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The Distribution and Present Status of Primates in the Northern Region of Lao PDR

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ABSTRACT.– In the northern Lao PDR, threats to the future existence and well-being of non-human primates are increasing as forests are extensively cut open and the cycle of shifting-culture has become shorter so as even the secondary forests cannot recover. We therefore surveyed the distribution and status of primate fauna in the northern region of Lao PDR in May 2006. Big and small lorises (*Nycticebus bengalensis* and *N. pygmaeus*), three species of macaques (*Macaca arctoides*, *M. assamensis*, and *M. mulatta*), and a species of langur (*Trachypithecus phayrei*) were reported at approximately half of all sites surveyed. Gibbons, though not identified to species, were reported at one third of all sites, and in two National Biodiversity Conservation Areas (NBCAs) *Nomascus concolor* and *N. leucogenys* were distributed. Pig-tailed macaques (*M. nemestrina leonina*), although previously suspected to be absent in the northern region, were in fact found to be present at 15% of all the surveyed sites. Francois's langur (*T. francoisi*) was reported with certainty only at the Phou Loei NBCA.

KEY WORDS: Primates, distribution, present status, conservation

INTRODUCTION

Lao PDR (People's Democratic Republic) is situated at the center of the Indochina Peninsula, and ranges from 13° 54' to 22° 31' N in latitude and from 100° 05' to 107° 42' E in longitude. The country has an area of 236,800 km^2 with an undulating hilly topography, and harbors a large diversity of wildlife. Recently, two new mammal species were discovered in Lao PDR; the Saola (*Pseudoryx nghetinhensis*, Dung et al. 1993) and the "Kha-nyou", a rock-rat (*Laonastes aenigmamus*, Jenkins et al., 2005) of the new family Laonastidae. However, whilst primate fauna also appears diverse, there are still no sufficiently reliable or extensive surveys, especially in the northern region.

The physiography of northern Lao PDR is undulating highlands with altitudes from 500 to 2,000 m above sea level (a.s.l.). From a zoogeographical viewpoint, Lao PDR is situated in the Indochinese subdivision of the Indo Malayan Realm

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(Corbet and Hill, 1992). The fauna of Lao PDR are composed of elements of influx from neighboring countries belonging to different zoogeographical regions and this is especially true in the northern region of Lao PDR which is adjacent to Vietnam and southern China. The details of dispersal and migration history of primates presently deployed in the northern region have not been delineated.

The primate populations in the northern regions in Lao PDR are considered to have been impoverished much more than those in other regions. With a high rate of increase in the human population (ca. 2.5%, 5.6 million people in 2005, http://www.state.gov/r/pa/ei/bgn/2770.htm) and with the economical development relying heavily upon the natural resources, the destruction of forested lands and other unmanaged habitats are increasing significantly. This extensive deforestation is especially true for the northern highlands, where there is little forest cover north of 19° 30' N, and overall is much lower than the reported national average of 40% forested area in 1996 (Duckworth et al., 1999). The distribution and present status of primates in this region has not been surveyed, and thus the current and future impact of human activities on primates has not been evaluated in this once important biodiversity hotspot.

Although five out of twenty National Biodiversity Conservation Areas (NBCAs, and another 11 are proposed) were established in this region, their wildlife (especially primates) has been poorly assessed even compared to those in the central and southern NBCAs. Moreover, the areas outside of the NBCAs, which cover a significant area of the northeastern region, have not been assessed for primates either.

Here we report the result of a survey on the distribution and present status of primates in the northern region of Lao PDR, carried out in May 2006

LOCALITIES OF SURVEY AND METHODS

Round-Travel Survey

We travelled 1,450 km by car around the northern region of Lao PDR from 22nd to 31st of May 2006. The region for survey ranges from 20° 03' to 21°54' N and from 104° 02' to 100° 48' E (Fig. 1), including Houa Phan, Luang Prabang, Phongsali, Oudom Xay and Luang Nam Tha Provinces. We interviewed local residents at 46 sites (Table 1) along National Road Nos. 6, 1, 4, 13 and 3, and Provincial Roads as indicated (Fig. 2). We also collected information from the Agriculture and Forestry Department officers (Provincial and District). Nam Xam, Nam Et, Phou Loei, Phou Daen Din and Nam Ha National Biodiversity Conservation Areas (NBCAs) are situated in this region (Fig. 1), and we interviewed wildlife management officers at each of these NBCAs.

The northern region is heavily undulating with mountains and valleys. There are tributaries of the Mekong River to the south and west of the mountains at the Nam Et and Phou Loei NBCAs, and several rivers flow to Vietnam to the east of these mountains. The altitudes of villages we surveyed ranged from 397 m to 1,568 m a.s.l. (834 m in average for 46 sites, Table 1). The main roads, which we used, have been constructed to connect between the major cities.

The village people whom we interviewed expressed distance in terms of walking, such as 'close to village', 'within

TABLE 1. Sites of Interview.

Site-No	Date	Village (Ban)	District	Province	Latitude	Longitude	Altitude (m)
1	23-May-06	Lak 12	Xam Neua	Houa Phanh	20.37	104.00	1,273
2	23-May-06	Na Keng	Hua Mouang	Houa Phanh	20.18	103.93	1,151
3	23-May-06	Kang Khao	Hua Mouang	Houa Phanh	20.17	103.82	1,253
4	23-May-06	PhouLao	Hua Mouang	Houa Phanh	20.07	103.71	964
5	23-May-06	Soblab	Hua Mouang	Houa Phanh	20.05	103.61	964
6	23-May-06	Keo Lom	Viengthong	Houa Phanh	20.08	103.46	1,549
7	23-May-06	Keo Lom	Viengthong	Houa Phanh	20.08	103.44	1,568
8	24-May-06	Nam Sat	Viengthong	Luang Prabang	20.11	103.34	791
9	24-May-06	Sakok	Viengthong	Luang Prabang	20.19	103.20	767
10	24-May-06	Don Keo	Vieng Khan	Luang Prabang	20.32	103.02	823
11	24-May-06	Phou Titpheung	Mouang Ngoi	Luang Prabang	20.52	102.79	868
12	24-May-06	Nong Ian	Mouang Ngoi	Luang Prabang	20.54	102.65	881
13	25-May-06	Pak Mong	Nam Bak	Luang Prabang	20.58	102.41	397
14	25-May-06	Mak Phouk Tai	Nam Bak	Luang Prabang	20.58	102.28	1,093
15	25-May-06	Song Ja	Nam Bak	Luang Prabang	20.57	102.25	1,263
16	25-May-06	Pongving	Mouag Xay	Oudom Xxay	20.57	102.16	836
17	25-May-06	Phonesavat	Mouag Xay	Oudom Xay	20.59	102.09	1,092
18	25-May-06	Nagngeo	Mouag Xay	Oudom Xay	20.62	102.00	829
19	25-May-06	Houay Phae	Mouang La	Oudom Xay	20.91	102.19	444
20	27-May-06	Bouamphon	Mouang Khoua	Phongsali	21.13	102.14	694
21	27-May-06	Nam Li	Samphanh	Phongsali	21.21	102.11	758
22	27-May-06	Laosen mai	Boun Tai	Phongsali	21.25	102.07	952
23	27-May-06	Sano mai	Boun Tai	Phongsali	21.35	102.05	1,019
24	27-May-06	Sing Xai	Boun Tai	Phongsali	21.43	101.93	607
25	27-May-06	Wang Doi	Boun Nuea	Phongsali	21.45	101.87	652
26	27-May-06	Nam Phae	Boun Nuea	Phongsali	21.50	101.87	699
27	27-May-06	Yo	Boun Nuea	Phongsali	21.51	101.85	695
28	27-May-06	Sin Xai	Boun Nuea	Phongsali	21.55	101.88	998
29	26-May-06	ChiCho	Phongsali	Phongsali	21.60	101.99	1,145
30	26-May-06	Hat Sa	Phongsali	Phongsali	21.74	102.20	430
31	27-May-06	Houay Nyeung	Boun Nuea	Phongsali	21.77	101.87	1,010
32	27-May-06	Ngay Neua	Boun Nuea	Phongsali	21.84	101.90	734
33	29-May-06	Chaleunsouk	Nam Tha	Luang Nam Tha	20.88	101.34	701
34	29-May-06	Thasae (=Nam Ha)	Nam Tha	Luang Nam Tha	20.83	101.28	623
35	29-May-06	Khuasoung	Nam Tha	Luang Nam Tha	20.80	101.25	642
36	29-May-06	Palang	Vieng Phouka	Luang Nam Tha	20.78	101.24	675
37	29-May-06	Talong	Vieng Phouka	Luang Nam Tha	20.78	101.22	696
38	29-May-06	Nam Ou	Vieng Phouka	Luang Nam Tha	20.71	101.12	694
39	30-May-06	Phim Ho		Luang Nam Tha	21.08	101.40	618
40	30-May-06	Nam Leuang	Nam Tha	Luang Nam Tha	21.08	101.39	636
41	30-May-06	Nam Makkao	Nam Tha	Luang Nam Tha	21.13	101.35	669
42	30-May-06	Sop Oe	Nam Tha	Luang Nam Tha	21.14	101.19	727
43	30-May-06	Namkang mai	Mouang Sing	Luang Nam Tha	21.09	101.08	712
44	30-May-06	Nam Ma	Long	Luang Nam Tha	21.02	101.04	653
45	30-May-06	Sivilay	Long	Luang Nam Tha	21.00	100.93	570
46	30-May-06	Kang Kao	Long	Luang Nam Tha	21.00	100.92	565
*	23-May-06	Xam Neua	Provincial	Houa Phan	20.41	104.05	+
*	26-May-06	Phongsali	Provincial	Phongsali	21.68	102.09	1,367
*	26-May-06	Boun Neua	District	Phongsali	21.65	101.91	943
*	27-May-06	Boun Tai	Restaurant	Phongsali	21.39	101.98	596
*	29-May-06	Luang Nma Tha	Provincial	Luang Nam Tha	21.01	101.40	584
*	30-May-06	Muang Sing	District	Luang Nam Tha	21.19	101.15	649
*	30-May-06	Muang Long	District	Luang Nam Tha	20.96	100.82	516

+Altidude data was not measured.
*** Interviews not on site (villages) but at the Agriculture and Forestry Department Office and other places**

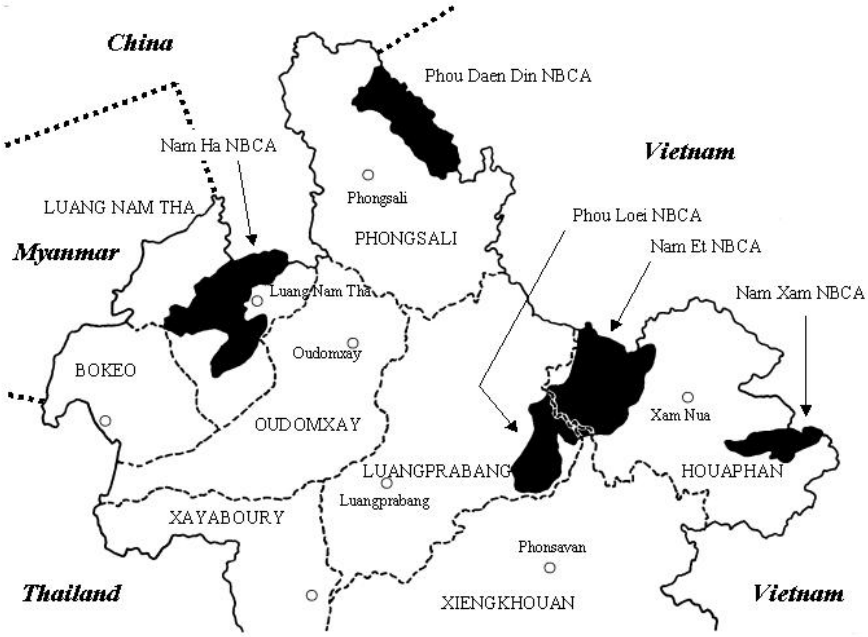

FIGURE 1. Northern regions of Lao PDR. The round-travel survey was carried out in Houa Phan, Luang Prabang, Oudom Xay, Phongsali, and Luang Nam Tha Provinces. The painted parts are National Biodiversity Conservation Areas (NBCAs).

