot-billed Pelican *Pelecanus philippensis* or Sarus Crane *Grus antigone* and there is probably none in the area. The absence of sightings of storks and ibises (in contrast to Xe Piane PPA) would be alarming if due to hunting; the shortage of standing water at the time of the survey makes this difficult to assess.

White-winged Duck *Cairina scutulata*

This duck is secretive and consequently easy to overlook. However, suitable areas of water are scarce in PXH: all streams on Phou Hinho were probably too small, while those on Phou Xang He had dried to a series of small pools at the time of survey, such pools receiving a deal of attention from hunters. Standing water in the flat areas is probably much too disturbed for the species to patronize. No hunters claimed familiarity with the species.

Vultures

Three species of vulture used to be common throughout Thailand and Indochina; all are now verging on extinction in Thailand. They are still common in Xe Piane PPA, particularly in more open parts, so it is worrying that none was seen in PXH. A group of buffalo carcasses (a favoured food in Xe Piane) observed for some time failed to draw in any vultures. A possible reason for absence or at least scarcity is that the open areas visited were intensively used by people; in Xe Piane vultures were not seen feeding in close proximity to people.

Green Peafowl *Pavo muticus*

This species used to occur in the flat areas of PXH. The certain cause of its decline and probable extinction is overhunting: the fowl is a favourite quarry on account of its large size and showy plumage which can be sold for decorative purposes. The flat riverine areas are those most intensively used by the local populace, placing it under extra pressure. Two villages outside the area of the present survey, Ban Phonboke and Ban Nagnon (respectively north and south of Phou Xang He) recently reported the presence of peafowl. This should be investigated and if the birds are present appropriate measures taken.

Crested Argus *Rheinardtia occellata*

This large pheasant is exceptionally secretive and easy to overlook (indeed, to have seen one on such a brief survey would have been most unexpected). It is best located in the field by finding display grounds or hearing calling (of unknown seasonality in Laos). No sign was found. Alternatively, it is presumably susceptible to snaring as are other pheasants, but if such trapping is of the same seasonality as in Xe Piane PPA, it is unlikely to have been in operation at the time of the survey. The feathers are attractive (the male's tail feathers are the biggest of any living bird) and likely to be kept; none was seen in the considerable number of houses entered. Results from DWFC questioning in the area are ambiguous about the bird's presence, but it is so elusive it could be overlooked by most villagers.

4.3 DIFFERENCES BETWEEN PHOU XANG HE, PHOU HINHO AND THE CORRIDOR

As varying amounts of time and effort were spent in different habitats and areas, comparative conclusions must be cautious. In terms of both species richness and number of key species the most important region was the Phou Hinho Evergreen forest. In a total of at least 102 species, there were 13 key species, five of which were not found elsewhere in PXH. The other main forest block, Phou Xang He, is also important, because, although fewer key species were found (five, only one found only in this sector), the bird communities differed between the two hills.

Phou Hinho supports unbroken Evergreen forest, very similar to some peripheral flatland forest and Corridor isolates, especially around Ban Khame. The extent of this forest-type on Phou Hinho is uncertain, but probably small (sect. 3.2), meaning that the Corridor isolates, despite their condition, are very important. These flatland patches vary in area, stature and disturbance. The avifauna of the least-disturbed patches differed little from that of the main forest block of Phou Hinho. Eight key species were found in the patches. One of these (Siamese Fireback) was not located elsewhere, though it is a shy species, easily overlooked. In total, only 17 species observed on Phou Hinho were not located in the isolates, and nine of these 17 were seen only once or are species strongly associated with streams. The presence of isolates suffering varying degrees of degradation and supporting different avifaunas allowed assessment of which species seemed especially sensitive to habitat alteration. Structurally-degraded isolates supported fewer species than primary isolates. Table 7 lists 12 bird species which were found in PXH only in fairly pristine habitat.

Table 7: bird species thought to indicate good-quality Evergreen or Semi-evergreen forest in PXH.

Bar-backed Partridge *Arborophila brunneopectus*	Long-tailed Broadbill *Psarisomus dalhousiae*
Siamese Fireback *Lophura diardi*	Scaly-crowned Babbler *Malacopteron cinereum*
Mountain Imperial Pigeon *Ducula badia*	Grey-throated Babbler *Stachyris nigriceps*
Brown Hornbill *Ptilolaemus tickelli*	Rufous-throated Fulvetta *Alcippe rufogularis*
Pale-headed Woodpecker *Gecinulus grantia*	Fulvetta sp. A *A.* cf. *A. peracensis*
Silver-breasted Broadbill *Serilophus lunatus*	Purple-naped Sunbird *Hypogramma hypogrammicum*

Fewer species (93) were found in Mixed deciduous forests, even those with a tall forest structure, and fewer key species. Three of the seven key species observed in this habitat were only in areas transitional with Semi-evergreen forest. The bird community was fundamentally a depauperate derivative of that of Semi-evergreen forest.

Fewest species were reported from Dry dipterocarp areas (55), only two of which were of conservation interest (Black-headed Woodpecker and Hill Mynah), but there were six species recorded only in this vegetation.

Heavily degraded areas supported many birds unrecorded in forests. For the majority there is no likelihood of threat and no key species were found. Communities in lightly degraded areas reflected the habitats from which they were derived, though such similarity decreased with increasing habitat change, thus leading to increased distinctiveness of the community.

4.4 THREATS TO BIRDS

All key species found essentially inhabit Semi-evergreen and Evergreen forest and tolerate degradation, fragmentation and intergradation with more deciduous forest types to varying degrees. Evergreen habitats probably also have the highest bird species richness. The rapid clearance and burning of large tracts of forests (Evergreen, Semi-evergreen, Mixed deciduous and also secondary regeneration) is thus of concern.

The other main threat is from hunting. Guns abound and shots, frequently heard at most sites, were often at birds. Hunting was fairly opportunistic, birds as small as drongos and orioles frequently being shot. Bird shooting seemed most frequent close to villages, rather than in the better forests further afield. The lack of paths into the Phou Hinho area suggested low hunting pressure compared to Phou Xang He which can be entered by well-used paths particularly so in the Ban Nalay area. Birds are also snared; while only Scaly-breasted Partridges were seen, but these traps catch all types of ground-dwelling birds, including the threatened pheasants and pitta.

