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A Review of François' Leaf Monkey *Trachypithecus francoisi* (*sensu lato*) in Lao PDR

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Abstract: A monkey population allied to François' leaf monkey *Trachypithecus francoisi* discovered in 1920 constitutes the taxon *laotum*, endemic to Lao PDR. The next seven decades provided very little additional information about it. Wildlife surveys in the 1990s found a large population of *T.* (*f.*) *laotum* in Phou Hinpoun (=Khammouan Limestone) National Protected Area (NPA) and north into southern Nam Kading NPA, and a large population in and around Hin Namno NPA of *T.* (*f.*) *ebenus*, known outside Lao PDR only from adjoining Vietnam. Detailed here are confirmed records of smaller and more localized populations of leaf monkeys of the *T. francoisi* group (*sensu* Groves 2001, 2005, p.175) from two other areas (Nakai–Nam Theun NPA and a region outside the protected area system, Muang (=District of) Vilabouli, in Savannakhet province), highly plausible reports from one more site, and records of *T.* (*f.*) *ebenus* from southern Phou Hinpoun NPA. Animals from Nakai–Nam Theun NPA and Muang Vilabouli differ in pelage from reported forms, and further information is required to resolve their taxonomy in relation to the named forms *hatinhensis* and *ebenus*. All Lao records of the *Trachypithecus francoisi* group leaf monkeys are within the latitudinal band of 16°58'N (probably 16°49'N) to 18°17'N, but reports from local people suggest the possibility of occurrence north of this latitude, and perhaps (parallel with the complex's distribution in Vietnam) north to the Chinese border. Populations in large karst landscapes remain healthy but cannot be assumed to remain so, and those in smaller karst and non-calcareous ranges are highly vulnerable to hunting-induced local extinction. Many uncertainties remain concerning the species-complex in Lao PDR: its overall distribution, the number of forms present, their distribution, and their taxonomy. Undescribed forms may yet be found, most likely to the north of the known range, where threats are much higher, adding to the urgency for surveys in this region.

Key Words: Conservation status, distribution, habitat, *Trachypithecus* (*francoisi*) *ebenus*, *Trachypithecus* (*francoisi*) *hatinhensis*, *Trachypithecus* (*francoisi*) *laotum*

Introduction

Since the description of François' leaf monkey (François' langur) *Semnopithecus francoisi* Pousargues, 1898, six additional, closely related taxa have been proposed: *Semnopithecus poliocephalus* Trouessart, 1911, of Cat Ba island (north-east Vietnam); *Pithecus laotum* Thomas, 1921 of Central and, marginally, North Lao PDR; *Pithecus delacouri* Osgood, 1932, of northern Vietnam (to the south of *francoisi*); *Trachypithecus leucocephalus* Tan Bangjie, 1957, of south-east China; *Presbytis francoisi hatinhensis* Dao Van Tien, 1970, of central Vietnam; and *Semnopithecus auratus ebenus* Brandon-Jones, 1995, of Central Lao PDR and, perhaps only marginally, adjacent Vietnam (*contra* the original hypothesized type locality of the vicinity of Lai Chau, in north-west Vietnam); nominate *francoisi* itself inhabits southern China and northern Vietnam. The range of all these taxa lies entirely east of the Mekong, in northern and central Vietnam, Central and, marginally, North Lao PDR, and southeastern China. This is a relatively small area for even a single primate species, let alone, potentially, seven, increasing the chances that at least some of the taxa will be highly threatened with extinction (Brandon-Jones 1995; Groves 2001, 2005; Nadler *et al*. 2003; Brandon-Jones *et al*. 2004).

The inter-relationships of these monkeys are unresolved. In the latter decades of the 20th century they tended to be regarded as conspecific under *Trachypithecus* (or *Presbytis* or *Semnopithecus*) *francoisi* (for example, Eudey 1987; Corbet and Hill 1992). Recently some or all forms have been considered distinct species, but there remains no consensus view

(contrast Groves 2001, 2005; Brandon-Jones *et al*. 2004; Roos *et al*. 2007). Although Brandon-Jones (1995) even dispersed the taxa among multiple other species, Groves (2001, 2005) re-affirmed the conventional view that these taxa form a cohesive phylogenetic group, which he called the "*Trachypithecus francoisi* group". Within this group there seem to be two groupings, a northern and a southern (for example, Roos *et al*. 2007). It is unclear whether all named forms represent discrete taxa: it has been argued that *T.* (*f.*) *leucocephalus* and *T.* (*f.*) *ebenus* may be morphs of *T. francoisi* (*sensu stricto*) and of *T.* (*f.*) *hatinhensis*, respectively (Brandon-Jones 1995; Nadler *et al*. 2003; Roos *et al*. 2007). Overlap in geographic range has been suggested in two cases, both discussed below: *ebenus* with *hatinhensis*, and *ebenus* with *laotum*. There is no evidence in Lao PDR for large-scale overlap, but the areas where such overlap might be most expected remain insufficiently investigated.

The IUCN/SSC *Action Plan for Asian Primate Conservation* (Eudey 1987) ranked *Trachypithecus francoisi* (*sensu lato*) as "a very high conservation priority." Despite this, and the long-term listing of the taxa in Lao PDR as globally threatened or at least Data Deficient by the IUCN Red List (Le Xuan Canh *et al*. 2008; Timmins and Boonratana 2008), little information is readily available on the status of these monkeys in Lao PDR. Before the early 1990s, there were only a handful of records (detailed below), but from 1992 onwards many areas across the country were surveyed for large mammals, including primates (effort per site presented in Timmins and Duckworth 1999, 2008). Two national protected areas (NPAs) in the newly-created NPA system (see Berkmüller *et al*. 1995a, 1995b; Robichaud *et al*. 2001) were found to support large populations of these monkeys: Phou Hinpoun (=Khammouan Limestone) NPA, with *T.* (*f.*) *laotum* over much of it but *T.* (*f.*) *ebenus* in the south (Steinmetz *et al*. in press) and Hin Namno NPA, holding *T.* (*f.*) *ebenus* (Timmins and Khounboline 1996; Walston and Vinton 1999; P. Phiapalath pers. comm. 2008). Additional information was gathered in several sites away from the immediate vicinity of these two NPAs. The conservation status of *T.* (*f.*) *laotum* is detailed in Steinmetz *et al*. (in press). The dual purposes of the present compilation are (1) to detail Lao records known to the authors of these monkeys other than *T.* (*f.*) *laotum*, but excluding those from Hin Namno NPA and its surroundings because there are many records from other observers; and (2) to provide a national status overview of the entire complex in Lao PDR. Most of these records have appeared previously only in internal project reports of limited circulation, or not at all.

Conventions

Areas and sites referred to in the text are marked on Fig. 1. Place names are based on the 1985–1987 series of 1:100,000 maps of the *RDP Lao Service Geographique d'État* (RDPL SGE) maps with the minor modifications of Thewlis *et al*. (1998), except that the Nakai plateau and derivatives are spelled thus, not as Nakay, reflecting widespread current usage. Where there is no RDPL SGE map-name, the name in local usage is given, transliterated according to the original observer. Coordinates and altitudes, except where stated, are derived from the RDPL SGE maps. The division of Lao PDR into North, Center and South is defined in Duckworth *et al*. (1999). Considerable detail accompanies the distributional data, following the urging of Brockelman and Ali (1987) for such precision in primate records, and which is particularly important in a situation where multiple morphological forms occur in close proximity. With the taxonomic lability and ongoing instability, and a general lack of attention given to English names in mammalogy (see Grubb 2006), these monkeys have been referred to under various English names. The present paper uses a single explicitly general name, "François'-group leaf monkey", for the entire group (*T. francoisi* [*sensu lato*]), because neither the taxonomic identity of some populations nor the number of species involved are clear.

Lao words incorporated in place-names: *Ban*=village (here, meaning the area surrounding the village, rather than the village itself); *Daan*=rocky flat; *Hinpoun*=limestone; *Muang*=administrative district; *Na Pha*=cliff face; *Nam*=river; *Pak*=river-mouth; *Pha*=cliff-girt massif, often but not invariably of karst; *Phou*=mountain or hill; *Sayphou*=hill or mountain range.

Methodological Background

Direct-observation mammal surveys undertaken across Lao PDR during 1992–2007 were characterized by Timmins and Duckworth (1999, 2008) citing the original, often internal, reports from each. Most consisted of a few weeks to a few months of direct observation to assess general habitat type and condition, and to seek by direct observation (mostly during daylight) birds and large mammals (generally, those identifiable without the need for specimen procurement) of elevated national and, especially, global conservation concern. Monkeys were thus among the best covered groups of mammals. The loud, far-carrying, calls of François'-group leaf monkey, even if their identity is not known when first heard, make it likely to be well recorded when present. However, because it seems fairly to highly localized when outside large karst landscapes, it can be overlooked by even quite lengthy surveys of a general area (most NPAs are of 1,000–2,000 km² and on any given survey only a small portion could be covered). While karst itself attracted specific survey because of its various specialist birds (Thewlis *et al*. 1998; Duckworth *et al*. 1999; Alström *et al*. 2009; Woxvold *et al*. 2009) as well as these monkeys, precipitous non-calcareous terrain was rarely a survey target: in most areas it is not extensive, and in general it has relatively low conservation potential and priority.

Of the surveys here reviewed, only in Muang Vilabouli (2008) and in the region east of Nam Kading NPA (1995 and 2005) was a focused effort made to find François'-group leaf monkeys using village information, because such species-specific use of time was inappropriate to the surveys' more general remit.