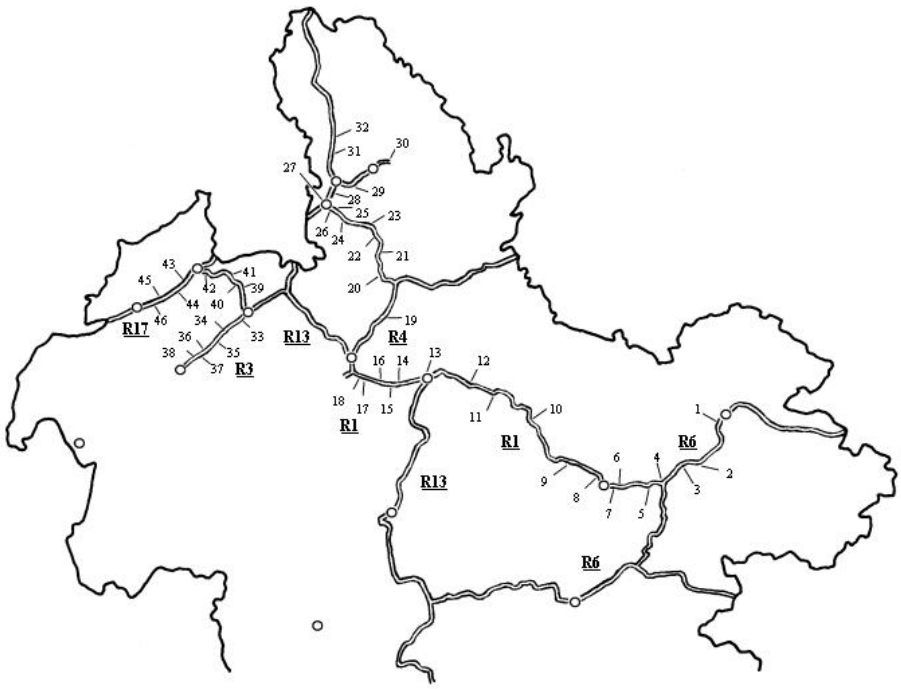

FIGURE 2. The roads along which we carried out the round-travel survey, and the sites of interview. See Table 1 for the address of site by the site No.

2-3 hrs. walking', 'within a half-day's walk', 'one-day's walk', or 'several days' walk'. However, the majority of their activities appear to occur within a half-day's walking range and, therefore, they would principally encounter primates in an area within a radius of about 15 km from the village. Based on this, we determined the frequency of interview.

Items of Interview

We asked the address of the site, village, district, and province and additionally recorded each location by GPS (Global Positioning System). The items we asked and recorded were: the name of interviewee, the primate species present in the village area or its vicinity, the characteristics of each of the primates, the density or number of primates, the place or microhabitat where primates were found, what agricultural products the villagers produced, what damage to crops was caused by primates, whether they hunted or killed primates, whether they eat primates or not, the local names of primates, the size of the village in terms of both the numbers of households and the population, the history of village (when it was established, and where the people composing the present village came from), if there are any recent changes in the subsistence pattern, the ethnicity of people within the village (the majority of village peoples in the northern region are of different ethnicity than Lao people), and their beliefs and practices with respect to primates.

The primate fauna that were considered to reside within the northern region of Lao PDR include Lorisids (lorises), Cercopithecids (macaques and langurs), and Hylobatids (gibbons, see Appendix I). For specifying primates to the species level, we used pictures from brochures and posters. In addition to these visual materials, whilst trying not to lead or coax answers, we verbally asked about the morphological and behavioral traits to specify species, for example, the crown hair crest, body color pattern, neonatal body color, vocal sounds, behavioral patterns (aggressive to humans or ready to run-away), and so on.

We tried to interview the people who knew or were likely to know the most about wildlife and the forest in each village, those known to be well informed and good at discrimination of wildlife. As an initial start we, therefore, tried to interview the head of each village or his representatives.

Observation of pet primates

We actively enquired about and remained perceptive to hearing about the location of pet primates in each village and visited the home of all pet primates we found out about. We interviewed the pet-owner, observed the primates, and collected samples for DNA analysis when permitted (hairs, oral epithelium, or faeces). We interviewed the person who appeared to know the most subtle information on the pet (typically the pet-owner or his/her parents), for the origin of the primates, the way they obtained the primates, and if possible the name of hunter, and the way the primates were captured. We also asked whether living primates are traded internally or with other villages or not. We measured crown-rump length and tail length using a tape; recorded the pelage pattern, hair pattern (the direction of crown hair, crest or whorl at the crown or at the cheek), and other morphological characteristics.

RESULTS

Primates reported in the interview

We interviewed at 46 sites in Houa Phan, Luang Prabang, Phongsali, Oudom Xay, and Luang Nam Tha Provinces (Tables 1 and 2, Figs.1 and 2). The majority of interviewees reported precise information.

Ten species of primates were reported as follows: big and small lorises (*Nycticebus bengalensis* and *N. pygmaeus*), four species of macaques (*Macaca mulatta*, *M. nemestrina leonina*, *M. assamensis*, and *M. arctoides*), two species (or forms) of langurs (*Trachypithecus phayrei* and *T. francoisi*), and two species of gibbons (*Nomascus concolor* and *N. leucogenys*). Although we asked about the size of lorises, the replies did not convincingly ascertain the occurrence of the intermediate loris beyond doubt. Likewise after looking at the brochure, interviewees claimed that silvered langurs were present, but they failed to provide any other characters specific to silvered langurs other than the pelage color, and thus their determination remains equivocal to dubious. Certainly, considering previous reports on distribution, we cannot exclude the Phayre's langur which also has grayish pelage and insignificant pale colored "ring" around the eyes. Gibbons could not be specified to species in all sites but one, because too few morphological and pelage traits were reported. Indeed, typically interviewees noticed gibbons only by their sounds.

The frequency of distribution of Primates

We compared the frequency of primates between three localities as follows: (i) Houa Phan – Luang Prabang – Oudom Xay Provinces (hereafter abbreviated as HLO): along the National route Nos. 6, 1 and a part of 4 (site Nos. 1-19 in Tables 1 and 2 and Fig. 2), (ii) Phongsali Province (PS): a part of the National route 4 and Provincial roads (site Nos. 20-32), and (iii) Luang

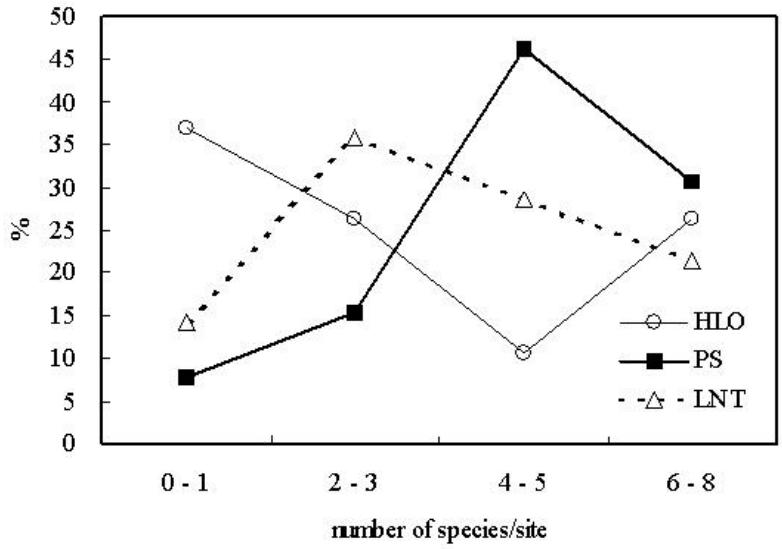

FIGURE 3. Frequencies (%) of sites according to the number of species found in a site. HLO, PS, and LNT stand for Houa Phan – Luang Prabang – Oudom Xay (n=19), Phongsali (n=13), and Luang Nam Tha localities (n=14).

Nam Tha Province (LNT): along the National route Nos. 3 and 17 (site Nos. 33-46).

Within these three localities PS revealed the highest frequencies of primates with 53.8% of sites per species on average (Table 3) and an average of 4.85 species per site. The average numbers of species per site were 3.50 in LNT and 2.84 in HLO. As shown in Figure 3, 4-5 and 6-8 primate species per site were the highest and second highest frequency, respectively, at PS. In contrast, the most frequent class in HLO was 0-1 species per site, though the frequency of sites with 6-8 primate species was as high as that for 2-3 species per site (27%). This suggests that there are both considerably degraded and well-preserved habitats within the HLO region. Of the three northern Lao regions assayed, the LNT region was intermediate with 2-3 and 4-5 species per site being the highest and second highest frequencies, respectively.

The distribution patterns of primates by species are summarised in Figs. 4-9. The altitudinal distribution displays no difference between species. The median of altitude is about 800 m a.s.l., which coincides with the average altitude of 46 interview sites. At the highest site (1,568 m a.s.l., Keo Lom village, Vieng Thong District, Houa Phan Province), Assamese and stump-tailed macaques, Phayre's langur, and pygmy lorises were reported. Thus, primates appear to be distributed at higher elevations than was previously reported (Duckworth et al., 1999). For example, rhesus macaques were previously reported to be distributed in areas lower than 600 m a.s.l. and exceptionally to Nam Et NBCA at 850 m a.s.l.