Certain birds are caught to be pets. Numerous nestling parakeets *Psittacula* were proudly shown to us in villages. At the moment this is not serious as the two parakeet species recorded were very common (even adjacent to villages) while Hill Mynas (also seen captive) were also common throughout.

5. FINDINGS WITH RESPECT TO MAMMALS

5.1 STATUS OF MAMMALS IN PXH

5.1.1 Completeness of coverage

The general recording level of mammals was rather low and insufficient for generating comprehensive species lists. Comparisons between habitats are hampered by the different methods which had to be employed. Very large species were encountered directly only twice, although indirect evidence revealed most other expected genera. Diurnal primates were seen frequently, but their great shyness hindered status assessment. Squirrels and treeshrews were common and their abundance was accurately established. Other species seen by day were essentially found by chance. An excellent impression was gained of the nocturnal community of the Corridor isolates, especially the arboreal species. Within the main forest blocks nocturnal animals were not studied.

The status of all species recorded is summarised in Table 17 and contact frequencies for nocturnal species are presented in Table 19 (both in Annex 6).

5.1.2 Diurnal communities

The presence of four species of higher primate is encouraging. Two are of high conservation priority: Douc Langur and a gibbon (not yet identified to species). The other two species were macaques. There was no evidence of langurs of the Francois's group *Semnopithecus francoisi* (reported during village interviews by DWFC in 1991 and 1993, primarily from parts of Phou Xang He not visited on this survey) nor was any limestone habitat found in PXH itself. (Such langurs were reported during the present survey on limestone outcrops only 5-15km to the north; Fig. 2.) These langurs vary greatly through their restricted world range; each taxon occurs in a tiny area and most are under imminent threat. If these langurs are confirmed in PXH, their conservation is of the highest priority.

Squirrels showed an interesting distribution. Tall forests throughout the area were inhabited by one form of *Callosciurus*, however the form differed between Phou Hinho and Phou Xang He. Animals in the Corridor isolates belonged to the Phou Hinho form. This is the same partition as observed in the forest-types (sect. 3.3) and in the bird communities (sect. 4.3). Neither form has yet been identified, but both are probably representatives of the *C. (erythraeus) flavimanus* group.

5.1.3 Nocturnal communities

Much effort was concentrated on the roads running through the Corridor. Evergreen and Semi-evergreen forest was by far the most productive habitat, with 73 contacts (excluding bats and murid rodents; roughly one per hour), while the Dry dipterocarp was very poor (three contacts; one per 5.5 hours). This probably understates the difference as the open nature of the Dry dipterocarp compared with the Evergreen meant that many fewer animals would have been overlooked. No key species were located in Dry dipterocarp or degraded areas (only four species in total) but the eleven species located in Evergreen and Semi-evergreen isolates included three of conservation interest (Large-spotted Civet, Pygmy Loris and Asian Elephant).

5.1.4 Signs

Bear scratch marks were found throughout the forested hills. Footprints in muddy areas and dung revealed numerous wild cattle in the Xe Kong area (confirmed by direct sighting to include at least Gaur; some seemed more likely to be Banteng), pigs, small terrestrial carnivores, otters, deer and mousedeer. A hole in a tree base was claimed by guides to be that of a pangolin.

5.2 MAMMALOGICAL IMPORTANCE OF THE AREA

5.2.1 Key Species Accounts

The following species of conservation interest (all globally threatened species listed in IUCN 1990) were found:

Pygmy Loris *Nycticebus pygmaeus*

There were four sightings of this enigmatic species in Evergreen/Semi-evergreen Corridor isolates 3-7km south of Ban Khame. One gave prolonged and unobscured views as it fed in a leafless fruit tree, allowing positive identification. The other three were in thick vegetation and probably many more were overlooked.

There have been few field sightings of this species from anywhere in its world range (Indochina). Groves (1971) lists Lao records from Phongsaly in the north and the Bolovens plateau in the south; PXH lies between these two. The species is probably not rare judging by the number currently turning up in trade in Thailand (R. Wirth, pers. comm. to M.I. Evans *in litt.* 1993) and its current IUCN status category (Vulnerable) may be unduly pessimistic. Eudey (1987) accorded this species "a very high conservation rating" among Asian primates. Slow Loris *N. coucang* was extremely common in the area (25 seen) and there was no clear habitat difference between the two. Villagers are aware of the presence of two species of loris (one claimed three), and say that both are common. In many villages (including Ban Khame) they are not considered worth eating.

Douc Langur *Pygathrix nemaeus*

Several sightings of these monkeys on Phou Hinho (Fig. 9) probably related to two groups (at least 10 individuals in one group). A captive one in Ban Phongsavang was destined to be eaten in the village. All showed characters of the red-shanked (sub)species, *nemaeus (s.s.)*. There were no sightings elsewhere, but the shyness of those observed meant they could easily have been overlooked on Phou Xang He. However they are certainly not present in the Corridor or any forest within 2km of villages. Eudey (1987) accorded this species "the highest conservation priority rating" among Asian primates.

Gibbon *Hylobates* sp.

Gibbons occurred in the forests of both Phou Xang He and of Phou Hinho (Fig. 9). Their distribution seems rather patchy, particularly on the former, but stationary observers on the hills could hear 0-5 groups each morning; this was many fewer than in Xe Piane PPA (November - February, May). They have been extirpated from the Corridor and probably most areas within 2km of villages. Those sighted were shy. The form concerned is yet to be identified conclusively. Under Eudey's (1987) taxonomy, it is *H. concolor*, accorded "a very high conservation rating".

Bear sp. *Ursus thibetanus* or *U. malayanus*

An old corpse partially dismembered was found tied to a tree on Phou Xang He. The claws proved it was a bear, but the head was missing. Bears' paw soup is a delicacy, particularly in China, resulting in international trade (Servheen 1990); as this corpse retained its paws it was probably killed for other reasons. Scratches on trees proved that bears were present in the main forest blocks. Hunters report both species (DWFC questionnaires).

Large-spotted Civet *Viverra megaspila*

One animal foraging in a bamboo stand in Evergreen/Semi-evergreen Corridor forest 5km south of Ban Khame. Two further sightings of *Viverra* civets were too poor for certain identification. Several other *Viverra* or *Viverricula* civets were heard foraging in leaf-litter but were obscured by roadside vegetation. This species has a wide geographical range but some populations are considered critically threatened, it seems to be nowhere common and it is not known from any protected area anywhere in its range; field surveys to locate surviving populations are a high priority (Schreiber *et al*. 1989).