Historical Records

The first Lao record of François'-group leaf monkey comprised three animals collected in February 1920, of which one constituted the holotype for *Pithecus laotum* Thomas, 1921 (Weitzel *et al*. 1988; Brandon-Jones 1995). The collection site, given at the time as "Camp 42", "Ban Sao", and "Ban Na Sao", has been interpreted variously, with Thomas (1921, p.182) giving it as "on the French side of the Mekong, in latitude about 17°30'N", and Kloss (1921, p.75) as "about 40 miles north-east of the town of Pak-Hinboun [17°35'N 104°37'E] on the Mekong" (i.e., about 18°02'N, 105°01'E; but this takes it outside the major limestone belt of the region); while Brandon-Jones (1995), having consulted the expedition's detailed diary, compiled by Day (1920), concluded that Ban Na Sao lay near the coordinates of today's Ban Phontiou (17°53'N, 104°37'E). This is a trifling readjustment by comparison with some errors of location made by Thomas in other

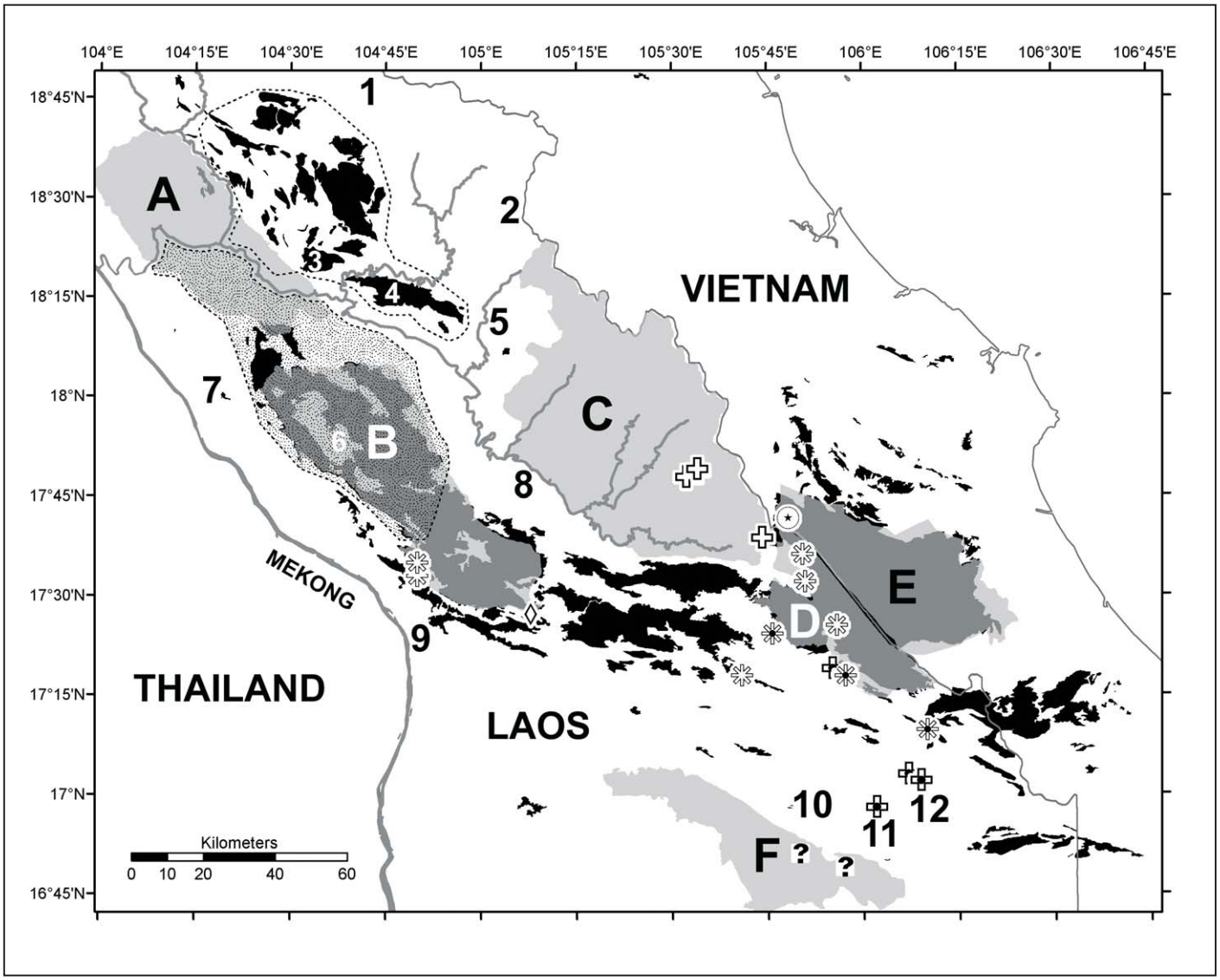


Figure 1a. Lao PDR, showing locations of records of François'-group leaf monkey and other sites and areas mentioned in the text. Black = karst, pale gray = national-level protected areas (not comprehensive for Vietnam), dark gray = karst within national-level protected areas.

Known range. *T.* (*f.*) *laotum* within dashed line of A and B, south of the Nam Theun (from Steinmetz *et al*. in press). Other taxa marked as points: diamond = vocal record far from any sighting; white-centered asterisk = black-headed animals (those from in and around area D, from Timmins and Khounboline 1996, and Walston and Vinton 1999); black-centered asterisk = apparently black-headed animals (after Walston and Vinton 1999); white-centered cross = animals with white-cheek band; black-centered cross, animals with dark head but white pinna-stripe; ringed dot = typical *T.* (*f.*) *hatinhensis* (Vietnam; from Timmins *et al*. 1999); question-mark = apparent *T.* (*francoisi*) (s)sp.

Dashed line around karst north of the Nam Kading and east of the Nam Mouan = Interview area of Table 4. The river shown entering the Mekong is the Nam Theun/Kading (known as the latter in its lower reaches, the former in its upper); the tributary entering the Nam Kading within area A is the Nam Mouan.

A, Nam Kading NPA plus Nam Sanam PPA; B, Phou Hinpoun NPA; C, Nakai–Nam Theun NPA; D, Hin Namno NPA; E, Phong Nga–Ke Bang National Park; F, Phou Xang He NPA. 1, Nam Chouan proposed NPA; 2, Nam Theun Extension proposed NPA; 3, Nadi Limestone; 4, Sayphou Loyang; 5, Ban Lak-20; 6, Ban Na Sao / Ban Phontiou; 7, Pha Som; 8, Nakai plateau; 9, Thakhek; 10, Pha Lom; 11, Phou Padan; 12, Pha Kat and Pha Tadang.

specimens he received (for example, in the type locality of the jungle cat subspecies *Felis chaus fulvidina*; see Duckworth *et al*. 2005). Deuve and Deuve (1963) located Ban Na Sao as 12 km north of Thakhek (and beside the Mekong), giving Phontiou as 70 km to the north, but indicated that they based this on Thomas (1921), not on any independent re-evaluation.

A single *T.* (*f.*) *laotum* arrived at San Diego Zoo in 1947, but died after two days (Dolan 1994). The only other historical references of *T. francoisi* (*sensu lato*) in Lao PDR seem to be those in Deuve and Deuve (1963) and Deuve (1972), who made essentially the same statements, that they had formally identified the species (whether they actually encountered it in the field themselves is unclear) at the limestone outcrops of "Phasom" (presumed to be the Pha Som on route 13 from Thakhek to Ban Pakkading, at 18°00'N, 104°19'E), and of "Phontiou" (presumed to be that listed above). They

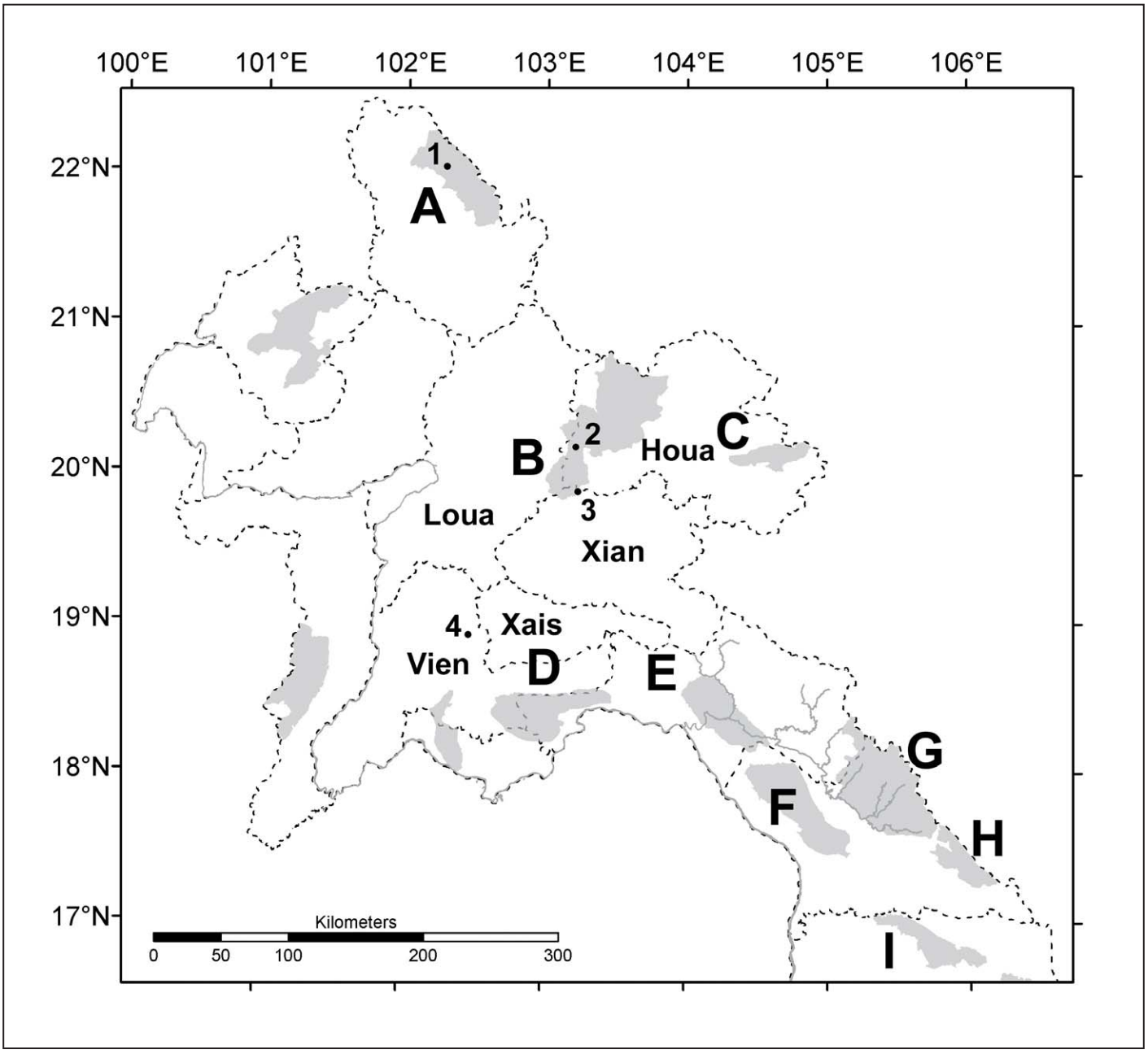


Figure 1b. Lao PDR, showing locations and features relevant to the possible occurrence of François'-group leaf monkey in the northern part of the country. Pale gray = national-level protected areas (not comprehensive for Vietnam); dashed lines separate provinces.

