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PRIMATE POPULATION DENSITY AND SIZES IN BAC SON DISTRICT, LANG SON PROVINCE

Nguyen Vinh Thanh[1,*], Nguyen Dinh Duy[2], Ly Ngoc Tu[2], Nguyen Danh Khang[1], Le Truong Giang[3], Pham Anh Tuan[3] and Tran Minh Dung[3]

[1]*VNU University of Science, Vietnam National University, Hanoi*
[2]*Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology*
[3]*NorthWest Sub-Institute, Forest Inventory and Planning Institute*

Abstract. Primate species composition has been surveyed in Bac Son district, Lang Son province, but no study has provided an estimation of the primate densities. Our research was conducted in 32 days, in September-October 2018 using line transects for 21 days and 11 nights. In Bac Son district, 03 primate species have been recorded including Bengal Slow Loris (*Nycticebus bengalensis*) with a density of about 0.02 individuals/ha, a population size estimated at 673 individuals, Rhesus Monkey (*Macaca mulatta*) with a density of about 0.03 individuals/ha and estimated population size of about 1010 individuals, and the Assamese Macaque's (*Macaca assamensis*). Information on *Macaca assamensis* was only obtained from interviews and that was estimated of more than 12 individuals. Primate species were only found in secondary forests on rocky mountains, but not in soil mountainous areas, possibly due to higher hunting pressure.

Keywords: *Macaca assamensis*, *Macaca mulatta*, population density, *Nycticebus bengalensis*, primate.

1. Introduction

Bac Sơn is a mountainous district in Lang Son province, bordering two provinces Thai Nguyen and Bac Kan. With many forest areas connecting with two neighboring provinces and Huu Lien Nature Reserve, Bac Son is forming a convenient green corridor for primates. Tran Hong Viet (1995) [1] gave a list of 63 mammal species of Binh Gia and Bac Son districts, in Lang Son province, in which there were 6 primate species (including Bengal Slow Loris *Nycticebus bengalensis*, Rhesus Monkey *Macaca mulatta*, Stump-tailed Macaque *Macaca arctoides*, Northern Pig-tailed Macaque *Macaca leonina*, Francoi's Langur *Trachypithecus francoisi*, and Western Black Crested Gibbon *Nomascus concolor*), without Assamese Macaque *Macaca assamensis*. The population

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Contact Nguyen Vinh Thanh, e-mail address: nguyenvinhthanh@hus.edu.vn

of two species *N. bengalensis* (formerly known as *N. coucang*) and *M. mulatta* were assessed by Tran Hong Viet (1995) [1] to have the same abundance. Dang Ngoc Can *et al.* (2000) [2], Tran Hong Viet and Tran Hong Hai (2003) [3] provided a list of mammals of Lang Son with the addition of *M. assamensis* to the list of 7 primate species in the province. Do Anh Dung (2006) [4] also recorded primates and reported the wildlife trade in 6 districts of Lang Son province in the period from 1998 to 2004. Dang Ngoc Can *et al.* (2008) [5] stated that there was no such species of *Nomascus concolor* in Lang Son. Nguyen Truong Son *et al.* (2011) [6] listed only five primate species in Lang Son, including Bengal Slow Loris, Stump-tailed Macaque, Assamese Macaque, Rhesus Monkey, and Francoi's Langur. In recent times, this area and the quality of forests in the area have been strongly affected by human activities, such as converting natural forests into production forests, hunting, road construction, etc. Although the presence of primate populations is still recorded, now it is believed that there are only 3 primate species remaining in the area, including Rhesus Monkey (*Macaca mulatta*), Assamese Macaque (*Macaca assamensis*), and Bengal Slow Loris (*Nycticebus bengalensis*). The number of subpopulations is also very limited and scattered. There have been no studies to estimate the population size and density of the primates in this area. The preliminary interview results with the local people show a decrease in the diversity of primates in the area compared to those 20 years ago due to the disappearance of 03 primate species including Stump-tailed Macaque (*Macaca arctoides*), Northern Pig-tailed Macaque (*Macaca leonina*), Francois' Langur (*Trachypithecus francoisi*). To assess this declining trend, we researched to record the presence of primate species and estimate their population density and sizes at 03 communes: Tan Tri, Nhat Tien, and Nhat Hoa, in Bac Son district. The results of the study may contribute to the Lang Son biodiversity database and serve as the scientific basis for conservation management and biodiversity research in the future.

2. Content

2.1. Time, place, and research methods

The research subjects are primates in Bac Son district, Lang Son province, focusing on populations in 3 communes Tan Tri, Nhat Tien, and Nhat Hoa. The study period was 32 days, as follows: September 24 to October 3, 2018: Survey in Tan Tri commune; October 4 to October 11, 2018: Survey in Nhat Hoa commune; October 12 to October 25, 2018: Survey in Nhat Tien commune.

