

Population Assessment and Threats to Long-Tailed Macaques (*Macaca fascicularis* Raffles) in Areas Outside Sumile Botanical and Zoological Park, Butuan City, Philippines

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ABSTRACT

Long-tailed macaques overlap extensively with humans across their ranges in Southeast Asia and consequently live together in several locations. Human-macaque interactions were documented in the neighboring Sumile Zoological and Botanical Park in Barangay Sumile, Butuan City. Due to anthropogenic activities resulting to the loss of their natural habitat, the macaques are forced to live within human settlements resulting to a positive and negative interactions which greatly affected their population. The primary objective of this study is to assess the population of long-tailed macaques in Maibu, Butuan City. We also identified the current threats, as well as the food sources of the macaques in the area. The results showed that the current estimated population of long-tailed macaques was about 688 individuals. Based on key informant interviews, the threats to long-tailed macaque populations were attributed to mining activities, deforestation through illegal logging, and the prevalent wildlife hunting. Furthermore, researchers found that fruit trees, such as coconut, banana, papaya, mango, and root crops, such as sweet potatoes, cassava, and taro, are the main sources of food. Researchers recommend expanding the scope of future studies to include home ranges, range distances, and potential sites, to obtain a larger sample size to effectively plan conservation measures of the species.

INTRODUCTION

The *Macaca fascicularis* Raffles, is an old-world monkey native to Southeast Asia (Active Wild, 2019; Hansen et al., 2022; Kemp & Carter, 2007). Locally called “*unggoy*”, the species is a cercopithecine primate known for several common names like long-tailed macaque, crab-eater macaque, and the cynomolgous monkey as used in laboratories. In Indonesia, *M. fascicularis* and other macaque species are generically known as *kera*, because of the high-pitched alarm calls they provide when in danger (Perveen & Anuar, 2014; Raffles, 1821).

Long-tailed macaques are sexually dimorphic (Richtsmeier et al., 1993; Turcotte et al., 2022). Males are larger than females, weighing between 4.7 - 8.3 kg and measuring between 41.2 - 64.8 cm. Comparatively, females weigh between 2.5 - 5.7 kg and measure 38.5 - 50.3 cm (Cawthon Lang, 2006; Fa, 1989). The population of the macaques are distributed throughout Peninsular Malaysia, Sabah, and Sarawak, as well as throughout southern Asia; lower north of Thailand, Myanmar, southern Laos, Cambodia, Vietnam, Sumatra, Java, and the Philippines (Malaivijitnond & Hamada, 2008). Long-tailed macaques can be found everywhere in Peninsular Malaysia, Sabah, and Sarawak, especially in lowland areas and along the coast, and they can be easily found in urban areas (DWNP, 2006).

The long-tailed macaques in the study site are believed to have originated in the islands of Visayas and Mindanao. Long-tailed macaques have a conservation status of Near Threatened according to The IUCN Red List of Threatened Species and are vulnerable in the wild (Hansen et al., 2022). It is important to know about primates and human have long history of coexistence, i.e., the areas where both of them are sharing resources and their densities occur in abundance (Jones-Engel et al., 2004). With the development of a zoological and botanical park in the neighboring Barangay Sumile (Crismundo, 2022), populations of macaques in Maibu were affected since the species are frequently spotted on forest periphery at tourist attraction sites, recreational parks, and nearby human settlements (Likusol et al., 2018) due to the influx of people and destruction of their natural habitats by way of road construction. Consistent with this, researchers were motivated to conduct this study where the main objective is to evaluate the present population of long-tailed macaques in the area. Along with this, the food sources of the species as well as the threats to their existence were also determined.

METHODOLOGY

Study sites

The study was conducted in the three rural barangays namely: Bilay, Don Francisco, and Maibu, in Butuan City. It has an aggregate total land area of 2,311.43 hectares and is approximately 20 km away from the city proper. The sites are bounded to the North by Salvacion and Camayahan, East by Sumile, West by Amparo, and on the south by Maguinda. About 45% of its terrain is mostly steep and rolling where forest species and fruit trees are the predominant vegetation. In some areas, residents also planted various

agricultural crops in small farms to include coconuts, bananas, corn, and other root crops.

The present survey was conducted particularly Sitio Aneslag located in the innermost forested areas bordering the three barangays. The topography of the area is an ideal habitat for the long-tailed macaques being mountainous, cliffy portions, bordering rivers, agricultural farms in the high- and lowlands, and slightly disturbed forested areas (Figure 1). Using GIS image classification techniques, the total dense forested areas of the study sites was determined to be 733.59 hectares.