Provinces with extensive karst have abbreviated names: Loua = Louangphabang province; Houa = Houaphan province; Xais = the former Xaisomboun Special Zone, recently distributed among the neighbouring provinces; Xian = Xiangkhouang province; Vien = Vientiane province. A, Phou Dendin NPA; B, Phou Louey NPA; C, Nam Xam NPA; D, Phou Khaokhoay NPA; E, Nam Kading NPA plus Nam Sanam PPA; F, Phou Hinpoun NPA; G, Nakai–Nam Theun NPA; H, Hin Namno NPA; I, Phou Xang He NPA.

1, Ban Hathin; 2, Ban Sakok; 3, Ban Sopkhao; 4, Vangviang.

gave the Lao name "khang" for the species; while this cannot safely be assigned to François'-group leaf monkey (see "Local Names"), Ban Phontiou is in Phou Hinpoun NPA and within the complex's recently validated range, and Pha Som is nearby; both are suitable karst habitat for these monkeys. Since the mid-1990s, Pha Som has been exploited for cement, and is so small, so isolated from other karsts by farmland, and so close to the country's major road, that it seems unlikely to retain any leaf monkeys. Even if they inhabit this outcrop, numbers could not be significant compared with the nearby NPA populations.

Modern Records

Modern records of *T.* (*f.*) *laotum* come from much of Phou Hinpoun NPA, and, to its north, Nam Sanam Provincial Protected Area (PPA) of Khammouan province, southwestern Nam Kading NPA, and the unprotected land where a main road (route 8) runs between Phou Hinpoun NPA and Nam Sanam PPA (Nadler 2009; Steinmetz *et al*. in press). They are not detailed further here. Records of other taxa within the complex come from four areas in addition to Hin Namno NPA and its surrounds, as follows.

Nakai–Nam Theun NPA

Records come from two parts of the NPA (Table 1). The active sleeping site on Phou Vang was on a small non-limestone cliff, with old and fresh feces piled 20 cm deep at the base (Robichaud and Stuart 1999). The camera-trapped animals were sitting on large rocks in the bed of a short flat stretch of stream in steep terrain, with one apparently drinking. This camera trap was active over 4 March – 6 June 2008, and these were the only leaf monkeys photographed (WGR). At 3,500 km², Nakai–Nam Theun NPA is Lao PDR's largest NPA, mostly covered in hill and montane (semi-)evergreen forest. This NPA has been relatively well surveyed using direct observation for large mammals, in 1994 (Evans *et al*. 2000), 1996 (Duckworth 1998), 1997 (WCS 1997), 1998–1999 (Boonratana 1998b; Robichaud and Stuart 1999), 2001 (Boonratana 2001) and 2006–2008 (WGR and the Nam Theun 2 Watershed Management and Protection Authority unpubl. data). Although in this very large NPA, a fair number of areas of precipitous terrain remain unsurveyed, the high, geographically widespread, survey effort indicates that these monkeys are localized in the NPA, and their total population is certainly much smaller than in the karst-dominated NPAs of Phou Hinpoun and Hin Namno.

Phou Hinpoun NPA

As well as the large population of *T*. (*f.*) *laotum* (which has extensive white on the head) in the north and center of the NPA (Nadler 2009; Steinmetz *et al*. in press), animals fitting *T*. (*f.*) *ebenus* (lacking white on the head) occur in its south. Calls heard around Ban Lak-9 (=Ban Lak Kao; 17°27'N, 105°07'E) on 22 May 1994 were attributed by villagers to black-headed animals, and reports from nearby Ban Nakayak (17°28'N, 105°07'E) and Ban Nampik (17°29'N, 105°09'E) also were of black-headed animals (Timmins 1997). Further interviews in 1998 spread across the NPA received reports of black-headed animals around Ban Viang (17°36'N, 104°58'E), Ban Nakhu (17°39'N, 104°48'E) and Ban Phin (17°29'N, 105°00'E); in the last, southernmost site, only black-headed animals were reported, whereas at the other two, animals with white on the head were said to live in the immediate area as well (Steinmetz 1998). Two direct sightings of black-headed animals were made in early 1999, both south of 17°35'N (Table 2). Nadler (2009) observed three animals lacking any white on the head or ears (as far as could be told, with observation at 100 m range) in the southern part of the NPA, about 1 km from route 12 (T. Nadler pers. comm. 2009). All evidence therefore suggests only a narrow zone of overlap, if any, between animals typical of *T.* (*f*) *laotum* and those with black heads.

Muang (administrative district of) Vilabouli, Savannakhet province

Records came from several outcrops (Table 3). Pha Kat is a small (*c*.2.5 km²), narrow, karst which was surveyed only on its west face. All observations of monkeys were made from the plains below; JWD spent the day of 20 November 2008 and the morning of 22 November within tall semi-evergreen forest on the lower karst, without seeing, or, more surprisingly, hearing, the species. The animals on 16 November 2008 seemed to be heading towards a large cave, feeding now and

Table 1. Records of François'-group leaf monkey from Nakai–Nam Theun NPA.

Location	Co-ordinates	Date and time	Number of animals	Other notes	Observer / reference
West slope of Phou Vang	17°47'47"N, 105°32'15"E; 1,150 m	13 December 1998, evening; one evening within 31 December 1998 to 5 January 1999	15+	At cliff-ledge sleeping site; also seen once by day in nearby evergreen forest	Robichaud and Stuart 1999
Lower north slope of Phou Hua*	17°48'40"N, 105°34'04"E; *c*.1,000 m	29 March 2008, 12:30 to 12:33	8+ (6 adults, 2 clinging, orange, infants)	Camera-trapped in evergreen forest	WGR
Lower north slope of Phou Hua	17°49'N, 105°34'E; *c*.1,000 m	6 April 2008, 10:25	Group; no count possible	Flushed in evergreen forest canopy	WGR
Scarp slope of Phou Ak	17°38'40"N, 105°44'11"E; *c*.850 m	27 May 2007, 17:00	3 adults with 1 baby	In SEF; photographed by observer	B. L. Stuart pers. comm. 2008

* Part of the Phou Vang massif.

SEF = semi-evergreen forest.

then on their slow journey. Based on calls heard earlier that afternoon, either two groups were involved, or these animals had moved a mile or more. The nearby karst of Pha Tadang is smaller (*c*.0.6 km²); the leaf monkeys seen were foraging in tall semi-evergreen forest half-way up the karst, watched from the plain below. Phou Padan is a rugged *c*.12 km² quartzite sandstone massif, disjunct from any karst. Most of this massif was not explored, but a cave high on the south face was visited specifically because local hunters reported that dark long-tailed monkeys used it as a sleeping site.

Muang Vilabouli is outside the NPA system and comprises a village- and road-studded landscape of heavily degraded semi-evergreen forest, secondary regrowth and agriculture, with various small rugged massifs. The intervening area north-west to Phou Hinpoun NPA holds a dispersed archipelago of small karst outcrops. Muang Vilabouli was surveyed using direct observation for large mammals only for a month (in late 2008), and time was insufficient to assess leaf monkey status in many of its rugged areas; village interviews suggested that *khung* (probably François'-group leaf monkey; see "Local Names") might be quite widespread in its various cliffs, mostly non-limestone. Nonetheless, although various isolated populations probably remain undocumented in the area, suitable habitats comprise blocks so tiny by comparison with those in Phou Hinpoun and Hin Namno NPAs that populations can only be relatively small.

Phou Xang He NPA (unconfirmed records)

During 8–10 May 1998, a group of three animals was seen by a village guide (RB himself only heard the crashing of foliage) in a narrow valley between two parts of the Phou Hinho massif at *c*.16°49'N, 105°57'E (*c*.400 m above sea level). The guide directly afterwards called the animals *thanee* (invariably used for gibbons) but stated (in Lao), upon enquiry, that the animals were all black/dark, with long tails and crested heads; and the way he described their mode of locomotion through the canopy was consistent with leaf monkeys rather than gibbons, the only other black primates in the area. However, the possibility that these might have been silvered-type leaf monkeys *T.* aff. *T. cristatus* (a group also of unstable taxonomy in Indochina) cannot be ruled out. Villagers reported that some *khong* (probably François'-group leaf monkey; see "Local Names") regularly sleep at two caves or crevices in the precipice of Na Pha Daan, west of Ban Naphaling, at *c*.16°51'N, 105°50'E (300–600 m above sea level), and fresh and old droppings and urine were observed on the trail just below the sleeping sites, with urine stains visible on the cliff face (Boonratana 1998a; Duckworth *et al*. 1999, plate 13; RB own data). These signs were perfectly consistent with those known for François'-group leaf monkeys, but it is uncertain whether such signs are left by other monkey species when living amid rock faces. Eudey (1991) suspected that red streaks on cliff faces in Huay Kha Khaeng Wildlife

Table 2. Records of black-headed François'-group leaf monkey in Phou Hinpoun NPA.

Location	Co-ordinates; altitude above sea level	Date and time	Number of animals	Other notes	Observer / reference
Ban Koktong-Noy	17º34'55"N, 104º49´45"E; 160 m	10 January 1998; *c*.10:00	15–20	Base of karst near heavily degraded plains forest	M. F. Robinson
Tam Sompoy	17º33'05"N, 104º49'50"E; 160 m	14 January 1998; morning	1	Seen at 30–50 m range in open karst near scrub and bamboo	M. F. Robinson

See also Nadler (2009).

Table 3. Records of François'-group leaf monkey in Muang Vilabouli.

