

**POPULATION, SOCIAL ORGANIZATION AND BEHAVIORS OF
MACACA FASCICULARIS IN PENANG BOTANICAL GARDENS
PENANG, MALAYSIA.**

By

KARIMULLAH

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Dedication.....

My research is dedicated to my parents and especially to my late father

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LIST OF ABBREVIATION & SYMBOLS

ANOVA	=	Analysis of variance
H.G	=	Herbal Garden
J.G	=	Japanese Garden
M.G	=	Main Gate
O.G	=	Orchid Garden
PBA	=	Perbadanan Bekalan Air (Water Supply Corporation)
P.N	=	Plant Nursery
P.G	=	Picnic Garden
R.S	=	Rubbish Side
S.N	=	Sun Rockery
α	=	Alpha
$^{\circ}\text{C}$	=	Degree centigrade

POPULASI, ORGANISASI SOSIAL DAN SIFAT PERLAKUAN *MACACA FASCICULARIS* DI TAMAN BOTANI, PINANG MALAYSIA

ABSTRAK

Di Pulau Pinang Malaysia, kajian tentang populasi, organisasi sosial, tingkah laku am dan tingkah laku pengawanan pada spesies monyet *Macaca fascicularis* belum dilakukan secara ekstensif. Oleh yang demikian, kajian yang dilakukan terhadap 1134 haiwan di persekitaran Kebun Bunga Pulau Pinang ini adalah untuk menggabungkan kesemua parameter ini. Fokus utama kajian adalah tentang agihan (bajet) aktiviti harian melalui penyampelan secara imbasan dan berfokus sepanjang bulan dalam tempoh kajian. Antara agihan aktiviti harian yang telah dikaji, aktiviti bergerak (15%) merupakan aktiviti yang paling kerap dilakukan. Parameter lain yang dikaji iaitu aktiviti makan (13%), berlari (11%), aktiviti bersuara (8%), membersihkan bulu (7%), bergaduh (4%), menyerang lawan (4%), bermain (4%), seks (2%) adalah signifikan, manakala aktiviti melompat (6%), berehat (6%), mengangga mulut (5%), memanjat (5%), menggaru badan (5%), menjaga anak (2%), memberi makan (2%) dan mencuri benda (1%) didapati tidak signifikan. Organisasi sosial haiwan ini turut diperhatikan dan kajian mendapati bahawa monyet jantan alfa memperlihatkan kedominanan semasa berlaku pergaduhan, melakukan seks, menggoyangkan ranting pokok, bergerak, menghiasi diri (bersolek) menyerang lawan dan melindungi diri jika dibandingkan dengan monyet jantan beta. Di samping itu, hubungan sosial antara monyet jantan dan betina juga ditafsirkan dan dibandingkan dengan anggota lain dalam kumpulan. Kajian yang dijalankan tentang populasi anggota kumpulan yang terdiri daripada monyet jantan dewasa (193), monyet betina dewasa (252), monyet remaja (635) dan bayi monyet (54), menunjukkan bahawa bilangan monyet remaja adalah paling tinggi. Kajian juga menunjukkan bahawa bilangan monyet betina dewasa adalah lebih tinggi daripada bilangan monyet jantan dewasa. Parameter-parameter ini juga dikaji dari segi lokasinya di persekitaran kebun bunga. Hasil dapatan menunjukkan bahawa haiwan ini lebih suka berada di persekitaran yang berdekatan dengan manusia kerana manusia dianggap sebagai sumber untuk mendapatkan makanan. Tingkah laku mengawan antara haiwan jantan dan betina turut dikaji dan kajian mendapati bahawa cubaan untuk mendekati pasangan, menunggang badan pasangan, menghiasi diri sebelum seks, memeriksa alat kelamin dan melakukan interaksi agonistik lebih kerap dilakukan oleh haiwan jantan manakala cubaan mengelak, memeluk, menunjukkan bahagian anogenital (belakang kelamin) dan renggekan suara semasa pengawanan lebih kerap dilakukan oleh haiwan betina. Kajian juga mendapati bahawa sentuhan antara mata, pemancutan mani (ejakulasi), perapian zakar, menghiasi diri haiwan betina, tindakan agresif terhadap haiwan betina adalah lebih kerap dilakukan oleh haiwan jantan manakala aktiviti perapian faraj, menguap, menggaru diri dan mengasah gigi lebih kerap dilakukan oleh haiwan betina. Sebaliknya, aktiviti seks sesama jenis (homoseks) dan pengonanian turut diperhatikan dan kajian mendapati bahawa aktiviti ini kerap dilakukan sepanjang masa. Kajian juga menunjukkan bahawa sistem pengawanan monyet *Macaca fascicularis* adalah bersifat poligami dan poliandrus.

