

The Indochinese Silvered Leaf Monkey *Trachypithecus germaini* (*sensu lato*) in Lao PDR

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Abstract: The Indochinese silvered leaf monkey *Trachypithecus germaini* (perhaps comprising two species, *T. germaini* [*sensu stricto*] and *T. margarita*) is probably the rarest and most threatened monkey in Lao PDR. It has received less conservation-related attention in the country, however, than have the primates endemic to Indochina east of the Mekong because until recently it was generally considered conspecific with the widespread *T. cristatus* of Sundaic South-east Asia. All Lao records with firm locality details are from south of 16°23'N (in Dong Phou Vieng National Protected Area) and in lowland forests (up to 550 m above sea level), with many from near waterbodies. The predominant habitat seems to be semi-evergreen forest as patches and strips within a mosaic of more deciduous forest types, especially semi-evergreen forest in riparian and other waterside situations. Occupied semi-evergreen forest seems generally at the dry end of its spectrum, with a high deciduous tree component (this is the predominant type in interior plains-level Indochina), where this forest type grades to what some call mixed deciduous forest. Few if any records come from the interior of extensive unbroken semi-evergreen forest, or from highly-deciduous mixed-deciduous forest. Occupied areas include narrow stands flanking watercourses in deciduous dipterocarp forest, but there are no records from the more extensive deciduous dipterocarp forest matrix itself. Vague reports suggest occurrence up to 1,200 m, but given the high survey effort in such habitat, the species is at best very rare above the lowlands. Lao villager reports, and comparison with its status in similar habitats in adjacent Cambodia, suggest steep declines in Lao PDR. Suitable habitat (as profiled above) naturally covers only a small part of the southern Lao landscape, is among Lao PDR's most threatened habitats, and bears heavy hunting. Hence the great rarity of Indochinese silvered leaf monkeys compared with sympatric monkeys and gibbons, which inhabit the more extensive hill forests. There are records of the Indochinese silvered leaf monkey from only one Lao site since 2001. Although appropriate surveys during the 2000s have been limited, the species may now be extremely rare in the country and should join other, better publicized, bird and mammal species of these southern lowland plains landscapes as in need of urgent conservation action.

Key Words: Conservation status, distribution, habitat, Laos, *Trachypithecus margarita*, *Trachypithecus villosus*

Introduction

Lao People's Democratic Republic (Lao PDR; Laos), a land-locked country of 236,800 km² in South-east Asia, supports a rich primate fauna comprising *c.* 15 species, depending on taxonomy. Several of these primates are of obvious international conservation concern because of their restricted geographic ranges, living only east of the Mekong, and in some cases only in small parts of that area: pygmy loris *Nycticebus pygmaeus*; red-shanked douc *Pygathrix nemaeus*; François' group leaf monkey *Trachypithecus francoisi* (*sensu lato*), of

which there are several distinct forms; and various gibbons *Nomascus*. These species have, understandably, dominated the common thinking about Lao primate conservation, and detailed national status overviews have been prepared for these monkeys (Timmins and Duckworth 1999; Duckworth *et al.* 2010; Steinmetz *et al.* 2011) and for Lao gibbons (Duckworth 2008; Boonratana *et al.* in press). A further Lao primate which has to date received little attention is a gray leaf monkey *Trachypithecus* occurring in the southern third of the country. During the 1950s–1990s, its populations in Lao PDR (and neighboring Thailand, Cambodia and Vietnam) were

almost universally considered conspecific with the relatively well-known, widespread and numerous silvered leaf monkey *T. cristatus* of Sundaic South-east Asia (the Malay peninsula, Borneo, Sumatra and associated small islands).

Morphological and genetic characters both suggest, however, that these Sundaic and non-Sundaic populations are not conspecific, although this view is not universal: Brandon-Jones *et al.* (2004) continued to treat them as one species, which they called *T. villosus*. Groves (2001, 2005) used the name *T. germaini* for the non-Sundaic populations, inhabiting southern Vietnam, Cambodia, much of Thailand and perhaps adjacent Myanmar, as well as Lao PDR. Nadler *et al.* (2005), followed by Roos *et al.* (2008) and Francis (2008), divided these non-Sundaic populations into two species, suggesting that *T. germaini (sensu stricto)* lived west of the Mekong and *T. margarita* to the east. Morphological differences between the taxa were proposed (illustrated by Nadler *et al.* 2005), but sample sizes and intra-taxon variation were not discussed, hindering independent evaluation of the taxonomic conclusions. Brandon-Jones *et al.* (2004) had recognized these two taxa as subspecies, and assigned two specimens from Thailand west of the Mekong to *margarita*. Nadler *et al.* (2005) implicitly disagreed with the identification of one of these records and accounted for the other (and some more from west of the Mekong purportedly of *margarita*, from southern Vietnam) through confusion over original provenance, a problem not uncommon with primate records (Brockelman and Ali 1987).

Nadler *et al.* (2005, 2007, 2008) and Groves (2007) underlined the urgent need for more data relevant to this proposed division of the non-Sundaic silvered leaf monkeys into two species, and in particular the speculation that the Mekong forms the barrier between them. Observations of external morphology during 2006–2007 surveys along the Mekong in northern Cambodia (for example, Timmins 2008) show that the Mekong does not make a clear division. Resemblance to the two purported forms (based on relative contrast of extremities and circum-orbital coloration) varied, often considerably, within groups, even allowing for perception effects of viewing conditions. Moreover, observations in 1998 and 2000 in northeastern Cambodia (Timmins and Men 1998; Timmins and Ou 2001) involved sightings of *germaini (sensu stricto)*-like animals (retrospective identification) east of the Mekong, up to 20 km “inland” (at 13°11'N, 106°15'E). Seeing the Mekong as a barrier is too simplistic if these pelage characters have taxonomic relevance. Several lengthy reaches of the Mekong in southern Lao PDR and especially Cambodia have

extensive braiding, including many secondary seasonal channels and islands, and the main channel has switched course over time (Meijaard and Groves 2006), allowing populations to change from one side of the river to another.

Francis (2008) noted the likelihood that both Indochinese taxa were severely threatened by habitat loss and hunting, urging clarification of current status: *T. germaini (sensu lato)* is considered Endangered on *The IUCN Red List of Threatened Species* (Nadler *et al.* 2008). Here we review information from Lao PDR concerning the Indochinese silvered leaf monkey to determine its range and conservation status in the country. Most of the records reviewed here have not previously been published in detail, although text overviews and verbal summations incorporating most of them have informed review sources such as Duckworth *et al.* (1999) and Nadler *et al.* (2003, 2005, 2008).

Conventions

All Lao populations are treated, as in *The IUCN Red List of Threatened Species* (Nadler *et al.* 2008), as *T. germaini*: the analyses recognizing *T. margarita* (Nadler *et al.* 2005; Roos *et al.* 2008) used no samples from Lao PDR; no modern pelage specimens are available from the country; and the paucity of historical specimens (Table 1) prevents confident identification as *germaini (sensu stricto)* or *margarita* inferred through location.

Areas and sites referred to in the text are marked on Figure 1. Place names are based on the 1985–1987 series of 1:100,000 maps of the RDP Lao Service Géographique d'État (RDPL SGE) maps with the minor modifications of Thewlis *et al.* (1998). 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. Considerable location detail accompanies the records (Appendix), following the urging of Brockelman and Ali (1987) for such precision in primate records.

Lao words incorporated in place-names: *Ban* = village (here, meaning the area surrounding the village, rather than the village itself); *Houay* = stream; *Keng* = rapids; *Nam* = river; *Nong* = pool; *Pak* = river-mouth; *Phou* = mountain or hill; *Xe* = river.

Table 1. Historical (pre-1990) specimens of the Indochinese silvered leaf monkey from Lao PDR.

| Location | Coordinates (approx.) | Date | Specimen | Reference |
|------------------------------|-----------------------|------------------|------------|---|
| Bolaven plateau ¹ | 15°26'N, 106°23'E | 6 February 1932 | AMNH 87259 | Fooden 1976; D. P. Lunde <i>in litt.</i> 2007 |
| Ban Phon | 15°25'N, 106°42'E | 28 November 1931 | FMNH 38014 | ² Brandon-Jones <i>et al.</i> 2004 |
| Ban Phon | 15°25'N, 106°42'E | 22 January 1932 | FMNH 38015 | ² Brandon-Jones <i>et al.</i> 2004 |

¹Fooden (1976) gave 15°10'N, 106°20'E, a roughly central point for the Bolaven plateau, for this specimen, but Legendre specimens from the “Bolaven plateau” nearly all came from Ban Thateng (Legendre 1932, 1936); most were purchased from local people and their precise origin is unknown (see text).