The interview was carried out with local officials and local people, hunters, or people who used to hunt and snare animals. The interview form combines single interview and group interviews to collect more accurate information. The interview results were used to select the survey area and build a system of transects. The interview information was not used for calculation.

Transects were established based on topographic and forest status maps, and existing or newly created trails (Figure 1, see Results and Discussion). There was a total of 21 times of transect surveys. The survey time was from 6:00 to 17:30 (for diurnal primates) and from 20:00 to 24:00 (for nocturnal primates). When a primate is detected, it is observed by eye or binoculars. A GPS Garmin 64s was used to determine the coordinates of the encounter point. Habitat description of the area was recorded in the survey form.

Because the number of encounters for each primate species in Bac Son was not enough to apply the method described by Buckland *et al.* (1993 [7], 2004 [8]), the density (D) of a species (individuals/hectare) was estimated based on the total number of observed individuals of a species (N) divided by the total surveyed square (S).

$$D = N/S \text{ (individuals/ha)}$$

The total surveyed square (S) was calculated as the average observation distance (A) multiplied by the total length of the survey transects (L). In this area, day-by-day transects were established along trails, that follow close to the rocky mountains, so only one side of the transects can be observed. An estimated average observation distance was of 100 metres, so A_{day} = 100 m. The night transects also follow the same trails but have an estimated average observation distance of about 15 meters, so A_{night} = 15 m.

$$S = A*L \text{ (hectares or ha)}$$

The population size of a primate species (P) was calculated as the density (D) of the species multiplied by the total natural forest square of Bac Son district (T). According to Decision No. 911/QD-BNN-TCLN dated March 19, 2019, announcing the state of national forests in 2018, the total natural forest square of Bac Son district was 33651.6 hectares (ha). Therefore, T = 33651.6 ha.

$$P = D*T \text{ (individuals)}$$

2.2. Results and discussion

Currently, there are only 3 primate species remaining in the area, including Bengal Slow Loris (*Nycticebus bengalensis*), Rhesus Monkey (*Macaca mulatta*), and Assamese Macaque (*Macaca assamensis*). These species are listed in Vietnam Red Data Book (2007) as Vulnerable (*N. bengalensis* and *M. assamensis*) and Lower Risk (*M. mulatta*). They are also included in Decree No. 84/2021/ND-CP dated September 22, 2021, of the Vietnamese Government. *Nycticebus bengalensis* is listed in Group IB and the two macaque species are categorized in Group IIB of the decree. The detailed data of the 3 primate species' population size and distritbution are summarized in Figure 1 and Table 1.

Table 1. Primate species found in communes of Bac Son dítrict

No.	Species	No. of individuals	Location/Coordinates	Source
1	*Nycticebus bengalensis*	1	Tan Tri commune 389115/2421860	Observed, photos
2	*Macaca mulatta*	7	Tan Tri commune 387293/2418527	Observed, photos
		5 - 7	Nhat Hoa commune 398215/2409789	Observed, photos
		5 - 7	Nhat Hoa commune 398088/2408815	Observed, photos
		2	Nhat Tien commune 394889/2400233	Observed, photos
3	*Macaca assamensis*	10 - 12	Nhat Tien commune	Interview

