

## Full Length Research Paper

# Current Status and Population Estimates of Long-tailed Macaques (*Macaca fascicularis*)

Karimullah\* and Shahrul Anuar

School of Biological Sciences, University Sains Malaysia, 11800 Penang, Malaysia.

Accepted 9 January, 2024

This study discusses the population size of *Macaca fascicularis* in Penang Botanical Gardens, Malaysia. The scan sampling method was used to observe the groups of *M. fascicularis* in the gardens. The study was carried out from February 2007 to June 2007. Chi-square test was used to find the correlation of individual appears on the specific area of the gardens. The total number of observations that were carried out during this study was 1134. Among these observation the adult females were observed as 22% ( $P = 0.15$ ), adult males 17% ( $P < 0.05$ ), juveniles 56% ( $P < 0.05$ ) and infants 5% ( $P = 0.34$ ). This study revealed that the population of long tailed macaques is decreasing in Penang Botanical Gardens. In arranging to get better human contact with macaque and at the similar time to keep up a developed macaque inhabitants in Botanical Gardens Penang, there is an imperative requirement for wildlife department to enhance their safety, food availability and predator's threats.

**Key words:** *Macaca fascicularis*, scan sampling, botanical gardens Penang, wild life.

## INTRODUCTION

*Macaca fascicularis* (long tailed macaques) is one of the foremost biologically well-known and plentiful anthropoid species of primate in the world (Wheatley, 1999). The long tailed macaque inhabits from west to east, as of Myanmar toward the Philippines, and north to south as of Northern Thailand to the southern islands of Indonesia (Fooden, 1995). They are living near the sea sides at the height of 1524 to 2000 m (Medway, 1970) and in the edges of primary and secondary forests (Lekagul and McNeely, 1977). They use to live and adopt in the areas where other primates are not living (Angst, 1975). These types of monkeys have great similarities with human behaviors in their natural condition. This has occur on Mauritius (Sussman and Tattersall, 1986), Hong Kong (Southwick and Manry, 1987; Wong and Ni, 2000), Tinjil Island, Java (Kyes, 1993), Jayapura area, Ngeuar Island, Republic of Palau (Wheatley et al., 2002), West Papua, (Kemp and Burnett, 2003) and Kabaena Island, Sulawesi (Froehlich et al., 2003). *M. fascicularis* has been established obviously in a broad range of habitats with naturally, built-in, mangrove, coastal, swamp and riverine forest (Wolfheim, 1983). They adapt well to changed their

environments (Wheatley, 1999) and frequently develop atmosphere exaggerated by human arrangement and farming (Fuentes et al., 2005). In Malaysia, they are dominant near sea sides' that is the sea sides of Penang, Langkawi, Tioman, Singapore, tall bamboo, and beaches (Medway, 1983). *M. fascicularis* is mostly isolated, reserved, highly awoken and emotional in comparison to lion-tailed macaques (*Macaca silenus*) and rhesus macaques (*Macaca mulatta*) (Clarke et al., 1988). These are because of diet, habitat and social factors, which are based on group development (Clarke et al., 1994).

*M. fascicularis* is grey-black and brown-gold in color. Its lower part of the body is brown-pale, their face, hand's palms and feet are hairless and coloured like red meat. Its tail is hairy and longer than *Macaca nemestrina* (pig-tailed) (Medway, 1983). In old animals (*M. fascicularis*) the tail may be shortened by accident (Adams et al., 1985). Head length is different among *M. fascicularis* from different locations (Fooden and Albrecht, 1993).

Macaque's populations have declined (Corlett, 1992). The current inhabitants of macaques are extremely noticeable and they oftenly facing in habitat lost in the region of Penang Botanical Gardens. In this area, the predators, loss of natural environment and less availability of food occur over declining of species. Other aspects, such as human acts of violations and behaviors have great manipulation on long tailed macaques (e.g.

\*Corresponding author. E-mail: [karimullah76@yahoo.com](mailto:karimullah76@yahoo.com). Tel: +60174105298.

giving food, etc) can be increasing influence on clashes toward macaques. In view of long-tailed macaques' conflicts with predators, it is vital to assess in dispose to find the main cause of these clashes. As described by Achmad et al. (2009) that the population of long tailed macaques are decreasing in Southeast Asia, because of habitat variation and loss.