Comparisons of the reported occurrence frequencies between primate species (Table 3, Figs 4-9) and the characteristics of primates revealed pygmy loris that was the most frequently reported primate in the interview, with 27 sites out of 46 positive sites (Table 3, Fig. 4). The next most frequent primate was the big lorises with positive reports from 22/46 sites, although in the village where one species of lorises was reported it remains probable that people misidentified big lorises as "pygmy" simply because all lorises are relatively small. That said, however, we asked villagers about the size of lorises to check that their answers were correct.

Rhesus (Fig. 5) and stump-tailed macaques (Fig. 7) were the most frequently reported macaques, with 25 and 24 positive sites, respectively. The frequency of sites positive for Assamese macaques (Fig. 6) was a little lower (22 sites from the 46), but they were common in two (HWO and LNT) of the three districts, with relatively less frequent reports in PS. Assamese macaques were reported more frequently in LNT than in PS. On the other hand, rhesus and stump-tailed macaques were found more frequently in PS than in LNT. Reports of pig-tailed macaques (*M. nemestrina leonina*, Fig. 6) were the least frequent in the northern Lao PDR, with only seven of the 46 sites being positive, and they were especially deficient in PS with only a single (from 13) positive site.

Stump-tailed macaques are known to show a wide variation in pelage color ranging from light brown to blackish (Fooden, 1990; Malaivijitnond and Hamada, 2005; Koyabu et al., 2007). From the interviews, the pelage color of stump-tailed macaques was reported to range from gray, dark brown and blackish, although

TABLE 2. The number of householdsand etnicity of residents in each village, if damage to crops by primates was observed, and whether the villagers hunt or eat primates.

Site No.[1]	Village	Ethnicity	House holds	Damage on Crop	Hunting	Eat monkeys?
1	Lak 12	Mong	46	No	No	No
2	Na Keng	Mong	26	-	Yes	Partially
3	Kang Khao	-	150	-	-	?
4	PhouLao	-	-	-	-	-
5	Soblab	-	-	-	Yes	Partially
6	Keo Lom	-	2	-	-	No
7	Keo Lom	-	2	-	-	No
8	Nam Sat	-	46	-	-	Partially
9	Sakok	-	40	Yes	Yes	Partially (Macaques and Langurs, but not Gibbon)
10	Don Keo	Khmu	68	-	-	Before Yes, but not now
11	Phou Titpheung	Mong	63	-	-	No
12	Nong Ian	-	72	-	Yes	Yes
13	Pak Mong	-	248	-	-	-
14	Mak Phouk Tai	Mong	18	-	-	-
15	Song Ja	-	248	-	-	-
16	Pongving	Mong, Lue, Khmu	64	-	-	No
17	Phonesavat	Mong	32	-	-	-
18	Nagngeo	Lue, Khmu	45	-	-	-
19	Houay Phae	-	58	-	-	-
20	Bouamphon	-	100	No	-	-
21	Nam Li	-	172	-	Yes	Yes
22	Laosen mai	Khmu+Mong	47	-	-	-
23	Sano mai	Akha Chappyu	60	Yes	-	No
24	Sing Xai	-	48	-	-	-
25	Wang Doi	Phou Noi, Lue, Mong Khmu, Lao Seng	66	No	No	No
26	Nam Phae	Phou Noi	56	-	Yes	-
27	Yo	Lue	110	-	Yes	Yes
28	Sin Xai	Phou Noi	34	Yes	Yes	Yes (Gibbon, too)
29	ChiCho	-	60	-	-	Before Yes, but not now
30	Hat Sa	-	79	-	Yes	Yes
31	Houay Nyeung	-	28	Yes	Yes	Yes
32	Ngay Neua	Lue	138	-	-	Yes
33	Chaleunsouk	Khmu	62	-	Yes	Yes
34	Thasae (=Nam Ha)	Khmu Yuan, Khmu Kaen, SamTao	104	No	No	Partially
35	Khuasoung	Khmu	48	-	-	No

TABLE 2. Continued.

Site No. [1]	Village	Ethnicity	House holds	Damage on Crop	Hunting	Eat monkeys?
36	Palang	Kui	40	Yes	-	-
37	Talong	-	41	-	-	No
38	Nam Ou	Khmu Kaen	100+	-	-	Yes (Bush meat traders come)
39	Phim Ho	-	-	-	-	-
40	Nam Leuang	Khmu (one household of Phu-Noi)	47	-	-	-
41	Nam Makkao	Akha	34	-	-	No
42	Sop Oe	-	47	No	No	No
43	Namkang mai	-	-	-	-	-
44	Nam Ma	Akha	40	No	Yes	Yes
45	Sivilay	Lue	79	-	No	No
46	Kang Kao	Lue	19	-	Yes (by snare)	-

[1]See Table 1 for the address of the site.
Partially = eat some but not all species

TABLE 3. Frequency of non-human primate distribution by site (%).

Area	Number of Sites	Loris		Macaque				Langur		Gibbon	Average
		Pygmy	Big	Rhesus	Pig-tailed	Assamese	Stump-tailed	Phayre's	Francois'		
HLO	19	10 (52.6)	7 (36.8)	8 (42.1)	4 (21.1)	7 (36.8)	8 (42.1)	6 (31.6)	1 (5.3)	4 (21.1)	5.7 (29.8)
PS	13	12 (92.3)	7 (53.8)	11(84.6)	1 (7.7)	5 (38.5)	11 (84.6)	9 (69.2)	-	7 (53.8)	7.0 (53.8)
LNT	14	5 (35.7)	8 (57.1)	6 (42.9)	2 (14.3)	10 (71.4)	5 (35.7)	8 (57.1)	-	4 (28.6)	5.3 (38.1)
Total	**46**	**27 (58.7)**	**22 (47.8)**	**25 (54.3)**	**7 (15.2)**	**22 (47.8)**	**24 (52.2)**	**23 (50.0)**	**1 (2.2)**	**15 (32.6)**	**18.4 (40.1)**

wide intra-population variation was not reported. However, the photos taken by the camera traps, which were kept at the Nam Et and Phou Loei NBCAs Project Office, revealed strong evidence of the presence of both darkish and light brown individuals in those areas.

Langurs are regarded as a different class of monkeys from macaques. Phayre's langur (*T. phayrei*) were reported from as many as 23 sites (Fig. 8), which is comparable to the frequencies of three of the macaque species. Probably based only on the observation of the grayish pelage color, the majority of interviewees reported the occurrence of the silvered langur (*T. cristatus*) without describing other classification traits. It is perhaps unlikely that this species is distributed this far north of its recorded range and is more likely that these reports are in fact of Phayre's langur (see Appendix I).

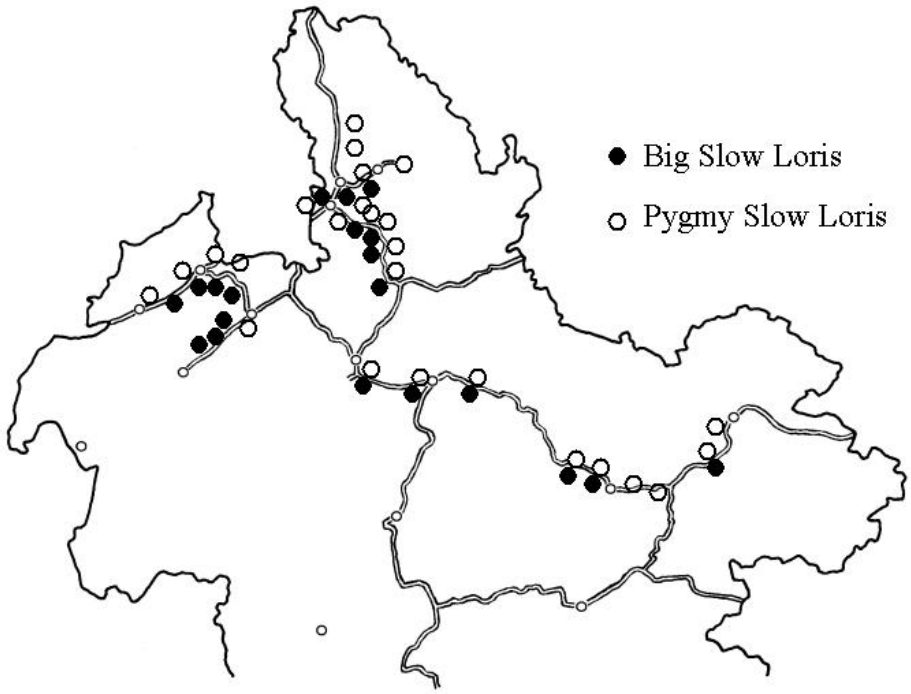

FIGURE 4. Sites where big (painted circle) and pygmy lorises (circle) were reported.

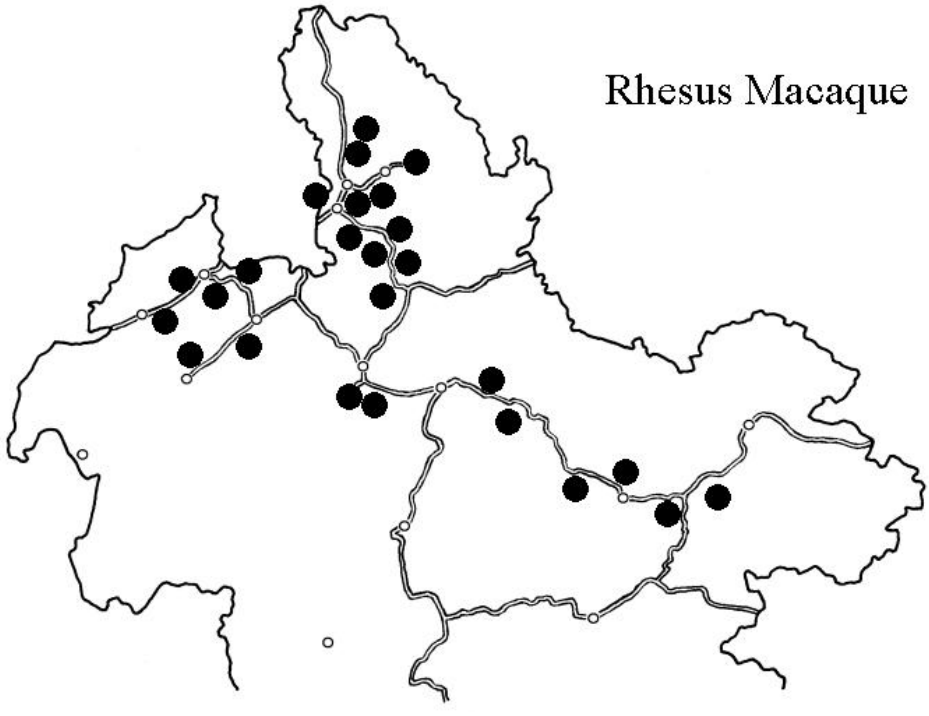

FIGURE 5. Sites where rhesus macaques were reported.