Location	Co-ordinates; altitude above sea level	Date and time	Number of animals	Other notes	Observer / reference
Pha Kat	17°03'N, 106°07'E; 450 m	15 November 2008, 15:30–15:45	2-3 adults and one black young	Towards the southern end of the west face	JWD
Pha Kat	17°03'N, 106°07'E; within 320–600 m	16 November 2008, 15:00–15:45	Calls heard intermittently	Central west face	JWD
Pha Kat	17°03'N, 106°07'E; 350–400 m	16 November 2008, 16:50–17:00	12+, including two black young	Low on the west face of the karst, south of center	JWD
Pha Kat	17°03'N, 106°07'E; within 320–600 m	20 November 2008, 11:30–12:15	2+ adults	Southern end of the west face	I. Woxvold pers. comm. 2008
Pha Kat	17°03'N, 106°07'E; within 320–600 m	21 November 2008, 11:05	Calls heard	Northern part of the west face	JWD
Pha Tadang	17°02'N, 106°09'E; within 320–500 m	7 December 2008, morning	Calls heard several times		JWD
Pha Tadang	17°02'N, 106°09'E; 400 m	8 December 2008, 16:00–16:20	5+ adults, 1 *c*. ½-adult-length young	North-west tip of the outcrop	JWD
Phou Padan	16°58'N, 106°02'E, 700 m	25 November 2008, 16:00–17:45	2 adults, one black young		JWD
Phou Padan	16°58'N, 106°02'E, 700 m	26 November 2008, 05:50	Calls heard at first light)	Same animals, same site as previous evening	JWD
Phou Padan	16°58'N, 106°02'E, 700 m	30 November 2008, 10:30	Calls heard	Same site as previous animals	I. Woxvold pers. comm. 2008

Sanctuary, Thailand, came from urine and/or faeces of Assamese macaques *Macaca assamensis*.

Phou Xang He NPA consists of two semi-evergreen clad hill ranges separated by a narrow lowland plain, in which forest is heavily degraded and fragmented; the bigger, sandstone, Sayphou Xanghe and the smaller, more mesic, igneous Phou Hinho. Fairly brief and spatially-limited surveys were carried out in the NPA in 1993 and 1998 (Duckworth *et al*. 1994, Boonratana 1998a). It is possible that the François'-group leaf monkey population is much larger than can yet be inferred, not least because Sayphou Xanghe has a *c*.40 km-long, several hundred meter-high, precipitous scarp that has not been surveyed. This being a linear feature, however, it could not support numbers comparable to those in Hin Namno and Phou Hinpoun NPAs.

Other areas

Village interviews across Lao PDR during 1988–1993 included François'-group leaf monkey as a species for discussion, and of the 24 areas in which they were undertaken (which did not include Hin Namno NPA), positive responses were received in only four (Duckworth *et al*. 1999: Annex 5): Nakai–Nam Theun and Nam Kading NPAs, where later field records have confirmed their presence; Phou Xang He NPA, corroborated as above; and Phou Khaokhoay NPA, where occurrence remains highly uncertain. Only two of 16 interview villages in and around Phou Khaokhoay NPA reported animals that the interview team took to be François'-group leaf monkeys. The NPA contains much rugged terrain, and given the relatively light survey effort there to date (Timmins and Duckworth 2008) it is quite plausible that François'-group leaf monkeys might indeed live there. There are also reports from local people of dark leaf monkeys from just north of their confirmed occurrence in a poorly-surveyed area with many limestone outcrops extending from north/east of the Nam (=River) Theun around Ban Lak-20 (=Ban Lak Xao; 18°11'N, 104°58'E) north to the Nam (=River) Mouan and east to the Lao–Vietnam border (Duckworth *et al*. 1999; Timmins and Robichaud 2005), including the Nam Theun Extension proposed NPA (Berkmüller *et al*. 1995b). This area is north of the Nam Theun, a river forming a biogeographic barrier for, for example, *Callosciurus* squirrels (Timmins and Duckworth 2008). D[ao] Van Tien (1989, p.502) stated that "rivers seem to be frequent natural barriers" for this group of monkeys, but gave no basis for this; an anonymous referee of the present text stated that it "was the Vietnam museum specimens documented by Brandon-Jones (1995)… a totally inadequate basis for such generalization". The available information (Table 4) is inconsistent between interviewees, but suggests there might be a François'-group leaf monkey in the area north of the Nam Theun and south of the Nam Mouan, with a white/grey pattern on the head ranging from a greyish forehead area to perhaps a *laotum*-like white facial surround, with white to or perhaps even beyond the ears.

There are also several, rather weak, suggestions of occurrence in Lao PDR's northern highlands. Davidson (1998) received local reports in Phou Louey NPA which he felt perhaps referred to François'-group leaf monkey, from Ban Sakok (20°11'N, 103°13'E) and Ban Sopkhao (19°53'N, 103°14'E); both these villages are close to substantial forested limestone outcrops; however "these discussions about langurs were somewhat confused, and the team left being uncertain as to the reliability of the villagers' identifications" [this might have been better phrased as "… the reliability of their interpretations of the villagers' views"]. Hansel *et al*. (1998) presented some highly uncertain village reports perhaps of François'-group leaf monkey from Nam Xam NPA. Unfortunately neither source seems to have provided the name(s) used by villagers to refer to the monkeys in question. Reports were again received, in 2006, of animals fitting François'-group leaf monkey from Ban Sakok by Hamada *et al*. (2007). In Phou Dendin NPA in 2004–2005, WGR received reports in Ban Hathin (22°03'N 102°16'E), from three informants in their late 40s to early 60s (questioned together) that two types of leaf monkey (*khang*) inhabit the area (no karst is known in or around it), a dark one (*khang dam*) and a pale one (*khang khao*). The types were said to be about equally common, and always to be found in separate groups. Phayre's leaf monkey *Trachypithecus phayrei* has already been confirmed from this NPA (Evans *et al*. 2000); if the two forms represent different species, then François'-group leaf monkey is the most likely other candidate. Hamada *et al*. (2007) received reports of François'-group leaf monkey in Nam Ha NPA, but dismissed them as unreliable, although without any discussion as to why they should be any more particularly unreliable than all the other mass of interview information they presented. Phou Louey and Nam Xam NPAs have had substantial direct observation surveys, and Phou Dendin NPA has been visited briefly several times; but the lack of records of François'-group leaf monkey is not a strong indication of genuine absence from these areas, given the highly localized occurrence of these monkeys apparent in other hill forest NPAs, such as Nam Kading and Nakai–Nam Theun, and the generally greater hunting pressure in northern than in southern Lao PDR (see "Conservation Considerations"). Reports of dark-coated long-tailed monkeys living on rugged karst cannot, however, be assumed to be François'-group leaf monkeys: a group of Phayre's leaf monkeys was seen in such habitat (near the border of Nam Kading NPA) in April 1995 (Evans *et al*. 2000). And around Vangviang (18°55'N, 102°27'E), detailed questioning by S. Chounnavanh (with oversight by JWD) in 2009 found that long-tailed, non-macaque, monkeys (always called *khang*) lived around (or were recently extirpated from) the karst of 14 of 17 villages, but on detailed discussion were invariably described as gray (*si mok* and *si khi thao*; "fog-colored" and "wood-ash-colored" respectively), not black, in pelage, and thus are likely be Phayre's leaf monkeys.

In April 2010, a resident of Ban Phonsavat, Muang Sanakham, Vientiane province (18°17'N, 101°44'E), evidently very knowledgable of the area's wildlife, swore that two sorts of *khang* lived in the area, which contains extensive

forested karst. They differed in color, one being *si mok* (fog-colored) and the other *si dam* (black or dark), kept separate company, and were certainly different "types" (= *sanit*). This is as suggestive as any of the Lao northern highland reports for a François'-group leaf monkey. However, on detailed discussion, the only other difference was said to be that the dark one had a longer tail. It was specifically said to live in the same habitats as, to have calls identical to, and to have identical face-markings to, with white only around the eyes and mouth, the fog-colored *khang*. Both were said to have been seen during the previous week's survey (of non-karst areas) when he was village counterpart (but observing separately, much of the time) to JWD, who saw only typical Phayre's leaf monkeys. The balance of probabilities, given how adamant the informant was concerning head-markings, is that both types refer to Phayre's leaf monkeys.

Local Names

Assessing François'-group leaf monkey distribution and status in Lao PDR through local information requires extreme care. First, the adjective *dam*, usually translated as "black", is not conclusive of François'-group leaf monkey rather than any congener because it means simply "dark": potentially gray. Thus, H. Wright (pers. comm. 2010), an ornithologist asking on our behalf in Lao-speaking northern Cambodia about the colobines present there, heard about an animal called "taloung", described through translation from Lao as "considerably larger than a long-tailed macaque, mostly black with a very long tail". It is inconceivable that François' leaf monkey would occur in these lowland, predominantly deciduous plains habitats; in southern present-day Lao PDR, "taloung" shows some linkage with silvered

Table 4. Names and appearance of village-reported monkeys in and around the Nam Kading catchment.

