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## **A large population of the northern yellow-cheeked gibbon (*Nomascus annamensis*) and new records on the primate diversity in Ba Na-Nui Chua Nature Reserve, Danang, Vietnam**

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**Key words:** *Nomascus annamensis*, *Pygathrix nemaeus*, *Macaca arctoides*, *Macaca leonina*, *Nycticebus pygmaeus*, listening posts, trail surveys, camera traps, Annamite Mountains

### **Summary**

Primates are in the focus of conservation in the Central Annamite Mountains, and biological assessments, such as on-the-ground surveys, are essential for providing necessary data to develop suitable conservation strategies to ensure their long-term survival. Ba Na-Nui Chua Nature Reserve (BNNC), is located in the vicinity of Danang City in Vietnam and encompasses a stretch of evergreen forests that has not been surveyed extensively. Especially for the newly included expansion areas, northwest of the original reserve boundaries, there is only limited information. Of particular concern in this area are the crested gibbons (*Nomascus* spp.) and douc langurs (*Pygathrix* spp.) and information on their distribution and population status are urgently needed. From June 2016 to July 2017, we conducted mixed methodology interview surveys of reserve rangers and local residents in order to assess the presence of primate species in the area. The study revealed that at least six primate species occur. Five of these species were confirmed during the subsequent surveys: northern yellow-cheeked gibbon (*Nomascus annamensis*), red-shanked douc langur (*Pygathrix nemaeus*), stump-tailed macaque (*Macaca arctoides*), northern pig-tailed macaque (*M. leonina*), and pygmy loris (*Nycticebus pygmaeus*).

We surveyed the 2000 ha of the expansion areas and recorded 14 to 16 groups of the northern yellow-cheeked gibbon, which lead us to estimate a total population in the expansion areas of more than 100 groups.

Based on these findings, we recommend conservation and research activities in BNNC and promote the long-term protection of primates at this site by incorporating BNNC as part of the critical conservation priority area in the Central Annamite Mountains.

## **Ghi nhận mới về 2 loài linh trưởng quý hiếm vượn đen má hung phía bắc và voọc chà vá chân nâu và những thông tin chung về khu hệ linh trưởng ở khu bảo tồn thiên nhiên Bà Nà – Núi Chúa, Đà Nẵng.**

### **Tóm tắt**

Khu bảo tồn thiên nhiên Bà Nà – Núi Chúa (BNNC) nằm ở phía Tây Bắc thành phố Đà Nẵng, miền trung Việt Nam, với hơn 30.000 hecta rừng thường xanh mùa mưa mùa nhiệt đới ẩm. Khu bảo tồn bị tác động mạnh từ các khu du lịch, đường cao tốc, và dân cư sống xung quanh khu vực vùng đệm. Kết quả khảo sát trước đây đã từng ghi nhận có mặt của loài Voọc chà vá chân nâu, 1 loài Vượn, và các loài Khỉ tại khu bảo tồn BNNC, tuy nhiên, chưa có thông tin chi tiết về hiện trạng quần thể của các loài. Từ tháng 6.2016 đến tháng 7.2017, chúng tôi đã sử dụng kết hợp nhiều phương pháp khác nhau gồm: phỏng vấn 40 người tại địa phương, khảo sát trên 30.1km tuyến và 5 điểm nghe Vượn hót, và

lắp đặt 24 điểm đặt bẫy ảnh (Camera Trap) để điều tra thành phần loài và hiện trạng quần thể các loài Linh trưởng tại đây. Kết quả, chúng tôi xác định được có ít nhất 5 loài linh trưởng phân bố trong khu bảo tồn thiên nhiên BNNC gồm Vượn má hung phía bắc (*Nomascus annamensis*), Vượn chà và chân nâu (*Pygathrix nemaeus*), Khỉ đuôi lợn bắc (*Macaca leonina*), Khỉ mặt đỏ (*Macaca arctoides*); và Cu li nhỏ (*Nycticebus pygmaeus*). Trong đó, chúng tôi ghi nhận được 14 -16 đàn Vượn đen má hung phía bắc tại 5 điểm nghe. Ngoài ra, trên các tuyến khảo sát ghi nhận được 6 đàn Vượn chà và chân nâu với khoảng 36 – 44 cá thể và đặc biệt có hình ảnh từ 3/24 điểm đặt bẫy ảnh ghi nhận loài này hoạt động dưới đất. Cán nhân mạnh là loài Khỉ đuôi lợn và Khỉ mặt đỏ rất hiếm gặp trực tiếp khi khảo sát trên tuyến, nhưng cả 2 loài này đều cùng xuất hiện và được ghi lại hình ảnh từ 15/24 điểm đặt bẫy ảnh.