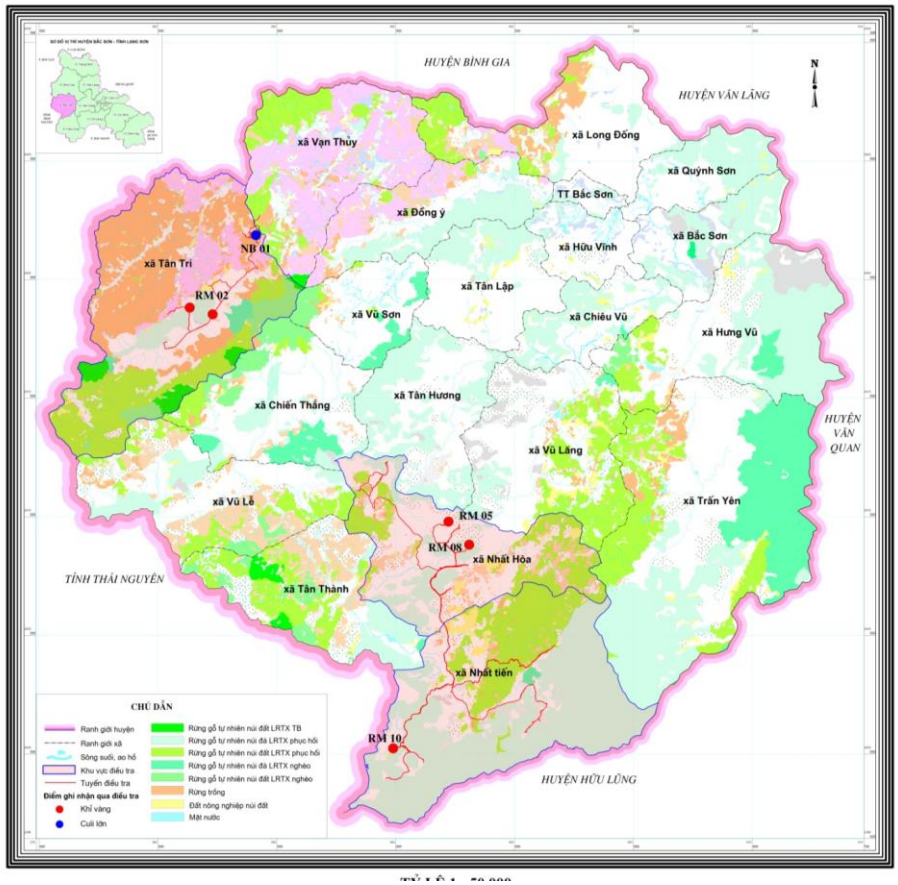

Figure 1. Map of field record of primates at 3 communes in Bac Son district

**** Nycticebus bengalensis***

There was only one individual of *Nycticebus bengalensis* was observed in the study site, at Suoi Tat area, Tan Tri commune (see Table 2 and Figure 2).

Figure 2. A Bengal Slow Loris individual at Suoi Tat area, Tan Tri commune

Overall, in 11-nights survey transects, as in Table 2: $L_{N.bengalensis}$ = 33100 m; $N_{N.bengalensis}$ = 1 individual; $S_{N.bengalensis} = A_{night} * L_{N.bengalensis}$ = 15 * 33100 = 496500 m^2 = 49.65 ha; $D_{N.\ bengalensis} = N_{N.bengalensis} / S_{N.bengalensis}$ = 1/33.1 ha ≈ 0.02 individuals/ha; $P_{N.\ bengalensis}$ = 0.02 * 33651.6 ≈ 673 individuals.

Table 2. Night surveys for Nycticebus bengalensis in the Bac Son district

No.	Area name	No. of replication	Transect length (meters)	No. of observed individual(s)
1	Na Mau mountain	1	2800	0
2	Tang Dien moutain	1	2700	0
3	Suoi Tat	1	2500	1
4	Lan Danh, Lan Duong	1	3500	0
5	Kha Village	1	3800	0
6	Lan Quang, Lan Oai	1	3300	0
7	Lan Nhan, Lan Hui	1	2400	0
8	Lan Lay, Lan Day	1	3800	0
9	Lan Lan Do	1	3100	0
10	Lan Ong Hien Cai	1	2700	0
11	Lan Lang	1	2500	0
Total		***11***	***33100***	***1***

**** Macaca mulatta***

Survey data of 19 Rhesus monkey individuals observed in Bac Son district were shown in Table 3 and Figure 3.

Overall, in 21-day survey transects, as in Table 3: $L_{M.\ mulatta}$ = 62400 m; $N_{M.\ mulatta}$ = 19 individuals; $S_{M.\ mulatta} = A_{day} * L_{M.\ mulatta}$ = 100 * 62400 = 6,240,000 m^2 = 624 ha; $D_{M.\ mulatta} = N_{M.\ mulatta} / S_{M.\ mulatta}$ = 19/624 ≈ 0.03 individuals/ha; $P_{M.\ mulatta}$ = 0.03 * 33651.6 ≈ 1010 individuals.

Table 3. Daytime surveys for Macaca mulatta in Bac Son district

No.	Area name	No. of replication	Transect length (m)	Total transect length (m)	No. of observed individuals
12	Na Mau mountain	6	2800	16800	7
13	Tang Dien moutain	2	2700	5400	0
14	Suoi Tat	2	2500	5000	0
15	Lan Danh, Lan Duong	1	3500	3500	0
16	Kha Village	2	3800	7600	0
17	Lan Quang, Lan Oai	1	3300	3300	5
18	Lan Nhan, Lan Hui	1	2400	2400	5
19	Lan Lay, Lan Day	2	3800	7600	0
20	Lan Lan Do	1	3100	3100	0
21	Lan Ong Hien Cai	1	2700	2700	0
22	Lan Lang	2	2500	5000	2
Total		**21**		**62400**	**19**