²Also listed, as *argenteus*, by Osgood (1932); assigned to *margarita* by Brandon-Jones *et al.* (2004).

Methods

Direct-observation general large mammal survey-effort across Lao PDR during 1992–2007 was summarized by Timmins and Duckworth (1999, 2008) citing the original, often internal, reports from each. Mammal-related information-gathering activities with little opportunity to generate reliably identified locality records of this monkey (for example, village-based activities, training activities, camera-trapping and trade studies) are not covered by these summations. Most of the relevant surveys 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, and including hunted remains) birds and large mammals (generally, those identifiable without specimens) of high national and, especially, global conservation concern. Monkeys were thus among the best covered groups of mammals. These surveys were supplemented by appeals to colleagues for records, and the authors' own surveys after 2008.

Identification in Lao PDR of gray leaf monkeys as *T. germaini* needs care, because another gray species, Phayre's leaf monkey *T. phayrei* (also of disputed taxonomy), inhabits the country. There are too few Lao specimens of gray leaf monkeys to define even the coarse ranges of both these species (Table 1, Fig. 1; also Timmins *et al.* in press). Although the two are readily separated when seen well, monkeys recorded during 1990s–2000s surveys in Lao PDR were typically shy, so views were often brief and partly obscured. Therefore, identification of all field records from these decades has been checked during preparation of this review, in particular to isolate where the original identification as silvered was simply inferred through locality. Additionally, two records (one provisional) of animals in villages were in error. Evans *et al.* (2000, p.78) wrote of a captive youngster, “believed to be this species” on the Bolaven plateau, in Ban Nongmek (15°10'N, 106°32'E), which “reportedly came from nearby”. Several photographs of the young colobine in the village, taken on 19 February 1995, were found in the archives of the Wildlife Conservation Society Lao office in mid 2010: they

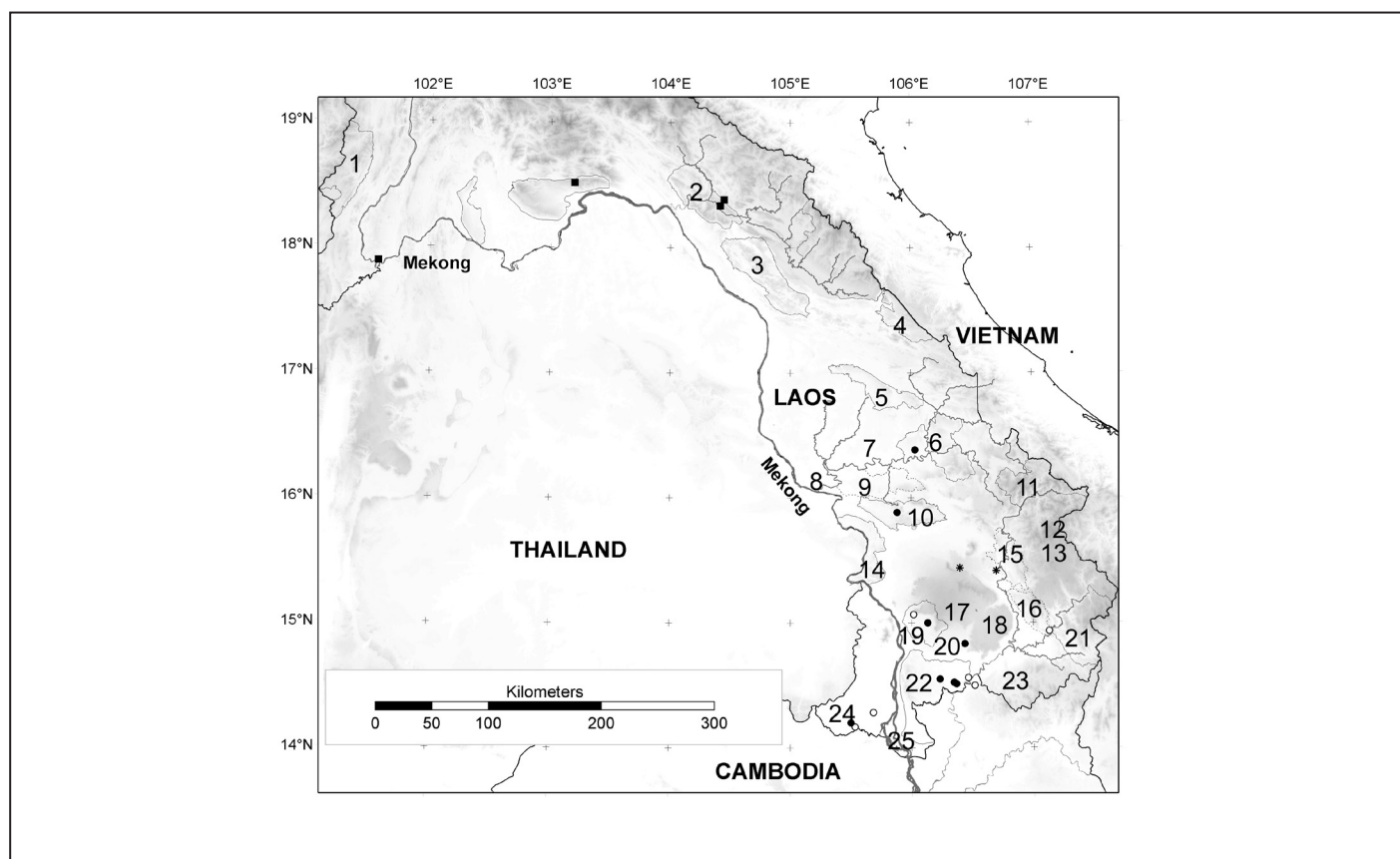


Figure 1. Lao PDR, showing localities mentioned in the text and records. Background shading shows altitude, darker areas being higher. All national protected areas (NPAs) within the area covered, but only those national production forest areas (PFAs) referred to in the text, are shown.

- modern record of the Indochinese silvered leaf monkey, identification confirmed;
- modern record of the Indochinese silvered leaf monkey, identification provisional;
- * historical record of the Indochinese silvered leaf monkey, identity confirmed, locality imprecise;
- southernmost records of Phayre's Leaf Monkey in Lao PDR.

Numbered areas: 1, Nam Pouy NPA; 2, Nam Kading NPA; 3, Phou Hinpoun NPA; 4, Hin Namno NPA; 5, Phou Xang He NPA; 6, Dong Phou Vieng NPA; 7, Xonboulou Eld's Deer Sanctuary; 8, Xe Banghiang and major tributaries; 9, Dong Sithouan PFA; 10, Xe Bang-Nouan NPA; 11, Xe Sap NPA; 12, Phou Ahyon; 13, Dakchung plateau; 14, Phou Xiang Thong NPA; 15, Houay Pen PFA; 16, Nam Pa PFA; 17, Bolaven plateau; 18, Xe Namnoy headwaters; 19, Dong Hua Sao NPA; 20, Bolaven Southwest pNPA; 21, Dong Ampham NPA; 22, Xe Pian NPA; 23, Nam Ghong Provincial Protected Area; 24, Dong Khanthung NPA; 25, Siphandon.

clearly show a young red-shanked douc. Secondly, in December 1993, Bergmans (1995) purchased a colobine skull (no lower jaw, or upper incisors or canines) in Ban Tangyeung (Dakchung plateau, 15°30'N, 107°02'E) that was reportedly hunted nearby; all land lies above 1,040 m. The skull (ZMA 24.918) is from a douc, based on the “greater depth [than in *Trachypithecus*] of its choana or posterior nares (i.e., the rear opening of the nasal aperture below the cranium)” (D. Brandon-Jones *in litt.* 2010; see also Pocock 1935) evident in comparison with specimens of both genera held at the Natural History Museum, London, by P. D. Jenkins and JWD, corroborated by D. Brandon-Jones’s examination of photographs. Its youth (its last molar is not yet erupting), gives it a superficial resemblance to *Trachypithecus* in some characters.