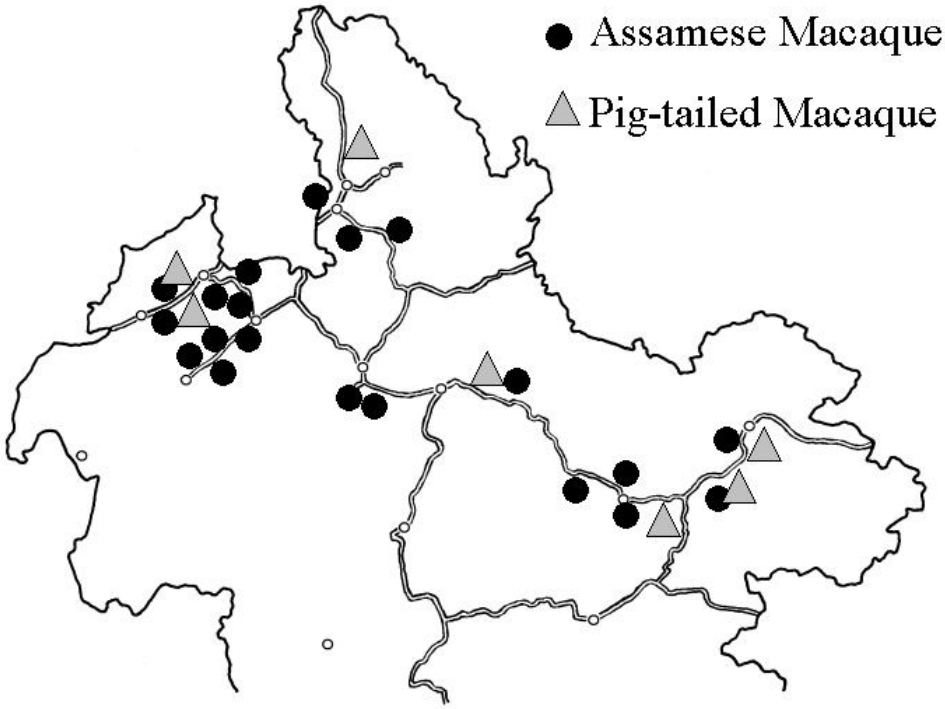

FIGURE 6. Sites where assamese (painted circle) and pig-tailed macaques (gray triangle) were reported.

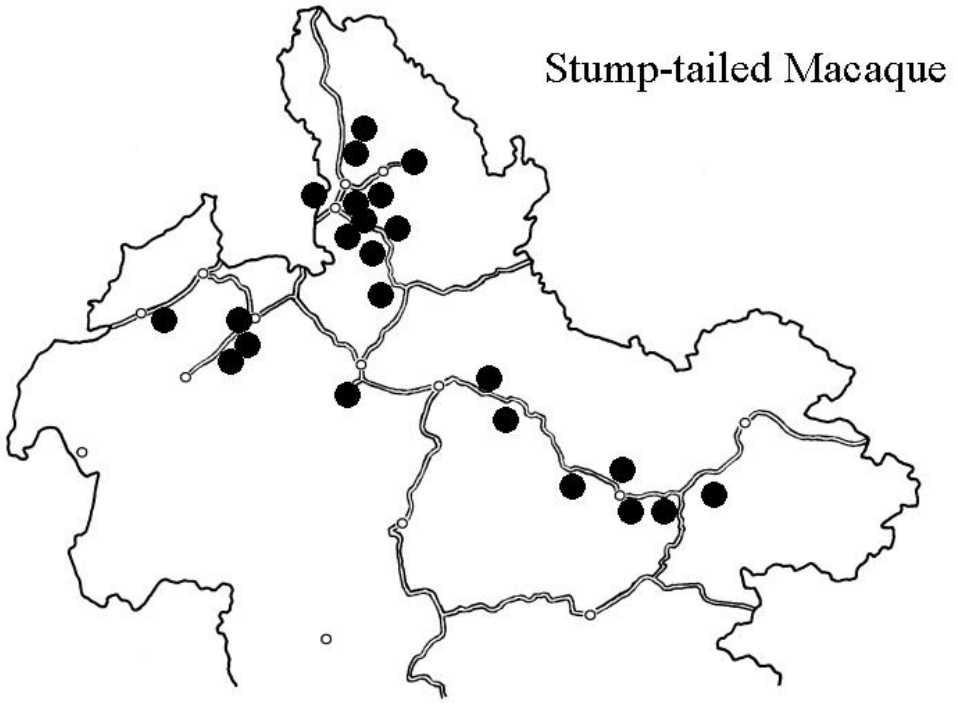

FIGURE 7. Sites where stump-tailed macaques were reported.

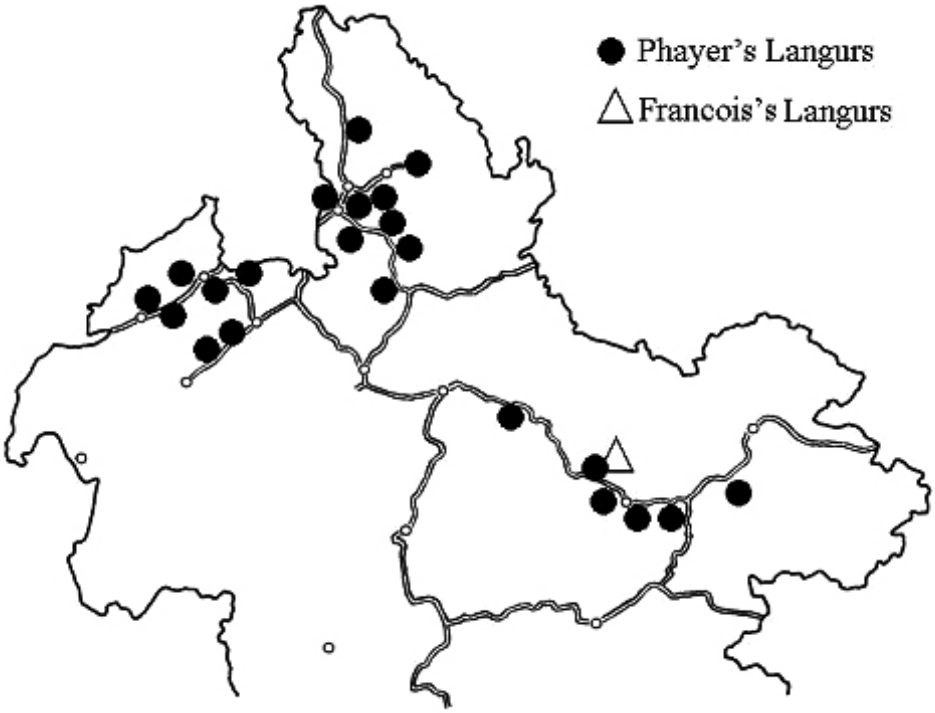

FIGURE 8. Sites where Phayre's (circle) and Francois's langurs (triangle) were reported.

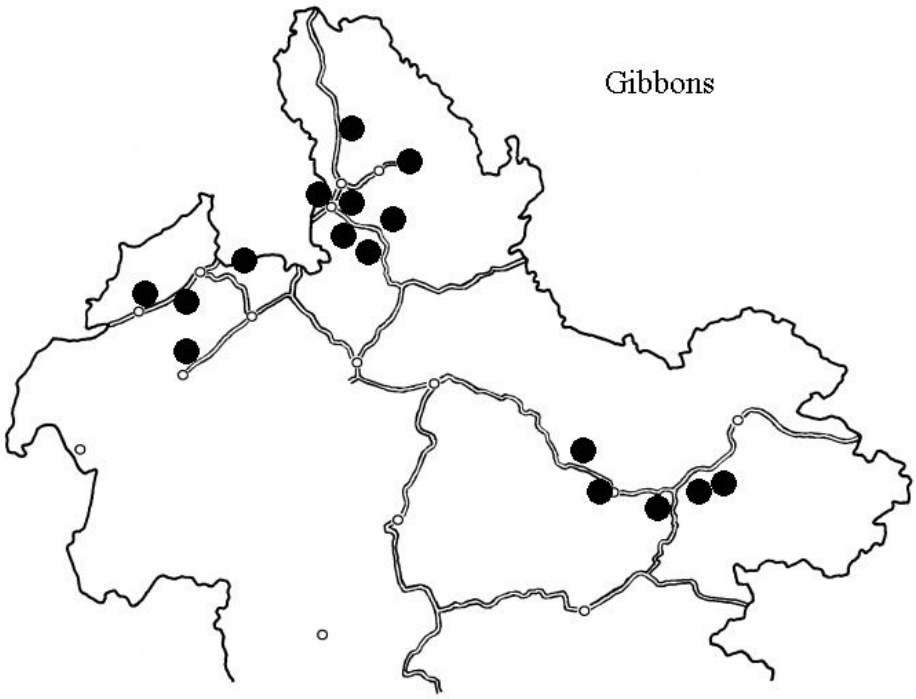

FIGURE 9. Sites where gibbons were reported.

Reliable reports of Francois's langur (*Trachypithecus francoisi*) were given only from the Ban Sakok village, Luang Prabang Province (site No. 9). The village ranger of the Nam Et and Phou Loei NBCAs described "langurs with the hair crest at the crown and whitish cheek-hair" whilst the officer of the Nam Ha NBCA in LNT also suggested the occurrence of Francois's langurs in that NBCA.

Contrary to our supposition that the occurrence should be highly restricted, gibbons were reported at as many as 15 sites out of 46 (Fig. 9). Gibbons were considered to be either Black (*Nomascus concolor*) or White-cheeked gibbons (*N. leucogenys*), but they were not specified to species in the interviews. Occurrences of gibbons were noticed only by their vocal, not by morphological traits. Exceptionally, gibbons at two sites were specified to species. According to the survey carried out by Wildlife Conservation Society (WCS) and NBCA offices, Nam Ha NBCA harbors black-crested gibbons. The village ranger at Ban Sakok reported that white-cheeked gibbons are found at Phou Loei Noi (lesser Mt. Loei) in Phou Loei NBCA. Gibbons inhabit the area along the Huai Punghae (meaning "stream with salt site") and Huai Soop Rivers and their vocals can be heard from Ban Sakok village during winter.

Characteristics of pet macaques

All pet primates found were either infant or young juvenile macaques. The composition of the 11 pet monkeys by species were six Assamese macaques, two pig-tailed macaques, two rhesus macaques, and one stump-tailed macaque (Table 4). Monkeys were traded by the hunter himself or by a broker of traditional medicine, or were donated to relatives. The distance of transportation of monkeys was not considered great, but we could get no definitive information about the interprovincial or international trades of living primates.