In discussion with above, relevant studies, it is also not clear that the population of long tailed macaques in Penang Island has increased since this population was counted. In order to know the current position of macaques in Penang Botanical Gardens, a survey was conducted on the population size of long tailed macaques for suitable judgment. This research study provides important and detail information about the long tailed macaques in Penang Botanical Gardens, and the factors that influence population.

## **MATERIALS AND METHODS**

### **Study area**

Penang Botanical Gardens was selected as study area. Botanical gardens are very famous, it gives out plant resources and it is the main center for the protection of wild species (Heywood, 1991). It is situated eight kilometers off the north-western coast of Peninsular Malaysia. George Town, the capital of Penang. This study was conducted from February 2007 until June 2007. Permission for this research was confirmed by the appropriate institutional animal care committee (Wild Life Department Pulau Penang, Malaysia). For moral cure of these primates, the Management of Botanical Gardens Penang, Malaysia was allowed the observer for the observation of long tailed macaques.

### **Study subject**

The study was carried out only on *M. fascicularis* spp. because this specie has lot of behaviours and activities, as compared to other primates, that is:

- (1) Easy availability, as this specie oftenly used to come down to the Gardens in search of food.
- (2) There was more probability of accuracy to count the group's members.
- (3) Simply familiar with humans (the gardens have unique attraction for tourists and *M. fascicularis* is abundant in number).
- (4) *M. fascicularis* was selected as study subject because they are so similar to humans.

### **Field method and population study**

The method of observation in the botanical gardens used

in this study was quite slow with gentle walking and waiting in different corners of the forest (Cooper, 2000). Maximum time was spent waiting outside the jungle for the troop to appear. The dense jungle was difficult to access and noisy because of thick bushes, and not as satisfactory for finding monkeys like in open spaces such as those that walks on open grounds or tall trees standing alone. Another procedure used was to stay and wait for a long time near the fruiting trees and location where food was available for them. This method usually requires more time for observer to walk around in the whole gardens. The observer took all observations, though, occasionally information was provided by other sources either gardeners or visitors regarding the presence of troops elsewhere in the gardens. This study took five months from 3<sup>rd</sup> of February to 24<sup>th</sup> of June 2007, and most of the fieldwork was done in the morning from 09:00 to 12:00 h and in the evening from 14:00 to 17:00 h. After 17.00 h the troops would be heading their way back towards the forest. All possible ways were carried out to investigate, identify and count the monkeys. Counting the troops was usually difficult because of shy responses from monkeys and thick foliage of forest. The sighting of two or three monkeys indicated that there is a group hiding. The troops used to enter and leave the forest by many ways as it is next to the gardens. Most of the troops used to rush for food in the rubbish near the palm garden.

### **Population size of *M. fascicularis* in botanical gardens Penang**

This paper estimated the population of *M. fascicularis* in Botanical Gardens Penang. The population size of *M. fascicularis* in the gardens was projected by counting all troops and individuals examined throughout the study. The observer verified the size of all five groups. The total population size in botanical gardens was projected from troops and individual count up of identified groups from the study as well as reported numbers from the various areas in the gardens. The population from out-side the boundaries of gardens were not considered and no survey was conducted in this study. This gardens consist of all adjoining forest maintain areas, such as bushes, forest and visitors' parks surrounded by the boundaries of gardens.

### **Statistical analysis**

The data was first uploaded to the computer through excel's spreadsheet. Percentages were calculated among different ages/sexes with the use of pivot tables in excel. Pearson correlation used to analyze the asso-ciation between the number of macaque troops and the different area of the gardens. Chi-square test was used to find the correlation of individual appears on the specific

areas of the gardens. The significant value for the findings must be less than 0.05 ( $p < 0.05$ ). All analyses were made by the statistical package for the social sciences version 16.0 (SPSS) (Sri, 1997).