Reliable identification of *T. germaini* using local names is impossible in Lao PDR. Echoing similar problems elsewhere (Nadler *et al.* 2005), Duckworth *et al.* (2010) discussed the difficulties of this activity with colobines in Lao PDR. The name *taloung* in wide use in the southern half of Lao PDR is commonly associated with this species, but is probably best seen as meaning simply *Trachypithecus*: in the north of its area of use, around Phou Hinpoun National Protected Area (NPA) and perhaps Nam Kading NPA, it is apparently used for François’-group leaf monkey *T. (francoisi) ebenus* and perhaps *laotum* and Phayre’s leaf monkey (Duckworth *et al.* 2010), and the sometime perception of a tight linkage of *taloung* with the Indochinese silvered leaf monkey probably simply reflects that the latter is the only species of *Trachypithecus* known in Lao PDR south of Savannakhet province. In Lao PDR north of Vientiane, *khang* is generally used for gray leaf monkeys, which in that part of the country are all Phayre’s leaf monkeys, as far as is known (Timmins *et al.* *in press*). There are too few direct validations of local name usage for gray leaf monkeys to speculate on whether the transition from *taloung* in the south to *khang* in the north generally reflects that from Indochinese silvered to Phayre’s leaf monkey. Because *khang* also seems to be used locally for François’-group leaf monkey (Duckworth *et al.* 2010), it is quite likely that relative usage of *taloung* and *khang* says more about human language patterns than about monkey species distributions. A further complication is that in Thailand *khang*, pronounced with a longer “a” sound, and perhaps more intuitively written as “khaang”, is used as a general term for leaf monkeys. RB recorded apparent such usage in Lao PDR, around Dong Hua Sao NPA in 1997, during pre-survey discussions of mammals likely to live in the area; a few months later in this area, the animals in view were referred to as *taloung*. Such non-specific usage of *khang* is likely to become more frequent in Lao PDR, particularly among the urban sector receiving higher education, and reflecting greater use by Lao citizens of Thai wildlife books, Thai television and training institutes in Thailand.

Morphological notes

Descriptive notes relevant to identification come only from Xe Pian NPA, Bolaven Southwest pNPA and Dong Phou

Vieng NPA (records as detailed in the Appendix). In Xe Pian NPA, a young animal seen in December 2000 (Fig. 2) had already molted into a gray coat and its pattern fitted ‘*margarita*’, including the generally pale gray head, body and tail, with blackish patch on forehead, lower forelimbs and paws, and contrasting pale rings around the eyes. Of the animals seen in 1992, none of which allowed for a particularly good view, the faces were noted as “various shades of gray”, and one was suspected to have a paler underside to the body; on another the hands were darker than the arms. This mix does not clearly fit either ‘*margarita*’ or *T. germaini (sensu stricto)*. The larger group on 5 March 1993 had limbs black from the elbow/knee to the soles of feet and hands, and almost entirely black tails, with the body pelage gray, mixing silver, ashy and sooty; some had darker backs, some had dense guard hairs of silver. The foreheads were black, the facial skin darkish. These broadly fit ‘*margarita*’, although uniform black shanks are not consistent with information in Nadler *et al.* (2005) or later observations in Dong Phou Vieng NPA. The group seen in Bolaven Southwest pNPA on 17 April 1995 was of animals basically gray, darker on body than limbs, and thus consistent with nominate *T. germaini (sensu stricto)*, not ‘*margarita*’. In none of these field observations was any note made of the eyes having pale spectacles. All these notes were taken unaware of features to distinguish between these two forms of Indochinese silvered leaf monkey; none allows conclusive identification.

The morphology of the animals in Dong Phou Vieng NPA was checked carefully in August 2010 against features in Nadler *et al.* (2005). The animals were seen well (for about ten minutes spread across half an hour, at 150–200 feet range) and resembled closely ‘*margarita*’ as portrayed in Nadler *et al.* (2005; Figs 6 and 12). Specifically, the feet, hands and lower arms (but not the legs) were blackish, contrasting strongly with the gray body; this was much paler ventrally

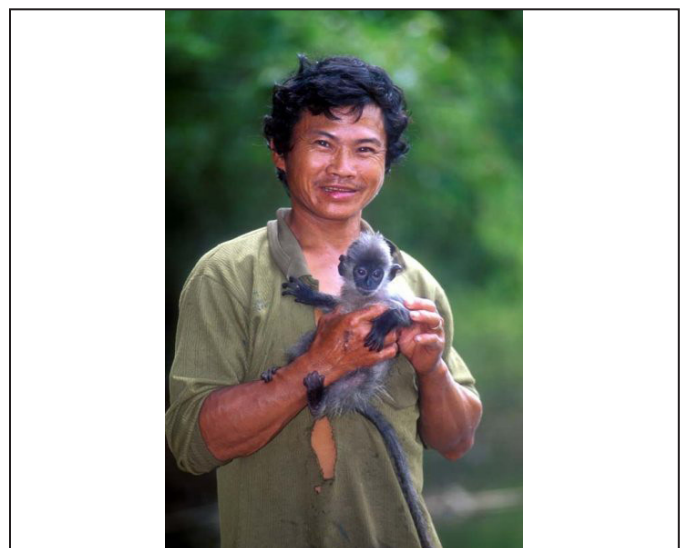


Figure 2. Captive young Indochinese silvered leaf monkey *Trachypithecus germaini*, showing characters of ‘*margarita*’, beside the Xe (= River) Pian, Xe Pian National Protected Area, December 2000. Photograph by G. Marris.

than dorsally, but the latter had abundant long silvery-white guard hairs giving it a muddy-gray overall tone. Blackish hair was also visible around the ears and sometimes on the forehead, although less prominently than in Nadler *et al.* (2005; Fig. 6): the long silvery hairs projecting horizontally from the forehead hid the black under-hair from some angles. These long hairs were also abundant sideways from the cheeks, down the nape, as an all-round beard and, with shorter and probably sparser hairs, as a moustache. There was, however, no hint of a vertical crest from the crown, in contrast to the luxuriant such growths depicted in Francis's (2008) drawings for both *margarita* and *germaini* (*sensu stricto*). The tail seemed darker on the upperside than under. The facial skin was blackish with distinct pale-fleshy colored spectacles, somewhat narrower than on Nadler *et al.* (2005: fig. 6); there was no pale skin around the mouth. Bare skin between the legs was also pale flesh in tone, as was the penis on the single male on which it was seen. Paw and limb characters were assessed on four adults, but the face critically on only one.

Habitat use

All Indochinese silvered leaf monkey records in Lao PDR with precise habitat information (given in the Appendix) were from forms of semi-evergreen forest or its degraded derivatives, in areas with uneven canopy (Fig. 3). Occupied areas were typically as patches and strips within a mosaic of more deciduous forest types, especially in riparian and other waterside situations. Where noted, occupied semi-evergreen forest was generally at the dry end of its spectrum, with a high deciduous tree component (as is the predominant form in plains-level locations in inland Indochina). Such forest grades into what some botanists consider a separate formation, mixed deciduous forest. In Cambodia many records come from habitat best described as mixed deciduous forest, but at the least deciduous end of its spectrum, and usually in association with wetland/riparian situations (RJT). Few if any records come



Figure 3. Habitat typical of *T. germaini*: level lowland forest with open canopy. Ban Vangsikeo, Dong Phou Vieng National Protected Area; 6 November 2007. Photograph by D. Van Gansberghe.

from the interior of extensive unbroken semi-evergreen forest, or from highly deciduous mixed deciduous forest. Despite high survey effort, none was found in deciduous dipterocarp forest. This latter is extensive in the species's Lao range, and various records were from semi-evergreen gallery forests running through such habitat (for example, the Xe Kong plains sector of Xe Pian NPA). The paucity of records from the very large (*c.* 1,500 km²), contiguous, "main block" of closed-canopy lowland semi-evergreen forest in Xe Pian NPA probably indicates, given the high survey effort (which in 1992–1993 was much more intensive than in the NPA's other habitats), a natural scarcity of such habitats unless in mosaic with more open forests. Indeed, the only main block record comes from the Houay Kua salt-licks, the largest area of broken-canopied and generally more open forest in the block. That these monkeys had previously been common but were almost hunted out from the main block by 1992 seems unlikely, given the large populations of similarly hunting-sensitive black giant squirrel *Ratufa bicolor* and gibbons in the main block on the 1992–1993 survey (Duckworth *et al.* 1994) and the number of leaf monkey sightings at that time in the more open and thus more easily hunted habitat of the NPA's Xe Kong plains.