**POPULATION, SOCIAL ORGANIZATION AND BEHAVIORS OF *MACACA FASCICULARIS* IN PENANG BOTANICAL GARDENS
PENANG, MALAYSIA.**

ABSTRACT

The population, social organization, general behaviours and mating behaviours of the species *Macaca fascicularis* have not been studied extensively previously in Penang, Malaysia. Thus this study was conducted on 1134 animals in 2007 in the Penang Botanical Gardens to consolidate these parameters. The major focus of the work was on the daily activity budgets, in terms of scan and focal sampling during all the months in the study. Of the daily activity budget, moving (15%) was found out to be the most frequent activity. The other parameters studied were eating (13%), running (11%), vocal (8%), cleaning hair (7%), fighting (4%), attacking (4%), playing (4%) and sex (2%) all these were found significant, while jumping (6%), resting (6%), opening mouth (5%), climbing (5%), itching (5%), baby care (2%), feeding (2%) and snatching (1%) were found non significant. The social organization of the animals was also taken into account and it was observed that the alpha males depicted dominance for fighting, sex, shaking branches, moving, grooming received, attacking and protection as compared to the beta males. Furthermore, the male and female social relationships were also assessed and compared to the other members of the group. A study of the population was conducted and it was found that of the member's adult males (193), adult females (252), juveniles (635) and infants (54) the proportion of the juveniles was the highest. Furthermore, it was found that the number of adult females was higher than the adult males. These parameters were also studied with respect to the locations in the garden; it was found that these animals prefer proximity to human environments since they have learned to associate them as a food source. The mating behaviour was also studied for the males and the female and it was found that the attempts to approach the partner, mounting on the partner, grooming for sex, inspection of the genitalia and agonistic interaction were higher in the male and the attempts to refuse, reach back, presentation of the ano-genital region and vocal calls during copulation were higher in females. Furthermore, eye contact, ejaculation, penis grooming, grooming of the female, aggression towards the female, was higher in the male and vaginal grooming, yawning, self scratching and teeth grinding were higher in the female. Homosexuality and masturbation was also observed and it was found that the sexual activity remains uniform through out the day. Furthermore, it was found that the mating system of *Macaca fascicularis* is polygamous and polyandrous.

CHAPTER 1

INTRODUCTION

1.1 Background:

Long-tailed macaque is non human primate specie belonging to the family of cercopithecidae. The scientific name is *Macaca fascicularis* (Engelhardt *et al* 2005). *Macaca fascicularis* is native to South East Asia i.e. Philippines, Malaysia, Borneo, Indonesia, Burma, India, Vietnam, Cambodia, Laos and Thailand (Fittinghoff and Lindburg 1980 and Jack 2006) and is also called Cynomolgus monkey and Crab Eating Macaque (Fooden and Albrecht 1993). *Macaca fascicularis* are socially dispersed. This specie found in riverine, coastal forests of nipa palm, mangrove and in primary and secondary forests. Long-tailed macaques live most successfully in dispersed land habitats and on the boundaries of forests (Paul and Kuester 1996). This species of monkey is an extensive part of the medical studies; most of the experimental work of the neuroscience is done on *Macaca fascicularis* (Maxime *et al* 2009). Additionally it is an honor for this species to be the fundamental mammals that travel in the test flight to space (Balls 1995).

Groves (2005) described that these are very social animals and can easily adjust to humans and human made environments. They live in groups and every group consists of six to fifty eight (6-58) individuals (van Noordwijk 1985). Furthermore, these groups are multi-male and multi-female, normally containing two to five (2 to 5) males and the number of females are 2 to 3 times as many compared to males (van Schaik *et al* 1983). The number of offspring's is comparative to the number of females in the group. Group size often depends on the level of predation and availability of food. Their groups are female centered, as the females are

philopatric (i.e. stay in same group most of their life time) and the males shift in and out of these female-based groups (Van Schaik *et al* 1999).

Males generally first migrate from their natal group at the age of four to six (4 to 6) years (Maria *et al* 1985). They will remain in group up to four or five (4 or 5) years and then will migrate several times throughout their life (Maria *et al* 1988). These monkeys are extremely despotic and have a solid dominance hierarchy. Adult males rank higher than females, but the female ranks are more stable than that of the males, as males from time to time are defeated and lose rank. High-ranked males generally are more successful at reproduction and high-ranked females usually fare better at raising surviving offspring. The females are organized in a matrilineal manner; the female-based families consist of the resident females and their offspring (Datta and Beauchamp 1991). Some families have greater social power than others and this difference in rank persist for several generations (Marina 1988). Matrilineal overthrows seldom occur and if it takes place difficulties are faced to the reproductive success of the defeated matriline in the following year (Kummer *et al* 1997). The daily activities and movement patterns of long-tailed macaques involve traveling, feeding, resting and socializing (Van Schaik *et al* 1983).

