

FIELD OBSERVATIONS OF MAMMALS IN LAOS, 1992–1993

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ABSTRACT

From October 1992 to July 1993 mammals were surveyed at three large forest areas in southern and central Laos. These, namely Xe Pian, Dong Hua Sao and Phou Xang He, are among the first protected areas in Laos. Status and distributional data were collected on many threatened or little-known species, those particularly noteworthy being: Pygmy Loris *Nycticebus pygmaeus*, Douc Langur *Pygathrix nemaeus*, Yellow-cheeked Gibbon *Hylobates gabriellae*, Dhole *Cuon alpinus*, Tiger *Panthera tigris*, Sun Bear *Helarctos malayanus*, Large-spotted Civet *Viverra megaspila*, Asian Elephant *Elephas maximus*, the muntjac *Megamuntiacus vuquangensis*, Gaur *Bos frontalis* and Banteng *B. javanicus*. Villagers reported many further species of conservation importance.

The susceptibility of Black Giant Squirrel *Ratufa bicolor* to human pressure and the unknown global status of Inornate Squirrel *Callosciurus inornatus* are highlighted. Contrasting with former reports, two species of *Tamiops* were widely sympatric, though they were separated by habitat. In the heart of Xe Pian a complex of saltlicks was seasonally very important for large herbivores. The continued reports of Kouprey *Bos sauveli* beg further investigation and appropriate protective measures.

All three study areas were of high global importance for mammal conservation. Each probably supported relatively intact mammal faunas, though in all most large species had probably been reduced in numbers through habitat destruction and hunting. Particularly in Xe Pian, critically important gibbon populations remained. Many important species rely on large regions of relatively undisturbed habitat, as provided by the three areas, particularly Xe Pian and Dong Hua Sao which are close to each other. Any reduction of natural habitat will prejudice this function. Each of the three study areas has particularly crucial yet imminently threatened regions for mammals: at Xe Pian, the saltlicks and Dong Kalo; at Phou Xang He, the Corridor forest isolates; at Dong Hua Sao, the remaining undisturbed plateau forest.

INTRODUCTION

Laos's low population density and extensive remaining forest (47.2%, although this includes all areas with as little as 20% canopy; LSFPC, 1992) give it a major importance for wildlife conservation. Very few mammal records have been published since 1950, although several internal reports contain valuable information (e.g. COX ET AL., 1991, 1992; SALTER, 1993; SALTER ET AL., 1991). From October 1992 to July 1993, mammals were

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surveyed in several areas as part of a broad-based assessment of management priorities for the Forest Resources Conservation Sub-programme of the Lao-Swedish Forestry Cooperation Programme. This paper considers mammals observed in the field or found in villages. Market specimens are not listed because their site of capture was not established. Similarly, information from villagers is presented only where relevant; that collected adds little to SALTER (1993).

There is no synthesis of Lao mammal records to date, making it difficult to assess the distributional significance of these observations. Earlier lists (GRESSITT, 1970; DEUVE, 1972) included speculation (not always explicit) and were probably based partly on market specimens with inadequately established provenance; such species as Hoolock Gibbon *Hylobates hoolock* assuredly never lived in Laos. Later compilations (LEKAGUL & MCNEELY, 1977; CORBET & HILL, 1992; SALTER, 1993) used a best-guess approach to distribution in the country. There is clearly a need for a comprehensive checklist of valid Lao mammal records.

Indochina, following DELACOUR & JABOUILLE (1931), and widespread usage since, refers collectively to Laos, Viet Nam and Cambodia, rather than to the expanded region of CORBETT & HILL (1992).

Abbreviations:

BM (NH), British Museum (Natural History), South Kensington, UK; DDF, dry dipterocarp forest; DHS, Dong Hua Sao NBCA; HN, Houei Nhang nature reserve; MDF, mixed deciduous forest; NBCA, National Biodiversity Conservation Area; PXH, Phou Xang He NBCA; SEF, semi-evergreen forest; XP, Xe Pian NBCA.

STUDY AREAS

All Study areas are shown in Fig. 1.

Xe Pian, Champassak and Attapeu Provinces (14°00'–14°50'N, 105°53'–106°30'E); 28 November 1992–14 March 1993; 6–15 May 1993

Xe Pian NBCA (Fig. 2) includes about 1500 km² of mainly undegraded SEF, mostly on rolling hills at 150–350 m, supplemented by Dong Kalo and the Xe Kong plains (totalling 900 km²) which support a mosaic of SEF, MDF, DDF and many small wetlands. The highest point is 844 m. Much of the southern boundary runs along the Cambodian frontier where similar forest apparently grows (aerial photographs held at the National Office of Forest Inventory Planning, Vientiane). The Northern Fringe of the protected area consists of MDF, wetlands (seasonal and permanent) and agricultural land.

Fieldwork was performed from villages of the Northern Fringe (38 days), the SEF of the Main Block (53 days, mainly around Houei Saoe, Houei Kua, the saltlick and Houei Tapkua) and on the Xe Kong plains (17 days primarily around the Xe Pian/Xe Khampho confluence). Work deep in Dong Kalo was curtailed to four days by security problems. A number of sites just outside the proposed boundaries were briefly visited to give useful comparative data on degraded habitats.

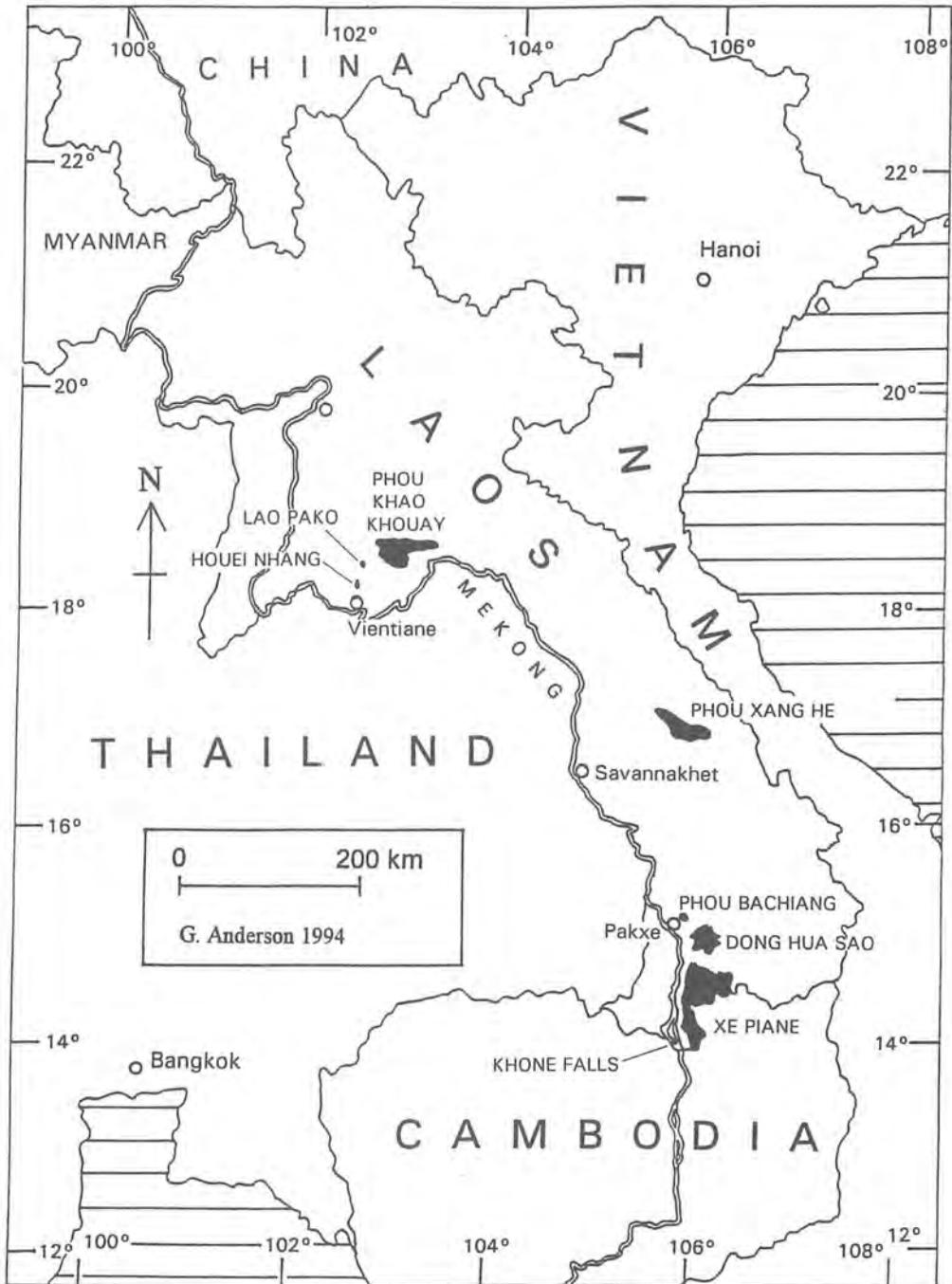


Figure 1. Laos and surrounding countries showing study sites.