Village	Monkeys reported (focus on colobines)
North of the Nam Kading	
Ban Hinggunn (NE of Nam Kading NPA, north of Nam Theun, south of Nam Mouan)	"Ling khang", macaque; "khang" (long tail – two types) one sounds like François'-group LM (black; only on cliffs) the other like Phayre's LM ("sii mok" [= fog-coloured] with white lips)
Ban Nadi (NE of Nam Kading NPA, north of Nam Theun, south of Nam Mouan)	1st interview: "cung" (all black, on rock mountains); "cadung" (black, white crown and chin (jaw) and white ventral midline, on rock mountains); "khang" (sii mok in good forest, not really on rock mountains). 2nd interview (different villagers): "cadak" (fog-coloured, with white "chin", on rock mountains); these villagers did not mention "cung" saying the only other long-tailed "monkey" was "cadung".
Ban Paka (along Lak-20 limestone)	"Cung", also sometimes called "cadung" (all of head including the crown white, face also white; body black).
Ban Tampung (along Lak-20 limestone)	"Cung", also called "talung" (black with white face; another man said white face with whitish coming down and around the nape).
Ban Phon(sat) (along Lak-20 limestone)	"Cung" = "talung" (black, with black face and white around forehead and temples and going back to the ears).
Ban Mai-sivilai (along Lak-20 limestone)	"Cung" (black including the face with white forehead).
Ban Phong (along Lak-20 limestone)	"Cung" (all black apart from a white crown not extending down face or past the top of the ears); "ling khang", macaque.
Ban Kokton (on Nam Mouan - north)	"Kang" (long tail, grey pelage, no mention of white lips)
Ban Phoupiang (on Nam Mouan - south)	"Kang" (all grey pelage, long tail,)
Ban Vangmagk (NE of Nam Kading NPA, north of Nam Theun, south of Nam Mouan)	In 1979 the interviewee shot a black colobine; he'd not seen such an animal before, but a friend told him that it was a "cadung". Another interviewee saw a "cadung" shot by a friend in limestone close to Ban Lak-20 (Ban Tasala). Both these animals were described as black, but with dark greyish heads and a paler ashen-grey spot on the forehead. There was a consensus that there was a "langur" called "cadung" in other areas to the south, but few people had ever seen them.
Ban Supsai (NE of Nam Kading NPA, north of Nam Theun, south of Nam Mouan)	"Khang" (long-tailed, fog-coloured, limestone)
Ban Chomthong (on Nam Mouan)	"Khang" (big, long tail, all palish grey, on limestone); "khang", a sort of "ling", evidently macaque (tail 20 cm).
In range of *T*. (*f*.) *laotum*	
Ban Nakua-nai (SW of Nam Kading NPA, south of Nam Theun)	"Cung", evidently François'-group LM
Ban Konglor (in middle of Phou Hinpoun NPA)	"Cung", François'-group LM (black, black face, head all white, but: tail short!!!); "khang", seems to be macaque.
Hin Namno NPA	
Ban Tasang	"Cung", evidently François'-group LM (all black); "khang", evidently macaque (tail 20 cm)
Ban Vangngnow	"Cung", evidently François'-group LM (all black); "talung" (black, as "cung"; but without the pointed crest, and with white lower jaw and chin; pale area across chest; on sandstone mountains and escarpments); "khang", macaque (lives in karst).
Ban Katok	"Cung", evidently François'-group LM (all black); "ling khang"

LM = leaf monkey.

All information from RJT.

The focus of the undertaking was to investigate if François'-group leaf monkey lived north of the Nam Theun. Other colobines and, particularly, macaques were only discussed to the extent necessary to exclude given names from possible reference to François'-group leaf monkey.

No sightings of living monkeys were possible to validate any of these usages. Black and gray were determined by the interviewee pointing at something comparable in color. Use of c, k, and kh is as transcribed and implies nothing about the actual Lao consonant.

leaf monkey (see p. 71), and this is evidently the species under discussion here, notwithstanding the stated pelage color in translation. This ambiguity can be minimized by asking informants to point to a visible object of color comparable to the animal under discussion. Second, names vary in use for a given species across Lao PDR (see below; discussions concerning Tables 4–6). Third, a set of words used in monkey names is so similar-sounding that many listeners not fluent in Lao find significant confusion. Fourth, Lao has a unique alphabet and lacks a universal system of transliteration into the Roman alphabet, thus consultation of half-a-dozen documents mentioning a place name like Xaignabouli may find as many different spellings (as different as "Sayabury"), and whether a Roman spelling is "correct" has meaning only according to a specified base (such as the 1:100,000 maps taken here as the datum for place-names). Fifth, Lao is tonal (hampering representation of vowel sounds in non-tonal languages) with consonants and vowels that do not all equate directly to Roman letters. These transliteration difficulties would be irrelevant were animal names in village use noted in the Lao alphabet, but many outside surveyors use only the Roman. Finally, even transcription in the Lao alphabet is insufficient to prevent later ambiguity with words from the many ethnic minority languages in Lao PDR: and in much of the Lao range of these monkeys, the first language of many people is not Lao.

Of particular relevance to monkeys, Lao has three discrete consonants that sound similar, to many western ears, to Roman "k". One (seen by some Lao-speaking westerners as closer to a Roman "g" sound) is an unaspirated voiceless velar stop; the other two are voiceless aspirated velar stops. Confusingly, these two distinct phonemes are not contrastive in English (i.e. "k" is used for both, as in "sky" and "king" respectively), but in Lao (which lacks the voiced velar stop, as in the first "g" of "gang") the first is fairly consistently transcribed in the Roman alphabet as a "k" not followed by an "h", the latter two as linked "kh". This convention is not, however, known (or, therefore, used in field transcriptions) by all foreigners active in Lao, even for many years (such as, until this manuscript, JWD).

Preparation of this account revealed difficulties on this topic far greater than initially suspected, sufficient to hinder communication between wildlife surveyors not fluent in Lao (often unaware of difficulties beyond those of tone) and those few who are (who often read too much into the way a word has been transcribed by someone in the former group). For example, in March 2009 during discussions in the Vangviang area it was clear to JWD that two distinct forms of monkey existed locally, one of which he transcribed as "ling khang" (clearly, from the hunter's morphological description, macaque *Macaca*) and the other as "khang" (a colobine). Despite several minutes of focus on these names (to see if

Table 5. Use of *ling kang* for macaques.

Location, year	Identification	Validation	Source	Notes
Nam Pouy NPA, 1997, 1999	Pig-tailed	Direct sighting	RB	
Vangviang, 2009	Stump-tailed?	Villager description	JWD & S. Chounnavanh	Karst
Nakai–Nam Theun NPA, 1998–2004	Pig-tailed	Direct sighting	RB	
West of the Nakai plateau, 1998	Pig-tailed	Direct sighting	RB	Multiple local observers
Phou Hinpoun NPA, 1998	Assamese?	Villager description**	Steinmetz 1998	Karst?
Muang Vilabouli, 2008	Assamese	Direct sighting*	JWD	Two well-separated villages; karst

* Name was not known to be *ling kang* as distinct from *ling khang* (but no wildlife surveyor fluent in Lao has ever heard the latter combination, and it may well not exist).

**Source presents name as *kang* (not as *ling kang*); it was transcribed thus in over 50 separate interviews, and never as *ling kang* (R. Steinmetz pers. comm. 2009).

In no case was exclusive linkage (at village or even individual person level) between the name and the species of macaque established.

See also Table 4.

Table 6. Local names used for François'-group leaf monkey in Lao PDR.

Location	Name used	Validation	Source	Notes
Nam Kading NPA, 1995	*khung*	Villager description of animals	RJT	Transcribed in Lao
Phou Hinpoun NPA, 1995, 1996	khung (or kung)*	Direct sighting and hearing	RJT	*laotum*-type animals
Hin Namno NPA, 1996	khung (or kung)*	Direct sighting and hearing	RJT	*ebenus*-type animals
Phou Hinpoun NPA, 1998	*khong*	Direct sighting	R. Steinmetz pers. comm.	White-headed animals (only?)
Phou Hinpoun NPA, 1998	*taloung*	Villager description of animals	R. Steinmetz pers. comm.	Black-headed animals (only?)
Muang Vilabouli, 2008	*khung*	Direct sighting	JWD	Three sites, many people; transcribed in Lao at one
Nakai–Nam Theun, 2008	*khong*	Direct sighting	WGR	Sek guide speaking Lao

Transliterations following the k/kh convention for initial consonant (see text) are in italics. Those transliterated "as heard" (without reference to this convention) are not italicized.

* Not distinguishable to observer at time of survey.

See also Table 4.

the vowel tone was the same) it never occurred to JWD that the two words had, in Lao terms, entirely different leading consonants. Discussions in the same area by S. Chounnavanh (native Lao speaker) in May 2009 proved that the two names were in fact *ling kang* and *khang*. JWD had simply spelled both as "khang" because he knew of a monkey-meaning word in Lao spelled thus, whereas WGR and RB inferred, until corrected by JWD, that the latter's rendering meant specifically *khang* and not *kang*. A similar confusion beset the presentation in Evans *et al*. (1997) of a common Lao name for White-winged Duck *Cairina scutulata* as "pet khaa"; in fact it is generally, quite probably universally, *pet kaa*. The upshot of this is that a monkey name transliterated in Roman by a person of limited or unknown linguistic bent cannot necessarily be interpreted meaningfully back into Lao.

A focus on the genuine difficulties for people of varying nationalities and fluencies in Lao to transcribe unambiguously Lao names for wildlife risks overshadowing an even more important issue: that detailed investigation (multiple precise questions to multiple people in the area) invariably shows that specific morphological and ecological characters attributed to a named animal are inconsistent between interviewees, and that a given name can be applied to multiple discrete biological entities. Table 4 shows the results of RJT's discussions in 1995 and 2005 with villagers in Bolikhamxai province north of the Nam Kading (also with some examples from areas of known François'-group leaf monkey range), to exemplify how intractable is this problem. These interviews were all conducted through Lao counterparts speaking good English and mostly with significant wildlife survey experience, and RJT spoke enough basic Lao to follow the general nature of the discussion; neither RJT nor the counterpart took note of any conventions for transcription of Lao into the Roman alphabet, and the Lao names are written here as they were transcribed in the field. Adding to the bewildering variety in Table 4 of monkey names beginning with consonants similar to Roman "k", Steinmetz (1998) listed a couple more (for macaques) in nearby Khammouan: *khama* and *khameut*. How many of these names come from Lao and how many from ethnic minority languages was not recorded; this oversight is widespread, and severely hinders attempts to understand vernacular animal names in Lao PDR. *Kang* / *ling kang* (treated here as the same name) provide the particularly significant confusion risk of a macaque with a colobine (*khang*) using Lao language. *Kang*, in most areas with the *ling* prefix, is in wide use for macaques in Lao PDR over a wide geographical area, including the entire known latitudinal range of François'-group leaf monkey; it is not tied to a single species (Table 5). There is no evidence of *kang* being used for a colobine or of *khang* being used for a macaque, but this does not mean such usage does not occur. Considerable further work is necessary before even provisional records of François'-group leaf monkey would be defensible solely through deduction from a Lao name.

