

**POPULATION STATUS AND DISTRIBUTION OF RHESUS MACAQUE
Macaca mulatta (Zimmermann, 1780)
AT CAT BA NATIONAL PARK, VIETNAM**

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SUMMARY

There is little information known about the Rhesus macaque (*Macaca mulatta*) distribution and population status within Vietnam. Information regarding species distribution and population status is crucial for effectively planning, and designing a conservation strategy. Thus, this study aimed to acquire data and information about *M. mulatta* status and distribution at Cat Ba National Park, Hai Phong, Vietnam. Survey interviews and line transect surveys have been applied to detect populations and the distribution of the species. Four marine transects and two terrestrial transects were surveyed from June to August 2018. The study results showed that there were 222 individuals and 11 groups of Rhesus macaque observed in Cat Ba National Park. The average number of individuals in each group is 20. In transect number 2 (Van Ta – Hang Cai), the surveyors observed the highest number of monkeys among all transects with 108 individuals in 6 groups. The average occurrence frequency is 0.11 group/km and 2.31 individuals/km. For the distribution characteristics, the *M. mulatta* mainly distributed in the east of the National Park such as the Cua Dong, Gio Cung, and Van Ta areas. However, the study did not detect the species in the north and southwest of Cat Ba Island. The study also showed that the suitable elevation of *M. mulatta* ranges from 0 to 150 m a.s.l. The main habitats for the species in Cat Ba national park are evergreen forests, and shrubs on limestone mountains and grassland.

Keywords: Cat Ba National park, *Macaca mulatta*, primates, Rhesus macaques.

1. INTRODUCTION

Vietnam is ranked among countries with the highest primate diversity in the tropical region with 25 species of primates recorded here (Roos et al., 2014). However, 20 out of the 25 primate species have been listed as endangered in IUCN Red List of Threatened Species and two species are on the world's top 25 most endangered primates primarily due to hunting and habitat loss (Schwitzer et al., 2017). There are three families of primates that have been recognized within Vietnam including Loricidae (two species), Cercopithecidae (17 species), Hylobatidae (six species) (Roos et al., 2014). Some taxa have been well studied for species distributions, population status and behavior such as Tonkin snub-nosed monkey (*Rhinopithecus avunculus*), Delacour langur (*Trachypithecus delacouri*), and Red-shanked douc langur (*Pygathrix nemaeus*) (Boonratana and Canh, 1998; Le Khac Quyet et al., 2007; Lippold et al., 2010; C. Workman, 2010) while the other species are poorly known, especially the macaque group. Thus, this study aimed to

collect and provide missing information about the Rhesus monkey (*Macaca mulatta*) on Cat Ba Island in order to provide information for the species conservation planning.

The Rhesus monkey (*Macaca mulatta*) is among five monkey species widely distributed in Vietnam. Globally, the species has a very wide range of distribution from Pakistan to Indochina (Timmins et al., 2008). In Vietnam, this primate has been recorded from the Northern to Central highlands (Nguyen Van Minh et al., 2012). Currently, there has not been any official assessment on the population status at international scale, however, a larger number of individuals are believed to remain globally (Timmins et al., 2008). In Vietnam, the Rhesus monkey population has been documented as decreasing significantly due to illegal hunting for food, traditional medicines and habitat loss (Pham Nhat, 2002; Timmins et al., 2008; Nadler & Brockman, 2014). The Rhesus monkey is protected under Vietnamese's Law in degree no. 06/2019/NĐ-CP (category IIB- restricted to be explored and

commercial used), listed in Appendix II on CITES (CITES, 2017) and listed as Low Risk (LR) in Vietnam's Red Data Book (2007).