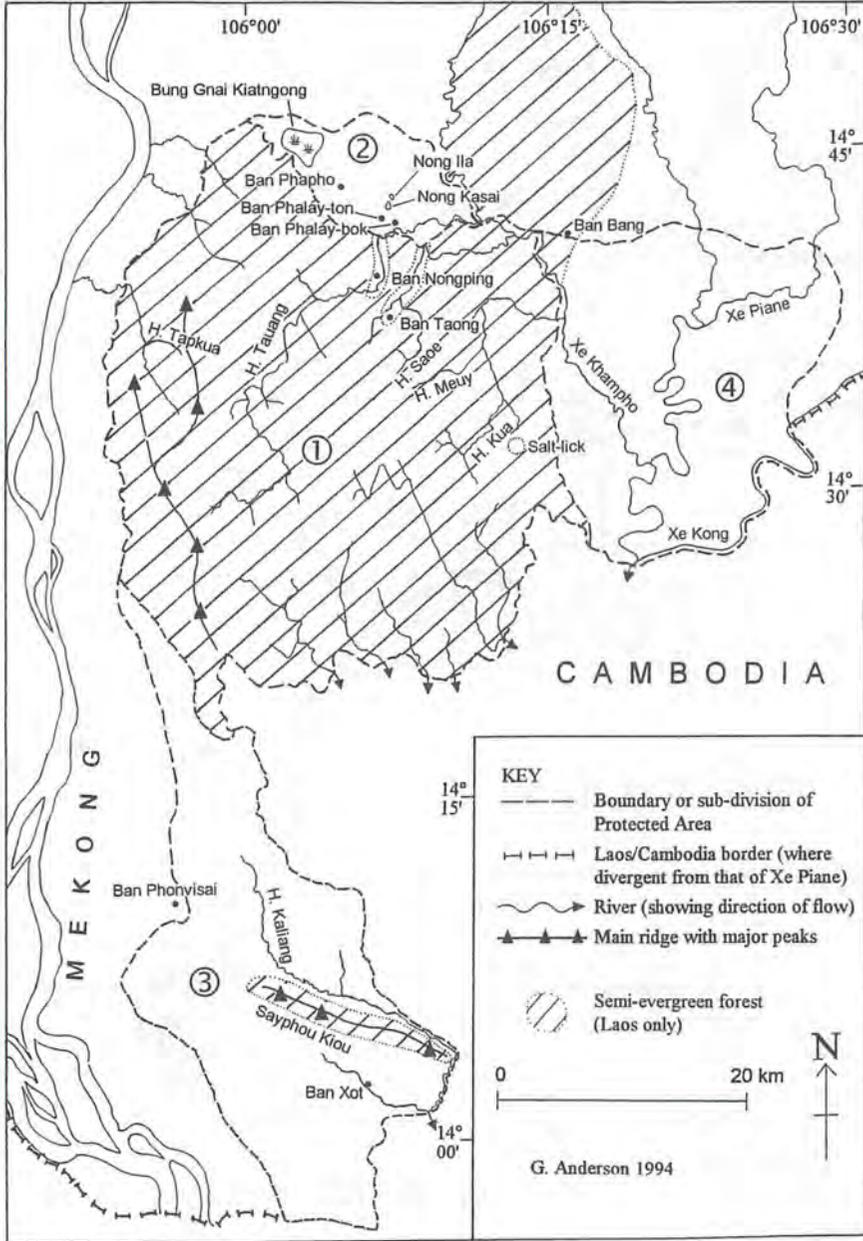


Figure 2. Xe Pian NBCA, showing locations named in the text. 1: Main Block of semi-evergreen forest; 2: Northern Fringe of wetlands, forest and agriculture; 3: Dong Kalo; 4: Xe Kong Plains. H. = Houei (River)

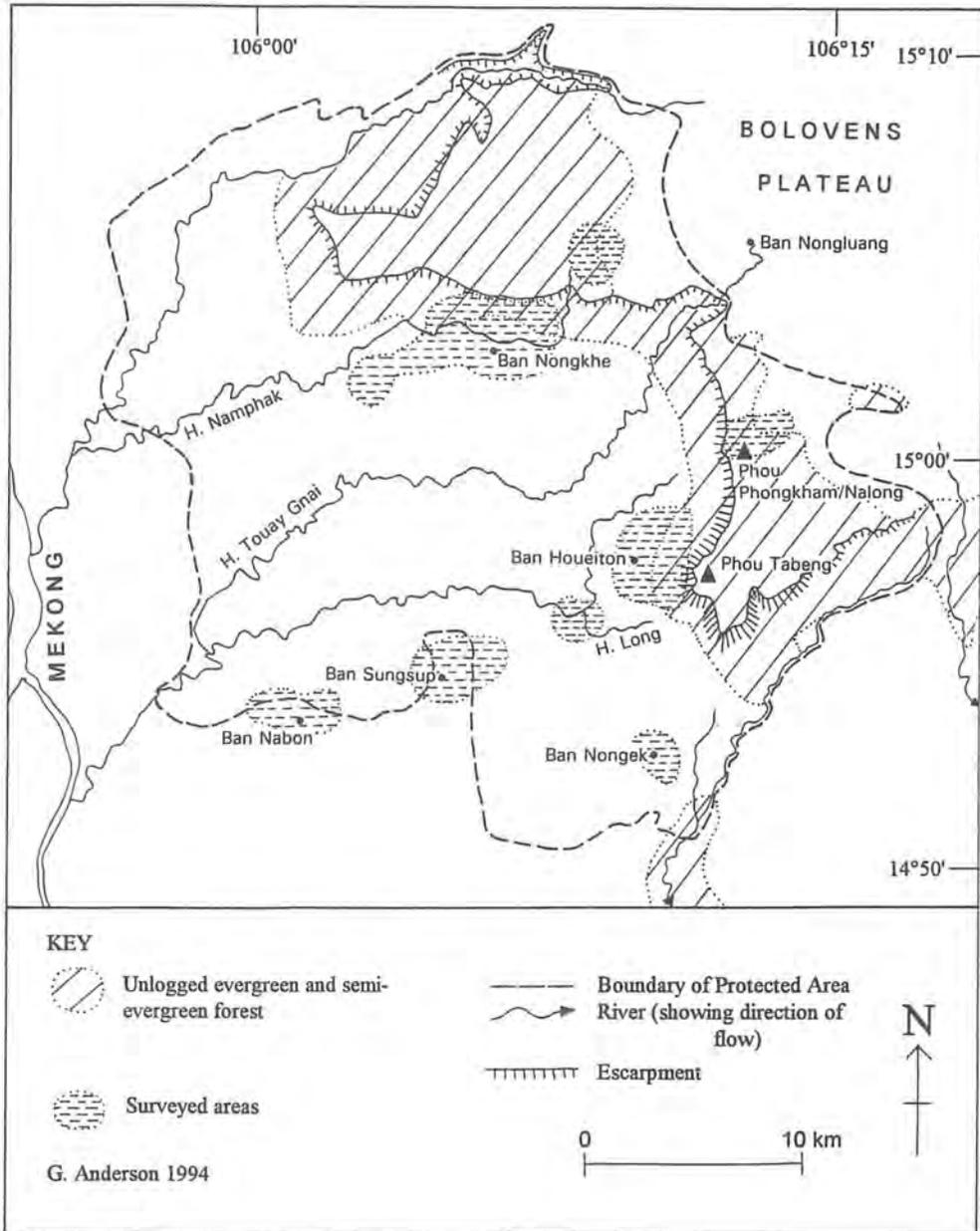


Figure 3. Dong Hua Sao NBCA, showing areas surveyed and locations mentioned in the text. H. = Houei (River)