Most Lao sightings came from within ½ km of waterbodies (11 of the 12 with adequate information, excluding repeat sightings of one troop; Appendix). This pattern is probably not an artifact, given the many records of other monkey species on these southern Lao surveys well away from rivers or pools (Timmins and Duckworth 1999, for douc; others not documented in detail yet). A number of records were, however, specifically noted as several kilometers from the nearest canopy-breaking stream (see site accounts). Speculations that this species is associated with rivers may well be true (particularly if narrow streams are included), but so far lack strong evidentiary basis in Lao PDR.

Most of the modern records come from lowland plains: the two highest confirmed sites are at only 550 m and 340 m (Appendix). The historical specimen location of Ban Phon (Table 1) is amid lowland habitat typical of modern records. Hunters' reports suggest this monkey can live up to 1,200 m or so in Xe Sap NPA (Appendix), but cannot be taken as proof of this. Even if gray leaf monkeys do occur in these hills, it cannot be discounted that they are Phayre's leaf monkeys unexpectedly far south. Indeed, J.-P. Pédrone (verbally 2010), long-term resident in Lao PDR, said that a leaf monkey was locally common on the Bolaven plateau, in the evergreen forest on the higher mountains, during 1956–1961 when he lived on a farm there. However, he recalled this monkey, which is not represented in his hunting photographs, as blue-gray in pelage and with prominent pale spectacles, characters better fitting Phayre's than the Indochinese silvered. Two 1990s claims of Indochinese silvered leaf monkeys from the Lao mountains were identification errors (see "Methods"), and while the identity of the historical "Bolaven" specimen as Indochinese silvered is not in doubt, it cannot be taken as evidence of highland occurrence. Even its rough altitude cannot be inferred, because the expedition in question in this

area purchased many animals from visiting people (Legendre 1932, 1936). At this time there was easy road access to the lowlands from Ban Thateng, their collection base, and the collection includes various other predominantly lowland species.

Several local informants in Nam Pa PFA in 2010 specifically contrasted to JWD and Chaynoy Sisomphone (Division of Forest Resource Conservation, Department of Forestry, Vientiane) the status of *taloung* with that of *thani* (= gibbon) and *khadeng* (= douc), saying that the latter two lived deep in the hill (semi-)evergreen forest (which is extensive) and thus many animals remained, whereas the former did not occupy such areas and so, because the plains were so encroached, was rare. Moreover, all four areas with multiple sightings (Dong Phou Vieng NPA, Bolaven Southwest pNPA, Xe Pian NPA and Dong Khanthung pNPA; Appendix) are or contain lowland regions with extensive gentle terrain.

The high 1990s survey effort in the closed (semi-)evergreen hill forests that comprise much of the NPA area in southern Lao PDR, gave many sightings of other monkeys (Timmins and Duckworth 1999, for red-shanked douc; not published in detail for the other species): the lack of records in those forests of the Indochinese silvered leaf monkey shows it to be at best very rare in them. In sum, in Lao PDR the species seems not generally to occupy rugged hill ranges.

Distribution

The Indochinese silvered leaf monkey inhabits Lao PDR from its southernmost extent north to at least the Xe Banghiang catchment (including north of the main stream) at 16°23'N, in Dong Phou Vieng NPA (Fig. 1). It remains to be clarified whether it occurs even further north in Lao PDR. Boonratana (1998b) listed the species from Nam Pouy (= Nam Phoun) NPA, far to the north (based on a sighting near Ban Mai of at least 22 individuals [at least six adult females with four clinging infants] on 10 March 1998, in mixed deciduous forest at *c.*18°30'N, 101°22'E; *c.*300 m above sea level; RB) but adjusted the identification to provisional in Duckworth *et al.* (1999); no notes on appearance were taken. There has been no subsequent documentation of gray leaf monkeys from this part of Lao PDR, and their specific identity remains unknown.

The Indochinese silvered leaf monkey's apparent northern limit in Vietnam is rather similar, at 16°37'N; the provenance of animals collected there is not certain, and the northernmost solid record is from only 14°30'N (Nadler *et al.* 2003, 2005). The northernmost Thai record traced by Geissmann *et al.* (2004) was at *c.*15°30'N, with a fair number of leaf monkey records in the next degree north being all of Phayre's.

The southern boundary of Lao PDR's other gray colobine, Phayre's leaf monkey, is also unclear. The most southerly and southeasterly certain records traced by Timmins *et al.* (in press; included on Fig. 1 here) are from Khet Dong Hieng (17°53'N, 101°34'E; Fooden 1976) and Nam Kading NPA (18°20'N, 104°25'E), but interview records suggest occurrence south to Hin Namno NPA (17°34'N, 105°48'E). There is, therefore, a wide swathe (almost 2° of latitude; Fig. 1) across

the central part of Lao PDR with no solid record of either gray leaf monkey species. If gray leaf monkeys do inhabit this area, they must be scarce, given the heavy direct survey effort in this part of the country, including remote areas with many direct sightings of other monkeys (for example, Timmins and Duckworth 1999). There is a similar latitudinal gap (at least 16°37'–17°53'N) between the recorded distribution of Indochinese silvered and Phayre's leaf monkeys in Vietnam (Fooden 1996; Nadler *et al.* 2003; Groves 2007), but apparently a very close approach in Thailand (Fooden 1976, Geissmann *et al.* 2004).

Fooden (1976) implied that this gap reflected general allopatry among *Trachypithecus*, and so because François'-group leaf monkey occurred in this latitudinal area, a gray leaf monkey might not be expected. However, this alone cannot explain the pattern, because away from karsts François'-group leaf monkey is highly localized, resulting in large tracts of central Lao forest today without any *Trachypithecus* records. In Lao PDR, this lacuna in gray leaf monkey distribution corresponds fairly closely to the distribution of red-shanked douc as portrayed in Timmins and Duckworth (1999). There is some co-occurrence of gray leaf monkeys with the douc at coarse geographic scale; at least Dong Phou Vieng, Xe Bang-Nouan and Dong Hua Sao NPAs hold both, but there are too few precise locality records to determine the extent of overlap in altitude and habitat, and no proof that it occurs at all. (In Cambodia there is, however, some overlap, with black-shanked douc *Pygathrix nigripes* occurring in Indochinese silvered leaf monkey's main habitat, but not, apparently, the leaf monkey extending into the douc's main habitat; for example, Timmins and Ou [2001].) Notably, in contrast to Vietnam and Lao PDR, red-shanked Douc does not occur in Thailand, where these two gray leaf monkey species' ranges abut.

The red-shanked douc has not been recorded down in the highly deciduous semi-evergreen forests of the Lao Mekong plain (Timmins and Duckworth 1999); it is plausible that these hold only gray leaf monkeys. However, plains forest north of the Bolaven plateau is now present only as small, degraded fragments from which most of the hunting-sensitive large vertebrates have been eradicated, and so it may never be possible to determine the natural distribution of primates there.