The regional status and geographic factors also play very important role in the behaviors of *Macaca fascicularis*. A study revealed that the behavior of *Macaca fascicularis* varies. There are measurable differences in behavior, physiology, social organization and geographic distribution within and between the various species of the macaques (Clarke and Lindburg 1993). A study carried out on the social behavior of captive *Macaca fascicularis* from Indochina and island populations. After transferring them to a new environment and new social groups, changes in their behavior occurred over time and there was no sign of decrease in the high levels of

agonistic behavior. Thus, it was found that the long-tailed macaques show low levels of habituation to a new environment and is highly awakened in comparison to other macaque species. A clear difference in the behavior of males, females and infants was observed. It appeared that the infants played more, while the females were in higher levels of proximity with other individuals, and males exhibited more sexual activity and were more aggressive. A comparison of social behavior in long-tailed macaques of different origins indicates that Indochinese macaques are generally less affiliative and their males are more aggressive than others (Brent and Veira 2002).

Macaca fascicularis are non-seasonal breeders. Sexual behavior is most likely a compromise between male and female interests and a real judgment of each sex's mating approach is difficult (Wheatley 1981). In primates, female mating choice is based on male behavior such as social rank, age and familiarity (Small 1989), also described by Reeder (2003) in primates. Menstrual cycles of sexually mature females have also been examined by vaginal swabbing (Bruggemann and Grauwiler 1972). Females in the majority of primate species are particularly promiscuous (Eberhard 1996). The relationship between the alpha female and the male persists by grooming. Furthermore, the alpha female cleans up the alpha male often and also feels angry if a lower-ranking female makes a relationship with him. Males of any rank take care of females most habitually during estrus (Wheatley *et al* 1999).

In Malaysia this species is widely distributed, especially on the hilly coastal rain forest running across the islands. In Penang, they are found in abundance in the Botanical Gardens, the environment provided to them is almost similar to their natural habitat and they move freely among the visitors, visiting the spot, but so far there is no prominent effort have been attempted to estimate their social behavior

(Payne and Phillipps 1985). Through this study we have tried to explore the social, sexual and physical behaviors of this specie.

1.2. Objectives:

1. To observe daily activity budget of *Macaca fascicularis*.
2. To understand social behaviours of *Macaca fasciularis*.
3. To document the physical and sexual behaviours of *Macaca fascicularis*.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction:

This research study emphasizes mainly on population, social organization, activity budget and sexual behaviors of *Macaca fascicularis*. By using or quoting the work of others, the sources of the work or information have been clearly illustrated in this thesis. According to Kate (2003) most of the research done on social behaviours of macaques is still not completed. Thus an attempt has been made in this research to answer some important issues.

2.2 Taxonomy:

- 1) Kingdom: Animalia
- 2) Phylum: Chordate
- 3) Class: Mamalia
- 4) Sub Class: Theria
- 5) Infraclass: Eutheria
- 6) Order: Primate
- 7) Family: Cercopithecidae
- 8) Scientific Name: *Macaca fascicularis*

Previously it was known as *Macaca irus* or cynomolgous monkeys.

Subspecies: *Macaca fascicularis argenteimembri* in Pulau Tioman.

Macaca fascicularis lacta (Elloit) occur in Pulau Tioman and Pulau Tinggi.

Macaca fascicularis (Raffles) occur in other places.

This specie of primates is also called long-tailed macaque (Zeller 1996).

2.3 Average Measurement:

- 1) Head and body: 350-455mm
- 2) Tail: 400-565mm
- 3) Weight: 3.5-6.5kg (Visalberghi and Fragaszy 1990)

2.4 Identification:

Macaca fascicularis is grey-black and brown-gold in colour, its lower part of body is brown-pale, and its face, hand's palms and feet are hairless and coloured like red meat. Its tail is hairy and longer than *Macaca nemestrina* (pig-tailed macaque) (Medway 1983). In older animals (*Macaca fascicularis*) the tail may be shortened due to accident (Adams *et al* 1985). Head length of *Macaca fascicularis* varies from location to location (Fooden and Albrecht 1993).

Long-tailed macaques from different locations vary in skin colours and hair patterns (Furuya 1965). Genetic analysis has revealed that Indochinese and Indonesian *Macaca fascicularis* are genetically different (Izard and Smith 2000). However, in terms of physical appearance the Indochinese *Macaca fascicularis* more closely resembles to the rhesus macaques (*Macaca mulatta*) (Butterfield 1997).

New born babies are black in colours, their faces and ears are light reddish. The skin colour of the face changes from light reddish to pinkish grey within a week. After six weeks their black colour is changed to brown (Medway 1983).

2.5 Distribution:

Macaca fascicularis is found in Borneo Island, Thailand, Myanmar, Indochina, Philippine, Indonesia (Sumatra and Jawa) and Peninsular Malaysia (Khan 1992) and Southeast Asia (Jack 2006). This specie live near the sea sides at the

height of 1524meters (Medway 1970). Whereas, according to Linda (1978), at the height of 2000meters, in the edges of primary and secondary forests. They live and adopt themselves to the areas where other primates are not living (Angst 1975).