The morphology of pet macaques appears to be typical for each respective species. Here we describe the characteristics of pet rhesus macaques, as the intraspecific variation in rhesus macaques are of interest from the viewpoint of subspecies classification and hybridization (Fooden, 2000; Groves, 2001; Brandon-Jones et al., 2004; Hamada et al., 2006). One rhesus macaque found at Ban Sing Xai village in PS (site No.24, pet No.3 in Table 4) had the fluffy and darkish tail of ca. 40% of crown rump length (CRL) and the bipartite pelage color pattern (upper-body grayish and lower-body light orange). From these traits, this individual is morphologically close to the rhesus macaques of the eastern group (China and its vicinity; Fooden, 2000). The crown hairs of this individual were directed obliquely in both sides from the mid-sagittal line, which is not found in the majority of rhesus macaques. Another rhesus macaque found at Oudom Xay city (pet No.8, Table 4) also showed traits typical for rhesus macaques of the eastern group, that is, a tail length of 32% of the CRL and clearly demarcated bipartite pelage color pattern

Practices to non-human primates and frequency of non-human primates

At many villages non-human primates were reported to be consumed as food (Table 2). We compared the number of primate species between sites where monkeys were eaten with those where monkeys were

TABLE 4. Pet monkeys found in the northern region of Lao PDR in May 2006.

No.	Species	Sex	Age (yrs.)[1]	Address of owner	Origin
1	*M. assamensis*	F	2	Pak Mong, Nam Bak District, Luang Prabang Prov. (20.6-deg. N, 102.4-deg. E, H=397 m)	Vieng Kham District
2	*M. leonina*	F	1	Ban Longkor Deur, Muang OudomXay, Oudom Xay Prov. (20.7-deg. N, 102-deg. E, H=633 m)	Nam Pak Ben (ca 30 km from the owner's home)
3	*M. mulatta*	M	1	Ban Shing Xay, Boun Tai District, Phongsali Prov. (21.4-deg. N, 101.9-deg. E, H=607 m)	Same village as the owner
4	*M. assamensis*	M	2.5	Ban Longkor Deur, Muang OudomXay, Oudom Xay Prov. (20.7-deg. N, 101.9-deg. E, H=633 m)	Details unknown, Oudom Xay Province
5	*M. arctoides*	M	0.75	OudomXay Market, Muang OudomXay, Oudom Xay Prov. (20.5-deg. N, 102.0-deg. E, H=529 m)	Mouang Na District, Oudom Xay Province (close to Pak Mong)
6	*M. assamensis*	M	1	OudomXay Market, Muang OudomXay, Oudom Xay Prov. (20.5-deg. N, 102.0-deg. E, H=529 m)	Mouang Na District, Oudom Xay Province
7	*M. assamensis*	F	1	OudomXay Market, Muang OudomXay, Oudom Xay Prov. (20.5-deg. N, 102.0-deg. E, H=529 m)	Mouang Na District, Oudom Xay Province (close to Pak Mong)
8	*M. mulatta*	M	2	OudomXay Market, Muang OudomXay, OudomXay Prov. (20.5-deg. N, 102.0-deg. E, H=529 m)	Unknown
9	*M. assamensis*	F	2.5	Ban Palang, Vieng Phouka District, Luang Nam Tha Prov. (20.8-deg. N, 101.2-deg. E, H=675 m)	From the village (Mousa = Kui people) about 1 hr. walk.
10	*M. leonina*	M	0.5-0.75	Mouang Sing, Luang Nam Tha Prov. (21.2-deg. N, 101.2-deg. E, H=649 m)	From Long District, Luang Nam Tha Province
11	*M. assamensis*	M	0.75	Ban Kang Kao, Long District, Luang Nam Tha Prov. (21.0-deg. N, 100.9-deg. E, H=565 m)	Near the village where the owner lives

[1]Ages were estimated from dental development
[2]CRL for Crown-Rump Length, and BM for Body Mass
H = Height above sea level

not eaten. The average number of primate species was significantly greater in the sites where monkeys were eaten, 5.60 species/site (n=15) than that in sites where monkeys were not eaten, 2.83 species/sites (n=12). In all three regions surveyed, the same tendency was found. The average numbers of species found in sites where monkeys were eaten and not eaten were

TABLE 4. Continued

Way of acquisition	Capture method	Body size[2] and Morphology	Remarks
Purchased	Unknown	Typical Assamese. Pelage color in general light brown with a medial band at the back from thoraci, lumbar, tail are dark grayish brown; face, hands and feet a little darkish, tail length about 35% of CRL, ca. 1.5 kg of BM.	-
Purchased from hunter	Unknown	Typical pig-tailed, as shown by the darkish hair patch at the crown where the whorl is formed. Tail about 30% of CRL.	Hunter in Ban Na Pa Tai, at 30,000 Kip (cheaper than market price as owner is a relative of the hunter).
Captured by the owner	Caught as neonate	Typical rhesus. Tail about 40% of CRL and fluffy, bipartite pelage color pattern	-
Purchased	Unknown	Pelage light grayish brown, base of tail to proximal one fourth of thigh grayish. Tail 120 mm and CRL 330 mm. Shape of glans-penis typical for Assamese	-
Purchased at the market	Unknown	Pelage mixture of infant whitish and darkish hairs. Tail 28 mm and CRL 285 mm	Price 50,000 Kip.
Purchased at the market	Unknown	Typical Assamese. Tail 120 mm and CRL 298 mm.	Price 70,000 Kip for the two assamese macaques.
Purchased at the market	Unknown	Typical Assamese. Tail 127 mm and CRL 284 mm.	
Monkey came to the home itself	Unknown	Typical rhesus. Tail 115 mm and CRL 359 mm (relative tail length = 32%)	The monkey came to the owner's house by itself. Monkeys Nos. 5-8 are kept by the same owner.
Purchased	Unknown	Typical Assamese.	Right eye injured by gun-shot.
Purchased	Unknown	Typical pig-tailed. Tail 102 mm and CRL 224 mm	-
Captured by the owner	Snair	Typical Assamese. Tail 130 mm and CRL 293 mm.	-

5.83/site (n=6) and 1.60/site (n=5) in HLO; 5.43/site (n=7) and 5.0/site (n=2) in PS; and 4.5/site (n=4) and 3.2/site (n=3) in LNT, respectively.

The local names of primates are diverse in the northern region of Lao PDR, because inhabitants are of diverse ethnic groups. The local names indicate the recognition of primates possessed by people (Appendix II). Table 5 lists the local names by villages. As the number of samples is not large enough, we could not relate names with ethnic groups, which will be the subject of future studies.

TABLE 5. Local names of non-human primates in the northern region of Lao PDR.

Site[1]	Village (Ban)	Province	Ethnic group	Monkey in general	Slow loris	
					Big	Pygmy
1	Lak 12	Houa Phanh	Mong	Dia	-	-
5	Soblab	Houa Phanh	-	-	Ling Lom	Ling Lom
7	Keo Lom	Houa Phanh	-	-	-	-
	Dept. Agriculture and Forestry at ViengThong	Houa Phanh	-	-	-	-
8	Nam Sat	LuangPrabang	-	Hwua (Macaque)	Ling Lom, Lai Cheng Noi	Ling Lom, Lai Cheng Nyai
9	Sakok	LuangPrabang	-	Hwua (Macaque), Khang or Chan (Langur)	-	-
12	Nong Ian	LuangPrabang	-	-	LaiCheng or LaiChaul	LaiCheng or LaiChaul
16	Pongving	Oudomxay	Mong, Leu, Khmu	-	Lai Chouroun ?	Lai Chouroun ?
17	Phonsavat	Oudomxay	Mong	-	-	-
20	Hat Sa	Phongsali	-	-	-	-
21	ChiCho	Phongsali	Khmu, Phou-Noi	-	Keuk keuiya	Keuk keuiya
22	Houay Ngeung	Phongsali	-	-	Myou lang	Myou lang
23	Ngay Neua	Phongsali	Leu	-	Hyn-dum	Hyn-dum
24	Sin Xai	Phongsali	Phou Noi	-	Ling Lom, Koun-Keiaa	-
25	Yo	Phongsali	Leu	-	-	-
27	Wang Doi	Phongsali	Phou Noi, Leu, Mong, Khmu, Lao Seng (Kui)	-	Keuk keuiya	Keuk keuiya

[1]See Table 1 for the site location. **Comments**
Site 5: General names of Lao people
Site 8: Ling Lom (Lom = Flow with wind), Khmu group
Site 9: Khmu groups
Site 20: E-Ko for Phou-noi group
Site 21: Keuk keuiya - Phou-noi group

DISCUSSION

Species composition in the northern region of Lao PDR

A total of ten species of primates, from prosimians to hominoids, were recorded in the northern region of Lao PDR which comprised of big and small slow lorises (*Nycticebus bengalensis* and *N. pygmaeus*); rhesus, pig-tailed, Assamese, and stump-tailed macaques (*Macaca mulatta*, *M. nemestrina leonina*, *M. assamensis*, and *M.*

TABLE 5. Continued

Macaque				Langur		Gibbon
Rhesus	Pig-tailed	Assamese	Stump-tailed	Phayre's	Francois's	
-	-	-	-	-	-	-
-	Ling Khang	-	-	Khang	Khang	Chany
-	-	Blood Monkey(Red Faces)	-	-	-	-
Ling Daeng (=red), Ling Wok	-	Ling Kwai (Buffalo)	Ling Kang, Ling Din (Ground)	-	-	Chany
Ling Daeng (=red)	-	Ling Kwai, Ling Kang	Ling Din	Chang	Chang	-
Ling Daeng (=red)	-	Ling Kwai, Ling Mai (wood)	Ling Din, Ling Dum, Ling Phaa (Hill)	(Khang Mhok)	Khang Mhok	Re-olle
-	Ling Hang Khor (Tail)	-	Ling Leuad Tha Na (red face and hip)	-	-	Re-olle
-	-	-	-	-	-	-
Ling Daeng	-	-	-	-	-	-
-	Ling (ordinary monkey)	-	E-Ko, Ling Thon	-	-	-
Dabbro-apuicheu	-	-	Dabbro	-	-	-
Amiew (Yo yong)	-	-	Amiew	-	-	-
Wok Daeng	Wokko-tok	-	Koo	I-Khang	-	Nang Ni
Myuo Pheu	-	Myuo Hooph	Ling Thi Kon, Dabbo-do	Ling Hang Yao, Dabbado- Tong Houng	-	Dabbor-Nareu
Ling Daeng	-	Ling Mon	Ling Na Daeng, Ling Dam	Khang Mon (or Mhok)	-	Tha Ni
-	-	Myuo Pheu	Amiew dor	-	-	-

[1]See Table 1 for the site location.