Abundance

Perhaps the most startling result concerning the Indochinese silvered leaf monkey in Lao PDR is the number of wildlife surveys within its range by experienced surveyors that did not record it, even though some lasted several weeks, and, usually, recorded other monkeys multiple times: Dong Phou Vieng NPA in 1997 (Appendix); the Dakchung plateau and Phou Ahyon in 1996 (Timmins and Vongkhamheng 1996a); Houay Pen PFA and adjacent protection forest in 2009 (Timmins 2009); Phou Xiang Thong NPA in 1996 (Evans *et al.* 1996a) and 1997 (Boonratana 1998a); Dong Hua Sao NPA in 1993 (Duckworth *et al.* 1994); Nam Pa PFA (then known as

Phou Kathong pNPA) in 1997 (Davidson *et al.* 1997); southern Attapu province in 1997 (Schaller 1997); Xe Kong plains of Xe Pian NPA in 2005 (M. R. Bezuijen 2006, *in litt.* 2010); and Dong Khanthung pNPA in 1996 (Timmins and Vongkhamheng 1996b). Moreover, P. Cunningham (*in litt.* 2010) never came across the species despite living throughout 1997 in the Siphandon (= “four-thousand islands”) stretch of the Mekong adjoining Cambodia: yet Mekong bank and island forest support fair numbers of these monkeys in the wilder stretches of the river downstream in Cambodia (Timmins 2008).

Four of the 11 surveys which did find these monkeys (Appendix) had records only of hunted animals: Dong Hua Sao NPA 1996, Xe Pian NPA 1997 and 2000, and Dong Khanthung pNPA 1998. Even on the seven surveys with direct field sightings (Appendix), only three (Bolaven Southwest pNPA in 1995, Xe Pian NPA in 1992–1993 and Dong Khanthung pNPA in 1997) generated more than one record. Although Xe Pian NPA in 1992–1993 had the most records of any survey, that there were only four encounters indicates extreme rarity in the areas surveyed, when taking into account the enormous survey effort (62 person-weeks; Timmins and Duckworth 1999: Table I).

By contrast, red-shanked doucs were seen regularly during many surveys comparable in search effort (Timmins and Duckworth 1999). In sum, this general paucity of sightings of the Indochinese silvered leaf monkey suggests that it is typically scarce in its Lao range.

Conservation status

The Indochinese silvered leaf monkey is probably the rarest and most threatened monkey in Lao PDR. No survey has found a population at even moderate density over a large area. This forest-dependent species seems to be naturally localized and, at best, very scarce on rugged terrain: it is implausible that it could have been severely reduced by hunting in areas where black giant squirrel, red-shanked douc and gibbons remain relatively numerous. By contrast, the numbers documented lower down the Mekong in Cambodia (Timmins and Ou 2001; Timmins 2008) suggest that the species would not naturally be scarce throughout the Lao plains, but that in suitable habitats there it had been heavily reduced by hunting even by the early 1990s. The large populations of red-shanked doucs surviving in Lao PDR reflect not active conservation management, but the persistence of large rugged tracts of hill forest into which access, particularly for carrying out heavy items like ordinary-value wildlife meat, is laborious (Timmins and Duckworth 1999). There is little similar natural protection for Indochinese silvered leaf monkey habitat in Lao PDR: rivers are much used for transport and fishing, and their plains are more sought for agriculture than are steep slopes (for example, Thewlis *et al.* 1998). Riparian habitat is naturally linear, and because most of Lao PDR is rugged, in any given area there is generally less plains habitat to start with than there is hill forest. The extensive plains in the southern half of Lao PDR (Fig. 1) have been heavily converted

for agriculture and areas not yet cleared are mostly deciduous dipterocarp forest, which does not support this monkey except along riparian semi-evergreen forests.

Hunting is intense throughout Lao PDR, including for arboreal diurnal primates (Duckworth 2008 and references therein). A recent wildlife trade study in Attapu province (Singh *et al.* 2006), based mostly on interview, concluded that this monkey is traded; the low numbers suspected by that study probably indicate rarity, not lack of buyer interest. Trade-driven hunting of general wildlife meat is likely to be a threat throughout its Lao range. This monkey is legally totally protected from hunting and trade throughout Lao PDR, but enforcement of the laws, particularly within the NPA system, is an urgent priority for it. There is no evidence of directed hunting for this species, but appropriate survey effort has been too low to be sure that it does not occur.

At Ban Vangsikeo (Dong Phou Vieng NPA), reflecting village traditional beliefs that the leaf monkeys are manifestations of dead people’s spirits, the villagers do not shoot them. This has allowed their survival in an area of generally heavy hunting. During 90 minutes in the area in August 2010, three shots were heard, one within 100 m of the troop of monkeys; the animal under observation at that time looked briefly towards the shot, but did not flee. The monkeys were fully aware of the observers at 150–200 feet range, and at ease. A closer approach was impossible, however, suggesting that attempts are sometimes made on them by catapult. The villagers reported to Steinmetz and Baird (1997) that they restricted their own use of resources to ensure that food and habitat remained for the monkeys.

It is possible that neighboring villages also extend such protection to leaf monkeys, but the extent to which this is protecting a viable population, rather than a few troops (so far, confirmed only one) near villages is not known. Similar reverence for gibbons is known from various villages in Lao PDR, but traditional beliefs are weakening and some villagers themselves point out that the beliefs give gibbons no long-term security, particularly because outsiders (settlers or itinerant hunters) usually do not share them (Duckworth 2008). It is likely that the same is true for areas in Lao PDR where *T. germaini* is currently revered.

Timmins (2009) concluded that the Indochinese silvered leaf monkey (alone among primates there, including red-shanked douc and a form of gibbon) had been extirpated from surveyed parts of Houay Pen PFA by overhunting. This may be an increasingly common situation in encroached and fragmented areas. Substantial areas (that is, blocks exceeding 500 km²) of forest on level or gentle lowland terrain and without a wide spread of villages across them survive in the species’ Lao range only in few places. Based on current patterns of habitat extent and connectivity, human settlement and access routes, the areas that may stand the best chance of conserving large contiguous populations of the species in Lao PDR are the hilly lowlands south of the Xe Kong, parts of which are within Nam Ghong Provincial Protected Area; the lava soils between Dong Hua Sao NPA, Xe Pian NPA and the

Bolaven plateau, and Dong Khanthung pNPA (Fig. 1). These lowland southern landscapes are already identified as nationally very high conservation priorities for a suite of hunting-sensitive birds and mammals (Duckworth *et al.* 2005 and references therein). The Indochinese silvered leaf monkey should be added to the list of focal species for conservation in these areas, and given high priority in management plans and interventions.

The leaf monkeys of Ban Vangsikeo came to outsiders' notice during assessment of ecotourism possibilities in Savannakhet province, and have since then been promoted by the provincial authorities as a tourist attraction, with some revenues going to the village (P. Chanxaiyavong verbally 2010, J. Johnston verbally 2010). In principle, applying a solid financial value to living monkeys could ease the inevitable crisis when village customary beliefs weaken, but tourism money alone may not secure their future, based on Brown's (2009) findings that it did not prevent rapid population decline of a small gibbon population in an area of North Lao PDR.

Setting the Lao populations in an international context is hindered by the lack of clarity on the number of species involved and their relative distributions (both in and outside Lao PDR). Cambodia supports the largest numbers of *T. germani* (*sensu lato*) globally; it is still widespread and numerous in some areas, especially the north-east and, perhaps, the lowland fringes of the Cardamom mountains in the south-west (Timmins and Ou 2001; Nadler *et al.* 2005; Timmins 2008; Coudrat *et al.* in press; Moody *et al.* in prep.). Populations in Vietnam and Thailand may be comparable to, or lower than, those in Lao PDR; in both countries, it apparently occurs now only as localized small populations (Nadler *et al.* 2003, 2005, 2007; Nabhitabhata and Charnard 2005).

If there are two Indochinese species of silvered leaf monkeys, Lao PDR may contain both. If the Mekong has significant bearing on their distribution, most of the Lao range will hold the eastern taxon, which globally may be extremely rare, and seriously threatened outside the Cambodian parts of its range. The small part of South Lao PDR west of the Mekong has no national protected area and monkeys there are probably now highly threatened (see discussion for pileated gibbon *Hylobates pileatus* in Duckworth 2008). Future wildlife and conservation surveys in Lao PDR south of 18°N should make every effort to assess gray leaf monkeys' status and to identify the form(s) present in each area. Rather little suitable survey (that based on species-focused direct diurnal observation) has occurred in southern Lao PDR in the 2000s (Duckworth 2008), so the present Lao status of the Indochinese silvered leaf monkey is unclear. That records from only one site after 2000 were traced here suggests that it may now be very rare. In this light, a critical analysis of the current status and future prospects of this monkey in Dong Phou Vieng NPA, paying particular attention to local beliefs (number of villages where cultural protection is strong, number of troops so protected, outlook for such beliefs) and to the government-administered tourism scheme, is urgently required. This is probably more important than investing resources in clarifying the overall

present status of these monkeys in Lao PDR, because time may be very short to ensure the Dong Phou Vieng NPA population's survival. Besides, the challenges operating at any other sites in the country which do hold these monkeys may be insuperable in the time available.