Cat Ba National Park (NP) located in Bac Bo bay (coordinate: 20°42' – 20°54'N and 106°54' – 107°09'E) is a marine and limestone area with mountains with high biodiversity values both on land and in the ocean. The park has a total natural area of 16,196 ha, with a land area of about 10,931 ha and a marine area of 5,265 ha (Viet and Lin, 2001). The park contains a diverse range of fauna and flora with coral reef islands, freshwater wetlands, and limestone forest. Forests in Cat Ba NP is classified as a special use forest in accordance to decree 79-CT in effect on 31st March 1986 by the Prime Minister. Due to its location in a high biodiversity region, Cat Ba NP recorded more than 3,150 species of fauna, flora, and sea creatures (Cat Ba NP, 2013). Some unique species are well studied and preserved in Cat Ba NP such as Cat Ba Langur (*Trachypithecus poliocephalus*), Cat Ba Tiger Gecko (*Goniurosaurus catbaensis*) and many other important plants and animals.

Many studies regarding flora and fauna diversity have been conducted within the park. However, none of them were designed specifically for the Rhesus monkey. Hence, information on species status and distribution of this species is very limited. This study on population status and distribution of Rhesus macaque (*Macaca mulatta* Zimmermann, 1780) will contribute information about the status and distribution of the species for conservation planning on local and international scales. The results of the study will also be a baseline for the park to take effective conservation actions for the species.

2. RESEARCH METHODOLOGY

2.1. Line transect survey

We conducted six non-linear line transect surveys (details in figure 2) from June to August 2018. Based on the information from the survey interview, the line transects have been designed to assess the presence of *M.*

mulatta populations. The team spent three days on each transect to search for the Rhesus macaque. Two types of line transects were established including terrestrial line transects by walking and marine transects by boat surrounding the islands.

Terrestrial line transects:

The study conducted 2 transects on land which were transects 5 and 6. Based on a topographic map (scale: 1/25,000), a map of forest types and interview information, line transects were designed based on old pathways or newly created ones to cross as many habitat types as possible. In addition, the transects were also designed to cross "easy-terrain" areas which provide good support for observation. The length of transects 5 and 6 were 9.75 and 8.14 km, respectively. During the investigation, the surveyors moved at a normal speed of 1 - 1.5 km/hour without talking or smoking.

Marine line transects:

Based on the topographic map and information from the survey interviews, four marine line transects were established by boat. The transects crossed areas with a high possibility of detecting Rhesus monkeys. A high-speed boat was used for moving with an average speed of 5 - 8 km/h, especially during the most active time of Rhesus monkeys (in the morning and afternoon). The length of each transect ranged from 10 to 30 km. When detecting the monkeys, we turned off the boat engine and moved quietly to avoid noise to observe the monkeys.

The survey team observed the monkeys carefully and counted the number of individuals by using cameras and binoculars. The observation results were noted on notebooks including the number of monkey groups, the ages, gender structure of each group, coordinates at detected points (GPS coordination), and the habitat of the location. The supporting equipment was 8 x 40 Nikon binoculars and Cannon Powershoot SX50 HS camera.

To identify Rhesus monkeys in the field, the surveyors used the guideline of Francis (2008), and Nguyen Vu Khoi & Shaw (2005).

2.2. Data analysis

To distinguish different monkey groups during the surveys, the surveyors would count the number of individuals and record the structure of the group.

Furthermore, in order to distinguish separate groups of *M. mulatta*, we used Mapinfo 10.5 to show the location of monkey groups and calculate the distance between each group. According to Jiang et al., (1991) the living area of the Rhesus macaque ranged from 0.16 to 0.72 km². Fooden (2000) also reported that the residence habitat of the monkey was about 0.65 km² in an area without forest and about 1.96 km² within the forest. The average distance moved a day by the Rhesus monkeys is about 1.15 km. Thus, in this study, if the location of the monkey groups was greater than 1 km from others, they were considered two different groups. Mapinfo 10.5 software was used to illustrate the distribution of the

Rhesus monkey population using coordinate points and azimuths collected while detecting the monkeys.

To compare the population status in different study areas, we used the frequency of occurrence. The efficiency of detecting the primate was determined by the following formula:

$$X = N/d$$

Where:

X – Frequency of occurrence;

N – Number of individual/group detecting on the line transect;

d – Length of the transect.

3. RESULTS AND DISCUSSION

3.1. The status of Rhesus macaque population in Cat Ba national park

3.1.1. The number of Rhesus macaque group observed

In Cat Ba NP, the study observed 11 separate groups of Rhesus macaque in different locations. Times, locations and number of the groups and individuals were shown in table 1.