Big cat *Panthera* sp.

Footprints either of Leopard *P. pardus* or Tiger *P. tigris* were found in Phou Xang He semi-evergreen forest. Both are reported by villagers (DWFC questionnaires) and probably occur throughout the area.

Asian Elephant *Elephas maximus*

Elephants were smelt and heard feeding in a bamboo stand along the road 6km south of Ban Khame on 16 April (Fig. 9). The observer did not investigate closely, but in conversation the following day the villagers knew of the animals' presence and said that they frequently appeared at this season because there was no longer enough water for them on Phou Xang He. They had been smelt about 3km south of Ban Khame the preceeding night but the following night no indication of continued presence was found. Widespread characteristic vegetation damage, wallows and dung was found east and northeast of Ban Nalay (none particularly recent), where again Elephants were stated to be wandering in search of water (Fig. 9).

Gaur *Bos gaurus*

Numerous footprints in open grassy areas on Phou Xang He were probably of this species; one individual was seen. No signs were found on Phou Hinho or elsewhere (Fig. 9). The presence of domestic water-buffalo in peripheral forest areas and in isolates meant that wild cattle footprints would easily have be overlooked.

5.2.2 Conservation considerations

There are numerous globally-threatened mammals in PXH, many of which are large species (elephants, cattle, big cats, bears) which require large areas of fundamentally undisturbed habitat for their survival; although each can tolerate a certain degree of habitat fragmentation, their survival is less likely when this occurs, especially when accompanied by hunting. The sheer size of PXH and its largely pristine state are of major importance in supporting these species. On a species-specific level, the populations of Douc Langur and gibbon are very important, yet both are severely at risk in the area from uncontrolled hunting. Pygmy Loris and Large-spotted Civet are inconspicuous species, unlikely to be recorded except by substantial periods of nocturnal searching. This has rarely been done within the range of Pygmy Loris so it is difficult to assess the significance of the records; the same is true to a lesser degree for Large-spotted Civet.

Phou Xang He PPA clearly supports a good community of mammals, which was by no means completely sampled in the present survey. Futhermore, in line with the birds, the forests on the two main mountains may have different species complements. The difference in *Callosciurus* squirrels may be parallelled in less easily-visible groups. This means that representative habitats should be preserved on both hills.

5.3 THREATS TO MAMMALS

Preservation of the remaining forest patches in the flat areas including the Corridor is vital, primarily because in times of water stress it appears that large herbivores visit the more reliable water-sources in the lowlands. Reported salt-licks and waterholes higher on Phou Xang He were stated by hunters to draw in large numbers of herbivores during February. Two visited had dried up and there was no evidence of animals visiting during the survey. A number of licks in the lowlands around Ban Nalay, at the foot of Phou Xang He, were still moist and showed signs of recent use by ungulates and elephants. Further reduction of the already decimated lowland habitat will increase the possibility of conflicts between the villagers and large wildlife. DWFC questioning of villagers showed a moderate degree of conflict already, with Tigers and Dholes *Cuon alpinus* frequently mentioned as attacking livestock (Jungle Cats *Felis chaus*, civets and mongooses *Herpestes* less frequently mentioned), and crops being raided by Wild Pigs *Sus scrofs* (almost ubiquitously), Sambars *Cervus unicolor*, porcupines, rats and monkeys (unspecified). Tigers, Dholes and possibly the monkeys are threatened species.

In addition, these fragments were the only areas confirmed to hold Pygmy Loris and Large-spotted Civet, two mammal species important in an international perspective.

Several dead water buffalos were seen in Ban Muangsen, apparently having died of disease. There may be a risk of transmission to wild cattle populations in the region.

Hunting of mammals was common. Hunters were sometimes encountered walking trails by night, and various medium-size species were killed (including flying squirrels *Petaurista* and mousedeer *Tragulus*). Larger animals are also taken: a Sambar skull was present in a hunters' camp in Phou Xang He, and at Ban Nalay three hunters brought in a dismembered Wild Pig to the village. A dead bear tied to a tree had had various parts removed. During conversations it became clear that the main hunting areas are in Phou Xang He. Villagers mentioned hunting sambar, barking deer *Muntiacus*, civets, pigs and all monkeys (the latter were not eaten at a few villages). No evidence was seen of commercial hunting, though this is apparently rife (R. Dobias 1993).

Hunting in the smaller isolates is likely to be unsustainable, particularly as fragmentation increases. However, in general, the area is large enough to withstand a certain hunting pressure, and the unexploited nature of Phou Hinho in particular suggests that reasonable mammal populations may remain. The likely disappearence of Green Peafowl *Pavo muticus* sounds a warning that similarly susceptible mammal species could be extirpated, so any hunting allowed should be restricted to suitable species such as barking deer and pigs.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