arctoides, respectively); Phayre's and Francois's langurs (*Trachypithecus phayrey* and *T. francoisi*); and gibbons (probably *Nomascus concolor* and *N. leucogenys*). This composition is similar to that found in southern inland China, especially that in the Yunnan Province (Zhang et al., 2002) and in northern Vietnam (Fooden, 1996; TRAFFIC Southeast Asia, 2000). However, rare and private species, such as Douc langurs and Snub-nosed langurs, which are distributed in China, southern Lao PDR and/or Vietnam, were not recorded in this region. Loris with intermediate size was never reported. Neither such northerly- nor southerly-distributed primate species such as Tibetan macaques, gibbons of the genus Hylobates (restricted to the right bank of Mekong River); long-tailed macaques; dusky, pileated and silvered langurs were

TABLE 5. Continued

Site[1]	Village (Ban)	Province	Ethnic group	Monkey in general	Slow loris	
					Big	Pygmy
29	Sano mai	Phongsali	Akha Chappyu	-	Kouin, Myurou	Kouin, Myurou
	Villlage in Pass	-	-	Amiew	Laicheng	Laicheng
30	Laosen mai	Phongsali	Khmu, Mong	-	-	-
31	Nam Li	Phongsali	-	-	Ling Lom	Ling Lom
	Dept. Agriculture and Forestry Office at Luang Nam Tha	Luang Nam Tha	-	-	-	-
35	Khouasoung	Luang Nam Tha	Khmu	-	-	-
36	Palang	Luang Nam Tha	Kui	-	-	-
37	Talong	Luang Nam Tha	-	-	-	-
38	Nam Ou	Luang Nam Tha	Khmu Kaen	-	-	-
41	Nam Makao	Luang Nam Tha	Akha	-	Alahkoua	Alahkoua
43	Kang mai	Luang Nam Tha	-	Lia	-	Liabor-Mwua
44	Nam Ma	Luang Nam Tha	Akha	-	Miew - lor, Amiew Ma Tozae	Miew - lor, Amiew Ma Tozae
46	Kang Kao	Luang Nam Tha	Leu	-	-	-

found in northern Lao PDR. Thus, the primate fauna in the northern region of Lao PDR (excepting the right bank of the main stream of Mekong River) is transitional between those in China/Vietnam and southern Lao PDR or Thailand, and is devoid of endemic species unique to this region.

Two pet rhesus macaques (pet Nos. 3 and 8, Table 4) had the bipartite pelage color pattern (grayish upper-body and vivid light orange lower-body) typical for that species (Fooden, 2000). They had a fluffy and darkish tail of ca. 40% and 32% of crown rump length, respectively. From these traits, they are morphologically close to the rhesus macaques of the eastern group which are mainly distributed in China and Vietnam (Fooden, 2000). Although it is rather premature for any conclusive comments, rhesus macaques distributed to the northern region of Lao PDR appear to show no traits of hybridization with long-tailed macaques but rather are similar to conspecifics of the eastern group as classified by Fooden (2000).

Differences in the frequency of primates between localities

Excepting the probable cases of gibbons and Francois's langurs, broadly the same composition of primates was distributed throughout the northern region of Lao PDR.

TABLE 5. Continued

Macaque				Langur		Gibbon
Rhesus	Pig-tailed	Assamese	Stump-tailed	Phayre's	Francois's	
Amiew	-	-	Iko-Chupia	Amyunyuna	-	-
Amiew	-	-	Ling Kang, Hwua	-	-	Lior
-	-	-	Hwua	-	-	-
Ling Daeng	-	-	-	-	-	-
-	-	-	-	-	Khang Houa Chuk	-
-	-	-	-	-	-	Lior
-	-	Hwua Sa-Onag (Monkeys in the tree Canopy)	-	-	-	-
-	-	Hwua, Hwua Sa-Onag	-	-	-	-
Hwua	-	Hwua Sa-Onag	-	-	-	-
Khuato-Haa	-	Amiew Bapiew	-	Aminew-yeu	-	Amiew na
Lia	Lia	-	-	Nyah	-	-
-	Amiew Bappeu (Peu: white, white cheek)	Amiew Bappeu, Miew-shu	Amiew Ba Ne (Ne=red)	Ling Kyo	-	Meu-na
I-ko	-	Ling Wok	-	-	-	Agile, Nang-Ni (Nang: "lady")

The most frequently reported primate was the pygmy loris, which is more frequent than its bigger congenerics. Among macaques, rhesus, stump-tailed and Assamese macaques were found with broadly comparable frequencies. Langurs, most-probably Phayre's, were also reported frequently. Gibbons, although they were not specified to species level since they were mostly identified by vocal calls, were reported at rather high frequencies. The least frequently reported primates were Francois's langur and pig-tailed macaques. The frequencies of reported occurrence of primates differ with species and localities, and this may indicate differences in habitat conditions, requirements of habitat conditions, in the tolerance to habitat degradation, and in community ecology (e.g., competition between species for habitat). However, the frequency of occurrence is also likely to be affected by the different probabilities of encounter by the village peoples. For example, those villagers actively involved in foraging within the forest, and especially those hunting for primates, are more likely to see primates than the more agricultural based domiciled villagers.

The average number of species reported was 3.61 per site (n=46) in the northern region of Lao PDR which is less than the

half of the largest number (eight species) reported at the Bang Sakok village located just outside of the Phou Loei NBCA. Excepting for the nine sites where no species of primates were reported, the mode (most frequent) of species number reported was five (at 7 sites out of 37). Thus, the likely cause is considered to be that habitats for primates are more or less degraded.

The Phongsali Province (PS locality), located at the northern-most end of the Lao PDR, appeared to have the richest primate fauna (average of 4.85 species/site, n=13) compared to the other two localities of Houa Phan - Luang Prabang - Oudom Xay (2.84 species/site, n=19, HLO locality) and Luang Nam Tha Province (3.50 species/site, n=14, LNT locality). The patchiness and diversity of reported sightings between villages within HLO suggests there appears to be both good and bad habitats for primates.

Primates were reported to occur at villages with an altitude of more than 800 m a.s.l., which is in contrast with that previously reported (Duckworth et al., 1999). Villages tend to be established along roads, which are constructed along the ridges of mountain chains, that is, in the elevated areas. Thus the actual habitats of primates may have been situated below the ridges in the valley and thus at lower altitude than that recorded for the villages. However, this simple caveat cannot explain all the cases where primates were reported from elevated areas. For example, lorises were mainly observed in the vicinity of the villages, as they are nocturnal. Therefore, although lorises were previously described to be distributed in areas lower than 500 m a.s.l. (Duckworth et al., 1999), in the northern region of Lao PDR they were also distributed at higher elevations. The same holds true for the altitudinal distribution of the rhesus macaques. The majority of rhesus macaques were previously reported from areas lower than 600 m a.s.l., excepting the report from Nam Et NBCA, northern Lao PDR of 850 m a.s.l. The topography of PS where primate fauna is the most diverse is mountainous, as shown by the elevation of Phongsali city at about 1,400 m a.s.l.

The differences in the occurrence between species

The frequency of occurrence differs with species in each of the three localities. The frequency of Assamese macaques is high in LNT and low in PS localities, whilst in contrast those of rhesus and stump-tailed macaques are high in PS and low in LNT. This reversal of frequency is worthwhile to note as it seems to reflect the differences in ecological requirements between the three macaque species. The habitat condition, especially the topography, may relate to the frequency of reported sightings of these macaques. Villages where we interviewed within LNT were situated in the valley plain and surrounded by gently sloping hills. In contrast, the sites surveyed in PS were situated within steep hills. Assuming the reported primate sightings relate accurately to their presence, if not partially to population sizes, this habitat difference is contradictory to our expectation that Assamese macaques would be preferentially found in steep hills more than rhesus and stump-tailed macaques, as they are nicknamed “rock monkey” by Hmong and Karen Hill tribes in western Thailand (Rowe, 1996). Therefore, there may well be other factors determining the species

frequencies and distribution for macaques in northern Lao PDR including, potentially, displacement and adaptation to secondary habitats following destruction or fragmentation of their preferred habitats.

The distribution of pig-tailed macaques: Ecological Competition

Pig-tailed macaques were reported at about one sixth of the sites in the present study, and this is the least common of the macaques. However, the occurrence of pig-tailed macaques was not anticipated, because Fooden (1975) did not record pig-tailed macaques in northern Lao PDR. Interestingly, Fooden (1975) reported that pig-tailed and Assamese macaques are subject to competitive exclusion, and that they are consequently parapatric in distribution with each other. The Assamese macaque is better adapted to the northern and cooler habitats than the pig-tailed macaques (Fooden, 1980). The body size difference between the two species coincides with this habitat segregation (Bergman's rule). However, in the present survey of three regions of NE Lao PDR, Assamese and pig-tailed macaques were reported to co-occur at five out of seven sites. Pig-tailed macaques have been reported from localities close to and more northerly than the region surveyed in the present study, at Meng-hai, Yunnan, China (21° 52' N, 100° 28' E; Kao et al., 1962). Indeed, a recent report in China (Zhang et al., 2002) also described the distribution of pig-tailed macaques from southern areas in the Yunnan Province, which are close to the northern region of Lao PDR.

It is probable that the two macaque species share the same broad habitat by finer segregation of habitats or resources (niche segregation) to avoid direct competition, but this awaits further study for confirmation. Pig-tailed macaques were also reported to inhabit dense and large forests in this survey and it is probable that people conducting intensive shifting-culture do not go into such forests and, thus, they do not encounter pig-tailed macaques. Ngay Neua village is the only one in which pig-tailed macaques were reported in PS with a long history. The people in that village cultivate rice in paddy fields along the Nam Ngay River and other crops in hill slopes by shifting-culture in a sustainable manner, and collect various non-timber forest products from the forest reserve. Thus, the probability that these people will encounter pig-tailed macaques should be higher than that for people living in the other villages surveyed.

The behavioral differences and attitudes to humans

The reported frequencies of macaque occurrences will also depend upon their behavioral patterns, and especially their attitude to humans and tolerance of human proximity. Stump-tailed macaques are terrestrial, and they were called "ground monkeys" in several villages (see Appendix II). They were reported in many sites to frequently raid crops and to be aggressive towards humans. Rhesus macaques are also rather terrestrial, raid crops, and come close to human settlements, which is why they are often called "Ling Tammadar" (ordinary monkey). Thus, these two species of macaques are more likely to be encountered by people than other macaque species that are shy of humans independent of their actual population density and occurrence. In contrast, Assamese macaques were reported to raid crops much less frequently than these two macaques.