Table 1. The number of Rhesus macaque groups was observed in Cat Ba NP

No.	Species	Location		Transect	No. individuals
		X	Y		
1	<i>M.mulatta</i>	717833	2301985	Transect 1	8
2	<i>M.mulatta</i>	716697	2302732	Transect 1	9
3	<i>M.mulatta</i>	715965	2304598	Transect 2	12
4	<i>M.mulatta</i>	714881	2304072	Transect 2	35
5	<i>M.mulatta</i>	716598	2305610	Transect 2	18
6	<i>M.mulatta</i>	717139	2303906	Transect 2	11
7	<i>M.mulatta</i>	718831	2302614	Transect 2	6
8	<i>M.mulatta</i>	719367	2301260	Transect 2	26
9	<i>M.mulatta</i>	714326	2296755	Transect 3	35
10	<i>M.mulatta</i>	702616	2306230	Transect 4	32
11	<i>M.mulatta</i>	706685	2301412	Transect 5	30
Total					222

In this study, we recorded a total of 222 individuals in 11 separate groups of *M. mulatta*. This is the first study on the status of the Rhesus macaque population at Cat Ba Island. The previous surveys have only documented the occurrence of the Rhesus macaque without any information on the number of individuals

and distributions (Cat Ba NP, 2006; 2013). In addition, the other intensive surveys mainly focused on the Cat ba langur (*Trachypithecus poliocephalus*) - an endemic species of Cat Ba island (Nadler & Ha Thang Long, 2000, Luu Tuong Bach & Le Van Dung, 2013).



Figure 1. A Rhesus macaque (*Macaca mulatta*) group at Cat Ba NP
(Photo by Nguyen Huy Cam)

The population size of macaque at Cat Ba National Park is much larger compared to macaque populations at other locations within Vietnam. According to Nguyen Tai Thu (2018), 15 groups and 65 individuals were observed in Cu Lao Cham Island. However, the study area in Cu Lao Cham is rather small compared to Cat Ba islands (about 1,317 ha and 10,931 ha, respectively). In addition, there was a study of *M. mulatta* population at Son Tra peninsular (Da Nang city). However, the species population has remained unknown (Tran Huu Vy et al., 2016).

The number of individuals of each group is different at Cat Ba NP. Eight out of 11 groups of macaque observed have had more than 10 individuals in each group. The largest number of individuals were recorded in group 4 and 9 with 35 individuals (table 1). Meanwhile, group 7 had the lowest number with 6 individuals. The average number of individuals per group is about 20 individuals/group. According to Pham Nhat (2002), the Rhesus macaque group size in Vietnam ranges between 5 and 25 individuals, with an average of 11.8 individuals. Compared to the other group sizes of *M. mulatta* in Vietnam, the Cat Ba population is significantly higher. However, in comparison to the world's Rhesus average group size, the Cat Ba Rhesus average group size is relatively low. Fooden (2000) reported that the average group size of macaques in the world is roughly 32.3

individuals/group. In another study in India, Imam (2013) showed that the Rhesus macaques can range from 15 - 155 individuals/group (with an average of 48 individuals/groups).

3.1.2. The Rhesus macaque observation frequency

The results showed that the number of *M. mulatta* groups and individuals were significantly different between the transects (table 2). For example, transect number 2 (Van Ta - Hang Cai) observed the highest number of macaques with 108 individuals in six groups, while the remaining survey transects recorded only one or two groups. Especially, transect number 6 (Center of National Park - Gia Luan) did not record any group of the species.

The results (table 2) also shows that the marine transects recorded more groups of Rhesus macaques than terrestrial ones. Because the better view from the sea might make it easier to detect the *M. mulatta* populations than in the complex forest in terrestrial transects. Furthermore, the study also found that the *M. mulatta* was often active near the coast in the morning or late afternoon which makes it easier to see them from the sea.

The occurrence frequency of the Rhesus macaques in Cat Ba Island is 0.11 groups/km and 2.31 individuals/km. Specifically, the average group frequency of occurrence of Rhesus macaques on the sea lines transect is 0.13 groups/km and 2.46 individual/km. By

contrast, the frequency of occurrence in terrestrial line transects is lower with 0.06 group/km and 1.68 individual/km, respectively.