1. PXH is a large area of undisturbed habitat supporting important populations of large mammals and rare birds. Any degradation of habitat within the area will prejudice this function.
2. The surveyed area contains a representative diversity of habitat types present in south-central Laos, in relatively intact condition over large parts.
3. Evergreen forest is the most important habitat; a large block on Phou Hinho is complemented by significant fragments in the Corridor.
4. Semi-evergreen forest is also important. The main area is on Phou Xang He. Fragments in the Corridor are more degraded, compared with Evergreen forest.
5. The two hilly areas are two different ecosystems in terms of geomorphology, hydrology, vegetation communities and many bird and some mammal species. A comprehensive conservation strategy for PXH therefore must involve preservation of good habitat on both hills.
6. While hill forest areas are largely intact, no continuous forest remains in the lowland Corridor; it is predominantly cultivation, scrub and fragments of degraded forest.
7. The lowlands are important in their own right (see point 14).
8. Shifting cultivation is a major threat to all lowland and peripheral areas. Different tasaengs (units of several adjacent villages) clear forest at different rates; the largest areas are reportedly disappearing around Phongsavang (which tasaeng includes Ban Khame and the Corridor Evergreen/semi-evergreen forest isolates; see points 13 and 14).
9. A habitat link across the Corridor between the forested hills would greatly enhance conservation importance of the area. Three links could be made, including all the remaining Evergreen forest isolates. New hamlets along the road in the best area will rapidly degrade the remaining patches without swift action.
10. All large lowland rivers are heavily used by the existing settlements and virtually no pristine forest remains along any of their courses; but these rivers are important water sources for large mammals during the dry season. Hill rivers are heavily exploited and disturbed during the dry season, when aquatic animals are concentrated in pools.
11. Mixed deciduous forest (in the Corridor and on Phou Xang He) and Dry dipterocarp are extensively burnt and degraded as a result.
12. Large dipterocarps are tapped for resin at high levels; this could cause death of important canopy trees.
13. An impressive list of threatened large mammal species was reported by villagers during DWFC interviews. The current survey confirmed the continued presence of some of these, but the survey techniques were not particularly appropriate for detecting such species. Instead, two further species of interest were discovered (Pygmy Loris *Nycticebus pygmaeus* and Large-spotted Civet *Viverra megaspila*), both of great conservation significance on the basis of current knowledge (which, however, is inadequate for both species).
14. Pygmy Loris and Large-spotted Civet were detected only in Corridor Evergreen/Semi-evergreen forest isolates; however suitable surveys to detect them were limited in other areas. Elephants were also found in the Corridor, apparently having left the forest block of Phou Xang He in search of water, which is more available in the Corridor in the dry season. These facts mean that the Corridor is of crucial importance as wildlife habitat.
15. Diurnal primates, all very shy, had been extirpated from the Corridor and from slope forest close to villages. These facts suggest heavy hunting, confirmed by answers to DWFC questionnaires, which revealed that Douc Langur *Pygathrix nemaeus* is a particularly sought-after source of meat. Douc Langur has a very restricted world range and is critically threatened; these descriptions probably also apply to the gibbon *Hylobates* in PXH. Primate hunting could become very damaging.
16. Nocturnal hunting is heavy but over a limited area. Those areas still supported adequate numbers of common species. This suggests that monitoring or restriction of non-specific night-hunting is of less importance than similar action over primate hunting.
17. Seventeen key bird species were found. Three are globally Threatened, four globally Near-threatened and ten At Risk in Thailand. Most of these species have large populations in PXH meaning that the area is important for bird conservation.
18. Green Peafowl *Pavo muticus*, a particularly vulnerable bird, may already been hunted out from the area. Other vulnerable species are probably threatened in PXH.
19. Table 8a summarises the threats to and conservation value of the different habitats Those most in need of management attention are the Corridor forest isolates and Phou Hinho Evergreen forest. Table 8b amplifies, with a rationale for the assessments and presentation of the most important spheres of management for each habitat.

Table 8a: urgency of management for different habitats in PXH.

Threat	Hinho EF	Xang He forest	Corridor EF/SEF	MDF	DDF	Cultivation	Scrub
Habitat clearance	Low	Low	High	High	Low	Low	High
Hunting pressure	Low	Mid	High	High	Mid	Mid	High
Overall	**Low**	**Low**	**High**	**High**	**Low**	**Low**	**High**
Conservation Value							
Mammals	High	High	High	Low	Low	Low	Low?
Birds	High	Mid	Mid	Mid	Low	Low	Low
Habitat condition	High	High	Mid	Mid	High	Low	Low
Overall	**High**	**Mid**	**High**	**Mid**	**Low**	**Low**	**Low**
Management Urgency	**Mid**	**Low**	**High**	**Mid**	**Low**	**Low**	**Low**

Table 8b: rationale for "Conservation value" in Table 8a and management priorities for each habitat

Habitat	Rationale	Management needed
Hinho EF	13 key bird species, 5 unique to Phou Hinho in PXH context; two critically-threatened primate species	Monitor hunting; control primate hunting; stop forest clearance at edge
Xang He	5 key bird spp. (1 unique); gibbons; large herbivores	As Hinho
Corridor EF/SEF	8 key bird spp., few avifaunal differences from main block of EF; two major mammal finds; crucial to large hebivores in dry season	Stop all forest clearance; reduce extent of cultivation; reduce disturbance along streams and rivers; establish habitat link between 2 hill ranges
MDF	fewer bird species (7 key), degraded; mammals little-known	Monitor hunting and clearing
Dry dipterocarp	fewer bird spp., only 2 key species; few mammal species, none key	None
Scrub	no key bird or mammal species, disturbed habitat	None
Cultivation	as scrub	None

Table 9: key bird and mammal species of PXH: threats and management priorities.

	Threat from		
Species	Habitat degradation	Hunting	Specific action required
Bar-backed Partridge	Low	Possibly high	Monitor, perhaps control, hunting
Siamese Fireback	Low	Possibly high	Monitor, perhaps control, hunting
Grey Peacock-Pheasant	Low	Possibly high	Monitor, perhaps control, hunting
Ruddy Kingfisher	Very low	Low	None
Brown Hornbill	Low	Low	None
Wreathed Hornbill	Low	Low	Monitor, perhaps control, hunting
Red-vented Barbet	Very low	Low	None
Red-collared Woodpecker	Low	Low	None
Black-headed Woodpecker	Low	Low	None
Pale-headed Woodpecker	Low	Low	None
Bar-bellied Pitta	Low	Unknown	Monitor, perhaps control, hunting
Ratchet-tailed Treepie	Low	Low	No
Grey-faced Tit-Babbler	Low	Low	No
Rufous-throated Fulvetta	Low	Low	No
Fulvetta sp. A	Low	Low	No
Golden-crested Mynah	Very low	Low	Monitor, perhaps control, capture as cagebird
Hill Mynah	Very low	Mid	Monitor, perhaps control, capture as cagebird
Pygmy Loris	Probably low	Probably low	Survey status and hunting levels
Douc Langur	Mid	Very high	Control, perhaps end, hunting
Gibbon	Mid	High	Control, perhaps end, hunting
Sun / Asiatic Black Bear	Probably low	Probably mid	Survey status and hunting levels
Large-spotted Civet	Probably low	Probably low	Survey status and hunting levels
Leopard / Tiger	Mid	Probably mid	Survey status and hunting levels
Elephant	Very high	Probably low	Protect lowland forest by perennial streams
Gaur	Possibly very high	Possibly high	Survey status and hunting levels

20. Table 9 presents the degree of threat to the key species found during the survey. For mammals especially, lack of knowledge is a major handicap to these assessments and therefore to management planning. Few species are threatened by habitat loss, mainly because the remaining forests are so extensive. The species needing imminent forest protection are those large mammals which roam in search of water during the dry season: certainly Elephants *Elephas maximus* and probably also wild cattle. Hunting is a more pressing threat, especially to terrestrial birds (pheasants, partridges and probably pittas) and diurnal primates (especially Douc Langur and gibbons, in view of their threatened status) and probably wild cattle.