**Introduction**

The Central Annamite Mountains are home to an incredible diversity of wildlife and have been identified as an area of global conservation priority area of critical biological importance (Tordoff et al. 2003). Primates are a conservation focus within this priority landscape, and biological assessments, such as on-the-ground surveys, are essential for providing the necessary data to develop suitable conservation strategies. Of particular concern are the crested gibbons (*Nomascus* spp.) and douc langurs (*Pygathrix* spp.). Information on the species distribution and population status is either lacking or incomplete (Pham Hong Thai 2015).

Ba Na-Nui Chua Nature Reserve (BNNC), is located in the vicinity of Danang City, Vietnam (15°57'-16°08'N, 107°49'-108°04'E) and encompasses a stretch of evergreen forest spanning from the foothills of the Central Annamites to the lower montane level. The reserve was established in 1986 and originally covered 8,134 ha. It was enlarged in 2013 to a total size of 32,377 ha through the addition of two expansion areas.

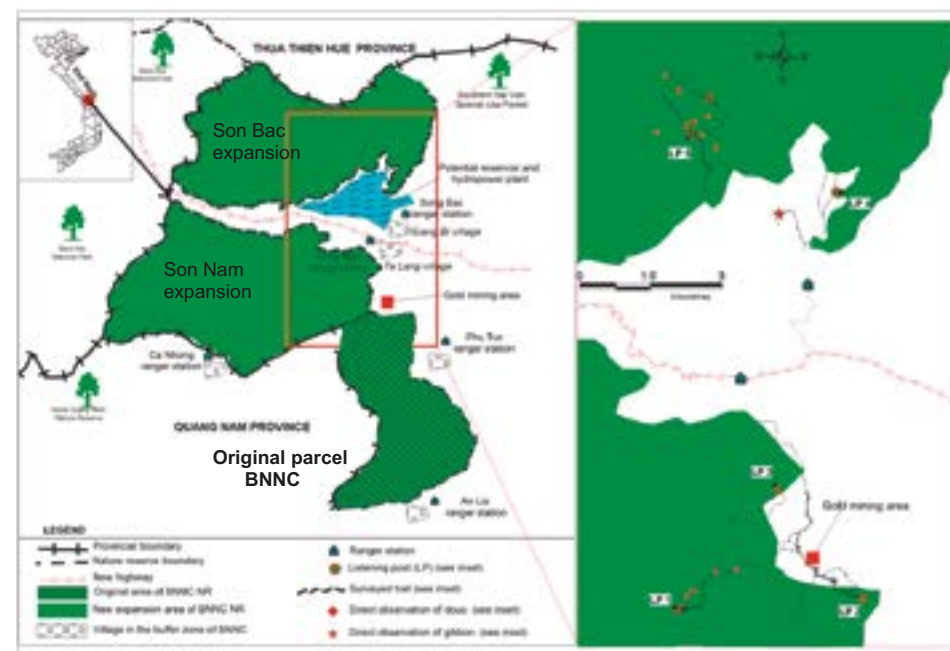
The diversity of flora and fauna in BNNC is high. Of particular interest is that many plant species possess transitional characteristics between those of the northern and those of the southern eco-regions of Vietnam (Dinh Thi Phuong Anh et al. 2005). Several notable surveys have been conducted since the 1990's. Currently 739 vascular plant, 77 mammal, 214 bird, 81 reptile, 38 amphibian, 33 fish and 126 butterfly species are recognized for the area (Pham Hong Thai 2015; Le Vu Khoi et al. 2011; Dinh Thi Phuong Anh et al. 2005; Hill et al. 1996).

However, all surveys were conducted in the original parcel of BNNC, and none of them focused on primates. Consequently there is not only no data on the status of primates in the expansion area but data reflecting the primate diversity within the original nature reserve is also lacking.

This study constitutes the first inventory of primate species in the BNNC expansion areas.

**Study sites**

The primate surveys were conducted within the two expansion areas of BNNC Nature Reserve. The southern expansion is locally known as Song Nam and comprises 12,401 ha and the northern expansion as Song Bac and comprises 11,841 ha (Fig. 1). The surveyed areas represent approximately 2,000 ha or about 10% of the total expansion area. The study sites ranged from 70 to 1200 m asl, with an elevations increasing from south (maximum 900 m asl) to north (maximum 1,200 m asl). Comparatively, the terrain of the northern expansion is more rugged than the south, consisting of a number of deep river valleys, and steep ridges with prominent rock outcrops.



**Fig.1.** Ba Na-Nui Chua Nature Reserve and the expansion areas Song Nam and Song Bac. Insert map show the study site and surveyed trails, listening posts and direct sightings of red-shanked douc langurs (*Pygathrix nemaeus*) and northern yellow-cheeked gibbons (*Nomascus annamensis*).