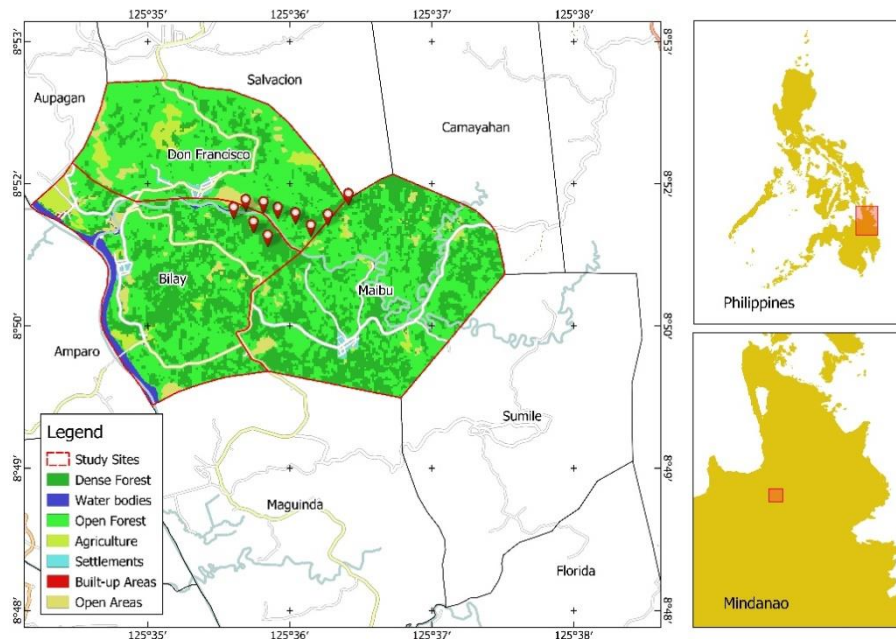


Figure 1. Location of study sites Bilay, Don Francisco, and Maibu in Butuan City.

Data gathering

The researchers requested permissions from the barangay councils of the three barangays prior to the conduct of fieldwork. Upon approval, the researchers then administered a survey questionnaire to selected respondents through face-to-face interviews. Data were recorded, sorted, and tabulated for statistical analysis.

Considering the high cost of faunal biodiversity surveys, population assessments are usually done in an annual basis since conservation activities do not have enough resources to achieve all its goals (Pienkowski et al., 2021). This study, however, is the first robust assessment of the macaque population in study sites. Prior to the inventory, the team conducted reconnaissance survey for over a month to observe and evaluate possible resting and sampling sites of the species in the area.

Long-tailed macaques prefer forest edges (Riley et al., 2015); therefore, when surveying a location, the researchers began by walking edges in and around the area, except where access was prohibited (i.e., restricted and private land). A 2-Km transect line was laid out along mountain ranges and cliffs and traversed during the active hours of the long-tailed macaques. Sampling points at an interval of 250 m were observed for a maximum of 1 h to minimize errors

in repeated counts. To lessen survey time and disturbance, the researchers were divided into two teams and assigned at each opposite end of the transect, surveying simultaneously until both teams meet at the center of the transect. A handheld radio was used for communication since most areas were out of coverage using mobile phones. Binoculars were also used to visually identify the species. All individuals encountered and observed were recorded based on sex and maturity stage.

For the historical data of macaque's presence in the community, eighteen residents from Sitio Aneslag were interviewed as key informants using the semi-structured questionnaire. Some information required in the questionnaire includes recent activities of the long-tailed macaques, time of activity, number of individuals sighted, and the species' food preferences.

Data Analysis

Information on the size of the home range of the animals is needed to estimate the population density of Philippine long-tailed macaques (Bernard & Hamzah, 2006; Ofstad et al., 2016). A 0.75 km distance buffer from the riverbank was applied to the population density to estimate the surveyed area. This buffer serve as the maximum perpendicular distance from the riverbank for long-tailed macaques to move around from their resting sites (Laman & Aziz, 2019).