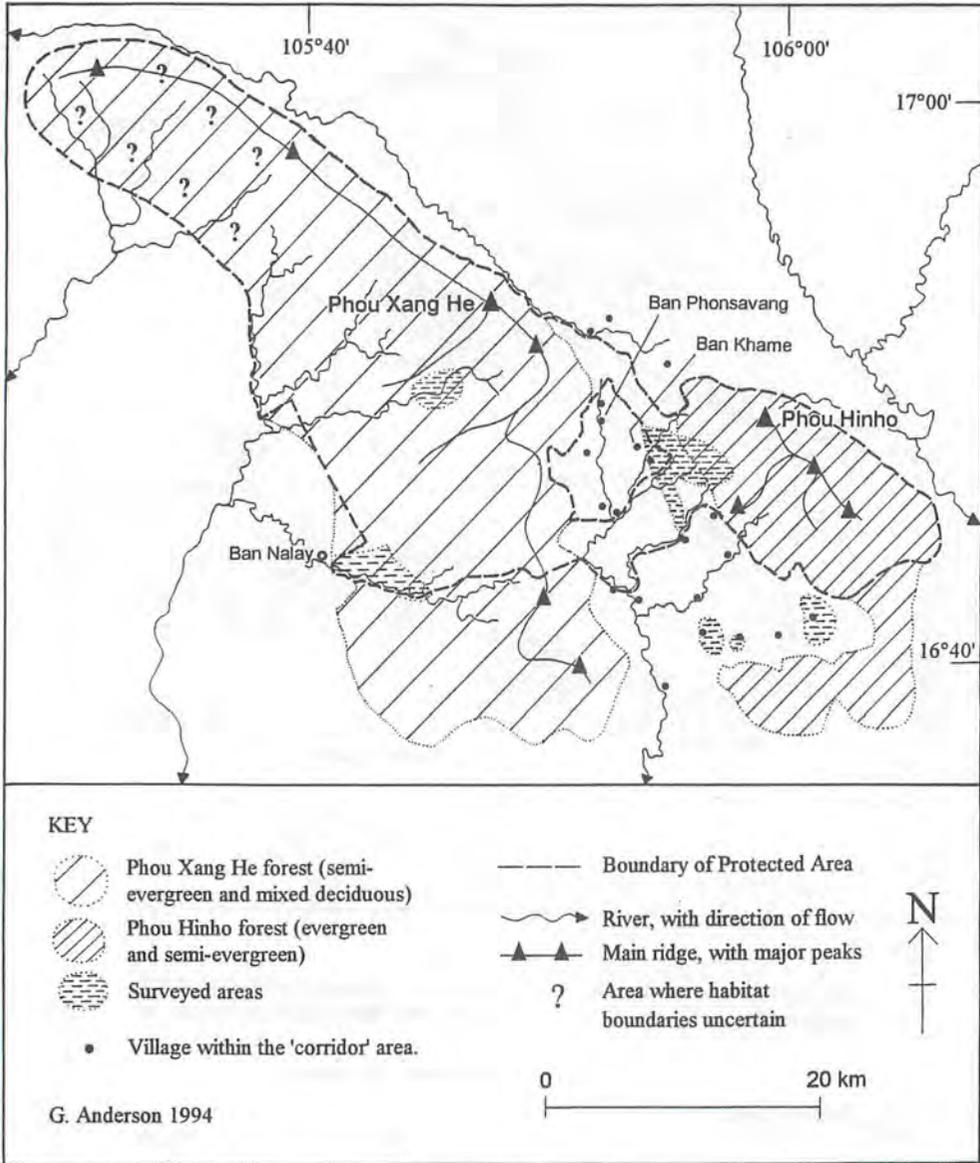


Figure 4. Phou Xang He NBCA, showing areas surveyed and locations mentioned in the text.

Prior to the survey, mammals of Xe Piane were known only by unconfirmed reports from villagers and brief visits by COX ET AL. (1991, 1992) and SALTER ET AL. (1991) seeking Kouprey and BAIRD (1991, 1992) Irrawaddy Dolphins *Orcaella brevirostris*.

Dong Hua Sao, Champassak and Attapeu Provinces (14°50'–15°11'N, 105°55'–106°17'E); 12 May–26 July 1993

Dong Hua Sao NBCA (Fig. 3) covers about 900 km², mostly (70%) lying below 250 m, but with a sheer escarpment and the Bolovens Plateau rising to over 1200 m. The slope SEF is largely intact, but the plateau evergreen forest is being rapidly cleared for coffee plantations and most lowland forests have been degraded by logging. The area is surrounded by cultivation except to the east, where a large tract of forest probably links DHS with XP. Lowland and slope SEF covers over half the area and MDF is extensive in the lowlands. Most forest on the plateau is hill evergreen forest.

Fieldwork was concentrated at: Middle Houei Namphak (250 m; 12–28 May), Bolovens Plateau (1100–1200 m; 30 May–22 June; Ban Nonglouang, Upper Houei Namphak and Phou Phongkham) and the southern lowlands (250 m; 26 June–26 July; Ban Sungsup, Ban Houeiton, Ban Nabon and Ban Nongek).

Many specimens previously collected in this region, especially on the Bolovens plateau, were documented by OSGOOD (1932).

Phou Xang He, Savannakhet Province (16°42'–17°04'N, 105°19'–106°06'E); 20 March–21 April 1993

Phou Xang He NBCA lies about 85 km east of the town of Savannakhet. The 1140 km² area (Fig. 4) consists of two largely forested northwest-southeast orientated hill ranges mostly at 200–700 m altitude divided by a flat Corridor, 6–10 km wide, containing many villages and forest fragments. The eponymous sandstone mountain Phou Xang He, dominated by SEF and MDF, endures marked drought conditions during the dry season. On the opposite side of the Corridor, Phou Hinho is a steep igneous formation with narrow ridges and valleys, supporting predominantly evergreen forest. South of the protected area is a tract of flat, mainly lateritic land dominated by DDF. The surrounding plains are largely deforested.

Although a few forays each of a few nights were made into the forest of both hill ranges, work was concentrated in the Corridor and around Ban Nalay, as these were the sites under most immediate threat.

Other localities visited and dates

The following were visited only briefly except for 3, which was so degraded and so close to Vientiane that few large mammals remained.

- (1) Degraded forest on the southern slope of Phou Bachiang 7 km east of Pakxé (15°7'N, 105°52'E), 22 November 1992.

- (2) Khong-Phapheng Falls, 4–7 February 1993 (a 5-km stretch of the Mekong with waterfalls is collectively referred to as “Khone Falls” in the literature. We visited specifically Khong-Phapheng Falls).
- (3) Houei Nhang Nature Reserve (18°04'N, 102°41'E): 16 October–16 November 1992. Also sporadic visits between January and September 1993.
- (4) Ban Hai, a limestone outcrop 15 km north of Phou Xang He (17°2'N, 105°46'E), 3–4 April 1993.
- (5) Vientiane, sporadically, October 1992–October 1993.

METHODS

Survey effort was restricted to larger mammals: bats, shrews and small rodents were not surveyed because of internal restrictions on the collection of specimens. To maximise the range of species encountered six methods were employed:

1. Nocturnal walks. Routes were chosen primarily on the basis of habitat and visibility. The widest roads or paths allowed the greatest volume of habitat to be searched. Observations commenced shortly after dusk (usually by 1930 h) and continued on some nights until dawn (0500 h). While walking at 0.6–1.3 km/h (depending on ease of viewing), a headtorch was continuously used to search vegetation at all levels for reflecting eyes and illuminated body shapes. The observer was alert for sounds of dropping fruit or vegetation movements and for vocalisations. Animals were viewed by powerful spotlight (Nitech Xcell, 100,000 cp) in conjunction with 10x40 binoculars. Most arboreal animals were identified (a few fled too quickly), but those on the ground were frequently obscured by dense ruderals or were too shy. In PXH, unexploded mines deterred the observer from leaving the road to investigate sounds. Each sighting was characterised by: species, basis of identification for difficult species, time, habitat, height in vegetation, vegetation stratum, observer-animal distance, angle between path midline and observer-animal line, method of detection and reaction to light. Interesting behaviour was also noted.

At least 30 min were spent at a turning point before return to minimise duplication of sightings (thus, only for resting Common Palm Civets *Paradoxurus hermaphroditus* was the same individual frequently seen both on outward and return). Fruiting trees were searched diligently, sometimes for 30–90 min at a time. Smouldering fires (widespread in February–April) were walked rapidly. Bright moons were avoided as many species may then be detected less frequently (DUCKWORTH, 1992).

The technique was widely employed in XP and PXH, but few walks were attempted in DHS because of problems with rain, fog and malaria.