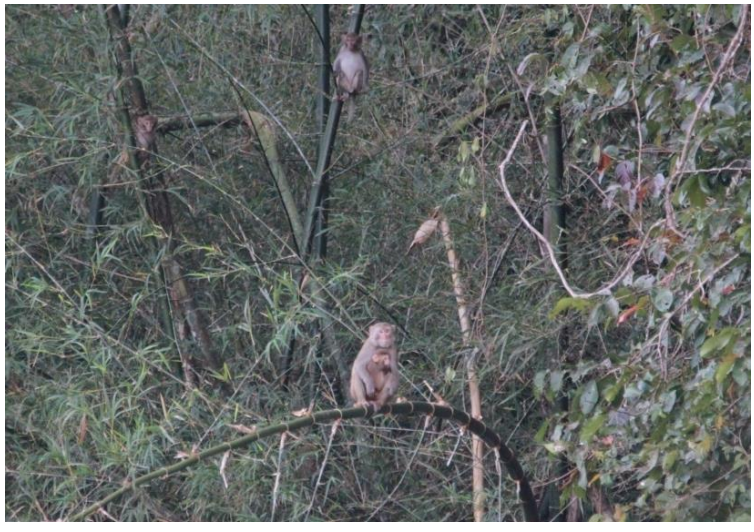

Figure 3. Macaca mulatta individuals at Lan Quang, Nhat Hoa commune.

**** Macaca assamensis***

Based on interview data, we determined that in the Bac Son district, there are at least two groups of *M. assamensis* with a total of 10 -12 individuals. However, it seems that they only appear in the Nhat Tien commune. The monkeys were not recorded in the field, so the population density could not be calculated. Through interviews, the size of each group observed was about 5-6 individuals. The habitat of the Assamese macaques in the area is poor forest, regenerated forest on limestone mountains. No evidence of the macaques has been found in this area when the forest was transited into plantation forests. At the same time, long-term hunting in easily accessible mountainous areas has led to this situation.

**** Discussion***

The results of this study show that among the three primate species distributed in Bac Son district, *M. assamensis* was the most difficult to encounter, while *M. mulatta* was the most frequent. This seems consistent with previous studies. Tran Hong Viet (1995) did not mention *M. assamensis* in the list of mammals in Binh Gia and Bac Son districts, Lang Son province, and then Dang Ngoc Can *et al.* (2000) provided a list of mammals of Lang Son with the addition of the *M. assamensis*, which proves that this species is not easy to find by field survey. Furthermore, Do Anh Dung (2006) documented the wildlife trade in 06 districts of Lang Son province from 1998 to 2004, it seems that the Bengal Slow Loris (481 individuals) and the Rhesus Macaque (139 individuals) were easier to meet and catch than Assamese Macaque (1 individual). The number of two species *N. bengalensis* (formerly known as *N. coucang*) and *M. mulatta* were assessed by Tran Hong Viet (1995) to have the same richness and were the species with a small number, as denoted by symbol (++) in the report. The current suitable habitat area for loris species is about 64.2 km^2, concentrated in 2 communes of Tan Tri and Van Thuy. The habitat of the Bengal Slow Loris recorded in the area was timber-bamboo mixed forest. However, several of these areas are gradually being converted into plantations. At the same time, hunting activities took place quite often in the area. In the face of hunting pressure, the Bengal Slow Loris was probably the more vulnerable species and more difficult to recover, as shown in the data by Do Anh Dung (2006). Furthermore, the lorises are nocturnal primates and were known to have low densities (Streicher, 2004; Nekaris *et al.*, 2008), so a low degree of detection probability is common. Most of them were recorded in disturbed forest areas as reported in previous studies (Streicher, 2004; Starr *et al*., 2011; Nekaris & Starr, 2015). These studies explained why all three primate species can be found in secondary forests and why the probability of loris detection was the smallest among the 3 species. However, in this study, the easier encounter of *N. bengalensis* than *M. assamensis* could be explained by the assumption that *M. assamensis* is more intelligent and better at avoiding people, or by the Assamese macaque population had declined so much that it was very difficult to find them. The high rate of encounters with another macaque species, *M. mulatta*, in the same area, suggests that the reason for the population decline of the Assamese macaque may be due to competition with *M. mulatta*, rather than hunting pressure or habitat loss.

3. Conclusions

Three primate species have been recorded in Bac Son district, including the Bengal Slow Loris (*Nycticebus bengalensis*), the Assamese macaque (*Macaca assamensis*), and the Rhesus monkey (*Macaca mulatta*). In the field, a Bengal Slow Loris individual was observed one time and the species density estimated was about 0.02 individuals/ha, the population size in Bac Son district was estimated at about 673 individuals. The number of Rhesus Monkey individuals observed was 19 the estimated density was about 0.03 individuals/ha and the population size for the Bac Son district was calculated at about 1010 individuals. *Macaca assamensis* information was collected through interviews with an estimated population size of more than 12 individuals for the Bac Son district.

Recommendation:

- More studies are needed to estimate primate density in Bac Son and surrounding areas to compare with this result, and periodic surveys to predict a tendency for primate populations to increase or decrease.

- Strengthening forest protection, propagandizing to raise people's awareness about the conservation of rare and endangered wildlife species. It is necessary to create livelihoods for people to limit illegal hunting activities.

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