The population density of the long-tailed macaques was calculated by dividing the cumulative number of individuals in the forest by the total area of the surveyed forest following Laman and Aziz (2019). The total surveyed area is the cumulative distance of the surveyed riverbank of that forest multiplied by a 0.75 km perpendicular distance from the riverbank. The formula used is as follows:

$$\begin{aligned} \text{Population Density} &= \frac{\text{Cumulative number of individual sited}}{\text{Total surveyed area (sq km)}} \\ &= \frac{\text{Cumulative distance from the surveyed riverbank (km)} \times 0.75 \text{ km}}{\text{Population size} = \text{Population density} \times \text{Total forest area}} \end{aligned}$$

The estimated population size of long-tailed macaques was correlated with the estimated population density. The estimated population density in the forest was extrapolated by multiplying it by the total area of the forest to obtain the estimated population size of the long-tailed macaques. The overall estimated population size was finally obtained multiplying the population density with the total dense forest areas of the study sites.

RESULTS

Population Density and Size

The researchers encountered and recorded an accumulated total of 593 Philippine long-tailed macaques for the three weekly sampling periods or an average of 198 ± 9 individuals per sampling period. Table 1 shows the number of counts relative to sex and maturity stage of individuals.

Observation period	Males	Females	Juveniles	Total
Week 1	55	83	58	196
Week 2	59	68	64	191
Week 3	46	91	69	206
<i>Mean</i>	53	86	53	198
<i>SE</i>	7.53	13.21	6.32	8.64

Table 1. Number of individuals with respect to male, female, and juveniles.

The population density formula was adapted from (Laman & Aziz, 2019) on the population estimation of proboscis monkey in Sarawak, Malaysian Borneo. The total population density was calculated as 94 individuals per square kilometer. A total surveyed area of 2.107 square kilometer was computed from 2.809 kilometers cumulative distance surveyed multiplied by a buffer zone of 0.75 kilometer. The total population size was then computed to an estimated 688 individuals for the entire forest areas of the three barangays.

Threats to long-tailed macaque population

Based on the responses, researchers have identified three threats to long-tailed macaque survival: mining, illegal logging, and wildlife hunting (Table 2). In 2011, large-scale gold mining operations began in Maibu. This has affected the populations of the long-tailed macaques owing to forest destruction and habitat loss. Two years after mining, the operation was fully stopped because of political influence. Mining disturbs and destroys macaque habitats, degrades soil quality and fertility, and increases soil toxicity. Mining causes deforestation, leading to the extinction of flora as a food source for long-tailed macaques.

Threats	Frequency	Percentage
Wildlife Hunting	18	100.00%
Illegal Logging	3	16.67%
Mining	2	11.11%

Table 2. Threats to the Philippines long-tailed macaques in Maibu, Butuan City.

Illegal logging on the other hand leads deforestation and habitat loss which significantly reduce population of long-tailed macaques. Both mining and illegal logging destroys natural habitats, thus considered one of the most serious threats to primates worldwide (Starin, 1989). Wildlife hunting on the other hand was perceived to be the most prevalent threat of population decline of macaques in the area. Due to fear being hunted, some macaques have become elusive and therefore hard to find. Macaques were hunted either for food or illegal trade, however, due to the scarcity of food in particular rural areas, most respondents observed that macaques were hunted for subsistence.

Food sources of long-tailed macaques

Long-tailed macaques are omnivores that exploit many different types of food, reflecting the diversity of habitats that they can utilize. They eat a wide variety of foods such as fruits, crabs, flowers, insects, leaves, fungi, and grasses. Some limited observation suggests that long-tailed macaques select fruit based on ripeness, which is based on color.

Coordinates		Fruits				Root Crops			Animals		
Northing	Easting	B	P	M	C	SP	C	T	F	C	CF
8.8550	125.5983	33	0	2	28	✓	✓	✓	✗	✗	✗
8.8558	125.5963	15	3	0	35	✗	✗	✗	✗	✗	✗
8.8561	125.5938	12	1	1	21	✓	✗	✓	✗	✗	✗
8.8550	125.5921	9	1	1	26	✗	✓	✓	✗	✗	✗
8.8563	125.6075	6	0	0	32	✗	✗	✓	✗	✗	✗
8.8542	125.6038	5	2	0	18	✗	✗	✓	✓	✓	✓
8.8525	125.6016	3	0	2	27	✗	✗	✓	✓	✓	✓
8.8538	125.6011	0	1	0	20	✗	✓	✓	✓	✓	✓
8.8530	125.5949	18	3	1	34	✗	✗	✓	✗	✗	✗
8.8511	125.5969	15	2	0	32	✗	✗	✓	✗	✗	✗

Table 3. Availability of food sources for long-tailed macaques

The Table 3 above shows number and the presence/absence of preferred food sources where *M. fascicularis* were sighted. Table 4 shows a list of observed foods preferred by long-tailed macaques based on the respondents' observations. All respondents claimed that the most common fruits consumed by macaques were bananas and coconuts (100%). In addition, papaya (83.33%) and mangoes (72.22) were also their best alternative.