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Literature Cited

- Bergmans, W. 1995. On mammals from the People's Democratic Republic of Laos, mainly from Sekong Province and Hongsa special zone. *Z. Säugetierk.* 60: 286–306.
- Bezuijen, M. R. 2006. Incidental wetland bird observations from Attapu and Savannakhet provinces, Lao PDR, March–June 2005. *Forktail* 22: 49–56.
- Boonratana, R. 1998a. *Wildlife Survey Training at Dong Hua Sao and Phou Xiang Thong National Biodiversity Conservation Areas, Lao PDR*. IUCN / Lao–Swedish Forestry Programme, Vientiane.

- Boonratana, R. 1998b. *Field Management of Nam Poui and Phou Xang He National Biodiversity Conservation Areas*. IUCN, Vientiane.
- Boonratana, R. 2000. *A Rapid Participatory Assessment of Wildlife Diversity in the Dong Sithouane Production Forest*. FOMACOP, Department of Forestry, Vientiane.
- Boonratana, R., J. W. Duckworth, P. Phiapalath, J.-F. Reumaux and C. Sisomphane. In press. The white-handed gibbon *Hylobates lar* in Lao PDR. *Asian Primates Journal*.
- Brandon-Jones, D., A. A. Eudey, T. Geissmann, C. P. Groves, D. J. Melnick, J. C. Morales, M. Shekelle and C.-B. Stewart. 2004. Asian primate classification. *Int. J. Primatol.* 25: 97–164.
- Brockelman, W. Y. and R. Ali. 1987. Methods of surveying and sampling forest primate populations. In: *Primate Conservation in the Tropical Rain Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp.23–62. Alan R. Liss, New York.
- Brown, J. 2009. Status of the western black crested gibbon (*Nomascus concolor*) in the Nam Ha National Protected Area, Lao PDR. *Gibbon Journal* 5: 28–35.
- Coudrat, C., L. Rogers and K. A. I. Nekar. In press. Abundance of primates reveals Samkos Wildlife Sanctuary, Cardamom Mountains, southwest Cambodia as a priority area for their conservation. *Oryx*.
- Davidson, P., W. G. Robichaud, R. J. Tizard, C. Vongkhamheng and J. Wolstencroft. 1997. *A Wildlife and Habitat Survey of Dong Ampham NBCA and Phou Kathong Proposed NBCA, Attapu Province, Lao PDR*. Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Duckworth, J. W. 2008. *Preliminary Gibbon Status Review for Lao PDR 2008*. Fauna & Flora International, Hanoi.
- Duckworth, J. W., R. J. Timmins, R. C. M. Thewlis, T. D. Evans and G. Q. A. Anderson. 1994. Field observations of mammals in Laos, 1992–1993. *Nat. Hist. Bull. Siam Soc.* 42: 177–205.
- Duckworth, J. W., R. E. Salter and K. Khounboline (compilers). 1999. *Wildlife in Lao PDR: 1999 Status Report*. IUCN–The World Conservation Union / Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Duckworth, J. W., C. M. Poole, R. J. Tizard, J. L. Walston and R. J. Timmins. 2005. The jungle cat *Felis chaus* in Indochina: a threatened population of a widespread and adaptable species. *Biodiv. Conserv.* 14: 1263–1280.
- Duckworth, J. W., R. Boonratana, W. G. Robichaud and R. J. Timmins. 2010. A review of François’ leaf monkey *Trachypithecus francoisi (sensu lato)* in Lao PDR. *Primate Conserv.* (25): 61–79.
- Evans, T., A. J. Stones and R. C. M. Thewlis. 1996a. *A Wildlife and Habitat Survey of the Phou Xiang Thong National Biodiversity Conservation Area*. IUCN Biodiversity Conservation Project, Pakxe, Laos.
- Evans, T., A. J. Stones and R. C. M. Thewlis. 1996b. *A Wildlife and Habitat Survey of the Dong Hua Sao National Biodiversity Conservation Area*. IUCN Biodiversity Conservation Project, Pakxe, Laos.
- Evans, T. D., J. W. Duckworth and R. J. Timmins. 2000. Field observations of larger mammals in Laos, 1994–1995. *Mammalia* 64: 55–100.
- Fooden, J. 1976. Primates obtained in peninsular Thailand June–July, 1973, with notes on the distribution of continental Southeast Asian leaf-monkeys (*Presbytis*). *Primates* 17: 95–118.
- Fooden, J. 1996. Zoogeography of Vietnamese primates. *Int. J. Primatol.* 17: 845–899.
- Francis, C. M. 2008. *A Field Guide to the Mammals of Southeast Asia*. New Holland, London.
- Geissmann, T., C. P. Groves and C. Roos. 2004. The Tenasserim Lutung, *Trachypithecus barbei* (Blyth, 1847) (Primates: Cercopithecidae): description, of a live specimen, and a reassessment of phylogenetic affinities, taxonomic history, and distribution. *Contrib. Zool.* 73: 271–282.
- Groves, C. P. 2001. *Primate Taxonomy*. Smithsonian Institution Press, Washington, DC.
- Groves, C. P. 2005. Order Primates. In: *Mammal Species of the World*, 3rd edition, D. E. Wilson and D. M. Reeder (eds.), pp.111–184. Johns Hopkins University Press, Baltimore, MD.
- Groves, C. P. 2007. Speciation and biogeography of Vietnam’s primates. *Vietnam. J. Primatol.* 1(1): 27–40.
- [ICF] International Crane Foundation 1996. *Preliminary Report of a Survey of Sarus Cranes and Other Wildlife in the Dong Khanthung Area, Champasak Province, Lao PDR, August 1996*. Unpublished typescript.
- Legendre, S. J. 1932. Adventures on hunting trails of Indochina. *Natural History* 32: 481–496.
- Legendre, S. J. 1936. *Land of the White Parasol and the Million Elephants: A Journey Through the Jungles of Indochina*. Dodd, Mead & Co., New York.
- Meijaard, E. and C. P. Groves. 2006. The geography of mammals and rivers in mainland Southeast Asia. In: *Primate Biogeography: Prospects and Progress*, S. Lehman and J. G. Fleagle (eds.), pp.305–329. Springer Verlag, New York.
- Moody, J. E., An D, C. N. Z. Coudrat, T. Evans, T. Gray, M. Maltby, Men S., Nut M. H., H. O’Kelly, Pech B., Phan C., E. Pollard, H. Rainey, B. M. Rawson, Rours V., Song C. S., Tan S. and Thong S. In preparation. A summary of the conservation status, taxonomic assignment, and distribution of the Indochinese silvered langur, *Trachypithecus germaini (sensu lato)* in Cambodia.
- Nabhitabhata, J. and T. Chan-ard. 2005. *Thailand Red Data: Mammals, Reptiles and Amphibians*. Office of Natural Resources and Environmental Policy and Planning, Bangkok, Thailand.
- Nadler, T., F. Momberg, Nguyen X. D. and N. Lormée. 2003. *Vietnam Primate Conservation Status Review 2002. Part 2: Leaf Monkeys*. Fauna & Flora International Indochina Programme and Frankfurt Zoological Society, Hanoi.