Mindful of the previous minefield, some general patterns of Lao-language colobine nomenclature can be proposed, using the k/kh convention as described above. Although the Lao word *ling* is often translated as "monkey", in fact all evidence suggests it means specifically macaque (or, in the combination *ling lom*, loris), never colobine. The latter have a series of unique names: *khadeng* means red-shanked douc *Pygathrix nemaeus* and seems to be a very tight linkage (Deuve's [1972] assignment of *ling kha deng* to stump-tailed macaque *Macaca arctoides* seems not to have been corroborated in more recent times and was presumably an error; *kha deng* means "red leg", but the Deuves misidentified the doucs in Lao PDR as black-shanked doucs *Pygathrix nigripes*). The names *khang* and *taloung* have several times been validated for *Trachypithecus* spp. (Deuve's [1972] assignment of *taloung* and *loung* to douc has never recently been found, and is surely in error). *Khang* is used for gray *Trachypithecus* species widely in Lao PDR; areas where this has been validated, by direct observation of live animals, include Nam Pouy NPA (North Lao PDR west of the Mekong; RB) and Vientiane province (east of Mekong; JWD). The possibility remains that *khang* may be used, somewhere in Lao PDR, for François'-group leaf monkey, although there is as yet no firm evidence of this. Specifically, Deuve's (1972) assignment of *khang* to François'-group leaf monkey, in the light of his other errors, is meaningless; moreover, as he knew of no Lao silvered leaf monkey records, and declared that the Lao had no name for Phayre's leaf monkey *T. phayrei* because they did not know it existed, François'-group leaf monkey was the only *Trachypithecus* to which he could apply the name *khang*!

Across Khammouan province and in neighboring parts of Savannakhet and Bolikhamxai supporting the species, one or more word(s) distinct from *khang* seem(s) to predominate in local usage for François'-group leaf monkey, although validations, by direct sighting of the species simultaneous with local speech, are few (Table 6). The name, transliterated as *khung* (rhyming with "[tuk-]tuk") or *khong* (rhyming with "[tele]phone"), is apparently an onomatopoeia of a commonly given loud call. Because the words heard were almost always transcribed into English, not Lao, it is unclear whether the *khong* / *khung* transliterations reflect genuinely different forms, or simply idiosyncrasies in listeners' hearing. Our only two direct transcriptions into Lao, from the northern extent of the known Lao range (by RJT and K. Khounboline, Nam Kading NPA, April 1995; not validated to species by direct sighting, but village description clearly indicated François'-group leaf monkey) and the southern (by Bounhaem Xaikhongham at Ban Houayhong in January 2010) have the same spelling, which is pronounced *khung*, without hesitation, by both Lao (S. Chounnavanh) and non-native Lao-speakers (WGR).

RJT's detail in Bolikhamxai province (Table 4) suggests that "khang"/"kang" (= *khang*?) is used for Phayre's leaf monkey and perhaps François'-group leaf monkey where sighting the latter is not a regular occurrence; "cadung" is used for François'-group leaf monkey and/or Phayre's leaf monkey north of the Nam Theun; "cung" (= *khung*) is used for François'-group leaf monkey both north and south of the Nam Theun, and perhaps might be used for Phayre's to the

north; "talung" is used for Phayre's to the south of Nakai–Nam Theun NPA [and, further in the south of Lao PDR for silvered leaf monkey], but north of this NPA it might be being used for François'-group leaf monkeys; and that "khang"/ "ling khang" (=[*ling*] *kang*?) is an amalgam of macaque species.

A fresh and significant further source of confusion is that the recently published first color-illustrated comprehensive guide to large mammals of Lao PDR (Parr 2008), receiving wide circulation, gave the names *khung* and *khong* as alternatives for silvered leaf monkey, and gave for François' -group leaf monkeys only the name *khang*. It cannot be ruled out that these names might be appropriate somewhere in Lao PDR, but these are about the least helpful associations that could have been given for these names, and were evidently made with no primary deference to common usage in rural areas. Given the way that pictures and Lao name are typically used in rural interviews in Lao PDR (see p. 75, right column), this situation is sure to lead to erroneous records of silvered leaf monkeys actually relating to François' -group leaf monkeys, and to bogus claims of François' -group leaf monkeys, probably predominantly in the northern half of the country, based on Phayre's leaf monkey.

Morphology

The animals observed in Nam Kading NPA were typical of *T*. (*f*.) *laotum*. Those in southern Phou Hinpoun fitted typical *T*. (*f*.) *ebenus*. There is no information on morphology in Phou Xang He NPA. The animals in Nakai–Nam Theun NPA and in Muang Vilabouli were not typical of any named form as presented in available literature such as Brandon-Jones (1995) and Francis (2008). The two named forms living closest by are *hatinhensis* and *ebenus* (see Timmins and Khounboline 1996; Walston and Vinton 1999; Nadler *et al*. 2003). The former is conventionally seen as having a bold white facial stripe including moustache and white marks on the nape, the latter an all-black head (see, for example, Brandon-Jones 1995; Francis 2008). Moreover, Nadler *et al*. (2003) stated that *T.* (*f*.) *hatinhensis* shows a white moustache but *T.* (*f*.) *francoisi*, otherwise similar in head pattern, lacks one.

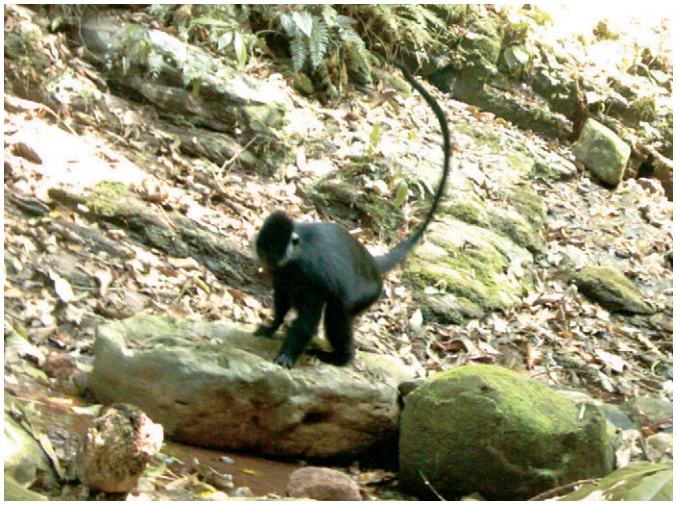
The camera-trapped Nakai–Nam Theun NPA animals show a facial pelage pattern consistent with *T.* (*f*.) *hatinhensis*, a neat white stripe across each cheek to over the ear; but all animals showing the back of the head lack extensive white on the nape (Fig. 2a), although some images show significant white extension behind the ear (Fig. 2b). Most animals on which the face can be seen seem to have a trace of a pale moustache (Fig. 2d), but a few seem not to (Fig. 2e); the feature is difficult to interpret from these photographs. T. Nadler (pers. comm. 2009) found, through observation of over 60 captive animals, all from Phong Nha–Ke Bang NP, and a number of close observations in that protected area, that *hatinhensis* is much more variable in head color and pattern than published information states. In sum, the white beards vary from thin and light gray, to wide and clear white; young to "nearly subadult" individuals (about three years old) can show a nearly white forehead up to the crest, although most lose their pale forehead after one year; the white line behind the ear is variable in length (but in all examined so far extended well beyond the ears) and sometimes clear, bright, white but sometimes duller, gray-tinged; and the white moustache is very variable, sometimes there being only about a dozen white hairs amid the black ones. Superficially, these photographs also need careful distinction from *T.* (*f*.) *francoisi*, even though its occurrence at this locality is highly unlikely, given its documented range (northern Vietnam and adjacent China). Stevens *et al*. (2008) documented how *T.* (*f*.) *hatinhensis* habitually carries its tail differently from *T.* (*f*.) *delacouri* and stated that on casual observations *T.* (*f*.) *francoisi* resembled the latter in this feature. Two photographs of the same animal from Nakai–Nam Theun NPA (Figs 2a, 2c) show the tail in the "back concave up" position of *T.* (*f*.) *hatinhensis* and three other photographs strongly suggest this, although viewing angle is not optimal for assessment. The camera-trapped animals are clearly, therefore, not *T.* (*f*.) *francoisi*. The photographs of the Phou Ak animals show white on the sides of the face, but no napes or tail postures are visible, and no relevant information is available for the 1998-1999 or 6 April 2008 sightings. Nothing suggests that these animals differed in pelage or postural characters from the camera-trapped animals.

Animals in Vilabouli were different from conventional *T.* (*f*.) *hatinhensis*, *T*. (*f*.) *ebenus* and the Nakai–Nam Theun NPA animals. All three animals (two of adult size and one a youngster, about half adult length) observed at Phou Padan had the head (pelage and exposed skin) black except for a bright, well-demarcated, white line along the top of the pinna (the rest of the ear being black). Poorer views at Pha Tadang confirmed the bright white ear-top stripe on the only animal where the feature could be assessed. Similarly at Pha Kat, although the animals were at an even greater distance, some pale around the top of the ear and/or on the adjacent part of the head was visible. An animal seen in Hin Namno NPA in 1998 had a head pattern at least somewhat similar to these Vilabouli animals, although it was described as a "short, indistinct, narrow, horizontal white line on the tip of each ear, or on the sides of the head just above the ear" (Walston and Vinton 1999, p.25).