2. Nocturnal static watches. Following advice from hunters, watches from platforms overlooking pools or glades at the Houei Kua saltlicks (13 nights) and on the Xe Kong plains (12) (both XP) were mounted, mainly on moonlit nights. Animals were found by moonlight or torch scans. In DHS and PXH there were five overnight watches, but no really suitable hotspots were found (salt-licks, pools in a dry environment, etc.).

3. Daytime field observation. Diurnal species (principally squirrels, treeshrews and

primates) were recorded incidentally during bird surveying. In XP, 50 person-mornings were invested in assessing gibbon status by triangulation of morning calls. At Ban Houeiton (DHS), five person-days were devoted to specific searches for Douc Langur with a guide.

4. Examination of captive animals and trophies in houses. This allowed examination of species difficult to identify in the field such as otters. Villages were not checked exhaustively.

5. Searches for signs. Because many groups have several similar species (e.g. cattle, large and small cats, otters, bears, deer) few prints are unequivocally identifiable to species, even by hunters. Evidence of tracks and signs is discussed below where appropriate.

6. Discussions with hunters. Hunters were occasionally questioned about mammals using illustrated books, particularly LEKAGUL & MCNEELY (1977), although a special survey would have duplicated work summarised in SALTER (1993).

Following the urgings of BROCKELMAN & ALI (1987) distributional data are presented in detail, though no study areas contained streams of sufficient width to inhibit mammalian dispersal: each species probably occurred throughout its preferred habitats within the study areas that it was recorded. Location names are taken from the RDP Lao Service Geographique d'Etat, 1:100,000 series of maps (1986).

Names of villages and rivers and the boundaries of major land-cover types were generally accurate, but discrepancies were noted:

The rivers Houei Meuy and Houei Sae had their names transposed (south of Ban Taong, XP).

Pools within the Main Block of XP were not marked.

The open, stunted forest around the saltlicks south of Houei Kua (XP) was not differentiated, nor were the pools and clearings shown.

Nong Ila and Nong Kasai (Northern Fringe, XP) were not marked as open water.

Ban Bang (XP) and sundry villages in the Corridor of PXH were not marked.

Many settlements had been established in the lowlands of DHS since mapping.

Considerable areas of forest had been cleared for coffee on the Bolovens plateau (DHS) since mapping.

MAMMALS FOUND

All records are detailed by site in Table 1. Only the more interesting are discussed below; they include all records of species of special conservation significance in Laos

Table 1: status of all mammals recorded at all sites during the surveys.

- C, Common (seen or heard daily or nearly so);
 F, Frequent (detected on more days than not);
 O, Occasional (only detected infrequently);
 P, known to be present, but too inconspicuous for categorisation into above three levels;
 -, believed to be absent during the survey (can only be assigned for conspicuous species);
 L, Local within the site;
 r, restricted to Riverine sites;
 slope (DHS only), status in unlogged slope forest;
 flat (DHS only), status in logged flatland forest;
 Village, remains or captive living animal(s) found in village, precise provenance not established;
 1-5 (other sites), sites numbered as in text.
 prov, provisional identification;
 conf, confirmed identification (sometimes merely on basis of known range);
 A, sighting(s) of live animal
 S, signs found (footprints, shed quills etc.)
 V, live/freshly-killed specimen(s) found in villages
 R, preserved remains found in village

Coverage, a subjective impression of the level of coverage is given for each site, based upon the amount of effort in the site and the ease with which mammals were detected;

Reliability of estimate, a subjective assessment of the species' status estimate is given for the habitats where a symbol is inserted: absence of any symbol, even for a "high" species, should not be considered indicative of absence of the mammal, as appropriate techniques may not have been employed. A more confident estimate can be made of a species' status if it is conspicuous or commonly seen.

Table 1 (continued)

Species	Study Area									
	Xe Piane					Dong Hua Sao				
	Xe Kong	Dong Kalo	Northern zone	Main block, primary	Main block, degraded	Lowland SEF	Lowland MDF	Degraded lowlands	Plateau forest	Degraded plateau
Lesser Gymnure <i>Hylomys suillus</i>										P
Northern Treeshrew <i>Tupaia belangeri</i>		Cr	O	C	C	C	P	P	P	
Painted Woolly Bat <i>Kerivoula picta</i>										
Slow Loris <i>Nycticebus coucang</i>		P	C	P	P					P
Pygmy Loris <i>Nycticebus pygmaeus</i>										
Assamese Macaque <i>Macaca assamensis</i>						P: slope		-		
Long-tailed Macaque <i>M. fascicularis</i>	Cr	Pr	-	-	LF	-	-	-	-	-
Pig-tailed Macaque <i>Macaca nemestrina</i>		P7	Village	F		C: slope P: flat		-	-	-
Silvered Langur <i>Trachypitecus cristata</i>	Fr		-	O	-	-	-	-	-	-
Doac Langur <i>Pygathrix neamaeus</i>							P	-		
Yellow-cheeked Gibbon <i>Hylobates gabriellae</i>	-	Cr	Village	C	LF	C: slope LP: flat	-	-	C	-
Dhole <i>Cuon alpinus</i>	P					P				
Leopard Cat <i>Prionailurus bengalensis</i>										
Tiger <i>Panthera tigris</i>				P						
Leopard/Tiger <i>Panthera pardus/tigris</i>		P		P						
Small Asian Mongoose <i>Herpestes javanicus</i>	P		P				P	P		
Crab-eating Mongoose <i>Herpestes urva</i>						P: slope				
Smooth-coated Otter <i>Lutrogale perspicillata</i>			Village							
Otter sp. <i>Lutrogale/Lutra</i>	P			P						
Yellow-throated Marten <i>Martes flavigula</i>	P			P					P	
Sun Bear <i>Helarctos malayanus</i>						P				
Bear sp <i>Ursus/Helarctos</i>	P		Village	P	P	P	P			
Small-toothed Palm-Civet <i>Arctogalidia trivirgata</i>				LC						
Masked Palm-Civet <i>Paguma larvata</i>									P	
Common Palm-Civet <i>Paradoxurus hermaphroditus</i>	C			C					P	
Large-spotted Civet <i>Viverra megaspila</i>	P			P						

Table 1 (continued)

Species	Study Area							Level of identifi-	Reliability est cation
	Phou Xang He						Other sites		
	Phou Hinho	Phou Xang He	Corridor	Mixed decid	Dry dipterocarp	Degraded			
Lesser Gymnure <i>Hylomys suillus</i>								prov A	Low
Northern Treeshrew <i>Tupaia belangeri</i>	C	O	C	C		O	2,	conf A	High
Painted Woolly Bat <i>Kerivoula picta</i>							5,	conf V	
Slow Loris <i>Nycticebus coucang</i>			C		P	P	4,	conf A	High
Pygmy Loris <i>Nycticebus pygmaeus</i>			C					conf A	Mid
Assamese Macaque <i>Macaca assamensis</i>	F		-	-	-	-		prov A	Mid
Long-tailed Macaque <i>M. fascicularis</i>	-	-	-	-	-	-		conf A	Mid
Pig-tailed Macaque <i>Macaca nemestrina</i>	F		-	-	-	-		conf A	Mid
Silvered Langur <i>Trachypithecus cristata</i>	-	-	-	-	-	-		conf A	Mid
Doac Langur <i>Pygathrix neamaeus</i>	F		-	-	-	Village		Conf A	Low
Yellow-cheeked Gibbon <i>Hylobates gabriellae</i>	F	F	-	-	-	-		conf A	High
Dhole <i>Cuon alpinus</i>								conf A	Low
Leopard Cat <i>Prionailurus bengalensis</i>			P					conf A	Low
Tiger <i>Panthera tigris</i>								conf S	Mid
Leopard/Tiger <i>Panthera pardus/tigris</i>		P						- S	Mid
Small Asian Mongoose <i>Herpestes javanicus</i>						P	3?	conf A	Low
Crab-eating Mongoose <i>Herpestes urva</i>								conf A	Low
Smooth-coated Otter <i>Lutrogale perspicillata</i>								conf V	Low
Otter sp. <i>Lutrogale/Lutra</i>						P		- A	Low
Yellow-throated Marten <i>Martes flavigula</i>						P		conf A	Low
Sun Bear <i>Helarctos malayanus</i>								conf A	Low
Bear sp <i>Ursus/Helarctos</i>	P	P						- S	High
Small-toothed Palm-Civet <i>Arctogalidia trivirgata</i>		P	C					conf A	High
Masked Palm-Civet <i>Paguma larvata</i>								conf A	Low
Common Palm-Civet <i>Paradoxurus hermaphroditus</i>			C	P		P	3,	conf A	Mid
Large-spotted Civet <i>Viverra zibetha</i>			P					conf A	Low