In Malaysia, they are dominant near sea sides, such as the sea sides of Langkawi, Penang, Singapore, Tioman, tall bamboo and beaches (Medway 1983 and Bonadio 2000). Early sailors transported the Long-tailed macaques from Mauritius to Indonesian island (Lawler *et al* 1995). *Macaca fascicularis* are mostly isolated, reserved, highly awoken and emotional in comparison to the rhesus macaques (*Macaca mulatta*) and lion-tailed macaques (*Macaca silenus*) (Clarke and Mason 1988). This is due to diet, habitat and social factors, which are based on group development difference (Clarke *et al* 1994).

This species damage vegetation, rice fields, rubber farms and orchards. They are also found in developed areas and land farms. For example, villages, botanical gardens in Singapore, Kuala Lumpur and Penang's waterfall. Sometime they are harmful to people and their belongings (Harrison 1969). *Macaca fascicularis umbrosa* is found on the Nicobar group of islands, other species of long tailed macaques are found in Myanmar, Cambodia, Laos, Vietnam, Thailand, Malaysia, Indonesia and Philippines (Rodman 1991).

2.6 Habitat:

Long-tailed macaques live most successfully in dispersed habitats and on the periphery of forests (Paul and Kuester 1996). In Sumatra, *Macaca fascicularis* have highest population that live in mangrove swamps, secondary hill forests and some of them in freshwater swamps, scrub grassland, lowland, primary forests and rubber groves (Payne and Phillipps 1985).

In Thailand long-tailed macaques are abundance in evergreen and bamboo forests. In Malaysia, *Macaca fascicularis* can be found near the coastal areas and lowland forest (Visalberghi and Fragaszy 1990). They colonize some ground areas, plane areas and plantation areas. *Macaca fascicularis* drink much water and eat crabs; they like to live near the water (Paul and Kuester 1996).

Macaca fascicularis is an arboreal animal. A study of the long-tailed macaque behaviour revealed that normally they never come down to the ground unless they are within a range of five (5) meters to the edges of the rivers near their trees. They are active at day time and are also called diurnal species (Payne and Phillipps 1985).

The crab-eating macaques exhibit a quadruped movement (Fleagle 1988). *Macaca fascicularis* commonly travel in the form of groups. Each group is composed of five to twenty (5-20) members (Khan 1992). The groups contain less number of adult males as compared to adult females (Medway 1983) and the groups are lead by a dominant male. For achieving dominancy in the group of *Macaca fascicularis*, fighting among the males take place and occasionally facing severe casualties. But during external disturbances, when intrusion happens in their territories then they decide and control themselves, push their differences a side and take unanimous action against their enemies (Mah 1980).

They usually stay on the trees and come down to the ground in the evening for some time and they climb back to the trees during threats (Medway 1983). At night, they sleep in the form of group (Khan 1992) and make a ball like circle (Hock and Sasekumar 1979). *Macaca fascicularis* commonly sleep like strata emerge as the tree's nude. *Macaca fascicularis* prefer to sleep near rivers and leafless trees for the purpose of protection and guarding their territory and also to avoid clashes among

different groups (Blake 1980). *Macaca fascicularis* can also swim well in the water (Fittinghoff and Lindburg 1980).

2.6.1 Depression habitat:

Depression habits exist in *Macaca fascicularis* due to various factors and causative (Shively 1998) such as

2. 6. 1 (a) Social status:

Social status is one of the major factors, which causes depression and stress in *Macaca fascicularis*. Shively (1998) observed that low ranking females of long tailed monkeys have more aggressive efforts and many guards against threats. They groom less and spend more time alone, thus they appear socially stressed.

2.6.1 (b) Stressful environment:

Stressful situation also produce depression, Adams *et al* (1985) suggested that stressful social environment cause depression. Certain physiological features of the subordinates also cause many diseases that produce depression and stress.

2.6.1 (c) Physiological status:

Various types of chemicals and physiological conditions produce depression and stress as well, such as hypercortisolemic, dyslipidemic and carotid atherosclerosis causes increased heart beat which leads to stress and depression (Adams *et al* 1985). Differences between dominant and subordinates brain functions also exists. Subordinate females are very sensitive (Hamm *et al* 1983) and such types of females spend more time alone (Grant *et al* 1998).

During a female's sexual cycle, sexual hormones and puberty are major causes of depression and stress in *Macaca fascicularis* similar to the human females. In this situation, the ovarian cycle becomes slow and the above stated factors also cause heart attacks (Adams *et al* 1985). The presence and absence of depression and stress in both gender shows that there are great differences between dominants and subordinates (Grant *et al* 1998). Spending of time alone without the reach of other monkeys, suggested that they are socially isolated. These behaviours are categorized into three stages:

Time spent alone: *Macaca fascicularis* spend most of their time alone; they attend objects or events (Hamm *et al* 1983).

Resting: In this situation, they close their eyes and keep quite (Grant *et al* 1998).