As BNNC is situated in the Central Annamite Range, the climate is characterized as tropical monsoon climate with two distinct seasons; the wet season lasts from August to December, with the greatest amounts of rainfall in October and November, the peak of the dry season falls between February and June. The total annual rainfall averages about 2,500 mm. Average daily temperature ranges from approximately 20°C in December and January, to approximately 29°C in June, July and August (Nguyen Khanh Van et al. 2000).

The main vegetation types at BNNC are lowland evergreen forest (<1,300 m asl) and lower montane evergreen forest (>1,300 m asl) (Fig. 2). Dipterocarpaceae dominate the lowland evergreen forest, but are absent in the lower montane evergreen forest, which is characterized by Fagaceae, Lauraceae and Podocarpaceae (Hill et al.1996).



**Fig.2.** Lower montane evergreen forest at Ba Na-Nui Chua Nature Reserve. Photo: T. Nadler.

Selective logging occurred in the Annamite Mountains in the early 1900's, and the habitat suffered further devastation during the Vietnam War. Consequently the forests at all elevations in BNNC have been impacted. Previous clearings support only secondary growth, which varies in vegetation structure and composition depending on the time that has elapsed since the disturbance. The original parcel of BNNC has been opened for tourism in 2002 and in the past 15 years habitat disturbance has increased dramatically, especially on Ba Na Mountain where a major tourism development transformed the forest area into a resort and amusement park, which included the installation of a 5.8 km long cable car system. The area is a very popular tourist destination and averaging 5000 visitors daily, the number of visitors to Ba Na Mountain surpassed 1.5 million in 2015 (Data: Ba Na Cable Car Co., Ltd) (Fig. 3).



**Fig.3.** Mountain top in Ba Na-Nui Chua Nature Reserve in 2012 during the conversion in a Mega-Tourist Amusement Park. Photo: T. Nadler.

The original BNNC Nature Reserve forest is contiguous with the southern expansion. However, the northern expansion is separated from the southern expansion and the original nature reserve's forest by the nearly completed La Son-Tuy Loan Highway, which connects Thua Thien Hue Province and Danang City (Fig. 1).

Approximately 10,000 people (about 90% Kinh and 10% Co Tu ethnicities) live in several villages bordering the reserve. Although public access to the expansion areas is strictly prohibited, hunting, logging and harvesting of non-timber products still occur. There is also a small governmentally approved gold mining concession that operates on property adjacent to the eastern boundary of the southern expansion area, Song Nam.

**Survey methods**

**Interviews**

Prior to implementing the field surveys interviews were conducted in order to gather information about BNNC, and specifically, about the study sites Song Nam and Song Bac. Such interviews are important to assess the general distribution, status, and threats to the different primate species, as well as trends in primate populations during the last 15 years. The interviewees included 10 rangers of the nature reserve and 30 local residents from Ta Lang and Giang Bi villages, of whom five were retired or active hunters, 15 were non-timber forest product collectors, and ten were farmers. No rangers were present during the interviews with local residents to avoid any bias in their responses. The interviews were semi-structured; and though we used a prepared questionnaire, with a strict order in the questions, but the format also allowed the interviewees to provide additional information freely. A set of color images of primate and other mammal species, which inhabit the Central Annamite Mountains was shown to the interviewees to assess their knowledge and responses regarding species identification.