6.2 MANAGEMENT PRIORITIES

6.2.1 Boundaries

The boundaries of PXH should include all suitable areas found in this survey (Figs 1, 7, 8).

1. All Phou Hinho, which at the time of the survey was only a proposed extension, should be included; it seems more important from an ornithological point of view than Phou Xang He.
2. The western area of Phou Xang He is reportedly poorer and has lost much of the wildlife (R. Dobias, from villagers reports) but the inclusion of the whole massif would allow a natural and easily definable northern and western boundary to the area. Furthermore, the habitat is in good condition and with cessation of hunting could support more important mammal populations. The boundary should follow the present forest limits, mainly along the foothills: though less discernable to the south it should include all predominantly forested land, and larger pieces of disjunct forest. The northern edges of both Phou Hinho and Phou Xang He are more definable by the steep ridges; all areas of ridge down to the flatlands should be included together with any significant areas of forested land up to the Nam Mi or Xe Bay respectively.
3. The corridor area should be included with special emphasis on the habitat links between the two hill ranges. The northern boundary would run from the main Phou Xang He ridge north, within 1km east of Ban Muangsen, following the northern edge of the remaining lowland forest, then going southeast within 1km south of Ban Donggnang to join the northern edge of Phou Hinho. The southern boundary would run from the Phou Katot hills west, 4-5km south of Ban Ngoikasan to the Phou Nang Ngoy hills.

4. The southward extent of the Phou Nang Ngoy hills should be included.
5. The boundary in the Ban Nalay area (Fig. 8) should follow the forest edge on the lower slopes of Phou Xang He. This is 2km to the north of said village, but to the east fairly good MDF and less degraded Semi-evergreen forest come within 1km of the village and the boundary should include this area and the eastern reaches of the Xe Xang Xoy and Houei Tin-Gnalong. The boundary should perhaps from Ban Nalay head south along minor hills that parallel the Phou Nang Ngoy Hills, the area between the two hill ranges being included; and then east along the current forest edge to meet the boundary on the east edge of the Phou Nang Ngoy hills.
6. A buffer zone should be considered around the whole area. It should include at least the Xe Bay in the north, and the Xe Xang Xoy in the south (before its confluence with the Xe Kasok)
7. There is currently no limestone component to PXH, although limestone hills are frequent to the north (Fig. 2). One such area, Phou Kasat, 16km north of current boundaries, reportedly supported both Douc and Francois's Langurs *Semnopithecus francoisi*, Serow *Naemorhedus sumatraensis* and Gaur *Bos gaurus*, the former three not being hunted. The lack of hunting of Douc Langurs stands in contrast to the situation in the main part of PXH. This would add greatly to the diversity of habitats and wildlife protected and the feasability of adding such an area should be considered. The Evergreen and Semi-evergreen block east of Muangsen would be an appropriate link to Phou Kasat. This forest block is already probably continuous with forest on Phou Soung (probably a limestone hill) only 5km north of current boundaries.

6.2.2 Future surveys

1. Some sections of the PPA were not visited due to the constraints listed in sect. 2.1.2. While some are probably protected by their remoteness, the following boundary areas need visiting for assessment of habitat condition and threats:

a) the eastern side of Phou Hinho; establishment of the extent of Evergreen forest is important
b) the western half of Phou Xang He.

2. A closer monitoring of the pattern of natural resource exploitation is required, including the burning of forest understorey during the dry season, the harvesting of some forest products such as resin, roofing tile production (which involves very large trees) and the hunting of some animals (particularly primates). The

disruption of hill rivers during the dry season may be a greatly under-rated threat and should be investigated immediately.

3. Shifting cultivation involves regular clearance of new areas. Its current extent and the forest-types being cleared need to be established.

4. The range of species hunted with estimates of numbers taken for each species needs to be established for firmer assessment of how damaging hunting practices are.

5. Further information on the status of large mammals is needed as additional key species are sure to be present and distributions of large species (cattle and elephants) probably change seasonally.

6. Hunters gave equivocal information concerning the locations of salt-licks and the numbers of animals using them. These are likely to be critical resources at certain seasons so this information should be established urgently, together with an idea of hunting levels.

7. Grazing may be occurring deep within forest on Phou Xang He and should be investigated.

8. Two species of major international conservation interest are reported to occur in restricted parts of the area by villager: Francois's Langur and Green Peafowl. Elucidation of these species' status in the area is extremely important.

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ANNEXES

ANNEX 1: DETAILS OF VILLAGES UNMAPPED OR KNOWN BY OTHER NAMES

Table 10: villages unmapped or where map information is incomplete.

Name on map	Number (Fig. 3)	Local name	Notes
unmapped	3	unnamed	
not mapped	8	Ban Katep Noy	soon to be renamed Sumsanuk
Ban Khame	9	Ban Nomsamlane	Beware of confusion with Ban Khame (no 12)
unnamed village	12	Ban Khame (Noy)	near Nakaphoung
Ban Alom	13	as map	not a Ban Hang
unmapped	14	unnamed	
Ban Phalou	15	as map	not a Ban Hang
Ban Nonglouang	17	as map	not a Ban Hang
Ban Ngonsai	18	Ban Houeysay	
Ban Ngoikasan	19	Ban Sumsaat	
Ban Lavay	20	as map	not a Ban Hang
not mapped	22	Ban Labhoun	

Note: a Ban Hang is a seasonal or abandoned village.

ANNEX 2: SUMMARIES OF LANDSCAPE MATRICES

Annex 3 contains explanations of the habitat terminology used here.

Table 11: summary of landscape matrices 1-9.