Depressed Behaviour: They look like attached their body organs together and sitting a side, in these behaviours the eyes are opened (Melissa *et al* 2002). This depressive behaviour was observed in 42 females for 26 months. Subordinate females with a history of being subordinate in a social group were significantly more likely than other monkeys to display this depressed behaviour (Shively *et al* 2005).

2.6.2 Behaviour between human and *Macaca fascicularis*:

According to Wheatley (1980), *Macaca fascicularis* shows closed similarities in behaviour towards human being, whereas, human also have various interactive influences upon *Macaca fascicularis* behaviour. The study was composed of two social groups of *Macaca fascicularis*, one group was located around human influence

(habituated group) and another group had little human contact as possible (non habituated group). It was observed that by spreading out the food in an open and clear area to both of the groups separately, the habituated group came faster to the food site and the non habituated group was arrived late, as compared to the habituated group (kyes 1993).

During an interaction of human towards the non habituated group they felt a direct threat, ran away, climbed to trees and showed aggressive behaviours (Kaufman and Rosenblum 1966). They communicated with each other by vocalization during threats which included opening of mouth with exposure of the teeth, thrusting the head forward, flattening the ears against the head and retracting the brow. The body was generally held solid and upright and was pushed forward (Kaufman and Rosenblum 1966). The habituated group came closest towards the food and ate the food without feeling any fear. (Wheatley 1980).

2.7 Food:

The *Macaca fascicularis* are omnivores (Hock and Sasekumar 1979), their food is crab, prawn, small animals, fruits-young shoots and plant shoots (Khan 1992). They also eat worm bean, which can be found in the Paya Bakau forest (Hock and Sasekumar 1979). In cages, they are feed by fruits, rice, young shoot, meat, milk, eggs and many other things (Medway 1983). According to the analysis of Cheang (1962) the list of food and plants consumed by the *Macaca fascicularis* in Penang Waterfall is as follows:

1. Plants shoot like cyrtostachys lakka, sealing wax palm, and buffalo grass.
2. Shrubs leave like memecylon coeruleum and variety of hibiscus that have white flowers.

3. Some flowers like, ipomoea learii, morning glory, arachnis Maggie oei.
4. Fruits from the trees like Eugenia grandis, diospyros discolor and garcinia mangostana.

Growing animals having more proteins than adult (Blake 1980), *Macaca fascicularis* store food in cheek-pouches and use their fingers, whenever they like to eat the same stored food (Brent and Veira 2002).

2.8 Vocalization:

Vocalization is an indication of communication among the *Macaca fascicularis*, which is further divided on the basis of function respectively, such as:

2.8.1 Non Sexual Vocalization:

These types of vocalization are used for indications of food, protection and grooming. The long tailed macaque communicate vocally with one another, they even exhibit facial expressions and move with signals (Smith and David 1988). The *Macaca fascicularis* move with sound (rattle) and make noise as a sign of approaching danger and the Juvenile also cry and shout during threats. After the threat is over, they give a signal of vocalization to be relieved (Medway 1983).

Macaca fascicularis have many types of vocal communications; they use this vocalization in many situations. Two type of vocalization are most common which are “Harsh” and “Clear” call. The examples of harsh call are “kra call” this name is given for its sound and “Alarm Calls” are given during situations of threats or potential predator. The other call is “Barks” which is given during aggressive interactions between individuals (Palombit 1992). “Clear Calls” are giving in the

form of “Coos” which indicates friendly interaction and also to avoid aggression between individuals (Wheatley 1999).

Furthermore other calls include “Screams” which is utilized for aggressive interaction, the “Affiliation Calls” is given by females in the attempt to get closer to another female’s infant, and “Geckers” are using by infants during weaning (Wheatley 1999).

2.8.2 Sexual Copulation Call:

Copulation call is used to announce the mating attempts to low ranking males (O’Connell and Cowlshaw 1994). Dominant males then show reaction to the low ranking males to avoid copulation. This way, the females get the superior genes for their offspring (Cox and LeBoeuf 1977). The females also give calls before the dominant males ejaculate, it is allowed full time to complete the copulation by the female (O’Connell and Cowlshaw 1994).

Some calls are given as a result of disturbed copulations without ejaculation and the disturbing male is expected to be the dominant male, after that the females dislike to copulate with the dominant male (O’Connell and Cowlshaw 1994).

Copulation call is the attraction of multiple males to copulate the female (Todt and Pohl 1984), by this way they promote sperm competition (O’Connell and Cowlshaw 1994).

2.9 Reproduction:

The menstrual cycle of the female *Macaca fascicularis* varies from twenty six (26) to thirty eight (38) days (Medway 1983). The duration of pregnancy is one hundred and sixty to one hundred seventy (160 - 170) days. *Macaca fascicularis* give

birth to a single baby in one delivery. The maximum age of *Macaca fascicularis* is twenty seven (27) years (Khan 1992).

In Sumatra, the social group has more number of females than males thus; many female partners are available for the male. The male dominating the group is called alpha male or highest ranking male, it has the highest access to females and most of the offspring belong to him (Zeller 1996).