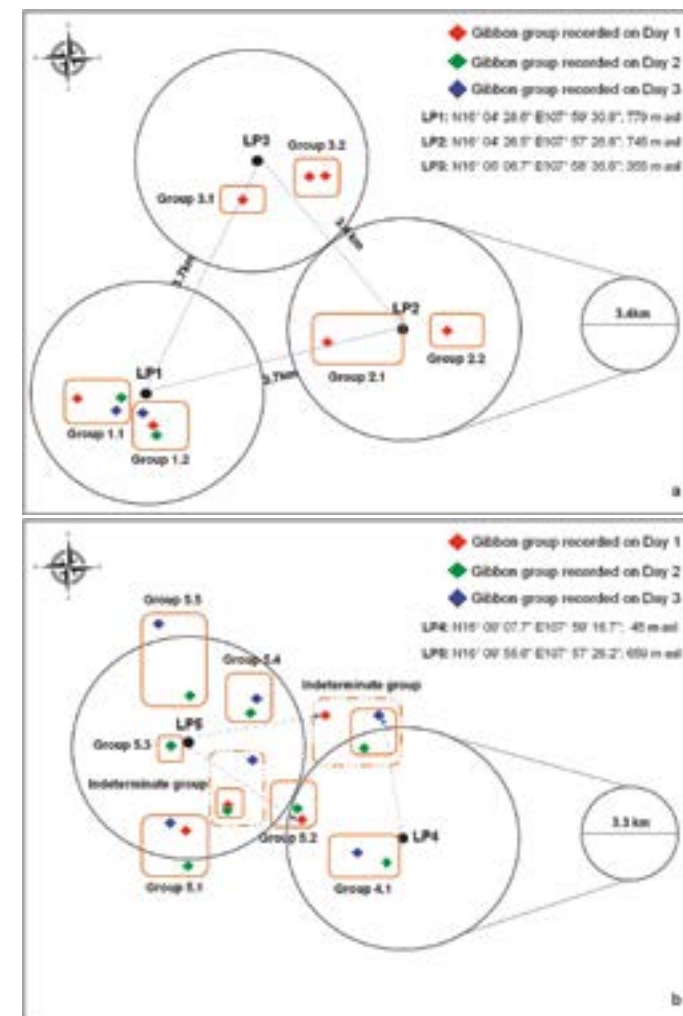
**Field surveys**

Different survey efforts but the same methodologies were used at the two study sites. In Song Nam three teams and in Song Bac two teams conducted the survey using three methods:

1. listening posts (LP) to record gibbon vocalization and to define locations
2. trail surveys (TS), walking along existing trails to detect the presence of diurnal primates by direct observation
3. camera traps (CT), deploying camera traps to capture images of terrestrial species along or near the trails

**Listening posts (LP)**

Based on the information obtained during the interviews, each team selected a LP location near their camp (100-300 m distance) to record gibbons singing every morning (Nguyen Ai Tam et al. 2017) (Fig. 4). As the camps were located at least 3.4 km apart in Song Nam and 3.3 km apart in Song Bac, it was assumed the auditory range, which the LP's covered, were non-overlapping because any gibbon songs more than 1.5 km from listening posts can not be recorded reliably and consistently (Channa & Gray 2009).



**Fig.4.** *Nomascus annamensis* groups based on acoustic data collected at listening posts and during trail surveys in Song Nam (a) Song Bac (B).

Between approximately 5am and 7:30am gibbon songs were recorded on either a Sony ICDPX370 Mono Digital Voice Recorder or Roland R-26 6-Channel Digital Field Audio Recorder with a Takstar SGC-568 directive interview microphone. The distance and direction of the vocalization were noted to a field diary (Brockelman & Srikosamatara 1993).

#### Trail surveys (TS)

Diurnal surveys were conducted along 13 existing trails in Song Nam (n=7) and in Song Bac (n=6). Each trail was walked only once. The survey began at about 8am and ended between 4pm and 6pm, depending on the length of the trail (range: 1.7-3.4 km). The species of primates observed were identified directly or with the aid of binoculars. Photographs were taken when the situation allowed. The numbers of individuals in the group, sex and age classes were recorded when possible. The time of encounter, habitat type, and forest condition and GPS coordinates were noted using a Garmin 62Sc GPS unit.

#### Camera traps (CT)

We deployed 21 digital camera traps with infrared sensor and no glow 'black' LED flash (Bushnell Trophy Cam, models 119445, 119446) along the survey trails in locations deemed suitable to monitor terrestrial mammals. The location of each camera trap was recorded by GPS with the distance between cameras being 100 to 500 m. Cameras were mounted on trees at a height of 50 to 100 cm above the ground. No baits or lures were used. The trapping effort lasted from June 28<sup>th</sup> 2016 to July 5<sup>th</sup> 2017.

Each camera was programmed as follows: still image, 8 M pixel image size, 3 photos in sequence per trigger, 5-sec interval between triggers, time and date stamp on. Each camera was fitted with a 16 GB SD card (SanDisk Ultra). Although the camera's internal battery compartment can accommodate eight AA batteries, we loaded only four (Energizer alkaline batteries) and placed four 5 g silica gel desiccant packs in the remaining slots. To further reduce the possibility of moisture accumulating inside the battery compartment, the rubber gasket around the battery compartment was coated with silicone grease (Nikon WP-G1000) before closing the camera case (Tan et al. 2015).

The cameras were examined at 37-275 day intervals depending upon remoteness of location. Batteries and/or SD cards were replaced as necessary. The images were evaluated, and if the quality was poor and/or the number of animal pictures captured was low, the cameras were remounted at a different location. The number of trap days (24-hr period) from date of camera deployment until date of retrieval was calculated. Any data resulting from false-triggers, (i.e. when a camera continuously captures images even though there is no subject) were excluded. Three cameras were stolen during the study, and one camera failed. For the report we used images captured at 24 camera locations of which 14 were located in Son Nam and ten in Song Bac.