## RESULTS

### Population size and distribution

This study counted the population size in the form of groups in the Penang Botanical Gardens. Five habituated groups that always came down and have close interaction with visitors and four nonhabituated groups; they were running away from observer. Based on counts and reports of this study, it was estimated that the total population for Penang Botanical Gardens was 164 individuals in 9 groups. Present study calculated the size of population in the different area of the gardens. The mean of population derived as 18 individuals per group. The population exhibit high attentiveness within two unambiguous areas such as Main Gate and Orchid Garden. In these areas the troops enlarged considerably with increasing nearness to food and visitors. The statistical analyses illustrated the value of population in the form of Pearson correlation for juveniles, adult males, adult females and infants as:

Pearson correlation:  $r$  (juveniles) = -0.187,  $P = 0.047$  (df = 20).

Pearson correlation:  $r$  (males) = -0.206,  $P = 0.045$  (df = 10).

Pearson correlation:  $r$  (females) = -0.264,  $P = 0.152$  (df = 10).

Pearson correlation:  $r$  (infants) = -0.228,  $P = 0.343$  (df = 4).

The total number of *M. fascicularis* in botanical gardens was 164 as shown in Table 3. The long tailed macaques were classified in four categories, such as infants, juveniles, adult males and adult females. The percentage of infants was 5%, juveniles 49%, adult males 21% and adult females 25% (Table 3).

The number of observation of categories was divided in relation to each month. The total number of observations counted in February was 145; March was 290, April proved 245, May provided 204 and June 250, respectively. The total number of infants was 54, juveniles 635, adult females 252, adult males 193 and the total number of categories was 1134 (Table 1).

### Group description of population

The study was conducted from February until June 2007. A total of 218 groups were observed. In these groups 19 individuals, 78 small groups and 121 large groups were

thoroughly observed and studied. The members of large groups were more than the members of other groups. These groups consisted of fourteen to thirty members (Table 2).

Total numbers of *M. fascicularis* in botanical gardens The composition of the groups of *M. fascicularis* was observed in different areas of the botanical gardens, Table 3.

### Number of individuals

The locations of adult males, adult females, juveniles and infants were evaluated in different areas of the gardens (Table 4).

### Comparison by sex

*M. fascicularis* was calculated on the basis of sex (males and females). Total males and females populations of long-tailed macaques in five months of period were observed. During data collection only the adult individuals were observed because of their sexual characteristic that distinguished them from other members of the group (Table 5).

## DISCUSSION

The present study found a projected total macaque population of 164 individuals in Penang Botanical Gardens. The inhabitants of *M. fascicularis* at the present come into view to be mainly plentiful in areas closeness to human surroundings and gardens, competence in the conflicting habitats. Macaques associate with human surrounding, so the observation is more clear compare to the jungle. Although, the results are reliable with recognized distributions of *M. fascicularis* and thus it is suspect that observing good organization only can account for the difference in distribution as examined. *M. fascicularis* exhibit solitary riverine behavior (Wheatley, 1980; Van Schaik et al., 1996), they are mostly sharing these behaviors in beach side near the jungle in 100 m of rivers (Crockett and Wilson, 1980; Bismark, 1991) and have a tendency to take place at fewer size in interior jungles (McConkey and Chivers, 2004). It was found that long tailed macaques have an inclination for forest fringe environment, and therefore, the atmosphere provided to them in Penang Botanical Gardens is almost similar to their natural habitat. *M. fascicularis* has higher members in the group with great proportion of male and female ratio. Moreover, they are frequently inhabitants near the human settlement where food is easily available and therefore, they are paying attention to human behaviors

**Table 1.** Total Observed *M. fascicularis* in botanical gardens.

Age/sex	February	March	April	May	June	Percentage	Total
Infants	8	12	12	9	13	5	54
Juveniles	77	157	151	119	131	56	635
Adult females	36	72	48	44	52	22	252
Adult males	24	49	34	32	54	17	193
Total	145	290	245	204	250	100	1134

**Table 2.** Total observed groups of *M. fascicularis* in botanical gardens.

No.	Month	Observed groups			Total
		Individual	Small group	Large group	
1	February	3	11	14	28
2	March	7	21	29	57
3	April	3	17	25	45
4	May	2	15	30	47
5	June	4	14	23	41
Total		19	78	121	218

**Table 3.** Groups sizes and compositions of long-tailed macaques in botanical gardens.

Location	Adult females	Adult males	Juveniles	Infants	Total group size
Main gate	3	2	7	1	13
Plants nursery	6	5	9	0	20
Rubbish side	2	2	4	0	8
Picnic garden	7	5	13	2	27
Orchid garden	8	7	15	3	33
Herbal Garden	2	3	8	0	13
Sun Rockery	1	1	3	0	5
Dam (P.B.A)	5	4	9	1	19
Japanese garden	7	5	12	2	26
Total	41	34	80	9	164
Means	4.5	3.7	8.8	1	18
Percent composition (%)	25	21	49	5	100

(Sha et al., 2009; Fuentes et al., 2008).