2.9.1 Maturity of male and female:

Males get sexual maturity at the age of six (6) years approximately; while female mature at four (4) years. The higher-ranked females become sexually mature early as compared to lower-ranking females. It is also dependent on their environment and food availability, while some offspring dependent on high rank sperm (Harvey *et al* 1987).

2.9.2 Ovulation:

In the process of ovulation, females feel swellings of skin in perinea. This secret of ovulation could exist in order to explain to the unwanted males to stay with females for two to three days (Paul and Kuester 1996). Estrus period is eleven (11) days, during which the female is looking for male to copulate with her (Sussman and Tattersal 1986). The male very easily identify ovulation period, by smiling and swelling of sexual organ, which increase male sexual desire for copulation (Paul and Kuester 1996).

2.9.3 Nursing Duration:

The average time for nursing is approximately 420 days (Wolfheim 1983). Lactation duration of *Macaca fascicularis* is fourteen to eighteen (14 - 18) months (Sussman and Tattersall 1986). The mother cares full time for the infant, holding it and not allowing it to go away from her. Mother is in close contact with new born infant, while this contact reduces with the passage of time and after ten to eleven months the mother starts to reject it and may act aggressively if infant tries to nurse, than the mother will exhibit normal ovarian cycles again (Wheatley 1999).

The births are commonly start from May to July and increases in rainy season (Payne and Phillipps 1985). Normal delivery has a single offspring, while rarely the mother gives birth to twins. Young females are likely to remain in the troop into which they were born, whereas males are like to immigrate at or near sexual maturity (Maria *et al* 1988).

2.10 Social Organization:

Macaca fascicularis has various social behaviours as compared to other primates (Angst 1975). Some of them are very common, such as:

2.10.1 Family Social Behaviours:

Macaca fascicularis show less aggressive behaviors to their family members as compared to others (Kawai 1965). Thus they exhibit combine family system and such positive effects are beneficial to them. They help each other, show less aggression to their family members, live together and groom one another. *Macaca fascicularis* show relationships like human family relationships, especially the

relationship between a mother and a baby; the following behaviors were frequently observed (Angst 1975).

2.10.1 (a) Infant-Mother attraction:

The baby has a specific vocal signal, physical gesture to mother and needs full attention when weaning (Kawai 1965). The mothers are very close to their new born babies and give full attention to them; it is genetic property of the *Macaca fascicularis*. The level of attraction decreases with the passage of time until the end of the weaning period (Kawai 1965).

2.10.1 (b) Sexual Attraction:

Sexual attraction occurs usually between adults and sexual process is very important for future generation. The female is more proximity to the dominant male for sexual achievement, because dominant male provide better sexual satisfactions than lower ranking male (Angst 1975).

2.10.1 (c) Dominance - Inferiority Relation:

This behaviour is observed when food is served to the animals. The dominant member attack and try to snatch food from weak members of the group. Sometime other members of the group moved away to give chance to the dominant (Kawai 1965).

2.11 Dominant Characteristics:

The *Macaca fascicularis*'s dominant characteristics become obvious during their moving and vibrating ears reaction to others, they open their mouths widely and

show their enlarge teeth as threat and express various facial expression of anger. When a dominant member challenges others, the individual opens its mouth and its teeth jolt out of the lips. The exhibition of large teeth by the dominant member is considered as a warning sign (Angst 1975). Dominants have some unique characters which differentiate them from lower ranking individuals, the characteristics are as follows:

1. During movement the tail is always erect.
2. Shaking of trees branches (Angst 1975).
3. Protect its group from external interference and disturbance like human beings, dogs and other group of *Macaca fascicularis*.
4. Open mouth with large teeth in time of anger as sign of danger.
5. Dominant male is sexually stronger and uses all the group's females but mostly couples with the dominant female (Smith and David 1988).

In 1975, Angst compared the research of Van hoof and Shirek Elleson, on the dominate characteristics of *Macaca fascicularis*, which are as follows:

Characteristics	Van hoof 1967	Shrek Ellefson 1969
Dominance aggressive	Showing face with threat, open the mouth wide	Open the mouth wide
Obedient followers	To silence or keep quit, expose teeth	Grimace
Aggressive followers	Showing face with threat, showing large tooth and vocalization	Cry during threat

2.11.1 Female's Dominance Characteristics:

The female always remain in her natal group and makes the dominance hierarchies. They get rank and become strong in matrilineal (DeJong *et al* 1994). The group is composed of the family members, like sister, half-sister, cousins or mother-daughter (DeJong *et al* 1994). The high ranking female enjoy more in terms of grooming because of dominance towards the low ranking individuals (Wheatley *et al* 1999). The other females show their teeth and give indications to the dominant female to leave the feeding site. The dominant female displaces the other members from the feeding site (Steenbeek and Elisabeth 1997). When *Macaca fascicularis* are dividing into groups for the purpose of foraging, the dominant female is followed by the main group's members and the low ranking females form the subgroup for foraging (Sterck and Steenbeek 1997). High ranking females easily can get food, safety from predators and also get the dominant genes from the high ranking males for their offspring (Wheatley *et al* 1999).