- Nadler, T., L. Walter and C. Roos. 2005. Molecular evolution, systematics and distribution of the taxa within the silvered langur species group (*Trachypithecus [cristatus]*) in Southeast Asia. *Zool. Garten* NF 75: 238–247.
- Nadler, T., Vu N. T. and U. Streicher. 2007. Conservation status of Vietnamese primates. *Vietnam. J. Primatol.* 1(1): 7–26.
- Nadler, T., R. J. Timmins and M. Richardson. 2008. *Trachypithecus germaini*. In: IUCN 2009. *IUCN Red List of Threatened Species*. Version 2009.2. Website: <www.iucnredlist.org>. Accessed 27 February 2010.
- Osgood, W. H. 1932. Mammals of the Kelley–Roosevelts and Delacour Asiatic Expeditions. *Publ. Field Mus. Nat. Hist., Zool. Ser.* 18(10): 193–339.
- Pocock, R. I. 1935. The monkeys of the genus *Pithecus* and *Pygathrix* found to the east of the Bay of Bengal. *Proc. Zool. Soc. London* (1934): 895–961.
- Roos, C., T. Nadler and L. Walter. 2008. Mitochondrial phylogeny, taxonomy and biogeography of the silvered langur species group (*Trachypithecus cristatus*). *Mol. Phylogen. Evol.* 47: 629–636.
- Round, P. D. 1998. *Wildlife, Habitats and Priorities for Conservation in Dong Khanthung Proposed National Biodiversity Conservation Area, Champasak Province, Lao PDR*. Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Schaller, G. B. 1997. *A Preliminary Survey of Large Mammals in Two Areas of Attapeu Province, Laos, January 1997*. Unpublished typescript held at WCS Lao office.
- Showler, D. A., P. Davidson, C. Vongkhamheng and K. Salivong. 1998. *A Wildlife and Habitat Survey of the Southern Border of Xe Sap NBCA and the Dakchung Plateau, Xe Kong Province, Lao PDR*. Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Singh, S., R. Boonratana, M. Bezuijen and A. Phonvisay. 2006. *Trade in Natural Resources in Attapeu Province, Lao PDR: an Assessment of the Wildlife Trade*. TRAFFIC / Mekong Wetlands Biodiversity Conservation and Sustainable Use Programme, Vientiane.
- Steinmetz, R. 1998. A survey of habitats and mammals in Dong Phou Vieng National Biodiversity Conservation Area, Savannakhet Province, Lao PDR. In: *Dong Phou Vieng NBCA. Rapid and Participatory Biodiversity Assessment (Biorap) Final Report*, pp.22–43. WWF Thailand Project Office, Patumthani, Thailand.
- Steinmetz, R. and I. Baird. 1997. *Participatory Biodiversity Assessment of Dong Phou Vieng Protected Area, Savannakhet Province, Lao PDR*. WWF Thailand Project Office, Bangkok, Thailand.
- Steinmetz, R., T. Stones and T. Chan-ard. 1999. *An Ecological Survey of Habitats, Wildlife, and People in Xe Sap National Biodiversity Conservation Area, Saravan Province, Lao PDR*. Final report. WWF, Patumthani, Thailand.
- Steinmetz, R., R. J. Timmins and J. W. Duckworth. 2011. Distribution and conservation status of the Lao leaf monkey *Trachypithecus (francoisi) laotum*. *Int. J. Primatol.* 32: 587–604.
- Thewlis, R. M., R. J. Timmins, T. D. Evans and J. W. Duckworth. 1998. The conservation status of birds in Laos: a review of key species. *Bird Conserv. Int.* 8 (Suppl.) 1–159.
- Timmins, R. 2008. Large mammals. In: *Biological Surveys of the Mekong River Between Kratie and Stung Treng Towns, northeast Cambodia, 2006–2007*, M. R. Bezuijen, R. Timmins and Seng T. (eds), pp.81–90. WWF Greater Mekong – Cambodia Country Programme, Cambodia Fisheries Administration and Cambodia Forestry Administration, Phnom Penh.
- Timmins, R. J. 2009. *Biodiversity Significance and Management of the Phou Theung Forest Area, Xekong Province, Lao PDR*. WWF, Vientiane.
- Timmins, R. J. and J. W. Duckworth. 1999. Status and conservation of douc langurs (*Pygathrix nemaeus*) in Laos. *Int. J. Primatol.* 20: 469–489.
- Timmins, R. J. and J. W. Duckworth. 2008. Diurnal squirrels (Mammalia Rodentia Sciuridae) in Lao PDR: distribution, status and conservation. *Trop. Zool.* 21: 11–56.
- Timmins, R. J. and Men S. 1998. *A Wildlife Survey of the Tonle San and Tonle Srepok River Basins in North-eastern Cambodia*. Fauna and Flora International and Wildlife Protection Office, Hanoi and Phnom Penh.
- Timmins, R. J. and Ou R. 2001. *The Importance of Phnom Prich Wildlife Sanctuary and Adjacent Areas for the Conservation of Tigers and Other Key Species*. WWF, Phnom Penh.
- Timmins, R. J. and C. Vongkhamheng. 1996a. *A Preliminary Wildlife and Habitat Survey of Xe Sap National Biodiversity Conservation Area and Mountains to the South, Saravan Province, Lao PDR*. Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Timmins, R. J. and C. Vongkhamheng. 1996b. *A Preliminary Wildlife and Habitat Survey of the Dong Khanthung area, Champasak Province, Lao PDR*. Wildlife Conservation Society / Centre for Protected Areas and Watershed Management, Vientiane.
- Timmins, R. J., J. W. Duckworth and W. G. Robichaud. In press. The conservation status of Phayre’s leaf monkey *Trachypithecus phayrei* in Lao PDR. *Primate Conserv.* (26).
- Vongkhamheng, C. and S. Phirasack. 2002. *Eld’s deer (Cervus eldi [sic] siamensis) Surveys in Chonbuly District, Savannakhet Province, Lao PDR*. Wildlife Conservation Society, Vientiane.
- Wolstencroft, J. 1998. *An Assessment of the Natural Heritage Value Including Tourism Potential of the Dong Khanthung plains (a Proposed National Biodiversity Conservation Area) in the Xe Lampao Catchment of Champasak Province, Southwesternmost Lao PDR*. Unpublished typescript held at WCS Lao office.

Appendix: site accounts

Dong Phou Vieng NPA: a group of at least eight, including one half-length youngster, was seen on 30 August 2010, 15 minutes' walk from Ban Vangsikeo (16°23'N, 106°02'E; 140 m; local name Ban Vongsikeo), in the patches and strips of semi-evergreen forest amid deciduous forest crossed by many small streams, at least one wide enough to break the canopy. Gray leaf monkeys were also seen here, within 20 minutes of entering the forest (locally called "Dong Sakee Sacred Forest"), on five of eight visits between December 1999 and June 2004 (J. Johnston *in litt.* 2010) and on 6 November 2007 (D. Van Gansberghe *in litt.* 2007). Most recently, in early 2011, J. Johnston (*in litt.* 2011) saw a single group estimated to comprise *c.*40 animals (including at least three golden infants) in this forest. At all four villages in the NPA interviewed in a 1997 survey, *taloung* was reported to be severely depleted, but less so in Ban Vangsikeo where numbers were assessed as half of those 10–30 years previously; the other villages estimated the current population to be, respectively, only 20%, 10% and 5% of earlier (Steinmetz and Baird 1997). S. Thonongto, the observer of direct sightings of silvered leaf monkey in the NPA given in Steinmetz (1998) reported (verbally 2010) that he saw the animals (twice) so poorly that although they were certainly colobines, even douc could not be ruled out; the identification was an assumption based on range in Thailand.

Xe Bang-Nouan NPA: one on Phou Satung in semi-evergreen forest (amid a landscape at the extreme dry end of the spectrum of semi-evergreen, widely verging on mixed deciduous) of the central hills (15°53'N, 105°53'E; 550 m) on 15 June 1994, several kilometers from the nearest large river (Evans *et al.* 2000, where altitude given in error as 650 m; RJT).

Dong Hua Sao NPA: [two hunters along the Houay Takit (*c.*15°04'N, 106°01'E; 220 m, but within a few kilometers rising to 1,000 m) during 31 January – 6 February 1996 were carrying two colobine corpses without hair, which they called *taloung*; they indicated that they came from the nearby hills (Evans *et al.* 1996b). No parts were salvaged and the identification is kept provisional because red-shanked douc also occurs in this area]. RB watched a group totaling seven or more (including at least one adult male, two adult females, two adult-sized individuals and one juvenile) over 10:15–11:34 on 18 December 1997 near the Houay Touay-Gnai (14°59'40"N, 106°08'02"E; *c.*340 m) in lowland semi-evergreen forest, about 50 m from the Houay Haet when first found (Boonratana 1998a).