Table 1 (continued)

Species	Study Area							Level of identifi-	Reliability est cation
	Phou Xang He						Other sites		
	Phou Hinho	Phou Xang He	Corridor	Mixed decid	Dry dipterocarp	Degraded			
Large Indian Civet <i>Viverra zibetha</i>			P					conf A	Low
Small Indian Civet <i>Viverricula indica</i>					P	P		conf A	Low
Asian Elephant <i>Elephas maximus</i>		P	O					conf A, S	Mid
Eurasian Wild Pig <i>Sus scrofa</i>	C	C	P					conf A, S	Mid
Lesser Chevrotain <i>Tragulus javanicus</i>		P					3,	conf A, S	Low
Sambar <i>Cervus unicolor</i>		P						conf A, S	Mid
Indian Muntjac <i>Muntiacus muntjak</i>		C	C					conf A, S	High
Muntjac <i>Megamuntiacus vuquangensis</i>			Village					conf R	Low
Gaur <i>Bos frontalis</i>		F						conf A, S	Mid
Banteng <i>B. javanicus</i>		P						conf S	Low
Kouprey <i>B. sauveli</i>								prov S	Low
Malay Pangolin <i>Manis javanica</i>								conf V	Low
Pallas's Squirrel <i>Callosciurus erythraeus</i>	C	C	C	C	-	C	4,	prov A	High
Variable Squirrel <i>Callosciurus finlaysoni</i>	-	-	-	-	-	-	1, 2	conf A	High
Inomate Squirrel <i>Callosciurus inornatus</i>	-	-	-	-	-	-	3,	conf A	High
Red-cheeked Ground Squirrel <i>Dremomys rufigenis</i>	P	F	F	-	-	-	3,	conf A	High
Indochinese Ground Squirrel <i>Menetes berdmorei</i>		F	P	P	P		1, 2	conf A	High
Black Giant Squirrel <i>Ratufa bicolor</i>	F	F	-	-		-		conf A	High
Chinese Striped Squirrel <i>Tamiops maritimus</i>	-	-	-	C	F	C	2, 3	prov A	High
Cambodian Striped Squirrel <i>T. rodolphi</i>	C	C	C	F	-	O		conf A	High
Flying squirrel sp. <i>Hylopetes</i>			P					- A	Low
Indian Giant Flying Squirrel <i>Petaurista philippensis</i>			C					conf A	High
Giant flying squirrel sp. <i>Petaurista</i>								- A	Mid
Asiatic Brush-tailed Porcupine <i>Atherurus macrourus</i>		P						conf A, S	Low
Hodgson's Crested Porcupine <i>Hystrix brachyura</i>								conf A, V	Low
Burmese Hare <i>Lepus peguensis</i>						P		conf A	Mid
Coverage: day	fair	fair	fair	fair	fair	mid	-		
Coverage: night	poor	poor	good	poor	fair	poor	-		

Table 2. Contact frequencies of nocturnal mammals in PXH.

Scientific names in Table 1. Ease of survey refers to the ease of detection and identification of mammals.

Species	Habitat			
	Corridor EF/SEF	Degraded sites	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

Table 3. Contact frequencies of nocturnal mammals in Xe Piane NBCA

Scientific names in Table 1. All flying squirrels were small, probably a species of *Hylopetes*. All Muntjacs were heard not seen. Ease of survey refers to the ease of detection and identification of mammals. The unidentified mammals at Houei Tapkua were both medium to large arboreal carnivores.

Species	H. Saeo/Kua	H. Tapkua	B. Phalay	Logging road	B. Nongkhe	Xe Khampho
Slow Loris	4	5	4	1	2	-
Small Indian Civet	-	1	-	-	-	-
Common Palm-Civet	6	9	-	-	-	1
Small-toothed P.-Civet	1	1	-	-	-	-
Muntjac	1	1	-	1	1	-
Flying squirrel	-	-	3	2	-	-
Brush-tail. Porcupine	-	1	-	-	-	-
Unidentified	-	2	-	-	-	-
Hours searching	30	46.25	11.5	4.25	4.25	1
Total contacts	12	20	7	4	3	1
Ease of survey	Very difficult	Difficult	Fairly easy	Fairly easy	Easy	Fairly easy

(*sensu* SALTER 1993). It is likely that some represent the first documented records from Laos. Contact frequencies of nocturnal mammals in PXH and XP are given in Tables 2 and 3.

The nomenclature and taxonomy of WILSON & REEDER (1993) is followed, with alternatives where helpful.

Painted Woolly Bat *Kerivoula picta*

One found dead in Vientiane; CORBETT & HILL (1992) do not map the species for Laos, though it occurs in all neighbouring countries (WILSON & REEDER, 1993).

Slow Loris *Nycticebus coucang*

This species was probably common throughout the three study areas, including in degraded forest and within 1 km of villages. It was the most frequently seen mammal other than diurnal squirrels and treeshrews. In many areas villagers did not hunt it. This status contrasts with Vietnam, where it was much less frequently found than Pygmy Loris at a variety of sites (R. RATAJSZCZAK, *in litt.*, 1994).

Pygmy Loris *Nycticebus pygmaeus*

The four sightings of this enigmatic species in evergreen/SEF Corridor isolates 3–7 km south of Ban Kham (PXH) are detailed in DUCKWORTH (in press). OSGOOD (1932) recorded it from the Bolovens plateau, so the species probably occurs in DHS. As predicted by OSGOOD (1932) and confirmed by RATAJSZCZAK (1988) the two lorises are probably widely sympatric. There appears to be no basis for NISBETT & CIOCHON's (1993) contention that the two may be allopatric.

EUDEY (1987) accorded this species "a very high conservation rating" among Asian primates in a summation process considering the species' degree of threat, taxonomic uniqueness and association with other threatened forms. The species' current IUCN status category (Vulnerable) may be unduly pessimistic. Its persistence in fragmented forest in PXH echoes findings in Vietnam, where it widely used secondary forest and bamboo groves with up to seven being found nightly (R. RATAJSZCZAK, *in litt.*, 1994). Villagers knew two species of loris (one claimed three), calling both "ling lom" and considering both as common. In many villages (including Ban Kham) they were not considered worth eating, though their eyes are used as medicine by some tribes (RATAJSZCZAK, 1988).

Assamese Macaque *Macaca assamensis*

Macaques provisionally identified as this species in undegraded forest of PXH and DHS are well south of the known range (CORBETT & HILL, 1992).

Long-tailed Macaque *Macaca fascicularis*

This species was locally common in the riverine forests of the Xe Kong and Dong Kalo plains, and in degraded forest at the margin of the Main Block and the Northern

Fringe (all XP). The habitat segregation of this and the next species, with Long-tailed in riverine and degraded habitats and Pig-tailed in more hilly areas, is well known (FITTINGHOFF & LINDBURG, 1980; FLEAGLE, 1988).

Pig-tailed Macaque *Macaca nemestrina*

This macaque was recorded at all three sites in SEF and probably also in riverine forest in Dong Kalo. Although it has a wide global range, EUDEY (1987) ranked it as Vulnerable.

Douc Langur *Pygathrix nemaeus*

Several sightings on Phou Hinho (PXH) probably related to two groups (one of at least 10 individuals). One in Ban Phongsavang was destined to be eaten there. Although shy and possibly overlooked elsewhere in PXH, they were certainly absent from the Corridor.

Repeated searches in DHS were unsuccessful except around Ban Houeiton. Here, a reputedly knowledgeable guide found only one group (a pair and two half-grown young) in 30 hours' searching. The monkeys were in MDF transitional with SEF on flat land at the base of Phou Tabeng along the Houei Long river.

The lack of records around Ban Nongkhe suggests that even in unencroached slope forest it is not common. Locals knew this distinctive species (name 'cadeng') well, saying that it was to be expected only in unlogged slope and plateau forest; thus the population is probably shrinking as clearance and hunting penetrate deeper into its refuges. The guide opined that there was some seasonal movement along the slopes.

All were of the red-shanked form, *P. (n.) nemaeus*, as expected on the basis of range. Douc Langur, restricted to Indochina, is critically threatened by habitat degradation and hunting for food and trade (SALTER, 1993). EUDEY (1987) awarded it the "highest conservation priority".

Silvered Langur *Trachypithecus cristatus*

Silvered Langurs were seen on four occasions in open forest of XP (thrice along the Xe Piane in riverine forest typical of them in Borneo, and once in trees at the Houei Kua salt-lick) in parties of 5–20. The species only marginally ranges into Laos (CORBET & HILL, 1992); it favours a particularly threatened habitat (riverine forest) and was considered globally vulnerable by EUDEY (1987).