Table 2. Occurrence frequency of Rhesus macaque on the survey transects

No	Transect	Length (km)	Groups	Individuals	Occurrence frequency		Note
					group/km	Individual/km	
1	Transect 01 (Cua Dong - Van Ta)	14.78	2	17	0.14	1.15	marine transect
2	Transect 02 (Van Ta - Hang Cai)	34.19	6	108	0.18	3.16	marine transect
3	Transect 03 (Cua Dong - Nam Cat)	18.35	1	35	0.05	1.91	marine transect
4	Transect 04 (Phu Long - Bai Giai)	10.84	1	32	0.09	2.95	marine transect
5	Transect 05 (NP Center - Viet Hai)	9.75	1	30	0.10	3.08	terrestrial transect
6	Transect 06 (NP Center - Gia Luan)	8.14	0	0	0.00	0.00	terrestrial transect
Total		96.04	11	222	0.11	2.31	

Compared to the results of Rhesus macaque surveys in other areas, the frequency of occurrence of the primate species in Cat Ba Island is higher than in Kon Ka Kinh National Park but smaller than in Hon Lao Island. According to Tran Huu Vy (2014), the occurrence frequency of the macaque is 0.01 group/km in Kon Ka Kinh National Park, while the frequency of occurrence is 0.52 group/km in the Hon Lao Island (Nguyen Tai Thu, 2018).

3.2. The distribution of the Rhesus macaque in Cat Ba Island

3.2.1. Rhesus macaque distribution within Cat Ba NP

From the location of the macaque recorded in Cat Ba NP, there are nine groups of *M. mulatta* distributed in the eastern part of Cat Ba Island including Cua Dong, Gio Cung, and Van Ta areas. A group was recorded in the area near Cat Ba National Park headquarters (Trung Trang cave area) and another group was observed in the northwest of Cat Ba Island (Phu Long area). In the north and south-west of Cat Ba Island, the study has not recorded the distribution of Rhesus macaque (figure 2).

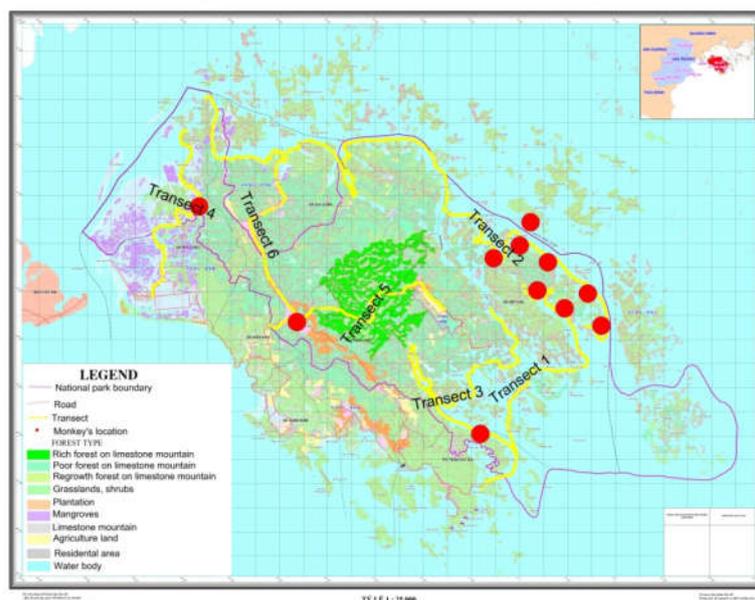


Figure 2. Map of survey transects, and Rhesus macaque population observed at Cat Ba National Park

The distribution of Rhesus macaques in Cat Ba Island might be influenced by the growth of human population, and the fast development of tourism. Human activities are considered to be the biggest issue for the species' distribution on the island. Illegal hunting by snare traps is still the main threat to the wildlife of Cat Ba Island. Rhesus monkeys are no exception. In following a patroller, it was seen that there are still thousands of snare traps that have not been removed from the forest which have impacted on the Rhesus monkeys. In the north of Cat Ba Island, there is a ferry terminal at Gia Luan connected to Tuan Chau (Ha Long Bay). The southern part of Cat Ba island is the highly developed tourism area which includes Cat Co 1, 2, 3 beaches. In addition, there is also a Mekong high speedboat, which takes tourists to the island. Tourism development has strong effects on habitat of the Rhesus macaques. Therefore, these areas did not record any occurrence of the species.