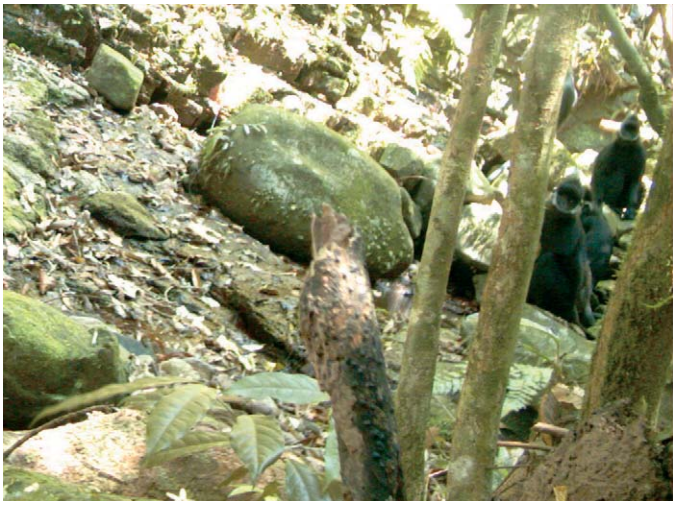
As well as white head stripes connecting the face stripes to the white nape pelage, *T.* (*f*.) *hatinhensis* typically has a white line also along the top of the pinna (T. Nadler pers. comm. 2008). In various forms of François'-group leaf monkeys, including the holotype (and then sole known specimen) of *T.* (*f*.) *ebenus*, Brandon-Jones (1995) documented on some specimens the presence of inconspicuous white or pale hair tracts on various parts of the head, although these would not be visible in the field (even during the close observation on Phou Padan). This indicates intra-taxon variability, and given the few specimens reported on in detail so far, the extent of such variation in each taxon is unclear. Age-related variation is a further complication: the *ebenus* at the Endangered Primate Rescue Center (born most probably in 1996) had a completely black head for its first decade, but in the last two years

2a

2b



2c



2d

2e

Figure 2. François'-group leaf monkeys camera-trapped in Nakai–Nam Theun National Protected Area, 29 March 2008. Note the absence of white on the nape in at least some animals (2a), but, on others, the presence of some white pelage behind the ear (2b); the way the tail is held (2a, 2c; the same animal, taken only seconds apart); the apparent white moustache (Fig. 2d), although this may be lacking on some (Fig, 2e); and the pale buttocks and pubic patch (Fig. 2e). Photographs by Nam Theun 2 Watershed Management & Protection Authority.

has shown an increasingly light grey color where *hatinhensis* has its pale beard (Nadler 2009; T. Nadler pers. comm. 2009). A *hatinhensis* at Korat Zoo, Thailand, fully grown but of otherwise unknown age, shows a similar feature (Nadler 2009).

The single animal with white ear-stripes seen in 1998 in Hin Namno NPA was responsible for the statement of animals in that NPA "tending towards [*T.* (*f.*)] *hatinhensis*, but most appeared black-headed" (Duckworth *et al*. 1999, p.177). In fact, all animals seen well enough to assess in the estimated six groups observed in two parts of the NPA by Timmins and Khounboline (1996) were entirely black-headed, as were all animals viewed similarly well in the eight other groups observed in several parts of the NPA by Walston and Vinton (1999). These, thus, fitted the holotype of *T.* (*f.*) *ebenus*. Various external sources (Nadler *et al*. 2003; Nadler 2009; Roos *et al*. 2007) have stated that *T.* (*f.*) *ebenus* overlaps with *T.* (*f.*) *hatinhensis* in Lao PDR, citing Ruggeri and Timmins (1997), which contains no statement to that effect, and Duckworth *et al*. (1999), which made the unfortunately vague, although explicitly non-conclusive, statement quoted above. The present review of evidence from Lao PDR provides no support to the suggestion that *T.* (*f.*) *ebenus* and *T.* (*f.*) *hatinhensis* overlap in range within the country, although survey effort has been inadequate to state that they do not. Nadler *et al*. (2003) traced only one explicit record of *ebenus* from Vietnam (they cautioned that many given as *T.* (*f.*) *hatinhensis* might better be considered unidentified): two observations of a one animal in Phong Nha–Ke Bang National Park. They made no explicit statement that *T.* (*f.*) *hatinhensis* was recorded in the same area. Another population of *T.* (*f.*) *ebenus* has subsequently been found in Vietnam, but there were no records of *T.* (*f.*) *hatinhensis* from the area (Le Khac Quyet 2004). It therefore seems questionable whether *T.* (*f.*) *hatinhensis* and *T.* (*f.*) *ebenus* really do overlap to any significant extent in Vietnam, either (Groves 2004).

Nadler *et al*. (2003) and the IUCN Red List (Le Xuan Canh *et al*. 2008) both subsumed *ebenus* within *hatinhensis*, seeing the former as a melanistic variant of the latter. Such a course leaves open how to name the black-headed animals in southern Phou Hinpoun NPA, which are remote from any animals resembling *T.* (*f.*) *hatinhensis*. There is no information on the geographic origin of the *T.* (*f.*) *ebenus* holotype and, therefore, at this stage, no objective reason to associate it more with populations close to those of *T.* (*f.*) *hatinhensis* (e.g. Hin Namno NPA) than with those close to *T.* (*f.*) *laotum*. That it has been done so reflects nothing more than that the first wild *T.* (*f.*) *ebenus* population found, in Hin Namno NPA, was geographically closer to *T.* (*f.*) *hatinhensis* than to *T.* (*f.*) *laotum*, and that the analyzed parts of the mitochondrial DNA of two specimens (themselves of unknown provenance) do not differ strongly from those of *T.* (*f.*) *hatinhensis* (Roos *et al*. 2007; Nadler 2009).

However these names will eventually be found to relate to real biological entities, the spatial separation of forms in Lao PDR indicates a pattern that cannot be dismissed as simple individual variation: in sum, in Nakai–Nam Theun NPA, all animals documented had white face stripes, which are not known (except in *T.* (*f.*) *laotum*) from any other populations in Lao PDR; at least most animals in the surveyed parts of Hin Namno NPA and southern Phou Hinpoun NPA have all-black heads (including ears); and animals in Muang Vilabouli are black-headed except for a white pinna-stripe, with no evidence to suggest it is ever lacking there.

Another pelage feature noted on Lao animals in several areas is a neat white or whitish patch across the buttocks. This is shown by the only animal in the Nakai–Nam Theun NPA photographs (Fig. 2e) with a clean rump view, although the harsh lighting prevents determination of exactly how pale it is. All three animals observed at Phou Padan (Muang Vilabouli) had a bold, well-demarcated, bright white patch in this position, extending right to the insertion of the tail. Because it was usually hidden by the animals' posture, it was a deal more difficult to see in the field than was the white ear-stripe. This same feature has been noted on animals elsewhere in Lao PDR. During a sighting of a group of 10-11 *T.* (*f.*) *ebenus* in Hin Namno NPA (1996), the anal area of two animals was seen clearly and was whitish (RJT). In two sightings of *T.* (*f.*) *laotum* in Phou Hinpoun NPA in 1996, two from one group (the other animals of which were not seen well) and several in the other group were noted to have "white patches in anal area"; in a third well-observed group (in this NPA in 1995), of at least eight, one animal showed "a white round patch in anal region" as it walked away in a view similar to that of the animal in Fig. 2b, but at least some others in the group did not show such a patch (RJT). RJT also observed two *T.* (*f.*) *hatinhensis* in the field in Phong Nha–Ke Bang National Park, Vietnam, in 1998, and noted that one had a "large white bare anogenital patch". The buttock patch is clearly distinguishable in Fig. 2e from the adjoining pale pubic patch. These pale patches occur, variably in extent and brightness, in females of all known forms of François'-group leaf monkeys; they have no taxonomic value (e.g., Groves 2001; T. Nadler pers. comm. 2009).

Distribution and Habitat Use

These field records confirm the presence of François'-group leaf monkeys in a rather small portion of Lao PDR. North of this area, there are extensive karsts scattered across Vientiane, Xiangkhouang, Louangphabang and Houaphan provinces; these (including the former unit of the Xaisomboun Special Zone, now reabsorbed by neighboring provinces) have barely been surveyed (see Timmins and Duckworth 1999, Fig. 1 for survey areas). François'-group leaf monkeys may thus have a more extensive Lao range to the north than is yet known, and the interview-derived suggestions from Phou Dendin, Phou Louey and Nam Xam NPAs might be corroborated. Earlier, Deuve (1972) also speculated that François'-group leaf monkey (specifying *T.* (*f.*) *delacouri*) might be found to inhabit the northern highlands, in the karsts of Xiangkhouang and Sam-Nua (=Houaphan) provinces; these remain almost unsurveyed. East of Lao PDR, the

various forms of François'-group leaf monkey extend from a known southern limit in Vietnam rather similar to that known in Lao PDR, north right through Vietnam into China (Nadler *et al*. 2003; Nguyen Manh Ha 2006). It is thus entirely plausible that they inhabit Lao PDR's northern highlands. Groves (2004, p.20) wrote that "the distribution of [François'-group leaf monkey] does not reach south of 17°N." These records push it slightly below, to 16°58'N (probably to *c*.16°49'N), and this may be the real limit in Lao PDR: south of the known Lao range, large blocks of karst do not exist and other forms of rugged terrain are more limited. Surveying has been more intense in this southern area than in the northern highlands and there has been no suspected occurrence of François'-group leaf monkeys. A claim in Vietnam from well to the south (14°33'N, 108°35'E), from Kon Cha Rang (Lippold and Vu Ngoc Thanh 1995), was published without any indication of what was actually seen, and was rejected by Nadler *et al*. (2003).

Clarifying the Lao range of each taxon requires understanding taxonomic variation within the complex. This will be complicated: it requires detailed observation of pelage supported by, preferably, genetic analysis of animals in as many areas as possible. Information from areas where two forms occur in close proximity or even overlap is particularly valuable.

These monkeys are often believed to be strongly associated with karst limestone. For example, Groves (2004, p.18), remarking on the lack of a handy, non-cumbersome, name for François'-group leaf monkeys, urged use of the term "limestone langurs" for them, but this does not seem to be particularly apt for Lao PDR: all records in and around Nam Kading and Nakai–Nam Theun NPAs are from non-calcareous formations, which they also inhabit in Muang Vilabouli. There are, however, no records known from any Lao site which is remote (more than 25 km) from a massive karst landscape.

Nadler *et al*. (2003) speculated that the association with karst reflected the thermal benefits of sleeping within caves, and that in warmer areas the animals would not need these benefits, and so might be less tied to karst areas. The present set of records, coming from the southern part of the global distribution of François'-group leaf monkeys, and at generally fairly low altitudes, are consistent with this suggestion. However, non-karst rugged terrain is not bereft of caves, and on at least Phou Padan the monkeys sleep in a non-calcareous cave. Furthermore, other monkeys occur in northern Indochina without needing caves to sleep in, and there is no obvious reason why François'-group leaf monkey would be more thermally challenged than the other species. Even in the far north of the complex's range, Li and Rogers (2005) questioned that limestone karst was an obligate habitat of these monkeys, rather than just overwhelmingly the most likely place for them to survive heavy hunting in a landscape of widespread forest conversion. This latter suggestion could not, however, apply in Central Lao PDR, where forest is much more extensive: here, there were many dozens of direct field encounters with monkeys during wildlife surveys in the 1990s (Timmins and Duckworth 1999, for red-shanked douc; not published in detail for the other species), spread across gentle and steep terrain; but François'-group leaf monkey was found only in areas with cliffs. This comparison with the other monkeys, which were often found far from such landforms, suggests strongly that the association of François'-group leaf monkey with precipitous landforms occurs irrespective of human activity and is not a facultative result of heavy habitat conversion and hunting.