Although with this effort, food is giving by the visitors still happens usually in the gardens. However, the growth of population of this specie is not appearing to be the main issue in the raise of human-macaque clash in Penang Botanical Gardens. According to this study it is originated that there is no obvious confirmation of a large inhabitants amplify from earlier population estimated. The information is not provided yet according to the cause of not increasing the population of long tailed macaques in Penang Botanical Gardens, but it is probable that population is not increased by inappropriate conservation and unavailability of natural environment, also by the mortality of natural causes. The size of long tailed macaques found of 18 individual per area of the gardens

and its margin is measured very less in contrast to density estimated in other published data as described in previous study (Southwick and Cadigan, 1972), that the number of individuals in a group of *M. fascicularis* in Penang, Kuala Lumpur, Cape Rachado and Singapore varied from 7 to 44 individual and the average group of *M. fascicularis* consisted of 24 individuals.

Many people described that they are having fun and enjoying with the long tailed macaques in the surrounding environment and consider essential to preserve these macaques (Sha et al., 2009). Addition to these, another feature that amplified consideration require to be paid to *M. fascicularis* as they are reducing in some areas of their range due to the animal trade and environmental alteration (Eudey, 2008). Moreover, it is essential to

**Table 4.** Number of adult males, adult females, juveniles and infants in various locations of botanical gardens.

Sex	Main gate	Orchid garden	Japanese garden	Rubbish side	Plant nursery	Dam (P.B.A)	Sun rockery	Herbal garden	Picnic garden	Total	P-value*
Male (%)	61 (31.61)	14 (7.25)	7 (3.63)	23 (11.92)	33 (17.1)	16 (8.29)	23 (11.9)	9 (4.7)	7 (3.6)	193	0.045
Female (%)	87 (34.5)	16 (6.35)	17 (6.75)	30 (11.9)	33 (13.09)	12 (4.8)	24 (9.52)	21 (8.3)	12 (4.8)	252	0.152
Juvenile (%)	204 (32.12)	35 (5.51)	33 (5.2)	82 (12.9)	72 (11.33)	45 (7.1)	79 (12.44)	52 (8.2)	33 (5.2)	635	0.047
Infant (%)	21 (38.88)	3 (5.55)	4 (7.4)	5 (9.26)	6 (11.11)	4 (7.4)	7 (13.0)	2 (3.7)	2 (3.7)	54	0.343

\*Chi-square analysis.

**Table 5.** Sex proportion of *M. fascicularis* in botanical gardens.

No.	Month	Sex compositions				Total	Percent	Ratio
		Females	Percent	Males	Percent			
1	February	36	08.09	24	05.39	60	13.48	3:2
2	March	72	16.18	49	11.01	121	27.19	1.47:1
3	April	48	10.79	34	07.64	82	18.42	1.41:1
4	May	44	09.88	32	07.19	76	17.08	1.37:1
5	June	52	11.68	54	12.13	106	23.82	1:1.03
Total		252	56.62	193	43.37	445	100	1.3:1

provide them housing in recreational areas, for education purpose. Careful consideration also wants to be paid to the expansion of behavioral management and preservation contact programs to control human performance in periphery areas since it is recognized that human settlement areas is sources of food for the macaques and these macaques are more attractiveness to human and human made environments. Improved development with amplified systematic investigate on the activities and environmental science of Penang Botanical Gardens, *M. fascicularis* will give better and faster to a perfect supervision model for an uphold macaque inhabitants to the landscape of human settlement.