Bolaven Southwest proposed NPA (pNPA): three troops, of at least 20, *c.*15 and 25 animals, were seen south of Ban Nonghin and west of the Xe Pian in partly logged semi-evergreen forest centered on 14°50'N, 106°26'E (260 m) on 17 and 19 April 1995. Several kilometers from the nearest large river, all were within 300 m of waterbodies; two groups were seen drinking at pools (Nong Hoi and Nong Gnai) amid dense forest (Evans *et al.* 2000; TDE).

[*Dong Ampham NPA*: a gray leaf monkey was glimpsed in the tall canopy of old-growth semi-evergreen forest, near the east bank of the Xe Kaman (14°56'N, 107°08'E; *c.*170 m) *c.*4 km downstream of the Xe Kaman 1 dam site in January 1997; villagers reported that the animal, *taloung*, was scarce and rarely seen (Davidson *et al.* 1997).]

[*Nam Ghong Provincial Protected Area, Attapu province*: a small group of rapidly-fleeing animals believed to be gray leaf monkeys was seen in evergreen forest at *c.*14°30'N, 106°31'E (very roughly, *c.*100 m; in Cambodia according to the national boundary on the RDPL SGE 1: 100,000 map boundary (as followed for Fig. 1), but said by villagers at time of survey to be in Lao PDR) on 5 March 1998 (P. Fernando *in litt.* 2010). (This record was erroneously presented as confirmed in Duckworth *et al.* [1999], based on a draft interim survey report which referred in error to observations of the species in two survey sectors.)]

Xe Pian NPA: a group of at least eight was seen at the Houay Kua salt-lick (*c.*14°33'N, 106°14'E; 140 m) on 25 December 1992, an area of short, open, semi-evergreen forest well supplied with pools and *c.*1½ km from the nearest canopy-breaking stream. On 5 March 1993, two groups were seen along the Xe Pian upstream of its confluence with the Xe Khampho, one of *c.*20, 500 m up (west bank; 14°31'N, 106°21'E; 80 m), and one of at least five, several kilometers up (east bank; 14°31'N, 106°22'E; 80 m), the latter in highly degraded secondary riverside growth (Duckworth *et al.* 1994; TDE). Details on a fourth record from this survey cannot now be traced but it was assessed as valid at the time and came from the same area along the Xe Pian as did the other records. A leaf monkey skull, presumed this species, was found on a January–February 1997 survey along the Houay Kua (140 m) (M. F. Robinson *in litt.* 1999); there were no field sightings and while survey style (focus on signs rather than sightings, large field teams) was not optimal for these monkeys, they could at best have been rare in the areas surveyed. Village reports at that time suggested they were most common deep in the southern part of the main block of semi-evergreen forest (RS), a habitat association at variance with all individual records here traced. [Guides meeting R. Tizard (*in litt.* 1998) reportedly saw a small group of gray leaf monkeys near Ban Sompoy (14°34'N, 106°28'E, 80 m) on 2 March 1998.]. MKP, who never observed the species in the field on multiple forays into the NPA in 2000–2001, saw a young captive along the Xe Pian between Ban Phonsaat and its confluence with the Xe Khampho on 19 or 20 December 2000 (Fig. 2). It was held by a Vietnamese who said he had been at his river camp for a month already, and that he purchased the monkey from a passer-by. It is unlikely that anyone would take a young leaf monkey caught far afield into this stretch of river to sell, but highly plausible that they would be taking one caught in the general area out for sale. Over 31 May – 4 June 2005, Bezuijen (2006) undertook several days of boat-based river survey along the same rivers as providing the 1993–2000 records and did not find the species (M. R. Bezuijen *in litt.* 2010).

Dong Khanthung pNPA: [in 1996 at least one individual identified by guides as a gray leaf monkey was heard along the Houay Phak (c.14°10'N, 105°32'E, 100 m) on 14 August 1996 (W. G. Robichaud in ICF 1996).] A group of 7–11 was frequently encountered in gallery forest along the Houay Ongvin (=Houay Vian; c.14°12'N, 105°30'E; 110 m) in March–April 1997, and another group was found c.6 km further along the river (Wolstencroft 1998). [A skinned, dried carcass, with the tail removed, but thought to be this species, was seen hanging on a gibbet at a villager's house at Nong Soumhong (14°17'N, 105°41'E; 110 m) on 27 February (Round 1998).]

Areas where monkeys plausibly this species have been reported by local people, but there are no field records: in Xonboulouy Eld's Deer Sanctuary (Muang [= District of] Xonboulouy, Savannakhet province) *taloung* was reported in June 2002 in the south (adjacent to Dong Sithouan Production Forest Area (PFA) and to the north-east, adjacent to Dong Kapho PFA (Vongkhamheng and Phirasack 2002); however, conservation staff of the Savannakhet Provincial Agriculture and Forestry Office reported (verbally) in August 2010 that they did not consider that this sanctuary still held *taloung*. In Dong Sithouan PFA itself, *taloung* was reported in January 2000 from 20 villages interviewed, nearly all specifying that it lived around Phou Mali (16°04'N, 105°55'E; rising to nearly 800 m) and Dong Aa Chien (immediately south of Phou Mali, mostly at 300–600 m) (Boonratana 2000; RB). In Houay Pen PFA, Xekong province, *taloung* was reported, from habitats that resemble known Lao sites, to have occurred in the past, but no recent sightings could be traced (Timmins 2009). In Nam Pa PFA, Attapu province, in early 2010, *taloung* was said to persist only in a few areas and now to be very rare (JWD). All the foregoing are predominantly, or contain, extensive lowland areas. In Xe Sap NPA, *taloung*, described as gray and long-tailed, was reported by several villages around the southern border in early 1998 (Showler *et al.* 1998) and a gray leaf monkey (no local name noted) was reported around the Phou Leng area (southwest corner of the NPA, in areas at 560–1,080 m; big streams but no fringing tall forest) in early 1999, when some informants said it had become locally extinct in the past decade, some that it had declined dramatically. People from the other three parts of the NPA interviewed either knew of no such animal, or knew it and said it had always been absent from their area (Steinmetz *et al.* 1999). All the foregoing areas are south of Dong Phou Vieng NPA. In addition, Boonratana (1998b) received local reports in Phou Xang He NPA, some 50 km north of Ban Vangsikeo (Dong Phou Vieng NPA; the northernmost confirmed Lao locality for the species), that he attributed to the species. Neither his survey nor an earlier one (Duckworth *et al.* 1994) resulted in any records of this species, although unidentified leaf monkeys are apparently present (Duckworth *et al.* 2010).

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Note added in proof. M. R. Bezuijen (*in litt.* 2011) pointed out that one early explorer's text refers to *T. germaini* along the Lao-Thai Mekong, although without specifying which bank the animals were on: Garnier (1885: p.218) wrote "while we proceeded [by boat, upstream] beside the [Mekong] bank, a band of small, bizarrely colored monkeys descended from branch to branch to the ground and amused us with their skipping and gamboling. They have gray fur and black faces; a long white beard runs from one ear to the other." This sighting took place some way (probably within one or two days' non-mechanical boat-ride) upstream of the Khemmarat rapids (16°02'N, 105°13'E; 150 m above sea level), in the late 1860s. Garnier wrote that "above these last rapids the river [Mekong] becomes magnificent again. It runs, two thousand meters wide, in a vast plain...", and the monkeys were seen some way into this stretch, perhaps about 20–30 km north of Khemmarat. The topography is perfectly comparable to the confirmed Lao localities. The morphological description fits *T. germaini* very well; the only other taxon it could suggest is the form of François'-group leaf monkey *T. (f.) laotum*, but this is almost impossible on habitat grounds. The (imprecise) location may be similar in latitude to the northernmost confirmed Lao record.

Reference:

Garnier, F. 1885. *Further Travels in Laos and in Yunnan. The Mekong Exploration Commission report (1866–1868)*, vol. 2. Translated by W. E. J. Tips (1996) from original excerpts published in various issues of *Le Tour du Monde* 1869–1871 and in F. Garnier (1885. *Voyage d'Exploration en Indo-Chine*. Hachette & Cie, Paris). White Lotus Press, Bangkok, Thailand.