Line 1

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	93			
No natural or semi-natural forest	47			
Scrub and Eupatorium scrub	60			
Forest types:	EF	SEF	MDF	DDF
Natural forest	13	9	2	5
Semi-natural forest	24	16	23	12
Heavily disturbed forest	13	26	41	1
Clear-felled forest	6	17	47	1

Line 2

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	95			
No natural or semi-natural forest	33			
Scrub and Eupatorium scrub	42			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	28	0	0
Semi-natural forest	6	67	11	0
Heavily disturbed forest	0	89	61	0
Clear-felled forest	0	22	22	0

Line 3

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	93			
No natural or semi-natural forest	53			
Scrub and Eupatorium scrub	58			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	2	0	36
Semi-natural forest	0	9	13	33
Heavily disturbed forest	0	33	58	11
Clear-felled forest	0	11	29	13

Line 4

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	78			
No natural or semi-natural forest	83			
Scrub and Eupatorium scrub	95			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	0	0	13
Semi-natural forest	0	0	5	13
Heavily disturbed forest	0	25	50	0
Clear-felled forest	0	0	58	0

Line 5

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	79			
No natural or semi-natural forest	50			
Scrub and Eupatorium scrub	100			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	7	0	0
Semi-natural forest	0	50	7	0
Heavily disturbed forest	57	21	0	0
Clear-felled forest	0	21	36	o

Line 6

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	100			
No natural or semi-natural forest	9			
Scrub and Eupatorium scrub	27			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	77	0	11
Semi-natural forest	9	41	0	84
Heavily disturbed forest	9	9	11	68
Clear-felled forest	0	28	5	42

Line 7

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	100			
No natural or semi-natural forest	11			
Scrub and Eupatorium scrub	21			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	0	0	63
Semi-natural forest	0	47	0	84
Heavily disturbed forest	0	32	11	68
Clear-felled forest	0	11	5	42

Line 8

500m sections in which were recorded:	Percentage of sections in which recorded			
Any type of forest	88			
No natural or semi-natural forest	38			
Scrub and Eupatorium scrub	75			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	50	0	25
Semi-natural forest	0	75	0	13
Heavily disturbed forest	13	38	0	0
Clear-felled forest	0	25	0	0

Line 9

500m sections in which recorded	Percentage of sections in which recorded			
Any type of forest	94			
No natural or semi-natural forest	63			
Scrub and Eupatorium scrub	73			
Forest types:	EF	SEF	MDF	DDF
Natural forest	0	13	0	0
Semi-natural forest	0	38	0	0

Heavily disturbed forest	0	56	0	0
Clear-felled forest	0	56	0	0

Notes on Line 1
Length: 51.5km; route: Ban Nathom Xe to Ban Muangsen by car and foot; bearing: north along main Corridor road; lowland.
Additional features:
Section 25: reed beds
Sections 3, 29, 79, 89: small hamlets
Natural forest only occurs in small clusters 2.5-3km long, only three of DEF (sections 37-40 and 46-50, and 81-88); the northernmost two are visibly encroached on either side
Sections 12-51 show greatest landscape heterogeneity with three types of forest recorded all along

Notes on line 2
Length: 9km; route: by car from Ban Phalon to Ban Laboun, on foot to forest; bearing: northeast; lowland and lowest slopes.
Comments:
The area was said to have been more densely populated during the war
Forest was SEF and MDF only, some of it seemingly good forest but tended to be in strips
Many signs of disturbance along path

Notes on line 3
Length 22.5km; route and bearing: by foot from Ban Ngonsai through Ban Nonglouang to Ban Nathou, then SSW to Ban Nathom Xe (Ban Kamsay) and to main road; lowland.
Additional features:
Most of the scrub observed was derived from MDF and SEF
section 2: scattered remnants of 30-40m tall SEF in strips
section 5: remnants of tall *Lagerstroemia* dominated MDF containing small bamboo in understorey
section 10: site of abandoned village, Ban Nonglouam, remnant domestic fruit trees
section 13: Xe Thamouak: healthy riparian vegetation, bamboo, willow-like shrubs etc.
sections 13-17: DDF only of type 1, max. 12-15m tall, average 8-10m with dense regeneration
sections 19-29-30: River Xe Thamouak
section 24: Houey Kasan
section 32: MDF short and poorly developed , bamboo 10-15m as tall as canopy trees
Ban Nathou: claims of no good forest on the lowlands or between Nathou and Nakaphoung. Best forest reported to be about 7km to the northeast

Notes on line 4
Length: 20km; route and bearing: Ban Phongsavang to Ban Katep (southwest), Ban Katep to Ban Nakaphoung (southeast), then northeast to Ban Katep Noy, by foot; lowland.
Notes:
36% of sections containing heavily-disturbed forest were burning or recently burned
Mixed deciduous forest was probably the most common forest-type in the area
Bamboo groves were common both in wooded areas but also as a feature of the Xe Thamouak river valley
section 5-6: remnant *Lagerstroemia* dominated MDF: canopy 25-30m (mid-dense); mid-storey 10m but virtually absent, probably removed, understorey 3-5m bamboo clumps and scattered shrubs. Ground layer absent or burned.

Notes on line 5
Length: 7.5km; route: Ban Naphilang to Ban Donggnang by foot; bearing: northeast; lowland.
Comments:
Route bombed fairly heavily (36 craters adjacent to the road); some bamboo not recorded
Forest types are MDF and SEF although the latter probably a remnant of EF.
Sections 3-10: felled MDF, dense SEF regenerating with absent A layer, B sparse, C+D dense. Two main layers present, with remnants of a main canopy up to 18m and a dense 8-10m mid-storey. C to 4m, and dense ground vegetation to 0.5m. Generally many open areas. Occasionally small areas of *Sindora cochinchinensis, Rhus succedanea, Dipterocarpus alatus* (some tapped; can attain 30m but usually small and exposed). Many thorny shrubs.
Section 5: forest to south of track; good path to Ban Khame.

Section 12: exit remnant forest to scrub, large forest clearance and pasture to Ban Donggnang.

Notes on line 6
Length: 11.5km; route: from Ban Muangsen to base of Phou Xang He ridge (sections 1-5) to top of ridge (section 9) and down along the H. Gnang valley by foot; bearing: southwest; hills.
Comments:
Forest recorded in 100% of sections, 86.9% as SEF
Forest along sections 5-10 best forest observed: A: 35-40m (open/mid-dense); B: 18-20m (dense); C: 6-8m (mid-dense); D: 1-1.5m. (dense)
MDF recorded near village as heavily disturbed/clear felled and also on Phou Xang He, having a lower canopy on rocky ground.
bamboo groves common on rock areas in Phou Xang He
rivers mostly dry or with remnant pools
good Semi-evergreen forest on ridge: A 25-30m (mid-dense); B 18m (dense); C 8-10m (dense); D 1-1.5m (dense), seedlings, few vines in understorey.
Sections 8-10: large banana plantation (on clear felled SEF)
Section 17: Houey Chale: relatively good forest stands (SEF) 25-30m dense undergrowth.