#### Results and Discussion

Using this mixed methodology we were able to confirm the presence of five primate species in the expansion areas of the nature reserve, namely the northern yellow-cheeked crested gibbon (*Nomascus annamensis*), red-shanked douc langur (*Pygathrix nemaeus*), stump-tailed macaque (*Macaca arctoides*), northern pig-tailed macaque (*M. leonina*), and pygmy loris (*Nycticebus pygmaeus*). Besides these species, long-tailed macaque (*M. fascicularis*), rhesus macaque (*M. mulatta*) and Bengal slow loris (*Nycticebus bengalensis*) have been reported in the original parcel of the reserve during the interviews (Table 1).

**Table 1.** Primate species and their conservation statuses as confirmed by previous and current studies in Ba Na-Nui Chua Nature Reserve.

Scientific, English and local names <sup>1</sup>	Conservation status		This study <sup>2</sup>			Previous studies <sup>3</sup>
	IUCN Red List	Viet Nam Red Book	DO	VA	CT	
<i>Nomascus annamensis</i> Northern yellow-cheeked crested gibbon <i>Vượn</i>	n/a	n/a	+	+		a, b, d
<i>Pygathrix nemaeus</i> Red-shanked douc <i>Độc</i>	EN	EN	+		+	d
<i>Macaca arctoides</i> Stump-tailed macaque <i>Khỉ cộc</i>	VU	VU	+		+	b, c
<i>Macaca leonina</i> Northern pig-tailed macaque <i>Khỉ đầu chó</i>	VU	VU			+	c
<i>Macaca fascicularis</i> Long-tailed macaque <i>Khỉ nước</i>	LC	LR	+			d
<i>Macaca mulatta</i> Rhesus macaque <i>Khỉ đất</i>	LC	LR				b, c, d
<i>Nycticebus pygmaeus</i> Pygmy loris <i>Khỉ gió" or cù lân nhỏ</i>	VU	VU	+			c, d
<i>Nycticebus bengalensis</i> Bengal slow loris <i>Khỉ gió" or cù lân lớn</i>	VU	VU				c

<sup>1</sup> Local name is based on the Kinh dialect.

<sup>2</sup> Survey conducted in the new expansion areas of Ba Na-Nui Chua Nature Reserve (DO = direct observation, VA = vocal analysis, CT = camera trap).

<sup>3</sup> a = Ghazoul et al., 1994; b = Hill et al., 1996; c = The People's Committee of Da Nang 1997 unpublished report; d = Le Vu Khoi et al., 2011. All surveys conducted in the original reserve parcel.

#### Northern yellow-cheeked gibbon (*Nomascus annamensis*)

The majority of our interviewees recognized the gibbons in the photograph we showed but we were not able to determine if this was based solely on field sightings or if it was related to the fact that a primate information poster produced by GreenViet has been on display in the village communal areas since 2015. Rangers stationed at An Loi and Phu Tuc near the original parcel reported the extirpation of gibbons in this area around 2006 when massive deforestation occurred at Ba Na Mountain for tourism development. And during the following construction phase, many primate species have become increasingly rare. The rangers assumed that the animals migrated from the disturbed original parcel into the forest northwest of the original parcel.

Near the expansion areas, rangers of Song Nam, Song Bac and Ca Nhung stations, as well as residents of Ta Lang and Giang Bi villages all provided recent information about gibbons. Specifically the forest product collectors and hunters reported direct gibbon sightings, farmers from Giang Bi

reported hearing gibbon songs every morning while working in their fields next to the primary forest of Song Bac, and Ca Nhung rangers described hearing gibbon calls from their station (Fig. 1).

During the trail surveys in Song Bac, two groups of gibbons were observed, one group with four individuals (one adult female, one adult male and two subadult black individuals). The second group consisted of five individuals (one adult male, two yellow females, two black subadults and one juvenile) and was observed in the buffer zone.

Data on calls collected from the listening posts and during trail surveys suggested that there are 14-16 gibbon groups residing in the two study areas; six of them in Song Nam and eight to ten in Song Bac (Fig. 3). The estimated distance from the listening posts to the singing groups ranged from 200 – 2100 m. Groups located near LP5 in Song Bac were singing throughout the day, whereas other groups mainly vocalized in the early morning between 5am and 7am and occasionally in late afternoon (Fig. 4). In total 75 minutes of gibbon songs were recorded.