Cua Dong, Gio Cung, Van Ta areas are strictly protected areas of Cat Ba National Park. These areas are home to the rest of the

species endemic to Cat Ba Island. Thus these areas are always patrolled by Cat Ba national park, and FFI staff. At the same time, tourism activities and boats are prohibited in these areas. Therefore, the habitats are protected with quiet space suitable for the residence of primates such as the Cat ba langur, and Rhesus macaque.

3.2.2. Distribution of Rhesus macaques by altitude and habitat

In Cat Ba NP, there are hundreds of islands with elevations ranging from 100 to 150 m a.s.l. The highest peak is 331 m a.s.l at Cao Vong area in the north of Cat Ba Island (Gia Luan commune). The elevation of the line transects ranges from 0 to 214 m a.s.l. The elevation of locations recorded the macaque groups are shown in figure 3. Most of the macaque groups were observed at low elevation. Eight other groups were recorded at the elevation ranging from 0 m to 100 m, while only two groups at 100 - 150 m a.s.l. The study recorded only one group of Rhesus monkey above 150 m a.s.l.

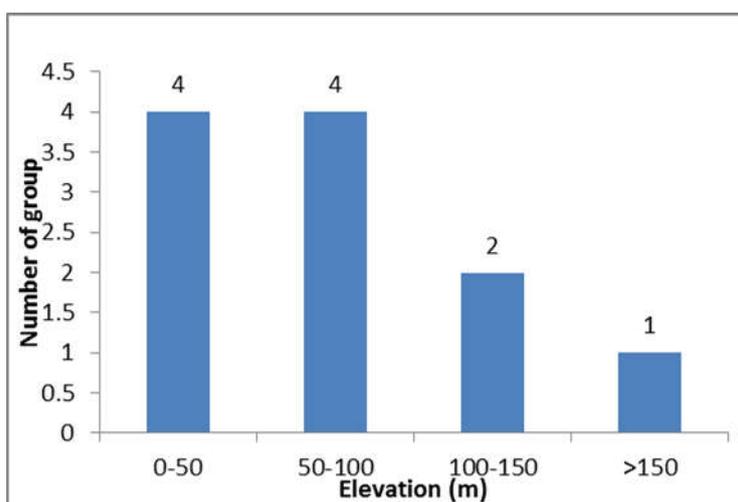


Figure 3. Distribution of Rhesus macaque at different elevation range

The Rhesus macaque is a widely distributed species, and the elevation range of its distribution is varied (Pham Nhat, 2002). In Vietnam, the species was recorded from 500 to 1000 m in the Central Highland (Nguyen Van

Minh et al., 2012). However, the highest elevation of the species distribution was recorded up to 4500 m (Fooden, 2000). At Cat Ba NP, Rhesus macaque was recorded at all elevation levels. Therefore, the distribution of

The Rhesus macaque at Cat Ba Island may not depend on elevation.

Regarding forest status, the Rhesus monkey at Cat Ba National Park is located in evergreen forests, limestone forests, grasslands and shrubs (figures 4, and 5). One group (group 11) was recorded on a rich limestone forest and six (group numbers 1, 3, 5, 7, 8, 9) in a secondary evergreen forest. Four groups (group numbers 2, 4, 6, 10) were observed in



Figure 4. Evergreen forest on limestone mountains habitat
(Photo by: Tran Van Dung)



Figure 5. Grassland and shrubs habitat
(Photo by: Tran Van Dung)

The populations of Rhesus macaques in Cat Ba National Park are distributed in both primary and secondary evergreen forests, and grassland on limestone mountains. This result is similar to Pham Nhat (2002) reported that the Rhesus macaque is a widely distributed species. They are capable of living in a variety of forest habitats ranging from evergreen broadleaved forest, deciduous forest, semi-deciduous forest, limestone forest, as well as bamboo mixed forests, mangroves, and mangrove grass shrubs.