Notes on line 7
Length: 10.5km; route: by car from main road (Ban Dong Beng) to river Xe Xangxoy, Ban Nalay; bearing: north; lowland.
Comments:
Forest recorded along entire route primarily Dry dipterocarp forest
38%=clear felled forest
71%=heavily disturbed forest
85%=disturbed
66%=natural/undisturbed
Some patches of MDF along the road to the east, and a strip of degraded SEF.

Notes on Line 8
Length: 4.5km; route: Ban Nalay to forest on foot; bearing: northeast; lowland.
Comments:
Through cultivated and clear-felled areas (hill rice)

Notes on Line 9
Length: 8km; route: Ban Nalay to forest; bearing: north; lowland and lowest slopes.
Comments:
Through cultivated and clear felled areas (hill rice)
Section 6: Houey Hin
Section 9: Houey Phee

ANNEX 3: SUMMARY OF MAIN RESULTS FROM FOREST STRUCTURE SAMPLING

Table 12: summary of main results from forest structure sampling.

Area	Phou Xang He	Phou Hinho	Corridor
Forest-types	SEF, MDF	Evergreen Forest	Evergreen Forest
Number of plots	20	20	20
Forest layering (number of plots)			
Two-layered	1	3	1
Three-layered	16	10	19
Four-layered	3	7	0
Height of main canopy and emergents (number of plots)			
absent or <20 m	8	1	1
20-25 m	5	0	2
25-30 m	5	8	10
30-35 m	2	11	7
35-40 m (emergents)	3	6	5
0ver 40 m (emergents)	0	4	0
Main canopy density (number of plots)			
closed	0	0	0
dense	8	7	4
mid-dense	5	10	7
open or absent	7	3	9
Mid-storey height range (m)			
range (m)	5-20	5-20	8-18
Mid-storey density (number of plots)			
closed	0	0	0
dense	6	1	0
mid-dense	10	9	8
open or absent	4	10	12
Understorey height range (m)			
range (m)	1.5-6	0-8	0-4
Understorey density (number of plots)			
closed	0	2	10
dense	9	6	8
mid-dense	3	1	0
open or absent	8	11	2

Density of layers: closed, overlap in the crowns (canopy) or foliage (lower layers); dense, average spacing between crowns less than average crown diameter; Mid-dense, average spacing of crowns greater than average crown diameter, Open, crowns well separated from one another; layers: A, canopy; B, mid-storey; C, understorey; D, ground layer (used in Annex 2)

Phou Xang He: data from 20 samples taken at approximately 200m intervals, descending a path from 450m a.s.l. to 300m through relatively homogeneous forest (with some patches of open MDF) between the Xe Kong valley and the eastern edge of Phou Xang He
Phou Hinho: data from 20 samples taken at 200-300m intervals whilst ascending a forested ridge to the east of Ban Khame from 235m to 450m a.s.l.
Corridor: data from 20 plots taken at 50m intervals in lowland remnant Evergreen forest along the road between Ban Khame and Ban Katep Noy. Bombs interfered with the measuring of palm density in the Corridor.

ANNEX 4: AGRICULTURAL LANDUSE

An attempt was made to obtain some information on rates of forest clearance in relation to the corridor area. Mr Somphong visited villages to interview the chiefs. The Muang Phin District Forestry office provide some data. Other district offices were not contacted: Ban Vilabuly District Office controls the upper area of the corridor and Atsaphanthon deals with villages on the western side of PXH.

1. Statistics from M. Phin District office.

M. Phin District land cover

Table 13: land cover in the M. Phin district

Land cover	area (ha)
Forest	307,393
Dense forest	98,000
Dry dipterocarp forest	70,000
Pasture	26,000
Rice paddies	297,415
Hill rice	344,075
Bamboo stands	41,500

Data on some village groups (tasaengs) in M. Phin District

Table 14: data on tasaengs in study area under the jurisdiction of M. Phin.

	Tasaeng			
	HOUAYSAI	NATHONG	XETHAMOUAK	NATHOM
no. of villages forming tasaeng	9	13	28	8
no. of families	423	682	1221	442
no. of houses	391	464	1124	351
population	2284	3481	7190	2528
males/females	1126/1158	1740/1741	3497/3693	1198/1330
area of paddy (ha)	287.8	362.6	350.3	206
area of new (1992) paddy (ha)	41.3	10.1	45.7	4.7
area of reinstated paddy (ha)	0.3	0.6	12.3	0
total area of paddy (ha)	329.1	272.1	310	209.4
area of hill rice (ha)	123.9	14.4	14.9	28.5
families with paddy only	244	594	1190	92
families with hillrice and paddy	0	87	20	350
families with only hill rice	179	1	11	0
area of forest (ha)	38514	36138	11834	5845

Tasaeng composition:
Houaysay: Houaysai, Phalou, Phalong, Labhoun, Lavay, Ngoikasan (Sumsaat), Nonglouong, Nathou, Alom.
Nathong: Khon Keng, Kham Noy, Alouai Khao, Alouay May, Nathong, Nathom-Khok, Houey Lakhouoy, Nua, Dong Son, Salai Nua, Kong Hin, Phonsay takhai, Xale-Tay (Thanot), Houey Lakhuey Thay
Xethamouak: 28 villages to the north and south of route 9
Nathom: Nathom Khao, Houey Kham, Posi, Nathom-Xe, Naxeng Noy, Naxeng Thao, Nakanong

2. Village interviews

Data from village interviews are presented in Table 15

Table 15: village interview results in PXH area.

ANNEX 5: BIRD SPECIES OF PXH

Bird status was assessed subjectively using the following criteria using the following criteria:

- 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's 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 storey inhabited: forest-canopy species can be more difficult to observe than those of the mid-storey or understorey.
- 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 16 indicates those species where calls had an important influence on assessment.
- flocking behaviour: 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 ocurrence: many species are migrants, whose abundance changes throughout the year. Thus, the status assessments given relate only to the months of March and April which is a major passage period for migrants.