All these records come from areas with extensive forest on or adjacent to the rugged terrain on which the monkeys were seen. On and around Phou Padan, the forest has been very heavily logged, with only a few groves of mature trees remaining. Several of the karst sightings were of monkeys foraging and resting on bare rock with scattered, often pachycaulous and/or deciduous, woody shrubs and small trees, while on thin-soiled non-calcareous slopes they were seen amid well-developed grass and herb swards. While it is clear that tall forests are much used, the extent of reliance upon such forest, if any, in Lao PDR is unclear. Because both timber and primates are harvested when people enter areas, the ease of human access is a major determinant of the status of both, and an absence of leaf monkeys from areas where forest has been cleared or degraded does not imply they could not persist in such habitat in the absence of hunting.

Conservation Considerations

Karst areas are difficult of access and the large ones are unlikely to be subject to wholesale habitat conversion, although small outcrops may be demolished as raw material for cement. Several low-level flights over much of the karst in Central Lao PDR (including Phou Hinpoun, but not Hin Namno, NPA) between 10 November 2008 and 8 July 2009 showed that many and large areas of reasonably tall forest remain in the karst landscapes. Much such forest has been lost around karst-bases, and species composition and structure has probably changed significantly even in many internal areas, particularly pockets where soil is suitable for agriculture. The sort of rugged non-calcareous areas used by the species are also ill-suited to agriculture on any but the smallest scale.

Hunting is therefore likely to determine the mid-term, and probably long-term, future of François'-group leaf monkey in Lao PDR. In Muang Vilabouli in 2008, individuals were readily observed on karst cliffs from the adjacent plains, where they seemed oblivious to noisy people moving around below (as did Assamese macaques *Macaca assamensis*). Those at Phou Padan were observed at a sleeping cave, known to local hunters. The observer intended to conceal himself in a bush; but the monkeys' arrival betimes (at 16:00) meant that they saw him, and responded with alarm calls (well-spaced, very loud, growling, wet-lip-smacking *hEEEY-hOOOORGHN* notes, sometimes with an extra terminal half-syllable sounding like *schll*) and by hiding in a rock fold, but only for 20 minutes. They then emerged, sat around and occasionally ate leaves of various unidentified species (and the flower

heads of the exotic composite *Chromolaena odorata*) for over 90 minutes, viewed from a distance of only *c*.50–60 m. That they did not flee corroborates village reports that hunting at these caves is very rare. At nightfall they were still outside the cave and it is unclear if they entered it. It is typical for François'-group leaf monkeys to rest in the vicinity of the cave mouth for a protracted period before entering (Huang Chengming *et al*. 2004; Nguyen Manh Ha 2006). Similarly, the progress towards a presumed sleeping cave an hour before dusk at Pha Kat, and its location low down (and quite plausibly accessible from the plains) contrasts with François'-group leaf monkey behavior in Phong Nha–Ke Bang National Park, Vietnam, where heavy hunting has forced them to arrive at and leave the caves under cover of darkness (Timmins *et al*. 1999); Nadler (1997) reported the same for heavily hunted Delacour's leaf monkeys *T.* (*f.*) *delacouri*.

Villagers in November–December 2008 reported that *khung* used to be common on Pha Lom, Muang Vilabouli (16°58'N, 105°48'E) and adjacent karst outcrops, which lie fairly close to, but west of, the sites in Phou Xang He NPA and in Muang Vilabouli; one informant said that it had been hunted out about a decade previously, while the others (as a group) believed that a few *khung* held on. The several days spent on Pha Lom (mainly for bird survey) by observers familiar with these monkeys' calls suggests that at most only a very few leaf monkeys remain (by contrast, Assamese macaques were seen and heard there near-daily). Reports apparently of François'-group leaf monkey were also received around here by Duckworth *et al*. (1994) in 1993, when two-person days on Pha Lom also failed to find any. Pha Lom is likely to typify small karsts in heavily settled areas, with François'-group leaf monkeys extirpated or nearly so. The larger and more remote karsts retain larger numbers of François'-group leaf monkeys, which at least sometimes are readily observed: villagers in eastern Vilabouli reported that they did not hunt them because it was difficult to retrieve the shot bodies from within the rugged terrain. However, this situation cannot be assumed to last, because some taxa in Vietnam (particularly *T.* (*f.*) *poliocephalus* and *T.* (*f.*) *delacouri*) have been devastated by directed hunting for the Vietnamese and Chinese markets (see, for example, Timmins *et al*. 1999; Nadler and Ha Thang Long 2000; Nadler *et al*. 2003; Nadler 2004; Nadler and Streicher 2004; Stenke and Chu Xuan Canh 2004; Nguyen Manh Ha 2006), as they have in China (Li *et al.* 2007). Lao PDR is already a major source country for wildlife markets in these two countries (for example, Nooren and Claridge 2001), and *T.* (*f.*) *laotum*, endemic to Lao PDR, has been confiscated in trade in Vietnam (Nadler 1996; Dang Huy Huynh 2004). Recent major expansion and upgrading of roads within these monkeys' known Lao range, especially in Muang Vilabouli and in Khammouan province, and across to Vietnam, and the massive rise in the number of vehicles in these areas, as in Lao PDR as a whole, has made many places much more accessible, and wildlife trade an add-on economic possibility to many more people, than in previous years. Animals and plants that were formerly not economically worth bulk collection may now, or soon, be so (see, for example, Wilkie *et al*. 2000). These leaf monkeys are at high risk of mid-term hunting-driven local extirpation, pending effective controls on trade-driven hunting.

The global significance of Lao populations of the various forms is very high. *Trachypithecus* (*f.*) *laotum* is endemic to the country, while *T.* (*f.*) *hatinhensis* and *T.* (*f.*) *ebenus* are severely imperiled in Vietnam, being known from few locations, perhaps only one of which, Phong Nha–Ke Bang National Park (Nguyen Manh Ha 2006), is a protected area.

The declaration of Lao PDR's impressive system of national protected areas is not yet matched by effective systems and sufficient resources to manage them, and currently the best protection for quarry animals in the country is that afforded by inhabiting remote, rugged, areas (Timmins and Duckworth 1999). Mindful of this, the huge karst-dominated NPAs of Phou Hinpoun and Hin Namno are surely the areas of overwhelming conservation importance to *T.* (*f.*) *laotum* and *T.* (*f.*) *ebenus* respectively, and the former also supports *T.* (*f.*) *ebenus* in its southernmost part (Timmins and Khounboline 1996; Walston and Vinton 1999; Nadler 2009; Steinmetz *et al*. in press). Nakai–Nam Theun NPA and Muang Vilabouli support smaller populations but are also important (precisely how much so remains unclear, pending taxonomic clarification) because their animals differ morphologically from those of the two main areas.

As yet undescribed taxa, if they exist at all, are most likely to inhabit the un- and poorly surveyed areas north of Nam Kading and Nakai–Nam Theun NPAs, and perhaps the northern highlands of Lao PDR. Compared with the South and Center of the country, in the North generally forest is more disrupted and hunting levels are higher, so many hunted species are more heavily depleted there (Duckworth *et al*. 1999; Timmins and Duckworth 2008). Of specific relevance to these monkeys, in the North agricultural conversion within karst is more prevalent, and karsts are generally smaller and less well connected. Therefore, localized extinctions, if these monkeys occur at all, are likely to be much advanced over the situation in the known Lao range, and reconnaissance surveys for these monkeys in these areas are of urgent priority. The strongly suggestive results from fairly extensive interviewing for these monkeys north of the Nam Theun in Bolikhamxai province in the mid-1990s by RJT and colleagues means that the priority there is field surveys of the larger, most rugged, karsts (especially the Sayphou Loyang and Nadi Limestone areas), in particular using local knowledge to find sleeping sites.

The general congruence of areas where well-executed village interviews and subsequent field surveys found these monkeys in Central Lao PDR, coupled with the monkeys' often localized distribution, suggests that surveys in poorly known regions should start with extensive interviews around areas topographically most likely to support them. Given the complexities of similar-sounding words in use for various monkeys, such surveys cannot take a "dictionary" approach to names heard from villagers, but must assign identifications based only upon how the animals are described, irrespective

of what they are called locally. Pictures of animals should not be shown until late in an interview (if at all), that is, once the number of named forms in the basic group under discussion has been established together with the particular local name, morphology, distinguishing characters, local distribution and abundance, and the interviewer's hypothesized zoological identification, of each. If pictures are introduced early on, firstly, it is difficult to determine, within what is said by the informants, what was previously known or believed by them, versus what is being drawn subconsciously or deliberately from the picture; and secondly, the range of pictures used defines unintentionally to the interviewees the animals of interest to discussion. Such circumscription is highly undesirable when novel forms may be present (as here): the most dramatic example of this is that numerous picture-based interviews in the Lao range of saola *Pseudoryx nghetinhensis* failed to reveal the presence of this animal in the years immediately before it was discovered in Vietnam in 1992 (Vu Van Dung *et al*. 1993), whereas verbal discussions using such topics as "please name and describe each species of large animal living round here" would certainly stimulated mention of this remarkably distinctive animal. It is quite possible that, if there are François'-group leaf monkeys in Lao PDR's northern highlands, they will be known by one or more Lao or minority-language names different from any yet recorded, so they cannot predictably be picked up by interviews asking whether each of a list of named (Lao name) species lives in the area.

It is generally impossible to determine the precise morphology of François'-group leaf monkeys from village reports (Table 4), and thus in each discrete area where such monkeys are convincingly reported, it will be necessary to see them directly, well enough to determine the exact distribution of white or grey pelage, if any, on them. Priority areas for these interview surveys include the massifs of Louangphabang province and karst in eastern Houaphan province; massifs of the Vangviang–Kasi area (Vientiane province) are a lower priority given the strong suggestion that karst-living leaf monkeys there, at least in the southern part, are not a form of François'-group leaf monkey.

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