Yellow-cheeked Gibbon *Hylobates gabriellae*

Gibbons in XP and DHS were seen well and tape recorded; their pelage resembled *H.g. gabriellae*, but some characters of male song in at least the XP population resembled *H.g. siki*. These areas may be on the hybrid zone between the two forms (T. GEISSMANN *in litt.*, 1994). Those in PXH, seen only poorly, might have been *H.g. siki*. Substantial populations remained in all three areas, that of XP being very large: over most of the Main Block densities probably reached 2–2.5 groups per km². In PXH and DHS, stationary observers on the hills heard 0–5 groups each morning. During triangulation in XP, each observer typically heard 4–8 calling bouts per morning around the Houei Kua, and 2–5 around the Houei Tapkua. When Houei Kua was visited in May, calling levels were much

increased from their December levels: it was impossible to distinguish clearly the individual calling-bouts.

Gibbons were absent from logged forest in DHS and from the Corridor in PXH, from where they had probably been extirpated. In XP, they were still present startlingly close to settlements. None was found in MDF or DDF. They were at least occasionally hunted. If forest east of DHS links with that of XP and supports gibbons (as is reported by hunters), the connection should be maintained to heighten the region's already high importance for this gibbon.

Under EUDEY's (1987) classification, these populations represent the polytypic *H. concolor* which is awarded a "very high conservation priority". *H.g. gabriellae* occupies Indochina south of about 15°N and east of the Mekong (GROVES, 1993) and protection of the large XP population is probably the most important element in the race's conservation. The status and conservation of gibbons in southern Laos is considered elsewhere.

Dhole *Cuon alpinus*

Four were seen at a water buffalo carcass by the Xe Khampho (XP) and at least two in forest on Phou Tabeng (DHS: 400 m). Footprints probably of this species were found west of Ban Nabon (DHS). Though also reported from the Northern Fringe (XP) by villagers, such reports may refer to feral dogs (SALTER, 1993). COX ET AL. (1992) saw one on the Houei Kiang plains (Dong Kalo, XP).

Dholes are shy and elusive, hampering accurate status assessment. The ubiquity of hunters' dogs means that identification of footprints can never be certain. They are widely persecuted, being frequently blamed for livestock deaths (SALTER, 1993). The species has a wide world range but is vulnerable as it lives at low density and requires large regions with minimal hunting. The main hope for the species' survival rests on the complete protection of large areas (GINSBERG & MACDONALD, 1990) such as the XP / DHS complex.

Leopard Cat *Prionailurus bengalensis*

One was seen in SEF 4 km south of Ban Kham (PXH); footprints of small cats were found widely in all three areas and the animals were probably missed during nocturnal observation through shyness, though the individual observed was extremely confiding. Its presence in a disturbed site is not surprising as it adapts well to habitat degradation (LEKAGUL & MCNEELY, 1977).

Big cats *Panthera* spp.

No Tigers *Panthera tigris* or Leopards *P. pardus* were seen although in XP and PXH a few footprints were photographed and measured. Tiger was confirmed in XP on the basis of size (all other species, and small Tigers, show overlap in size). The number of footprints seemed rather low and may indicate a small population (A. RABINOWITZ, *pers. comm.*, 1994). COX ET AL. (1992) considered that they had seen footprints of both species in Dong Kalo (XP) and both are widely reported by villagers in all three study areas (SALTER, 1993).

Small Asian Mongoose *Herpestes javanicus*

Small numbers were seen in disturbed sites and by forest streamsidings in all three areas and probably also at Houei Nhang. Laos is not mentioned in the species' range by WILSON & REEDER (1993), so these may be the first records for the country.

Smooth-coated Otter *Lutrogale perspicillata*

Three captive cubs in Ban Phalay-tong (XP) supplemented a few unidentified otter sightings along major rivers in XP. Prints were not identified to species. OSGOOD (1932) considered it the commonest otter of the Mekong and one was collected near Pakxé.

Sun Bear *Helarctos malayanus*

One in unlogged forest beside the Houei Namphak (DHS) only 20 mins' walk from Ban Nongkhe. A headless corpse was found tied to a tree on Phou Xang He (PXH). 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.

Scratch marks, probably mainly of this species but perhaps also of Asiatic Black Bear *Ursus thibetanus*, were widespread in SEF of all three study areas. Signs in the logged lowlands of DHS may have been made prior to logging. Both species leave scratches (LEKAGUL & MCNEELY, 1977) and only typical signs of each are distinctive. Although conventional wisdom has Black Bear absent from southern Laos (e.g. CORBETT & HILL, 1992), villagers are adamant that two species of bear occur throughout the country (SALTER, 1993).

Large-spotted Civet *Viverra megaspila*

Singles in the Main Block SEF and on the Xe Kong plains in open DDF (both XP) and in Corridor SEF (PXH). The records, with those of *V. zibetha* and *Viverricula indica*, and the identification of the former genus, are discussed by DUCKWORTH (1994).

Field surveys to locate surviving populations of this civet are a high priority (SCHREIBER ET AL., 1989). Laos is not mentioned in the species' range by WILSON & REEDER (1993), so these may be the first records.

Asian Elephant *Elephas maximus*

Two single animals and two dung piles were found in Main Block SEF (XP) during November–February. These few signs suggest a rather small population, or one concentrated elsewhere during the survey (A. RABINOWITZ, pers. comm., 1994). Hunters reported that in May and June herds totalling over 100 congregated at salt-licks near Houei Kua (XP); but in early May the large quantities of dung found were several weeks old. Evidently the site is of great importance to Elephants, but the animals are not permanently present in large numbers. COX ET AL. (1992) reported old signs of Elephants from Dong Kalo in 1992.

Elephants were smelt and heard feeding in bamboo 3–6 km south of Ban Kham on

15 and 16 April (PXH). The villagers said that they frequently appeared at this season because little water remained on Phou Xang He. Vegetation damage, wallows and dung were widespread east and northeast of Ban Nalay in late April (none particularly recent), where again Elephants were stated to be wandering in search of water.

Hunters reported that only occasional wandering animals, from across the Xe Khambo (Fig. 1), patronised the DHS area, although SALTER (1993) considered that the lowlands of DHS were important for Elephants.

Lesser Chevrotain *Tragulus javanicus*

One at Houei Nhang was well north of the species' mapped range (CORBETT & HILL, 1992) though it is reported commonly in far northern Laos by villagers (SALTER, 1993).

Muntjac *Megamuntiacus vuquangensis*

As well as widespread records of *Muntiacus muntjak*, one pair of the distinctive long antlers of this newly-described species was found (and photographed) in a village house in PXH. The antlers were not obtained.

Gaur *Bos frontalis*

Footprints were found at the salt lick (where the survey guides saw four in mid-December) and elsewhere in the Main Block (XP), atop Phou Phongkham / Phou Nalong (DHS) and in open grassy glades on Phou Xang He (PXH) where one individual was seen.

Gaur were reported widely, particularly from the salt-licks in May; as rare on the Xe Kong plains and Dong Kalo (where found by COX ET AL., 1992), which are not their typical habitat; as restricted to the remotest parts of DHS, especially around the upper Houei Touay Gnai; and in a reasonable population east of DHS in a currently unprotected area (Fig. 1).

Except deep in SEF, the universal presence of domestic water-buffalo, even on the Xe Kong plains (XP) meant that wild cattle footprints would easily have been overlooked.

Banteng *Bos javanicus*

Several sets of Banteng footprints in Dong Kalo (XP), north of the Houei Kaling differed from Gaur by their more pointed shape and smaller size. COX ET AL. (1992) saw hoofprints frequently on the Xe Kong plains, a small herd east of the Xe Pian river there, and footprints and a shot individual in Dong Kalo.

Kouprey *Bos sauveli*

Hunters from Ban Phonvisai (XP) claimed, as they had to COX ET AL. (1991, 1992), that a few Kouprey resided in Dong Kalo. A single set of footprints north of the Houei Kaling (XP) were, from their size and rounded appearance (see COX ET AL., 1992), more likely to be Kouprey than Gaur. COX ET AL. (1992) had concluded that hunting and disturbance in May and June rendered the site unsuitable for Kouprey.

Kouprey were reported to SALTER ET AL. (1991) in XP from the south of the Main Block, from Dong Kalo, from south of Ban Xot and from the Xe Kong Plains. Addition-

ally SCOTT & POOLE (1989) mentioned that Kouprey occasionally visited Bung Gnai-Kiatngong marsh (XP) but the marsh is now greatly disturbed.