Population size in Penang Botanical Gardens assessed in this study. The observations prove

that like the other primates the long-tailed macaques also prefer living in large groups to receive protection and show riverine refuting behaviour since they have learned to associate with humans or food. These animals preferred to live in area where food is available in abundance. In this study, the observer found a projected total macaque population of 164 individuals inside the Penang Botanical Gardens. Furthermore, it was shown that the ratio of the females was 0.3 times higher than the males, which agrees with the findings for most of the primates. Present study explains that the population of long tailed macaques is decreasing in Penang Botanical Gardens. In dispose to get better macaque-human contact and at the similar keeping up a maintain macaque population in Botanical Gardens

Penang, it is an essential need for the department of wildlife to enhance their safety, food availability and predator's threats. It is recommended that any future planning or improvement within Penang Botanical Gardens should take into consideration the existing wildlife population in the area.

## ACKNOWLEDGEMENTS

The authors acknowledge the immense contribution of Associate Professor Dr. Shahrul Anuar their supervisor at School of Biological Sciences, University Sains Malaysia, Management of Wild Life Penang, Mr. Lim Boon Tiong Superintendent of the Botanical Gardens Penang for their facilitation and cooperation and special thanks to Mr.

Ganish School of Biological Sciences for providing guidance and assistance in 'Gardens' during data collection, and at the end we would like to thank the School of Biological Sciences, University Sains Malaysia.