For species identification the recorded sound data files were first converted into WAV files and then analyzed using Avisoft-SASLab Pro. To validate the gibbon species the vocal recordings were analysed based on the methodology described by Nguyen Van Thien et al. (2017). The song of the northern yellow-cheeked crested gibbon is distinct from those of the southern yellow-cheeked crested gibbon and the southern white-cheeked crested gibbon (Van Ngoc Tinh et al. 2010a)

The current known distribution of *N. annamensis* reaches from the Thach Han River in the North (about 16°40'-16°50' N) to the Ba River in the South (about 13°00'-13°10' N) (Van Ngoc Tinh et al., 2010a, b), although this southern boundary is still in dispute (Hoang Minh Duc, pers. comm.).

Populations of *N. annamensis* are known from 18 protected areas (Rawson et al. 2011).

Our survey covered only about 10 % of the extension area of BNNC Nature Reserve and the survey areas were close to areas of human activities. We suppose that remote parts of the expansion areas still hold a significant population of the species, and estimate that there might be as more than 100 further groups.

Previous surveys referred this population to the northern white-cheeked gibbon (*N. leucogenys*) (Geissmann 2002; Hill et al. 1996; Ghazoul et al. 1994).

**Red-shanked douc langur (*Pygathrix nemaeus*)**

All interviewees recognized the red-shanked douc langur in the photographs shown to them. As was the case with gibbons, rangers of An Loi and Phu Tuc stations had not seen any signs of *P. nemaeus* since about 2006, which they attributed to habitat loss linked to tourism and continuous infrastructural development which started in 2004 and still continues. In contrast, rangers of Ca Nhung station reported seeing *P. nemaeus* often. In total, 24 out of the 40 people interviewed had seen douc langurs directly; so of all primate species the douc langur was the one most frequently observed

During the trail surveys, which covered a total distance of 30.1 km, 6 groups of *P. nemaeus* were observed; two were spotted in Song Nam and four in Song Bac. The animals were observed at elevations ranging from 440 to 1034 m asl (Table 2). Most of the groups were encountered along streams in complex terrain. At observations were made at locations, where the habitat disturbance was low and the canopy consisted of multiple layers of trees averaging 20 – 25 m in height. The smallest group comprised only three to five individuals, whereas the largest group comprised between 12 and 15 animals. We estimated the total number of animals at this location at 44 individuals. As the individuals were wary of humans only the numbers of individuals were counted, sex and age classes could not be recorded.

**Table 2.** Red-shanked douc langur groups (*Pygathrix nemaeus*) encountered during trail surveys in Song Nam and Song Bac of Ba Na-Nui Chua Nature Reserve

Site	Trail no.	Length (km)	Date	Time	Group no.	Individuals observed (estimated group size)	Coordinates	Elevation (m asl)
Song Nam	TS7	2.5	06/29/2016	07:21	1	12 (15)	N16° 04' 35.0" E107° 57' 31.9"	756
				12:04	2	3 (5)	N16° 04' 30.5" E107° 57' 30.2"	775
Song Bac	TS8	3.4	07/09/2016	15:48	3	3 (5)	N16° 09' 52.1" E107° 57' 28.9"	570
				11:48	4	4	N16° 10' 23.8" E107° 57' 13.1"	1034
				14:27	5	10 (11)	N16° 10' 09.8" E107° 57' 29.9"	725
16:34	6	4	N16° 09' 58.2" E107° 57' 38.6"					

Photographs of *P. nemaeus* were taken at three of 24 camera trap locations (Song Nam: SN05, SN07; Song Bac: SB6) (Table 3). Camera SN05 captured three juveniles of similar age playing on the forest floor (Fig. 5). This group contained at least seven individuals and in this exceptional case we were able to record sexes and age; we recorded one adult male, three adult females and three juveniles. Camera SN07 captured three individuals traveling on the ground. Camera SB6 captured one individual foraging on the ground.

**Table 3.** Camera trap locations showing presence of red-shanked douc langurs (*Pygathrix nemaeus*), stump-tailed macaques (*Macaca arctoides*) and northern pig-tailed macaques (*M. leonina*) in Song Nam and Song Bac of Ba Na-Nui Chua Nature Reserve.