Table 16: bird species recorded at PXH (overleaf)**.**

Species limits and nomenclature follow Boonsong Lekagul and Round (1990), which see for scientific names (given here for species not in that work).
Additional information:
1, includes some pond herons identified only to genus;
2, includes some accipiters identified only to genus;
3, includes some green pigeons identified only to genus;
4, includes some nightjars identified only to genus;
5, *Megalaima lagrandieri*;
6, *Picus rabieri*;
7, records related to form *A. (n.) richardi*;
8, records probably related to birds of the *H. (d.) striolata* group;
9, records related to either Ashy Minivet or Rosy Minivet of form *P. (r.) cantonensis*;
10, Slender-billed Oriole *Oriolus tenuirostris* not always eliminated;
11, *Temnurus temnurus*;
12, *Macronous kellyi*;
13, records related to either Greenish Warbler *Phylloscopus trochiloides* or Two-barred Warbler *P. (t.) plumbeitarsus*;
14, most records were of the race *L. c. lucionensis*;
15, *Acridotheres cristatellus.*

Key:
Abundance codes: C = common; F = frequent; O = occasional. L (prefix) = local; d (suffix) = declined in numbers during survey period (initial abundance given); m (suffix) = only in the parts approaching MDF.
Other: A = predominantly aerial species (some could not be categorised according to habitat and are listed only here, with status assessment in parentheses); I = species's identification provisional; P = many records of birds on passage; V = knowledge of the species's vocalisations greatly helped status assessment; W = species strongly associated with water, including when in other listed habitats.

ANNEX 6: MAMMAL SPECIES OF PHOU XANG HE

Table 17: mammal species recorded at PXH.

Order and scientific nomenclature follow Corbett and Hill (1992). No specimens were taken. As mammals are difficult to detect, absence of a symbol should not be taken to suggest absence of a species from that habitat.
Abbreviations:
Identification: conf = confirmed; prov = provisional; A = field sighting; R =, remains in field; S = sign. (R and S records are detailed in sect. 5.1.4). Use of a classification other than that of Corbett and Hill (1992) may result in a species changing from confirmed to provisional or vice-versa.
1, identified as this species solely on basis of range;
2, *N. intermedius* not ruled out (but very unlikely);
3, old remains of one of these two species found;
4, not seen but smelt and heard;
5, *M. rooseveltorum* not ruled out (but very unlikely);
6, type A occurred in the MDF of the Corridor, type B in MDF south of Phou Xang He;
7, both squirrels occurred in MDF and scrub, but with minimal overlap. *T. maritimus* was found in more open MDF and predominant in the scrub, while *T. rodolphei* occurred in denser MDF and only in areas of scrub retaining tall trees.
Abundance codes: C = common or abundant; F = frequent; O =, occasional or rare; a dash (-) indicates a habitat where the species probably was not present during the survey; this category is only possible for conspicuous species.
Reliability Est = Reliability of estimate: an assessment of the reliability of the species's status categories. A more confidant estimate can be made of a species's status if it is conspicuous or commonly seen. Inconspicuous species or those seen only a few times are more likely to be accorded an erroneous category. Estimates relate only to those habitats where a status assessment is given.
Coverage: an assessment of the completeness of knowledge of the species community of that habitat. This is based upon the amount of effort expended in it and the ease with which mammals can be detected.

Table 18: mammal species reported for PXH by villagers during DWFC questioning in 1991 - 1993.

Animal	Villages	Information from current survey
Francois's Langur	4	Not found; probably not present in sites surveyed
Douc Langur	16	Seen
Gibbons	13	Seen and heard
Wild Dog	13	Not found; easily overlooked
Sun Bear	13	Possible signs and remains found; easily overlooked
Black Bear	15	Possible signs and remains found; easily overlooked
Otters	14	Prints found; species not known
Clouded Leopard	12	Not found; easily overlooked
Leopard	13	Possible prints found
Tiger	14	Possible prints found
Elephant	9	Herds or signs found in two separate areas
Wild Pig	16	Signs common
Mousedeer	16	Signs and one direct sighting
Sambar	11	Hunted remains found deep in forest; not seen or heard alive
Barking Deer	16	Commonly heard
Gaur	12	Footprints common in one area; one seen nearby
Banteng	8	Probable footprints found
Wild Water Buffalo	1	Not found; footprints easily overlooked, especially as domestic ones common
Serow	8	Not found; easily overlooked
Goral	5	Not found; easily overlooked
Pangolin	16	Hole at base of tree claimed by guides to be this animal's
Hog Badger	16	Not found; fairly easily overlooked
Binturong*	2	Not found; easily overlooked
Bamboo Rat*	2	Not found
Giant Squirrel*	2	Found

The column "villages" shows the number of villages where the species was reported to be currently present. Interviews were held at 16 villages, but those species marked * were only discussed in two villages. The following further animals were discussed but no villagers claimed their current presence: rhinoceroses, Eld's Deer, Hog Deer, Kouprey, Tapir and Spotted Linsang*.

Table 19: contact frequencies of nocturnal mammals in PXH.

Species	Habitat			
	Corridor EF/SEF	Degraded areas	Nalay SEF	Dry dipterocarp
Slow Loris	29	1	1	1
Pygmy Loris	4	-	-	-
Large-spotted Civet	1	-	-	-
Small Indian Civet	-	-	-	2
Common Palm-Civet	6	-	1	-
Small-toothed Palm-Civet	10	-	-	-
Leopard Cat	1	-	-	-
Elephant	1	-	-	-
Muntjac	3	-	2	-
Giant flying squirrel	9	-	-	-
Small flying squirrel	3	-	1	-
Burmese Hare	-	1	-	-
Unidentified	6	1	-	-
Hours searching	**78.25**	**8**	**3.25**	**16.5**
Total contacts	**73**	**2**	**5**	**3**
Ease of survey: ground	V. difficult	Variable	V. difficult	V. easy
Ease of survey: trees	Fair	Fair	Fair	V. easy

Scientific names in Table 17. Routes walked are shown in Fig. 4.
Ease of survey refers to the ease of detection and identification of mammals.

ANNEX 7: OTHER SPECIES

A single Impressed Tortoise *Geochelone impressa* was found in the Phou Hinho area, concealed under vegetation debris in a stream bed. The species is categorised as Insufficiently known by IUCN (Groombridge 1982) and considered threatened throughout its range. It is eaten in the area. Monitors *Varanus* were also sought and after a night of heavy rain nine were seen being carried to the main road from Ban Nalay.