Sunda Pangolin *Manis javanica*

Pangolins were taken in to market in Pakxé from XP and DHS; about three were seen on buses from study areas to Pakxé, and others may have been eaten locally around XP and DHS or taken to towns. As none was seen in the field, yet they are not prone to torch-shyness, pangolins may not be particularly common in the region, making the level of commerce (high throughout Laos; SALTER, 1993) of concern. Hunters may use dogs to find them and Pakxé remains a centre of trade (SRIKOSAMATARA ET AL., 1992; SALTER, 1993).

Squirrels *Callosciurus*

These squirrels showed interesting local distributions. Tall forests throughout PXH were inhabited by two forms of *Callosciurus*, one on Phou Hinho and another on Phou Xang He. Animals in the Corridor isolates (including those of MDF) belonged to the Phou Hinho form, while those in MDF around Ban Nalay were of the Phou Xang He form. This partition was also observed in the forest-types and in the bird communities (DUCKWORTH ET AL., 1993). Both were probably forms of *C. erythraeus*; those on Phou Xang He closely resembled *C.e. flavimanus*.

On the plateau (DHS), there was great variation, but all were presumably conspecific as a mating between individuals at opposite ends of the range was seen. Both resembled the morph of Phou Xang He and were presumably also *C. erythraeus*, of the form called *C. flavimanus bolovensis* by OSGOOD (1932). Lowland forests supported *C. finlaysoni*. These two forms shared a basic structure and character, though the vocalisations (especially an alarm call) differed between *C. finlaysoni* and *C. erythraeus*.

C. finlaysoni occurred throughout XP's tall forests; the uniform distribution probably stemmed from the absence of high hills. They closely resembled *C. ferrugineus williamsoni* as described by OSGOOD (1932), which was taken near Pakxé; the form is now submerged into *C. finlaysoni* (CORBET & HILL, 1992).

PXH is well beyond the known geographical range of *C. finlaysoni* and this was the only site where *C. erythraeus* was found in flat areas; where the two species overlap, the former inhabits flat lowlands and the latter the hills. A close juxtaposition of phenotypically distinct forms, and wide intrapopulation variability, are well known in *C. erythraeus* (CORBET & HILL, 1992). *C. finlaysoni* is of conservation concern (SALTER, 1993) on account of its limited range (central and east Thailand, Cambodia, and, marginally, NW and extreme SW Laos; CORBET & HILL, 1992). It remains extremely common in XP and the lowlands of DHS.

Inornate Squirrel *Callosciurus inornatus*

This squirrel was found only in Houei Nhang; there was a handful of records in a month's work. The identification was checked against specimens. Their usual shyness hampered status assessment and presumably reflected heavy hunting pressure. None was

seen in Vientiane markets, despite careful checking of the widespread trade in squirrels, although it had been common in the plains around Vientiane (DEUVE, 1972); OSGOOD (1932) earlier considered it the commonest *Callosciurus* in northern Laos. Very little is known of this species' status although it is geographically extremely restricted (north Laos and adjacent NW Viet Nam and southern Yunnan; WILSON & REEDER, 1993) and has apparently been collected over a wide altitudinal range (100-1600 m; specimen labels, as *C. imitator*, in BM(NH)). It should perhaps be assigned the IUCN status category "Insufficiently known".

As no other *Callosciurus* species occurs at Houei Nhang, at no site visited did two species of the genus overlap on a microgeographic scale.

Indochinese Ground Squirrel *Menetes berdmorei*

The many records from PXH were well outside CORBET & HILL's (1992) mapped range. It was the least frequently seen diurnal squirrel in primary SEF (except for *T. maritimus*), but was widely recorded in degraded sites outside the study areas (Table 1).

Black Giant Squirrel *Ratufa bicolor*

Giant squirrels were by far the most restricted diurnal squirrel genus. They were found only in primary SEF of the Main Block (XP), in undisturbed forest on the hills (PXH) and in unencroached plateau forest (DHS). Although widespread in SEF, these squirrels were not recorded in deciduous forests, even extensive ones. The lack of records from isolated forest patches and in logged forests echoes the distribution of gibbons and is presumably due to overhunting and intolerance of habitat disturbance. WANG ET AL. (1989) considered that the species was endangered in China through habitat destruction.

The species was not mapped for south and central Laos by CORBETT & HILL (1992) nor in the south by LEKAGUL & MCNEELY (1977).

Striped squirrels *Tamiops*

Two species in this genus were found. Although no specimens were taken, *T. rodolphei* was readily identified in the field by its small size, rich coloration, orange venter (sometimes intensely so), four pale dorsal stripes of equivalent width and, most importantly, the pale streak within the mid-dorsal dark line. The other species lacked such positive features and was provisionally identified as *T. maritimus* primarily on the basis of geography.

These small squirrels showed a clear distribution pattern in the three areas. In XP, *T. rodolphei* abounded in the SEF of the Main Block and the MDF/SEF riverine association of the Xe Kong plains and Dong Kalo. *T. cf. T. maritimus* predominated in the MDF of the Northern Fringe and the DDF of the Xe Kong plains and Dong Kalo. In DHS, *T. rodolphei* was common in SEF (including logged parts), plateau evergreen forest and denser MDF, and *T. cf. T. maritimus* in open MDF and degraded habitats. In PXH, *T. rodolphei* was very common in SEF on the hills and in the Corridor, and was recorded less frequently in denser MDF and in scrub retaining tall trees; *T. cf. T. maritimus* was commonest in more open MDF and predominated in scrub, and was also frequent in DDF. On occasion the two species were seen in the same vegetation, but they did not overlap

significantly in habitat use at these three sites. CORBET & HILL (1992) considered that the members of the genus were parapatric, but in south and central Laos they are widely sympatric. *T. cf T. maritimus* was also seen in heavily degraded SEF in Houei Nhang (North Laos) and on roadside stops in central Laos.

The implications in LEKAGUL & MCNEELY (1977), that *T. rodolphei* occurs commonly in villages and usually above 700 m, are most unlikely to be true in Laos.

T. rodolphei is of conservation concern (SALTER, 1993) on account of its limited range (SE Thailand, Cambodia, Cochinchina and, marginally, south Laos; CORBETT & HILL, 1992). While it remains extremely common in all three areas surveyed, its narrow habitat choice may cause concern in the future. The PXH records are significantly north of its known range east of the Mekong.

Indian Giant Flying Squirrel *Petaurista philippensis*

Giant flying squirrels were observed around dusk along major streamsides through SEF in XP; one sunning by its hole on the Xe Kong plains was this species. They were common and confiding in Corridor forest at PXH (Table 2); the lack of records from nightwalks in XP is not easily explicable. They resembled specimens at BM(NH) labelled *P. lylei badiatus* or *P. annamensis*. Laos is not mentioned in the species' range by WILSON & REEDER (1993); however, OSGOOD (1932) lists a specimen from the country. The record of *P. petaurista* from XP by COX ET AL. (1992) presumably refers to this species, following recent taxonomic reassessment by CORBET & HILL (1992). They submerge *badiatus* in *P. philippensis annamensis*.

DISCUSSION

Completeness of Coverage

Most very large mammals, being unobtrusive or skulking, were recorded by chance or indirectly (by signs). Thus, for no study area could a comprehensive species list be compiled. Furthermore, comparisons among the areas and their habitats were hampered by the different methods perforce employed. Shyness also hindered status assessment of monkeys, especially at briefly-visited sites. Squirrels and treeshrews were bolder and their abundance was accurately established.

The assessment of nocturnal communities was handicapped by the dearth of wide trails, the dense vegetation and the shyness of many species. In PXH, an excellent impression was gained of the nocturnal arboreal community of the Corridor forest isolates from a road, but other study areas lacked suitable trails. Several species not detected on foot were seen from platforms, though overall observation rates were low: on some nights no mammals (other than bats) were seen.

Diurnal Communities

The presence of at least four species of higher primate in each study area is encouraging. Douc Langur and Yellow-cheeked Gibbon are of high conservation priority. The macaques and Silvered Langur are less so, but as the latter and Long-tailed Macaque only

just penetrate into southern Laos, XP probably holds most of the country's populations. Francois's Langur *Trachypitecus francoisi* (reported by villagers at PXH; SALTER, 1993) was reported on limestone outcrops 5-15 km north of PXH (site 4, Table 1). If these reports are confirmed, their conservation would be of the highest priority.