Food Types	Frequency	Percentage
Fruits		
Banana	18	100.00%
Coconut	18	100.00%
Papaya	15	83.33%
Mango	13	72.22%
Root Crops		
Cassava	17	94.44%
Taro	16	88.89%
Sweet Potato	14	77.78%
Animals		
Crabs	18	100.00%
Fish	15	83.33%
Cray Fish	13	72.22%

Table 4. Observed fruits consumed by the long-tailed macaques

The most preferred root crops that long-tailed macaque was cassava (94.44%), taro (88.29%), and sweet potatoes (77.78%). Furthermore, the animal foods that long-tailed macaques best consumed was crabs (100.00%), fish (83.33%), and cray fish (72.22%) as commonly observed.

Table 5 shows the observed trees where long-tailed macaques usually hang around. Accordingly, most respondents (94.44%) observed such monkeys on *Ylang-ylang* trees. Of these, 83.33% witnessed monkeys on *Ibu* trees, 77.78% on *Lauan* trees, and the least on *Salonganan* trees with 38.89%.

Trees	Frequency	Percentage
Ylang-ylang	17	94.44%
Ibu	15	83.33%
Lawaan	14	77.78%
Ipil-ipil	13	72.22%
Tugas	11	61.11%
Salonganan	7	38.89%

Table 5. Common resting trees of long-tailed macaques in the study site

CONCLUSIONS AND RECOMMENDATIONS

This study was conducted in Barangays Bilay, Don Francisco, and Maibu, in Butuan City. The study was in close coordination with the village councils and locals to assess the population of long-tailed macaques. The present assessment encountered a total of 198 ± 9 individuals (53 ± 8 males, 81 ± 13 females, and 64 ± 6 juveniles). Total population was estimated to be 688 individuals for the entire forester areas. Food sources were found to be abundant in the area. Threats on their existence was predominant and caused by anthropogenic activities. The tree species frequently visited by long-tailed macaques have been documented.

As this study is the first robust assessment on the population estimate of long-tailed macaques in areas outside the newly established botanical and zoological park in the neighboring Barangay Sumile, a similar analysis should be applied in future studies to monitor changes in population size and population density as the species migrates or transfer to the park. Without this information, it would be impossible to construct an effective conservation plan for this species. In the future, as studies on home ranges are updated, the maximum ranging distance used in this analysis may also be updated. Future studies should include other sites to obtain a larger sample size. It is also recommended that the survey period be extended and that a larger area be covered with more replications.

REFERENCES

- Active Wild. (2019, September 16). Types of monkeys with pictures & facts: Monkey groups & species. *Active Wild*.
<https://www.activewild.com/types-of-monkey/>
- Bernard, H., & Hamzah, Z. (2006). 2006. Population Size and Distribution of Proboscis Monkey (*Nasalis larvatus*) in the Klias Peninsula, Sabah, Malaysia. *Malayan Nature Journal*, 56(2), 153-163.
https://www.academia.edu/27967724/Henry_Bernard_and_Zulhazman_Hamzah_2006_Population_Size_and_Distribution_of_Proboscis_Monkey_Nasalis_larvatus_in_the_Klias_Peninsula_Sabah_Malaysia_Malayan_Nature_Journal_56_2_153_163