This may relate to the arboreal way of life of Assamese macaques, as noticed by their local names, e.g., "Ling Mai (=wood)", and would likely lead to a lower frequency of reported sightings in PS. One pet owner reported that Assamese macaques were tame and followed his orders, e.g., carrying firewood, which has never been practiced by stump-tailed macaques. Although, according to the interview in the Ngay Neua village, a pig-tailed macaque once attacked a lady on a path, such interaction is considered to be rare and conceivably was made by a solitary male macaque. Indeed, pig-tailed macaques are thought to keep their distance from humans being rather stealthy in behavior.

Influences of human beliefs and practices on the frequency of Primates

The peoples' beliefs on and practices to non-human primates are considered to be important factors in the variability of primate fauna richness including the prevention of local extinction of primates through the importance and usefulness of conservation education.

In Ban Sakok village, Luang Prabang Province (site No. 9, Table 2), where eight species of primates, including white-cheeked gibbons (*Nomascus leucogenys*), were reported, people have a belief that as gibbons are closely related to humans, a person who kills a gibbon will go to hell, and actually they neither hunt (shoot) nor eat gibbons. Similar beliefs may have helped prevent the extinction of black-cheeked crested gibbons (*Nomascus concolor*) in Nam Kan PNBCA, Bokeo Province, northern Lao PDR (Duckworth et al., 1999).

The belief concerning slow lorises may also participate in their higher frequency of reported occurrence. Although lorises are used as a traditional medicine in other areas of Lao PDR (e.g., Savannakhet Province in central Lao PDR, personal obs.), they are believed to be a spiritual animal in many villages of the northern region of Lao PDR, perhaps simply because they are nocturnal. For example, Iko ethnicity people at Ban Sop Oe village, Luang Nam Tha Province (site No. 42) believed that only encountering lorises ("Myuron") is an ill omen, and when they accidentally kill lorises they believe they should donate pig meat to the spirit.

In many northern Lao PDR villages peoples believe in the traditional animisms, and there were neither Buddhist temples nor Christian churches. There are likely to be other practices concerning primates than those described above, which will have functioned to conserve primates. On the other hand, there are cases where religion did not always prohibit the hunting of primates. For example, at the Ngay Neua village, PS, there is an old Buddhist temple and the village inhabitants still actively believe in Buddha, yet they still hunt and eat wildlife (although their hunting does not appear exhaustive).

The present situation of primates and human activities in the northern region of Lao PDR

The heaviest impact on the primate populations is likely to be human activities. Here we briefly discuss the impact of human activities.

Lao PDR was established in 1975. Beside the changes in policies (e.g., the introduction of the "New Economic Mechanism"), road construction and its use is considered to be the most influential component on the lives of people. After

1975, new roads were constructed and old roads were upgraded (widened, paved or gravelled) in the northern region of Lao PDR with the aid of foreign countries, especially China. For example, the traffic to Phongsali city used to depend on the boats from Hat Sa village, in the hinterland of Phongsali city, but this was recently changed to a terrestrial way with the completion of the provincial road to connect Phongsali city to the National Road No. 4. The undeveloped road network may have participated in the richest primate fauna of Phongsali Province in comparison with those in other localities.

A higher standard road was constructed to replace the present National Road No. 3 connecting Luang Nam Tha city with Vieng Phouka town, which partly transects the Nam Ha NBCA. The route connecting Boten with Mohan, China, will soon be completed to increase both provincial and especially international traffic as this route will connect China with Luang Prabang and Vientiane by National Road No. 13 via Oudom Xay and Pak Mong. The resultant increase in the international and interprovincial trades will likely bring significant economical changes and influences to villages in the northern region of Lao PDR.

Villages have been established along roads shortly after their construction or upgrading, and people either migrate to these villages from previous villages of two to five hours walking away, or to more distant and remote localities. Following establishment or enlargement of existing villages, forests nearby the villages are felled to be cultivated with cash commodity as well as food crops. An example is the Keo Lom Village (site No. 6) at an elevation of about 1,550 m.a.s.l. Vast areas around the village have been slashed and opened for cultivation except, at present, the forest reserve areas.

In the northern region of Lao PDR, the traditional shifting-culture (slash and burn) has long been practiced on hill slopes by the local people, with rice cultivated in the flatter valley flood lands as paddy fields. People often enter forests for non-timber forest products, such as fungi, bamboo shoots, gums, barks (cardamom), rattans, animals, or fire woods. These human subsistence activities alone are not severe threats to the forest or to the well-being of the local wildlife because of their relatively small scale nature. However, with increasing population sizes in each village and the national aims of economical development, the government of Lao PDR started new policies in 1989 to not only allocate land to people (privatization of real estates), but to also control the land use of considerable forest reserve areas. These government policies have shortened the shifting cycle from seven years to four or less years, which is an insufficient time even for the secondary forest to recover resulting in permanent deforestation. With an annual increase in the population size of 2.5 %, people migrate along the roads to establish new settlements in the allocated land. Although forest regions around villages with a long history tend to be preserved, those situated close to newly established villages tend to be used exhaustively, which becomes a threat to the primate populations. Thus, in the northern region vast hill slopes forests have been slashed open and burned away for cultivation and extensive areas turned over to Imperata grassland or bamboo bushes. The forest cover in this region is now much less than the national average of ca. 40 %

cover, and this trend was largely driven by road construction as described above.

The permeation of a money-based economy, and the completion of traffic and trade systems are increasingly becoming the major influence on wildlife in the region. The people's perceived need for money has changed their activities away from subsistence level farming to cultivate cash crop commodities such as upland rice, corn, cassava, sugar cane, galingale, tea, and rubbers. The brokers from Luang Prabang city or China trade these agricultural products. Additionally, the cultivation of alternative crops to opiate poppies is promoted by the support of the Lao Government and foreign countries.

Thus, both the crops cultured and the way of cultivation are now being altered, but due to insufficient knowledge of new cultivation techniques, these alterations are frequently not manifested in a sustainable method promoting slash and burn farming with increased forest destruction. For example, tea farmers reported that they burn away tea trees every five years as the products decline in yield and quality and shift the tea plantation to new land plots. Thus they are cultivating tea by their traditional way of shifting-culture without adopting sustainable long-term agriculture methods. They grow cattle and pigs, and collect their faeces, but ironically they sell the faeces to brokers from China, and do not use them as fertilizer for the tea. Instead, they use nutrient poor ashes or dried weeds which are insufficient to nourish the tea trees (and likewise for other crops) leading to nutrient poor soil and the need to move on to a fresh site. The proper instruction in sustainable methods of agriculture for each crop type is indispensable for the people to produce crops efficiently and in doing so to decrease the pressure upon the environment and wildlife.

In the 1990s guns were collected from the local population with the aid of the Danish International Development Agency (DANIDA). Initially considerable numbers of guns were handed over, but at the second collection almost no guns were delivered. It is suspected that a number of guns were still hidden and used for hunting, and it has also been suggested that guns were produced illegally. Actually, we encountered men with hunting guns on roads in mountainous areas. The use of snares is also officially prohibited, excepting for protective uses when set around agricultural fields.

We could not collect information with any certainty of the systematic trade of bush-meat or living primates. We did find the relationship that the number of reported sightings of non-human primate species was higher in villages where people eat (or hunt) non-human primates. This perhaps un-anticipated relationship would mean either that people would stop hunting primates when it became difficult to hunt and/or that in the sites where sustainable hunting is practiced, primate populations are being maintained. Alternatively, it could just simply mean that villagers that hunt primates are entering deeper into primate territory and so are more likely to encounter (and thus report) primates than non-hunting villagers.

The present situation of primate conservation

The government agency to manage wildlife is the Department of Agricultural and Forestry and NBCA Office. However, the numbers of officers and rangers

currently employed are insufficient to control the various activities against wildlife conservation. For example, at the Nam Et and Phou Loei NBCAs where white-cheeked gibbons, Francois's langurs and tigers are distributed, only four officers are working. It was suggested that poachers enter some NBCAs close to the national boundaries (such as Nam Xan or Phou Daen Din NBCAs) to poach animals for meat, alternative medicine (e.g. internal organs such as the gall-bladder), or living animals for live trade as pets etc. For some of these NBCAs, village rangers are appointed to maintain NBCA, to carry out public-relations exercises to promote conservation, and to control poaching. This system appears to function well. Ecotourism has recently been introduced to the Nam Ha NBCA.

In depth surveys of the wildlife including primates inside and outside of NBCAs, the efficient control of poaching, and the instruction in efficient ways of subsistence farming and business (especially agro-forestry), are all urgently needed to decrease the threats to wildlife and their habitats. Regular monitoring is necessary.

Examination on the interview method

In the short term, efficient and extensive surveys of the distribution and present status of non-human primates and their habitats should be carried out routinely. The methodology of survey should be improved, incorporating the evaluation of quality of subsistence activity. Here we discuss the methodology of the present survey.

The direct interview was carried out in this study, because a questionnaire-based survey would be less applicable. We interviewed village people for between 30 to 60 minutes in every site. We asked various items, but as some of the items needed written statistics to answer, they were not always answered. For example, assessing the degree of damage to crops by primates, or defining the hunting pressure on a quantitative basis. This is also true for the density or total number of primates in the village area. It was exceptional that the interviewee at Ban Sakok village reported that the densities of macaques are in the order of Assamese, rhesus, and stump-tailed macaques, and that the troop sizes of Assamese and rhesus macaques are 20-30 individuals. Such statistics, although much needed, require careful assessment.

For specifying primates, we used brochure pictures and other printed materials, and we noticed that these visual materials alone were insufficient for accurate and reliable species identification and data retrieval. We asked about various primate traits, e.g., morphological traits, behavioral patterns (terrestrial-arboreal, attitude to humans; aggressive or ready to run away), and vocal sounds. Instead of the absolute body size, we found that asking about relative size was better, for example, in the discrimination between rhesus (smaller) and Assamese (larger) macaques. The most informative material was the photos, but we had not prepared enough photos showing the whole body (profile and from back) and details of face (from front and side), crown (vertex of the head), buttock region, and tail (fluffy or thin). As the color is difficult to express verbally, photographic examples of different colors and relevant shades should be useful. The knowledge of local names of primates is also useful, but names should be used with caution and never alone since sometimes

the same name may be used to indicate different species in different localities (see Appendix II).

We tried to choose people who knew the local wildlife well and who were in a position to collect information in the village, such as the head of the village or a suitable alternative person. However, since we interviewed as we came across villages and thus without any advance appointment, depending on the time of interview, the appropriate people were absent from village at the time of our interview. Thus, in future surveys it would be advisable to ask the head of village in advance for an interview or for them to arrange for the appropriate interviewee(s) to be available.

From the interviews, we concluded that langurs and gibbons were difficult to reliably specify to species level. Even though we questioned villagers about various morphological traits, we received no meaningful, if any, answers. This may be because either people would not go close to or enter forests where langurs or gibbons inhabit, or because these primates would run away at the sight of humans. As interviewees reported that they had heard the sound of these primates, replaying appropriate recordings of each primate's calls should be considered as a required character for future surveys.