## REFERENCES

- Adams MR, Adams JR, Kaplan TB, Clarkson DR, Koritnik (1985). Ovariectomy, social status and atherosclerosis in cynomolgus monkeys. *Arteriosclerosis*, 5: 192-200.
- Achmad Y, David JC, Jito S, Deborah JM, Jeremy TH (2009). The population distribution of pig-tailed macaque (*Macaca nemestrina*) and long tailed macaque (*Macaca fascicularis*) in West Central Sumatra, Indonesia. *Asian Prim. J.*, 1(2): 2-11.
- Angst W (1975). Basic data and concepts on the social organization of *Macaca fascicularis*. *Primate Behav. Dev. Field Lab. Res.*, 4: 325-388.
- Bismark M (1991). Analisis populasi monyet ekor panjang (*Macaca fascicularis*) pada beberapa tipe habitat hutan. *Bull. Penelitian Hutan*, 532: 1-9.
- Corlett RT (1992). The ecological transformation of Singapore (1819-1990). *J. Biogeogr.*, 19: 411-420.
- Clarke AS, Mason WA, Moberg GP (1988). Differential behavioral and adrenocortical responses to stress among three macaque species. *Am. J. Primatol.*, 14: 37-52.
- Clarke AS, Mason WA, Mendoza SP (1994). Heart rate patterns under stress in three species of macaques. *Am. J. Primatol.*, 33: 133-148.
- Cooper G (2000). The Behaviour and Ecology of the Buton Macaque: LIPI project report. Operation Wallacea website ([www.opwall.com/2000\\_research\\_section14.htm](http://www.opwall.com/2000_research_section14.htm)).
- Crockett CM, Wilson WL (1980). The Ecological Separation of *Macaca nemestrina* and *Macaca fascicularis* in Sumatra. In: *The Macaques: Studies in Ecology, Behaviour and Evolution*, Lindburg, D.G. (Ed.). Van Nostrand Reinhold, New York, pp. 182-214.
- Eudey AA (2008). The crab-eating macaque (*Macaca fascicularis*): Widespread and rapidly declining. *Primate Conserv.*, 23: 129-132.
- Froehlich J, Schillaci M, Jones-Engel L, Froehlich D, Pullen B (2003). A Sulawesi beachhead by longtail monkeys (*Macaca fascicularis*) on Kabaena Island, Indonesia. *Anthropologie*, 41: 17-24.
- Fooden J, Albrecht GH (1993). Latitudinal and insular variation of skull size in crab-eating macaques (Primates, Cercopithecidae: *Macaca fascicularis*). *Am. J. Phys. Anthropol.*, 92: 521-538.
- Fooden J (1995). Systematic review of Southeast Asian longtail macaques, *Macaca fascicularis* (Raffles 1821). *Fieldiana Zool.*, 81: 1-206.
- Fuentes A, Southern M, Suaryana KG (2005). Monkey Forests and Human Landscapes: Is Extensive Sympatry Sustainable for Homo Sapiens and *Macaca fascicularis* on Bali? *Am. Soc. Primatol. Publ.*, San Diego, pp. 168-195.
- Fuentes A, Kalchik S, Gettler L, Kwiat A, Konecki M, Jones-Engel L (2008). Characterizing human-macaque interactions in Singapore. *Am. J. Primatol.*, 70: 879-883.
- Heywood VH (1991). Developing a Strategy for Germplasm Conservation in Botanic Gardens. In *Tropical Botanic Gardens: Their Role in Conservation and Development*. Academic Press Limited, London, pp. 11-23.
- Kemp NJ, Burnett JB (2003). Final report: A biodiversity risk assessment and recommendations for risk management of long-tailed Macaques (*Macaca fascicularis*) in New Guinea. Indo-Pacific Conservation Alliance, Washington, DC. <http://www.indopacific.org/papumacaques.pdf>.
- Kyes RC (1993). Surve of the long-tailed macaques introduced onto Tinjil Island, Indonesia. *Am. J. Primatol.*, 31: 77-83.
- Lekagul B, McNeely JA (1977). *Mammals of Thailand*. 1st Edn., Kurasapha Ladprao Press, Bangkok, Thailand.
- McConkey KR, Chivers (2004). Low mammal and hornbill abundance in the forests of Barito Ulu, Central Kalimantan, Indonesia. *Oryx Int. J. Conserv.*, 38: 439-447.
- Medway L (1983). *The Wild Mammals of Malaya (Peninsular Malaysia) and Singapore*. 2nd Edn., Oxford University Press, Oxford, p. 131.
- Medway L (1970). *The Monkeys of Sundaland: Ecology and Systematic of the Cercopithecids of a Humid Equatorial Environment*. Academic Press, New York, pp. 513-554.
- Sha JCM, Gumert MD, Lee BPYH, Fuentes A, Rajathurai S, Chan S, Jones-Engel L (2009). Status of the long-tailed macaque *Macaca fascicularis* in Singapore and implications for management. *Biodivers. Conserv.*, 18: 2909-2926.
- Sussman RW, Tattersall I (1986). Distribution, abundance and putative ecological strategy of *Macaca fascicularis* on the island of Mauritius, south western Indian Ocean. *Folia Primatologica*, 46: 28-43.
- Southwick CH, Manry D (1987). Habitat and population changes for the Kowloon macaques. *Primate Conserv.*, 8: 48-49.
- Southwick CH, Cadigan FC (1972). Population studies of Malaysian primates. *Primates*, 13: 1-18.
- Sri S, Serge U, Elisabeth AW, Jan HMS, Van ARAM, Hooff (1997). Food Competition Between Wild Orangutans in Large Fig Trees. *Int. J. Primatol.*, 18(6): 909-927.
- Van Schaik CP, van Amerongen A, van Noordwijk MA (1996). Riverine Refuging by Wild Sumatran Long-Tailed Macaques. In: *Evolution and Ecology of Macaque Societies*, Fa, JA, and D.G. Lindburg (Eds.). Cambridge Univ. Press, New York. ISBN: 0521416809 9780521416801, pp. 160-181.
- Wheatley BP (1980). Feeding and Ranging of East Bornean. In: *The Macaques: Studies in Ecology, Behavior and Evolution*, Lindburg, D. (Ed.). Van Nostrand Reinhold Co., New York, pp. 215-246.
- Wheatley BP (1999). *The Sacred Monkeys of Bali*. Waveland Press, Long Grove, IL, US. ISBN 1577660595, p. 189.
- Wheatley B, Stephenson R, Kurashina H, Marsh-Kautz K (2002). A Cultural Primatological Study of *Macaca fascicularis* on Ngeaur Island, Republic of Palau. In: *Primates Face-To-Face: Conservation Implications of Human and Nonhuman Primate Interconnections*, Fuentes, A. and L. Wolfe (Eds.). Cambridge University Press, Cambridge, pp. 240-253.
- Wong CL, Ni IH (2000). Population dynamics of the feral macaques in the Kowloon Hills of Hong Kong. *Am. J. Primatol.*, 50: 53-66.
- Wolfheim J (1983). *Primates of the World: Distribution, Abundance, Conservation*. Seattle and London: ORYX. *Int. J. Conserv.*, 18: 252-253.