Location	Coordinates	Elevation (m asl)	<i>P. nemaeus</i>	<i>M. arctoides</i>	<i>M. leonina</i>
SN02	N16° 04' 44.8" E107° 57' 48.4"	817		+	+
SN03	N16° 04' 41.4" E107° 57' 43.6"	506		+	+
SN04	N16° 04' 37.5" E107° 57' 39.0"	819		+	+
SN05	N16° 04' 34.1" E107° 57' 32.6"	508	+	+	+
SN06	N16° 04' 28.1" E107° 57' 29.9"	764		+	+
SN07	N16° 04' 26.9" E107° 57' 27.6"	743	+	+	+
SN10	N16° 04' 20.9" E107° 57' 32.8"	727		+	+
SN16	N16° 04' 28.2" E107° 59' 28.9"	754		+	
SN17	N16° 04' 28.6" E107° 59' 29.7"	761		+	+
SN18	N16° 04' 28.7" E107° 59' 30.7"	773		+	+
SN19	N16° 04' 25.9" E107° 57' 33.6"	670			+
SB05	N16° 10' 04.0" E107° 57' 21.6"	786		+	+
SB06	N16° 10' 09.3" E107° 57' 15.6"	924	+	+	+
SB07	N16° 10' 15.4" E107° 57' 11.1"	1081		+	+
SB08	N16° 10' 19.4" E107° 57' 13.0"	1058		+	+
SB09	N16° 10' 27.3" E107° 57' 14.0"	1030		+	+
SB10	N16° 10' 30.5" E107° 57' 15.6"	998		+	+
SB12	N16° 10' 09.6" E107° 57' 50.1"	643			+



**Fig.5.** Camera trap photo shows three juvenile red-shanked douc langurs playing on the ground. Photo: LVDI International/GreenViet.

*P. nemaus* is generally considered an arboreal species, but it has been already reported that individuals occasionally descend to the ground (Vu Ngoc Thanh et al. 2008; Timmins & Duckworth 1999). Our camera trap photos confirm terrestrial behavior of douc langurs. We suspect that douc langurs spend more time on the ground when undisturbed. However they might be forced to travel on the ground in disturbed habitats with forest and canopy gaps.

That douc langurs crossed roads on the ground in areas where no closed canopy remained has previously been observed in nearby Son Tra Nature Reserve (Bui Van Tuan pers. obs.), exposing the douc langurs to an increased risk of traffic accidents. The La Son - Tuy Loan Highway which divides the expansion areas of BNNC also poses a great risk to crossing wildlife, including the douc langurs.

To date no surveys investigating the presence of douc langurs have been attempted in BNNC and reports that *P. nemaus* is common in the western and eastern parts of this nature reserve (Anonymous 1994) have not yet been verified.

#### Stump-tailed macaque (*Macaca arctoides*) and northern pig-tailed macaque (*Macaca leonina*)

As with *P. nemaus*, interviewees readily recognized the photographs of the stump-tailed macaque and the northern pig-tailed macaque and reported many sightings. 16 people could identify *M. arctoides* and 20 people recognized *M. leonina* and reported recent sightings, 11 of the 16 people who recognized *M. arctoides* were forest product collectors and hunters. Of the 20 people who reported seeing *M. leonina* in the expansion areas 17 were forest product collectors and hunters, and two were rangers. Two groups of *M. arctoides* were detected during the trail surveys in Song Nam at 670 and 741 m asl. A group with more than ten individuals was observed traveling on the ground and another with 15-20 individuals was seen in the canopy about 35 m above ground. During the survey was no direct sighting of *M. leonina*.

The camera trap photos indicated that *M. arctoides* groups were present at 16 locations and *M. leonina* groups were present at 17 locations. The species coexist at 15 locations, occupying the lowland evergreen forest of Song Nam and Song Bac (Table 3, Fig. 6, 7). We did not observe any behaviors that suggested direct competition.

Interestingly only *M. leonina* treated the novel object "camera trap" as a potential threat e.g. by showing aggressive facial expressions and body posture. This species might be more protective and might defend its home range from perceived intruders.



**Fig.6.** Camera trap shot a stump-tailed macaque (*Macaca arctoides*). Photo: LVDI International/GreenViet.



**Fig.7.** Camera trap shot a northern-pig-tailed macaque (*Macaca leonina*). Photo: LVDI International/GreenViet.

#### Long-tailed macaque (*Macaca fascicularis*) and rhesus macaque (*M. mulatta*)

The occurrence of long-tailed macaques and rhesus macaques was also confirmed by the interviewees. But during our survey we could not confirm the species by camera trap or direct sighting.

*M. fascicularis* and *M. mulatta* occur sympatrically in Vietnam between 16°30'N and 12°N, which includes also BNNC (Nguyen Van Minh et al. 2012). These species prefer secondary forests and areas associated with human activity. There is no information about their current status in the reserve. In 2012, three to four rhesus macaques were observed in cages in Ta Lang and Giang Bi villages (Bui Van Tuan, pers. obs.), and possibly the monkeys were trapped in the secondary forests nearby, but this was not confirmed and the animals might as well have come from another area. Between 2004 and 2010 the Department of tourism released a group of about 20 non-native long-tailed macaques of unknown origin on the top of Ba Na Mountains as tourist attraction and provisioned them there. Within a short time the habituated animals of this group became increasingly aggressive towards tourists and the group largely disappeared due to unknown reasons and at the time of this report only three individuals remain.