2.11.2 Male's Dominance Characteristics:

The dominant male is the most powerful member of a social group. The highest ranking male possesses the highest reproductive access and father of the majority of infants during his dominancy (Engelhardt *et al* 2004). The second ranking male or beta male is the father of the remaining twenty percent (20%) of infant (DeJong *et al* 1994). The relationship between the alpha male and female is dependent on grooming. The alpha female grooms the male and shows aggressive behavior if lower ranking females make partners with the dominant male or go closer to it. Dominant *Macaca fascicularis*'s males groom females mostly during the estrus period (Wheatley *et al* 1999).

2.12 Hierarchies:

In a group of *Macaca fascicularis*, the dominant adult male acquires a higher rank in the hierarchy, followed by other adult males, adult females and juveniles, the infants hang to their mothers and not accounted in the hierarchy. When a dominant male approaches an age of 20 years, he became older and his rank in the hierarchy lowers down. Male *Macaca fascicularis* after attaining of 10 years join the hierarchy (Angst 1975).

They change their group when they become adults. However, there are tremendous chances of survival for the children of high ranked mothers as compared to the lower ranked mothers in hierarchy, which is due to the close ties with the dominant male. Other individual also get place in the hierarchy with the help of the dominant male. If an individual is strong enough and has the capabilities of making place for itself, poses threats and challenges to the dominant male by making changes could become the alpha male. The defeated individual either he/she is eliminated from the same group. A female juvenile is inferior to all adult males and also the males of the same age (Angst 1975).

2.13 Composition of group:

The females of *Macaca fascicularis* are the permanent residents of the same group (Blake 1980), while the males change their groups (Southwick and Francis 1972), it is supposed that in various forests of Malaysia, an individual group of *Macaca fascicularis* consists of twenty four (24) members and has suitable habitat available (Charles *et al* 1972). The infants are more active than the adults; they spend more of their time in playing. The percentage of contact with other members of the

group is higher in females. While the male's behaviour more aggressive and sexual (Bernstein 1971).

Macaca fascicularis show few differences between the social behaviour of males in all male groups and sexual groups. There are very less sexual behaviours in all male groups, because they have no sexual partner. The grooming percentage is very less and higher contact proximity in all male groups, which are less affiliate in style, but there is no difference between groups in overall levels of aggression or affiliation. Adult male macaques do not often groom each other in the wild, friendly males that are housed in all-male groups spend twenty four to thirty percent (24–30%) of their time in affiliate interactions (Cohen *et al* 1994).

2.14 Behaviours Inside Group:

Macaca fascicularis has great interaction in the group (Blake 1980). The adult male of *Macaca fascicularis* takes action as a guard and warns its group about possible threats posed by external elements. The adult male is the only member of the group who observes all around and is the one who appear to face the situation of danger (Blake 1980). Long-tailed macaques had higher levels of total social behaviour than those of rhesus and pig-tailed macaques, and the highest rate of aggressive and submissive interactions of nine primate species (Bernstein 1971).

Newly emigrated males will sometimes commit infanticide, the infants are not their own and high-ranked females sometimes kidnap the infants of lower-rank females. These kidnapping usually result in the fatality of the infants, as the other female usually not lactating. Young juveniles stay with the mother and relatives mainly, and as male juveniles get older they become more peripheral to the group. Here they play together forming essential bonds that may help them when they

migrate from their natal group. Males that migrate with a partner seem to be more successful than those that move off alone. Young females on the other hand stay in the centre of the group and become incorporated into the matrilineal they were born into (Groves 2005).

2.15 Behaviours between Groups:

The small group separates from the big group and are further converted into big groups. The big group always manages the small group and the small group follows the big group's behaviours and are related to each other for food and defence (Angst 1975).

Playing behaviour was rarely recorded. *Macaca fascicularis* involve themselves in social and self play. Although most play behaviour occur between infants and juveniles. During playing they showed some of the activities like hanging from a branch and kicking the feet, fating at leaves and jumping up and down on a branch. The juveniles when shaking the branches signal a playful mood (Kurland 1973).

2.15.1 Social Behaviour of Captive Indochinese and Insular Long-Tailed

Macaques:

There are measurable differences in behaviour, physiology, social organization and geographic distribution within and between various species of macaques. The researchers collected information on the social behaviour of captive *Macaca fascicularis* from Indochina and island populations, and transferred them to a new environment and new social groups. While some changes in behaviour occurred over time, but the researcher found no decrease in the higher levels of

agonistic behaviours. The researchers interpreted this finding in the light of the previous research reporting that long-tailed macaques show low levels of habituation to novelty and are highly awakened in comparison to other macaque species.

Furthermore, it appeared that there were differences in behaviours of males, females and infants, among these the juveniles played more. Females exhibited increased levels of proximity to other individuals and the males depicted increased sexual and aggressive behaviour.