Each study area had several species of squirrel. Black Giant Squirrel seemed vulnerable to human pressure as it was absent from the same sites as were diurnal primates. The squirrel of most global concern was *Callosciurus inornatus*, which retains a toehold at Houei Nhang. Apart from Northern Treeshrews *Tupaia belangeri*, other mammals seen by day in natural habitats were essentially due to chance: the most notable were two packs of Dholes.

Treeshrews, squirrels and Small Asian Mongoose were the only species regularly recorded in heavily-degraded vegetation.

A large complex of saltlicks with grassy glades, seasonal pools and mud wallows south of the Houei Kua in XP (106°14'E, 14°27'N) had many ungulate footprints and a few animals in December. Hunters from several villages stated that in May large numbers of Elephants, Banteng and Gaur with, very occasionally, wild Water Buffalo *Bubalus arnee* and Kouprey visited the site. Ten man-nights in early May found no large herbivores nor any fresh dung. The animals had reportedly left when the pools had dried up, but there were uncertainties in the translation of this information; it was not possible to establish whether 1993 was atypical in this respect. This part of Xe Piang, probably crucial for many animals spending most of the year without the boundaries, can only retain this importance when surrounded by a large area of natural habitat.

Nocturnal Communities

Searching by night gave reliable data, especially about mammals rarely identifiable to species from reports (small carnivores, lorises, etc.). Platform watches recorded a different selection of species from walks.

Much effort was invested on the roads traversing the Corridor in PXH (Table 2). SEF was the most productive habitat, with 73 contacts (excluding bats and murid rodents; roughly one per hour), while the DDF was very poor (three contacts; one per 5.5 hours). This understates the difference as the leafless state of DDF meant that many fewer animals would have been overlooked. No rare species were located in DDF or degraded vegetation (only four species in total) but the 11 species in SEF included Large-spotted Civet, Pygmy Loris and Asian Elephant. The species recorded are probably a fair cross section of those present; the larger species have doubtless been eradicated as residents.

Night walks through the main Block SEF of XP around Houei Kua and Houei Saoe were uninformative and disappointing. The only species seen frequently were two indolent subcanopy animals which rarely become torch-shy: Common Palm-Civet and Slow Loris. Though many deer were heard, not one single terrestrial animal was seen, reflecting the dense understorey and a general shyness: tracks revealed a good community. Static watches produced a few more species, but the larger mammals remained elusive. The more broken canopy of the hilly terrain at Houei Tapkua facilitated viewing and, though most animals other than palm-civets and lorises fled rapidly, further species were detected.

Dong Kalo presented excellent opportunities for finding nocturnal mammals, though

the three nights here coincided with a full moon.

The Xe Khampo / Xe Piane confluence was among open forest studded with waterholes. Some of the many overnight watches were unproductive as the smoke from numerous smouldering fires was trapped by evening temperature inversions. The platforms both overlooked waterholes. There were many Burmese Hares *Lepus peguensis* and various other species, most notably a Large-spotted Civet, were seen. The only track suitable for walking was too deep in dry leaves for quiet passage. Furthermore, there was a bright moon most of the time at this site. A few hours' walking and boating up the two rivers were mainly for seeking crocodiles *Crocodylus siamensis* (none of which was found) but gave sightings of common mammals.

In the Northern Fringe, trails around Ban Phalay-Bok revealed many Slow Lorises and a small flying squirrel *Hylopetes* sp. unrecorded in forest; both occurred within a few hundred yards of villages. The road was heavily peopled by day. The easy viewing conditions gave higher sighting rates than in the forest; the absence of sightings of other species probably reflects hunting pressure.

For no nocturnal community in XP can meaningful encounter rates be given; nonetheless, a summary is presented in Table 3.

Many parts of DHS have good paths for walking by night, but this would be much more efficient during the dry season. The species seen during the brief work were all common and widespread on an international scale.

CONCLUSIONS AND RECOMMENDATIONS

Global Context

All areas have major global conservation importance for mammals in two ways:

1. The preservation of individual species, particularly Yellow-cheeked Gibbon, Douc Langur, Dhole and Asian Elephant. Pygmy Loris and Large-spotted Civet are rarely searched for, so it is difficult to assess the significance of the records but XP and PXH are the first protected areas within which Large-spotted Civet has been recorded (SCHREIBER ET AL., 1989). Villagers report an impressive complement of further species (SALTER, 1993).
2. The protection of huge areas incorporating diverse habitats, with a likely attendant range of mammal communities. Much forest remains nearly pristine. The proximity of XP and DHS enhances their importance; they are linked by an area scheduled as production forest. Habitat fragmentation as a survival problem for large mammals is of equivalent magnitude to habitat degradation and overhunting: management of the two as an organic whole would massively enhance each's long-term importance.

These two functions mutually complement each other as the diurnal primates, large carnivores and wild cattle are the very species requiring extensive, undisturbed habitat; although each species tolerates some habitat fragmentation, survival is then less likely, especially when accompanied by hunting.

Threats to Mammals

Habitat disruption

The mammalogical importance of the three areas stems from their size, so any reduction in size or habitat quality will prejudice this.

This problem is acute in DHS where most lowland forest has been logged over and new settlements are rapidly forming. Village formation in new areas is the critical turning point where human pressure is likely to become unsustainable (K. BERKMÜLLER, pers. comm., 1993). Plateau forest on the Bolovens is under equal or greater threat: clearance for coffee swept the forest edge back by 8 km between 1986 and 1993. The Bolovens plateau is of great biogeographical interest, as one of few flat montane areas in Indochina, yet the only three sizeable forest patches probably remaining outside of DHS are as threatened as the forest in DHS.

The flat Corridor of PXH retains only isolated forest patches; subsistence pressure is already affecting the surrounding slopes. The remaining flatland forest is vital because large herbivores seasonally visit reliable water-sources there and it acts as a forested link between the two hill ranges, yet it is the part of PXH most threatened by human use.

XP seemed least affected of the three, but as a largely flat area, it is permanently under potential threat for commercial logging as timber resources are exhausted elsewhere.

Hunting

Mammals are taken opportunistically whenever people enter the forest. As the areas remain large, for many species this threat is probably not yet critical, but may rapidly become so for all large species (including Sambar) not already declining. Hunting pressure round villages is high; animals are almost invariably killed for food, as pests or as potential human or livestock predators. Forest shrinkage will increase the possibility of conflicts between villagers and large wildlife.

Forest situations where mammal hunting may be of major detriment are:

1. The Houei Kua saltlicks (XP) with their attendant concentrations of wild cattle and elephants.
2. The Xe Kong and Dong Kalo plains (XP), which are open habitats where mammals are easily shot, especially at waterholes.
2. From their distributions in DHS and PXH, gibbons are clearly very susceptible to human pressure. The current healthy situation could probably change rapidly. Douc Langurs are probably under equal or greater threat.
3. Pangolins were captured opportunistically and taken into Pakxé for sale. The level of South-East Asian trade in pangolin products is only now being appreciated and it appears that Laos is a major source (SRIKOSAMATARA ET AL., 1992). Current levels are unlikely to be sustainable (F. LAMBERT, pers. comm., 1992).
4. Tigers are shot to reduce their population and to dissuade them from frequenting the region. Villagers considered them dangerous to humans and stock, as elsewhere in Laos; hunting has greatly fragmented their Lao range (SALTER, 1993).
5. Rebel insurgents. The extensive dense forests of XP along an international border could be a tempting refuge for guerrillas. One group occurred during the present survey.

Permanent establishment of soldiers would affect wildlife much more severely than does the current *laissez-faire* hunting by villagers.

6. Much hunting in Laos seems opportunistic, so activities increasing the time spent in forest trigger an equivalent rise in hunting. In particular, coffee planting now occurs deep within DHS, bringing previously little-disturbed populations under threat.

7. Fishing takes people furthest into the forest; it is concentrated in the late dry season, when mammals are already under high stress.

8. No evidence was seen of commercial hunting, which is apparently rife in at least PXH (R. DOBIAS, pers. comm., 1993).

Other threats not directly related to hunting or habitat destruction include:

1. Several apparently diseased water buffalos were seen on the Xe Kong Plains (XP) and near Ban Muangsen (PXH). There may be a risk of transmission to wild cattle populations.

2. Elephants are used as draught animals in XP and DHS, especially in Ban Phapho. All are of wild stock and capture is reportedly getting more difficult (R.E. SALTER, pers. comm., 1993), suggesting that populations are dropping. While capture for domestication may not have caused this, it may exacerbate other problems. Elephant usage gives a tangible benefit from the forest, so should be encouraged at sustainable levels. No new data were gathered concerning this, nor were observations made on the trapping of otters and dolphins in XP as reported by BAIRD (1992).

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