- Boonkusol, D., Sanyathitiseree, P., Thongyuan, S., & Jangsuwan, N. (2018). Population and Behavior Surveys of Long-Tailed Macaque (*Macaca fascicularis*) in the Old Town, Lopburi Province. *Journal of Biological Sciences*, 18, 226–236.
<https://www.semanticscholar.org/paper/Population-and-Behavior-Surveys-of-Long-Tailed-in-Boonkusol-Sanyathitiseree/130c36827248a16c1cfd1936230853c86485c95e>
- Cawthon Lang, K. (2006). *Primate Factsheets: Long-tailed macaque (Macaca fascicularis) Taxonomy, Morphology, & Ecology*. Wisconsin National Primate Research Center. <https://primate.wisc.edu/primate-info-net/pin-factsheets/pin-factsheet-long-tailed-macaque/>
- Crismundo, M. (2022). P11.8-M access road to boost eco-tourism in Butuan City. *Manila Bulletin*. <https://mb.com.ph/2022/06/01/p11-8-m-access-road-to-boost-eco-tourism-in-butuan-city/>
- DWNP. (2006). *Management plan for problematic macaques (Macaca fascicularis) in Peninsular Malaysia*. Department of Wildlife and National Parks, Kuala Lumpur, Malaysia.
- Fa, J. E. (1989). The genus *Macaca*: A review of taxonomy and evolution. *Mammal Review*, 19(2), 45–81. <https://doi.org/10.1111/j.1365-2907.1989.tb00401.x>
- Hansen, M. F., Ang, A., Trinh, T., Paramasiwam, S., Ahmed, T., Dimalibot, J., Ruppert, N., Griffioen, C., Lwin, N., Phiapalath, P., Gray, R., Kite, S., Doak, N., Nijman, V., Funtres, A., & Gumert, M. D. (2022). *Macaca fascicularis*. *The IUCN Red List of Threatened Species 2022*.
<https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T12551A199563077.en>
- Jones-Engel, L., Engel, G. A., Schillaci, M. A., Froehlich, J., Paputungan, U., & Kyes, R. C. (2004). Prevalence of enteric parasites in pet macaques in Sulawesi, Indonesia. *American Journal of Primatology*, 62(2), 71–82.
<https://doi.org/10.1002/ajp.20008>
- Kemp, N., & Carter, S. (2007). *Macaca fascicularis* (crab-eating macaque). *CABI Compendium*, CABI Compendium, 76108.
<https://doi.org/10.1079/cabicompendium.76108>

- Laman, C. J., & Aziz, A. F. (2019). *Population estimation of proboscis monkey, Nasalis larvatus with new analysis based on forest types in Sarawak, Malaysian Borneo.*
<https://www.semanticscholar.org/paper/POPULATION-ESTIMATION-OF-PROBOSCIS-MONKEY%2C-Nasalis-Laman-Aziz/cdcd70e8780539bc2c12d04b54959ac8cd904fdf>
- Malaivijitnond, S., & Hamada, Y. (2008). Current situation and status of long-tailed macaques (*Macaca fascicularis*) in Thailand. *Tropical Natural History*, 8(2), 185–204.
- Ofstad, E. G., Herfindal, I., Solberg, E. J., & Sæther, B.-E. (2016). Home ranges, habitat and body mass: Simple correlates of home range size in ungulates. *Proceedings of the Royal Society B: Biological Sciences*, 283(1845), 20161234. <https://doi.org/10.1098/rspb.2016.1234>
- Perveen, F., & Anuar, S. (2014). *Long-tailed macaques, Macaca fascicularis (Primate: Cercopithecidae): Human-monkey behavioural interaction in Botanical Gardens Penang, Malaysia.*
- Pienkowski, T., Cook, C., Verma, M., & Carrasco, L. R. (2021). Conservation cost-effectiveness: A review of the evidence base. *Conservation Science and Practice*, 3(5), e357. <https://doi.org/10.1111/csp2.357>
- Raffles, T. S. (1821). XVII. Descriptive Catalogue of a Zoological Collection, made on account of the Honourable East India Company, in the Island of Sumatra and its Vicinity, under the Direction of Sir Thomas Stamford Raffles, Lieutenant-Governor of Fort Marlborough; with additional Notices illustrative of the Natural History of those Countries. *Transactions of the Linnean Society of London*, 13(1), 239–274. <https://doi.org/10.1111/j.1095-8339.1821.tb00064.x>
- Richtsmeier, J. T., Cheverud, J. M., Danahey, S. E., Corner, B. D., & Lele, S. (1993). Sexual dimorphism of ontogeny in the crab-eating macaque (*Macaca fascicularis*). *Journal of Human Evolution*, 25(1), 1–30. <https://doi.org/10.1006/jhev.1993.1035>

Riley, C. M., Jayasri, S. L., & Gumert, M. D. (2015). Results of a nationwide census of the long-tailed macaque (*Macaca fascicularis*) population of Singapore. *RAFFLES BULLETIN OF ZOOLOGY*.

Starin, E. (1989). Threats to the monkeys of The Gambia. *Oryx*, 23(4), 208–214.
<https://doi.org/doi:10.1017/S0030605300023048>

Turcotte, C. M., Mann, E. H. J., Stock, M. K., Villamil, C. I., Montague, M. J., Dickinson, E., Cayo Biobank Research Unit, Surratt, S. B., Martinez, M., Williams, S. A., Antón, S. C., & Higham, J. P. (2022). The ontogeny of sexual dimorphism in free-ranging rhesus macaques. *American Journal of Biological Anthropology*, 177(2), 314–327.
<https://doi.org/10.1002/ajpa.24442>