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APPENDIX I.

Back-ground of the Primates considered to be distributed to the northern region of Lao PDR

Two or three species of lorises are possibly found in the region; that is, big (*Nycticebus coucang* was replaced by the *N. bengalensis*, Groves, 1998), small (pygmy, *N. pygmaeus*), and probably intermediate lorises. The former two species are reported from areas lower than 500 m a.s.l. (above sea level) across whole country (Duckworth et al., 1999). The third species, lorises with intermediate size, used to be classified as *N. intermedius* (Groves, 1998), but is presently regarded as the junior synonym of *N. pygmaeus* (Groves, 2001; Brandon-Jones et al., 2004). However, research in Bolikhamxai Province indicated that at least three forms (species) of loris inhabit Lao PDR (Alterman and Freed, 1997). The type specimens of intermediate lorises are found in Vietnam and Yunnan, China, but lorises

with intermediate size from Lao PDR have not been examined for their taxonomy to ascertain their true status. It is supposed that they are distributed to the national boundary zones between Lao PDR, Vietnam, and China.

Five species of macaques are known from Lao PDR: Assamese (*Macaca assamensis*), rhesus (*M. mulatta*), pig-tailed (*M. nemestrina leonina*), stump-tailed (*M. arctoides*), and long-tailed macaques (*M. fascicularis*). The last-mentioned species is found only in the southern-most areas of Lao PDR (Fooden, 1995). Although evolutionary scenarios were proposed for these macaque species (Fooden, 1980; Delson, 1980), the details have not been elucidated yet. It is especially true for rhesus macaques, which have geographically wide ranges, from Afghanistan in the west to China in the east, and to the Indochina Peninsula in the south. They have been classified into 10 or more subspecies (Fooden, 2000). However, regarding the smaller variation in morphology and genetic properties between local populations, six subspecies are retained with the reservation of future studies (Groves, 2001; Brandon-Jones et al., 2004). Fooden (2000) denied subspecific classification, but proposed three geographical groups; eastern (China and its vicinity), western (India and its vicinity), and southern (Indochina Peninsula). Molecular studies also showed Indian and Chinese major clusters (Smith and McDonough, 2005 and Smith et al., 2007). The southern group was hypothesized to be the offspring of hybrids with long-tailed macaques, which are parapatrcially distributed to the south of rhesus macaque range. The hybrid zone is supposed to lie between 15-20°N (Fooden, 1997, 2000; Hamada et al., 2006). Based on the genetic analyses, Tosi and his colleagues (2002) suggested that long-tailed macaques inhabiting the Indochinese zoogeographical region, that is, north to the Isthmus of Kra, have been genetically influenced by the rhesus macaques. The rhesus populations distributed to the northern region of Lao PDR are not considered to have acquired any genetic hybridization from long-tailed macaques, however, this notion requires testing to establish its validity first. The transitional zone between eastern and western groups of rhesus macaque is considered to lie around 95° E (Fooden, 2000), meaning that the zone lies in northern Lao PDR. Therefore, the biological characteristics of rhesus populations inhabiting northern Lao PDR are of much interest, but currently are little studied.

Pig-tailed, Assamese and stump-tailed macaques have been described from various localities in Lao PDR inclusive of the northern localities (Duckworth et al., 1999), though the pig-tailed macaque was suspected not to range there (Fooden, 1975). The former two species are considered to ecologically compete with each other (Fooden, 1982), resulting in the latitudinal and altitudinal segregation. Assamese macaques tend to be distributed to the more northerly and elevated localities than pig-tailed macaques. However, the exact nature of competition and for what resources, and thus the proposed competitive exclusion have not been evaluated.

Information on langurs (leaf monkeys) that inhabit Lao PDR is meager, and their classification accordingly differs with authorities. There are two species or species-groups of langurs that are supposed

to reside in northern Lao PDR. One taxon is the Francois's langur (*Trachypithecus francoisi*) and its subspecies or closely related species (Brandon-Jones et al., 2004), which are treated as "Francois's group". This group is characterized by the glossy black pelage color in the majority of the body, a blackish face, and sharply pointed crown crest hairs. Within them, *T. f. francoisi* and *T. (f.) delacouri* are suggested to reside in the northern region. The distribution of the latter, if any in Lao PDR, is considered to be restricted to the national boundary area between north eastern Lao PDR and Vietnam.

The second candidate species is Phayre's langurs, whose classification has been recently revised from *Semnopithecus phayrei* (Corbet and Hill, 1992), to *Trachypithecus phayrei* (Groves, 2001), or to *T. barbei holotephreus* (Ash gray leaf monkey, Brandon-Jones et al., 2004). We provisionally describe here Phayre's langurs (*T. phyarei*). Phayre's langurs are known from the north and central Lao PDR (Duckworth et al., 1999) and live in areas 800 m a.s.l. or lower. Because of its grayish pelage, this langur species is often confused with silvered langurs in Lao PDR (*Semnopithecus* (or *Presbytis*) *cristatus*, but recently revised as *T. cristatus* or *T. germaini*; Indochinese Lutung, Groves, 2001). However, the latter is known from only the southernmost area of Lao PDR.

Three species of gibbons can be found in the northern region, two *Nomascus* and one *Hylobates* species. The *Nomascus* gibbons are poorly characterized as to what species they are composed of and where each member species resides (Geissmann, 1995). The black gibbon (or black crested gibbon, *Nomascus concolor*) is considered to be distributed only in the Bokeo Province on the left bank of the Mekong River, that is, in the Nam Kan Proposed NBCA (south-western extension of Nam Ha NBCA, Duckworth et al., 1999). Another *N. concolor* population was reported from Houa Phan Province (North eastern Lao PDR). However, Geissmann (1995) suggested that this form is restricted to the east of the Black River in Vietnam. Therefore, the population, if any, should be restricted to the national border area. The population in the north western Lao PDR, reported from Ban Nam Kheung, was described as *N. c. lu*, but Brandon-Jones et al. (2004), citing Geissmann (1989), suspected that this form is a hybrid between *N. concolor* and *N. leucogenys*.

The second species-complex is the pale-cheeked *Nomascus* gibbons which are distributed widely across Lao PDR. Three species, *leucogenys*, *siki* (classified as full species or sub-species of *leucogenys*, Brandon-Jones et al., 2004), and *gabriellae*, are classified, and they are distributed in the north, central, and extreme south Lao PDR, respectively (Fooden, 1996). Surveys in 1997-1998 across the NBCAs of northern Lao PDR (Duckworth et al., 1999) found large populations of *N. leucogenys* only in Nam Xam NBCA and parts of Phou Loei NBCA.

White handed gibbon, *H. lar* was reported from Nam Phoun NBCA, right bank of Mekong River, in the northern Lao PDR (Boonratana, 1997). Thus the lar gibbon was not expected to be found in the area surveyed by us.

The exact distribution and classification of primates have not yet been determined in the northern region of Lao PDR. Field surveys have been conducted in NBCAs by Laotian government, IUCN, and conservation

NGOs (e.g., Wildlife Conservation Society), but sufficient broad and in-depth surveys, including those for primates have not been carried out. For example, the targets of surveys in NBCA were often such rare and flagship species as tigers or rhinoceros, and whilst the camera-trapping method was applied, those surveys are not necessarily suitable for primate fauna. Moreover, the areas outside of NBCAs have not been surveyed.

APPENDIX II

Local names of Primates

Several common names were used to indicate non-human primates (Table 5). People specify species with an adjective following the common names. The most frequently used common name is "Ling" of Thai-Laotian language, but it was never used for gibbons. The adjective used to specify loris is "Lom", meaning "monkeys flying with a wind". Those for macaques are, "Daeng" (red), "Na (or Nah) Daeng" (red face), "Wok" (common for Thai-Laotian) for rhesus; "Hang Khor (or Hang Ngor)" and "Khang (or Kang)" for pig-tailed macaques; "Kang", "Kwai" (buffalo), "Mai" (wood), "Mon", "Wok" (confused with rhesus) for Assamese macaques; and "Dam (or Dum)" (black), "Din" (ground), "Kang", "Leuad Tha Na (or Nah)" (red face and hip), "Na (or Nah) Daeng" (red face), "Thi Kon", "Thon" for stump-tailed macaques. Adjectives used for langurs are "Hang Yao" (long-tailed monkeys, common in Thai-Laotian) or "Kyo".

The second common name is "Amiew", "Myuo" or their derivatives. Lorises are called as "Amiew Ma Tozae", "Miew Lor", "Myuo Lang", or "Myu Rou". Macaques are called as only "Amiew" or "Myuo Pheu" (white) for rhesus; "Amiew Bappeu" (white face) for pig-tailed and Assamese macaques; and "Amiew Bane" (red face). Langurs are called slightly differently as, "Aminew Yeu" or "Amyunyuna". "Nyah" for langurs is considered to be derivative (abbreviated) from these names. Gibbons are called as either "Amiew Na" or "Meu Na". Thus, langurs and gibbons may be taken by people closely related with each other.

The third common name is "Dabbo" and its derivatives, "Dabbor", "Dabbro", "Dabbodo". Lorises were not indicated by this common name. For macaques, rhesus was called only "Dabbor" or "Dabbro Apuicheu" and stump-tailed macaques were called "Dabbo Chong Ti" or "Dabbodo". Langurs are called "Dabbo Tong Houng" or "Dabbo Thompho". Gibbons are called "Dabbor Nareu".

In addition to the system of common name followed by adjectives, each of lorises, macaques, langurs, and gibbons is called by a specific class of names. Lorises are called as "Laicheng", "Lai-Chaul", or "Lai-Chouron", and followed by "Noi" or "Nyai" for specification of big and small, respectively. They are also called as "Keuk Keyiya", "Kouin", "Kou-Kouin", or "Koun Keiaa", which probably mimic their sound. Unique names for lorises are "Alahkoua" and "Hyn-dum".

The macaques were commonly called as "Hwua" or its probable derivative of "Khuato-Haa"; "Lia"; "I-Ko", "E-Ko" or "Ko-O"; and "Wok" for rhesus or "Wokko-Tok" for pig-tailed macaques which may have come from the Thai-Laotian "Ling Wok". "Yo-Yong" was

uniquely used to indicate rhesus macaques in Ngay Neua village.

Special names for langurs were "Khang", "I-Khang" or "Chang" which are commonly used in Thai-Laotian with adjectives to follow, e.g., "Khang Mon", "Khang Mhok", and "Khang Houa Chuk". These names are used confusingly to both of Phayre's and Francois's langurs.

Gibbons are called "Chany" which is common in Lao PDR, and its derivatives of "Tha Ni" or "Nang Ni". They are also called as "Lior" or "Re-Olle", which may be similar to the "Lia" for macaques. Unique name of gibbons is "Agile".