A comparison of social behaviour in long-tailed macaques from different origins indicates that Indochinese macaques are generally less affiliate and Indochinese males are more aggressive than their opponents. The differences among macaque species, and within the *fascicularis*-group, should be considered for the management of captive colonies and when interpreting research data (Gerald 2002).

2.16 Conservation:

Macaca fascicularis can be found in the forests and national gardens. In Asia, Kuala Selangor (Malaysia) is considered as a specified location and protection area for *Macaca fascicularis* (Southwick and Francis 1972). These animals are also protected in the temples of Thailand and Bali (Indonesia) (Angst 1975).

In Malaysia, these animals are protected and kept under wild life department in protected areas (act 76 and section 2, wild life protection). In Thailand, these can be hunted, caught and looked after in the cages. The government issues licenses in the form of a quota system to individuals for exporting *Macaca fascicularis* (Lekagul and McNeely 1977).

These animals are expected to damage the gardens and to open the caps of rubbish bins to eat and disperse the rubbish. To overcome this problem, it is

suggested to utilize rubbish bins which could be kept closed. It is prohibited for public to feed them with general food rather than specific food provided by the authorities. To avoid public not to feed them, the authorities have introduced a method of punishing people by fining them with Malaysian Ringgit five hundred (RM 500/-) (Lekagul and McNeely 1977).

2.17 Previous research:

Osman (1998) estimated the composition of *Macaca fascicularis*, in Kuala Lumpur, as juvenile was found to be (41.1%) adult female (32.9%), adult male (17.2%) and babies (8.8%). A number of *Macaca fascicularis* are found near around University Malaya.

Hock and Sasekumar (1979) found that *Macaca fascicularis* is omnivores. According to them, in forest of paya bakau Kuala Selangor, (51%) of food consisted of plants, (33%) of rubbish and (14%) of worms and insects. The remaining food they get from other sources.

CHAPTER 3

METHODOLOGY

3.1 Introduction:

Certain objectives are applicable in a research study such as, to document the physical and sexual behaviours of *Macaca fascicularis*. To observe the daily activity budget, to understand the social behaviors and to estimates the population size of *Macaca fascicularis*. The research area was selected Penang Botanical Gardens. All the objectives were thoroughly observed and calculated.

3.2 Research area:

Penang Botanical Gardens was selected as study area. The Gardens was established in 1884 in the British era, it was meant to be an honour to Charles Curtis, its first superintendent who collected botanic specimens from the surrounding hills (Noorsiha *et al* 2006). The Botanical Gardens is very famous; it is used as a source of different plants collection and is the main centre for the protection of wild species (Noorsiha *et al* 2006). The gardens have a long tradition of introducing plants into agriculture and continuing them for long periods, especially in the case of economically important plants in agriculture, horticulture and forestry (Heywood 1991).

Gardens is located 8km away from George Town. The area of the Gardens is about six hundred (600) hectare and only one hundred (100) hectare has been developed. The Penang Botanical Gardens is the only Botanical Gardens, which is situated in the northern peninsular Malaysia and is the most interesting, that it is the oldest botanical institution in Malaysia. Botanical Gardens's climate can be described as equatorial, a pleasant mix of warm, sunny days and occasional cooling

rain storms. From August to November the season is rainy, the average rainfall is two hundred fifty five (255) cms (100 inches) throughout the year. Humidity is usually high and the temperature varies between twenty one (21) and thirty two (32) °C (Noorsiha *et al* 2006)

The Gardens is divided into two circles, the lower circle and upper circle. The lower circles total area is approximately fourteen hectare, round shape and slightly touches to upper circle. Lower circle consist of Orchid Garden, which is composed of botanical plants and tall trees. Its inner side towards the forest consists of a small lake, which has transparent water falling towards the lower circle to attract the tourist. It's further divided in to Palm Garden and wide empty ground while upper circle occupies approximately eleven hectares. It is oval in shape and the upper side is consists of a large dam, Water Supply Corporation (Perbadanan Bekalan Air) Pulau Penang Sdn Bhd (PBAPP).

Penang Botanical Gardens living plants are divided into attractive plantation of structural plants and a thematic collection. All plants and trees are used for educational and scientific purposes and for medicine, such as Oil palm (*Elacis guineensis*), Sea apple (*Borassus flabellifer*), Queen of flower (*Lagerstroemia loudonii*) (Heywood 1991). The Gardens environment and climate are well suited to monkey's surveillance and also interesting for tourist. The Gardens provided various facilities to tourist, such as entertaining, picnic areas, toilets, wheelchair access, footpaths, jogging tracks, jungle trails, resting lawns and plant nursery, it is also known as Waterfall Gardens (Noorsiha *et al* 2006). The Gardens was selected, because it is fully equipped with all the research requirements, such as good environment, good staff, large numbers of primates (especially *Macaca fascicularis*) and it is in close proximity and in easy approach to Universiti Sains Malaysia.