#### Pygmy loris (*Nycticebus pygmaeus*)

All interviewees recognized lorises but not everyone could differentiate between pygmy loris and Bengal slow loris. Both species are reported to occur in BNNC. Lorises were directly observed by 22 interviewees. Hunters from Ta Lang and Giang Bi mentioned that they are common in secondary forest near their villages. The Co Tu ethnic minorities in this area eat lorises but among the Kinh people eating lorises is a taboo.

The survey didn't focus on lorises and no night survey was conducted. But the presence of *N. pygmaeus* was confirmed through a trapped individual from a local Co Tu hunter, who was

encountered in the forest close to a survey trail. The animal was confiscated by the accompanying ranger and released back to the forest.

### Threats to the primates in Ba Na – Nui Chua Nature Reserve

Mining, logging, monoculture plantations, over-harvesting of medicinal plants and the associated habitat destruction as well as hunting have been, and remain the major threats faced by all wildlife in BNNC (Pham Hong Thai 2015). But our survey identified several additional immediate threats to the primates in BNNC.

The rising demand for water in fast-growing Danang City, induced the People's Committee of Danang to build a dam at a narrow gorge on the Bac River near Ta Lang and Giang Bi villages. It is projected that the entire area below 100 m asl will be inundated (Fig. 1). The group of *N. annamensis* observed in this area at this elevation, will lose its territory. The flooding of forest with to will further reduce the already limited habitat currently available to primates and other wildlife. *N. annamensis* was only recently described as a new primate species (Van Ngoc Thinh et al. 2010a), and its status has not been assessed for the IUCN Red List and the Vietnam Red Data Book. Thus, a more intensive survey of *N. annamensis* in the expansion areas is urgently needed to quantify the size of this population.

Moreover, the new La Son-Tuy Loan Highway divides the northern and southern expansion areas and does curtail the movements of primates; reduce the exchange of individuals and the necessary gene flow within this population. The highway also will provide easy access for hunters and trappers to areas which were previously difficult to reach. The camera traps captured many images of people, clearly non-timber forest product collectors and some hunters with dogs.

With support from the BNNC rangers a large number of snare traps were removed and hunter camps destroyed during this study. As *P. nemaus*, *M. arctoides* and *M. leonina* exhibit terrestrial activities these primates are particularly vulnerable to snare traps.

The Son Tra Nature Reserve close to Danang may serve as a lesson regarding the negative consequences of an easy access to a protected area. In April 2015, Danang FPD arrested four hunters from the northern provinces of Vietnam in this reserve. These hunters established a camp, deployed snares, and killed at least two red-shanked douc langurs, and several other mammals. Five months later Son Tra rangers found a dead douc langur near the road with six bullets in its body. Additionally, four rhesus macaques were run over by motorbikes and electrocuted on power lines (Bui Van Tuan et al. in press). The Management Board of BNNC, needs to find preventative measures to combat poaching and to reduce wildlife accidents in the reserve.

### Conclusions

Using mixed methodologies the study revealed that at least six primate species occur in the extension areas of BNNC, of which five were directly observed during our field surveys. The surveys provided the first records of the northern yellow-cheeked crested gibbon and red-shanked douc langur in these areas. Based on the high diversity of primates and other wildlife species found in the reserve (Bui Van Tuan et al. pers. com.), we recommend to increase research and conservation activities. BNNC should become part of a contiguous green corridor stretching from Phong Dien Nature Reserve to Bach Ma National Park (Thua Thien Hue Province) (Dickinson & Van Ngoc Thinh 2006).

Concerning the primate populations we recommend following:

### Research

- A comprehensive survey within BNNC and the expansion areas should be conducted, using mixed methodologies outlined in this paper to determine presence, abundance and habitat preference of diurnal and nocturnal primate and to assess the threats;
- Surveys specifically for the northern yellow-cheeked gibbon and douc langur populations should be carried out in the buffer zone and the unprotected areas adjacent to BNNC and assess habitat

disturbance to develop conservation strategies (e.g. highway, hydropower dam construction and other human activities)

### Conservation activities

- A ranger patrolling and monitoring program using the Spatial Monitoring and Reporting Tool (SMART) should be implemented to evaluate the impact on wildlife and to monitor primates and other endangered species
- Awareness and education activities conducted in cooperation with Danang FPD and the environmental police should combat wildlife consumption in local households and restaurants in Danang City and particularly in the buffer zone around BNNC;
- A conservation education and outreach program targeting children living in communities in the buffer zone should raise awareness and encourage stewardship in protecting endangered wildlife and essential habitats
- A master plan for eco-tourism development in the region should be prepared and incorporate jobs for local people to reduce the dependence on forest products

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