4. CONCLUSION

The study recorded 222 individuals of Rhesus macaques in 11 different groups at Cat Ba National Park. This is the first detailed survey on the size of the Rhesus macaque population in the park. Among the recorded groups, group number 6, and number 7 have

grassland and shrub habitats. In addition, most of the Rhesus macaque groups (except group number 11) were also observed near the sea in areas that are narrow with many large boulders or sandy beaches. They often appear on rocks, and sandy beaches to rest or play with each other before and after looking for food. This behavior should be investigated further in following studies.

the largest number with individuals at 35. The average number of individuals per group is 20.18 individuals/group.

We observed the greatest number of macaque groups which were 6 groups and a total of 108 individuals on transect 2 (Van Ta – Hang Cai). Transect 6 (park center - Gia Luan) did not record any macaques during the survey. The occurrence frequency of macaques on Cat Ba Island is about 0.11 group/km and 2.31 individual/km.

The macaque population at Cat Ba National Park is mainly located in the east of Cat Ba Island at Cua Dong, Gio Cung, and Van Ta areas. The Northern and Southwestern part of Cat Ba Island did not record the presence of the species.

The result of the study showed that the distribution of the Rhesus macaque at Cat Ba

Island may not depend on the elevation. In addition, evergreen forest and grassland on limestone mountains are the main habitats of the macaque species at Cat Ba Island.

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**TÌNH TRẠNG VÀ PHÂN BỐ CỦA QUẦN THỂ KHỈ VÀNG
Macaca mulatta (Zimmermann, 1780) TẠI VƯỜN QUỐC GIA CÁT BÀ**

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TÓM TẮT

Hiện nay, các thông tin về hiện trạng quần thể và phân bố của loài Khỉ vàng (*Macaca mulatta*) tại Việt Nam rất hạn chế. Nghiên cứu về tình trạng và phân bố của quần thể Khỉ vàng (*M. mulatta*) tại Vườn quốc gia Cát Bà được thực hiện nhằm góp phần bổ sung thêm thông tin về hiện trạng của loài Khỉ vàng phục vụ cho công tác quản lý và đề xuất các chiến lược bảo tồn trong tương lai. Phương pháp phỏng vấn và điều tra tuyến được sử dụng trong quá trình thu thập số liệu cho nghiên cứu trong thời gian từ tháng 6 đến tháng 8 năm 2018. Sáu tuyến điều tra, trong đó có bốn tuyến trên biển và hai tuyến trên cạn đã được tiến hành khảo sát. Kết quả của nghiên cứu đã ghi nhận được 222 cá thể Khỉ vàng thuộc 11 đàn khác nhau có phân bố tại VQG Cát Bà. Số lượng cá thể trung bình của một đàn là khoảng 20 cá thể/đàn. Tuyến số 2 (Vạn Tà - Hang Cái) là tuyến bắt gặp được nhiều đàn Khỉ vàng nhất với 6 đàn, tổng cộng 108 cá thể. Tần suất bắt gặp của Khỉ vàng trên đảo Cát Bà trung bình là 0,11 đàn/km và 2,31 cá thể/km. Khu vực phân bố chủ yếu của Khỉ vàng tập trung ở phía đông của đảo Cát Bà tại các khu vực Cửa Đông, Giỏ Cùng, Vạn Tà. Trong khi đó, khu vực phía bắc và tây nam của đảo Cát Bà không ghi nhận được sự phân bố của loài Khỉ vàng. Đồng thời, nghiên cứu đã ghi nhận được quần thể loài Khỉ vàng có độ cao phân bố từ 0 - 150 m. Sinh cảnh phân bố chính của loài Khỉ vàng tại VQG Cát Bà là rừng thường xanh trên núi đá vôi, và sinh cảnh cây bụi trên núi đá vôi.

Từ khóa: Khỉ vàng, linh trưởng, *Macaca mulatta*, Vườn quốc gia Cát Bà.

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